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ELECTRO-OPTICAL SYSTEM

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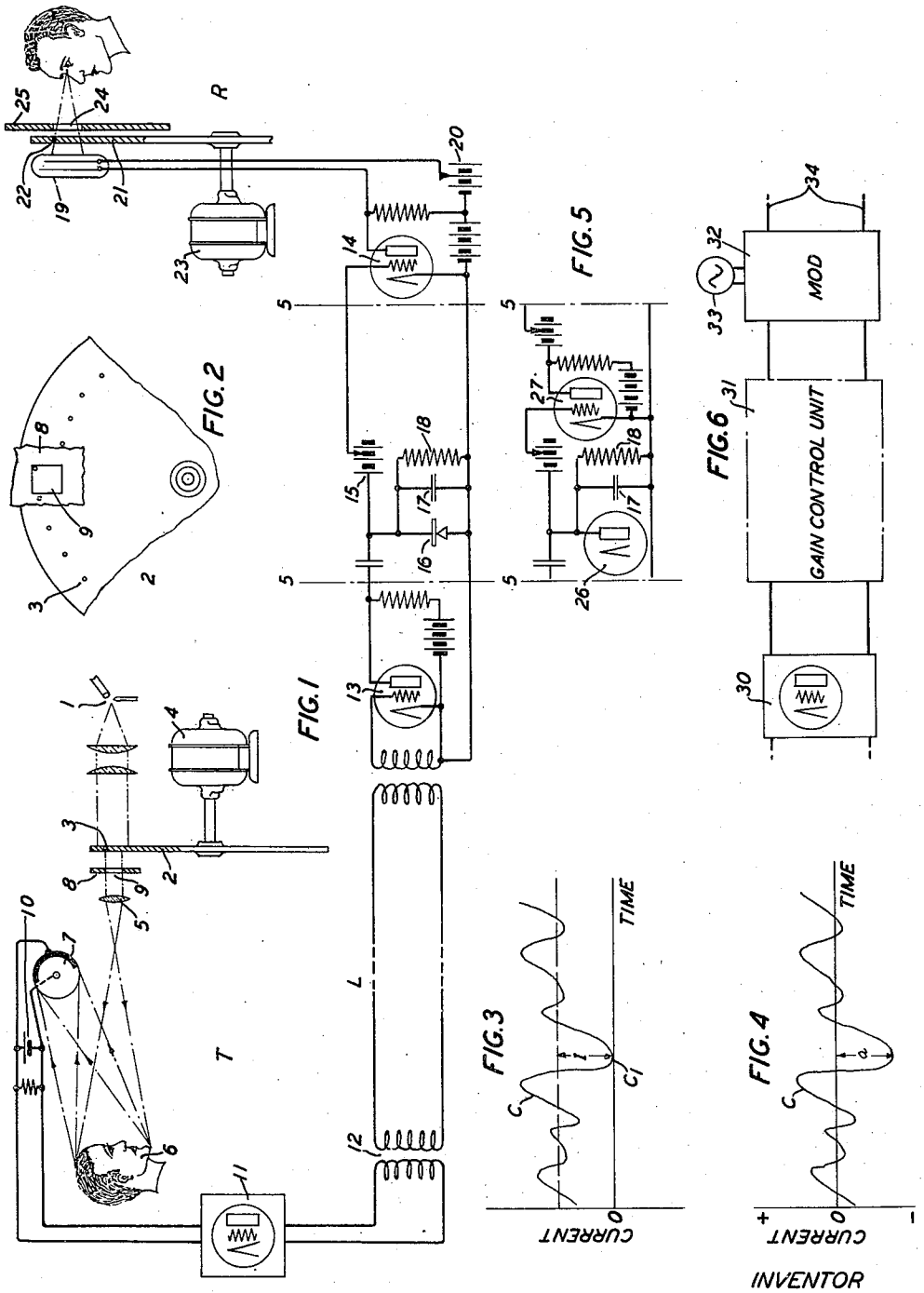

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ELECTRO-OPTICAL SYSTEM

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This invention relates to electro-optical systems and more particularly to a method of and means for reducing distortion in the operation of such systems.

The current, produced by the activation of a light sensitive cell at the transmitting station of such systems, may be considered as the sum of a number of alternating current components, the lowest frequency component being slightly below the scanning frequency, and a direct current that, for the usual moving subject, varies relatively slowly compared to the scanning frequency. In other words, the light sensitive cell supplies a current which consists of a complex alternating current superposed on a direct current. If the field of view scanned for transmission includes a black elemental area, the superposed alternating image current will include a variation which falls to zero, i. e., the amplitude of this variation will be equal in value to the direct current. As is well known, the direct current serves to determine the average tone value of the image produced at the cooperating receiving station, but it cannot be readily amplified and transmitted, as such, over the usual alternating current circuits to a distant station, and its amplification to the desired energy level for use in a modulator, in which the image current is combined with a carrier current, requires the use of direct current amplifiers, which are unsatisfactory from a practical standpoint.

In an effort to cause the production of an image having an average tone value closely approximating that of the field of view scanned at a television transmitting station and thereby reduce distortion of the image produced at the receiver, it has heretofore been proposed to separate the high frequency and very low frequency components of the image current resulting from scanning an object at the transmitting station, to transmit the separate current components over different communicating channels, and to rectify the low frequency components to produce a current corresponding to their average value, which is used to control the amplitude of the direct current component supplied to a light source included in the image producing apparatus.

It has also been proposed to suppress the direct current component of the picture or image current and to manually control an amplifier, which serves to repeat its alternating current components, in such manner that the output circuit of the amplifier includes a direct current component which corresponds approximately to the amplitude of the direct current which was suppressed.

The present invention relates to means for effecting the result accomplished in systems of the last mentioned type in which the amplifier is automatically controlled to restore the direct current component.

An object of the invention is to utilize the amplitude of a single variation of the alternating current component of the image current to control the average tone value of images produced at the receiving station of an electro-optical system.

An ancillary object is to utilize a variation of the image current, corresponding to a black elemental area of the subject scanned at the transmitter, to control the amplitude of the direct current supplied to the light control device included in an image producing apparatus at the receiver.

In accordance with one embodiment of the present invention, as applied to television transmission, the field of view is provided with one or more black areas, the direct current component produced by the light sensitive device is suppressed, the alternating current component is transmitted, and a current variation or variations of this component, corresponding to the black area or areas, is used to control the supply of a direct current which is proportional to and varies with the suppressed direct current. This is accomplished by using an alternating current amplifying device having associated therewith a rectifier for passing current in one direction to a network comprising a condenser shunted by a leak resistance. Each time a black area is scanned, the light sensitive device produces a current of peak value, equal in amplitude to that of the direct current component suppressed by the amplifier. This current of peak value is rectified and the rectified current charges the condenser, the voltage drop across which is applied to the grid of the amplifying device which is thereby caused to supply a plate current varying inversely with and proportional to the current variation corresponding to the black area. In this manner, the amplifier is controlled to cause it to supply a varying direct current which is proportional to the direct current produced by the light sensitive device.

By properly selecting the capacity of the condenser and the value of the associated leak resistance, the charge supplied through the rectifier leaks off at such rate that the amplifier operates to supply a direct current which follows

the variations in the amplitude of the direct current produced by the light sensitive device, as the subjects being scanned change.

In accordance with one aspect of the invention, the control apparatus may be included in the receiver, whereby the light control device, included in the image producing apparatus, operates to supply light proportional to the variations of average tone value of the object scanned at the transmitter and also in accordance with the tone values of its elemental areas.

In accordance with another aspect, the regulating means may be used at the sending station to control the operation of a modulator, in which the alternating image current is combined with a carrier current. In this case the modulated carrier current contains components varying with the average tone value of the image which, upon detection at the receiving station, furnish a slowly varying unidirectional current in addition to a direct current of constant amplitude corresponding to the non-modulated portion of the carrier. By suppressing this direct current, the image producing apparatus is supplied with a varying unidirectional current, which represents the average tone value of the image.

A detail description of the invention follows and is illustrated in the attached drawing, in which:

Fig. 1 is a schematic illustration of a television system embodying the invention;

Fig. 2 is a detail of the scanning apparatus of Fig. 1;

Figs. 3 and 4 show curves which will be used to explain the operation of the invention;

Fig. 5 is an alternative for the portion of the apparatus between section lines 5—5 illustrated in Fig. 1; and

Fig. 6 schematically illustrates the invention applied to a carrier system.

Referring now to Fig. 1, there is shown a transmitter T and a receiver R connected by a line L. The transmitter comprises a source of light 1 of constant intensity associated with an optical system, including a disc 2 provided with a row of apertures 3 arranged in a spiral line and adapted to be rotated by a motor 4, and a lens system, shown as a lens 5. Rotation of the disc causes light from the source 1 to pass through the successive apertures 3 to thereby produce a moving beam of light which is directed by the lens 5 to illuminate successive elemental areas of the field of view 6. The disc 2 is rotated at a speed such that, for one complete revolution, elemental areas of parallel adjacent lines of the complete field of view 6 are successively illuminated within the period of persistence of vision. Light reflected from the successive elemental areas of the field is applied to the light sensitive electric device 7, which is thereby activated to produce an image current varying in accordance with the tone values of such elemental areas. For a complete disclosure of the operation of the apparatus, briefly described above, reference may be made to an application of F. Gray, Serial No. 227,649, filed October 21, 1927, which issued as Patent No. 2,133,254 on April 5, 1938.

In front of the disc 2 is a screen 8 of opaque material provided with an opening 9 which determines the size of the field scanned and is so dimensioned that light passes through the apertures 3, one at a time, to the field of view 6.

For the purposes of the present invention, the field of view and the scanning apparatus operate in such manner that, for intervals corresponding to the time required to illuminate at least one elemental area, or a number of such areas, per complete scanning, no light is reflected to the light sensitive device 7 from the field of view 6. This may be accomplished, by providing a field of view having one or more black elemental areas, so positioned that they do not interfere with the illumination of the elemental areas of the view which are essential to the production of its image at the receiving station. For example, one edge of the field, traversed by the moving beam of light, may be provided with one or more black elemental areas, or with a black strip, corresponding in width to the width of an elemental area. By using the black strip each unit line illuminated by the moving beam of light will include one non-reflecting elemental area.

A preferred arrangement for effecting the last mentioned condition is shown in Fig. 2, wherein the lateral distance between the apertures 3 of disc 2 is greater than the width of the opening 9 in the screen 8, by an amount equal to the width of one elemental area.

In accordance with the principles of the invention, the field of view may be completely illuminated and a lens may be used to project an image of the field of view in the plane of the scanning disc, or other similar scanning member, adapted to be actuated to scan the image. In this case, the field of view may either be provided with one or more black elemental areas, a black strip, or the apertures in the scanning member may be spaced apart, as described above, whereby no light is supplied to a light sensitive electric device for time intervals corresponding to one or more elemental areas during each complete scanning of the image.

The light sensitive device 7, supplied with energizing current from a direct current source 10, will be activated, under control of the above described optical system, to produce a unidirectional image current of the type shown by the curve C in Fig. 3. This current consists of a slowly varying current having a maximum amplitude I, upon which is superposed current variations determined by the operation of the scanning apparatus and the varying tone values of the elemental areas of the field of view. The superposed current variations may be considered as a complex alternating current made up of a number of different frequency components, extending from a frequency of 20,000 cycles or more to a low frequency component slightly less than the scanning frequency, i. e., somewhat lower than 16 cycles per second. When no light is applied to the light sensitive device, due to the presence of a black elemental area, or to the fact that the scanning aperture is beyond the limits of the field of view, the amplitude of the current supplied by the light sensitive device 7 will be zero, as indicated at C_1 in Fig. 3.

While the major portion of the image current band can be satisfactorily transmitted over well known communication circuits, for example telephone lines, it is impossible to satisfactorily transmit the direct current and the slowly varying components over such lines, since they lie outside the frequency band which can be transmitted without distortion over such lines.

In the past, it has been proposed to suppress the direct current and low frequency current components of the image band at the transmitter and to effect a manual adjustment of the receiver to control the introduction of a direct current component to compensate for the components

suppressed at the transmitter. According to another proposal the direct current and low frequency components are not suppressed at the transmitter, but such components are separated from the higher frequency components by selection, amplified and then transmitted over a telegraph line to the receiving station, where they are rectified, and the rectified current is used to control the production of a direct current component which is applied to the light control device included in the image producing apparatus. This method of operation requires, in addition to an extra line, the use of direct current amplifiers which are difficult to design and operate, especially in electro-optical systems where an extremely high degree of amplification is required, in order to raise the weak currents supplied by the light sensitive device to the desired energy level for transmission over a line or for use in a modulator. The direct current introduced at the receiver serves to determine the average tone value of the image, which, with these systems, can only be approximated.

In accordance with one aspect of the present invention the current supplied by the light sensitive device is applied to the input electrodes of a distortionless alternating current amplifier 11, whereby the direct current component is suppressed. This amplifier operates to supply, through the transformer 12, to the line L an amplified image current of the type illustrated, in part, in Fig. 4.

At the receiving station the incoming image current is amplified by the device 13, and the amplified current is applied to the input electrodes of a three electrode amplifier 14, to the control or grid electrode of which is applied a negative biasing potential, from the source 15.

The output circuit of device 13 is connected to the input electrodes of amplifier 14 by a circuit including a rectifier 16, the electrodes of which are shunted by a condenser 17 and a leak resistance 18 connected in parallel. A portion of the amplified alternating image current, supplied by device 13, is rectified by the rectifier 16, which passes current in the direction of the arrow, to apply a charge to the condenser 17 such that its upper plate is positive. In other words, the charge upon the condenser is opposed to the potential of the grid polarizing source 15. Resistance 18 operates to control the rate at which the charge accumulated by the condenser, leaks off.

By properly selecting the capacity of the condenser 17 and value of the resistance 18, the charge supplied by the rectifier to the condenser can be caused to leak off at such rate that the amplifier 14 is controlled to supply a direct current which follows the variation in the amplitude of the direct current produced by the light sensitive device 7, as the subjects being scanned at the transmitter change.

Each time a black area is scanned at the transmitter, the light sensitive device produces a current having a peak value which is equal in amplitude to the direct current suppressed by the amplifier 11. This current is transmitted to the receiving station where it is rectified and the rectified current charges the condenser, the potential drop across which opposes the biasing potential supplied by source 15 to the grid of the amplifier 14, whereby its plate circuit is supplied with a direct current which varies inversely with and is proportional to the current corresponding to the black area. For example, if a black strip is used at the edge of the field scanned for transmission or a similar effect is attained by spacing the apertures 3 with respect to the opening 9, as described above, the values of resistance 18 and condenser 17 should be so chosen that practically all of the charge leaks off in less than an image scanning period. If the black elemental areas are used with only some of the scanning lines, the values of resistance 18 and condenser 17 are so chosen that the charge on the condenser would almost completely leak off in one or two seconds.

The amplified alternating image current and the direct current flowing through the space path of the amplifier 14 are applied to the glow lamp 19. This lamp is biased by a direct current source 20 so adjusted that practically no current flows through the lamp in the absence of any incoming signal.

Associated with the lamp 19 is a scanning disc 21 provided with a row of apertures 22 arranged in a spiral line and driven by a motor 23 in synchronism and in phase with the scanning disc 2 at the transmitter. A suitable system for maintaining the discs 2 and 21 in synchronism is disclosed in U. S. Patent 1,999,376 of H. M. Stoller, issued April 30, 1935.

An observer may view the image produced by the cooperation of the receiver scanning means and light source 19 through an opening 24 in an opaque screen 25. Glow lamp 19 may be of any desired type adapted to supply light which varies with the variations in amplitude of the applied image current. A suitable lamp for this purpose is disclosed in U. S. Patent 1,918,309, of H. W. Weinhart, issued July 8, 1933. As therein described the glow lamp may include a charge comprising a rare gas and a small percentage of active gas, as disclosed in U. S. Patent 1,871,266 of F. Gray, issued Aug. 9, 1932.

Fig. 5 illustrates a circuit including a two-electrode thermionic rectifier 26 in place of the rectifier 16. In this case, it is desirable to maintain the heated cathode of the rectifier at or near ground potential. This may be accomplished by connecting the rectifier 26, condenser 17 and resistance 18 in the input of a three electrode amplifier 27, the connected apparatus replacing that portion of the system of Fig. 1 included between the section lines 5—5.

Fig. 6 schematically illustrates an alternative arrangement in which the control means, shown in Fig. 1 or that of Fig. 5, is used to control a modulator at the transmission station of a carrier line or radio system. As therein shown, the alternating current image current component, produced by suppressing the direct current component of the unidirectional image current supplied by the photoelectric cell 7, after being amplified by the amplifier 30, is applied to the control unit 31 which includes either elements 16, 17, 18 of Fig. 1 or elements 26, 17, 18 of Fig. 5. This unit serves to control the modulator 32 supplied with carrier current by a source 33, which is thereby actuated to supply the transmission circuit 34 with a carrier current modulated in amplitude by the image current and an unmodulated current of carrier frequency. The latter varies in amplitude as does the direct current supplied by the photoelectric cell 7, when the objects being scanned change.

Demodulation of the image modulated carrier current at a receiving station by any suitable detector yields an image current proportional to the original current produced by the photoelec-

tric cell plus a direct current corresponding to the unmodulated part of the carrier, i. e., to the carrier when the photoelectric cell current is zero. By applying a suitable biasing potential to the image current amplifier 14, the direct current of constant amplitude may be suppressed, but the alternating and slowly varying current components will be produced to provide an image current proportional to the photoelectric cell current. The reproduced alternating image current and the slowly varying direct current components, repeated by the amplifier 14, are applied to the light source 19 which is thereby caused to supply illumination which varies not only as the tone values of successive elemental areas of the field scanned at the transmitter but also in accordance with the average tone value of the field.

The term "image current" used in certain of the claims is intended to cover either current produced by scanning the object field alone or such current having extraneously produced variations, the amplitudes of which are used to control the average brightness of the image. The term "field of view" is used broadly to denote either the field an image of which is to be produced or such a field with added portions to be scanned to produce the recurrent peak values to control the average brightness of the image. Some of the claims refer to the suppression of the direct current component of the image current without specifying that this is a component which slowly changes in value. It is to be understood that where this terminology is used, it is intended to cover a slowly varying component.

What is claimed is:

1. A television system comprising means for producing a variable image current corresponding to a field of view scanned for transmission and having a peak value equal to zero illumination, and means for utilizing said current variation of peak value to control the average tone value of an image of said field.

2. A method of producing an image current which comprises producing a unidirectional current having regularly recurring peak values, suppressing the slowly varying direct current component of said unidirectional current, and utilizing the peak values of the unsuppressed alternating current component to control the production of a carrier having regularly recurring peak values which are substantially proportional to said suppressed component.

3. A television system comprising means for scanning a field of view including at least one black elemental area to cause the production of a unidirectional image current, means for repeating the alternating current components of said image current and suppressing the direct current component thereof, and a control unit utilizing the current variation corresponding to said black area for causing said repeater to produce a current proportional to said suppressed component.

4. A system as described in the preceding claim in which the control unit comprises a rectifier, condenser and leak resistance.

5. A television system comprising means for producing an image current varying in accordance with the tone values of elemental areas of a field scanned for transmission, means for repeating at least the higher frequency components of said image current while suppressing the direct current component thereof, means for rectifying said repeated current, and means controlled by said rectified current for controlling the average tone value of a reproduced image.

6. In a television system in which the relatively slowly varying direct current components of the image current are suppressed, means at a receiver for selecting a variation of the incoming image current, and means for utilizing the selected component for automatically controlling the introduction of a current corresponding to said suppressed components.

7. A television system comprising means for scanning a field of view to produce an image current having direct and alternating components, means for suppressing said direct component and transmitting only alternating components of said image current, and means under control of certain of said transmitted alternating components for automatically controlling the introduction of a current having an amplitude corresponding to said suppressed component.

8. A television system comprising means at a transmitting station for scanning a field of view to produce an image current having direct and alternating components, means for suppressing the direct and certain low frequency alternating components of said image current and transmitting the higher frequency alternating components only to a receiving station, and means at said receiving station under control of said higher frequency alternating components for automatically controlling the introduction of a current having an amplitude corresponding to said suppressed components.

9. The method of television transmission which comprises scanning a field of view to produce an image current having direct and alternating components, suppressing the direct and certain low frequency alternating components and transmitting only the higher frequency alternating components of said current, and utilizing the transmitted components of said image current for automatically correcting for the suppression of said direct and low frequency alternating components.

10. A television system comprising means for producing an electromotive force having alternating components only of a unidirectional electromotive force produced as the result of scanning a field of view, the slowly varying direct component being suppressed, and means controlled by the alternating electromotive force for automatically adding to said alternating electromotive force a direct component, the amplitude of which varies in accordance with the amplitude variations of the suppressed slowly varying direct components.

11. A television system comprising means for producing an electromotive force having alternating components only of a unidirectional electromotive force produced as the result of scanning a field of view, the slowly varying direct component being suppressed, an electric discharge device controlled by said alternating electromotive force for producing in its output circuit a direct current having said alternating current components, and means responsive to said alternating electromotive force for controlling said device to vary the current in its output circuit in accordance with the slow amplitude variations of said direct component.

12. A television system comprising means for producing an electromotive force having alternating components only of a unidirectional image electromotive force produced as the result of scanning a field of view, the slowly vary-

ing direct component being suppressed, light producing means, means responsive to said alternating electromotive force for causing said light producing means to produce light variations in accordance with the successive instantaneous values of said alternating electromotive force, and means responsive to said alternating electromotive force to produce a unidirectional electromotive force which varies in accordance with the variations of the suppressed direct component of said unidirectional image electromotive force for controlling the average illumination produced by said light producing means.

13. A television receiver comprising means including light emitting means for producing an image of a field of view, a source of alternating image current produced as the result of scanning a field of view and suppressing the components corresponding to the average light tone value of the field of view for controlling said light emitting means to cause it to reproduce light variations corresponding to the variations of said alternating image current, and means controlled by said alternating image current for increasing the illumination produced by said light emitting means whenever the variation of said alternating image current corresponding to a black tone value falls below a predetermined minimum amplitude.

14. Means for automatically reinserting the direct component in a television image current from which the direct current component has been eliminated, comprising means for introducing into said image current regularly recurring peak values of amplitude dependent upon the average tone value of the field of view scanned, means for selectively utilizing said peak values to automatically control a biasing potential, an image producing device, and means for utilizing said biasing potential to control the direct current component of the current impressed upon said image producing device.

15. Television apparatus for producing a television image under control of image current from which the direct component has been eliminated and which contains regularly recurring peak values of amplitude dependent upon the average tone value of the object field, which comprises a repeating device, means for impressing said image current upon the input of said repeating device, an image producing device, and means for automatically selectively utilizing current amplitudes in the output of said repeating device which are dependent upon said peak values impressed upon the input circuit thereof to control the bias of said image producing device.

16. Television apparatus for producing a television image under control of image current from which the direct component has been eliminated and which contains regularly recurring peak values of amplitude dependent upon the average tone value of the object field, which comprises a repeating device, means for impressing said image current upon the input of said repeating device, an image producing device, and means comprising an electric storage device for selectively utilizing current amplitudes in the output of said repeating device which are dependent upon said peak values impressed upon the input circuit thereof to control the bias of said image producing device.

17. Television apparatus for producing a television image under control of image current from which the direct component has been eliminated and which contains regularly recurring peak values of amplitude produced by causing the object field scanning means to periodically scan a fixed area of constant tone value comprising a repeating device, means for impressing said image current upon said repeating device, an image producing device, and means for selectively utilizing the portions of maximum amplitude of the current in the output circuit of said repeating device to control the bias of said image producing device.

18. A television receiver for receiving incoming currents in part at least representative of the light tone values of the elemental areas of a field of view at the transmitting station and having maxima representative of average brightness at the transmitter comprising means for deriving from said current voltages proportional to said maxima, an image producing device, and means for utilizing said voltages to automatically control the bias of said image producing device and thereby to adjust the average brightness of the image produced by said device.

19. A television apparatus comprising means for producing a variable image current corresponding to a field of view scanned for transmission except that it has recurring peak values, and is devoid of low frequency variations corresponding to changes in average tone value of the field of view, means for inserting said low frequency variations, and means for utilizing said recurring peak values to control the operation of said last-mentioned means.

20. A method of operating a television apparatus which comprises producing a composite signal including a variable image current having maximum current variations of one sign corresponding to a limiting tone value of the subject to be transmitted and recurring current variations of varying peak amplitude opposite in sign to said maximum image current variations with respect to a line of demarcation of said composite signal current, combining said composite signal current with a carrier to produce a signal modulated carrier which includes an unmodulated component of carrier frequency, and utilizing a voltage corresponding to said variations of varying peak amplitude value to maintain the amplitude of the unmodulated carrier component at a substantially fixed value.

21. Means for setting up a composite current comprising a slowly changing direct current component and certain alternating current components, major periodically recurring portions of which composite current have components representative of the tone values of elemental areas of a field of view taken in succession and minor recurring portions of which, interspersed with said major portions, have a fixed amplitude, means for suppressing said slowly changing direct current component whereby said minor portions of the resulting current become of varying amplitude depending upon the amplitude of said suppressed slowly changing direct current component, and means selectively responsive to said varying peak values of said minor recurring portions of said resulting current for setting up a direct voltage proportional to said slowly changing direct current component.

22. Means for setting up a composite current comprising a slowly changing direct current component and certain alternating current components, the major periodically recurring portions of which composite current have components representative of the tone values of ele-

mental areas of a field of view taken in succession and minor recurring portions of which, interspersed with said major portions, have a substantially zero amplitude, means for suppressing said slowly changing direct current component whereby said minor portions of the resulting current become of varying amplitude depending upon the amplitude of said suppressed slowly changing direct current component, and means selectively responsive to the varying peak values of said minor recurring portions of said resulting current for setting up a direct voltage proportional to said slowly changing direct current component.

23. A television receiver for the reception of a composite signal including picture signals and recurrent control impulses, the picture signal voltage representative of conditions of light being of opposite polarity to the control impulse voltage with respect to the alternating current axis of the composite signal, said receiver comprising means for reproducing a picture, said means including a control circuit, means for supplying the picture signals to said first means and for deriving a unidirectional control voltage from the received composite signal which varies in response to a change in the average illumination of a view being transmitted, and means for applying said control voltage to said control circuit.

24. The method of reception of a composite signal comprising picture signals and recurrent control impulses which signals are devoid of the low frequency components representative of the average illumination of a view being transmitted, which method comprises reproducing a picture in accordance with said composite signal, deriving from the received composite signal a control signal which represents at least approximately said low frequency components, and varying the average illumination of said reproduced picture in response to variations in said control signal.

25. A system for transmitting and reproducing picture images comprising a transmitting station and a receiving station, means at said transmitter for producing picture signals, an impli-fier at said receiving station for amplifying said picture signals, a transmitting channel connecting said stations, said stations and said channel having the characteristic that between the point at which said picture signals are produced and a point in said amplifier the direct current component and certain low frequency alternating components of the picture signals are lost, and means at said receiving station for producing a picture image under control of said picture signals, said last means including means independent of said suppressed direct current and low frequency components for automatically correcting at least partially for the suppression of the suppressed direct current and low frequency components.

26. The method of operating a system having a transmitting station and a receiving station for transmitting and reproducing picture images, said method comprising scanning a field of view to produce an image current having direct and alternating components, transmitting to said receiving station at least the higher frequency alternating components of said current, suppressing at some point in said system the direct and certain low frequency alternating components, and utilizing at said receiving station only the said higher frequency alternating components of said image current for automatically correcting at least partially for the suppression of said direct and low frequency alternating components.

27. A system for producing images comprising a transmitting and receiving station, means at said transmitting station for setting up picture currents having no frequency components indicative of the picture background, a transmitting channel connecting said stations, and means at said receiving station for producing an image under control of said picture current, said means including means independent of the suppressed background components for automatically correcting for the suppression of the background components.

28. A system for transmitting and reproducing picture images comprising a transmitting station and a receiving station, means at said transmitter for producing picture signals, an amplifier at said receiving station for amplifying said picture signals, a transmitting channel connecting said stations, said stations and said channel having the characteristic that between the point at which said picture signals are produced and a point in said amplifier the frequency components indicative of the picture background are lost, and means at said receiving station for producing a picture image under control of said picture signals, said last means including means independent of the suppressed background components for automatically correcting for the suppression of the background components.

29. In a television system including a transmitting station and a receiving station, means at said transmitting station for scanning a field of view to produce an image current having direct and alternating components, means for transmitting at least the higher frequency components of said alternating components to said receiving station, means for suppressing at some point in said system said direct component and certain low frequency alternating components, and means at said receiving station under control of certain of said higher frequency alternating components for automatically controlling the introduction of a current having an amplitude corresponding at least approximately to said suppressed components.

30. A source of alternating television image electromotive force which is devoid of relatively low frequency components corresponding to variations in average tone value of a field of view and having impulses of one polarity the amplitude of which is a measure of instantaneous values of the missing low frequency, a light emitting image producing device controlled by said image electromotive force, and means operated in response to said impulses only when there occurs a change in the relationship between the average intensity of the light emitted by said device and the amplitude of said impulses to vary the average light emission of said image producing device and thereby correct for said change.

31. A television system comprising means for producing an image current varying as the tone values of elemental areas of a field of view scanned for transmission and including current variations corresponding to areas having definite characteristics, means for suppressing the direct current component of said image current and for repeating the alternating current components thereof including said current variations, an image producing apparatus, and means for separately utilizing said current variations to control said apparatus to determine the average tone value of an image produced thereby.

32. A television system comprising means for producing the alternating current components of an image current having a current variation corresponding to a black elemental area of a field of view scanned for transmission while suppressing the direct current component thereof, an image producing apparatus, and means for utilizing said black area current variation to control the value of a direct current component supplied to said apparatus.

33. A television system comprising means for producing and repeating the alternating current components while suppressing the direct current component of an image current resulting from scanning a field of view for transmission, and means for utilizing one of the current variations of the repeated components to control the production of a current at all times substantially proportional in value to the suppressed direct current component.

34. A method of television operation which comprises producing a variable image current which is devoid of low frequency components corresponding to the relatively slowly changing average tone value of a field of view scanned for transmission and having impulses recurring at a higher frequency than the frequency of said low frequency components the amplitude of which impulses is proportional to instantaneous amplitude values of said low frequency components and utilizing only said image current for controlling the production of an image current including said low frequency components.

35. A television system comprising means for producing an image current varying in accordance with the tone values of elemental areas of a field scanned for transmission having current variations of peak value, a source of carrier current, means for suppressing the direct current component of said image current and for combining the alternating current components thereof with the carrier current supplied by said source, means for rectifying the alternating current components of said image current, and means for utilizing the rectified current corresponding to said peak values to control the combining means for determining the average tone value of a reproduced image.

36. A source of electric television signals which are devoid of relatively low frequency components corresponding to the relatively slowly changing average tone value of a field of view and having recurring impulses the amplitudes of which are representative respectively of the average tone value of groups of successively scanned elemental areas of the field of view, and means for producing television signals including said missing low frequency components under control of signals from said source.

37. A source of television image electromotive force having amplitude variations representative of the variations in tone value of elemental areas of a field of view taken in succession and having recurring impulses which vary in amplitude in accordance with changes in average tone value of a series of elemental areas, said television image electromotive force being devoid of relatively slow amplitude variations corresponding to changes in average tone value, and means controlled by the electromotive force of said source for producing an image electromotive force having said missing amplitude variations.

38. A source of alternating television image electromotive force having portions the amplitude of which varies in accordance with variations in tone value of elemental areas of a field of view taken in succession and having impulses recurring during intervals between successive portions the amplitude of which varies in accordance with variations in average tone value of a series of elemental areas, and means for producing an image of said field of view under control of said electromotive force comprising means for controlling the average tone value of said image in accordance with the amplitude of said impulses.

39. A source of electric television signals having intermittently recurring datum portions of fixed amplitude and, in the intervals between successive datum portions, portions the amplitude of which varies in accordance with variations in tone value encountered in scanning elemental areas of a field of view successively, means which causes the suppression of a low frequency component of said signals, and means acted upon by said signals after suppression of said low frequency component for causing the production of television signals having said low frequency.

40. Television apparatus comprising means for producing an alternating television current having periodically recurring portions of short duration compared with the intervening portions, some at least of said recurring portions being of different amplitude than others, and said intervenings portions having variations representative of tone values along parallel elemental strips, taken in succession, of an object field an image of which is to be produced under control of said current, said current being devoid of relatively slow amplitude variations corresponding to changes in average tone value of said object field, transducing means upon which said current is impressed which changes its amplitude, and automatic means under control of said portions of short duration after said amplitude change has been effected for adding to said current a component which has a constant or slowly varying amplitude compared with amplitude variations of said intervening portions.

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