

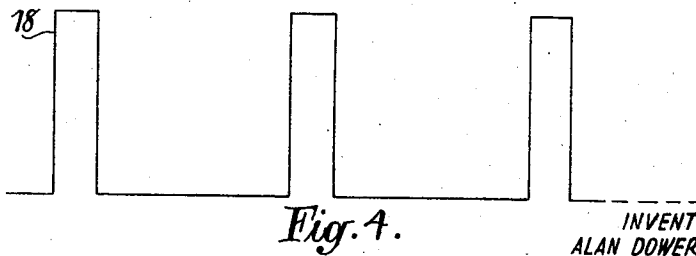
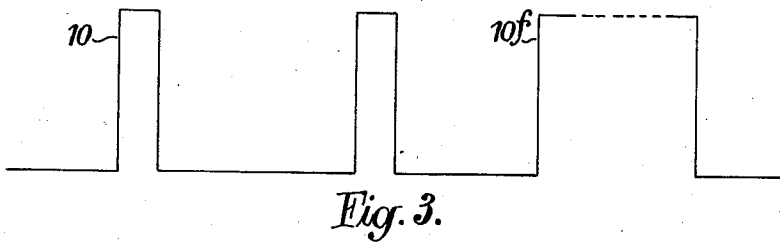
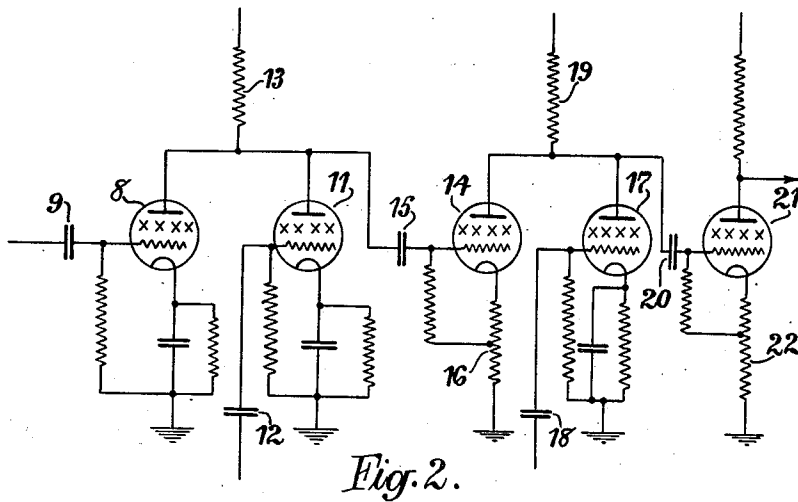
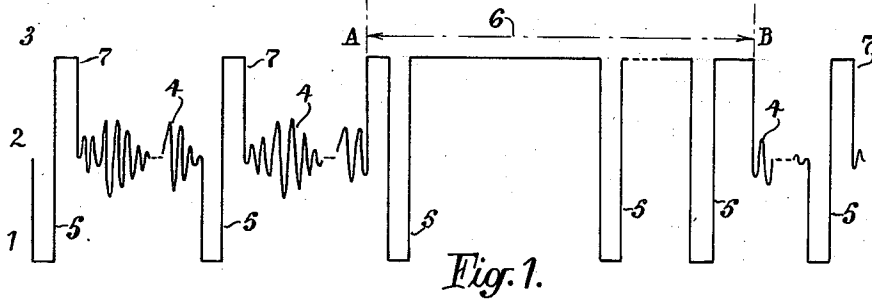
Sept. 2, 1941.

A. D. BLUMLEIN
TELEVISION SYSTEM

2,254,204

Filed May 11, 1937

2 Sheets-Sheet 1



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TELEVISION SYSTEM

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2 Sheets-Sheet 2

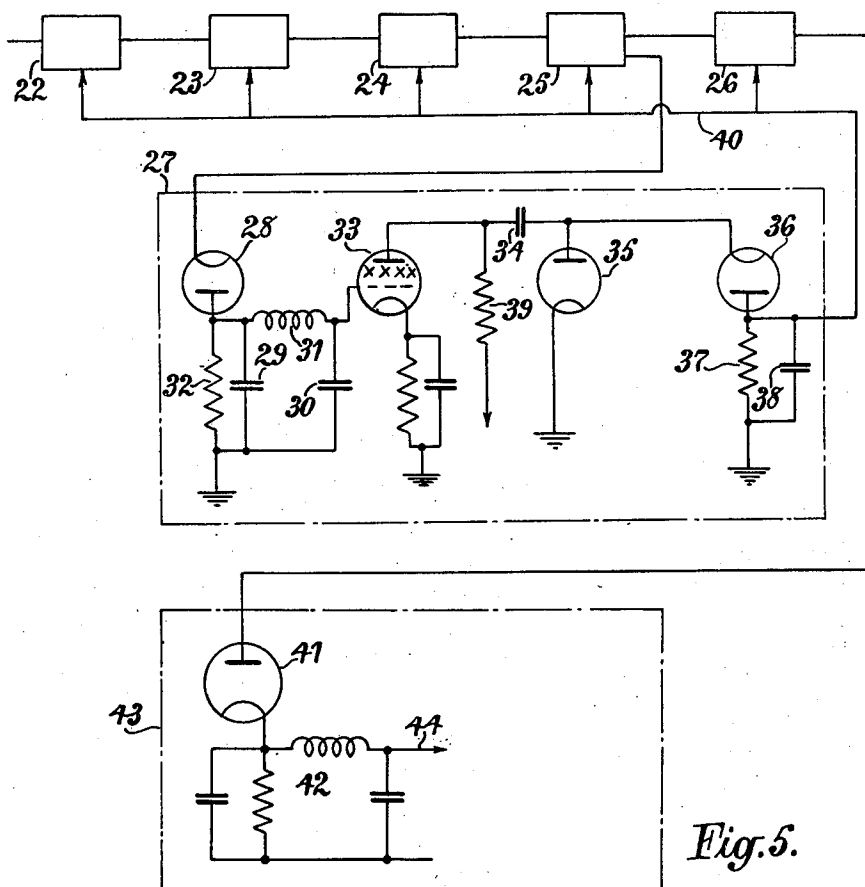


Fig. 5.

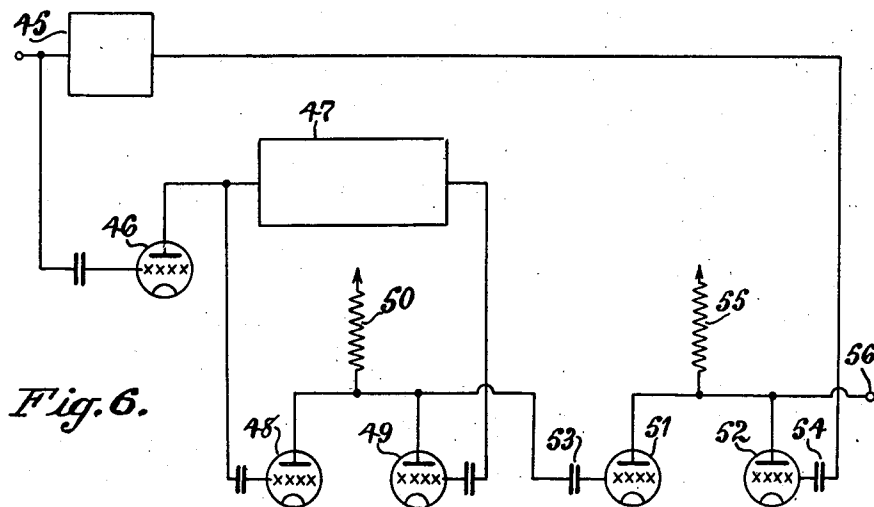


Fig. 6.

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TELEVISION SYSTEM

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This invention relates to television systems and has particular reference to methods of obtaining automatic gain or volume control.

When television signals are to be transmitted to or from moving objects such as aeroplanes, a gain control effect which will act rapidly is required, and while the invention has particular application to air-craft television systems and also to other light-weight equipment, it may also be employed in a general way, in wireless or line systems employing, for example, co-axial conductors.

The object of the present invention is to provide a method of producing a television waveform from which automatic gain control potentials may be obtained and receiver circuits responsive to such a waveform.

According to the present invention a waveform representing a scene or picture to be transmitted by a television system comprises portions representing successive lines of the scene or picture, interrupted by synchronising signals which take the form of double pulses a portion of which extends in one direction followed by a portion extending in the opposite direction, both portions having amplitudes lying outside the normal amplitude range occupied by signals representing vision amplitudes. The waveform may constitute a modulating waveform for a carrier wave of a transmitting system, or it may constitute the envelope of a carrier wave which is modulated by successive signals and line and frame synchronising signals, said line synchronising signals being constituted by a portion of said double pulses, the other portion of said double pulses constituting separate signals from which gain controlling potentials may be derived, said line synchronising signals modulating the carrier wave in the blacker-than-black sense and being succeeded immediately by said separate signals which modulate the carrier wave in the whiter-than-white sense.

A circuit arrangement for producing a waveform in accordance with the invention may include a valve to which picture signals interrupted at the line and frame frequencies are applied, said valve having its output combined with a second valve, to which a set of pulses at the line frequency are applied, the combined output being passed to a third valve, the output from which is combined with the output from a fourth valve supplied with a second set of pulses at the line frequency, but delayed with respect to said first set of pulses.

A particular form of television receiver adapted to be responsive to a carrier wave modulated by a wave form produced in accordance with the invention, includes high or intermediate frequency amplifying stages, a picture signal rectifier and a rectifier which provides gain controlling potentials for said high frequency amplifying stages, said gain controlling potentials being derived from one portion of the double pulses in the wave form. Part of the output from one of the high or intermediate frequency amplifying stages is fed to a further amplifying stage, and another part is fed to a circuit arrangement including a rectifier which provides automatic gain control potentials, the output of said further amplifying stage being maintained constant by applying to it automatic gain control potentials of selected value.

In order that the invention may be more clearly understood and readily carried into effect, a method of obtaining automatic gain control in accordance therewith will now be more fully described with reference to the accompanying drawings in which—

Fig. 1 shows an alternating current wave form including picture signals, line and frame synchronising signals, and additional signal pulses used for providing automatic gain control,

Fig. 2 shows a circuit arrangement for producing the wave form shown in Fig. 1,

Figs. 3 and 4 show respectively sets of signal pulses which are applied to the circuit of Fig. 2 for the production of the wave form shown in Fig. 1,

Fig. 5 shows a form of receiving circuit suitable for use with the wave form shown in Fig. 1, and Fig. 6 is a circuit arrangement illustrating a detail in the operation of a receiver.

Referring to Fig. 1 of the drawings, the point 1 represents zero, the point 2 represents the mean value of picture signal current, while 3 represents the peak or maximum of modulating signals. The amplitudes of the picture signals are limited to a range within the zero and peak points so that maximum white in the picture does not reach the peak value of the modulating signals and black does not reach zero value. The peak points are thus values representing whiter than white signals and the zero points represent blacker-than-black signals. The diagram shows several lines 4 each having a duration of 80 micro-seconds together with line synchronising signals 5 obtained by reducing the carrier wave to substantially zero for 10 micro-seconds, and a frame syn-

chronising signal 6 extending over ten complete line periods between the points A and B. As will be seen, the line synchronising signals 5 extend in the blacker-than-black direction and the frame synchronising signal 6 extends in the whiter-than-white direction.

Immediately following the line synchronising signals is an impulse 7 which extends in the whiter-than-white direction and is equal in duration to a line synchronising signal, that is a period of 10 micro-seconds. These impulses are used to provide gain controlling potentials at a receiver in the manner to be described with reference to Fig. 5 of the drawings. The gain controlling potentials obtained are proportional to the height of the signals 7 and also to the frame synchronising signals 6 which, as will be seen in Fig. 1, are interrupted by the line synchronising signals continuing during a frame synchronising signal.

The wave form shown in Fig. 1 may be generated by the circuit arrangement shown in Fig. 2 of the drawings. Incoming picture signals are applied to the valve 8 through a coupling condenser 9, the picture signals being free of the pulses 5, 6 and 7 shown in Fig. 1. The intervals between the signals representing successive lines and successive frames may contain spurious signals such as are produced for example by an electrical scanning tube. Signal pulses 10 of the form shown in Fig. 3 are applied to the grid of a valve 11 through a coupling condenser 12. These signals are mixed in an anode resistance 13 common to the valves 8 and 11 and are passed to a valve 14 through a coupling condenser 15, the valve 14 having a comparatively high resistance 16 in its cathode lead. The effect of the insertion of the resistance 16 is to give the characteristic curve of valve 14 a long linear portion with comparatively little curvature at the region of anode current cut-off. The valve 14 is so biased as to cut off the pulses added by valve 11 and to produce flat tops on the pulses 7 shown in Fig. 1. The line pulses 10 shown in Fig. 3 are of slightly longer duration than those obtained in the final wave form, and they occur towards the end of the interval between lines. A further valve 17 serves to mix with the output of valve 14 pulses 13 of the form shown in Fig. 4. The pulses 13 are applied to the grid of valve 17 through a coupling condenser 18, the outputs of valves 14 and 17 being combined in a common anode resistance 19. The pulses 18 occur at line frequency only and end slightly after the beginning of the pulses 10 shown in Fig. 3. The overlapping of the pulses 19 and 18 assist in producing a clean transition from one pulse to the other in the final wave form.

The mixed output from valves 14 and 17 is passed through a coupling condenser 20 to the grid of a valve 21 which also has a comparatively high resistance 22 in its cathode lead. The valve 21 tends to cut off the tops of the pulses 18 shown in Fig. 3, thus giving in its anode circuit a wave form of substantially the shape shown in Fig. 1. The beginning and end of the pulses 5 are produced by the pulses 13 shown in Fig. 3, and the pulses 7, with the exception of the portions neutralised by the over-lapping portions of the pulses 13 are formed by the pulses 10 shown in Fig. 3.

The resistances 16 and 22 in the cathode leads of valves 14 and 21 respectively, serve to depreciate the gain of these valves so that for a small

current the characteristic is sensibly linear and a sharp cut-off is obtained at the bottom of the characteristic curves.

The long pulse 10/ shown in Fig. 3 produces the flat top frame synchronising signal 6 shown in Fig. 1, this long frame pulse being divided up by the pulses 18 in Fig. 4, to produce the waveform shown in Fig. 1.

The low frequency waveform shown in Fig. 1 is used to modulate a carrier wave generated by transmitting equipment not shown in the drawings. The method of modulation is preferably such that the level 1 in Fig. 1 represents zero carrier and the level 3 represents carrier maximum. The inverse method of modulation may be adopted and again it is not necessary that the peaks 1 and 3 should represent zero or maximum carrier respectively, but they may represent intermediate values.

Fig. 4 shows diagrammatically the portions of a television receiver adapted to utilise the automatic gain control effect provided by the wave form shown in Fig. 1. Five stages of a receiver are represented by the block diagrams 22, 23, 24, 25 and 26. The output from the stage 25 is passed to an automatic gain control rectifying arrangement contained within the dotted rectangle 27. The signals fed from the stage 25 are rectified by a diode 28 in conjunction with condensers 29 and 30 of small value, constituting with an inductance 31, a radio frequency filter. The time constants of the condensers 29 and 30 with reference to the diode anode resistance is such as to pass the full frequency range of the signals or a sufficient frequency range to reproduce the pulses 5 and 7. The direct current biasing arrangements are not shown in the drawings as it is well known, for example, that a low frequency return must be provided for the lead connecting stage 14 with the diode 28.

The rectified signals obtained from the diode 28 are passed to an amplifying valve 33, and from thence, through a coupling condenser 34 to diode valves 35 and 36 arranged to operate in push-pull fashion. The direct current voltage set up across the diode anode resistance 37 will then be proportional to the double amplitude of the rectified wave provided by the anode 28. This double amplitude peak is in effect the distance between the peaks of successive rectified pulses 5 and 7 shown in Fig. 1. The arrangement is in effect a direct current re-establishment by the condenser 34 and diode 35, together with a peak rectification by the diode 36 co-operating with the resistance 37 and its shunt condenser 38. The time constant of condenser 34 and the anode resistance 39 of valve 33 in series with the resistance of either of the diodes 35 and 36, is arranged to be longer than the duration of any pulse including the duration of pulse 6 between any consecutive breaking pulse 5. In other words, this time constant should be longer than a line period. The time constant of resistance 37 and condenser 38 should be several lines longer, and is the controlling time constant for the speed of the automatic gain control effect. The voltage across the resistance 37 is fed back through lead 40 to one or more stages 22, 23, 24 and 25, and also to the stage 26 which it will be noticed follows the stage 25, from which the signals for providing the gain control effect are tapped out. Gain controlling potentials may thus be applied to one or more of the stages mentioned.

The control of the stage 26 is so adjusted that for average reception conditions the output of this stage is substantially constant. For example, a change of input of the order of 40 db. may produce change of rectified voltage at the diode 28 and from one to two volts. This may produce a change of rectified voltage across the resistance 37 of from ten to twenty volts, and this change of voltage applied to the control stage 26 must alter its gain by 2:1 so as to maintain substantially constant output. The output from the stage 26 is applied to a rectifier 41 and a filter 42 shown within the dotted rectangle 43, the rectified and substantially constant output signals being taken from a terminal 44. The adjustment of the stage 26 to convert the variable signals from the stage 14 into substantially constant signals may be made by means of a potentiometer not shown in the drawings which controls the fraction of the voltage across the resistance 37 applied to the control grid of the amplifier in stage 26.

In the case of a given set of reception conditions, a manual control of additional negative or positive bias potentials supplied to any of the stages 22 to 26 may be provided, so that the output from rectifier 28 may be kept within a certain range for which the correction by the stage 26 is most satisfactory. The correction as shown in stage 26, which as previously pointed out, operates beyond the point from which the signals providing the automatic gain control effect are tapped out, may be omitted, or it may be applied in one or more low frequency or high frequency stages, or both.

A rapidly acting gain control effect is obtained by the arrangement described, because the frequency of the recurrent pulses may be as high as 10,000 per second. The quickness of operation of the automatic gain control effect is controlled by the time constant of the resistance 37 and its associated condenser 38, which may for example, be of the order of 10 lines. Thus, the time constant of the automatic gain control will be one hundredth of a second, which is very much shorter than is possible in normal sound channel automatic gain control systems.

In order that picture interference may not occur, it is necessary at the receiver to black out or suppress some of the pulses which occur in the white direction. If as in the case described, the transmission is sent with a high value of carrier modulation representing white, the automatic gain control peaks must be blacked out to prevent them appearing as white in the picture. Again, if a low value of carrier modulation represents white in the picture, the line synchronising signals must be blacked out.

An alternative form of circuit arrangement for effecting blacking out of pulses is shown in Fig. 6 of the drawings accompanying this specification. In this figure the signals are applied to delay network represented by the block 45, and a tapping is taken from the input to the delay network to a limiter valve 46 which only passes amplitudes in excess of the peak white amplitude. The output from the limiter valve 46 is passed to a further delay network represented by the block 47, the time constant of this delay network being double that of the network 45. Signals are taken from the input and output of the delay network 47 and passed to the control grids of two valves 48 and 49 respectively, the anode currents of these valves being combined in a common load resistance 50. The voltage across the load resistance 50 is mixed

with the aid of further amplifying valves 51 and 52 with vision signals obtained from the output end of the delay network 45. The mixed output from the valves 48 and 49 is fed through a condenser 53 to the control grid of valve 51, and the vision signals from the delay network 45 are fed to the control grid of valve 52 through a coupling condenser 54. The valves 51 and 52 again have a common load resistance 55, the mixed output being passed to a cathode ray tube connected to the terminal 56. The mixing of the signals in the valves 51 and 52 is in such a sense that the signals obtained from the delay network 47 serve to add effective black to the vision signals arriving from the delay network 45. The arrangement will in effect produce black vision signals in place of white from just before the white pulse period to just after the white pulse period, the amount of overlap being the delay of the first delay network 45. Any difference of delay for the direct vision path from the network 45 to the valve 52 and the blacking out path, including the delay network 47 produced by the inevitable stray capacities and inductances of the amplifying valves, may be corrected by altering the delay of the network 45 while maintaining the delay of the network 47 constant. The high frequency cut-off of the delay network 45 must be sufficiently high to ensure that the vision signals will be transmitted without distortion, but it is not necessary for the delay network 47 to be of the same quality. The period of overlap which may be of the order of half micro-second is sufficient to ensure complete suppression of the white signals.

I claim:

1. A television transmission system including means for developing video signals, means for developing synchronizing signals to be transmitted in the interval between trains of picture signals, means for developing a signal of opposite polarity to the synchronizing signal, means for combining the synchronizing signal and said latter signal so as to form a signal having two differing components of polarity, said combined signal being indicative of the transmission level of the transmitter, the receiving means including a plurality of amplifying stages for receiving said transmitted signals, means for developing a corrective signal proportional to the value of the combined synchronizing signal and the signal of opposite polarity, means for impressing said corrective signal onto a plurality of amplifying stages of said receiver, and additional means for maintaining the output of said receiver substantially constant.

2. A television system including means for developing video signals, means for developing synchronizing signals to be transmitted in the interval between trains of picture signals, means for developing a signal of opposite polarity to the synchronizing signal, means for combining the synchronizing signal and said latter signal so as to form a signal having two different components of polarity, said combined signal being indicative of the transmission level of the transmitter, means for receiving said transmitted signal including a plurality of amplifying stages, means for rectifying a portion of the output of one of said stages, means for amplifying said rectified signal, a pair of uni-directional conductors connected in pushpull relationship for rectifying said rectified signal, and means for utilizing the output of the pair of uni-directional conductors

to control the gain of a plurality of stages of the receiver.

3. Apparatus in accordance with claim 2 wherein said uni-directional conductors connected in pushpull comprise a pair of diodes.

4. Apparatus in accordance with claim 2 wherein there is provided in addition rectifying means connected to the last stage of the receiver for maintaining the output thereof substantially constant.

5. Television reproducing means for utilizing signals comprising recurrent trains of video signals having interposed between said trains of video signals a synchronizing signal and a signal of opposite polarity thereto, said synchronizing signal and said signal of opposite polarity being indicative of the transmission level of the transmitter, said reproducing means including means for receiving said signals comprising a plurality of amplifying stages, means for developing a corrective signal proportional to the value of the combined synchronizing signal and the signal of opposing polarity, means for impressing said corrective signal onto a plurality of the amplifying stages, and additional means for maintaining the output of said receiver substantially constant.

6. Television reproducing means for utilizing signals comprising recurrent trains of video signals having interposed between said trains of video signals a synchronizing signal and a signal of opposite polarity thereto, said synchronizing signal and said signal of opposite polarity being indicative of the transmission level of the transmitter, said reproducing means including means for receiving said transmitted signal including a plurality of amplifying stages, means for rectifying at least a portion of the output of one of said amplifying stages, a pair of uni-directional conductors connected in push-pull relationship and having at least a portion of the output of said rectifying means impressed thereon, and means for utilizing the output of said push-pull connected uni-directional conductors to control the gain of a plurality of the stages of the receiver.

7. Apparatus in accordance with claim 6, wherein said uni-directional conductors connected in push-pull relationship comprise a pair of diodes.

8. Apparatus in accordance with claim 6, wherein there is provided in addition rectifying means connected to the last stage of the receiver for maintaining the output thereof substantially constant.

9. Television reproducing means for utilizing signals comprising recurrent trains of video signals having interposed between said trains of video signals a synchronizing signal and a signal of opposite polarity thereto, said synchronizing signal and said signal of opposite polarity being

indicative of the transmission level of the transmitter, said reproducing means including means for receiving said signals, rectifying means for rectifying at least a portion of the output of at least one of the stages of said reproducing means, a video frequency filter means connected in the output circuit of said rectifier, means for impressing at least a portion of the signal passing through said filter means onto a second rectifier, a time constant circuit connected between said filter means and said rectifier, said time constant circuit having a period longer than the duration of any pulse passing through said filter means, a third rectifier connected in push-pull relationship to said second rectifier, a time constant circuit connected in the output of said third rectifier and having a period greater than one line period of the image to be reproduced and less than one frame thereof, and means for utilizing the output of said third rectifier to control the gain of a plurality of stages of the reproducing.

10. Television reproducing means for utilizing signals comprising recurrent trains of video signals having interposed between said trains of video signals a synchronizing signal and a signal of opposite polarity thereto, said synchronizing signal and said signal of opposite polarity being indicative of the transmission level of the transmitter, said reproducing means including means for receiving said transmitted signal including a plurality of amplifying stages, a first means for rectifying at least a portion of the output of one of said amplifying stages, second rectifying means having at least a portion of the output of said first rectifying means impressed thereon, a time constant circuit connected in the output of said second rectifying means, said time constant circuit having a period greater than the period of one line of the image to be reproduced and less than one frame of said image, and means for utilizing the output of said second rectifying means to control the gain of at least one of the stages of said receiver.

11. Apparatus in accordance with claim 1, wherein the time constant of said corrective signal developing means is greater than one line of the image to be reproduced and less than a frame thereof.

12. Apparatus in accordance with claim 5, wherein the time constant of the corrective signal developing means is greater than one line of the image to be reproduced and less than a frame thereof.

13. Apparatus in accordance with claim 6, wherein the time constant of the stage containing the rectifying means is greater than one line of the image to be reproduced and less than a frame thereof.

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