

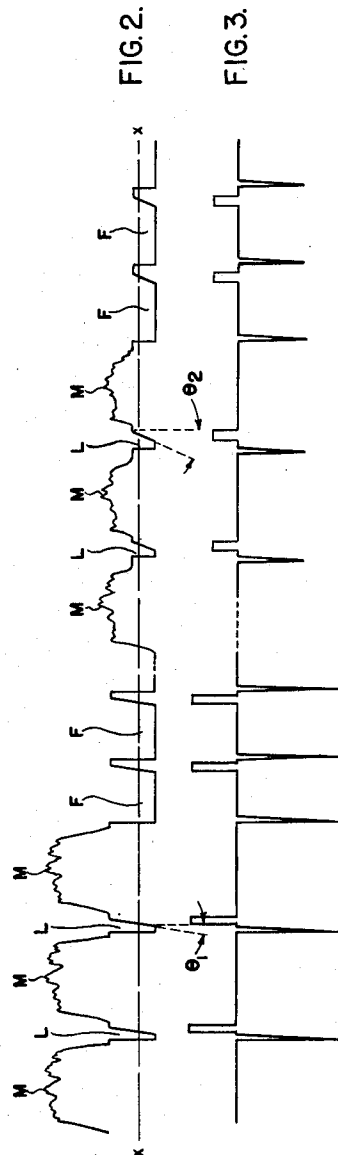
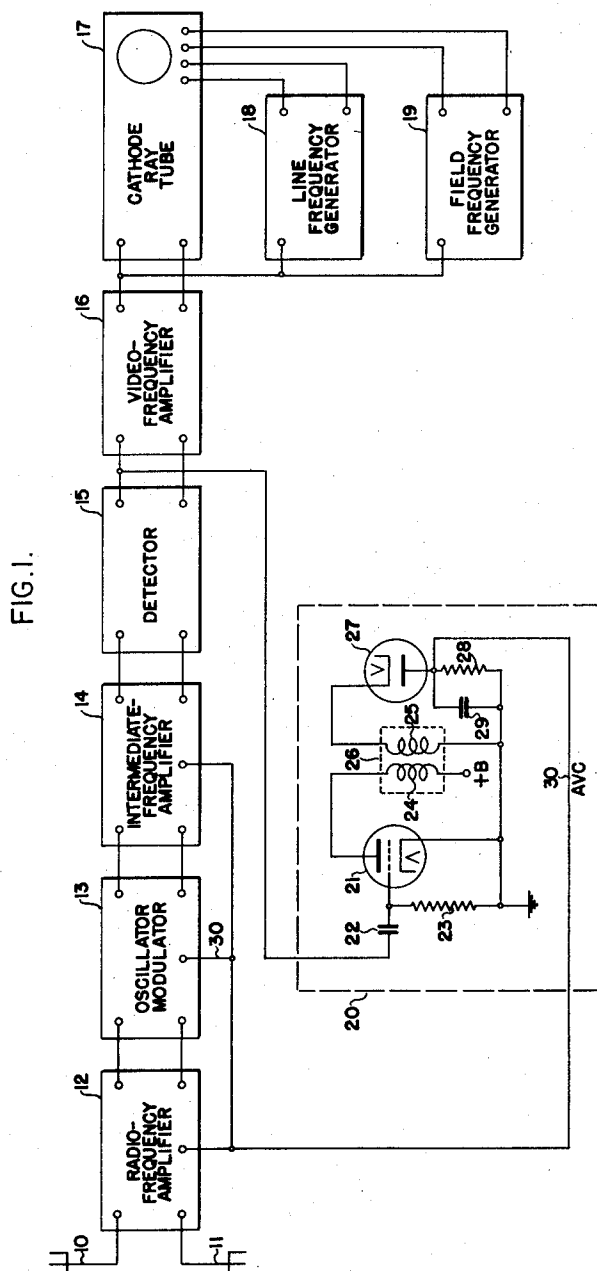
Sept. 17, 1940.

J. C. WILSON

2,214,846

TELEVISION AUTOMATIC AMPLIFICATION CONTROL SYSTEM

Filed June 21, 1938



INVENTOR
JOHN C. WILSON
BY *Laurence B. Dadds*
ATTORNEY

UNITED STATES PATENT OFFICE

2,214,846

TELEVISION AUTOMATIC AMPLIFICATION
CONTROL SYSTEMJohn C. Wilson, Bayside, N. Y., assignor to
Hazeltine Corporation, a corporation of Dela-
ware

Application June 21, 1938, Serial No. 214,880

12 Claims. (Cl. 178—7.5)

This invention relates to television receiving systems and, more particularly, to the automatic control of one or more operating characteristics of such systems in accordance with the amplitude characteristics of received signals. The invention is especially directed to the provision of an automatic amplification control system for television receivers.

In accordance with present television practice, a transmitted signal comprises a carrier wave modulated during successive intervals or trace periods by video-frequency components and during the intervening retrace periods by synchronizing pulses. The video-frequency components include both high-frequency and unidirectional components representative of variations in light and shade in the image being transmitted and of its average background illumination, respectively, while the synchronizing components correspond to initiations of successive lines and fields in the scanning of the image. At the receiver, a beam is so deflected as to scan and illuminate a target in a series of fields of parallel lines. The synchronizing components of the received signal are utilized to control the scanning apparatus of the receiver in such manner as to synchronize its operation with that of similar apparatus utilized at the transmitter in developing the signal. The intensity of the beam is controlled by the light-modulation components, thereby to reconstruct the image.

In certain systems the light-modulation components are so impressed on the carrier that increases in the carrier amplitude correspond to increases in brightness of the image while, in other systems, decreases in the carrier amplitude correspond to increase in the brightness of the image. These two types of modulation are commonly referred to as positive and negative modulation, respectively. Ordinarily, the background illumination information is transmitted directly, that is, by variations of the carrier intensity directly in accordance with the low-frequency and average background-illumination components. The synchronizing pulses are impressed on the carrier in opposite sense to the video components about a line of demarcation; in positive modulation systems, the synchronizing pulses usually reduce the carrier to zero.

While systems of the above types have, in general, given satisfactory results, it has been difficult to obtain satisfactory control of their operating characteristics in accordance with variations of the received carrier amplitude and independent of the light-modulation components,

for example, to procure satisfactory automatic amplification control. More particularly, since the average intensity of the carrier is varied in accordance with the background-illumination components, such average intensity cannot be utilized to derive a satisfactory automatic amplification control in the conventional manner, which requires a controlling effect dependent solely upon the average carrier intensity as determined by the power of the transmitting station, its distance, fading, and so forth, and independent of modulation components. Nor can the amplitude of the synchronizing pulses of a positively modulated signal be made available for this purpose since they are transmitted on inward peaks of modulation, usually of nearly zero amplitude.

It is an object of the present invention, therefore, to provide in a television receiver an improved method of, and means for, automatically controlling one or more of the operating characteristics of the receiver in accordance with the amplitude characteristic of the received modulated-carrier signal and independently of the video-frequency modulation components.

It is a further object of the invention to provide an improved method and means of the character described adapted for the reception of positively modulated television signals including background and high-frequency light-modulation components.

In accordance with the present invention there is provided in a television receiver adapted for the reception of a signal-carrier wave which is modulated during trace periods by background and video-frequency light-modulation components and during retrace periods by synchronizing pulses which, as transmitted, have edges of predetermined finite slopes for a given amplitude of the received television signal, an automatic amplification control system comprising means responsive to variations in the slopes of the edges of the synchronizing pulses of the signal, as received, for developing a controlling effect and means for utilizing this controlling effect to adjust an operating characteristic of the receiver.

In accordance with a preferred form of the invention, the receiver includes a signal-translating channel, a device for detecting the carrier wave to derive its modulation envelope, and means for limiting the derived signal to separate out the synchronizing pulses. Means are further provided for differentiating the synchronizing pulses to derive therefrom double pulses of

opposite polarity, while means responsive to the amplitude of the double pulses, for example, a peak detector responsive to the peak amplitude of the derived pulses of one polarity, are provided for developing a control-bias voltage and this voltage is utilized to control the amplification of the signal-translating channel, thereby to maintain the signal-output intensity of the receiver within a relatively narrow range for a wide range of received signal-input intensities. Where the term "differentiating" is used in this specification and in the appended claims, with respect to a circuit or operation, it is intended to connote a circuit or operation for deriving an electrical quantity upon the first time differential of a given wave. Of course, in actual practice the form of the synchronizing wave is not ideal and does not usually contain uniformly sloping portions, but there are in all cases regions of approximately uniform slope at or near the maximum slope on the sides of the pulses. This region provides a maximum differential magnitude which serves as the desired measure of the signal strength.

For a better understanding of the invention, together with other and further objects thereof, reference is had to the following description taken in connection with the accompanying drawing, and its scope will be pointed out in the appended claims.

In the accompanying drawing, Fig. 1 is a circuit diagram, partially schematic, of a cathode-ray tube television receiving system including circuits embodying the present invention; Fig. 2 is a diagrammatic illustration of one-half of the envelope of a positively modulated television carrier wave; and Fig. 3 is a curve representing certain periodic voltages derived by the receiver of Fig. 1, to aid in the understanding of the invention.

Referring now more particularly to the drawing, the system illustrated comprises a receiver of the superheterodyne type including an antenna and ground system 10, 11 connected to a radio-frequency amplifier 12 to which there is connected in cascade, in the order named, an oscillator-modulator 13, an intermediate-frequency amplifier 14, a detector 15, a video-frequency amplifier 16, and a cathode-ray signal-reproducing tube 17. A line-frequency scanning generator 18 and a field-frequency scanning generator 19 are also coupled to the video-frequency amplifier 16 and connected to the scanning elements of the cathode-ray tube in the conventional manner. The stages or units 10-19, inclusive, may all be of conventional well-known construction so that detailed illustrations and descriptions thereof are unnecessary herein.

Referring briefly, however, to the operation of the system described above, television signals intercepted by the antenna circuit 10, 11 are selected and amplified in the radio-frequency amplifier 12 and applied to the oscillator-modulator 13, wherein they are converted to intermediate-frequency signals which, in turn, are selectively amplified in the intermediate-frequency amplifier 14 and delivered to the detector 15. The modulation components of the signal are derived by the detector 15 and supplied to the video-frequency amplifier 16, wherein they are amplified and from which they are supplied in the usual manner to a brilliancy-control electrode of the cathode-ray tube 17 and the synchronizing control elements of the generators 18 and 19. The intensity of the electron beam of the tube 17 is thus modulated

or controlled in accordance with the video-frequency voltages impressed upon the control grid of the tube in the usual manner. Saw-tooth current or voltage scanning waves are generated in the line-frequency and field-frequency generators 18 and 19, respectively, which are controlled by a synchronizing voltage pulse supplied from the video-frequency amplifier 16, and are applied to the scanning elements of the cathode-ray tube 17 to produce electric scanning fields, thereby to deflect the ray vertically and horizontally so as to trace a rectilinear scanning pattern on the screen of the tube, thereby to reconstruct the transmitted image.

Referring now more particularly to the portion of the system of Fig. 1 embodying the present invention, for the purpose of developing a control-bias voltage proportional to the average amplitude value of the received carrier wave and independent of light-modulation components, there is provided a control system indicated generally at 20. The system 20 includes a vacuum-tube limiter 21 having its control grid coupled to the output circuit of the detector 15 by way of a coupling condenser 22 and grid-leak resistor 23. The anode circuit of the limiter includes a relatively low impedance primary winding 24 of a transformer 26, anode potential being supplied to the tube by way of this winding from a suitable source, as indicated by +B, and a secondary winding 25 being loosely coupled to the winding 24. With this arrangement, the current through the winding 24 is of the same wave form as the grid voltage of the tube 21, and the induced voltage in the winding 25 is the differential of the current through the winding 24. A diode rectifier 27 is connected across the secondary winding 25 through a load resistor 28, shunted by by-pass condenser 29. The bias voltage developed across resistor 28 is applied negatively, by suitable leads 30, to the control electrodes of one or more of the vacuum tubes included in the amplifier 12, oscillator-modulator 13, and amplifier 14, as shown. Preferably the load circuit 28, 29 of the rectifier 27 has a large time constant which is considerably greater than the field-scanning period which may, for example, be $\frac{1}{60}$ second, in which case the time constant of circuit 28, 29 may be of the order of $\frac{1}{10}$ second.

The operation of the present invention may best be explained with reference to the curves of Figs. 2 and 3. In each of these curves, abscissae represent time and the ordinates, amplitude. The curve of Fig. 2 represents one-half of the modulation envelope of a received signal as it appears in the output circuit of the detector 15. The left-hand portion of this curve represents a signal of relatively large amplitude, while the right-hand portion represents a similar signal of relatively low amplitude. The portions of the wave represented by the curve of Fig. 2 where the carrier is reduced to zero, as indicated at L and F, represent line-synchronizing and field-synchronizing pulses occurring during line-retrace and field-retrace periods, respectively. The portions of the wave between the line-synchronizing pulses L correspond to trace portions of successive lines and are modulated by the high-frequency and background-illumination components M.

As mentioned above, in a signal of the positive modulation type such as is illustrated in Fig. 2, increases in light intensity are represented by increases in the amplitude of the carrier and the average intensity of the signal is varied in accordance with the low-frequency and average

background-illumination components of the image so that carrier amplitude variations cannot be utilized for the purpose of amplification control or control of other operating characteristics of the receiver. Nor is there in this type of wave any synchronizing pulses which can be readily utilized, in any previously known manner, for the purpose in question, since the signal is reduced to zero during the retrace or synchronizing pulse periods.

However, in signals of the type described, the edges of the synchronizing pulses, as transmitted, may be given a predetermined fixed finite slope, as indicated by the angle θ_1 in Fig. 2, considering that the left-hand portion of the curve of this figure also substantially represents the signal as developed at the transmitter. In the signal as received at a receiver, however, the carrier intensity varies in accordance with the power of the transmitting station, its distance, fading, and so forth, and the slope, that is, the time rate of change of current or voltage corresponding with the edges of the synchronizing pulses varies proportionally to such carrier-amplitude variations and independently of average background illumination. In the portion of the signal illustrated at the right of Fig. 2, representing a signal the average intensity of which is substantially reduced, it will be noted that the slopes of the edges of the synchronizing pulses θ_2 are substantially less than for the same signal with greater amplitude.

The present invention utilizes this variation in slopes of the edges of the synchronizing pulses as a measure of the average value of the intensity of the received signal carrier independent of light-modulation components and for developing a control-bias voltage suitable for automatic amplification control or the control of any other desired operating characteristic of the receiver. To this end the detected signal is impressed on the input circuit of the limiter 21, with such polarity and with the limiter so biased that only that portion of the synchronizing pulses near the carrier zero axis, for example, the portion of the signal shown below the line X—X in Fig. 2, is passed thereby. The operating potentials applied to the electrodes of the limiter tube impart thereto a high internal impedance so that the current in the output circuit of the tube is of substantially the same wave form as the repeated portion of the applied synchronizing voltage. Hence, during each of the synchronizing pulses, current of trapezoidal wave form flows through the winding 24 and, since the current through the winding 29 is determined by the tube 21, the induced voltage in, and the voltage across, the secondary winding 25 is proportional to the differential of the current wave flowing through winding 24. Therefore, there is developed in the winding 25 a double pulse voltage wave, such as illustrated by the curve of Fig. 3, which is applied to the rectifier 27. It will be apparent that the double pulses thus derived from the synchronizing pulses have amplitude values which correspond to the slopes of the edges of their respective pulses. The rectifier 27 operates in a conventional manner to measure the peak amplitude of the pulses of one polarity, thereby to develop across its load resistor 28 a unidirectional-bias voltage which is proportional to the average amplitude of the received carrier wave and independent of light-modulation components. This voltage is applied negatively to the control electrodes of one or more of the tubes in stages 12, 13, and 14, thereby

to control the amplification therein inversely in accordance with the slope of the edges of the synchronizing pulses; that is, inversely in accordance with the average carrier amplitude just referred to. The output intensity of the receiver is thus maintained within a relatively narrow range for a relatively wide range of received input signal intensities.

While there has been described what is at present considered to be the preferred embodiment of this invention, it will be obvious to those skilled in the art that various changes and modifications may be made therein without departing from the invention, and it is, therefore, aimed in the appended claims to cover all such changes and modifications as fall within the true spirit and scope of the invention.

What is claimed is:

1. In a television receiver adapted for the reception of a signal-carrier wave transmitted with modulation during trace periods by video-frequency components and during retrace periods by synchronizing pulses having edges of predetermined finite slopes for a given amplitude of the received television signal, an automatic control system comprising means responsive to variations in the slopes of at least a portion of the edges of said pulses of the signal as received for developing a controlling effect, and means for utilizing said controlling effect to adjust an operating characteristic of said receiver.
2. In a television receiver adapted for the reception of a signal-carrier wave transmitted with modulation during trace periods by video-frequency components and during retrace periods by synchronizing pulses having edges of predetermined finite slopes for a given amplitude of the received television signal and having a wide range of signal-input intensities, an automatic control system comprising means responsive to variations in the slopes of the edges of said pulses of the signal as received for developing a controlling effect, and means for utilizing said controlling effect to maintain the signal-output intensity of the receiver within a relatively narrow range.
3. In a television receiver adapted for the reception of a signal-carrier wave transmitted with modulation during trace periods by video-frequency components and during retrace periods by synchronizing pulses having edges of predetermined finite slopes for a given amplitude of the received television signal and having a wide range of signal-input intensities, an automatic control system comprising a signal-translating channel and means for controlling the amplification of said channel inversely in accordance with variations in the slopes of the edges of said synchronizing pulses of the signal as received for maintaining the output intensity of said channel within a relatively narrow range.
4. In a television receiver adapted for the reception of a signal-carrier wave transmitted with modulation during trace periods by video-frequency components and during retrace periods by synchronizing pulses having edges of predetermined finite slopes for a given amplitude of the received television signal, an automatic control system comprising means for developing a control-bias voltage proportional to the slopes of the edges of said synchronizing pulses of the signal as received, and means for utilizing said voltage to adjust an operating characteristic of said receiver.
5. In a television receiver adapted for the re-

ception of a signal-carrier wave with modulation during trace periods by video-frequency components and during retrace periods by synchronizing pulses having edges of predetermined finite slopes for a given amplitude of the received television signal, an automatic control system comprising means for differentiating the synchronizing pulses of a received signal to derive auxiliary pulses, means responsive to the amplitude of said auxiliary pulses for developing a controlling effect, and means for utilizing said controlling effect to adjust an operating characteristic of said receiver.

6. In a television receiver adapted for the reception of a signal-carrier wave transmitted with modulation during trace periods by video-frequency components and during retrace periods by synchronizing pulses having edges of predetermined slopes, an automatic control system comprising means for detecting said carrier wave to derive its modulation envelope, means for limiting said derived signal to develop at least a portion of said synchronizing pulses, means responsive to variations in the slopes of the edges of said derived pulses for developing a controlling effect, and means for utilizing said controlling effect to adjust an operating characteristic of said receiver.

7. In a television receiver adapted for the reception of a signal-carrier wave transmitted with modulation during trace periods by video-frequency components and during retrace periods by synchronizing pulses having edges of predetermined slopes, an automatic control system comprising means for detecting said carrier to derive its modulation envelope, means for limiting said desired signal to develop at least a portion of said synchronizing pulses, means for differentiating said synchronizing pulses to derive auxiliary pulses, means responsive to the amplitude of said auxiliary pulses for developing a controlling effect, and means for utilizing said controlling effect to adjust an operating characteristic of said receiver.

8. In a television receiver adapted for the reception of a signal-carrier wave transmitted with modulation during trace periods by video-frequency components and during retrace periods by synchronizing pulses having edges of predetermined slopes, an automatic control system comprising means for deriving at least portions of said synchronizing pulses, means for differentiating said synchronizing pulses to derive auxiliary pulses, means for measuring the peak amplitude of said auxiliary pulses to develop a control-bias voltage, and means for utilizing said voltage to control an operating characteristic of said receiver.

9. The method of controlling an operating characteristic of a television receiver in accordance with the average amplitude of a received signal-carrier wave and independently of its

light-modulation components, said carrier wave being transmitted with modulation during trace periods by video-frequency components and during retrace periods by synchronizing pulses having edges of predetermined finite slopes for a given amplitude of the received television signal, which comprises deriving said synchronizing pulses from the received signal, developing a controlling effect in response to variations in the slopes of the edges of said pulses of the signal as received, and utilizing said controlling effect to adjust said operating characteristic.

10. The method of controlling an operating characteristic of a television receiver in accordance with the average amplitude of a received signal-carrier wave and independently of its light-modulation components, said carrier wave being transmitted with modulation during trace periods by video-frequency components and during retrace periods by synchronizing pulses having edges of predetermined finite slopes for a given amplitude of the received television signal, which comprises differentiating the synchronizing pulses of a received signal to derive auxiliary pulses, developing a controlling effect proportional to the amplitudes of said auxiliary pulses, and utilizing said controlling effect to adjust said operating characteristic.

11. The method of controlling an operating characteristic of a television receiver in accordance with the average amplitude of a received signal-carrier wave and independently of its light-modulation components, said carrier wave being transmitted with modulation during trace periods by video-frequency components and during retrace periods by synchronizing pulses having edges of predetermined slopes, which comprises detecting said carrier wave to derive its modulation envelope, limiting the derived signal to derive at least a portion of said synchronizing pulses, developing a controlling effect in response to variations in the slopes of said derived pulses, and utilizing said controlling effect to adjust said operating characteristic.

12. The method of controlling an operating characteristic of a television receiver in accordance with the average amplitude of a received signal-carrier wave and independently of its light-modulation components, said carrier wave being transmitted with modulation during trace periods by video-frequency components and during retrace periods by synchronizing pulses having edges of predetermined slopes, which comprises deriving said synchronizing pulses from the received signal, differentiating said synchronizing pulses to derive auxiliary pulses, detecting the peak amplitude of said auxiliary pulses to develop a control-bias voltage, and utilizing said bias voltage to adjust said operating characteristic.

JOHN C. WILSON.