June 24, 1941. R. S. HOLMES 2,246,939

TELEVISION RECEIVER

Filed May 28, 1938

FIG. 1.

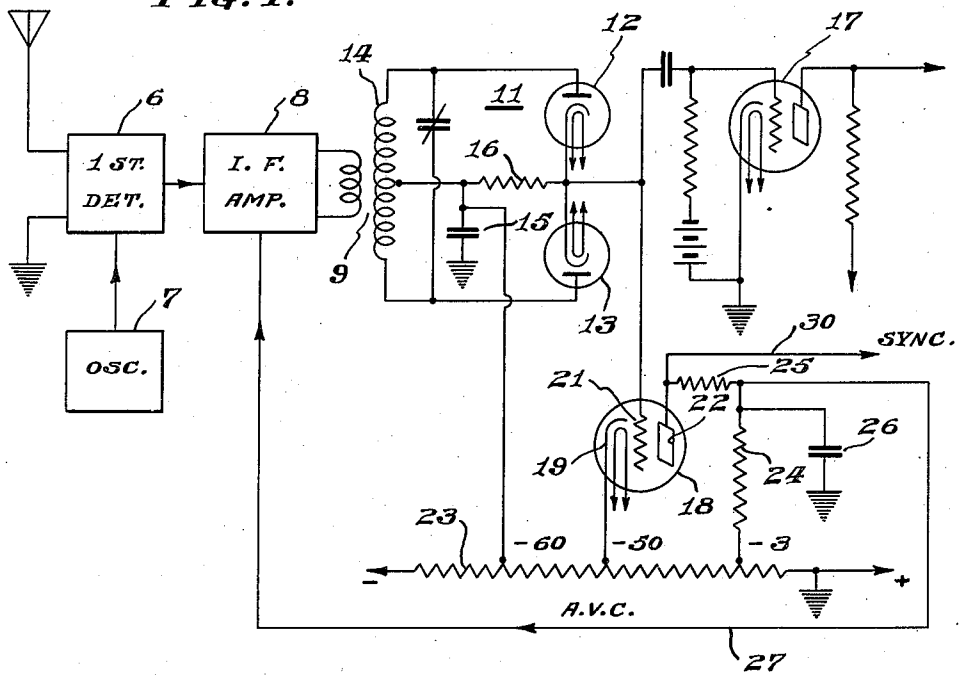


FIG. 2.

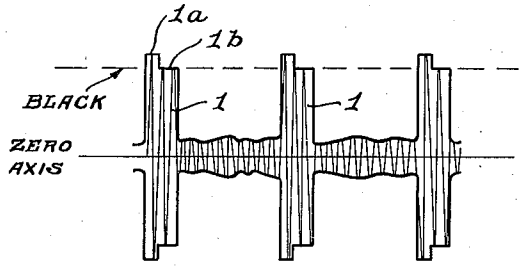
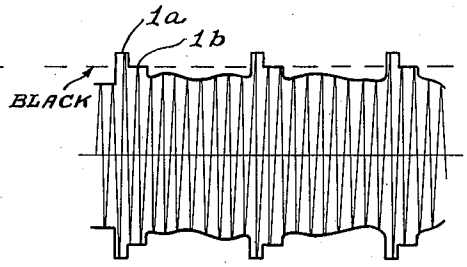


FIG. 3.



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2,246,939

UNITED STATES PATENT OFFICE

2,246,939

TELEVISION RECEIVER

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Application May 28, 1938, Serial No. 210,611

6 Claims. (Cl. 178—7.3)

My invention relates to automatic gain control or A. V. C. systems and particularly to A. V. C. systems for use in television receivers or the like.

It has been found desirable to so design television transmitters that the direct current component of the picture signal is transmitted whereby the transmitter tubes are utilized to transmit the maximum power which their rating permits. When the D.-C. component is transmitted, the amplitude of the transmitted carrier varies in accordance with the D.-C. component. Thus, the carrier amplitude is not a true measure of the attenuation or fading of the transmitted signal and a conventional A. V. C. system is not satisfactory.

It is, accordingly, an object of my invention to provide an improved automatic gain control system for television or picture receivers.

It is a further object of my invention to provide an improved system for automatically controlling the gain of a television receiver which is receiving signals from a transmitter of the type that transmits the direct current component of the picture signal.

It is a still further object of my invention to provide for use in a television system transmitting direct current an improved automatic gain control circuit which will not become ineffective and thus permit the amplifier tubes to overload as a result of the modulator being taken off the carrier and then being put back on.

It is a still further object of my invention to provide an improved television receiver in which a single vacuum tube may be employed for both A. V. C. and separation of picture and synchronizing signals.

In my Patent No. 2,109,618 there is described an A. V. C. system for a television receiver in which the volume or gain control voltage is derived from the synchronizing impulses rather than from the carrier wave.

In accordance with my invention, I make use of the broad principle described in my above-mentioned patent, that is, the gain control voltage is derived from the synchronizing impulses and has a value which is a measure of their height. In my improved system, however, the gain control voltage is derived from a point in the receiver where the D.-C. component is in the picture signal. Preferably, this voltage is derived from the second detector output in a manner which will be described hereinafter.

The invention will be better understood from the following description taken in connection with the accompanying drawing in which—

Figure 1 is a circuit diagram of an embodiment of my invention, and

Figures 2 and 3 are curves which are referred to in describing the invention.

The characteristics of the transmitted signal upon which my invention is dependent are illustrated in Figs. 2 and 3 which show a carrier wave modulated by a light picture signal (light background) and by a dark picture signal (dark background), respectively. The modulating video signal, of course, is the envelope of the carrier. The horizontal synchronizing impulses which occur at the end of each scanning line are indicated at 1.

In the specific case shown, each synchronizing impulse consists of a blanking impulse 1*b* which is referred to as the pedestal and a "super-sync" impulse 1*a* which is set on top of the pedestal. The top of the pedestal always goes to a certain level, in the signal transmitted, such as the black level or a certain amount beyond black. A system for producing picture and synchronizing signals of this character is described and claimed in Bedford Patent 2,192,121, issued February 27, 1940, entitled "Television systems and the method of operation thereof," and assigned to the Radio Corporation of America.

The picture signals and the synchronizing impulses may be transmitted with the D.-C. component included by employing D.-C. amplifiers at the transmitter or, preferably, by employing a system of the character described and claimed in Bedford application, Serial No. 203,015, filed April 20, 1938, entitled "Picture transmitting apparatus," and assigned to the Radio Corporation of America.

As indicated in Figs. 2 and 3, the so-called negative modulation by synchronizing impulses is employed. In other words, the synchronizing impulses (which are in the dark direction) produce maximum amplitude of the carrier wave.

A comparison of Figs. 2 and 3 shows that a change from a dark picture to a light picture does not cause a change in the amplitude or level of the synchronizing impulses. It follows that any variation in the height of the synchronizing impulses (or a variation in the amplitude of the carrier representative of synchronizing impulses) will be a result of fading or attenuation of the transmitted signal.

A gain control voltage which has a value depending upon the height of the synchronizing impulses, and which is independent of the background of the picture being transmitted, may be derived as shown in Fig. 1.

Referring to Fig. 1, my invention is shown applied to a television receiver of the superheterodyne type. The receiver comprises a first detector 6, a tunable oscillator 7, and an intermediate frequency amplifier 8 which usually consists of a plurality of amplifier stages.

The modulated I. F. carrier which is of the character shown in Figs. 2 and 3 is supplied from the I. F. amplifier 8 through a tuned I. F. transformer 9 to the second detector 11.

Preferably, the second detector 11 is of the push-pull type comprising diodes 12 and 13. In this particular circuit the plates of the diodes are connected to opposite terminals of the secondary winding 14 of the transformer 9 while the cathodes of the diodes are connected through a resistor 16 to the midpoint of the secondary 14. The plate end of resistor 16 is held at ground potential at the intermediate frequency by means of a condenser 15.

The video signal appears across the resistor 16 and is supplied to video amplifier, the first stage of which is indicated at 17 and then impressed upon a cathode ray tube (not shown).

The video signal may be supplied from the amplifier 17 to a suitable amplifying and separating circuit (not shown) which removes the picture signal and supplies only the synchronizing impulses to the usual deflecting circuits of the cathode ray tube. Or, as illustrated in Fig. 1 and as will be described hereinafter, the synchronizing impulses may be taken off the A. V. C. vacuum tube.

In order to obtain the A. V. C., the video signal from the second detector 11 is impressed upon an A. V. C. circuit comprising a vacuum tube 18 having an indirectly heated cathode 19, a control grid 21, and a plate 22. The grid 21 is connected to the cathode end of the second detector output resistor 16 while the cathode 19 is connected to the other end of the output resistor 16 through a portion of a voltage divider 23.

Thus, the signal supplied by the second detector 11 is impressed upon the input circuit of the vacuum tube 18.

It will be noted that in the example illustrated the grid 21 of the vacuum tube 18 is maintained at a negative bias of 10 volts whereby the tube 18 is biased beyond cut-off point for the condition of no signal input.

The plate 22 of the vacuum tube 18 is connected to a less negative point on the voltage divider through a plate resistor 24. In shunt to the plate resistor 24 there is connected a condenser 26 of such value that the periodically recurring synchronizing impulses cause a substantially steady voltage to appear thereacross as will be more fully described hereinafter. If synchronizing impulses are to be taken off the tube 18, a resistor 25 is connected between the plate 22 and the plate resistor 24.

A conductor 27 leading from the plate end of the resistor 24 to the I. F. amplifier 8 impresses the A. V. C. or gain control voltage appearing across the condenser 26 upon a suitable gain control electrode in the I. F. amplifier.

The operation and adjustment of the circuit is as follows: The negative bias applied to the grid 21 of the vacuum tube 18 is such that the tube will pass plate current only when a voltage is applied thereto corresponding to the peak values of the synchronizing impulses. Thus, the periodic flow of plate current corresponds to the peak values of the synchronizing impulses and, since the condenser 26 and plate resistor 24 have been given a suitable time constant, a comparatively steady voltage appears across the condenser 26 and resistor 24 which voltage is a measure of the heights of the synchronizing impulses and therefore a measure of the fading or attenuation of an incoming signal.

It will be understood that the time constant of the plate resistor 24 and the condenser 26 in series should be such that the condenser will discharge a comparatively small amount between the occurrence of successive synchronizing impulses. In this respect the present invention resembles the A. V. C. circuit described in my above-mentioned patent.

An important feature of my invention is that the receiver cannot block when the modulation goes off the carrier and comes back on because the D. C. produced by the unmodulated carrier (which D. C. is a measure of the carrier amplitude) is impressed upon the grid of the amplifier tube 18, thus holding down the gain.

If the D. C. from the unmodulated carrier were not impressed upon the grid of the amplifier tube 18, the receiver would be wide open, that is, at maximum gain, when the modulation went off. Then when the modulation came on, providing the signal were strong, the I. F. amplifier tubes would be overloaded, the synchronizing impulses would be distorted or wiped off, and the A. V. C. would remain ineffective whereby the gain would not be reduced and the tubes would continue to be overloaded.

It may be noted that the voltage divider should be provided with the usual bypass condensers unless its resistance is low enough to make them unnecessary.

As previously mentioned, the synchronizing impulses may be taken off the plate of tube 18 since they appear across the resistor 25. Preferably, resistor 25 is of low impedance as compared with the impedance of resistor 24. The synchronizing impulses, both horizontal and vertical, may be supplied through a conductor 30 to the grid of a synchronizing impulse amplifier tube (not shown) or they may be supplied through conductor 30 directly to the usual filter circuits for separating the horizontal and vertical synchronizing impulses from each other.

I claim as my invention:

1. In a television receiver for the reception of a carrier wave negatively modulated by a composite signal comprising picture signals and periodically recurring synchronizing impulses wherein the synchronizing impulses are of greater amplitude than picture signals of like polarity, said received carrier wave containing the direct current component of the picture signals, means for intercepting said carrier wave, means for demodulating said carrier wave to produce said picture signals and their direct current component and said synchronizing impulses, an amplifier connected in cascade with said modulating means, a rectifying device which is direct current connected across the output circuit of said demodulating means, means for making said rectifying device rectify only the peaks of said synchronizing impulses, means for integrating or smoothing said rectified peaks whereby a gain control voltage is obtained which is a measure of the heights of said synchronizing impulses, and means for controlling the gain of said amplifier in accordance with said gain control voltage.

2. In a television receiver for the reception of a carrier wave negatively modulated by a composite

signal comprising picture signals and periodically recurring synchronizing impulses wherein the synchronizing impulses are of greater amplitude than picture signals of like polarity, said received carrier wave containing the direct current component of the picture signals, means for intercepting said carrier wave, means comprising a diode and an output resistor for demodulating said carrier wave to produce said picture signals and their direct current component and said synchronizing impulses, an amplifier connected in cascade with said demodulating means, a rectifying device which is direct current connected across said output resistor, means for making said rectifying device rectify only the peaks of said synchronizing impulses, means for integrating or smoothing said rectified peaks whereby a gain control voltage is obtained which is a measure of the heights of said synchronizing impulses, and means for controlling the gain of said amplifier in accordance with said gain control voltage.

3. In a television receiver for the reception of a carrier wave modulated by a composite signal comprising picture signals and periodically recurring synchronizing impulses wherein said impulses are of greater amplitude than picture signals of like polarity and wherein said impulses modulate said carrier wave in the direction to make the carrier wave of maximum amplitude representative of said impulses, said received carrier wave containing the direct current component of the picture signals, means for intercepting said modulated carrier wave, means for demodulating said carrier wave to produce a demodulated signal including said composite signal and the direct current component, an amplifier connected in cascade with said demodulator, a rectifying device, means for impressing said demodulated signal including the direct current component across said rectifying device with the correct polarity to make said impulses produce a periodic flow of current through said rectifying device, means comprising a resistor and a condenser for making said rectifying device rectify only the peaks of said synchronizing impulses, said resistor and said condenser having a time constant such that said condenser discharges only a slight amount between successive synchronizing impulses, and means for controlling the gain of said amplifier in accordance with the resulting A. V. C. voltage appearing across said resistor.

4. In a television receiver for the reception of a carrier wave negatively modulated by a composite signal comprising picture signals and periodically recurring synchronizing impulses wherein the synchronizing impulses are of greater amplitude than picture signals of like polarity, said received carrier wave containing the direct current component of the picture signals, means for intercepting said carrier wave, means for demodulating said carrier wave to produce said picture signals and their direct current component and said synchronizing signals, an amplifier connected in cascade with said demodulating means, said demodulating means comprising a diode and a resistor connected in series to form a series combination across which said modulated carrier wave is impressed, a peak rectifier so direct current connected across said resistor as to rectify only the peaks of said synchronizing impulses and including means for integrating or smoothing said impulses to produce a gain control voltage which is a measure of the amplitude of said synchronizing impulses, and means for controlling the gain of said amplifier in accordance with said gain control voltage.

5. In a television receiver for the reception of a carrier wave modulated by a composite signal comprising picture signals including a direct current component and periodically recurring synchronizing impulses wherein said impulses are of greater amplitude than picture signals of like polarity and wherein said impulses modulate said carrier wave in the direction to make the carrier wave of maximum amplitude representative of said impulses, means for intercepting said modulated carrier wave, means for demodulating said carrier wave to produce a demodulated signal including said composite signal and a direct current component, an amplifier connected in cascade with said demodulator, a vacuum tube having a cathode, a grid and a plate, a plate resistor through which an operating voltage is applied to said plate, a condenser in shunt to said plate resistor, means for biasing said vacuum tube substantially beyond cut-off, means for impressing said demodulated signal including the direct current component upon said cathode and said grid with the correct polarity to make said impulses produce a periodic flow of current through said vacuum tube to charge said condenser, said plate resistor and said condenser in series having a time constant such that said condenser discharges only a slight amount between successive synchronizing impulses whereby said diode passes only the peaks of said impulses, and means for controlling the gain of said amplifier in accordance with the resulting A. V. C. voltage appearing across said resistor.

6. In a television receiver for the reception of a carrier wave modulated by a composite signal comprising picture signals and periodically recurring synchronizing impulses wherein said impulses are of greater amplitude than picture signals of like polarity and wherein said impulses modulate said carrier wave in the direction to make the carrier wave of maximum amplitude representative of said impulses, said received carrier wave containing the direct current component of the picture signals, means for intercepting said modulated carrier wave, means for demodulating said carrier wave to produce a demodulated signal including said composite signal and the direct current component, an amplifier connected in cascade with said demodulator, a rectifying device, means for impressing said demodulated signal including the direct current component across said rectifying device with the correct polarity to make said impulses produce a periodic flow of current through said rectifying device, means for making said rectifying device rectify only the peaks of said synchronizing impulses, and means for utilizing said rectified peaks for controlling the gain of said amplifier.

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