Aug. 12, 1941. H. A. WHEELER 2,252,148

TELEVISION CARRIER SIGNAL RECEIVER

Original Filed June 7, 1939

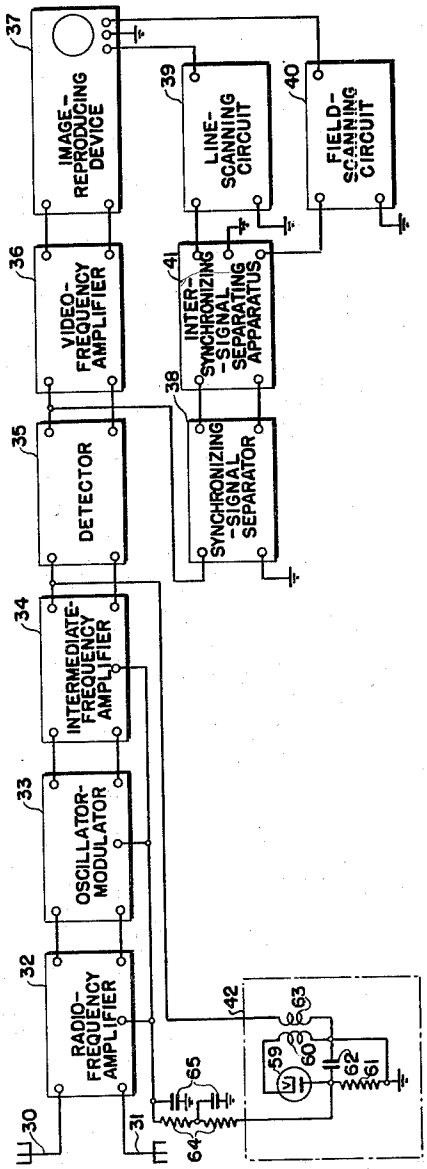


FIG. 1.

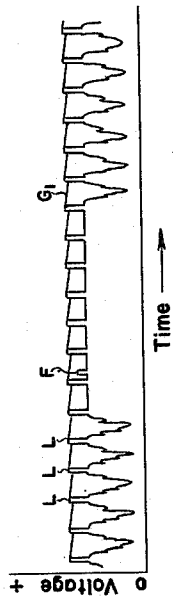


FIG. 2.

INVENTOR
HAROLD A. WHEELER

BY Lawrence B. Dodds

ATTORNEY

Patented Aug. 12, 1941 2,252,148

UNITED STATES PATENT OFFICE

2,252,148

TELEVISION CARRIER SIGNAL RECEIVER

Harold A. Wheeler, Great Neck, N. Y., assignor to Hazeltine Corporation, a corporation of Delaware

Original application June 7, 1939, Serial No. 277,861. Divided and this application September 5, 1940, Serial No. 355,442

4 Claims. (Cl. 178—7.5)

This invention relates to television carrier-signal receivers, and particularly to a television receiver adapted to receive a carrier wave modulated with video-frequency components and a composite synchronizing signal including field-synchronizing components and line-synchronizing components of greater amplitude than the field-synchronizing components.

The instant application is a division of applicant's copending application Serial No. 277,861, entitled "Television synchronizing system" and filed June 7, 1939.

In accordance with present television practice, there is developed and transmitted a signal which comprises a carrier wave modulated during successive intervals or trace periods by video-frequency components representative of light and shade values in an image being transmitted. During retrace intervals between the trace periods the carrier wave is modulated by synchronizing pulses or components which correspond to the initiation of successive lines and fields in the scanning of the image. At the receiver the beam is so deflected as to scan and illuminate a target in a series of parallel lines. The video-frequency components of the received signal are utilized to control the intensity of the beam. The line-synchronizing and field-synchronizing pulses are separated from the video-frequency components and are effectively separated from each other and utilized to synchronize the operation of the receiver scanning apparatus with similar scanning apparatus utilized at the transmitter in developing the signal. The transmitted image is thereby reconstructed on the target of the receiver.

In scanning of the interlaced type, the line-scanning and field-scanning pulses are so related that successive fields are staggered, the lines of one field falling between or interlacing those of a preceding field. Because of persistence of vision, the optical effect produced is as though each frame or group of fields comprised a multiple of the actual number of lines scanned per field and the frame-scanning frequency equalled the field-scanning frequency. In such systems certain of the field-synchronizing pulses must occur between line-synchronizing pulses.

Furthermore, such systems conventionally comprise line-doubling pulses so that the line-synchronizing pulses are not continuous, rendering the separation of line-synchronizing and field-synchronizing pulses a difficult problem. Applicant's above-mentioned copending application, of which this is a divisional application, describes and claims a television system utilizing a particular type of composite synchronizing signal having continuous line-synchronizing pulses of critical amplitude and frequency characteristics and field-synchronizing pulses spaced between the line-synchronizing pulses, of the same polarity as the line-synchronizing pulses and having predetermined different critical amplitude and frequency characteristics. By the use of such a composite synchronizing signal, separation of the line-synchronizing and field-synchronizing pulses is greatly facilitated.

Also, in television systems it is desirable to control automatically various receiver-operating characteristics, for example, to provide automatic amplification control in accordance with the average intensity of the carrier wave independent of intensity variations due to light-modulation components. For this purpose, in systems where negatively-modulated carrier waves are utilized, that is, where a decrease in carrier-wave amplitude corresponds to an increase in illumination, the synchronizing pulses generally appear as outward modulation peaks and the peak value of the synchronizing pulses provides a convenient measure of the carrier intensity variations independent of the light-modulation components. For various reasons, however, including the fact that the synchronizing signals utilized in the prior art have included field-synchronizing pulses of either the same or greater amplitude than the line-synchronizing pulses and the fact that these synchronizing pulses are not uniformly spaced with respect to the line pulses in interlaced systems, the irregular spacing of these pulses tends to affect the control effect derived from the signal and a measure of the intensity variations in question has been difficult or impossible to obtain without too great a time constant in the circuit.

It is an object of the present invention, therefore, to provide a television receiver including an improved automatic amplification control which avoids one or more of the above-mentioned disadvantages of prior art arrangements.

It is still another object of the invention to provide a television receiver including an automatic amplification control which is fast-acting and quick to recover from the effect of undesired signals.

It is still another object of the invention to provide a television system including an automatic amplification control arrangement which is responsive only to the line-synchronizing pulses of a composite signal including both line-synchronizing and field-synchronizing pulses.

In accordance with the invention, a television

carrier-signal receiver adapted to receive a carrier wave modulated with video-frequency components and a composite synchronizing signal including field-synchronizing components and line-synchronizing components of greater amplitude than said field-synchronizing components comprises means for rectifying only the line-synchronizing components of the received signal, the line-synchronizing components having an amplitude varying only in accordance with the amplitude of the received signal. A time-constant circuit is coupled to the rectifying means which has a time constant sufficiently long only to suppress components of frequencies of the order of the frequency of the line-synchronizing components, and means are coupled to the time-constant circuit for deriving a control effect therefrom and for utilizing it to control an operating characteristic of the receiver, for example, the gain of an amplifying stage of the receiver.

In the accompanying drawing, Fig. 1 is a circuit diagram, partly schematic, of a complete television receiving system embodying the invention, while Fig. 2 comprises a graph utilized to illustrate certain of the operating characteristics of the receiver of Fig. 1.

Referring now more particularly to Fig. 1 of the drawing, there is shown a circuit diagram, partly schematic, of a complete television receiving system of the superheterodyne type including, in cascade, an antenna system **30**, **31**, a radio-frequency amplifier **32**, an oscillator-modulator **33**, an intermediate-frequency amplifier **34**, a detector **35**, a video-frequency amplifier **36**, and an image-reproducing device **37**, such as a cathode-ray signal-reproducing tube.

A synchronizing-signal separator **38** also is coupled to the output circuit of the detector **35** and its output circuit is, in turn, coupled to line-frequency and field-frequency wave generators **39** and **40** by way of inter-synchronizing-signal separating apparatus, indicated generally at **41**. The generators **39** and **40** have their output circuits connected to the scanning elements of the device **37** in conventional manner. The parts of the system represented schematically may be of any conventional type or operation.

Since the system of Fig. 1 as thus far described is, in general, well known in the art, a detailed description of the system and its operation is deemed to be unnecessary. Briefly, however, a television-modulated carrier wave is intercepted by the antenna system **30**, **31** and selectively amplified in the radio-frequency amplifier **32**, from which it is impressed upon the oscillator-modulator **33** wherein it is converted into an intermediate-frequency signal which is thereupon further selectively amplified in the intermediate-frequency amplifier **34**. The amplified intermediate-frequency signal is thus delivered from amplifier **34** to detector **35** in which there is developed the composite modulation signal comprising the video-frequency components and the synchronizing-signal components. This modulation signal is supplied to the video-frequency amplifier **36** wherein it is amplified and from which it is applied in the usual manner to a brightness control element of the reproducing device **37**. The modulation signal is also supplied to the separator **38** wherein the composite synchronizing signal is separated from the video-frequency components and delivered to the apparatus **41**. In the apparatus **41** the line-synchronizing and field-synchronizing pulses are separated from each other and the separated pulses are applied to the generators **39** and **40** to synchronize their operations with the corresponding apparatus at the transmitter. The apparatus **41** may be of conventional design or may be in accordance with that described and claimed in applicant's above-mentioned copending application. The intensity of the beam of the reproducing device **37** is thus modulated or controlled in accordance with the video-frequency voltages impressed upon its control electrode in the usual manner. Scanning waves developed by the generators **39** and **40**, controlled by the synchronizing components, supplied from the apparatus **41**, are utilized in the conventional manner to deflect the scanning beam of the image-reproducing device **37**, for example, by producing electric fields of saw-tooth wave form which deflect the electron beam of the signal-reproducing tube in two directions normal to each other so as to trace the usual rectilinear scanning pattern upon the target of the reproducing device, thereby to reconstruct the transmitted image.

Referring now more particularly to the portion of the system of Fig. 1 constituting the present invention, there is provided an amplification control circuit **42** which may comprise a conventional diode rectifier **59** connected across a transformer secondary winding **60** by way of a load circuit including a parallel-connected resistor **61** and by-pass condenser **62**, the time constant of which is considerably greater than the period of the line-synchronizing pulses but usually less than that of the field-synchronizing pulses. The winding **60** is coupled to a transformer primary winding **63** which is connected to the output circuit of the intermediate-frequency amplifier **34**, while the negative terminal of the load resistor **61** is coupled, by way of a suitable filter including series resistors **64** and shunt condensers **65**, to the control electrode of one or more of the signal-translating tubes in the stages **32**, **33** and **34**.

In Fig. 2 there is illustrated the envelope of one-half of the signal which is received by the receiver of Fig. 1. In considering the operation of the amplification control circuit **42**, it will be seen that an improved result is obtained by virtue of a modification of design and the novel wave form of the signal which is applied thereto from the intermediate-frequency amplifier **34**. This signal includes a composite synchronizing signal including field-synchronizing components and continuous line-synchronizing pulses L, L of greater amplitude than the field-synchronizing pulses F. The line-synchronizing pulses have predetermined critical amplitude and frequency characteristics and the field-synchronizing pulses F are spaced between the line-synchronizing pulses, are of the same polarity as the line-synchronizing pulses and have predetermined different critical amplitude and frequency characteristics, specifically a lower frequency and a lesser amplitude. The circuit **42** including the diode rectifier **59** thus peak-rectifies the applied signal to derive across its load impedance **61**, **62** a unidirectional negative bias voltage which increases in proportion to the amplitude of the received carrier wave and independent of its light-modulation components. It will be appreciated that, since the field-synchronizing pulses of the novel composite signal are of a considerably lesser amplitude than the line-synchronizing pulses and since the time constant of the rectifier load circuit **61**, **62** is substantially greater than the period of the line-synchronizing pulses,

the field-synchronizing pulses do not undesirably affect the operation of the rectifier circuit as they do in the case of similar systems of the prior art, as explained above. That is, only the peaks of the line-synchronizing pulses are rectified and these peaks provide a precise measure of the intensity variations of the signal-carrier wave. The unidirectional control bias voltage thus developed across the load circuit **61**, **62** is illustrated by curve G_1 in Fig. 2. Such a voltage is readily smoothed out by the filter elements **65**, **64** of the A. V. C. system, thereby providing a steady unidirectional control-bias voltage of the exact required amplitude. This voltage, being applied negatively to the control electrodes of one or more tubes in the stages **32**, **33** and **34**, serves to vary the amplification in these stages inversely in accordance with the variations in received carrier intensity and independent of variations corresponding to light-modulation components, so as to provide a signal input to the detector **35** having relatively small variations in amplitude over a wide range of received signal-carrier wave variations, according to conventional A. V. C. practice.

In such control systems of the prior art where the field-synchronizing pulses affect the control, it was necessary that the time constant of the control circuit have a value much higher than the period of the field-synchronizing pulses. In the system of the present invention, however, the control is independent of the field-synchronizing pulses and the time constant of the control rectifier and filter circuits **61**, **62**, **64**, **65** may be made much smaller without irregularity of control; specifically, the time-constant circuit may have a time constant sufficiently long only to suppress components of frequencies of the order of the frequency of the line-synchronizing components. This smaller time constant is advantageous in that it minimizes the duration of the effect of strong transient disturbances, such as static. The greatest benefit in minimizing the effect of such disturbances is obtained if the time constant of the control circuit is of a value somewhat less than that of the field period, although its value is still much greater than the line period. The single requirement of the system of the present invention is that the time constant of the control circuit have a value much greater than the line period of the system. It may be of the same order of magnitude or even less than the field period, although such rapid control is ordinarily not necessary. In general, it will be satisfactory if it is somewhat greater than the field period but yet not nearly great enough to smooth out disturbances such as caused by field pulses in systems of the prior art. Therefore, when this novel composite synchronizing signal is used with a negatively-modulated carrier wave such as described in the instant case, a control bias voltage may be readily developed in accordance with variations in peak value of the line-synchronizing pulses alone for effecting a precise automatic control of some characteristic of the system, such as automatic amplification control, in accordance with variations in the received carrier wave intensity and independent of light-modulation components.

It will be readily apparent that various other improved automatic controls, such as automatic selectivity control, automatic signal level adjustment, etc., may be obtained by utilizing the composite television signal of the present invention with suitable control apparatus.

It will further be appreciated that a control bias voltage for automatically controlling various characteristics of the system may be obtained in a manner analogous to that described above by peak-rectifying the modulation signal developed by detector **35**. In this case, as in the arrangement illustrated, a quick and highly accurate control is obtained by reason of the fact that the peaks of the line-synchronizing pulses are available for rectification without interference from the field-synchronizing pulses.

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. A television carrier-signal receiver adapted to receive a carrier wave modulated with video-frequency components and a composite synchronizing signal including field-synchronizing components and line-synchronizing components of greater amplitude than said field-synchronizing components comprising, means for rectifying only the line-synchronizing components of the received signal, said line-synchronizing components having an amplitude varying only in accordance with the amplitude of the received signal, a time-constant circuit coupled to said rectifying means and having a time constant sufficiently long only to suppress components of frequencies of the order of the frequency of said line-synchronizing components, and means for deriving a control effect from said time-constant circuit and for utilizing it to control an operating characteristic of said receiver.

2. A television carrier-signal receiver adapted to receive a carrier wave modulated with video-frequency components and a composite synchronizing signal including field-synchronizing components and line-synchronizing components of greater amplitude than said field-synchronizing components comprising, means for amplifying the received signal, means for rectifying only the line-synchronizing components of the received signal, said line-synchronizing components having an amplitude varying only in accordance with the amplitude of the received signal, a time-constant circuit coupled to said rectifying means and having a time constant sufficiently long only to suppress components of frequencies of the order of the frequency of said line-synchronizing components, and means for deriving a control effect from said time-constant circuit and for utilizing it to vary the gain of said amplifying means inversely in accordance with the amplitude of the received signal.

3. A television carrier-signal receiver adapted to receive a carrier wave modulated with video-frequency components and a composite synchronizing signal including field-synchronizing components and line-synchronizing components having a greater amplitude than said video-frequency components and of greater amplitude than said field-synchronizing components comprising, means for amplifying the received signal, means for peak-rectifying only the line-synchronizing components of the received signal, said line-synchronizing components which are rectified having an amplitude varying only in accordance with the amplitude of the received signal, a time-constant circuit coupled to said rectifying means

and having a time constant sufficiently long only to suppress components of frequencies of the order of the frequency of said line-synchronizing components, and means for deriving a control effect from said time-constant circuit and for utilizing it to vary the gain of said amplifying means inversely in accordance with the amplitude of the received signal.

4. A television carrier-signal receiver adapted to receive a television signal including video-frequency components and field-synchronizing components and line-synchronizing components of greater amplitude than said video-frequency components and said field-synchronizing components comprising, means for amplifying the received signal, means for rectifying only line-synchronizing components of the received signal, said line-synchronizing components which are rectified having an amplitude varying only in accordance with the amplitude of the received signal, a time-constant circuit coupled to said rectifier and having a time constant sufficiently long only to suppress components of frequencies of the order of the frequency of said line-synchronizing components, and means for deriving a control effect from said time-constant circuit and for utilizing it to vary the gain of said amplifying means inversely in accordance with the amplitude of the received signal.

HAROLD A. WHEELER.