

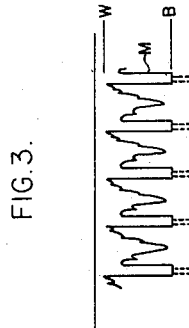
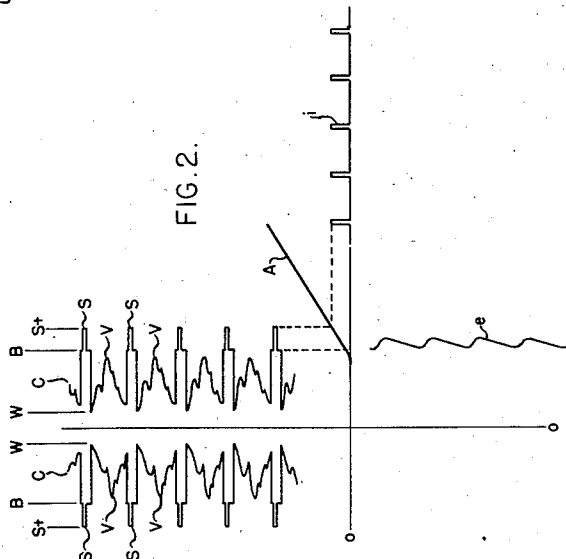
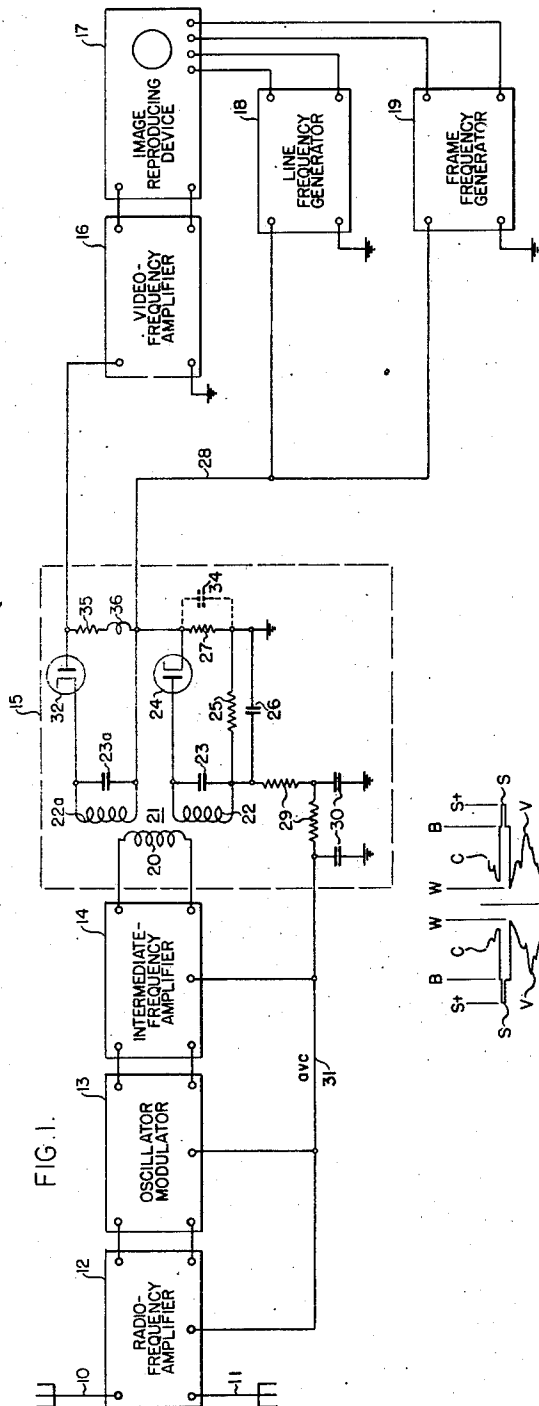
Oct. 21, 1941.

R. L. FREEMAN

2,259,520

TELEVISION RECEIVING APPARATUS

Filed March 15, 1939



INVENTOR
ROBERT L. FREEMAN

BY *Laurence B. Rodds*
ATTORNEY

UNITED STATES PATENT OFFICE

2,259,520

TELEVISION RECEIVING APPARATUS

Robert L. Freeman, Flushing, N. Y., assignor to
Hazelbline Corporation, a corporation of Dela-
ware

Application March 15, 1939, Serial No. 261,910

13 Claims. (Cl. 178-7.3)

This invention relates to television receiving apparatus and is especially directed to the provision of an improved system for detecting a television signal-carrier wave to derive its light-modulation components, for black-level setting of such detected components, for development of separated synchronizing-signal components, and for automatic amplification control in such receiving apparatus.

In accordance with present television practice, a transmitted signal comprises a carrier wave modulated during successive intervals or trace periods by high-frequency and unidirectional light-modulation components representative of varying light values over successive incremental areas of an image being transmitted and of its average background illumination, respectively. The carrier wave is unmodulated by light representative components during retrace periods, ordinarily having an amplitude level during portions of such periods which has a fixed relation to black in the transmitted image, and being modulated during the remaining portions of such periods by synchronizing-signal components which correspond to initiations of successive lines and fields in the scanning of the image. The latter components ordinarily have amplitude values outside of the amplitude range of the light-modulation components and extend in the direction of black.

At the receiver a generated scanning beam is so deflected as to scan and illuminate a target in a series of fields of parallel lines. The synchronizing-signal components of the received signal are utilized to control the scanning apparatus so as to synchronize its operation with that of similar apparatus utilized at the transmitter in developing the signal. The intensity of the cathode ray is controlled by the light-modulation components of the received signal, including the video-frequency and unidirectional background-illumination voltages, thereby to reconstruct the transmitted image.

Essential functions which must be performed in a television receiving system of the type described include detecting the signal-carrier wave to derive the light-modulation components; deriving from the detected signal separated line-frequency and field-frequency synchronizing pulses; developing a unidirectional-bias voltage representative of the average intensity of the carrier wave and independent of its light-modulation components; utilizing this voltage automatically to control one or more operating characteristics of the receiver, for example, to effect automatic

amplification control; and stabilizing the detected signal with respect to a predetermined shade level, that is, establishing a fixed amplitude level therefor corresponding to black or another predetermined shade value, in order that all light-modulation components of such amplitude will be represented by the correct shade in the reproduced scene and light gradations from black to white represented by the various other light-modulation values will be properly represented in the reconstructed scene. Various methods have heretofore been devised for performing these functions automatically but, in general, they have involved relatively complicated and/or unstable apparatus, or have otherwise left something to be desired.

It is an object of the present invention, therefore, to provide a television receiver for use in a system of the type described comprising improved means for deriving from a received television signal-carrier wave, the video-frequency modulation components stabilized with respect to an amplitude level thereof, corresponding to a predetermined shade value, for deriving the synchronizing-signal components separate from the other modulation components, and for deriving a unidirectional control-bias voltage representative of the average intensity of the received signal-carrier wave and independent of its light-modulation components.

In accordance with a feature of the present invention, there is provided a television receiver adapted for receiving and reproducing a television signal-carrier wave having combined light-modulation components and synchronizing-signal components, the latter having amplitude values outside the amplitude range of the light-modulation components. A single rectifying circuit is provided for deriving from the received signal-carrier wave an output signal including the synchronizing-signal components separate from the other modulation components and a control effect, such as a unidirectional-bias voltage, proportional to the average intensity of the received signal-carrier wave and independent of its light-modulation components. The receiver also comprises signal-detecting means operating jointly upon the output of the rectifying circuit and the signal-carrier wave to derive the light-modulation components separate from the synchronizing-signal components. Signal-reproducing means are provided for utilizing the detected light-modulation components without the synchronizing components. Means are further provided for utilizing the derived synchronizing-signal components

for synchronizing the operation of the receiver and for utilizing the control effect for controlling an operating characteristic of the receiver, for example, for automatic amplification control.

Also in accordance with a feature of the invention, a television receiver adapted to receive and reproduce a television signal-carrier wave modulated by combined light-modulation components and synchronizing-signal components having amplitude values outside the amplitude range of the light-modulation components comprises means including rectifying means having a load circuit for deriving from the signal the synchronizing components separate from the other modulation components and a diode detector, having a load circuit effectively connected in circuit with the load circuit of the rectifying means and operating jointly upon the output of the rectifying means and the signal-carrier wave, for deriving from the signal-carrier wave light-modulation components separate from the synchronizing components. The receiver also includes signal-reproducing means for utilizing only the detected modulation components without the synchronizing components to reproduce the translated picture.

Also in accordance with a feature of the invention, a television receiver adapted to receive and reproduce a television signal-carrier wave modulated by combined light-modulation components and synchronizing-signal components having amplitude values outside the amplitude range of the light-modulation components comprises, a rectifier circuit including a diode rectifier for deriving from the signal-carrier wave synchronizing-signal components separate from the other modulation components and a diode signal-detecting means connected in circuit with the rectifying circuit and operating jointly upon the output of the rectifier and the signal-carrier wave to derive from the signal-carrier wave light-modulation components separate from the synchronizing components. The receiver also includes signal-reproducing means including an input circuit for utilizing only the derived light-modulation components to reproduce the translated picture, and the above-mentioned diodes comprise separate load circuits series-connected in the input circuit of the reproducing means.

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 television receiver including circuits embodying the present invention; Fig. 2 is a group of curves representing certain operating characteristics of the system of Fig. 1 to aid in the understanding of the invention; and Fig. 3 is a curve representing the resultant light-modulation signal developed by the system of Fig. 1.

Referring now more particularly to the drawing, the system there illustrated comprises a receiver of the superheterodyne type including an antenna system 10, 11 connected to a radio-frequency amplifier 12, to which is connected, in cascade in the order named, an oscillator-modulator 13, an intermediate-frequency amplifier 14, a signal-detecting and control voltage-developing system 15, a video-frequency amplifier 16 including a stabilizing circuit and an image-reproduc-

ing device 17, which may be a cathode-ray signal-reproducing tube. A line-frequency generator 18 and a field-frequency generator 19 are also coupled to the system 15 and to the scanning elements of the image-reproducing device 17 in a conventional manner. The stages or units 10-19, inclusive, excepting the system 15 which is constructed in accordance with the present invention and will presently be described in detail, may all be of conventional well-known construction so that detailed illustrations and descriptions thereof are unnecessary herein.

Referring briefly, however, to the general operation of the above-described system as a whole, television signals intercepted by the antenna circuit 10, 11 are selected and amplified in the radio-frequency amplifier 12 and supplied 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 system 15. The video-frequency modulation components of the signal-carrier wave are derived by the system 15 and are supplied to the video-frequency amplifier 16 wherein they are amplified and stabilized and from which they are supplied in the usual manner to a brilliancy-control element of the image-reproducing device 17.

The intensity of the scanning beam of the device 17 is thus modulated or controlled in accordance with the light-modulation voltages impressed upon the control element of the device 17 in the usual manner. Saw-tooth voltage or current waves generated in the line-frequency and field-frequency generators 18 and 19, respectively, which are controlled by synchronizing-voltage pulses supplied from the system 15, as presently to be explained, are applied to the scanning elements of the device 17 to produce electric scanning fields, thereby to deflect the beam in two directions normal to each other so as to trace a rectilinear scanning pattern on the screen of the reproducing device and thereby to reconstruct the transmitted image.

Referring now more particularly to the system 15 of the receiver, which embodies the present invention, the output circuit of the intermediate-frequency amplifier 14 includes the primary winding 20 of a transformer 21 having secondary windings 22 and 22a which are preferably tuned to the intermediate-carrier frequency by condensers 23 and 23a. The winding 22 is coupled to a diode rectifier 24. This rectifier is provided with a load circuit comprising a parallel-connected resistor 25 and condenser 26 having a large time constant, preferably considerably greater than the period of the line-synchronizing pulses, for deriving an automatic amplification control bias. For conventional systems utilizing, for example, 30 frames (60 fields) per second of 441 lines, the resistor 25 may be of the order of 2,000,000 ohms and the condenser 26 of the order of 0.02 microfarad providing a time constant of 0.04 second.

For the purpose of deriving the synchronizing components separate from the other modulation components, a short time-constant circuit comprising a resistor 27 and capacitance 34 is included in series with the load circuit 26, 26 of the diode 24 and adjacent its cathode. The capacitance 34 may comprise, in whole or in part, the inherent capacitance of the cathode circuit and is indicated by dotted lines. Thus, the load circuit of the rectifier 24 comprises, in effect, two resistance-capacitance time-constant load cir-

cuits 25, 26 and 27, 34 in series, having large and small time constants, respectively.

The input circuits of the line-frequency and field-frequency generators 18 and 19 are connected across the resistor 27 by way of a suitable lead 28. Conventional circuits may be included in the generators 18 and 19 for separating the line-synchronizing and field-synchronizing pulses from each other. In order automatically to maintain the amplitude of the signal-carrier wave, independent of light-modulation components, at the input of the signal detector within a relatively narrow range for a wide range of received signals, the negative terminal of resistor 25 is connected, by way of a suitable filter including a series resistor 29 and shunt condensers 30 and by way of A. V. C. conductor 31, 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.

For the purpose of deriving the video-frequency modulation-signal components stabilized with respect to the amplitude level thereof representing black, there is provided a diode rectifier 32, connected across the secondary circuit 22a, 23a of intermediate-frequency transformer 21, so that the diodes 24 and 32 are effectively connected in parallel for application of the carrier wave thereto and so that diode rectifier 32 is effective to operate jointly on the signal-carrier wave and the output of the rectifying circuit including diode rectifier 24. The rectifier 32 is provided with a load circuit comprising a series-connected resistor 35 and inductance 36 providing a suitable uniform impedance across the video-frequency band for developing the modulation signal.

The operation of the system in accordance with the present invention may best be explained with reference to the curves of Fig. 2, in which curve A illustrates the load characteristics of the rectifier 24 with respect to the short time-constant load circuit 27, 34 for a given signal-carrier wave amplitude, the abscissae representing applied alternating voltage and the ordinates representing unidirectional load current. The applied voltage is illustrated by curve C, which represents the wave form of the envelope of the negatively-modulated carrier-wave signal developed in the output circuit of the intermediate-frequency amplifier 14 and applied by way of the transformer 21 to the diode 24. For the purpose of simplicity, only a few line-frequency cycles are shown. The light-modulation or video-frequency components and synchronizing-signal components are indicated at V and S, respectively, the latter, it will be noted, extending beyond the amplitude range of the former. Signal levels corresponding to white and black are indicated in the figure at W and B, respectively.

It will be seen that the rectifier 24 operates as a peak rectifier and passes current only during the occurrence of synchronizing pulses which represent the peak values of the modulated-carrier wave, such operation being determined by the large time-constant load circuit comprising resistor 25 and condenser 26. More particularly, the time constant of the circuit 25, 26 is such that the condenser 26 charges up to approximately 80 per cent. of the peak value of the applied signal, corresponding to the black level B of the modulated signal-carrier wave, so that the load current of diode 24 flows during the entire duration of the synchronizing pulses. Substantially all of the remaining amplitude of the applied signal, which corresponds to the synchro-

nizing pulses, is developed across the short time constant circuit 27, 34, the diode 24, with the time-constant circuit 27, 34, thus acting also as a synchronizing-signal detector.

Thus, the voltage built up across the load circuit 25, 26 is essentially a unidirectional negative-bias voltage, illustrated by curve e in Fig. 2, the average value of which is proportional to the peak amplitude of the signal-carrier wave, in the given case 80 per cent. of the peak amplitude, and independent of its light-modulation components. The filter comprising the resistor 29 and condensers 30 serves to remove residual fluctuations from the rectified voltage and the resultant steady unidirectional-bias voltage is impressed negatively on the control grids of one or more of the tubes in the stages 12, 13, and 14 to control the amplification of these stages inversely in accordance with the maximum value of carrier-wave amplitude and independently of light-modulation components. Thus, the output signal intensity of the signal-translating channel is maintained within a relatively narrow range for a wide range of received signal intensities.

This bias voltage e, developed across the long time-constant circuit 25, 26, also acts effectively as a delay bias on the diode 24 acting with the short time-constant load circuit 27, 34, as a synchronizing-signal detector, since the diode 24 passes current only during the occurrence of the synchronizing pulses, representing the charging current of condenser 26. Hence, the detected synchronizing-signal voltage pulses appear across the short time-constant load circuit 27, 34 free from the light-modulation components of the signal, as illustrated by curve i of Fig. 2. These pulses are applied by way of the lead 28 to the generators 18 and 19, in which conventional separating apparatus serves to separate the line-synchronizing and field-synchronizing pulses from each other and these pulses are utilized to maintain the generators 18 and 19 in synchronism with the corresponding apparatus at the transmitter, in the usual manner.

The intermediate-frequency voltages are also applied to the diode 32 by way of the secondary circuit 22a, 23a and this diode operates as a conventional diode signal detector, developing across its load circuit 35, 36 the complete modulation signal having a wave form corresponding to half the modulation envelope illustrated by curve C of Fig. 2. The synchronizing voltage pulses developed across the load circuit 27, 34, however, represent an inversion of the synchronizing pulses of the signal detected by the diode 32. Hence, by properly proportioning the impedances of load circuits 27, 34 and 35, 36, the modulation components, developed by the diode 32, and the separated synchronizing components, developed by the diode 24, are differentially combined so that the total voltage across these load circuits, which are effectively in series in the input circuit of video-frequency amplifier 16, comprises the video-frequency signal without the synchronizing pulses, as illustrated by the curve M of Fig. 3 in which these suppressed synchronizing pulses are indicated by dotted lines. This signal thus has an amplitude level corresponding to black throughout, indicated at B in Fig. 3, whereby it may be readily stabilized with respect to this level. Since this signal is poled with black most negative, it may be applied directly to the cathode-ray tube control grid or by way of the amplifier 16. For correct polarity, with the arrangement shown, an even number of video-

frequency amplifier stages should be included in the unit 16. Preferably, as stated, the amplifier 16 will include stabilizing means of the conventional type. These means may be the same as that illustrated, for example, in copending application of Harold M. Lewis, Serial No. 221,497, filed July 27, 1938. It will thus be seen that the system 15 suppresses or removes the synchronizing pulses from the signal so that the stabilizing means in the amplifier 16 may maintain a fixed black level for the signal at the input circuit of the signal-reproducing device regardless of the signal amplitude or other operating conditions.

The single rectifying-detective system 15 thus includes the signal-detecting means 32 effective to derive from the received television signal-carrier wave the video-frequency modulation signal without the synchronizing components and stabilized with respect to the black level thereof, while the single rectifying circuit thereof comprising diode 24 is effective to derive a unidirectional-bias voltage proportional to the intensity of the modulated signal carrier and independent of its light-modulation components for use as an automatic control voltage, and the synchronizing-modulation components separate from the other modulation components.

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 receiver adapted to receive and reproduce a television signal-carrier wave modulated by combined light-modulation components and synchronizing-signal components having amplitude values outside the amplitude range of the light-modulation components comprising, a single rectifying circuit for deriving from said signal-carrier wave an output signal including said synchronizing-signal components separate from said other modulation components and a control effect proportional to the average amplitude of said carrier wave and independent of light-modulation components, signal-detecting means operating jointly upon said output of said rectifying circuit and said signal-carrier wave to derive said light-modulation components separate from said synchronizing-signal components, means for utilizing said control effect for controlling an operating characteristic of the receiver, means for utilizing said separated synchronizing components for synchronizing the operation of the receiver, and signal-reproducing means for utilizing said derived light-modulation components.

2. A television receiver adapted to receive and reproduce a television signal-carrier wave modulated by combined light-modulation components and synchronizing-signal components having amplitude values outside the amplitude range of the light-modulation components comprising, a single rectifying circuit for deriving from the signal said synchronizing-signal components separate from said other modulation components and a control effect proportional to the average amplitude of said carrier wave and independent of light-modulation components, signal-detecting means for deriving from said signal said modulation components, means for utilizing said

separated synchronizing-signal components for suppressing the synchronizing components from said detected modulation components, signal-reproducing means for utilizing said detected light-modulation components without said synchronizing components, means for utilizing said control effect for controlling an operating characteristic of the receiver, and means for utilizing said separated synchronizing components for synchronizing the operation of the receiver.

3. A television receiver adapted to receive and reproduce a television signal-carrier wave modulated by combined light-modulation components and synchronizing-signal components having amplitude values outside the amplitude range of the light-modulation components, said wave having a wide range of signal-input intensities, comprising a single rectifying circuit for deriving from said signal-carrier wave a control-bias voltage proportional to the average amplitude of said carrier wave and independent of light-modulation components and for deriving from said signal-carrier wave said synchronizing-signal components separate from the other modulation components, signal-detecting means for deriving from said signal-carrier wave said modulation components, means for utilizing said separated synchronizing components for suppressing the synchronizing components from said detected modulation components, signal-reproducing means for utilizing said detected light-modulation components without said synchronizing components, means for utilizing said control-bias voltage for maintaining the amplitude of the signal output of said receiver within a relatively narrow range for a wide range of received signal-input intensities, and means for utilizing said synchronizing components to synchronize the operation of the receiver.

4. A television receiver adapted to receive and reproduce a television signal-carrier wave modulated by combined light-modulation components and synchronizing-signal components having amplitude values outside the amplitude range of the light-modulation components comprising, a single peak-rectifying circuit for deriving from said signal a control-bias voltage proportional to the peak value of said carrier wave and for developing from said signal said synchronizing components separate from the other modulation components, signal-detecting means for deriving from said signal the modulation components, means for combining said separated synchronizing components and said detected modulation components with such polarity as to suppress the synchronizing components from said detected modulation components, signal-reproducing means for utilizing said detected modulation components without said synchronizing components, means for utilizing said control-bias voltage for controlling an operating characteristic of said receiver, and means for utilizing said separated synchronizing components for synchronizing the operation of the receiver.

5. A television receiver adapted to receive and reproduce a television signal-carrier wave modulated by combined light-modulation and synchronizing-signal components having amplitude values outside the amplitude range of the light-modulation components comprising, a diode rectifier for deriving from said carrier wave a control-bias voltage proportional to the average amplitude of said wave and independent of its light-modulation components, impedance means in circuit with said rectifier for deriving from

said wave said synchronizing-signal components separate from the other modulation components, a diode detector for deriving from said signal said modulation components, means for differentially combining said separated synchronizing components and said detected modulation components to suppress the synchronizing components from the detected modulation components, signal-reproducing means for utilizing said detected modulation components without said synchronizing components, means for utilizing said control-bias voltage for controlling an operating characteristic of the receiver, and means for utilizing said separated synchronizing components for synchronizing the operation of the receiver.

6. A television receiver adapted to receive and reproduce a television signal-carrier wave modulated by combined light-modulation and synchronizing-signal components having amplitude values outside the amplitude range of the light-modulation components comprising, a diode rectifier having a load circuit including a long time-constant circuit for deriving from said signal-carrier wave a control-bias voltage proportional to the intensity of the carrier wave and independent of its light-modulation components and a short time-constant circuit for deriving from said wave synchronizing-signal components separate from the other modulation components, means for detecting said signal to derive its modulation components, means for utilizing said control-bias voltage for controlling an operating characteristic of said receiver, means for utilizing said separated synchronizing components for synchronizing the operation of the receiver and for suppressing the synchronizing components from said detected signal, and signal-reproducing means for utilizing said derived light-modulation components.

7. A television receiver adapted to receive and reproduce a television signal-carrier wave modulated by combined light-modulation components and synchronizing-signal components having amplitude values outside the amplitude range of the light-modulation components comprising, a diode rectifier for deriving from said carrier wave a control effect proportional to the average amplitude of said carrier wave and independent of light-modulation components and having a load impedance for deriving from said wave said synchronizing-signal components, a diode detector having a load circuit effectively connected in series with said load impedance of said rectifying means for deriving from said carrier wave said light-modulation components separate from said synchronizing components, means for utilizing said control effect for controlling an operating characteristic of the receiver, means for utilizing said separated synchronizing components for synchronizing the operation of the receiver, and signal-reproducing means for utilizing said light-modulation components without said synchronizing components.

8. A television receiver adapted to receive and reproduce a television signal-carrier wave modulated by combined light-modulation components and synchronizing-signal components having amplitude values outside the amplitude range of the light-modulation components comprising, detecting means for deriving from said signal said modulation components, a rectifying circuit for deriving from said signal said synchronizing-signal components separate from said other modulation components, means for differentially com-

bining said separated synchronizing components and said detected modulation components to suppress said synchronizing components from said detected modulation components, and signal-reproducing means for utilizing said detected modulation components with said synchronizing-signal components suppressed.

9. A television receiver adapted to receive and reproduce a television signal-carrier wave modulated by combined light-modulation and synchronizing-signal components having amplitude values outside the amplitude range of the light-modulation components comprising, a pair of diodes effectively connected in parallel for the application of said carrier wave thereto, one of said diodes having a long time-constant load circuit for developing from said carrier wave a control-bias voltage proportional to the average amplitude of said wave and independent of its light-modulation components and a short time-constant circuit for deriving from said wave said synchronizing-signal components separate from the other modulation components, said other diode having a load circuit effectively connected in series with said short time-constant circuit with such polarity as to derive from said carrier wave said modulation components with said synchronizing components suppressed, signal-reproducing means for utilizing said detected modulation components without said synchronizing components, means for utilizing said control-bias voltage for controlling an operating characteristic of the receiver, and means for utilizing said separated synchronizing components for synchronizing the operation of the receiver.

10. A television receiver adapted to receive and reproduce a television signal-carrier wave modulated by combined light-modulation components and synchronizing-signal components having amplitude values outside the amplitude range of the light-modulation components comprising, means including rectifying means having a load circuit for deriving from said signal said synchronizing components separate from said other modulation components, a diode detector having a load circuit effectively connected in circuit with said load circuit of said rectifying means and operating jointly upon the output of said rectifying means and said signal-carrier wave to derive from said signal-carrier wave light-modulation components separate from said synchronizing components, and signal-reproducing means for utilizing only said detected modulation components without said synchronizing components to reproduce the translated picture.

11. A television receiver adapted to receive and reproduce a television signal-carrier wave modulated by combined light-modulation components and synchronizing-signal components having amplitude values outside the amplitude range of the light-modulation components comprising, means including rectifying means having a load impedance for deriving from said signal said synchronizing components separate from said other modulation components, a diode detector having a load circuit effectively connected in series with said load impedance of said rectifying means to derive from said signal-carrier wave light-modulation components separate from said synchronizing components, and signal-reproducing means for utilizing only said detected modulation components without said synchronizing components to reproduce the translated picture.

12. A television receiver adapted to receive and reproduce a television signal-carrier wave mod-

ulated by combined light-modulation and synchronizing-signal components having amplitude values outside the amplitude range of the light-modulation components comprising, a pair of diodes effectively connected in parallel for the application of said carrier wave thereto, one of said diodes having a load impedance circuit for deriving from said wave said synchronizing-signal components separate from the other modulation components, said other diode having a load circuit effectively connected in series with said load-impedance circuit with such polarity as to derive from said carrier wave said modulation components with said synchronizing components suppressed, and signal-reproducing means for utilizing only said last-mentioned modulation components to reproduce the translated picture.

13. A television receiver adapted to receive and reproduce a television signal-carrier wave modulated by combined light-modulation components

and synchronizing-signal components having amplitude values outside the amplitude range of the light-modulation components comprising, a rectifier circuit including a diode rectifier for deriving from said signal-carrier wave said synchronizing-signal components separate from said other modulation components, diode signal-detecting means connected in circuit with said rectifying circuit and operating jointly upon the output of said rectifier and said signal-carrier wave to derive from said signal-carrier wave said light-modulation components separate from said synchronizing components, and signal-reproducing means including an input circuit for utilizing only said derived light-modulation components to reproduce the translated picture, said diodes comprising separate load circuits series-connected in the input circuit of said signal-reproducing means.

ROBERT L. FREEMAN.