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TELEVISION RECEIVER INCLUDING AUTOMATIC AMPLIFICATION CONTROL

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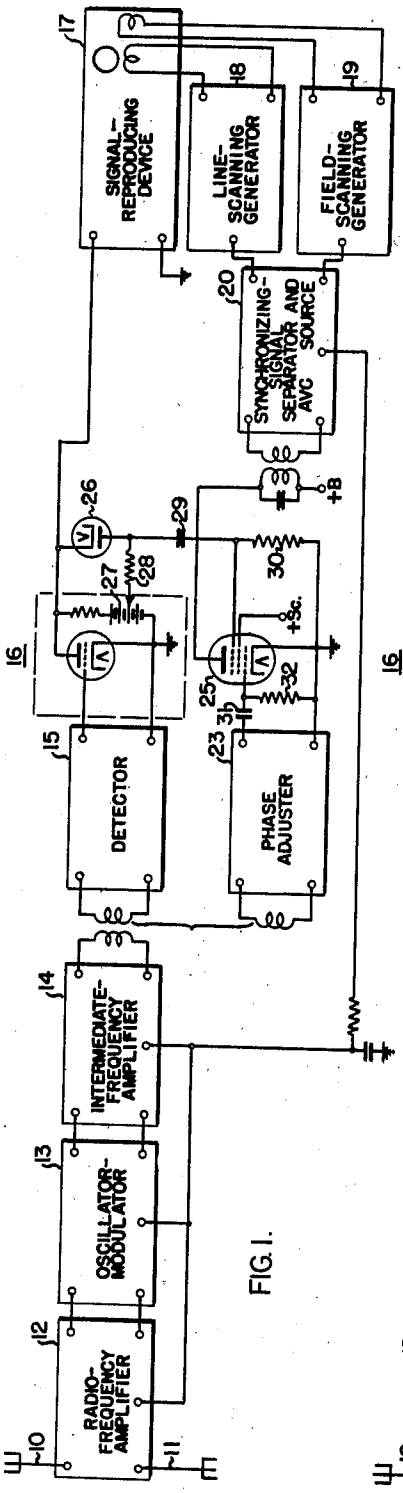


FIG. 1.

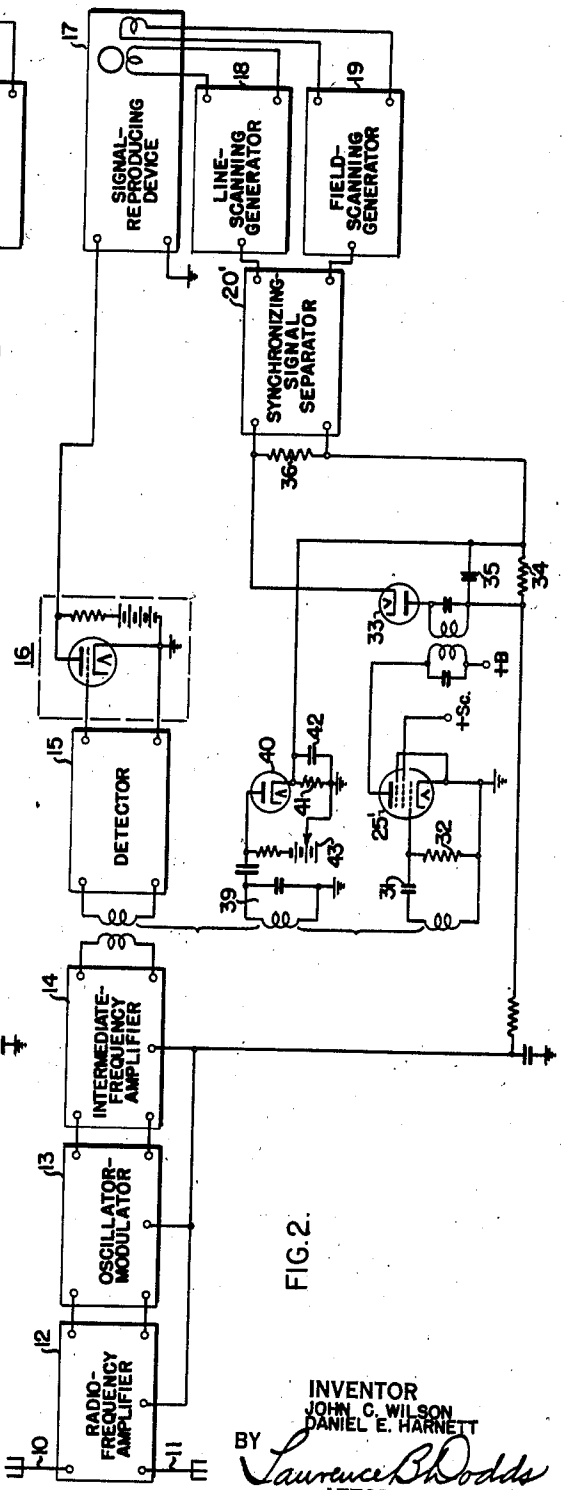


FIG. 2.

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TELEVISION RECEIVER INCLUDING AUTOMATIC AMPLIFICATION CONTROL

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14 Claims. (Cl. 178—7.3)

This invention relates generally to television receivers comprising automatic amplification control and particularly to a receiver of such type comprising an automatic amplification control source derived by peak-rectification of a received signal.

Automatic amplification control is commonly provided for television receivers by peak-rectification of predetermined components of a received signal and utilization of the rectified signal to control the amplification of the signal-translating channel of the receiver inversely in accordance with the strength of the received signal. In the case of such receivers adapted to receive a carrier wave negatively modulated with video-frequency components and synchronizing-signal components of conventional wave form, it is necessary to provide a time constant in the peak-rectifier circuit which is at least long with respect to the period of the line-synchronizing components and, in certain receivers, long with respect to the period of the field-synchronizing components of the signal in order to provide a relatively steady automatic amplification control-bias source which does not have a demodulating effect when utilized to control the gain of the amplifiers of the receiver. Time constants of the order of several times the interval between one set of field-synchronizing components and the next set in the received signal are usual, and this interval, for the conventional television signal, is one-sixtieth of a second; a time constant of approximately $\frac{1}{10}$ of a second is commonly used. Receivers having such control peak rectifiers, therefore, have the characteristic that the amplitude of the automatic amplification control source responds quickly to an increase in the peak amplitude of the received signal but responds relatively slowly to a decrease in the peak amplitude of the received signal, due to the time constant of the peak-rectifier circuit. A received noise component which effectively increases the amplitude of the received signal, therefore, is effective to reduce the gain of the receiver and the desired gain is not restored until after an appreciable period dependent upon the time constant of the load circuit of the peak rectifier. Periodic noise components of a frequency greater than the reciprocal of the time constant of the peak-rectifier circuit are thus effective completely to paralyze the automatic amplification control system of the receiver while sporadic noise components may also cause a complete or partial paralysis of the system for an objectionable interval. Furthermore, even though the automatic amplification control source is derived by means of an averaging rectifier rather than a peak rectifier, thus to provide a control bias having an amplitude varying in accordance with the average amplitude of the received signal, sufficient noise may be present in the received signal to impair the operation of the automatic amplification control system.

It is an object of the invention, therefore, to provide a television signal receiver comprising an improved automatic amplification control system not subject to the above-mentioned disadvantages of such receivers of the prior art.

It is a further object of the invention to provide a television signal receiver comprising an automatic amplification control system which is not paralyzed by the reception of noise components which effectively increase the amplitude of the received signal.

In accordance with the invention, a modulated-carrier television signal receiver comprises an automatic amplification control channel including an automatic amplification control source for the receiver and having a predetermined time constant of response. Means are provided having the same time constant of response and responsive to noise components of the received signal for deriving a suppression effect, together with means for utilizing the suppression effect at least partially to compensate for the effect of corresponding components of the received signal on the control source. Means are further provided for utilizing the control source for controlling the amplification of the received signal inversely in accordance with the received amplitude thereof. In one embodiment of the invention a rectifier provided for developing the automatic amplification control bias is a peak rectifier and the suppression effect is derived from noise components of the received signal which increase the effective peak amplitude of the received signal.

In accordance with one preferred embodiment of the invention, the noise components of the received signal which increase the effective peak amplitude of the received signal are detected and utilized instantaneously to suppress corresponding noise components of the signal input to the peak-rectifying means utilized to provide the automatic amplification control bias for the receiver. In accordance with another preferred embodiment of the invention, means are provided for peak-rectifying noise components of the received signal which increase the effective peak amplitude of the received signal and for differentially combining the peak-rectified noise com-

ponents with the normal automatic amplification control bias at least partially to suppress the effect of corresponding components on the automatic amplification control system.

For a better understanding of the present 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.

Figs. 1 and 2 of the drawing are circuit diagrams, partially schematic, of television signal receivers of the superheterodyne type, each including an automatic amplification control system in accordance with the invention.

Referring now more particularly to Fig. 1 of the drawing, the system there illustrated comprises a receiver of the superheterodyne type including an antenna system 10, 11 connected to a video-signal-translating channel including a radio-frequency amplifier 12 to which are 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 signal-reproducing device 17 such as a cathode-ray signal-reproducing tube. For developing saw-tooth waves for the scanning elements of the signal-reproducing device 17, there are provided a line-scanning generator 18 and a field-scanning generator 19. An input circuit of each of these generators is coupled through a synchronizing-signal separator and A. V. C. source 20 having a predetermined time constant of response, which source preferably comprises a peak rectifier, to the intermediate-frequency signal-translating channel of the receiver for maintaining them in synchronism with similar scanning apparatus at the transmitter, while the output circuits of generators 18 and 19 are connected to the scanning elements of the device 17 for developing scanning fields in a conventional manner. An automatic amplification control potential is applied from A. V. C. source 20 to one or more of the tubes of radio-frequency amplifier 12, oscillator-modulator 13, and intermediate-frequency amplifier 14 to vary the amplification thereof inversely in accordance with the received signal strength. The elements or components 10—20, inclusive, may all be of conventional well-known construction so that detailed illustrations and descriptions thereof are deemed unnecessary herein.

Since the system as thus far described is conventional and well understood in the art, a detailed explanation of its operation is deemed unnecessary. Briefly, however, signals intercepted by the antenna circuit 10, 11 are selected and amplified in 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 intermediate-frequency amplifier 14 and delivered to detector 15. The modulation components of the signal are derived by detector 15 and are supplied to video-frequency amplifier 16 wherein they are amplified and from which they are supplied to a brightness-control element of the signal-reproducing device 17. The intensity of the scanning beam of the image-reproducing device 17, for example a cathode ray where a cathode-ray signal-reproducing tube is employed, is modulated or controlled in accordance with the video-frequency voltages impressed upon its input circuit from video-frequency amplifier 16. The saw-tooth scanning waves developed by generators 18 and 19 serve to cause this beam to be deflected so as to trace a rectilinear scanning pattern on the target of the reproducing device 17 and thereby construct the transmitted scene. The generators 18 and 19 are synchronized with the corresponding apparatus at the transmitter by synchronizing pulses appearing in the output circuit of intermediate-frequency amplifier 14 and applied thereto through synchronizing-signal separator 20.

Referring now more particularly to the part of the system of Fig. 1 embodying the invention, there is provided a vacuum-tube amplifier 25 having an input electrode coupled to the intermediate-frequency signal-translating channel of the receiver, through a phase adjuster 23 and a coupling condenser 31, and having an output circuit coupled to the input circuit of synchronizing-signal separator and A. V. C. source 20 through an intermediate-frequency selector. A grid-leak resistor 32 is provided for amplifier 25. The receiver also includes a diode means 26 having its anode biased negatively by means of a potential derived from a source of unidirectional operating potential 27 provided for video-frequency amplifier 16 and having a load circuit comprising resistor 28. The circuit is such that diode 26 repeats only modulation components of the received signal above a predetermined amplitude and which comprise noise disturbances. The repeated noise components are coupled to an additional input electrode of vacuum-tube amplifier 25 through a coupling condenser 29 and grid-leak resistor 30. The diode 26, therefore, is included in a means for peak-rectifying the noise components of a received signal, which components increase the effective peak amplitude of the received signal.

In considering the operation of the portion of the system of Fig. 1 representing the present invention, it will be assumed that the anode of diode 26 is so biased by means of a negative potential derived from source 27 that only noise components of the signal which extend beyond the synchronizing-signal peaks of the signal and which, therefore, increase the effective peak amplitude of the received signal, are repeated by diode 26 for deriving a control effect. It is seen that, in the absence of noise components which are effective to increase the peak amplitude of the received signal, the circuit of vacuum-tube amplifier 25 is a conventional amplifier circuit and that the peak rectifier of synchronizing-signal separator and A. V. C. source 20 is effective to derive an automatic amplification control or A. V. C. bias for the receiver in a conventional manner.

However, in such conventional A. V. C. systems, the time constant of the A. V. C. system when the rectifier is nonconductive is necessarily relatively long and the system, neglecting the action of diode 26, has the characteristic that the automatic amplification control source responds quickly to an increase in the peak amplitude of a received signal but responds relatively slowly to a decrease in the amplitude of the receiver signal. Therefore, in the absence of diode 26, a received noise component which effectively increases the amplitude of the received signal is effective to reduce the gain of the receiver and the gain is not restored to a value corresponding to the received signal amplitude until after an appreciable period dependent upon the time con-

stant of the load circuit of the peak rectifier of unit **20**. The circuit of Fig. 1, however, is so proportioned that noise components derived from repeater **26** are effective instantaneously to decrease the transconductance of vacuum-tube amplifier **25**; that is, the load circuit of diode **26** includes condenser **29** and resistor **30** and has a very short time constant of response. Therefore, in the system of Fig. 1, the phase adjuster **23** may be so adjusted that the detected noise components derived by rectifier **26**, which are effective to increase the peak amplitude of the received signal, are impressed upon the additional control electrode of amplifier **25** through coupling condenser **29** simultaneously with corresponding components derived from the intermediate-frequency channel through phase adjuster **23**; that is, the time constants of response of the A. V. C. channel including the phase adjuster **23** and amplifier **25** and the channel including the amplitude-delayed rectifier **26** are very short and equal. As a result, the arrangement is effective at least partially to suppress or neutralize the effect of the noise components upon the automatic amplification control source **20**. The diode **26**, therefore, is included in a means having the same time constant of response as the A. V. C. source **20** and is responsive to the noise components of a received signal for deriving a suppression effect. The vacuum-tube amplifier **25** is included in a means for utilizing the suppression effect at least partially to compensate for the effect of corresponding components on the control source **20**. The phase adjustor **23** is included in a means for adjusting the relative phase of the signal output of the control source and the suppression effect.

A television-signal receiver in accordance with the embodiment of Fig. 1, therefore, comprises a video-signal-translating channel and a synchronizing-signal-translating channel. The latter channel also serves as a control channel and includes a means such as synchronizing-signal separator and A. V. C. source **20** for deriving a control effect from a received signal. Furthermore, there is provided in the receiver means including a rectifier **26** in the signal-translating channel which is responsive to noise components of a received signal for deriving a suppression effect. Amplifier **25** is included in a means for utilizing the suppression effect at least partially to compensate for the effect of corresponding components on the derived control effect. In addition, the receiver comprises means, including the intermediate-frequency amplifier **14**, which is response to the derived control effect for controlling an operating characteristic of the receiver. The scanning generators **18** and **19** are included in a means responsive to the derived synchronizing components for controlling the synchronizing of the receiver. The control channel has a predetermined time constant of response and the means included in the video-signal-translating channel for deriving a suppression effect has the same time constant of response.

The receiver of Fig. 2 is generally similar to that of Fig. 1 and similar circuit elements have identical reference numerals. The receiver of Fig. 2 differs from that of Fig. 1 primarily in that the noise components of the signal derived from the signal-translating channel of the receiver are not utilized instantaneously to suppress corresponding noise components in the signal input to the A. V. C. source of the system but are peak-rectified and differentially combined with the normal A. V. C. bias of the system at least partially to suppress the effect of corresponding received noise components on the A. V. C. source. The circuit of Fig. 2 thus comprises a vacuum-tube amplifier **25'** corresponding generally to amplifier **25** of Fig. 1 but differing therefrom in that the additional input electrode to which the detected noise signal of rectifier **26** of Fig. 1 is applied is omitted.

The output circuit of tube **25'** of Fig. 2 is coupled to a control source which includes peak detector **33** which is effective to provide a source of normal automatic amplification control bias for the receiver and a composite synchronizing signal for application to unit **20'**. Unit **20'**, therefore, includes only the intersynchronizing-signal separator of the system. Rectifier **33** comprises a load circuit including a resistor **34** and parallel-connected condenser **35**; the resistor-condenser combination **34**, **35** having such a time constant that peak-rectification is provided in a conventional manner. There is also included in series in the load circuit of detector **33** and unbypassed resistor **36** across which appears the composite synchronizing signal and to which the input circuit of synchronizing-signal separator **20'** is connected. In order to provide an integrated suppression effect for noise components of the received signal, there is provided a diode **40** having a load circuit including parallel-connected resistor **41** and condenser **42** and having its anode negatively biased by means of source **43** so that only noise components of the received signal which effectively increase the peak amplitude of the received signal are peak-rectified. Diode **40** is coupled to receive intermediate-frequency signals by means of tuned circuit **39** which is inductively coupled to the intermediate-frequency channels of the receiver. The load circuits of tubes **40** and **33** are connected in series with opposite polarity so that the signal or integrated suppression bias of diode **40** is differentially combined with the normal A. V. C. or peak-rectified control bias of the system developed across resistor **34** to suppress or compensate for the effect of noise components on the control source which includes rectifier **33**.

In considering the operation of the portion of the system of Fig. 2 constituting the present invention, it will be seen that, in the absence of noise components of the received signal which effectively increase the peak amplitude of the received signal, the operation of the system of Fig. 2 is entirely conventional and automatic amplification control is provided by peak-rectification of the received signal. However, when noise components which effectively increase the peak amplitude of the received signal are present, these components, in the absence of diode **40**, would be effective to paralyze the A. V. C. system in the manner described above. However, diode **40** is effective to provide compensation of the normal A. V. C. bias which prevents this paralyzing effect; that is, the noise components are peak-rectified to derive an integrated suppression bias and differentially combined with the normal A. V. C. bias of the system so that the differential or resultant A. V. C. bias source is effectively restored to its normal value simultaneously with, or shortly after, the occurrence of a received noise component which effectively increases the peak amplitude of the received signal. The time constants of the load circuits of diodes **40** and **33** are preferably so proportioned as to be substantially equal, so that a received noise compo-

nent which effectively increases the peak amplitude of the received signal has an effect of equal duration in each of the load circuits, thereby providing substantially complete compensation. The diode **26** of Fig. 1 and the diode **40** of Fig. 2 are therefore, in each instance, included in a means having the same time constant of response as the A. V. C. source **20** and the arrangement including peak detector **33**, respectively, each means being responsive only to noise components of a received signal which increase the effective peak amplitude of the received signal for deriving a suppression effect.

It will be understood that, while the suppression effect developed by the control system of Fig. 2 is derived in response to the peak amplitude of noise components of the received signal which effectively increase the peak amplitude of the received signal, other arrangements for providing a suppression effect in accordance with the invention may be utilized; for instance, the time constants of the rectifiers may be such that the automatic amplification control effect for the receiver may be derived in response to the average amplitude of the received signal and the suppression effect may be derived by rectifying the average noise over a portion of the frequency band of the received signal, provided, as required by the principles of the invention outlined above, the automatic amplification control source and the noise suppression source have substantially the same time constant of response and recovery in each case. Specifically, the noise components over a portion of the guard band provided for separating the received television signal from signals on adjacent channels may be rectified and utilized as a suppression effect. This may be done by providing tuned circuit **39** with sharply-selective characteristics for selecting the desired input for the rectifier utilized to develop the suppression voltage.

While there have been described what are at present considered to be the preferred embodiments 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 modulated-carrier television signal receiver comprising, an automatic amplification control channel including an automatic amplification control source for said receiver and having a predetermined time constant of response, means having the same time constant of response and responsive to noise components of a received signal for deriving a suppression effect, means for utilizing said suppression effect at least partially to compensate for the effect of corresponding components on said control source, and means responsive to said control source for controlling the amplification of said received signal inversely in accordance with the received signal amplitude.

2. A modulated-carrier television signal receiver comprising, an automatic amplification control channel including an automatic amplification control source for said receiver and having a predetermined time constant of response, means having the same time constant of response and responsive to noise components of a received signal for deriving a suppression effect, means for adjusting the relative phase of the signal output of said control source and said suppression effect, means responsive to said suppression effect at least partially to compensate for the effect of corresponding noise components on said control source, and means responsive to said control source for controlling the amplification of said received signal inversely in accordance with the amplitude of the received signal.

3. A modulated-carrier television signal receiver comprising, an automatic amplification control channel including an automatic amplification control source for said receiver including a peak-rectifying means for deriving a peak-rectified control bias and having a predetermined time constant of response, means having the same time constant of response and responsive only to noise components of a received signal which increase the effective peak amplitude of the received signal for deriving a suppression effect, means responsive to said suppression effect at least partially to compensate for the effect of corresponding components on said control source, and means responsive to said control source for controlling the amplification of said received signal inversely in accordance with the received signal amplitude.

4. A modulated-carrier television signal receiver comprising, an automatic amplification control channel including an automatic amplification control source in said receiver and having a predetermined time constant of response, means having the same time constant of response and responsive only to noise components of a received signal which increase the effective peak amplitude of the received signal for deriving a suppression effect, means responsive to said supression effect at least partially to compensate for the effect of corresponding components on said control source, and means responsive to said control source for controlling the amplification of said received signal inversely in accordance with the received signal amplitude.

5. A modulated-carrier television signal receiver comprising, an automatic amplification control channel including an automatic amplification control source for said receiver and having a predetermined time constant of response, means having the same time constant of response and including a diode biased to pass only noise components of a received signal which increase the effective peak amplitude of the received signal for deriving a suppression effect, means responsive to said suppression effect at least partially to compensate for the effect of corresponding components on said control source, and means responsive to said control source for controlling the amplification of said received signal inversely in accordance with the received signal amplitude.

6. A modulated-carrier television signal receiver including a signal-translating channel comprising, an automatic amplification control channel having a predetermined time constant of response and including a vacuum-tube amplifier coupled to said signal-translating channel, an automatic amplification control source for said receiver coupled to said amplifier, means having the same time constant of response and responsive to noise components of a received signal which increase the effective peak amplitude of the received signal for deriving suppression components, means for applying said suppression components to said amplifier at least partially to compensate for the effect of corresponding components on said control source, and means responsive to said control source for controlling

the amplification of said received signal inversely in accordance with the received signal amplitude.

7. A modulated-carrier television signal receiver including a signal-translating channel comprising, an automatic amplification control channel having a predetermined time constant of response and including a vacuum-tube amplifier including an input electrode coupled to said signal-translating channel and an additional input electrode, an automatic amplification control source for said receiver, coupled to said amplifier, means having the same time constant of response and responsive to noise components of a received signal which increase the effective peak amplitude of the received signal for deriving suppression components, means for coupling said suppression components to said additional electrode at least partially to compensate for the effect of corresponding components on said control source, and means responsive to said control source for controlling the amplification of said received signal inversely in accordance with the received signal amplitude.

8. A modulated-carrier television signal receiver comprising, an automatic amplification control channel including an automatic amplification control source for said receiver and having a predetermined time constant of response, means having the same time constant of response for rectifying noise components of a received signal to derive a suppression effect, means responsive to said suppression effect at least partially to compensate for the effect of corresponding components on said control source, and means responsive to said control source for controlling the amplification of said received signal inversely in accordance with the received signal amplitude.

9. A modulated-carrier television signal receiver comprising, an automatic amplification control channel including an automatic amplification control source for said receiver and having a predetermined time constant of response, means having the same time constant of response for peak-rectifying noise components of a received signal which increase the effective peak amplitude of the received signal, means responsive to said peak-rectified noise components at least partially to compensate the effect of corresponding components on said control source, and means responsive to said control source for controlling the amplification of said received signal inversely in accordance with the received signal amplitude.

10. A modulated-carrier television signal receiver comprising, an automatic amplification control channel having a predetermined time constant of response and including a source of automatic amplification control bias for said receiver, means having the same time constant of response for rectifying noise components of a received signal for deriving an integrated suppression bias, means for differentially combining said integrated suppression bias with said control bias to derive a differential bias at least partially to suppress the effect of corresponding components on said control source, and means responsive to said differential bias for controlling the amplification of said received signal inversely in accordance with the received signal amplitude.

11. A modulated-carrier television signal receiver comprising, an automatic amplification control channel including an automatic amplification control source for said receiver including a peak-rectifying means for deriving a peak-rectified control bias and having a predetermined time constant of response, means having the same time constant of response for peak-rectifying noise components of a received signal which increase the effective peak amplitude of the received signal, means for differentially combining said peak-rectified noise components with said peak-rectified control bias as least partially to suppress the effect of corresponding components on said control source, and means responsive to said control source for controlling the amplification of said received signal inversely in accordance with the received signal amplitude.

12. A modulated-carrier television signal receiver comprising, an automatic amplification control source for said receiver including a peak-rectifying means having a load circuit with a predetermined time constant, peak-rectifying means having a load circuit with a time constant substantially equal to that of said first-mentioned peak-rectifying means for rectifying only noise components of a received signal which increase the effective peak amplitude of the received signal, means for differentially including said peak-rectified noise components in said control source at least partially to compensate for the effect of corresponding components on said control source, and means responsive to said control source for controlling the amplification of said received signal inversely in accordance with the received signal amplitude.

13. A modulated-carrier television signal receiver comprising, a video-signal-translating channel, a control channel including means for deriving a control effect for said receiver and having a predetermined time constant of response, means having the same time constant of response and included in said video-signal-translating channel and responsive to noise components of a received signal for deriving a suppression effect, means for utilizing said suppression effect at least partially to compensate for the effect of corresponding components on said control effect, and means responsive to the derived control effect for controlling an operating characteristic of said receiver.

14. A modulated-carrier television signal receiver comprising, a video-signal-translating channel, a synchronizing-signal-translating channel including means for deriving synchronizing components from a received signal and having a predetermined time constant of response, means having the same time constant of response and included in said video-signal-translating channel and responsive to noise components of a received signal for deriving a suppression effect, means for utilizing said suppression effect at least partially to compensate for the effect of corresponding components on said derived synchronizing components, and means responsive to said derived synchronizing components for controlling the synchronization of said receiver.

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CERTIFICATE OF CORRECTION.

Patent No. 2,300,082. October 27, 1942.

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It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 2, second column, line 68, for "receiver" read --received--; page 3, first column, line 55, for "response" read --responsive--; and second column, line 23, for "and" read --an--; line 39, for the word "channels" read --channel--; page 4, second column, lines 12 and 13, claim 3, strike out "for deriving a peak-rectified control bias"; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 5th day of January, A. D. 1943.

Henry Van Arsdale,
Acting Commissioner of Patents.

(Seal)