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NOISE LIMITER AND AUTOMATIC VOLUME CONTROL FOR TELEVISION RECEIVERS

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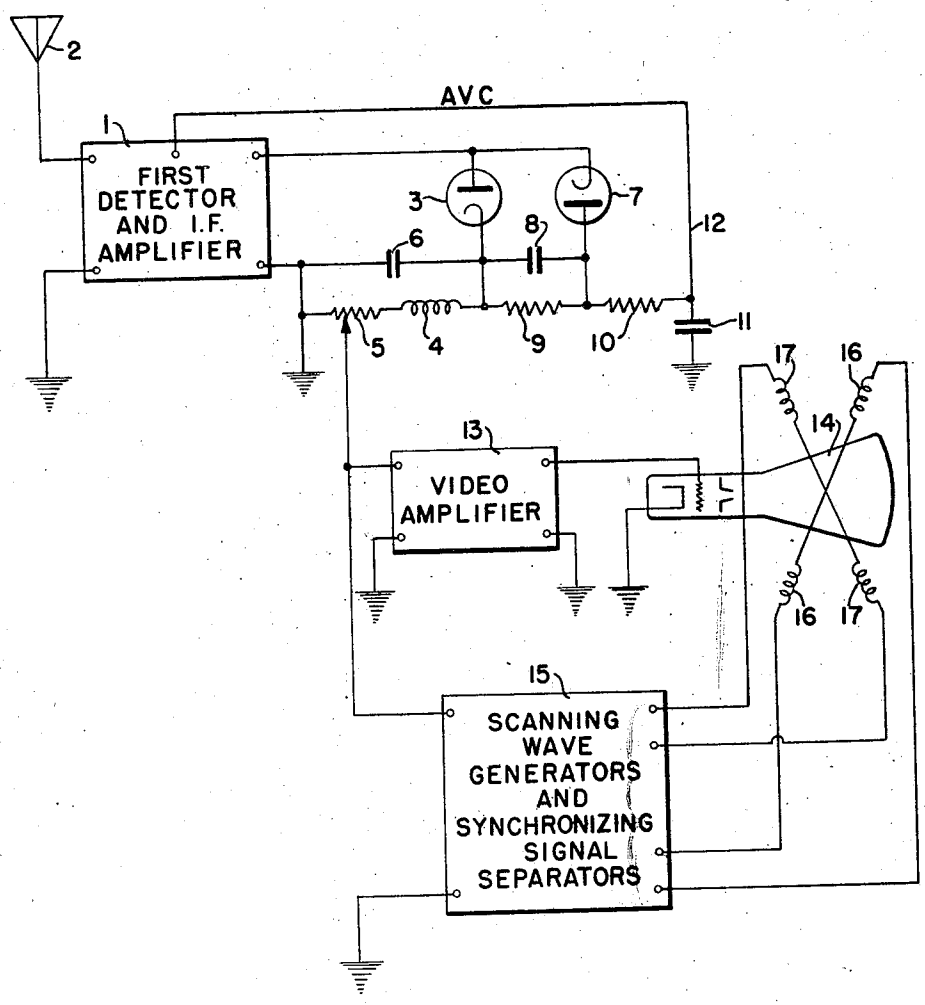

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NOISE LIMITER AND AUTOMATIC VOLUME CONTROL FOR TELEVISION RECEIVERS

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This invention relates to television receiving systems and particularly to apparatus for reducing the effects caused by the reception of undesired noise currents, static and the like.

According to conventional television practice employing United States standards, the video signals are transmitted by negatively modulating a carrier wave. That is, maximum picture brightness is represented by a minimum carrier amplitude or intensity and minimum picture brightness is represented by an intermediate carrier amplitude or intensity. For transmitting synchronizing signals no modulation of the carrier is effected so that amplitude or intensity thereof is at a maximum.

The scanning voltage generators for controlling the deflection of an electron beam on the screen of the receiver viewing tube are synchronized with the received signals by the maximum intensity carrier representing the synchronizing signals. When interference, such as noise currents, static or the like is superimposed upon the carrier in a manner to increase the amplitude or intensity thereof, coincidentally with a synchronizing signal, a synchronizing signal of excessive voltage is applied to the scanning generators and may have harmful effects upon this apparatus or, at least, will produce faulty synchronizing thereof. Also, excessive voltages produced by receiving interference effects during reception of the intelligence signals may cause damage to the screen of the viewing tube.

As is well understood in the art, there have been proposed numerous devices employing biased diodes for mitigating the effects of interference. Since the primary purpose of these devices is to limit the noise currents superimposed upon the carrier wave coincidentally with the intelligence signals, the biasing voltage varies as a function of the variable carrier wave intensity representing the intelligence signals. For example, one expedient is to vary the biasing voltage in accordance with the average signal intensity of the carrier wave. Apparatus functioning in such a manner has little or no value for eliminating noise currents from the synchronizing signals used in television systems. This is apparent when it is considered that synchronizing signals are represented invariably by the same carrier intensity. Apparatus, the functioning of which is dependent upon a portion of a carrier which is variable in intensity, is unsuitable for use to produce uniform elimination of interference from other portions of a carrier which are invariable in intensity.

It, therefore, is an object of this invention to

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provide an improved method and apparatus for limiting noise currents in television systems employing a negatively modulated carrier.

Another object of the invention is to provide, in a negatively modulated television receiving system, means to eliminate noise currents from synchronizing signals.

In accordance with the present invention, there is provided a novel method of and means for reducing the effects caused by the reception of noise currents in television apparatus where such apparatus is used to receive a negatively modulated carrier wave in which an intermediate intensity represents minimum picture brightness. The essential steps of this method include the demodulation of the carrier wave together with any superimposed noise currents, the development of a voltage which represents the excess intensity of the noise currents over the maximum carrier intensity, and the combination, in opposite polarity, of the demodulation product and the developed voltage. Thus, the effect of the noise currents is reduced by an amount equal to that by which the currents exceed the maximum carrier intensity.

The method, in accordance with the present invention, may be carried out by apparatus in which there is provided a signal detector to demodulate a received carrier wave including any interference which may be superimposed thereon. A noise-limiting detector also is provided and is biased to demodulate only those portions of the received carrier wave which exceed in intensity the carrier wave representing the synchronizing signals. There also is employed a load impedance which is connected in a manner so as to be common to both of the detectors, whereby the carrier wave of excessive intensity may be nullified therein. The biasing of the noise-limiting detector is controlled by the synchronizing signals. The time constant of the noise-limiting detector circuit is such that the biasing voltage is sufficiently constant to enable its use for automatic volume control purposes.

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, the single figure is a circuit diagram of a superheterodyne television receiver, partly schematic, embodying the present invention.

Referring now particularly to the drawing,

there is shown schematically, the radio frequency and intermediate frequency portions 1 of the receiver connected to an antenna 2. The output circuit of the intermediate frequency amplifier is connected to a signal demodulating circuit including the series connection of a diode 3, a load inductor 4 and a load resistor 5. The load impedance comprising the inductor and the resistor is shunted in the usual manner by a filter condenser 6.

There also is provided, in shunt with the signal detector diode 3 a circuit including a noise-limiting diode detector 7 and a parallel arrangement of a condenser 8 and a resistor 9. The diodes 3 and 7 are inverted with respect to each other.

An automatic volume control filter circuit including a resistor 10 and a condenser 11 is connected to the anode of the noise-limiting diode detector 7. A connection 12 from the point between the resistor 10 and the condenser 11 is made to the appropriate receiver circuits in a conventional manner for effecting automatic volume control thereof.

The television apparatus is connected in a manner to derive the intelligence and control signals therefor from the load impedance of the diode detectors. A connection is made from a point on the resistor 5 to the input circuit of a video amplifier 13. The output circuit of this amplifier is connected to the control grid of a cathode ray viewing tube 14. Also connected to the same point on the resistor 5 is the input circuit of apparatus 15 which functions in a conventional manner to separate the line and frame synchronizing signals by means of which the horizontal and vertical scanning wave generators are maintained in synchronism with the received signals. These generators are connected respectively to two sets of deflecting elements 16 and 17 respectively, for the control of the cathode ray tube electron beam.

The values of the load inductor 4, the load resistor 5 and filter condenser 6 are such that the time constant of the circuit comprising these elements is suitable to eliminate the carrier frequency from the voltage which is developed in the load resistor 5 and, at the same time, to permit the development of this voltage as an accurate reproduction of the carrier wave envelope produced by the intelligence and synchronizing signal modulations.

The values of the condenser 8 and the resistor 9 are chosen so that the time constant of the circuit comprising these elements is of an order sufficient to maintain the anode of the diode 7 at a voltage which is at no time less than the carrier intensity corresponding to the blackest portion of the picture. Preferably, this voltage should be maintained at a value closely approximating the maximum carrier intensity representing the synchronizing signals.

Referring now to the operation of the system, a carrier wave, having modulated thereon the video and synchronizing signals, is received and converted into an intermediate frequency by the apparatus 1. The positive half cycles of the intermediate frequency are conducted through the signal diode detector 3. Thus, there is developed in the load resistor 5 a unidirectional voltage which varies in magnitude in accordance with the varying intensity of the carrier wave. A suitable portion of this voltage is utilized for reproduction of the picture by the television apparatus in the conventional manner.

Upon receipt of a synchronizing signal represented by a maximum carrier intensity, the small charging current necessary to reestablish a voltage corresponding to the maximum carrier intensity across the condenser 8 is obtained by conducting the negative half cycles of the synchronizing signal through the noise-limiting detector 7. Because of the time constant selected for the storage circuit associated with this tube, there is only a small dissipation of the charge of the condenser 8 through the resistor 9 occurring between successive synchronizing signals. It is seen that, by the poling of the diode 7, the potential of the condenser 8 is of a character to maintain the anode of this diode at a negative potential which is at all times greater than the negative half cycles of the intelligence signal portion of the carrier. Consequently, there is effected no rectification of the negative half cycles of the video signals.

When there is interference superimposed upon the carrier coincidentally with, and having an intensity exceeding the normal intensity of, the carrier representing a synchronizing signal, the full intensity of the received carrier will effect the development in the load resistor 5 of a voltage which is higher than the normal voltage developed therein to represent a synchronizing signal. This voltage is developed by the rectification of the positive half cycles of the carrier by the signal diode detector 3. However, the excessively high negative half cycles of the carrier are rectified by the noise-limiting diode detector 7, thereby developing a neutralizing or nullifying voltage in the load resistor 5. The magnitude of the nullifying voltage is equal to the excess intensity of the carrier with the superimposed interference over the normal intensity of the carrier. The current, by means of which the nullifying voltage is developed in the load resistor 5, is of opposite polarity to the current by means of which the excess synchronizing voltage is developed in this resistor. Therefore, the two voltages are of opposite polarity and it is seen that the excess voltage is effectively eliminated from the synchronizing signals.

Following the reception of such a mutilated synchronizing signal the anode of the current limiting diode detector 7 is biased to a greater negative potential than that developed by normal synchronizing signals. It is desirable to provide the potential storage circuit including the condenser 8 with a time constant such that the biasing of the diode 7 will be restored to the normal maximum potential by the time that the following synchronizing signal is received. However, as in all devices of this character, should the interference be of a nature to cause the mutilation of successive synchronizing signals, the biasing of the diode 7 will become more and more negative. However, such a condition is rarely encountered in practice with the result that the potential of the anode of the diode 7 is maintained substantially constant, at a value corresponding to the carrier intensity representing the synchronizing signals.

For this reason the biasing voltage is well suited for use in automatic volume control circuits. An automatic volume control voltage derived in the present manner is a more accurate representation of the signal strength than is a similar voltage derived as a function of the average intensity of the intelligence signals. This average intensity reflects either one or both of two conditions. One condition is where there is a varia-

tion of the signal strength. The other condition is where the signal, in order to represent the intelligence accurately, has a low intensity for a substantial period of time. In either case the magnitude of the automatic volume control voltage is varied, whereas it is only in the first case that there is a need for varying it.

An automatic volume control voltage, derived in the manner disclosed herein, will vary only in response to the variation of the strength of the received signals. This is accomplished by deriving the voltage under the control of signals which invariably are represented by a predetermined carrier intensity. Of course, when the signal intensity varies because of fading or other atmospheric conditions, the strength of the received signals of the predetermined carrier intensity also varies and this variation properly is reflected in the magnitude of the automatic volume control voltage derived therefrom.

The noise-limiter in accordance with this invention also serves to protect the viewing screen of the cathode ray tube 14, in the case where the video signals are subjected to interference effects exceeding in intensity the intensity of the synchronizing signals. Such a result is obtained in a manner which should be clear from the foregoing description. In rectifying the positive half cycles of the carrier wave representing the video signals, any interference which is present in the received carrier wave which is of a character to increase the intensity of the carrier wave over its synchronizing signal intensity, would produce a voltage in the load resistor 5 which may be high enough to damage the screen of the viewing tube 14. However, since negative half cycles of the carrier wave exceeding the intensity of the synchronizing signals also are demodulated, there is produced a voltage in the load resistor which is sufficient in magnitude to nullify the excessive voltage produced by rectification of the positive half cycles. Consequently, it is seen that there is no part of the television apparatus which is subjected at any time to voltages in excess of the voltage representing the synchronizing signals.

While there has been described what at present is considered the preferred embodiment of the 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 therefore, it is aimed in the appended claims to cover all such changes and modifications as fall within the true spirit and scope of the invention.

What is claimed is:

1. In a television receiver, means for receiving a carrier wave variably modulated between minimum and intermediate intensities to represent intelligence signals and invariably modulated periodically to maximum intensity to represent synchronizing signals, said carrier wave at times having superimposed thereon interference effects exceeding said maximum intensity, a load impedance, means for developing in said impedance a unidirectional voltage of one polarity varying in intensity proportional to the intensity of said carrier wave, and means variably responsive as a function of said maximum carrier wave intensity for developing in said impedance a unidirectional voltage of opposite polarity coincident with the occurrence of and proportional to the excess intensity of said carrier wave over said maximum intensity, whereby to nullify the effect of said interference in said load impedance.

2. In a television receiver, means for receiving a carrier wave variably modulated between minimum and intermediate intensities to represent intelligence signals and invariably modulated periodically to maximum intensity to represent synchronizing signals, said carrier wave at times having superimposed thereon interference effects exceeding said maximum intensity, a load impedance, a signal diode detector connected to rectify all positive half cycles of said carrier wave for the development in said load impedance of a unidirectional voltage of one polarity corresponding to the modulations of said carrier wave, a noise-limiting diode detector connected in inverse polarity to said signal detector, means utilizing negative half cycles of said maximum intensity carrier wave to bias said noise-limiting detector for operation only in response to negative half cycles of said carrier wave exceeding said maximum intensity, and means for combining the products of said rectifications in said load impedance, whereby to nullify the effects of said excessive carrier wave intensities in said impedance.

3. In apparatus for receiving television signals comprising a carrier wave variably modulated between minimum and intermediate intensities to represent intelligence signals and invariably modulated periodically to maximum intensity to represent synchronizing signals, the method of reducing the effects caused by the reception of undesired noise currents which includes the steps of, developing a voltage of one polarity representing the television signals having noise currents superimposed thereon, developing a voltage of opposite polarity representing the excess of said noise currents over a synchronizing signal, and combining said developed voltages, whereby to reduce the effects caused by said noise currents.

4. In television apparatus for receiving a carrier wave variably modulated between minimum and intermediate intensities to represent intelligence signals and invariably modulated periodically to maximum intensity to represent synchronizing signals, the method of eliminating interference effects from received synchronizing signals which includes the steps of, developing a voltage of one polarity representing a synchronizing signal having interference effects superimposed thereon, developing a voltage of opposite polarity representing the excess of the interference effects over a normal synchronizing signal, and combining said developed voltages, whereby to eliminate said interference effects from the synchronizing signal.

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