Aug. 11, 1942. L. R. MALLING 2,292,765

DETECTOR SYSTEM FOR TELEVISION RECEIVERS

Filed April 18, 1940

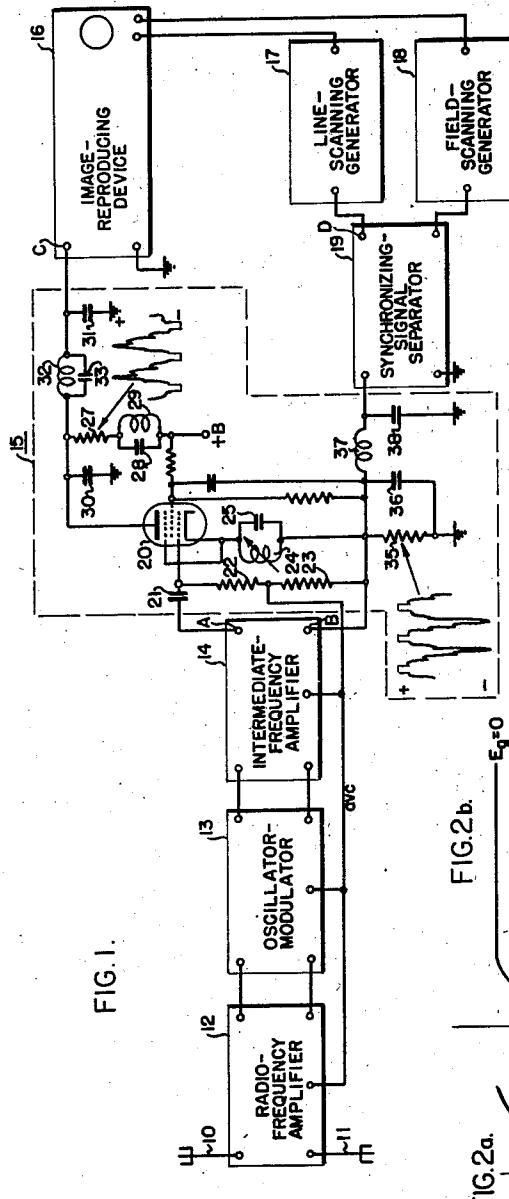

FIG. 1.

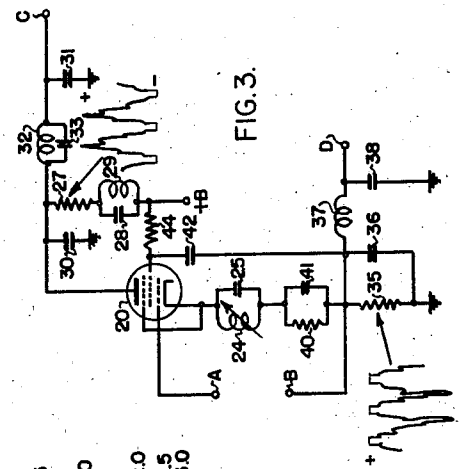

FIG. 3.

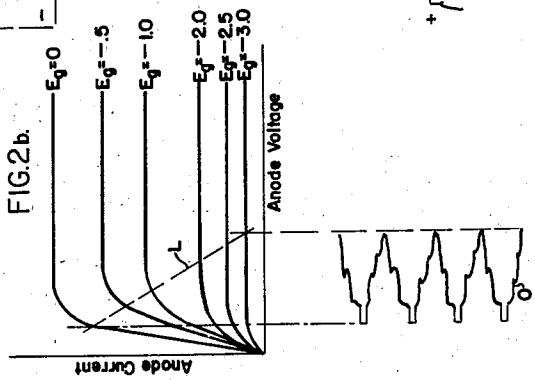

FIG. 2b.

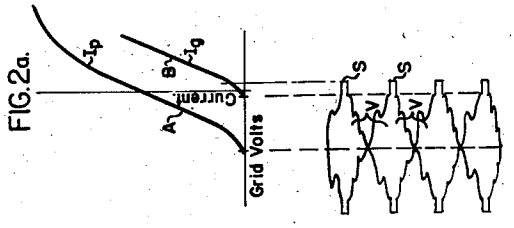

FIG. 2a.

INVENTOR
LEONARD R. MALLING
BY Lawrence B. Dodds
ATTORNEY

Patented Aug. 11, 1942 2,292,765

UNITED STATES PATENT OFFICE

2,292,765

DETECTOR SYSTEM FOR TELEVISION RECEIVERS

Leonard R. Malling, Douglaston, N. Y., assignor to Hazeltine Corporation, a corporation of Delaware

Application April 18, 1940, Serial No. 330,277

6 Claims. (Cl. 178—7.3)

This invention relates to detector systems for television receivers and more particularly to high-level anode-circuit detection systems for television receivers.

A high level of over-all amplification is required for the reproduction of a received modulated-carrier television signal. It is desirable to obtain the required amplification in as few stages as possible, both for the reason that the cost of the receiver is thereby reduced and for the reason that the over-all distortion in the signal-translating channel is likely to be less. Also, if a signal is raised to a high amplitude level in the intermediate-frequency channel of a television receiver, some useful limiting can be effected in a system where the synchronizing-signal components have a greater amplitude than the video-frequency components for the reason that noise or other spurious components of greater amplitude than that of the desired signal components can be substantially limited without adversely affecting the signal reproduction. However, the detection of the modulation components of the signal must also be effected with a minimum of distortion. It is, however, apparent that, if high-level detection can be effected without an undue amount of distortion, there is no need to provide a stage of video-frequency amplification in the receiver. Furthermore, if the video-frequency stage or stages can be avoided, there is no need for the usual additional arrangements which are provided for reinserting the unidirectional-background components of the signal at the input of each stage of the video-frequency channel of the television receiver.

Other difficulties, however, arise in a high-level signal detector system. For instance, synchronizing signals of a sufficient amplitude level for use in the synchronizing circuits of the receiver are present in such a high-level detector circuit, but they must be obtained therefrom with the proper polarity. In the usual synchronizing-signal separator for television receivers, separation of the synchronizing-signal components from the vision-signal components is effected by operating a vacuum tube beyond its negative grid-voltage cutoff point for video-signal components. Such operation requires that the signal input to the separating device be of such polarity that the synchronizing-signal peaks are positive, while in the signal input to the reproducing device the synchronizing-signal components thereof generally must be of negative polarity. It is desirable, therefore, to provide a high-level detector from which signals of opposite polarity may be applied directly to the signal-reproducing device of the system and to the synchronizing channel of the system, respectively.

It is an object of the present invention, therefore, to provide an improved high-level detector system for a television receiver.

It is another object of the invention to provide a high-level detector system for a television receiver which is effective to supply output signals of opposite polarities directly to the signal-reproducing device and to the synchronizing-signal channel, respectively, of the receiver.

In accordance with the invention, there is provided in a television receiver including an image-reproducing device and a synchronizing-signal separator, and adapted to receive a carrier signal modulated by video-frequency components and synchronizing-signal components of greater amplitude than the video-frequency components, a detector system comprising a high-level anode-circuit single detector tube having input and output circuits. Means are provided for applying the received signal to the input circuit of the detector with such amplitude that components of greater amplitude than that of the synchronizing-signal components are substantially limited in the detector. Means are further provided for rectifying in the input circuit of the detector at least a portion of the synchronizing-signal components of the translated signal to provide an operating bias for the detector, and there may be included with this means a means for deriving an automatic amplification control bias for the receiver from the input circuit of the detector.

In the preferred embodiments of the invention, a direct current passive network is provided for coupling the output circuit of the detector to the image-reproducing device of the receiver to supply thereto the detected modulation signal with a given polarity. Means are further provided for deriving from the output circuit of the detector the modulation signal having a polarity opposite to that of the first-named derived modulation signal and adapted for application to the synchronizing-signal separating apparatus.

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.

In the drawing, Fig. 1 is a circuit diagram, partly schematic, of a complete television signal-receiving system including a detector system in accordance with the invention; Figs. 2*a* and 2*b* comprise a number of graphs utilized to explain the operation of the detector system of the receiver of Fig. 1; while Fig. 3 is a circuit diagram of a modification of the detector system illustrated in the receiver of Fig. 1.

Referring now more particularly to Fig. 1, the receiver there illustrated is adapted to receive a carrier signal modulated by video-frequency components and synchronizing-signal components of greater amplitude than the video-frequency components and comprises the vision signal-translating channel of a television receiver of the superheterodyne type including an antenna system 10, 11 connected to 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 and A. V. C. supply indicated generally at 15 embodying the present invention and described in detail hereinafter, and an image-reproducing device 16 usually of the cathode-ray tube type. A line-scanning generator 17 and a field-scanning generator 18 are also coupled to an output circuit of detector 15 through an intersynchronizing-signal separator 19 and to the scanning elements of the image-reproducing device 16. The stages or units 10–19, inclusive, excepting the detector system 15, may all be of conventional well-known construction so that detailed illustrations and descriptions thereof are unnecessary herein.

Referring briefly to the operation of the receiving system just described, television signals intercepted by the antenna circuit 10, 11 are selectively 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 the intermediate-frequency amplifier 14 and delivered to the detector 15. The modulation components of the signal are derived by the detector 15 and supplied directly to the brilliancy-control electrode of the image-reproducing device 16 with proper polarity for signal reproduction. The intensity of the scanning beam of device 16 is thus modulated or controlled in accordance with the video-frequency voltages impressed upon its brilliancy-control element in the usual manner. The modulation signal is also applied with opposite polarity directly to synchronizing-signal separator 19, wherein the synchronizing signals are separated from the video-frequency components of the received signal and from which the synchronizing signals are applied to generators 17 and 18 to synchronize the operations of these generators with corresponding apparatus at the transmitter. Saw-tooth current or voltage scanning waves are generated by the generators 17 and 18 and these waves are applied to the scanning elements of the device 16 to produce scanning fields, thereby to deflect the scanning beam in two directions normal to each other so as to trace successive series of parallel lines or fields on the target of the image-reproducing device to reconstruct the image.

Referring now more particularly to the portion of the system of Fig. 1 embodying the present invention, detector 15 comprises a high-signal-level detector system including a single pentode detector tube 20 having input and output circuits to the input circuit of which the received signal is applied from the output circuit of intermediate-frequency amplifier 14 with such amplitude that components of greater amplitude than the synchronizing components are substantially limited in the detector. The input circuit of tube 20 comprises a coupling condenser 21 and a grid-leak circuit including resistors 22 and 23 in series. A trap circuit 24, 25 may be included in the cathode circuit of tube 20 in order to provide increased attenuation of undesired signals on adjacent channels. A direct current passive network is provided for coupling the anode of vacuum tube 20 to the input circuit of image-reproducing device 16 to supply thereto detected video-frequency components of the signal with a given polarity. This network includes a load resistor 27 in series with a parallel-resonant circuit 28, 29 through which a unidirectional operating potential is supplied to the vacuum tube 20. The network also includes shunt arms comprising condensers 30, 31 and an interposed series arm including a parallel-resonant circuit 32, 33.

In order to derive from the output circuit of tube 20 detected synchronizing-signal components of the received signal having a polarity opposite to those supplied to the image-reproducing device 16, there is provided a cathode load circuit which includes a resistor 35 by-passed for intermediate-carrier-frequency currents by condenser 36. The voltage across resistor 35 is applied through a filter comprising a series-inductance arm 37 and a shunt-capacitance arm 38 to the input circuit of synchronizing-signal separator 19.

Reference is made to the graphs of Figs. 2*a* and 2*b* for an explanation of the operation of the detector system 15 of the receiver of Fig. 1. In Fig. 2*a*, the curve A represents the grid voltage-anode current characteristic of tube 20, while curve B represents the grid-voltage-grid current characteristic of tube 20. The modulation envelope of the signal applied to the input circuit of detector 15 is also represented and comprises synchronizing-signal components S and video-frequency components V. Under normal operating conditions at least a portion of the synchronizing-signal components are rectified in the input circuit of the tube 20 and the condenser 21 and the resistors 22, 23 are effective so to bias the input electrode of vacuum tube 20 that grid current is obtained only from the peaks of the synchronizing-signal components of the applied modulation signal, as illustrated by the relationship of the modulation envelope of Fig. 2*a* to the grid voltage-grid current characteristic B of tube 20. There is, therefore, developed across resistors 22, 23 a voltage which varies in accordance with the peak amplitude of the received signal, independent of its modulation components, which voltage is used to provide an operating bias for the detector 20 to effect anode-circuit detection therein. Since the voltage across resistors 22, 23 varies in accordance with the amplitude of received signals, independent of light-modulation components thereof, it is also suitable for use as an automatic amplification control bias for the receiver and, for this reason, the mid-point of resistors 22, 23 is connected by the conductor labelled A. V. C. to one or more of the tubes of stages 12, 13, and 14, thereby providing automatic amplifi-

cation control in a manner which will be understood by those skilled in the art.

The anode current-anode voltage characteristics of the tube 20 for various bias voltages are illustrated in Fig. 2b. The load circuit of the detector tube 20 is so proportioned that it operates upon a load line as indicated by the dotted line L in a manner which will be well understood by those skilled in the art, the output voltage of the detector being represented by the wave form 0. There is thus developed across resistor 27 in the anode circuit of tube 20 a voltage having the same wave form as curve O of Fig. 2b in which synchronizing-signal components are negative with respect to the video-frequency components thereof, as indicated by the curve adjacent resistor 27 of Fig. 1. There is also developed across resistor 35 in the cathode circuit of tube 20 a voltage of the same wave form, but of opposite polarity, as indicated by the wave form adjacent resistor 35 of Fig. 1, this latter voltage being applied to synchronizing-signal separator 19 and being of the proper polarity to operate the first vacuum tube thereof beyond its negative grid-voltage cut-off point for video-frequency components of the detected signal.

The detector system of Fig. 1 is, therefore, such that high-level anode-circuit detection is effected by the vacuum tube 20 and the signal input thereto may be of such amplitude that components of amplitude greater than the synchronizing-signal components are substantially limited in the detector. Since a high-level detected signal output is derived from the tube 20, video-frequency amplification may be dispensed with and the direct current passive network can be utilized for coupling the output circuit of the detector 20 directly to the image-reproducing device 16 of the receiver. With such an arrangement, there is no need for devices for inserting the unidirectional background illumination component of the received signal for the reason that these components are present in the output circuit of tube 20 and are transmitted by the direct current network 30, 31, 32, 33.

In Fig. 3 there is illustrated a detector system in accordance with the invention which is generally similar to that of the detector system 15 of Fig. 1. Circuit elements which are identical in the two figures have the same reference characters. It will be understood that the detector system of Fig. 3 can be utilized in the receiver circuit of Fig. 1 by connecting terminals A, B, C, and D to the similarly marked terminals of the receiver of Fig. 1. No provision is made in the detector system of Fig. 3 for providing an automatic amplification control for the receiver.

The circuit of Fig. 3 differs from that of Fig. 1 primarily in the fact that in the circuit of Fig. 3 there is no rectification in the input circuit of vacuum tube 20 to provide an operating bias for the tube. Instead, there is provided in the cathode circuit of tube 20 of Fig. 3, a resistor 40, by-passed for intermediate-frequency and modulation-frequency signals by a condenser 41, across which is developed a unidirectional voltage effective to bias the input circuit of vacuum tube 20 for anode-circuit detection.

The operation of the system of Fig. 3 is generally similar to that described for the circuit of Fig. 1 and, with the above explanations of the differences between the circuits of Figs. 1 and 3, will be readily understood by those skilled in the art.

While it is not intended to limit the invention to any particular circuit elements, there follows a list of circuit constants which have been found to be particularly suitable for the circuit of Fig. 3, where the intermediate-frequency signal has a carrier frequency of 8.5 megacycles:

Tube 20		6AC7
Inductance 24	microhenries	5
Inductance 32	do	485
Inductance 29	do	142
Inductance 37	do	500
Capacitance 25	micro-microfarads	2,000
Capacitance 41	microfarads	500
Capacitance 30	micro-microfarads	12
Capacitance 33	do	2
Capacitance 31	do	15
Capacitance 36	do	200
Capacitance 42	microfarads	8
Capacitance 38	micro-microfarads	200
Resistance 40	ohms	220
Resistance 35	do	5,000
Resistance 27	do	6,000
Resistance 44	ohms	100,000

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. In a television receiver including an image-reproducing device and synchronizing-signal separating apparatus and adapted to receive a carrier signal modulated by video-frequency components and synchronizing-signal components of greater amplitude than said video-frequency components, a detector system comprising, a high-level anode-circuit single detector tube having input and output circuits, means for applying the received signal to said input circuit with such amplitude that components of greater amplitude than said synchronizing-signal components are substantially limited in said detector, means for rectifying in said input circuit at least a portion of said synchronizing-signal components to provide an operating bias for said detector, means for deriving an automatic amplification control bias for said receiver from said input circuit, a direct current passive network for coupling said detector output circuit to the image-reproducing device of the receiver to supply thereto the detected modulation signal with a given polarity, and means for deriving from said output circuit the detected modulation signal having a polarity opposite to that of said first-named derived modulation signal and adapted for application to said synchronizing-signal separating apparatus.

2. In a television receiver including an image-reproducing device and adapted to receive a carrier signal modulated by video-frequency components and synchronizing-signal components of greater amplitude than said video-frequency components, a detector system comprising, a high-level anode-circuit single detector tube having input and output circuits, means included in one of said circuits for substantially limiting in said detector components of the received signal of greater amplitude than said synchronizing-signal components, and a direct current passive network coupled to said detector output circuit and adapted to couple said detector output circuit directly to said image-reproducing device of

the receiver to supply thereto detected video-frequency components of said signal including the direct current component thereof.

3. In a television receiver including an image-reproducing device and synchronizing-signal separating apparatus and adapted to receive a carrier signal modulated by video-frequency components and synchronizing-signal components of greater amplitude than said video-frequency components, a detector system comprising, a high-level anode-circuit single detector tube having input and output circuits, means for applying the received signal to said input circuit, a direct current passive network coupled to said detector output circuit and adapted to couple said detector output circuit to the image-reproducing device of the receiver to supply thereto the detected modulation signal with a given polarity, and means for deriving from said output circuit the detected modulation signal having a polarity opposite to that of said first-named derived modulation signal and adapted for application to said synchronizing-signal separating apparatus.

4. In a television receiver including an image-reproducing device and synchronizing-signal separating apparatus and adapted to receive a carrier signal modulated by video-frequency components and synchronizing-signal components of greater amplitude than said video-frequency components, a detector system comprising, a high-level anode-circuit single detector tube having a cathode and input and output circuits, means for applying the received signal to said input circuit, a direct current passive network included in circuit with said anode and adapted to apply to the image-reproducing device of the receiver the detected modulation signal with a given polarity, and a load circuit connected in series with said cathode for deriving the detected modulation signal with a polarity opposite to that of said first-named derived modulation signal and adapted for application to said synchronizing-signal separating apparatus.

5. In a television receiver including an image-reproducing device and synchronizing-signal separating apparatus and adapted to receive a carrier signal modulated by video-frequency components and synchronizing-signal components of greater amplitude than said video-frequency components, a detector system comprising, a high-level anode-circuit single detector tube having input and output circuits, means for applying the received signal to said input circuit, means for rectifying in said input circuit at least a portion of said synchronizing-signal components to provide an operating bias for said detector, means for deriving an automatic amplification control bias for said receiver from said input circuit, a direct current passive network coupled to said detector output circuit and adapted to couple said detector output circuit to the image-reproducing device of the receiver to supply thereto the detected modulation signal with a given polarity, and means for deriving from said output circuit the detected modulation signal having a polarity opposite to that of said first-named derived modulation signal and adapted for application to said synchronizing-signal separating apparatus.

6. In a television receiver including an image-reproducing device and synchronizing-signal separating apparatus and adapted to receive a carrier signal modulated by video-frequency components and synchronizing-signal components of greater amplitude than said video-frequency components, a detector system comprising, a high-level anode-circuit single detector tube having input and output circuits, means for applying the received signal to said input circuit with such amplitude that components of greater amplitude than said synchronizing-signal components are substantially limited in said detector, a direct current passive network coupled to said detector output circuit and adapted to couple said detector output circuit to the image-reproducing device of the receiver to supply thereto the detected modulation signal with a given polarity, and means for deriving from said output circuit the detected modulation signal having a polarity opposite to that of said first-named derived modulation signal and adapted for application to said synchronizing-signal separating apparatus.

LEONARD R. MALLING.