Nov. 17, 1942. F. J. BINGLEY 2,302,520

DETECTOR COUPLING CIRCUIT

Filed May 31, 1940

Fig. 1.

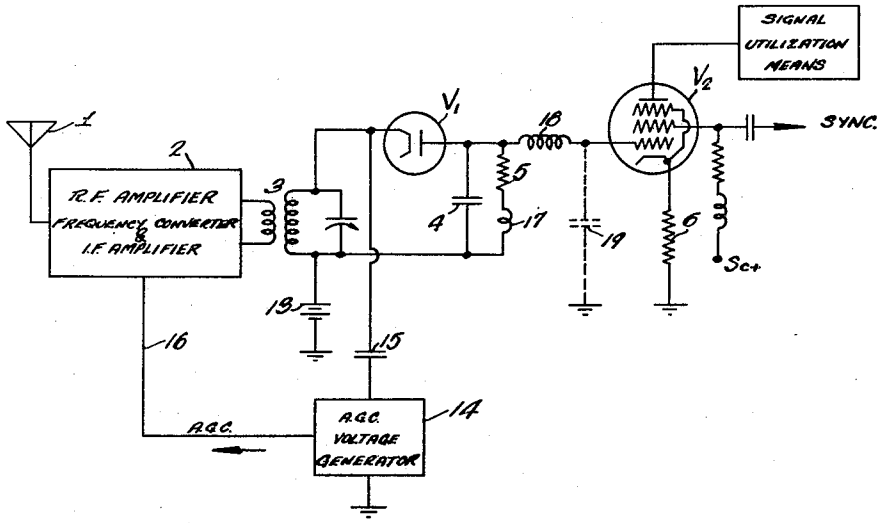


Fig. 2.

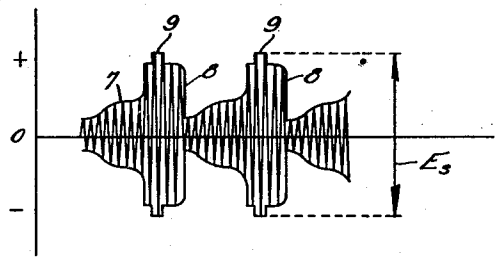
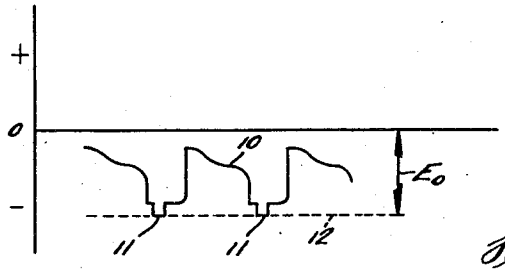


Fig. 3.



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DETECTOR COUPLING CIRCUIT

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In Great Britain June 8, 1939

9 Claims. (Cl. 178—7.3)

This invention relates to detector circuits for use in the reception of modulated carrier wave signals, and more particularly to a novel direct- or galvanically-coupled detector-amplifier circuit having highly desirable amplitude- or noise-limiting characteristics. The invention is applicable to detector systems employed in the reception of carrier frequency transmissions of sound, telegraph, facsimile, and television signals or the like, although its use is particularly advantageous in the reception of television transmissions.

In television systems wherein very low frequencies, as well as the so-called direct current components are transmitted, it is desirable to employ direct or galvanic coupling between the output circuit of the detector and the input circuit of the following amplifier. The present invention provides means for efficiently limiting the amplitude of the detected signals while simultaneously providing such a direct coupled system.

According to this invention there is provided in a detector-amplifier circuit, a source of modulated carrier signals, automatic gain control means for maintaining the amplitude of said signals substantially constant, a diode and load therefor for rectifying said signals, a vacuum tube amplifier having a sharp cut-off characteristic, and galvanic coupling means for coupling said diode load to the input of said amplifier.

The invention may best be understood by reference to the accompanying drawing, in which

Fig. 1 is a schematic diagram of one embodiment of the invention; and

Figs. 2 and 3 are certain explanatory diagrams.

Referring to Fig. 1, there is represented a portion of a superheterodyne television receiver which is supplied with carrier signal from a suitable antenna 1. The receiver may include the usual radio frequency amplifier, frequency converter, and intermediate frequency amplifier, and these units are represented collectively at 2. The output of the final intermediate frequency amplifier stage may be coupled, by way of a suitable coupling means, such as the transformer 3, to a detector which may comprise a diode V_1 and a suitable load 4—5. In the preferred embodiment, the detector output is galvanically coupled to a modulation-frequency amplifier V_2 having a relatively sharp plate-current cut-off as opposed to the remote cut-off of the so-called variable mu amplifiers. The signal output of the amplifier V_2 may be applied to a suitable signal utilization means, such as an electronic picture reconstituting device or the like. Synchronizing signals may be derived from the anode of V_2, but are preferably taken from the screen circuit of V_2, as illustrated. The particular screen pick-off circuit shown forms the subject of the copending application Serial No. 337,508, filed May 27, 1940.

In order to sharpen the cut-off characteristic of the amplifier V_2 it is preferably provided with an un-bypassed cathode load resistor 6. The cathode load additionally has the desirable property of straightening that part of the tube's characteristic which lies above the cut-off point, with the further advantage of minimizing the possibility of overloading by increasing the input voltage swing which the amplifier can handle.

The invention may be clearly understood by referring to Figs. 2 and 3. In Fig. 2 there is represented a modulated carrier wave television signal having an envelope 7. This signal is modulated in the negative sense, i. e., the blanking pulses 8 and the synchronizing pulses 9 extend in the direction of increased carrier amplitude or black, while the picture signals which lie between the blanking pulses, represent increasing light level in the direction of decreasing carrier amplitude. This is known as negative modulation. When the carrier signal illustrated is detected by means of a diode rectifier, an output signal is obtained as shown at 10 in Fig. 3. Since the detected signal is taken from the anode of the diode V_1, the signal will correspond to the envelope of the negative half of the modulated carrier wave shown in Fig. 2.

If the maximum amplitude E_s of the modulated carrier wave can be maintained substantially constant it will follow that the maximum amplitude E_o of the detector output will likewise remain substantially constant. It is therefore an important feature of this invention to provide an automatic gain control system (hereinafter A. G. C.) of such efficiency that the synchronizing peaks 11 of the detector output shall occur at a constant level 12 which may be adjusted to coincide approximately with the plate current cut-off level of the amplifier V_2 by means of a suitable biasing means 13. The result of this arrangement is that noise pulses which accompany the modulated carrier signal, and which have an amplitude greater than that of the carrier signal, will be limited by the sharp cut-off action of V_2 to an amplitude no greater than that of the synchronizing peaks 11, which level is that indicated at 12. The polarity or phase

of the detected signal 10 will, of course, be reversed in the amplifier V_2, but the relative voltage levels will not change.

The use of a galvanic connection between the detector load and amplifier input, in conjunction with a television system in which the so-called direct current component is transmitted, insures that the setting of the bias voltage source 13, once made, need not thereafter be readjusted.

The amplitude limiting action of this system will obviously prove advantageous to both the synchronizing and video frequency channels. In the synchronizing channel, the noise pulse amplitude will be limited to that of the synchronizing pulses, and due to the shorter duration of the average noise pulse its energy will be small compared to the energy in the synchronizing pulse. In the video channel, although the noise pulses extend in the "black" direction, it is desirable to limit their amplitude to within a reasonable limit in order to prevent transients due to shock excitation which may produce white spots on the viewing screen.

The A. G. C. system may be of any type which is capable of maintaining the amplitude E_s of the modulated carrier signal input to V_1 substantially constant in order that the detected synchronizing peaks 11 may coincide substantially with the cut-off level 12 of the amplifier V_2 as hereinbefore explained. The A. G. C. system should function efficiently over the usual range of signal amplitudes which may normally be encountered. If desired the A. G. C. voltage generator 14 may be coupled, by means of a small condenser 15, to a point on the transformer 3, while the A. G. C. voltage may be supplied by way of the lead 16 to the gain control electrodes of the amplifiers comprising the amplifier-converter section 2.

The detector circuit per se may take any of a number of different forms. In the particular embodiment illustrated, a small inductor 17 has been included in series with the load resistor 5 in order to improve the detector loading at the high modulation frequencies. To improve the coupling at these higher frequencies, a peaking coil 18 may be employed, as shown, and designed to resonate with the input capacity 19 of the amplifier V_2 at some high modulation frequency.

Instead of grounding the detector cathode, and connecting the secondary winding of transformer 3 between the high potential end of the detector load and detector anode as is customary, the said winding has been connected between ground and detector cathode, while the detector load 4—5—17 is connected directly between ground (through battery 13) and the detector anode. The advantage of this connection is that the distributed capacity to ground of the transformer 3 is divorced from the detector load circuit, whereas in the more conventional connection this distributed capacity is in shunt with the detector load. Where the modulation frequencies encountered may be very high, as they are in television, it is important that all undesired shunt capacities be reduced to a minimum.

Although the invention has been described with particular reference to signals employing negative modulation, it will be obvious that the same principles are applicable to transmissions employing positive modulation, or to ordinary sound broadcasts. Moreover, while the invention has been described with particular reference to the accompanying drawings, it will be understood that the invention is capable of various forms of physical expression and is therefore not to be limited to the specific disclosure.

I claim:

1. In a modulated carrier signal system in which it is desired to maintain the maximum output signal amplitude at a certain level and to prevent noise signals from exceeding said level, a circuit comprising a modulated carrier signal source, automatic gain control means for maintaining the maximum signal amplitude substantially constant at said level, a diode and a load circuit therefor for rectifying the signal, a vacuum tube amplifier having a relatively sharp cut-off characteristic, galvanic coupling means for coupling said diode load to the input of said amplifier, and means for biasing said amplifier so as to establish plate current cut-off thereof substantially at the level established by said automatic gain control means, whereby noise signals are limited in amplitude to the said level.

2. A system as claimed in claim 1, characterized in that said vacuum tube amplifier is provided with an unbypassed cathode load resistor, thereby sharpening the cut-off characteristic of said amplifier.

3. A system as claimed in claim 1, characterized in that said detector load circuit comprises a capacitor, a resistor, and a small inductor.

4. A system as claimed in claim 1, characterized in that said galvanic coupling means includes a peaking coil.

5. A system as claimed in claim 1, characterized in that the automatic gain control means comprises a voltage generator whose input is coupled to the high potential side of said modulated carrier signal source, and whose output is connected to gain control elements of a carrier signal amplifier.

6. In a modulated carrier signal system in which it is desired to maintain the maximum output signal amplitude at a certain level and to prevent noise signals from exceeding said level, a circuit comprising a modulated carrier signal source having low and high potential terminals, automatic gain control means for maintaining the maximum signal amplitude substantially constant at said level, a diode and a load circuit therefor for rectifying the signal, said diode load circuit being connected between the low potential terminal of said signal source and the diode anode, the high potential terminal of said source being connected to the diode cathode, a vacuum tube amplifier having a relatively sharp cut-off characteristic, galvanic coupling means for coupling said diode load to the input of said amplifier, and means for biasing said amplifier so as to establish plate current cut-off thereof substantially at the level established by said automatic gain control means, whereby noise signals are limited in amplitude to the said level.

7. A system as claimed in claim 6, characterized in that the junction between said source and said load circuit is connected to a point having substantially no radio frequency voltage to ground.

8. In a television receiver adapted to receive a negatively modulated carrier signal, a circuit for maintaining the synchronizing peaks of the signal at a certain level and for preventing noise signals from exceeding said level, comprising automatic gain control means for maintaining the synchronizing peaks substantially at said level, a diode and a load circuit therefor for rectifying the signal, a vacuum tube amplifier having a relatively sharp cut-off characteristic,

galvanic coupling means for coupling said diode load to the input of said amplifier, and means for biasing said amplifier so as to establish plate current cut-off thereof substantially at the level established by said automatic gain control means, whereby noise signals are limited in amplitude to the said level.

9. A television receiver according to claim 8, said amplifier having anode and screen grid circuits, means for deriving the video signal from said anode circuit, and means for deriving the synchronizing signal from said screen grid circuit.

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