July 21, 1942. J. HAANTJES 2,290,553

NEGATIVE FEED-BACK CIRCUIT ARRANGEMENT

Filed Jan. 11, 1941

Fig. 1

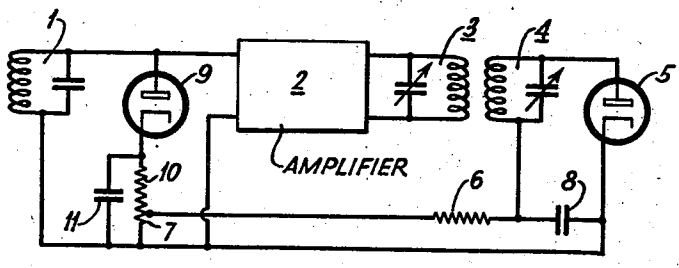


Fig. 2

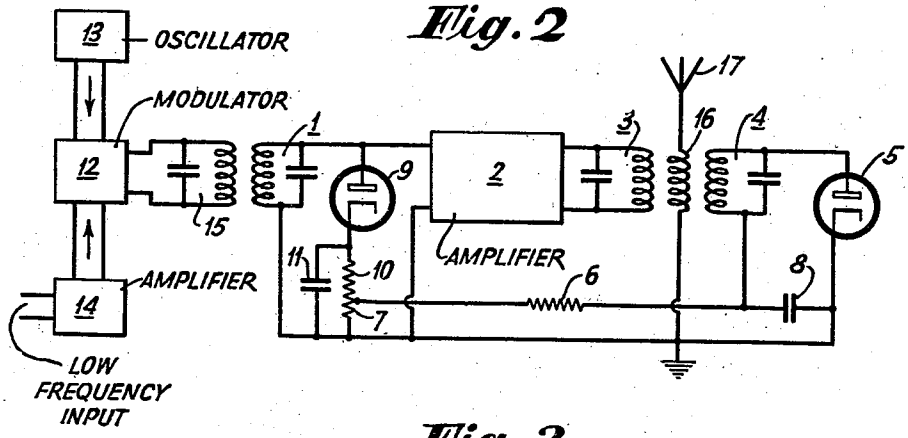
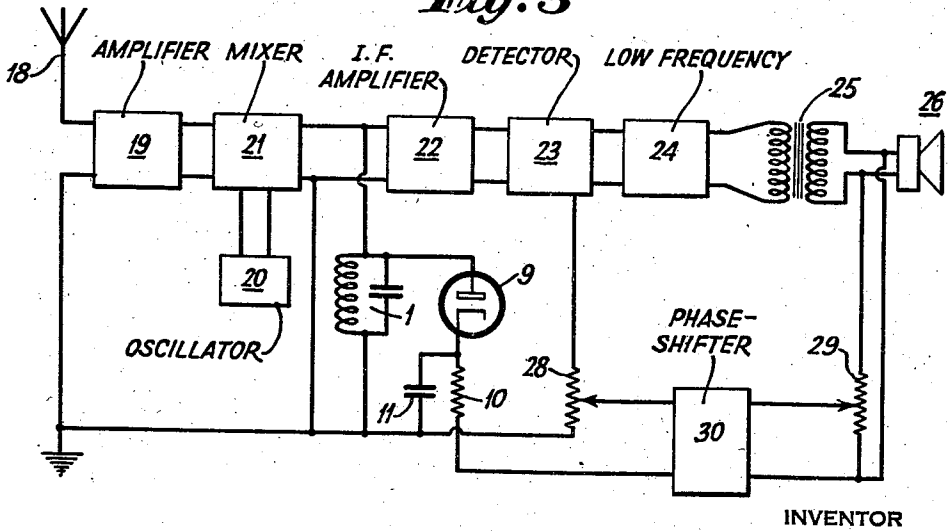


Fig. 3



INVENTOR
JOHAN HAANTJES
BY H. G. Grover
ATTORNEY

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NEGATIVE FEEDBACK CIRCUIT ARRANGEMENT

Johan Haantjes, Eindhoven, Netherlands

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4 Claims. (Cl. 179—171)

This invention relates to a circuit arrangement for transmitting amplitude-modulated oscillations through at least one amplifier.

Such a circuit arrangement is used, for instance, in radio receivers, in radio transmitters and in systems for carrier wave telephony.

The invention has for its object to utilize in such circuits negative feed-back for the modulation frequencies.

It has already been suggested to establish negative feed-back for the modulation frequencies by detecting the output voltage of the amplifier for amplitude-modulated oscillations and by modulating again the modulation-frequencies thus formed on the input voltage of the amplifier so as to counteract the initially available modulation. A difficulty heretofore encountered was that attempts to further modulate a modulated oscillation gave rise to the production of combination frequencies and of harmonics.

According to the invention this drawback is obviated by the use of an amplifier and a diode detector. The detected output voltage of the amplifier is used as a bias to a diode connected in parallel with an oscillatory circuit, the latter being tuned to the frequency of the amplitude-modulated oscillations. This oscillatory circuit is disposed in the input circuit of the amplifier in such manner that the applied bias becomes more positive with an increasing carrier wave amplitude.

The diode acting as a modulator involves amplitude modulation in the oscillatory input circuit, which modulation is additively composed of the amplitude modulation already available and the detected voltage carried back.

In this way the drawbacks referred to above do not occur in this circuit.

The invention will be more clearly understood by reference to the accompanying drawing given by way of example.

Figure 1 shows a circuit according to the invention;

Fig. 2 shows an application of the invention to a radio transmitter; and

Fig. 3 shows how it is used in a radio receiver.

In Fig. 1 the reference number 1 denotes an oscillatory circuit in which occur amplitude-modulated oscillations. These oscillations are supplied to an amplifier 2 which transmits the amplified oscillations to an oscillatory circuit 3. The oscillatory circuit 3 may have connected to it any suitable load, not shown.

The oscillatory circuit 3 has coupled to it an oscillatory circuit 4. A diode 5 having a load resistance is connected to the oscillatory circuit 4. This load resistance consists of two series-connected resistances 6 and 7. In parallel with the resistances 6 and 7 is connected a condenser 8 which has a negligibly small impedance towards the amplitude-modulated oscillations. A diode 9 having a load resistance is connected in parallel with the oscillatory circuit 1 in the input circuit of the amplifier 2. This load resistance consists of the resistance 7 and a resistance 10 connected in series. In parallel with the resistances 7 and 10 is connected a condenser 11 having a low impedance for the oscillations to be amplified. The operation of this circuit is as follows:

The amplitude-modulated oscillations in the oscillatory circuit 4 are rectified by the diode 5. As a result thereof a direct voltage having superposed thereon a low frequency alternating voltage is set up across resistances 6 and 7. The part of the sum of these voltages set up across resistance 7 constitutes a positive bias for the diode 9 which bias varies with the amplitude of the modulation frequency. This results in that the diode 9 exerts a variable damping on the oscillatory circuit 1 which damping depends on the instantaneous values of the modulation envelope.

In this way these modulation frequencies in the oscillatory circuit 1 are modulated again on the oscillations already available. When using the diode 9 this modulation is superposed on the initial modulation and the generation of higher harmonics and combination frequencies is avoided. The initially available modulation is counteracted by the modulation caused by the diode 9. Thus negative feed-back for the modulation frequencies ensues as a result of which the distortion caused in the amplifier is reduced.

This negative feed-back when restricted solely to the low frequency alternating voltage through the diode 9 is entirely sufficient. If, however, the direct voltage produced upon detection were not supplied at the same time there would ensue a decrease in modulation depth of the amplitude-modulated oscillations which would require stronger amplification.

In Fig. 2 the circuit arrangement referred to above is used in a radio transmitter to reduce the distortion to which the enveloping curve of the amplitude-modulated oscillations is liable in the transmitter. Corresponding parts of Figs. 1 and 2 bear the same reference numbers. The

amplitude-modulated oscillations are produced in a modulator 12 to which are supplied non-modulated oscillations by an oscillator 13, and modulation frequencies by a low frequency amplifier 14. The amplitude-modulated oscillations are transmitted to the oscillatory circuit 1 by an oscillatory circuit 15 connected to the modulator 12. The load connected to the oscillatory circuit 3 is constituted by a transmitting antenna 17 which is inductively coupled with the circuit 3 through a coil 16.

In Fig. 3 the circuit arrangement shown in Fig. 1 is used in a radio receiver where the intermediate frequency amplifier, and in addition the low frequency amplifier of the receiver, is back-coupled in a degenerative manner.

The oscillations picked up by means of an antenna 18 are amplified in a high frequency amplifier 19 and jointly with locally generated oscillations of an oscillator 20 supplied to a mixing stage 21. The intermediate frequency amplitude-modulated oscillations produced herein are amplified in an intermediate frequency amplifier 22 and subsequently detected by a second detector 23, whereupon the low frequency oscillations produced herein are amplified by a low frequency amplifier 24 and supplied through transformer 25 to a loud speaker 26.

The input circuit of the intermediate frequency amplifier 22 similarly to Fig. 1 includes an oscillatory circuit 1, a diode 9, a condenser 11 and a resistance 10.

For the negative feed-back of the enveloping curve of the amplitude-modulated oscillations and of the low frequency modulation frequencies two voltages are supplied in series to the diode 9. One of these voltages is a direct voltage which is a measure of the intensity of the intermediate frequency carrier wave and is produced by detection in the second detector 23 and diverted therefrom to ground by way of a potentiometer 28. A part of the voltage across this potentiometer is supplied in series with a low frequency voltage to the diode 9. This low frequency voltage is taken from the secondary winding of transformer 25 and, through a potentiometer 29 and a phase shifting device 30, connected in series with the direct voltage through part of the potentiometer 28. The potentiometer 29 permits adjustment of the correct value of the various components of the low frequency voltage, while the phase shifting device 30 allows adjustment of their phase.

In fact, frequency dependent phase displacement occurs in the intermediate frequency amplifier and in the low frequency amplifier, which displacement must be corrected prior to back-coupling in a degenerative manner.

Negative feed-back of the whole receiver might be achieved by connecting the diode 9 to the input oscillatory circuit of the high frequency amplifier 19. In this case, however, the drawback occurs that the incoming signal voltage is insufficient for suitable operation of the diode 9. Moreover, the risk of distortion in the high frequency amplifier is not great, since the signal voltage is low. Hence the diode 9 is preferably connected to one of the succeeding amplification stages or to the intermediate frequency amplifier.

I claim:

1. In a discharge tube amplifier and circuit arrangement therefor, a variable unilateral impedance of the diode type in shunt with an input circuit for said amplifier, means for rectifying a modulation component of the output energy from said amplifier, and means for superposing the rectified modulation component upon the energy shunted through said variable unilateral impedance, thereby to produce a negative feedback effect upon said input circuit.

2. In an amplifier according to claim 1, the combination so defined in which the circuit of said variable unilateral impedance includes a diode rectifier and a potentiometer a portion of which is in circuit with said means for rectifying a modulation component of the output energy.

3. A circuit arrangement for translating amplitude modulated oscillations, including an amplifier, a resonant input circuit for said amplifier, a diode rectifier in shunt with the resonant portion of said input circuit, an electronic detector coupled to the output side of said amplifier, a resistive impedance interconnecting the respective cathodes of said rectifier and said detector, a direct current connection from the cathode of said diode to ground, a resistive feedback circuit from the anode of said detector to an intermediate tap on the resistive impedance first mentioned, and capacitive means for dissipating unwanted alternating potential components in said input and output circuits; said diode rectifier and said feedback circuit being cooperative to produce a variable damping effect on said amplifier which is a function of the amplitude of said modulated oscillations.

4. A circuit arrangement for receiving amplitude modulated oscillations, including at least one amplifier, a resonant input circuit for said amplifier, a diode rectifier in shunt with the resonant portion of said input circuit, a detector coupled to the output side of said amplifier, a utilization device having an input circuit and means coupling the same to said detector, a feedback circuit connected to the coupling means between said detector and said utilization device, a phase shifting device in said feedback circuit, said phase shifting device having an output circuit coupled to the output side of said detector, and means for interposing a rectified modulation component derived from said detector upon the energy shunted through said diode rectifier, thereby to produce a negative feedback effect on the input circuit of said amplifier.

JOHAN HAANTJES.