Nov. 14, 1939. K. R. STURLEY 2,179,966

NOISE SUPPRESSION CIRCUITS

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Fig. 1

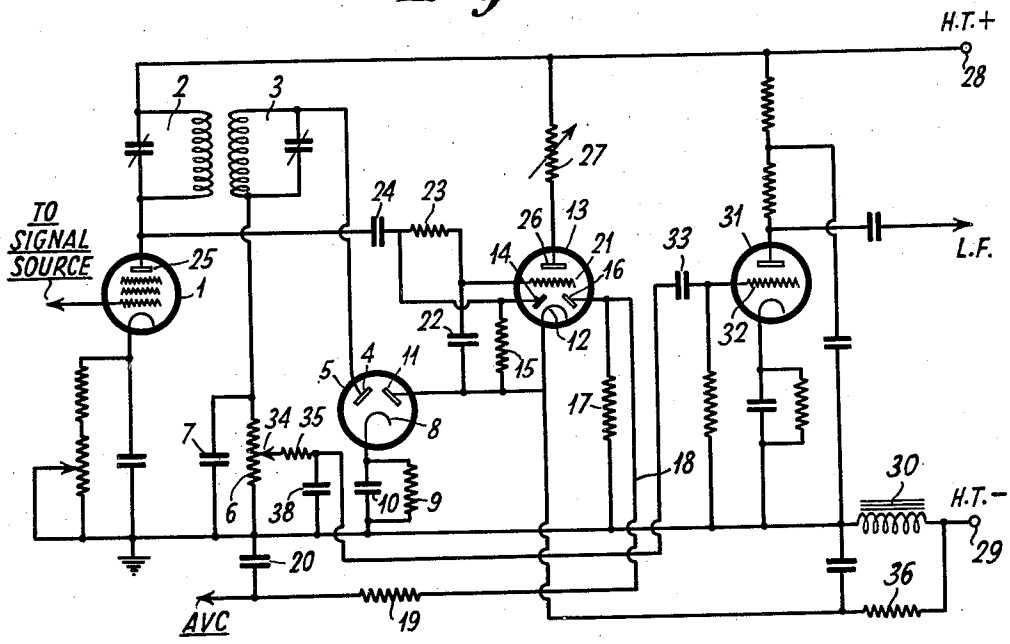
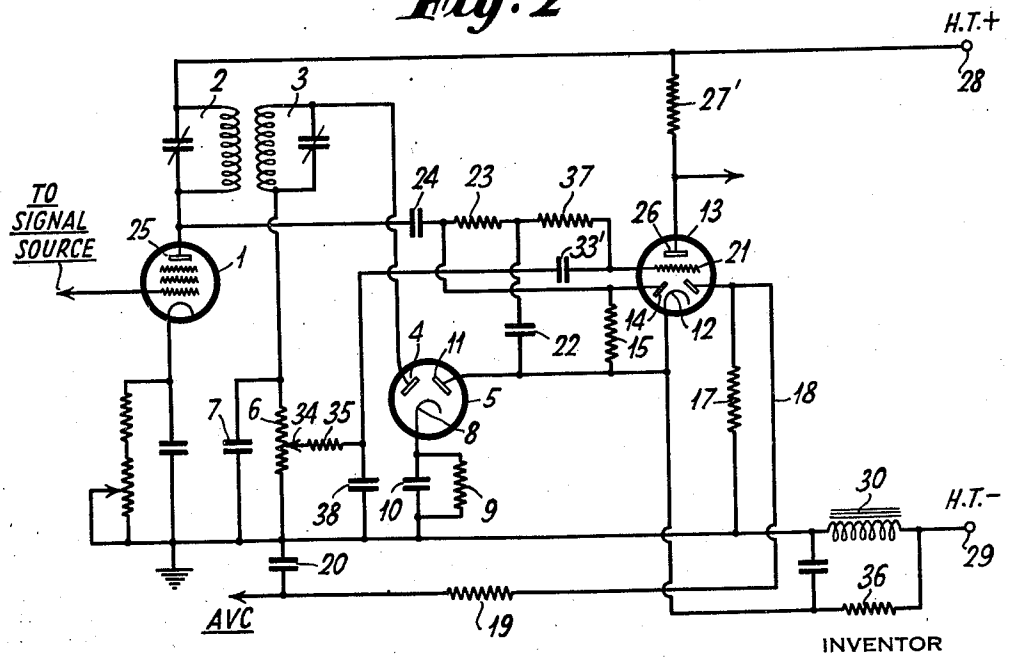


Fig. 2



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NOISE SUPPRESSION CIRCUITS

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6 Claims. (Cl. 250—20)

This invention relates to radio and like receivers and has for its object to provide improved so-called "noise suppression" circuits for such receivers.

For the sake of convenience of terminology the word "normally" will be employed in the description which follows to indicate that state of affairs which exists in the absence of incoming signals. According to this invention the demodulating detector of a radio or similar receiver is normally held inoperative by a biasing voltage drop which is set up across a resistive impedance which is, also, included in a rectifier circuit the anode of which is connected to a point which is normally maintained positive with respect to earth by a voltage drop set up across a second resistive impedance. The second resistive impedance is in the cathode-anode circuit of a valve which is normally conductive, but whose bias is controlled by the voltage drop set up across a third resistive impedance in the circuit of a further rectifier to which received signals are applied, the whole arrangement being such that when signals of a predetermined strength are received the bias on the said valve is reduced, the anode current thereof is reduced, the said point becomes less positive with respect to earth, and the voltage drop across the first mentioned resistive impedance is accordingly reduced until, when signals of a strength suitable for reproduction are received, the last mentioned voltage drop is reduced so far that the demodulating detector is rendered operative. Preferably the demodulating detector and the rectifier, whose anode point is connected to the point which is normally positive with respect to earth, form parts of a double diode having a common cathode, and preferably also the valve, the further rectifier and an additional rectifier, from whose circuit automatic volume control potentials are derived, are constituted by parts of a double diode triode.

The invention is illustrated in the accompanying drawing which shows diagrammatically two embodiments of the invention in Figs. 1 and 2.

Referring to Fig. 1 the valve 1 in the last carrier stage of the receiver, which stage may be a radio frequency stage but will most usually be the last intermediate frequency stage of a superheterodyne receiver, has in its anode circuit a carrier frequency tuned circuit 2 coupled to a second carrier frequency tuned circuit 3, one end of which is connected to one anode 4 of a double diode 5 and the other end of which is connected through a resistance 6, shunted by a capacity 7, to earth. The diode anode 4 constitutes, in conjunction with the common cathode 8 of the double diode, the demodulating detector of the receiver and the said cathode 8 is connected to earth through a resistance 9 shunted by a capacity 10. The second anode 11 of the double diode is connected to the cathode 12 of a double diode triode 13, the triode portion of which acts as an automatic volume control amplifier. The first diode anode 14 of the double diode triode 13 is connected to the cathode 12 thereof through a resistance 15, and the second diode anode 16 of the said double diode triode 13 is connected to earth through a resistance 17. The junction point of resistance 17 with the anode 16 is the point from which automatic volume control (designated as AVC) potentials are derived for application to the valve, or valves, of the receiver to be controlled, the AVC lead (18 is an AVC lead) having associated therewith the usual filter resistance and condenser (such as 19, 20) for smoothing the AVC potential.

The control grid 21 of the double diode triode 13 is connected to the cathode 12 through a condenser 22, and is also connected to the diode anode 14 through a resistance 23. A coupling condenser 24 is connected between the anode 25 of the valve 1 and the diode anode 14. The anode 26 of the triode section of the double diode triode 13 is connected either (as shown) through an anode resistance 27, or direct to the positive terminal 28, of a source of anode potential, and the cathode 12 of the said double diode triode is connected through a resistance 36 to the negative terminal 29 of the said source. The terminal 29 is connected through a choke 30 to earth and to the cathode return lead of the first audio frequency amplifier valve 31 of the receiver. The grid 32 of the said valve 31 is connected through a coupling condenser 33 to a tapping point 34 (which may be made adjustable for manual control purposes) upon the resistance 6. The lead to the tap 34 may include a high frequency filter circuit consisting of a resistance 35 and a condenser 38.

Although from the point of view of stability and freedom from distortion, it is preferred not to employ the triode section of the double diode triode for audio amplification, it is possible so to employ it while still retaining the noise suppression action unaffected. Thus, as shown in Fig. 2, the grid 21 of the said triode section may be connected through a coupling condenser 33' (and, if desired, the high frequency filter consisting of resistance 35 and condenser 38 may be included) to the tapping point 34 upon the resistance 6.

In this case the elements 22 and 23 are designed to filter out the detected audio components produced across resistance 15 and an additional resistance 37 is inserted between grid 21 and the junction point of elements 22 and 23. The output audio voltage from the double diode triode is then developed across any suitable impedance such as the resistance 27' or an audio frequency choke, or a transformer primary, in the anode-cathode circuit of the triode section.

In either case the whole arrangement is such that normally the voltage drop developed across the resistance 36 by the anode current of the triode section of the double diode triode is greater than the voltage drop across the choke 30 so that the cathode of the double diode triode is positive with respect to earth, and the second diode 8—11 of the double diode passes current and the voltage drop across the resistance 9 is sufficient to bias the demodulating diode back so that it is inoperative to demodulate incoming signals. When, however, the signal strength applied to the diode 12—14 of the double diode triode increases sufficiently, the voltage drop across the resistance 15 drives the grid 21 negative thus reducing the current flow through the resistance 36, and, also the positive potential with respect to earth at the cathode of the double diode triode. Accordingly, the current through the diode 8—11 of the double diode is reduced and the bias on the demodulating detector is reduced until, when the signal is strong enough, the demodulating diode operates correctly, the current through the diode 8—11 then being zero. In this way the "suppression" bias on the demodulating diode is removed as soon as automatic volume control commences, that is to say, as soon as the incoming signal is strong enough for proper reproduction.

The time constant provided by the resistance 9 and shunt condenser 10 should be approximately equal to that provided by the resistance 6 and shunt condenser 7, and the value of the said resistance 9 should be about one-tenth, or less, of the value of the said resistance 6. Change of position of the point of "suppression" may be achieved by changing the cathode bias of one or more of the gain controlled carrier frequency valves of the receiver, and/or by deriving the voltage on the anode of the triode section of the double diode triode either from an adjustable tapping on a potentiometer resistance connected between the positive terminal of the source of anode potential and earth, or from an adjustable series resistance between the anode of the said triode section and the said positive terminal.

The invention offers quite important operating advantages among them being:

1. The demodulating detector is biased only for noise suppression, and all bias is quickly removed as soon as the suppression point is passed allowing normal and, therefore, substantially distortionless operation of the detector thereafter.

2. One end of the audio frequency output resistance (the resistance 6 in Figs. 1 and 2) is earthed thus avoiding liability of "hum" pickup from the source of negative voltage for producing the AVC voltage. In mains-driven sets this source is often the field coil of a moving coil loudspeaker. This earthing of the audio frequency output resistance at one end also assists in preventing audio frequency "break through" when the normal volume control (the tapping 34 on the resistance 6) is set to zero.

3. In the preferred embodiment (Fig. 1) the double diode triode is not employed as an audio frequency amplifier, and, therefore, liability to instability and distortion due to varying bias on the grid of the triode section of the double diode triode is avoided altogether.

What is claimed is:

1. In combination in a radio receiver provided with a signal carrier transmission network, a demodulator coupled to said network, and including a demodulation voltage output circuit, a control circuit for the receiver comprising a signal rectifier coupled to said network and adapted to derive a direct current voltage from rectified signal current, an electron discharge device including an impedance in the space current path thereof, means for impressing said direct voltage on said device to control the current flow through said impedance, a second signal rectifier coupled to said network and adapted to derive a second direct current voltage from rectified signal current, means connecting said second rectifier to said demodulator so as to cause said second direct voltage to render the demodulator ineffective to produce demodulation voltage, and connections between said second rectifier and said impedance for rendering said second rectifier ineffective upon the current flow through the impedance decreasing below a predetermined value.

2. In combination in a radio receiver provided with a signal carrier transmission network, a demodulator coupled to said network and including a demodulation voltage output circuit, a control circuit for the receiver comprising a signal rectifier coupled to said network and adapted to derive a direct current voltage from rectified signal current, an electron discharge device including an impedance in the space current path thereof, means for impressing said direct voltage on said device to control the current flow through said impedance, means for producing a gain control potential for said network, a second signal rectifier coupled to said network and adapted to derive a second direct current voltage from rectified signal current, means connecting said second rectifier to said demodulator so as to cause said second direct voltage to render the demodulator ineffective to produce demodulation voltage, and connections between said second rectifier and said impedance for rendering said second rectifier ineffective upon the current flow through the impedance decreasing below a predetermined value.

3. In combination in a radio receiver provided with a signal carrier transmission network, a demodulator coupled to said network and including a demodulation voltage output circuit, a control circuit for the receiver comprising a signal rectifier coupled to said network and adapted to derive a direct current voltage from rectified signal current, an electron discharge device including an impedance in the space current path thereof, means for impressing said direct voltage on said device to control the current flow through said impedance, a second signal rectifier coupled to said network and adapted to derive a second direct current voltage from rectified signal current, means connecting said second rectifier to said demodulator so as to cause said second direct voltage to render the demodulator ineffective to produce demodulation voltage, connections between said second rectifier and said impedance for rendering said second rectifier ineffective upon the current flow through the impedance decreasing below a predetermined value, and means, responsive to said decreased

current flow through said impedance, for producing a gain control voltage for the network.

4. In combination in a radio receiver provided with a signal carrier transmission network, a demodulator coupled to said network and including a demodulation voltage output circuit, a control circuit for the receiver comprising a signal rectifier coupled to said nework and adapted to derive a direct current voltage from rectified signal current, an electron discharge device including an impedance in the space current path thereof, means for impressing said direct voltage on said device to control the current flow through said impedance, a second signal rectifier coupled to said network and adapted to derive a second direct current voltage from rectified signal current, means connecting said second rectifier to said demodulator so as to cause said second direct voltage to render the demodulator ineffective to produce demodulation voltage, connections between said second rectifier and said impedance for rendering said second rectifier ineffective upon the current flow through the impedance decreasing below a predetermined value, said network including a pair of cascaded resonant circuits tuned to a desired carrier frequency, said demodulator being coupled to the second resonant circuit, and said two rectifiers being coupled to the first resonant circuit.

5. In combination in a radio receiver provided with a signal carrier transmission network, a demodulator coupled to said network and including a demodulation voltage output circuit, a control circuit for the receiver comprising a signal rectifier coupled to said network and adapted to derive a direct current voltage from rectified signal current, an electron discharge device including an impedance in the space current path thereof, means for impressing said direct voltage on said device to control the current flow through said impedance, a second signal rectifier coupled to said network and adapted to derive a second direct current voltage from rectified signal current, means connecting said second rectifier to said demodulator so as to cause said second direct voltage to render the demodulator ineffective to produce demodulation voltage, connections between said second rectifier and said impedance for rendering said second rectifier ineffective upon the current flow through the impedance decreasing below a predetermined value, and means for connecting said demodulation voltage output circuit to said electron discharge device whereby the latter amplifies said demodulation voltage.

6. In combination in a radio receiver provided with a signal carrier transmission network, a demodulator coupled to said network and including a demodulation voltage output circuit, a control circuit for the receiver comprising a signal rectifier coupled to said nework and adapted to derive a direct current voltage from rectified signal current, an electron discharge device including an impedance in the space current path thereof, means for impressing said direct voltage on said device to control the current flow through said impedance, a second signal rectifier coupled to said network and adapted to derive a second direct current voltage from rectified signal current, means connecting said second rectifier to said demodulator so as to cause said second direct voltage to render the demodulator ineffective to produce demodulation voltage, connections between said second rectifier and said impedance for rendering said second rectifier ineffective upon the current flow through the impedance decreasing below a predetermined value, the electrodes of said demodulator and second rectifier being provided by a tube having a common cathode and two anodes, and the electrodes of the first rectifier being housed within the envelope of said discharge device.

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