

April 13, 1937.

J. VAN SLOOTEN

2,076,803

NOISE SUPPRESSOR CIRCUIT

Filed June 23, 1934

2 Sheets-Sheet 1

Fig. 1

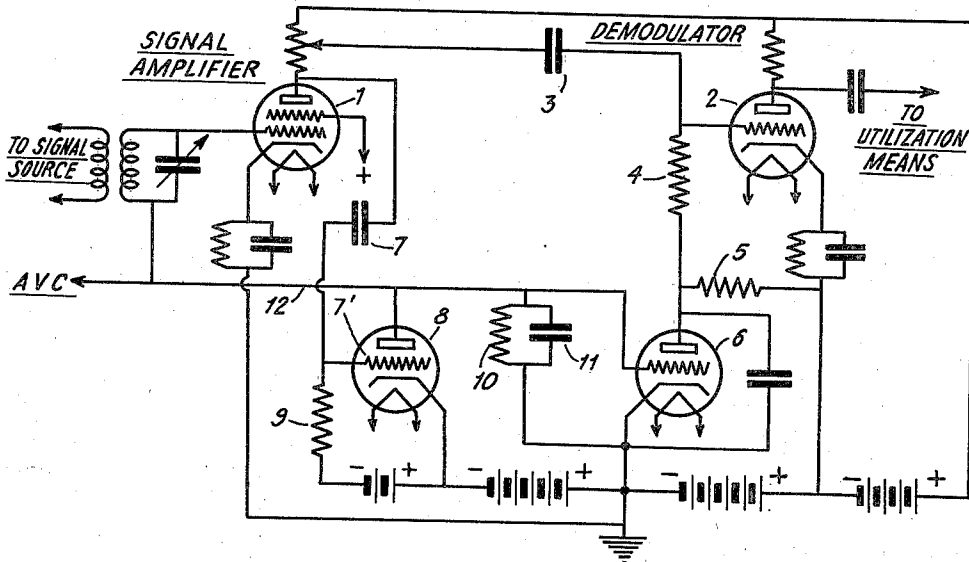
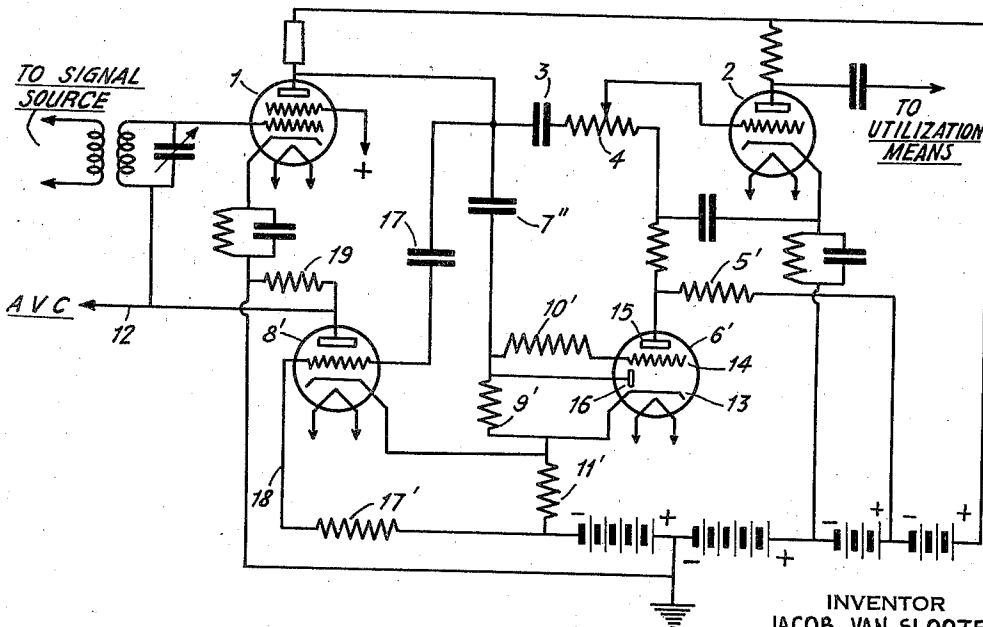


Fig. 2



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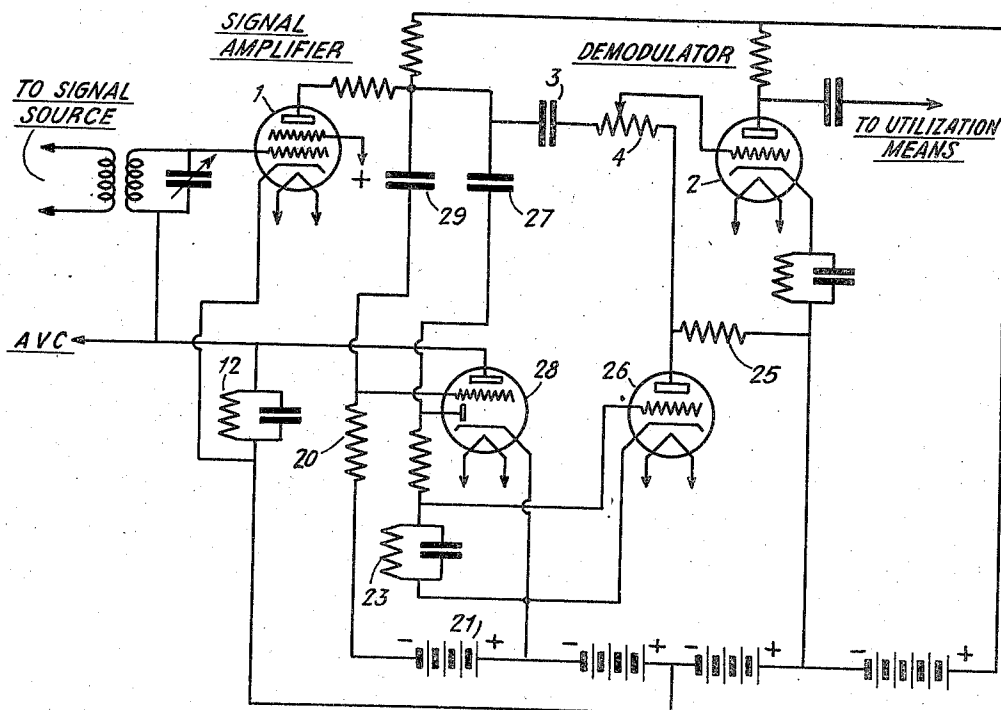
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Fig. 3



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NOISE SUPPRESSOR CIRCUIT

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3 Claims. (Cl. 250—20)

This invention relates to the noiseless tuning of radio receiving sets comprising automatic volume control of the sound strength.

One of the drawbacks inherent to receiving sets having automatic volume control is that upon modification of the tuning of the receiver the sensitivity is altered in such a manner that when no carrier wave is received the sensitivity, i. e. the amplification factor of the high- and/or medium frequency amplifier forming part of the receiver attains its maximum value. Owing to this noises caused by atmospheric discharges or other noises, for instance, due to electron emission in amplifying tubes (Schrot-effect), are amplified to a high extent and consequently manifest themselves in an annoying manner during the time in which no carrier wave is received. Such noises manifest themselves not only in the absence of a carrier wave, but also during the adjustment of the receiving set when it is tuned to a frequency lying between two carrier waves.

The present invention has for its purpose to provide means for suppressing noises in the receiver in the absence of a carrier wave, and for ensuring at the same time noiseless tuning of the receiver.

According to the invention this is ensured in a radio receiving set with automatic volume control during the time in which no carrier wave, or only a carrier wave having an amplitude below a definite value, is received by varying the potential of one of the electrodes of a thermionic tube for demodulating, or for converting the frequency of the received oscillations in such a manner that this tube is entirely or substantially rendered inoperative.

The novel features which I believe to be characteristic of my invention are set forth in particularity in the appended claims. The invention itself, however, both as to its organization and method of operation, will best be understood by reference to the following description taken in connection with the drawings, in which I have indicated diagrammatically several circuit organizations whereby my invention may be carried into effect.

The invention will be more clearly understood by reference to the accompanying drawings, Figs. 1, 2 and 3 thereof representing, by way of example, different embodiments.

In Fig. 1 of the drawings 1 denotes a high, or medium, frequency amplifying tube of a receiving set; the tube is coupled with a succeeding tube 2 serving for demodulation of the received oscillations. This coupling can be obtained in

any known manner, for instance, by connecting, as shown in Fig. 1, the anode of the tube 1 to the grid of the tube 2 by means of a condenser 3. The controlling grid circuit of the tube 2 comprises a leakage resistance 4, and in addition a resistance 5. This resistance is traversed by the anode current of an amplifying tube 6 so that the grid bias of the demodulator 2 depends on the size of the anode current of the tube 6. When this current is large the controlling grid of the tube 2 attains such a large negative voltage with respect to the cathode that this tube can no longer act as a demodulator. If, on the contrary, the anode current of the tube 6 is small then the negative voltage of said controlling grid is small relatively to the cathode so that the received oscillations can be rectified in a normal manner by the tube 2. This rectification can be ensured both by anode and by grid rectification.

As has already been stated the anode of the high or medium frequency amplifying tube 1 is coupled with the grid of the tube 2, and in addition to the grid 7' of a rectifying tube 8 by means of a condenser 7. Due to this, a high, or medium, frequency voltage drop occurs through a resistance 9 lying between the grid and the cathode of the tube 8, this drop causing a rectified current through the resistance 10 inserted in the anode circuit of the tube 8. This resistance is shunted by a condenser 11 having such a capacity that no, or substantially no, high or low frequency voltage drop can occur through the resistance. The direct voltage drop through the resistance 10, whose value depends on the amplitude of the high or medium frequency oscillations set up at the grid of the tube 8 and consequently also depend on the amplitude of the received carrier wave, determines the voltage of the grid of the tube 6 relatively to the cathode, and thus regulates the anode current traversing the resistance 5. The end of the resistance 10 connected to the anode of the tube 8 is at the same time connected to the controlling grid circuit of the amplifying tube 1 as indicated by the trunk line 12. Also the grid circuits of further high and/or medium frequency amplifying tubes preceding the tube 1 may be connected to the line 12.

The working of the arrangement set out is as follows: In the absence of a carrier wave no high or medium frequency oscillations occur in the anode circuit of the tube 1, so that the grids of the tubes 2 and 8 have no alternating tension relatively to the corresponding cathodes. In this case the grid of the tube 8 has a constant nega-

tive bias which is determined by the source of grid bias voltage, and has such a value that no anode current flows in the tube 8 due to which no voltage is present between the grid and the cathode of the tube 6. Consequently anode current flows in this tube 6 which current causes a voltage drop through the resistance 5 due to which the tube 2 is rendered inoperative.

In this manner it is impossible that, although the amplification factor of the high and/or medium frequency amplifying tubes (due to the absence of a voltage drop through the resistance 10 which drop regulates the amplification factor as has been set out above) has its maximum value, disturbances caused by atmospheric or other phenomena reach the low frequency amplifier and be successively reproduced, for instance, by a loudspeaker.

When receiving a carrier wave alternating tensions are set up through the resistance 9 which tensions are rectified by the tube 8, which acts as an anode rectifier, and cause a direct voltage drop through the resistance 10 in the anode circuit of said tube. This voltage drop first regulates the amplification factor of the amplifying tube 1, and of the preceding amplifying tubes, in such a manner that the amplitude of the alternating tensions set up in the anode circuit of the amplifying tube 1 always remains substantially constant independently of the amplitude of the received oscillations. Secondly, the grid of the tube 6 becomes highly negative due to the voltage drop through the resistance 10 so that the anode current in this tube is entirely, or almost entirely, suppressed due to which no voltage drop occurs through the resistance 5. In this manner the demodulator 2 can act in a normal manner, and rectifies the amplified received oscillations.

Another form of construction of the circuit arrangement according to the invention is represented in Fig. 2 in which, just as in the arrangement shown in Fig. 1, the noiseless tuning is ensured by rendering the controlling grid inoperative by a suitable negative voltage set up at the controlling grid during the time in which no carrier wave is received. The difference from the arrangement shown in Fig. 1 is that in the arrangement represented in Fig. 2 a binode, or multi-section tube, 6' is used for achieving noiseless tuning. Furthermore both arrangements differ from each other in that in the arrangement shown in Fig. 2 the working of the device for obtaining noiseless tuning is more independent of the working of the device serving for the automatic volume control.

The binode tube 6' comprises an amplifying system, or section, consisting of an indirectly heated cathode 13, a grid 14 and an anode 15, and, in addition, a rectifying system, or section, having an anode 16 which system and the amplifying system have a common cathode. Between the anode 16 and the cathode 13 is connected a resistance 9' which is coupled with the anode circuit of a high, or medium, frequency amplifying tube 1 through a condenser 7'. In the presence of high, or medium, frequency oscillations in the anode circuit of the tube 1 an alternating tension is set up in the anode circuit of the tube 1 through the resistance, which tension is rectified by the diode section of tube 6' and causes a direct voltage drop through the resistance 9'. This voltage drop controls through a resistance 10' the controlling grid 14 of the amplifying system of tube 6', and consequently also the anode

current thereof traversing the resistances 5' and 11'. The voltage drop through the first mentioned resistance determines the grid bias of the demodulating tube 2 in such a manner that when the anode current flows in the tube 6' the demodulator 2 is inoperative. The voltage drop through the resistance 11' regulates the grid voltage of a tube 8' in whose anode circuit a resistance 19 is inserted. The voltage drop across this resistance regulates in a known manner the amplification factor of the amplifying tube 1, and, if desired, the amplification factor of the preceding amplifying tubes.

The arrangement shown in Fig. 2 may furthermore be completed by providing a condenser 17 through which high or medium frequency oscillations are supplied to the controlling grid of the tube 8', and by connecting a resistance 17' in the line 13. In this case the tube 8' acts at the same time as an anode-detector for the high or medium frequency oscillations due to which the regulating working of the automatic volume control is still increased.

In this case it is possible by short-circuiting the resistance 11' to render the working of the tube serving for the automatic volume control entirely independent of the working of the tube serving for noiseless tuning.

Fig. 3 of the drawings represents an arrangement in which the device for the automatic volume control, and the device for the noiseless tuning are entirely independent of each other. In this arrangement, just as in that shown in Fig. 2, a binode 28 is used which acts as a diode-rectifier and as an anode rectifier. For this purpose the output circuit of a high, or medium frequency, amplifier is coupled through condensers 27 and 29 with the anode of the diode, and with the controlling grid of the triode section of the binode 28. The controlling grid circuit comprises a resistance 20 which is connected through a source of voltage 21 to the cathode of the binode 28. This voltage source 21 impresses such a negative bias on the controlling grid that anode rectification occurs in the anode circuit of the tube 28. The direct voltage drop thus occurring through the resistance 12 in the anode circuit of the binode 28 regulates the amplification factor of the amplifying tube 1.

The direct voltage drop occurring through a resistance 23, due to the rectification in the diode system, controls the grid of a tube 26 in the anode circuit of which a resistance 25 is inserted which, just as in the arrangements shown in Figs. 1 and 2, regulates the grid voltage of the demodulator tube 2.

The working of the arrangement shown in Figs. 2 and 3 entirely corresponds to that of the arrangement represented in Fig. 1, so that it need not be described here in detail. It will be readily appreciated that, although in the arrangements shown in Figs. 1, 2 and 3, the noiseless tuning and the suppression of noises during the time in which no carrier wave is received is ensured by adding a negative bias to the controlling grid of the thermionic tube serving for demodulation, it is also possible to render the demodulator inoperative by applying a bias to one of the other tube electrodes.

Furthermore, with superheterodyne receiving sets the thermionic tube serving for frequency conversion can be rendered inoperative by applying a suitable bias to one of the electrodes which measure may, if desired, be applied simultaneously with the first mentioned measure. Further-

more, it is possible without any further means by using suitable biases for the tubes in the arrangements, according to the invention, to ensure a retarded working of the demodulator and of the automatic volume control.

While I have indicated and described several systems for carrying my invention into effect, it will be apparent to one skilled in the art that my invention is by no means limited to the particular organizations shown and described, but that many modifications may be made without departing from the scope of my invention, as set forth in the appended claims.

What is claimed is:—

1. In combination with a signal amplifier and a demodulator of the plate rectification type, a plate rectification detector including a resistor in its space current path, an amplifier gain control connection from the plate side of the resistor to a gain control electrode of the amplifier, means for impressing signal energy upon said detector, a diode rectification circuit including an impedance, means for impressing signal energy upon the diode electrodes, an electron discharge device circuit having its input electrodes connected to points on said impedance such that space current flow of the device is prevented when signals are impressed on the diode circuit, a second resistor in the space current path of the said device, and the input electrodes of the demodulator being connected to points on the last resistor such that demodulation is prevented when the space current of said device flows and means responsive to plate current variation of said discharge device for regulating the space current flow of said detector.

2. In combination with a signal amplifier and a demodulator of the plate rectification type, a plate rectification detector including a resistor in its space current path, an amplifier gain control connection from the plate side of the resistor to a gain control electrode of the amplifier, means for impressing signal energy upon said detector, a diode rectification circuit including an impedance, means for impressing signal energy upon

the diode electrodes, an electron discharge device circuit having its input electrodes connected to points on said impedance such that space current flow of the device is prevented when signals are impressed on the diode circuit, a second resistor in the space current path of the said device, and the input electrodes of the demodulator being connected to points on the last resistor such that the demodulation of signals received from the amplifier is prevented when the space current of said device flows, a third resistor disposed in the space current path of said device, the input electrodes of said detector being connected to points of said third resistor whereby variations in amplitude of signals impressed upon the diode circuit causes control of the detection action of said detector.

3. In combination with a signal amplifier and a demodulator of the plate rectification type, a plate rectification detector including a resistor in its space current path, an amplifier gain control connection from the plate side of the resistor to a gain control electrode of the amplifier, means for impressing signal energy upon said detector, a diode rectification circuit including an impedance, means for impressing signal energy upon the diode electrodes, an electron discharge device circuit having its input electrodes connected to points on said impedance such that space current flow of the device is prevented when signals are impressed on the diode circuit, a second resistor in the space current path of the said device, and the input electrodes of the demodulator being connected to points on the last resistor such that the demodulation of signals received from the amplifier is prevented when the space current of said device flows and means responsive to plate current variation of said discharge device for regulating the space current flow of said detector, the electrodes of said device being included in a common tube envelope housing the diode electrodes, and the cathode of the diode and device being a common one.

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