Feb. 14, 1939. D. J. HILFERTY 2,147,595

ULTRA HIGH FREQUENCY TRANSCEIVER

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Fig. 1.

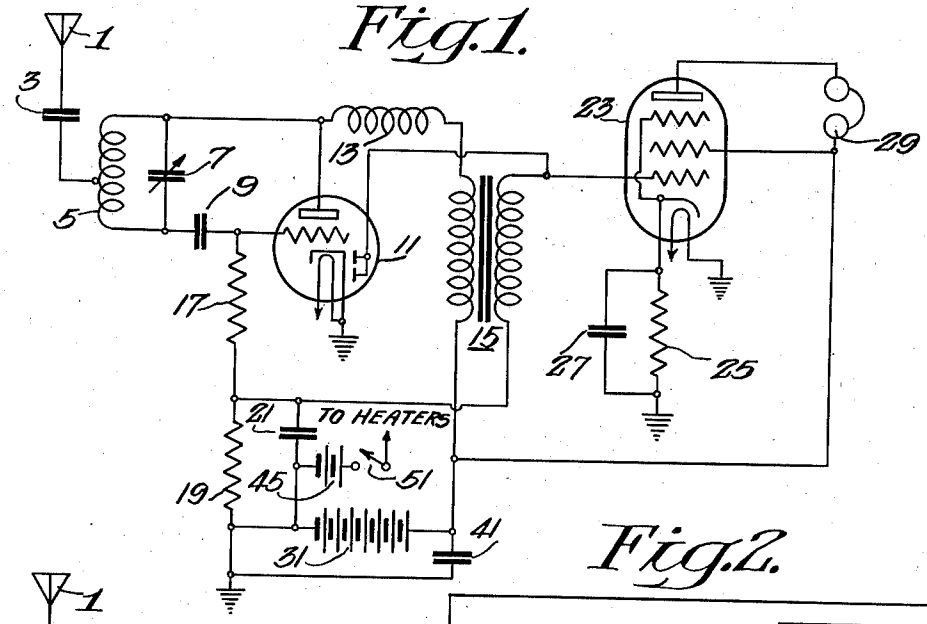
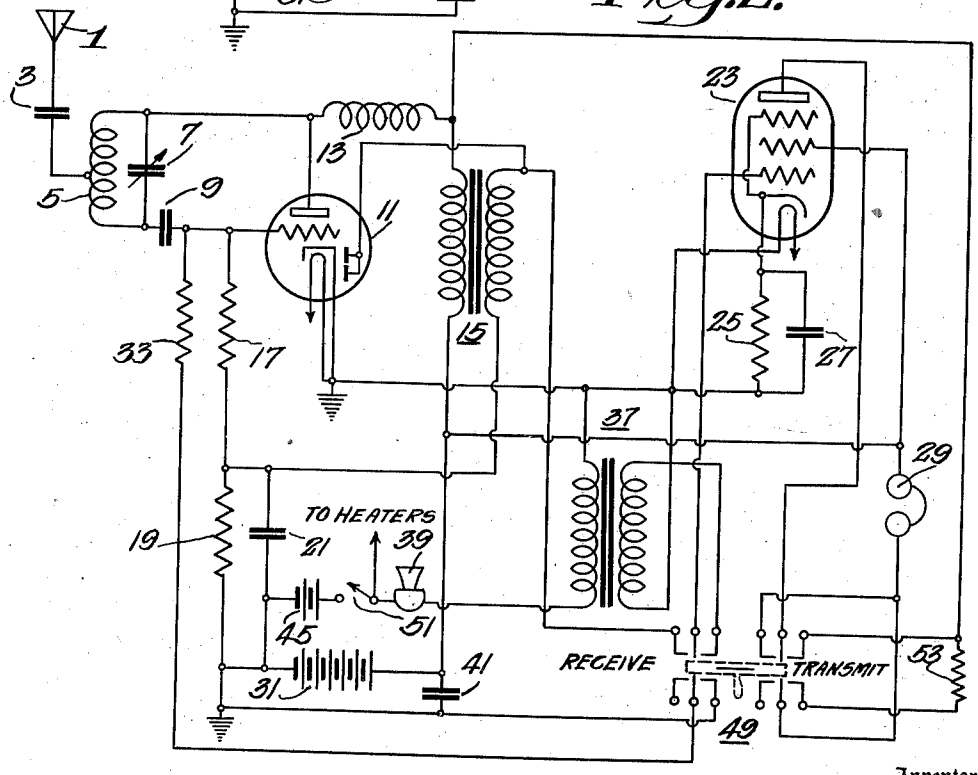


Fig. 2.



Inventor

Daniel J. Hilferty

By J. J. Fuff

Attorney

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ULTRA HIGH FREQUENCY TRANSCEIVER

Daniel J. Hilferty, Merchantville, N. J., assignor to Radio Corporation of America, a corporation of Delaware

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5 Claims. (Cl. 250—20)

My invention relates to radio receivers and more particularly to a receiver of the superregenerative type in which the inherent noise voltage is used to bias the detector when no radio frequency signal is reecived.

It is well known to those familiar with the conventional superregenerative receiver that when no signal is received the receiver generates a most annoying noise or "hash" in the headphones or loudspeaker. This noise disappears when a signal carrier is received, probably because of the biasing action of the signal on the detector tube.

I am aware of various automatic volume control systems which operate on the sensitivity of a receiver in proportion to the intensity of the radio frequency carrier. I am also aware of interstation noise suppressor systems which permit the receiver to be receptive only when a radio frequency signal is impressed on the control circuit.

In my invention I propose to utilize the noise voltage or "hash" which is present in the audio circuit to provide, after rectification, a negative d.-c. biasing voltage which may then be applied to the grid of the detector tube to decrease this objectionable noise. When a radio frequency signal is received the noise is thereby reduced, thus the noise-controlled bias is reduced, and the receiver will operate normally.

An especially valuable feature is obtained when my invention is used with a communication system as shown in Fig. 2. When the switch is in the "transmit" position the device becomes a transmitter and may be used to send out voice-modulated signals. By operating the switch the system is converted into a receiver, so that rapid two-way communication may be carried on. It will be noted that, if the switch is thrown to the "receive" position before the carrier signal from the transmitter with which communication is being held has been turned on, a conventional receiver would set up a very loud and objectionable noise, which is especially unpleasant if the operator is using headphones in connection with the receiver. However, if the system disclosed in my invention is used in connection with such a transmitter-receiver, the operator will never have to suffer the inconvenience of this noise, and conversation can be carried on with a minimum of effort.

One of my objects is therefore to provide means whereby the noise voltage in a superregenerative receiver may be used to limit the sensitivity of the receiver during the time in which no signal is received.

It is another object of my invention to provide a means whereby a d.-c. biasing or control voltage may be obtained from the noise or "hash" voltage present in a superregenerative receiver.

It is another object of my invention to provide a means of limiting the noise or "hash" voltage which is present in conventional superregenerative receivers.

It is another object of my invention to provide means for "interstation noise suppression" in a superregenerative receiver.

It is another object of my invention to provide means for more effective two-way communication between two or more transmitter-receivers by preventing a sudden surge of noise in any receiver should the switch be placed in the "receive" position at a time when no signal is being received.

My invention will be better understood from the following description when considered in connection with the accompanying drawing. Its scope is indicated by the appended claims.

Referring to the drawing,

Figure 1 is a circuit diagram of an embodiment of my invention wherein the noise reducing device is applied to a superregenerative receiver; and

Figure 2 is a circuit diagram of another embodiment of my invention wherein the noise reducing device is applied to a system which may be used either for reception or transmission.

Referring especially to Fig. 1, an antenna 1, which may be of any well-known form, is coupled through a capacitor 3 to a tap on an inductor 5. The inductor 5, together with the variable capacitor 7 which is shunted across it, forms the resonant circuit of the familiar "ultra audion" oscillator. One end of the resonant circuit 5 and 7 is coupled through a grid capacitor 9 to the grid of a diode-triode type vacuum tube 11; the other end of the resonant circuit is connected to the anode of tube 11. This anode is connected through a radio frequency choke coil 13 to one terminal of the primary of an audio frequency transformer 15; the other terminal of the primary is connected to a suitable source of d.-c. potential, which may be derived from a conventional rectifier and filter source or may be derived from a battery 31, as shown in the diagram.

The cathode of tube 11, as well as one of the heater terminals, is grounded. The other terminal of the heater, as well as the heater of the

audio amplifier tube 23 later to be described, is connected through the switch 51 to a suitable battery 45. The said heaters may be energized by a suitable a.-c. source in a manner well known to those skilled in the art. The anode battery 31 is by-passed by a capacitor 41. The grid of tube 11 is connected to ground through two resistors in series; the first, 17, is a grid leak resistor; the second, 19, is a diode load resistor. The midpoint of the resistors 17 and 19 is connected to the low potential terminal of the secondary winding of the audio frequency transformer 15. The diode load resistor 19 is shunted by an audio frequency bypass condenser 21. The remaining terminal of the secondary winding of transformer 15 is connected to the two diode electrodes in tube 11, and to the grid electrode of the audio frequency amplifier tube 23.

The amplifier tube 23 preferably includes a self-biasing resistor 25, bypassed by a capacitor 27, connected in the cathode circuit in the conventional manner. While headphone receivers 29 are shown in the output circuit of the amplifier tube, it is, of course, understood that the headphones may be replaced by a loudspeaker, or an audio frequency amplifier. The screen grid electrode of the amplifier tube 23 and the low potential side of the headphones 29 are connected to the positive high potential terminal of battery 31.

The operation of the circuit is understood to be as follows:

The cathode, grid and plate electrodes of the vacuum tube 11, together with the resonant circuit 5 and 7, grid capacitor 9, and grid leak 17, constitute an oscillator circuit which will generate oscillatory currents at a frequency determined by the resonant frequency of inductor 5 and capacitor 7. While I prefer this particular oscillatory circuit, my invention is not limited to it, as any other equivalent circuit may be employed. When the grid capacitor 9 and the grid leak resistor 17 are properly chosen, the tube does not generate steady oscillatory currents, but the oscillatory currents are interrupted at a frequency which is determined by the time constant of the grid capacitor 9 and the grid leak 17. By way of example, the capacitor 9 may have a capacity of 50 micromicrofarads and the resistor 17 a resistance of 0.1 megohm. These values provide an interruption frequency which is superaudible; i. e., of the order of ten to twenty thousand cycles per second.

The interruption of oscillatory currents at the so-called "interruption" or "quench" frequency causes superregenerative action to take place in the tube 11. When a signal from the antenna is impressed on the grid of tube 11, demodulation is effected and an audio frequency component appears across the primary of transformer 15. The radio frequency choke 13 is an inductor which presents a very high impedance to radio frequency currents, but which will readily pass audio frequency variations of the plate current, and thus serves to isolate the transformer 15 from the radio frequency circuits. This method of operation is well known to those skilled in the art.

My invention relates more particularly to features now to be discussed. Any voltage appearing across the secondary of transformer 15 is applied to the audio frequency amplifier tube 23, and to the diodes and the cathode of tube 11 through the diode load resistor 19 and capacitor 21. Thus the noise-representing voltage, which appears across the secondary of transformer 15, is rectified by the diode-cathode operation, and a d.-c. current flows through the diode load resistor 19 in such direction as to make the ungrounded terminal of said resistor 19 become negative with respect to ground. The audio frequency bypass condenser 21 shunted across resistor 19 provides a low impedance path for the noise voltage, so that the full voltage appearing on the secondary of transformer 15 is impressed across the diode-cathode rectifier elements of tube 11. Since the grid electrode of tube 11 is connected to the ungrounded terminal of resistor 19, the grid also becomes negative with respect to ground, thus effectively cutting down the noise voltage without materially reducing the sensitivity of the detector tube 11. When a signal carrier voltage appears across the resonant circuit 5 and 7 and is impressed on the grid of tube 11, the grid is made more negative and the noise is reduced or eliminated by operation of the signal, so that there is no noise voltage to be rectified by the diodes when a signal is received. A further feature of my invention is that during periods in which the noise voltage has been reduced by the incoming signal voltage, the audio modulation component which appears across the secondary of transformer 15 also appears across the diodes, and is rectified to provide a bias voltage which tends to hold the audio output at a constant level regardless of variations in modulation percentage in the incoming signal.

Referring now to Fig. 2, a second application of my invention is shown. When the "transmit-receive" switch 49 is in the "receive" position, the circuit and operation is seen to be identical with that just described for Fig. 1. However, when the switch 49 is in the "transmit" position, the circuit is changed to that of a conventional ultrahigh frequency transmitter. A microphone transformer 37 is added having one terminal of its primary connected through a microphone 39 and the switch 51 to a suitable source of d.-c. potential, and the other terminal grounded. For convenience, I have shown the battery 45 supplying the energy for the heaters of tubes 11 and 23 as well as for the microphone, but it will be realized that a separate microphone battery will be required if the heaters are energized from an a.-c. source. The grid electrode of tube 23 is connected through the secondary winding of transformer 37 to ground. The switch 49 also connects the plate of tube 23 to the junction of the primary winding of transformer 15 and the choke coil 13. A resistor 53 is inserted between the plate of tube 23 and the headphones, whereby the transmitted signals may be heard by the operator. Switch 49 also connects a resistor 33 between the grid of tube 11 and ground.

When the switch 49 is placed in the "transmit" position, the transmitter operates in the conventional manner. Resistor 33 changes the operating grid potential of the oscillator tube 11 to such a point that smooth continuous oscillation takes place. To accomplish this, resistor 33 preferably has a resistance of the order of 40,000 ohms. The microphone 39 is responsive to sound waves, and will impress an audio frequency voltage on the grid of the tube 23 through transformer 37. Since tubes 11 and 23 have as a common impedance in their plate circuits the primary of transformer 15, modulation of the radio frequency output of tube 11 takes place, as is well known. Since the grid of tube 11 is con-

nected to ground through resistor 33, it is obvious that the negative voltage appearing across resistor 19 has no effect during periods of transmission, but immediately upon placing the switch 49 in the "receive" position, the noise will be reduced as shown above.

I claim as my invention:

1. A superregenerative radio receiving system comprising means for receiving currents of carrier frequency, means for generating currents of quenching frequency, means for applying said currents of quenching frequency to said first-named means, means for rectifying transient currents representing noise established by said quenching frequency currents, means for obtaining a biasing voltage from said rectified currents, and means for applying said biasing voltage to said first-named means.

2. In a radio receiver of the superregenerative type, means for receiving signals of carrier frequency, means for demodulating said signals of carrier frequency, means for obtaining currents of quenching frequency, said quenching frequency being lower than said carrier frequency, means for applying said quenching currents to said demodulating means, means for rectifying transient currents representing noise created by said quenching currents, means for obtaining a biasing voltage from said rectified currents, and means for applying said biasing voltage to said demodulating means.

3. In a radio receiver of the superregenerative type, means for receiving signal currents of a desired carrier frequency, means for demodulating said signal currents including a thermionic vacuum tube oscillating at the frequency of said carrier frequency, means for interrupting said carrier frequency oscillations at a frequency substantially lower than said carrier frequency, means for rectifying transient currents representing noise created by said interruptions, means for obtaining a biasing voltage from said rectified currents, and means for applying said biasing voltage to said demodulating means.

4. In a superregenerative radio receiver, the method of controlling undesired noise-representing currents generated by the quenching operation, which includes resonating currents of carrier frequency, applying said resonated currents to local oscillatory currents having the same frequency as said carrier currents, interrupting said local oscillatory currents at quenching frequency, said quenching frequency being substantially lower than said carrier current frequency, demodulating said carrier currents, rectifying the noise-representing currents established by said interruption, and applying said rectified currents to reduce the intensity of said noise-representing currents.

5. In a superregenerative radio receiver, the method of controlling undesired noise-representing currents, generated by the quenching operation, which includes rectifying said noise-representing currents, and applying said rectified currents to reduce the intensity of said noise-representing currents.

DANIEL J. HILFERTY.