Oct. 23, 1945. G. G. YOUNG 2,387,632

HIGH FREQUENCY RECEIVER

Filed March 28, 1944

Fig. 1.

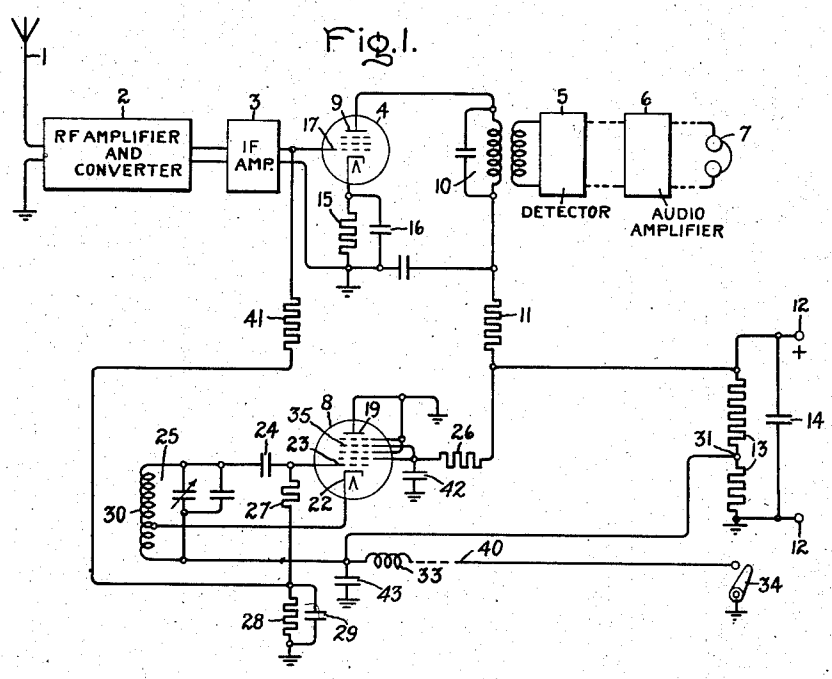
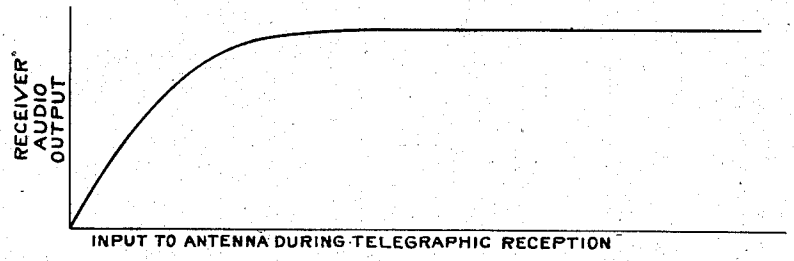


Fig. 2.



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HIGH-FREQUENCY RECEIVER

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5 Claims. (Cl. 250—8)

My invention relates to high frequency receivers and particularly to receivers adapted for telegraphic reception.

Frequently such receivers are adapted for either telegraphic continuous wave reception or telephonic reception. During telegraphic reception the received oscillations are combined with locally generated oscillations to produce a beat note which may be heard from a suitable reproducing device, such as headphones or loudspeaker. During such telegraphic reception the sensitivity of the receiver is likely to be greater than during telephonic reception with the result that the noise level, which may be tolerated during telephonic reception, may be intolerably high during the telegraphic reception.

An object of my invention is to provide improved means automatically to reduce the sensitivity of the receiver during telegraphic reception.

Another object of my invention is to provide improved means to couple the local oscillator with the circuits on which the received oscillations appear to produce the desired beat note.

Another object of my invention is to provide such improved coupling of such character that the intensity of the beat note never reduces in response to increase in the intensity of the received oscillations in any part of the range of intensities over which the received signal varies.

The novel features which I believe to be characteristic of my invention are set forth with particularity in the appended claims. My invention itself, however, both as to its organization and method of operation, together with further objects and advantages thereof, may best be understood by reference to the following description taken in connection with the accompanying drawing in which Fig. 1 represents an embodiment of my invention and Fig. 2 represents a characteristic of its operation.

Referring to Fig. 1 of the drawing, I have shown therein a radio receiver having an antenna 1, a radio frequency amplifier and converter 2, an intermediate frequency amplifier 3, a further intermediate frequency amplifier 4, a detector 5, an audio frequency amplifier 6, and a suitable signal reproducing device 7, such as headphones or a loudspeaker.

The apparatus 2 comprises the usual radio frequency portion of the receiver, which may be of superheterodyne type employing a radio frequency amplifier tunable over a band of frequencies in unison with a local oscillator which beats with the received oscillations to produce an intermediate frequency which is constant for all frequencies to be received. This intermediate frequency is amplified by the amplifiers 3 and 4 and supplied to the detector 5. During telephonic reception such oscillations are modulated with the voice and the voice waves are reproduced in the output of the detector, amplified by the audio amplifier 6, and reproduced by the signal device 7. During telegraphic reception the intermediate frequency wave is not so modulated and to render it audible it is combined with oscillations generated by a further local oscillator 8 in the amplifier 4 to produce at the output of the detector a beat note having a frequency of, for example, 1,000 cycles, which is reproduced by the signal device 7.

The amplifier 4 is conventionally shown as one having an anode 9 connected through a tuned circuit 10 and resistance 11 to the positive side of a source of operating potential, not shown but the terminals of which are indicated at 12. This source may be of any of the usual types and is commonly shunted by a bleeder circuit 13 and a smoothing condenser 14. This amplifier 9 also has a cathode which is connected to ground through the usual bias resistance 15 shunted by a bypass condenser 16. This amplifier also has a control electrode 17 and, if desired, additional electrodes interposed between this control electrode and the anode such as the ordinary screen and suppressor grids commonly employed in such devices.

The local oscillator 8 likewise comprises an anode 19, a cathode 22, and a number of grids interposed therebetween including a screen grid 35 which is connected in ground through a bypass condenser 42. The first grid 23, that is, the one adjacent the cathode, is connected through a grid condenser 24 to one terminal of a frequency determining oscillatory circuit 25. The second and fourth, or screen, grids are connected through a resistance 26 to the positive terminal 12 of the source of operating potential, and the remaining grids and the anode 19 are connected to ground.

The control electrode 23, in addition to the connection previously described, is connected through a resistance 27 and a further resistance 28 to ground, the latter resistance being shunted by a condenser 29. The cathode 22 is connected to an intermediate point on the inductance 30 of oscillating circuit 25, the lower terminal of which is connected to a point 31 on a bleeder circuit 13

across the terminals 12, which point is grounded for high frequency currents by bypass condenser 43. It is also connected through a choke coil 33 and a switch 34 to ground. This switch 34 may, if desired, be located at a remote point, as indicated by the dotted portions of the line 40 leading thereto.

During the operation of the receiver for telephonic reception the switch 34 is open and the electron discharge oscillator 8 is inoperative. The receiver is thus adapted for telephonic reception. The device 8 is rendered inoperative by the fact that its cathode 22 is connected to the point 31 on the bleeder circuit which is sufficiently positive with respect to ground and with respect to the potential of the control electrode 23 to interrupt the production of oscillations.

When it is desired to receive telegraphic signals switch 34 is closed. This lowers the potential of cathode 22 to ground potential and thus reduces the negative bias between cathode 22 and control electrode 23 and permits the device to oscillate, the electrode 23 acting as a control electrode and its next adjacent electrode 35 acting as an anode. These oscillations appear across circuit 25 and on resistance 28 and condenser 29 and during the positive peaks thereof produce grid current which also flows through resistances 27 and 28 producing thereon a negative bias potential by ordinary grid leak and condenser action. The portion of this unidirectional potential which appears on resistance 28 and the oscillations of the local oscillator frequency which appear thereon are supplied through resistance 41 to the control electrode 17 of the amplifier whereby these locally generated oscillations are combined with the intermediate frequency oscillations of the receiver to produce a beat note in the output of the detector which may be heard from the headphones 7. The tuned circuit 10, and, if desired, additional tuned circuits such as the input to the detector 5, prevents harmonic frequencies of the local oscillator 8 from being effective in the detector to produce undesired oscillations. The unidirectional potential on resistance 28 operates to increase the negative bias which is present between the cathode of the amplifier 4 and control electrode 17 by reason of the cathode bias resistance 15 and condenser 16 thereby reducing the amplification of this amplifier and hence the sensitivity of the receiver to reduce the noise level present in the signal device.

That is, commonly in such receivers the sensitivity of the receiver is greater during the reception of telegraphic signals than during the reception of telephonic signals with the result that the noise level may be excessive during telegraphic reception whereas it may not be excessive during telephonic reception. In accord with my invention, when the oscillator 8 is rendered operative by closing switch 34, bias voltage produced on resistance 28 drives the grid 17 additionally negative thereby reducing the amplification of this amplifier and hence reducing the sensitivity of the receiver and reducing the undesired noise level.

Condenser 29 is connected in shunt to resistance 28 and is a value such as to limit the oscillatory voltage at grid 17 to a desired value and independently of the unidirectional bias voltage supplied from resistance 28 to electrode 17.

In Fig. 2 I have represented the relation between the receiver audio output as heard from the loudspeaker 7 plotted as ordinates against input to the antenna during telegraphic reception plotted as abscissa. The curve illustrated in this Fig. 2 is observed to rise from zero in a substantially exponential fashion to a practically constant value at which it remains during any additional increase in the input signal intensity. This is highly desirable and results from the particular form of coupling described between the local oscillator and amplifier 4. It is highly undesirable, particularly in receivers carried by aircraft, for example, that there should be any negative slope in the curve illustrated in Fig. 2. This is because such negative slope would mean that the intensity of signal heard in the headphones decreases while the signal intensity in the antenna increases. Such effect might deceive the operator into believing that he is traveling away from the station from which he is receiving signals whereas in fact he is approaching it. I have found that with the coupling here described this undesired effect is avoided and that the desired characteristic illustrated in Fig. 2 is obtained. In addition, it is obtained by the very simple expedient employed in the coupling means described in connection with Fig. 1. The amount of local oscillator voltage supplied from resistance 28 to the input of amplifier 4 is very small yet very satisfactory. Telegraphic reception is had for signals varying over a very wide range of intensities, as from two volts at antenna down to a few microvolts. This results from the fact that this voltage is amplified by intermediate frequency amplifier 4 before it is applied to detector 5 to beat with the intermediate frequency oscillations.

It will also be noted that the conductor 40 of Fig. 1 leading to the switch 34 may be at comparatively low potential so that it may comprise one of the conductors of a multi-conductor cable leading to a remote point, as in an aircraft. It includes the choke coil 33 located at the receiver to prevent the transmission of oscillations produced by the oscillator 8 into the cable.

While I have illustrated a particular embodiment of my invention, it will of course be understood that I do not wish to be limited thereto since various modifications both in the circuit arrangement and in the instrumentalities employed be made, and I contemplate by the appended claims to cover any such modifications as fall within the true spirit and scope of my invention.

What I claim as new and desire to secure by Letters Patent of the United States, is:

1. The combination, in a high frequency receiver constructed and arranged for both modulated continuous wave reception and for telegraphic continuous wave reception and having sensitivity sufficiently great during said telegraphic reception to produce undesired noise response, of a local oscillator, means to beat the oscillations produced by said local oscillator with received oscillations to produce a beat note during reception of telegraphic pulses, means to render said oscillator alternatively operative and inoperative in accord with the type of reception desired, and means responsive to operation of said local oscillator to reduce the sensitivity of said receiver thereby to reduce said noise response.

2. The combination, in a high frequency receiver constructed and arranged for both modulated continuous wave reception and for telegraphic continuous wave reception and having sensitivity sufficiently great during said telegraphic reception to produce undesired noise re-

sponse, of a local oscillator comprising an electron discharge device having an anode, a cathode, a control electrode, an oscillatory circuit coupled regeneratively to said anode, cathode and control electrode, a grid leak and condenser connected between said control electrode and cathode, means to render said oscillator alternatively operative and inoperative in accord with the type of reception desired, means to beat the oscillations produced by said oscillator with received oscillations to produce a beat note during reception of telegraphic signals, and means responsive to voltage on said grid leak and condenser to reduce the sensitivity of said receiver during said telegraphic reception thereby to reduce said noise response.

3. The combination, in a high frequency receiver constructed and arranged for both modulated continuous wave reception and for telegraphic continuous wave reception and having sensitivity sufficiently great during said telegraphic reception to produce undesired noise response, of a local electron discharge oscillator having a control electrode in which current flows during operation, means to render said oscillator alternatively operative and inoperative in accord with the type of reception desired, means to beat the oscillations produced by said oscillator with received oscillations to produce a beat note during reception of telegraphic signals, and means responsive to current in said control electrode to reduce the sensitivity of said receiver during telegraphic reception to reduce said noise response.

4. The combination, in a high frequency receiver, of a radio frequency amplifier having a cathode, a control electrode, and an output circuit. a local electron discharge oscillator having a control electrode, a cathode, and an anode, circuits coupling said electrodes to produce oscillations of frequency different from the frequency of oscillations amplified by said amplifier by an audible amount, means to render said oscillator alternatively operative and inoperative, a parallel combination of resistance and capacitance connected between the control electrode and cathode of said oscillator to have voltage of the frequency produced by said oscillator and unidirectional voltage present thereon during operation of said oscillator, and means to supply both of said voltages between the control electrode and cathode of said amplifier to produce said beat note and to reduce the sensitivity of said receiver during operation of said local oscillator.

5. The combination, in a high frequency receiver, of a radio frequency amplifier having a cathode, a control electrode, and an output circuit, a local electron discharge oscillator having a control electrode, a cathode, and an anode, circuits coupling said electrodes to produce oscillations of frequency different from the frequency of oscillations amplified by said amplifier by an audible amount, means to render said oscillator alternatively operative and inoperative, and a parallel combination of resistance and capacitance having points spaced apart thereon connected to said control electrodes and to said cathodes respectively whereby unidirectional potential exists between said points during operation of said oscillator and also oscillations of the frequency of said oscillator, said unidirectional potential reducing the sensitivity of said receiver and said oscillations combining with received oscillations to produce said beat note in said output of said amplifier whereby reduction in intensity of said beat note with rise in intensity of received oscillations is avoided.

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