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HIGH FREQUENCY RECEIVER OF THE SUPERHETERODYNE TYPE

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Fig. 1

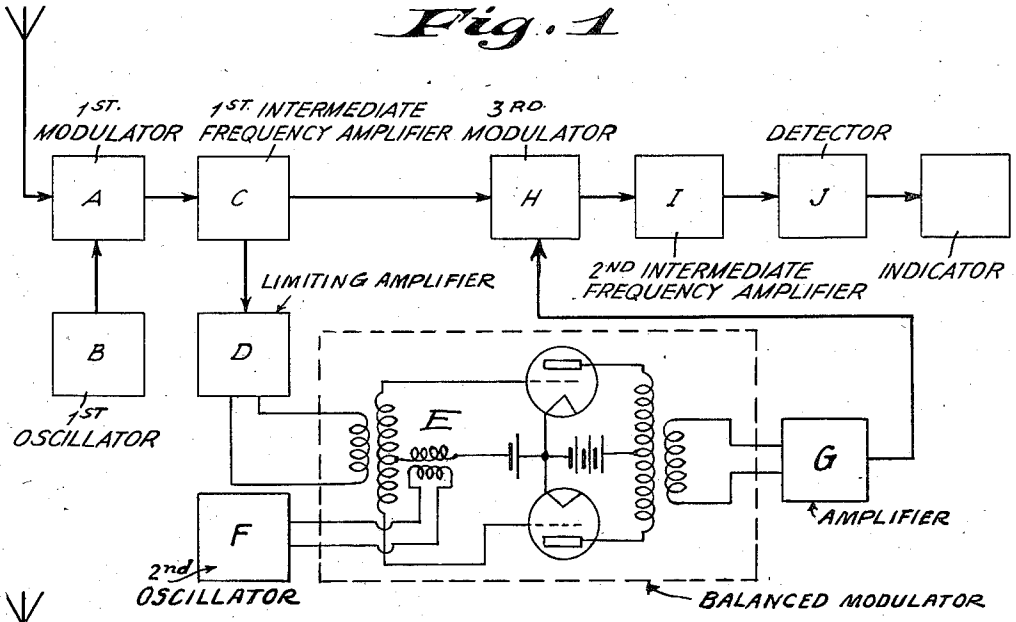
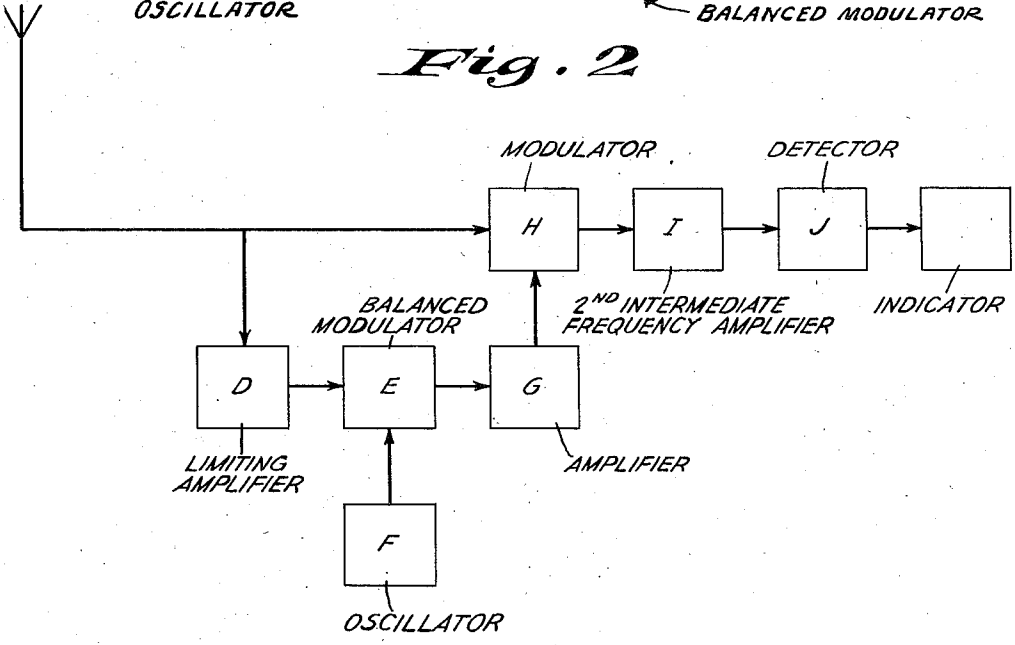


Fig. 2



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HIGH FREQUENCY RECEIVER OF THE SUPERHETERODYNE TYPE

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6 Claims. (Cl. 250—20)

This invention relates to the radio receiving art and deals more specifically with a superheterodyne receiver. The receiver briefly utilizes the principle of the common superheterodyne to obtain sensitivity and selectivity and then in addition generates a second intermediate frequency which is independent of the received signal frequency. This is accomplished by separating the first intermediate frequency from its sidebands by means of limiting, modulating this to obtain a frequency removed from the first intermediate frequency by a definite amount, and then modulating the first intermediate frequency with the frequency so produced. The second intermediate frequency is then constant, being the frequency of an oscillator in the receiver.

It has heretofore been the practice when using the superheterodyne principle for receiving a radio wave, to modulate the incoming wave with a local oscillator, and amplify and detect one of the resultant frequencies by means of an intermediate frequency amplifier and detector. With this method, the intermediate frequency, being the difference usually between the signal frequency and the local oscillator frequency, varies in cycles per second exactly the same amount as the signal frequency, assuming the local oscillator to be constant, as it usually is. With an ordinary low frequency signal such as is at present used for broadcast reception this variation is so small as not to cause any trouble in receiving, but when attempting to receive a high frequency signal it may cause considerable difficulty. In order to overcome this difficulty it has been the custom to employ a very broad intermediate amplifier, thus cutting down the amplification. This invention then is a method of obtaining an intermediate frequency dependent only on a local oscillator and being as constant as that oscillator can be made, allowing high amplification in few stages.

The novel features of my invention have been pointed out with particularity in the claims appended hereto. The nature of my invention and the manner in which the same is carried out will be better understood from the following detailed description thereof and therefrom when read in connection with the attached drawing in which Figures 1 and 2 illustrate diagrammatically receivers including the essential features of my invention.

Referring to the drawing a signal absorbing device is connected to a first modulator A. This first modulator includes any radio frequency amplifying devices desired and a first detector. The first detector in the modulator A is connected with a first oscillator B. The oscillator B impresses oscillations on the first detector in A to demodulate the carrier wave therein and produce in the output of A a demodulated wave comprising intermediate frequency energy including a carrier and side bands. The output of A is fed to an intermediate frequency amplifier C, which is in turn connected to a third modulator H and also to a frequency limiting amplifier D. The energy from D is supplied to a second modulator E, which is of a conventional balanced type, being supplied by oscillations from a second oscillator F. The term "balanced moduator" is used in this specification in reference to a combining network such as shown, for example in U. S. Patent No. 1,343,306, to Carson. Such networks are well known in the art and comprise generally a push-pull arrangement wherein high-frequency energy from one source is impressed contraphasally upon two balanced input circuits, while energy from another source, such as a local oscillator, is co-phasally impressed upon the same two input circuits, or else applied across an impedance common to and symmetrically disposed in the anode-cathode circuits. In the output circuit one of the frequencies, usually that of the local oscillator, is suppressed.

Energy from the output of the balanced second modulator E is supplied by way of an amplifier G to the third modulator H. Energy from the intermediate frequency amplifier C is also supplied to the third modulator H. The third modulator H includes a second detector in which the energy from C and G is combined for demodulation purposes. The second intermediate frequency is supplied from the output of H to a second intermediate frequency amplifier I and from I to a detector J. The energy from the detector J may be supplied to any utilization circuit.

The operation of the receiver is as follows:

Assuming a radio frequency signal with sidebands to be applied to the first modulator A by means of the pickup device, the first oscillator frequency being also applied to the first modulator will beat with it and produce two intermediate frequencies, each with sidebands corresponding to the sidebands of the received wave. One of these intermediate frequencies is fed to the first intermediate frequency amplifier C, in the usual method, the other frequencies being eliminated. This frequency with its sidebands is then amplified in this amplifier and fed to both the third modulator H and the limiting amplifier D. In the limiting amplifier D, the sidebands are eliminated and

the first intermediate frequency only, without sidebands, reaches the balanced second modulator E. The output of the second oscillator F is then also fed to the second modulator E, where it beats with the first intermediate frequency producing two sidebands, each removed from the first intermediate frequency by a frequency equal to that of the second oscillator.

The output of the second modulator E is now fed to the amplifier G, and thence to the third modulator H.

The third modulator H now has two frequencies feeding it, one, the first intermediate frequency with its sidebands, and the other a frequency separated from the intermediate frequency by a frequency equal to that of the second oscillator F. When these two frequencies combine in the third modulator they will generate another frequency, equal to the difference of their two frequencies, with sidebands, this new frequency then being the frequency of the local second oscillator F and thus a constant. This second intermediate frequency is then passed through a second intermediate frequency amplifier I to the detector J. Since this second intermediate frequency is constant the amplifier I may be sharply tuned. It is to be noted that although several operations have been performed, the signal itself has only passed through two modulators and an intermediate frequency amplifier before reaching the constant frequency stage of the second intermediate frequency amplifier.

It can be seen that the entire process of the first modulation and first intermediate frequency amplification may be eliminated, thus using a modulating frequency directly on the received wave, which modulating frequency would then differ from the received wave itself by a frequency equal to that of a local oscillator, there being now only one local oscillator and only one intermediate frequency. Such an arrangement is shown in Figure 2. Here as in the prior arrangement the frequency of the signal carrying wave impressed on I is the same as the frequency of the oscillator F and may be held nearly constant irrespective of shifts in the frequency of the signal carrier. Here, however, the signal carrier is filtered in D and stripped of all of its sidebands and then impressed on E the balanced modulator.

It may also be seen that the amplifier G may or may not contain a filter, this filter being used to supply only one sideband of the modulated intermediate frequency to the third modulator.

Having thus described my invention and the operation thereof, what I claim is:

1. In a receiver of the heterodyne type, means including signal absorbing means, and a first source of oscillations for deriving beat frequency signalling energy, a limiting amplifier connected to said absorbing means and tuned to the mean frequency of the absorbed signal, a balanced modulator connected with said limiting amplifier, a second source of oscillations to which said balanced modulator is also connected, a demodulator including a detector connected with said signal absorbing means, means connecting said demodulator with said balanced modulator, an intermediate frequency amplifier connected with said detector and indicating means connected with said intermediate frequency amplifier.

2. A receiver of the heterodyne type including a first local oscillator, a first heterodyne detector and a signal absorbing means, a limiting amplifier connected to said absorbing means and tuned to the mean frequency of the signal absorbed, a balanced modulator connected with said limiting amplifier, a second local oscillator connected to said balanced modulator, a demodulator including a second detector connected with said signal absorbing means, an amplifier connecting said demodulator with said balanced modulator, an intermediate frequency amplifier connected with said demodulator, demodulating means connected with said second intermediate frequency amplifier and an indicator connected with said demodulating means.

3. A receiver of the heterodyne type including signal absorbing means, a first local oscillator, a modulator connected with said absorbing means and local oscillator and an intermediate frequency amplifier connected with said modulator, a limiting amplifier connected to said modulator and tuned to the mean frequency of the energy in said intermediate frequency amplifier, a balanced modulator connected with said amplifier, a second local oscillator to which said balanced modulator is also connected, a second modulator connected with said first intermediate frequency amplifier, an amplifier connecting said second modulator with said balanced modulator, an intermediate frequency amplifier connected with said second modulator and demodulating means connected with said second intermediate frequency amplifier.

4. Means for adapting a superheterodyne receiver including signal receiving means, a local oscillator, a modulating means and an intermediate frequency amplifier, to the reception of ultra-high frequency waves and for maintaining a signal component characteristic of said waves within a narrow frequency band for amplification purposes comprising a filter tuned to the mean frequency of the energy in the output of said intermediate frequency amplifier, said filter being connected with said intermediate frequency amplifier, a balanced modulator having an input circuit connected to the output side of said filter, a local source of oscillations to which said balanced modulator is receptively connected, a second modulator connected to and fed by energy from said intermediate frequency amplifier and also from said balanced modulator, an intermediate frequency amplifier tuned to the frequency of said last named source of oscillations and connected with said second modulator and a utilization circuit connected with said last named intermediate frequency amplifier.

5. Means for adapting a superheterodyne receiver including signal receiving means, a local oscillator, a modulator and an intermediate frequency amplifier, to the reception of ultra-high frequency waves and for maintaining a signal component characteristic of said waves within a narrow frequency band for amplification purposes comprising an amplifying filter tuned to the mean frequency of the energy in the output of said intermediate frequency amplifier, said filter being connected with said intermediate frequency amplifier, a balanced modulator having an input circuit connected to the output side of said filter, a local source of local oscillations to which said balanced modulator is receptively connected, an amplifier connected to said balanced modulator, a second modulator connected to and fed by energy from said intermediate frequency amplifier and also from said balanced modulator, an intermediate frequency amplifier tuned to the frequency of said last named source of oscillations and connected with said second modulator, a demodulator connected with said last named intermedi-

ate frequency amplifier, and an indicator connected with said demodulator.

6. In a receiving system having two local sources of oscillations, the method of heterodyning incoming signalling energy with said sources and then demodulating the resultant energy, which comprises heterodyning said incoming signalling energy with a first one of said local sources to obtain an intermediate frequency, including a carrier wave and its side bands, amplifying the energy of said intermediate frequency, feeding a portion of said energy in the direction in which it is to be ultimately utilized, diverting another portion of said energy after filtering out the side bands thereof and then heterodyning the same with oscillations from a second one of said local sources, deriving from the last-mentioned heterodyning step energy of two side bands each removed from the first said intermediate frequency by a frequency equal to that of said second source of oscillations, combining the energy so derived with that portion of the energy which was directly fed in the direction of ultimate utilization to obtain by demodulation a substantially constant difference frequency equal to that of the second said source of oscillations, with side bands, amplifying, detecting and ultimately utilizing the energy so demodulated.

CLIFFORD B. TERRY.