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March 15, 1932. H. O. PETERSON 1,849,884

SIDE BAND SELECTOR RECEIVER

Filed Nov. 19, 1928

Fig. 1

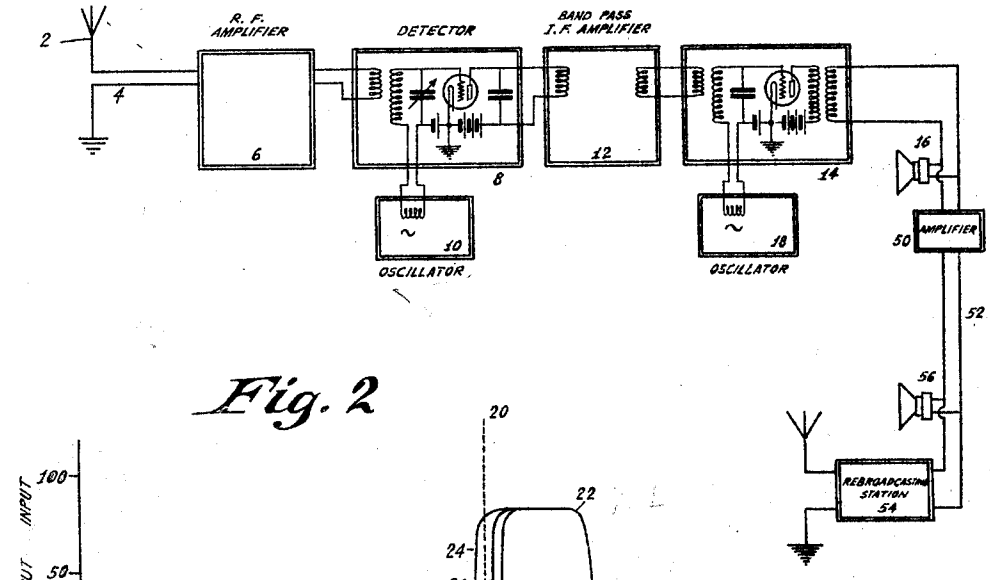
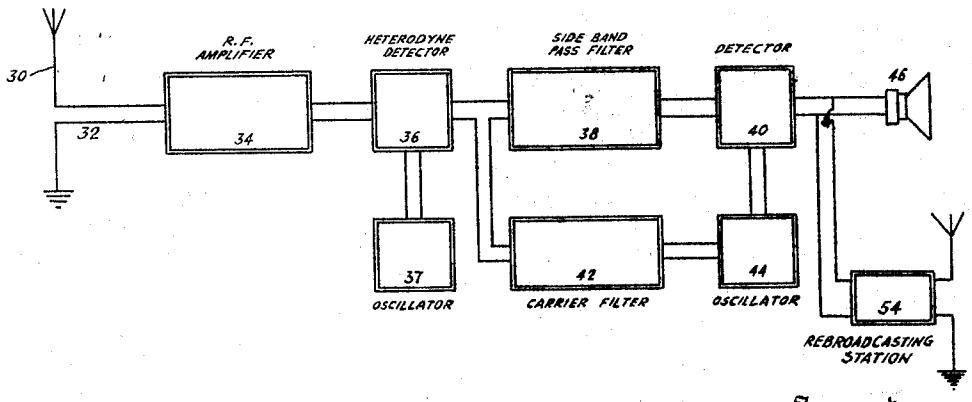


Fig. 2

Fig. 3



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UNITED STATES PATENT OFFICE

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SIDE BAND SELECTOR RECEIVER

Application filed November 19, 1928. Serial No. 320,490.

This invention relates to the reception of high frequency signals, and more particularly to speech or speech-simulating signals transmitted on a high frequency carrier.

The reception of speech or speech-simulating signals, when transmitted on a very high frequency carrier, has proven more difficult than the reception of simple code signals transmitted on a continuous wave high frequency carrier. This difficulty has been most strongly felt in attempting to obtain sufficiently good quality reception, at great distances, for rebroadcasting.

Modulation by a speech-simulating signal results in the radiation of carrier and side band energies, rather than energy of a single frequency, and these energies, although of only slightly different frequency, experience different degrees of fading, so that it is possible for the carrier to fade while the side bands do not, resulting in a beat between the side bands which is entirely different in frequency from the desired beat between either side band and the carrier, so causing distortion. Also, the energies of slightly different frequency are apt to considerably relatively fluctuate in phase, so that at times it is possible for the beat between one side band and the carrier to be opposed in phase relative to the beat between the other side band and the carrier, thereby destroying the signal. At an intermediate phase angle the signal will have only an intermediate volume.

To obviate these difficulties is the primary object of my invention, and to this end I arrange the receiver so that it rejects one of the side bands, and utilizes the other of the side bands for obtaining the signal. To reduce the effect of fading of the carrier, I may arrange the receiver to reject all of the carrier as well as one of the side bands, and to combine the other of the side bands with locally generated carrier energy. As a still further modification, if desired the receiver may be arranged so as to reject most but not all of the carrier, as well as one of the side bands, and to utilize the selected portion of the carrier to help control the frequency of the local oscillator which is resupplying the missing carrier.

It is exceedingly difficult to construct filters of sufficient discrimination to permit selection between side band and carrier frequencies which differ by only an audio frequency, when impressed on a high frequency carrier, and to overcome this difficulty I prefer to heterodyne the collected energy with locally generated energy to obtain energy of intermediate frequency, and then to filter the intermediate frequency energy, in which the percentage difference between the side band and carrier frequencies has been very materially increased. This refinement, however, is optional, and is designed merely for convenience.

My invention is described more in detail in the following specification which is accompanied by drawings in which Figure 1 is a schematic wiring diagram for one form of my invention; Figure 2 is explanatory of the filter action employed; and Figure 3 is a diagram for an alternative form of my invention in which the local oscillator is synchronized with the incoming energy.

Referring to Figure 1 there is an antenna 2, which is coupled by a transmission line 4 to a radio frequency amplifier 6. This is followed by a heterodyne detector 8, to which energy from a local oscillator 10, of relatively high frequency, is coupled, and the resulting beat energy of intermediate frequency is led to a band pass intermediate frequency amplifier 12. This may be arranged to reject one of the side bands and to pass the other of the side bands and the carrier energy, in which case the output from the amplifier 12 may be fed directly to a detector 14, and the resulting beat between the side band and carrier employed for translation in any suitable translating device 16, here exemplified by a monitoring speaker 16. The main output is preferably amplified in an amplifier 50 and fed over a land line 52 to a rebroadcasting station 54, the energy from the receiving station serving as the modulating input for modulating the radiated radio frequency energy. The rebroadcast station is likewise provided with a monitoring speaker 56.

As a further modification I prefer to ad-

just the band pass filter 12 so as to reject the carrier as well as one side band and to select only the other side band, and then to resupply the intermediate frequency carrier from a local oscillator 18, which is coupled to the detector 14. In this manner a considerable degree of fading may be removed, because the volume of energy from the local oscillator 18 is constant.

The action of the band pass filter 12 may be better understood by reference to Figure 2. The received radio frequency might be of any suitable value, say 20,000 kilocycles, and the local oscillator tuned to say 20,100 kilocycles, so as to differ from the received frequency by 100 kilocycles. This frequency is indicated in Figure 2 by the dotted line 20. The amplifier 12 is given a band pass characteristic resembling that indicated by the curve 22 so that only the desirable range of audio frequency is transmitted therethrough. If it is desired to cut off only one side band, and not the carrier, the filter characteristic should be like that indicated by the curve 24. The details of the filter are not described, for they are known in the art, and may be found in patents to G. A. Campbell, numbered 1,227,113, 1,227,114, and 1,493,600.

If it is desired to transfer a small percentage of the carrier through the filter, so as to help run the oscillator 18 in synchronism, the filter characteristic may be made like that indicated by curve 26.

For running the local oscillator synchronously a more elaborate arrangement may be used, as indicated in Figure 3, in which the antenna 30 is coupled by transmission line 32 to a radio frequency amplifier 34, which is led to a heterodyne detector 36, to which a high frequency local oscillator 37 also is coupled. The arrangement so far is exactly like that shown in Figure 1. The resulting intermediate frequency energy is fed to a band pass intermediate frequency amplifier 38, which is adjusted to pass only one side band, and the amplified side band is fed to a second detector 40.

A portion of the intermediate frequency amplifier output is taken to a filter or tuned cascade amplifier 42, which is coupled to the detector 36, and which is closely tuned to the intermediate carrier frequency itself, that is, it is arranged to symmetrically reject both side bands. The resulting carrier energy is fed to a local oscillator 44, which, when the received carrier is not fading, tends to follow the frequency of the energy supplied from the filter 42. However, should the received carrier fade, the oscillator still provides carrier energy at the normal carrier frequency. The local oscillator output is supplied to the detector 40, and the resulting beat is translated in any suitable translating device, here exemplified by the loud speaker 46. As in the arrangement shown in Figure 1 the energy may be broadcast in a rebroadcasting station 54.

No claim is made herein to a communication system in which only a side band is transmitted. Such a system includes means to suppress the carrier and a side band while the modulated energy is still feeble, and the remaining side band is amplified in a power amplifier having a linear amplification characteristic. In the present state of the art this arrangement, while successful with long wave energy, is inapplicable to short wave energy, because so far as I am aware no power amplifier for very short waves having a linear amplification characteristic has ever been constructed. When transmitting the carrier and both side bands the carrier is first amplified, and then modulated by the signal energy just before being radiated. No attempt to power amplify the modulated energy has been successful, and, of course, to power amplify a side band only is equally, if not still more difficult.

Furthermore, my arrangement is intended primarily, though not exclusively, for rebroadcasting from remotely located stations, so that in the region surrounding the original broadcast station the receivers may be of the ordinary detector type which respond to the beat between the side bands and the carrier. However, at a remotely located receiving station which is to collect energy for rebroadcasting over a cooperant transmitting station, the scheme here disclosed is employed, both because excellent quality is desired, and also because at the greater distance relative fading and phase fluctuation of the slightly different frequencies is greater and therefore more objectionable. Of course, the same advantages apply to any receiver which, even though not used for rebroadcasting, is, in contradistinction to nearby broadcast receivers, located remotely from the transmitting station.

I claim:

In a signalling system the combinations of an antenna for collecting radiated signal modulated energy; an amplifier for amplifying the collected energy; means for heterodyning the amplified energy; a filter for filtering a side band from the heterodyned energy; another filter for filtering the heterodyning carrier from the heterodyned energy; a local oscillator controlled by the filtered carrier; a detector for combining the filtered side band and energy generated by the local oscillator; and, means for electromagnetically propagating the output from the detector.

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