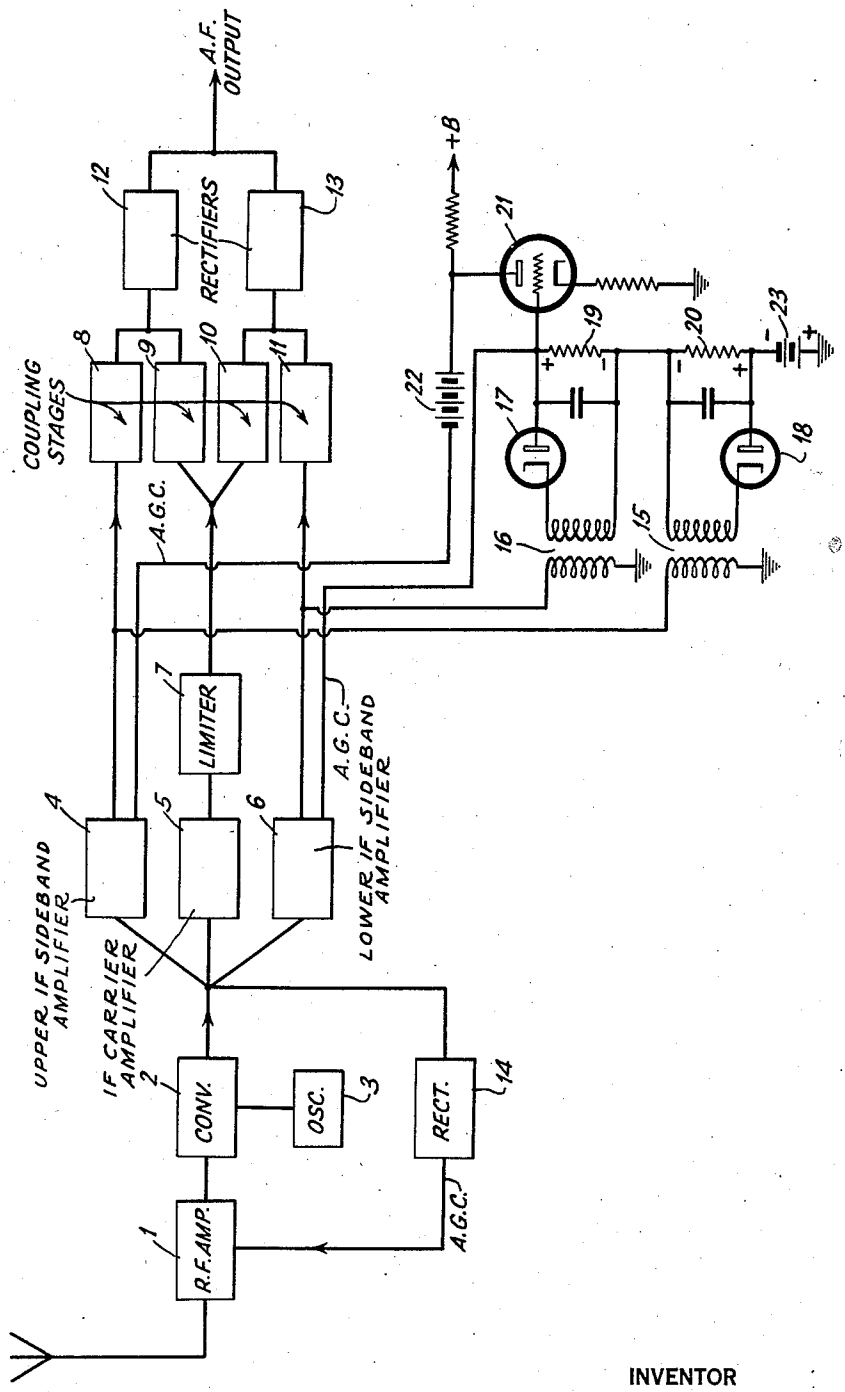
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RECEIVING SYSTEM

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RECEIVING SYSTEM

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The present invention relates to a receiving system in which an ordinary amplitude, frequency or phase modulated signal may be made to provide diversity effect. In the past, as far as I am aware, it has been necessary to use spaced antennas or antennas of different polarizations, directivities, etc., to obtain a diversity effect. Furthermore, these systems did not provide any means to reduce the distortion due to selective fading.

An object, therefore, of the present invention is to provide a diversity effect in a radio receiving system using only a single antenna.

Another object of the present invention is to reduce the effect of frequency selective fading.

Still another object is to provide a receiving system in which it is not necessary to used spaced antennas or antennas of different polarizations or directivities in order to obtain a diversity effect.

Still a further object of the present invention is to provide a radio receiving system which may also be used with spaced antennas or antennas of different polarizations and/or directivities to further increase the diversity effect and to further decrease the effects of frequency selective fading.

The foregoing objects and others, which may appear from the following detailed description, are obtained by utilizing a radio receiver operated from a single antenna and including a single channel high frequency amplifier, a mixer, a multi-channel intermediate frequency amplifier having one channel which is tuned to pass the carrier frequency only, another of which passes the upper side bands of the signal only and the other of which passes the lower side band only of the signal. The outputs of the two side band channels are separately combined with a portion of the output of the carrier channel and applied to separate rectifiers. The output of the rectifiers is combined to provide the audio frequency output of the system.

The present invention will be more fully understood by reference to the following detailed description which is accompanied by a drawing in which the figure illustrates in block diagram form an embodiment of the present invention.

The single figure of the drawing shows an antenna feeding a high frequency amplifier 1 which, in turn, feeds converter 2 where the signal is combined with the output of oscillator 3 to produce an intermediate frequency signal which is applied to the intermediate frequency channels 4, 5 and 6. A portion of the converter output or intermediate frequency is also applied to a rectifier 14 where it is rectified and the resultant direct current used in a conventional manner in radio frequency amplifier 1 to control the gain thereof. As a result, the intermediate frequency signal output from converter 2 is maintained at a substantially constant amplitude in spite of variations in signal input to the antenna.

Intermediate frequency channel 4 is tuned to pass only the upper set of side bands accompanying the converted radio frequency signal; channel 6 is tuned to pass only the lower set of side bands while channel 5 is arranged to pass only the converted carrier frequency. Each of channels 4, 5 and 6 may contain, in addition to the required filter networks for frequency separation, as many stages of amplification as may be deemed necessary.

The output of channel 5 carrying the converted carrier only passes through limiter 7 and is applied to coupling units 9 and 10. Channel 4 which carries the upper side bands has its output connected to a coupling unit 8 and channel 6 has its output connected to coupling unit 11. The output of coupling units 8 and 9 is combined in rectifier 12 to produce an audio signal representative of the modulations on the received signal. The output of coupling units 10 and 11 is combined in rectifier 13 to likewise produce an audio output. The audio output from rectifiers 12 and 13 is combined to produce a single audio frequency signal.

Now, in order to obtain a diversity effect, part of the output from intermediate frequency channel 4 is fed through transformer 15 and diode rectifier 18 to resistor 20. Also, part of the output from intermediate frequency channel 6 is fed through transformer 16 and diode rectifier 17 to resistor 19. These resistors are connected in series opposition and in series with bias battery 23. From the high potential side of resistor 19 automatic gain control is obtained for intermediate frequency channel 6 while automatic gain control for intermediate frequency channel 4 is obtained from the same point by passing through diode 21 and bucking battery 22 which reverses the control voltage polarity.

The diversity action of the present invention is obtained in the following manner. Part of the signal from channel 4 produces in resistor 19 a direct current potential of one polarity, as indicated, while part of the output from intermediate frequency channel 6 produces in resistor 20 a D. C. potential of opposing polarity, also as indicated.

Now, if the lower and upper sets of side bands are of equal strength these potentials will be

equal and opposite and, therefore, buck out leaving a biasing potential for the amplifiers in channels 4 and 6 equal to that with battery 23 alone. If, however, the upper set of side bands is stronger than the lower set, then the potential across resistor 20 will be greater than the potential across resistor 19 and the resultant biasing voltage in the high side of the resistor 19 will be greater than before. This increase in bias reduces the gain of the amplifiers incorporated in intermediate frequency channel 6 and, due to the polarity reversing tube 21, causes a decrease in bias on the amplifiers incorporated in intermediate frequency channel 4 resulting in a strong signal to coupling unit 8 and a weak signal to coupling unit 11. The diode output from the system under these conditions is then largely from rectifier 12. If the lower set of the side bands is stronger than the upper set then the potential across resistor 19 will be greater than the potential across resistor 20 and the resultant bias voltage at the high side of resistor 19 will be less than before, so the bias on intermediate frequency channel 6 will decrease while the bias on intermediate frequency channel 4 will, due to the interposition of polarity reversing tube 21 and battery 22, increase, resulting in a further increased signal from intermediate frequency channel 6 and a decreased signal from intermediate frequency channel 4. The audio signal output is then largely from rectifier 13.

In the embodiment of the invention shown there is incorporated a limiter 7 following the carrier intermediate frequency channel 5. This may not, in all cases, be essential as the rectifier 14 and its associated gain control circuit tends to hold the signal constant, but a limiter in this position tends to further maintain the amplitude of the carrier channel constant.

The separation of the received signal into separate channels and the re-combination into two channels each capable of supplying an audio frequency signal allows several things to be accomplished. First, it provides two signals neither of which is seriously bothered by a second harmonic distortion should the carrier fade to a value such that the modulation thereon is greater than that corresponding to 100% modulation. This is not true of a diode signal derived from the carrier and both upper and lower side bands combined. Second, it removes audio distortion due to some of the upper and lower side bands becoming out of phase with each other and neutralizing each other since the relative phase relationships of the side bands disappear after rectification. Third, from the output of a single receiver it provides two channels that when demodulated and applied to a single audio frequency output selects only the stronger audio components from the upper and lower side bands. Thus, the resultant audio signal might consist of a composite of 20% of the modulation band from the lower set of side bands and 80% from the upper set of side bands. Further, the 20% from the lower set of side bands might be divided up unevenly throughout the band as, for instance, 5% from the components nearest the carrier and 15% from the central portion of the side band envelope.

While I have particularly shown and described several embodiments of my invention, it is to be clearly understood that my invention is not limited thereto but that modifications may be made within the scope of the invention.

I claim:

1. A radio receiver including means for receiving modulated high frequency energy, selective means for separating said energy into a plurality of separate channels, one of said channels passing the carrier frequency and each of the other channels passing one group of the side band frequencies, means for separately combining the energy in each of said side band channels with a portion of the energy in said carrier channel, means for separately rectifying each of said combined energies and means for combining the output from each of said rectifying means, means for separately rectifying a portion of the energy in each of said side band channels, means for comparing said last mentioned rectified energies and means responsive to said comparison for discriminating against the energy in one of said channels.

2. A radio receiver including means for receiving modulated high frequency energy, selective means for separating said energy into a plurality of separate bands, separate amplifiers for each of said bands, one of said amplifiers for the carrier frequency and each of the other amplifiers for one group of the side band frequencies, means for separately combining the output of the amplifiers for each of said side band frequencies with a portion of the output of said carrier amplifier, means for separately rectifying each of said combined outputs and means for combining the output from each of said rectifying means, means for separately rectifying a portion of the energy in each of said side band amplifiers, means for comparing said last mentioned rectified energies and means responsive to said comparison for decreasing the gain in one of said side band amplifiers and increasing the gain in the other of said amplifiers.

3. A radio receiver including means for receiving modulated high frequency energy, selective means for separating said energy into a plurality of separate bands, separate amplifiers for each of said bands, one of said amplifiers for the carrier frequency and each of the other amplifiers for one group of the side band frequencies, means for separately combining the output of the amplifiers for each of said side band frequencies with a portion of the output of said carrier amplifier, means for separately rectifying each of said combined outputs and means for combining the output from each of said rectifying means, means for separately rectifying a portion of the energy in each of said side band amplifiers, means for comparing said last-mentioned rectified energies and means responsive to said comparison for decreasing the gain in the one of said side band amplifiers which supplies the smaller of said compared rectified energies.

4. A radio receiver including means for receiving modulated high frequency energy, selective means for separating said energy into a plurality of separate channels, one of said channels passing the carrier frequency and each of the other channels passing one group of the side band frequencies, means for separately combining the energy in each of said side band channels with a portion of the energy in said carrier channel, means for separately rectifying each of said combined energies and means for combining the output from each of said rectifying means, means for comparing the energies in each of said side band channels and means responsive to said comparison for decreasing the output of one of said side band channels which carries the lesser energy.

5. A radio receiver including means for receiving modulated high frequency energy, selective means for separating said energy into a plurality of separate channels, one of said channels passing the carrier frequency and each of the other channels containing one group of the side band frequencies, means for separately combining the energy in each of said side band channels with a portion of the energy in said carrier channel, means for separately rectifying each of said combined energies and means for combining the output from each of said rectifying means, means for comparing the energies in each of said side band channels and means responsive to said comparison for discriminating against the energy in the one of said channels which has the lesser energy therein, limiting means in said carrier channels for preventing the energy in said channel from exceeding a predetermined maximum.

6. A radio receiver including means for receiving modulated high frequency energy, means for amplifying said energy, means for converting said energy to an intermediate frequency, means responsive to the amplitude of said converted energy for controlling the gain of said high frequency amplifier, selective means for separating said converted energy into a plurality of separate channels, one of said channels passing the converted carrier frequency and each of the other channels passing one group of converted side band frequencies, amplifier means in each of said channels, means for separately rectifying a portion of the energy in the output of each of said amplifiers, means for comparing said rectified energies and means responsive to said comparison for decreasing the gain in the one of said amplifiers which passes the lesser energy and means for increasing the gain of the amplifier passing the greater energy, means for combining the output of each of said side band amplifiers with a portion of the output of said carrier amplifier, means for separately rectifying each of said separate combined outputs and means for combining the output from each of said rectifying means.

7. A radio receiver including means for receiving modulated high frequency energy, selective means for separating said energy into a plurality of separate channels, one of said channels passing the carrier frequency and each of the other channels passing one group of side band frequencies, amplifier means in each of said channels, means for separately rectifying a portion of the energy in the output of each of said amplifiers, means for comparing said rectified energies and means responsive to said comparison for decreasing the gain in the one of said amplifiers which passes the weaker energy and means for increasing the gain of the amplifier passing the stronger of said frequencies, means for combining the output of each of said side band amplifiers with a portion of the output of said carrier amplifier, means for separately rectifying each of said separate combined outputs and means for combining the output from each of said rectifying means.

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