

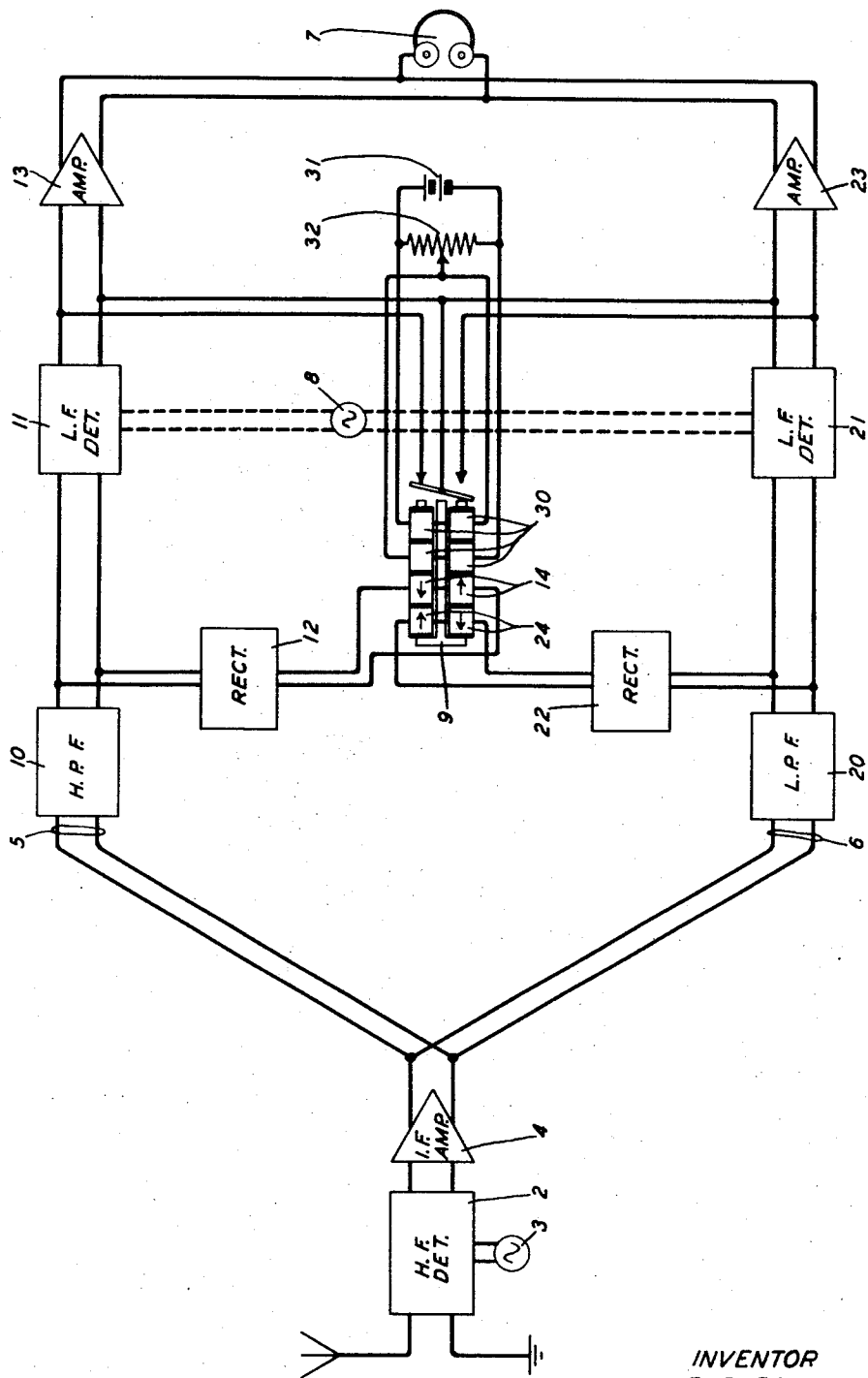
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RADIO RECEIVING SYSTEM

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RADIO RECEIVING SYSTEM

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5 Claims. (Cl. 250—20)

This invention relates to signaling systems and particularly to radio telephone receiving systems.

In radio signaling particularly at short waves considerable difficulty is sometimes encountered due to fading, that is, variations in the strength of the signals as received from the transmission medium. Disturbances due to this cause can often be avoided by the use of an automatic gain control in the receiver. However, when the fading is such that the strength of the received signal falls below the limiting noise level such a method becomes inadequate.

An object of this invention is to overcome such fading effects.

It has been observed that fading is a function of frequency and that often when its effects are so pronounced as to effectively obliterate one frequency or group of frequencies the transmission at an immediately adjacent frequency will be quite satisfactory. In fact it has been observed that the sidebands of a modulated wave often fade independently of each other.

In a specific preferred embodiment of the present invention the received radio wave is modulated by a wave from a local oscillator to produce an intermediate frequency wave which is supplied to two branch circuits, one of which is selective to the wave corresponding to one sideband of the received wave to the exclusion of the other sideband, and the other is selective to the frequency corresponding to the other sideband to the exclusion of the first sideband. The outputs of these two selecting circuits are separately detected so that they may be supplied to a signal frequency circuit. There is provided in addition a control path from each selecting circuit. Each of these control paths contains a rectifier, the output of which is connected to one winding of a differential relay, which is connected so that it will prevent the output of one or the other of the detectors from being supplied to the signal circuit. Thus, the signal circuit will at all times be responsive to only one of the received sidebands and if the fading conditions vary so that the sideband being received at any instant fades, the relay will operate to switch the signal circuit to the other sideband.

The invention may be more fully understood by reference to the following detailed description in connection with the drawing which shows diagrammatically one embodiment thereof.

The radio receiver shown on the drawing is of the double detection type. The received waves are supplied to the high frequency detector 2

in which they are combined with the waves from a beating oscillator 3 to produce intermediate frequency waves which are selected and amplified in the intermediate frequency amplifier 4.

The output of the amplifier 4 is branched into two separate circuits 5 and 6. Circuit 5 contains a high-pass filter 10 designed to select the upper sideband of the intermediate frequency waves, while the circuit 6 contains a low-pass filter 11 designed to select the lower sideband.

In the circuit 5 the output of the filter 10 is branched into two circuits, one containing a low frequency detector 11 and the other a rectifier 12.

The circuit 6 is similarly branched at the output of filter 20 to a low frequency detector 21 and a rectifier 22.

In each case the low frequency detectors operate to combine the carrier and the respective sidebands to produce the signal wave which is amplified by the audio frequency amplifiers 13 and 23, respectively. The outputs of these amplifiers are connected together to the telephone receiver 7.

The rectifiers 12 and 22 may be of any of the well known types for amplifying and rectifying the alternating current waves to produce a direct current of instantaneous amplitude determined by the amplitude of the respective sidebands supplied thereto. One type of circuit which has been found to be particularly satisfactory for this purpose is that disclosed in my copending application Serial No. 563,265 filed September 17, 1931.

The output of the rectifier 12 is connected to one of the sets of differential windings 14 of the polarized relay 9 while the output of the rectifier 22 is connected to the other set of differential windings 24 of the same relay. The armature and contact of the relay 9 are connected to the output of the detectors 11 and 21 so that when the relay is in one position, that is, when operated by the winding 14 the output of the detector 21 will be short-circuited and when in the other position, that is, operated by the rectifier by the windings 24 the output of the detector 11 will be short-circuited. Thus the circuit will operate so that the telephone receiver 7 will at all times be responsive only to the signals derived from one sideband, the dominating sideband operating to short-circuit the branch transmitting the other sideband.

In order to prevent instability at periods in which the energy level in the two sidebands is approximately the same or varying rapidly from a condition in which one slightly predominates

to a condition in which the other slightly predominates, the relay 9 is provided with biasing windings 30 connected to a battery 31 and potentiometer 32. By properly adjusting the potentiometer 32 the relay 9 may be adjusted so that the relay is maintained in such position as to short-circuit the circuit 5, for example, under all conditions except when the lower sideband transmitted to the circuit 6 dominates the upper sideband by a predetermined amount determined by the bias of the relay.

The filters 10 and 20 are preferably designed to transmit both the respective sidebands and the carrier suppressing the respective other sideband. However, if desired only the sidebands may be transmitted in which case an oscillator 8 is used to supply the carrier to the low frequency detectors 11 and 21. Such an oscillator may also be used in cases in which no carrier is transmitted from the radio transmitter.

In cases where selective fading is such that there is a marked difference in fading between the frequencies of a single sideband it may be desirable to divide each sideband into sub-bands. U. S. Patent 1,747,221 to Bown, February 18, 1930, discloses a system in which the output of each of a plurality of receivers is split into sub-bands and selection made between respective sub-bands. Each of the two sidebands may be divided in a similar way and the system of the present invention used for selecting between the respective sub-bands of the two sidebands.

Such sub-band selecting systems can be very economically used where a secrecy system of the sub-divided speech band type is employed.

What is claimed is:

1. In a radio receiver for receiving the two sideband components resulting from the modulation of a single carrier wave by a signal wave and subjected to varying transmission conditions, means for separately receiving the transmitted sidebands, a signal circuit alternatively responsive to the output of the respective sideband receiving means, and means for automatically rendering said signal circuit responsive to the output of one sideband receiving means to the exclusion of the other to select that sideband which gives an output exceeding a pre-assigned minimum.

2. In a radio receiver for receiving the two sideband components resulting from the modulation of a single carrier wave by a signal wave and subjected to varying transmission conditions, means for separately receiving the transmitted sidebands, a signal circuit alternatively responsive to the output of the respective side-

band receiving means, means for automatically rendering said signal circuit responsive to the output of that one of said sideband receiving means the output of which exceeds that of the other by a preassigned margin, and means for automatically causing the reselection of the output of the sideband receiving means when the energy level of the previously selected sideband falls below the preassigned margin.

3. In a system for receiving waves representing a single carrier wave modulated by a signal wave, means for separating the sidebands of the received wave, means for demodulating each sideband, and means for automatically selecting that demodulated sideband having an energy level exceeding that of the other by a predetermined margin.

4. In a system for receiving a signal modulated carrier wave comprising two sidebands representing the modulation of a single carrier wave by signal wave and subjected to varying transmission conditions, a source of waves, means for combining waves from said source with the received waves to produce two intermediate frequency sidebands one corresponding to each of the received sidebands, means for separating said intermediate frequency sidebands from each other, means for detecting the separated sidebands to produce the signal wave from each and means responsive to the relative energy levels of said sidebands for automatically selecting the signal output of that one which at any instant has an energy level exceeding that of the other by a pre-assigned margin.

5. In a radio system subject to fading, a radio receiver, means for selecting a frequency band representing the sum of the transmitted carrier and the signal waves, other means for selecting a frequency band representing the difference between the transmitted carrier and signal waves, means for detecting each of said frequency bands to produce the signal, a signal circuit, a transmission path connecting the output of each of the detecting means to said signal circuit, a relay having two windings for operation in opposite directions, means responsive to the operation of said relay in one direction for rendering inoperative one of said transmission paths and responsive to the operation in the opposite direction for rendering inoperative the other of said transmission paths, and a rectifier having an input connected to each of the selecting means and an output connected to each of said windings of said relay.

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