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FADING ELIMINATION

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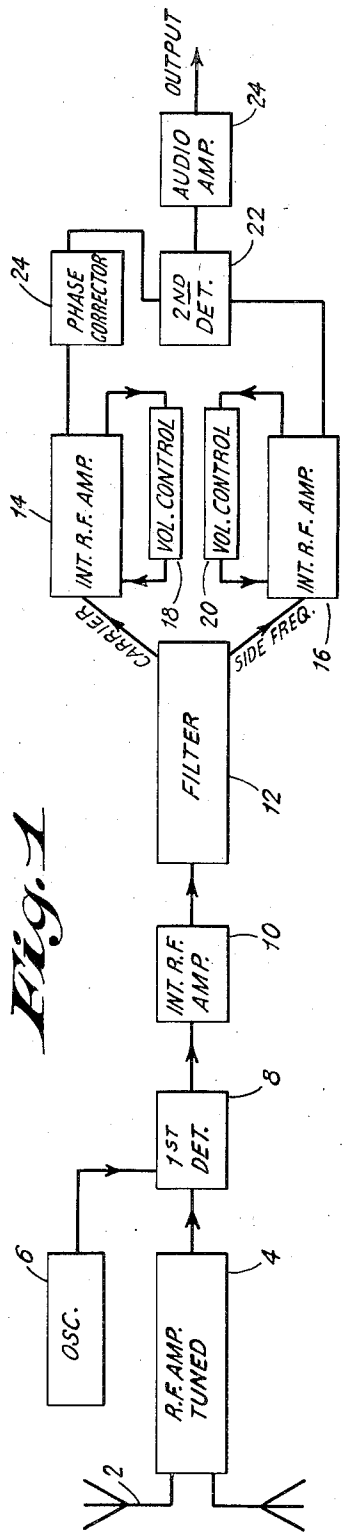

Fig. 1

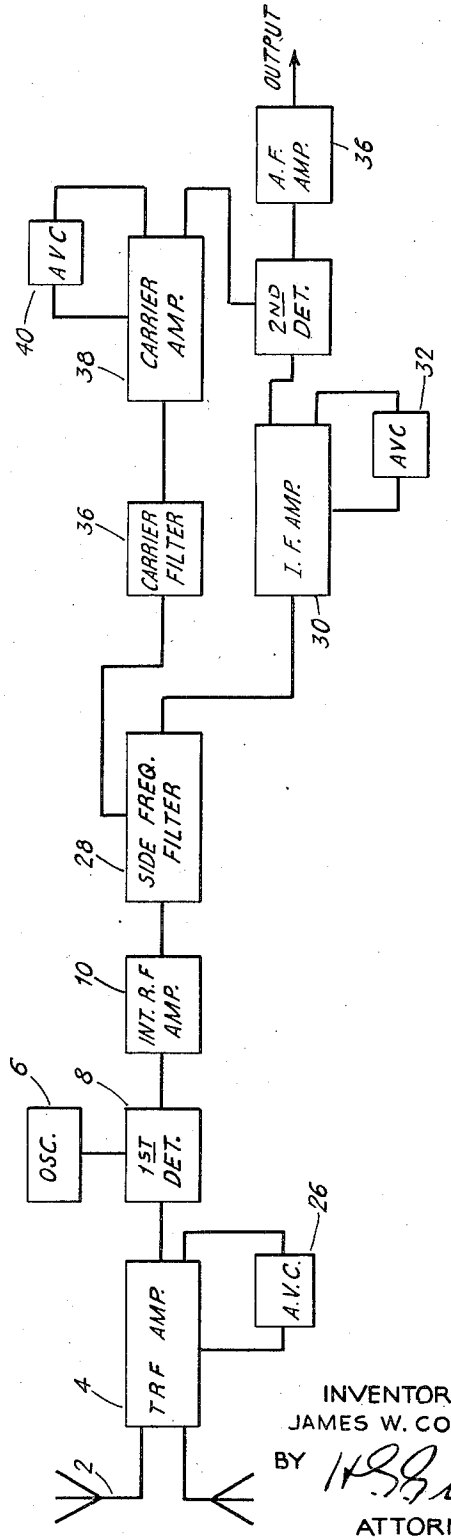

Fig. 2

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FADING ELIMINATION

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2 Claims. (Cl. 250—20)

My present invention relates in particular to a system for minimizing the effects of selective frequency fading on an amplitude modulated signal.

In systems for the reception of radio signals such as amplitude modulated signals used for broadcasting, telephony, multiplex-telegraphy, etc., the effects of fading, i. e. variation in signal intensity from transmission phenomena, have been materially reduced by so-called automatic volume controls.

Such automatic volume controls usually operate by utilizing the strength of the rectified radio frequency and in some cases audio frequency, signal to control the sensitivity of the system in such a manner, that as soon as the signal level begins to rise above a predetermined value the sensitivity of the system is reduced, limiting the rise.

Such systems are effective when the fading is uniform over the band being received. It often happens that some frequencies even within a small band will vary out of proportion to the others. In the case of an amplitude modulated signal, the proper reproduction of the modulating audio frequency signal will depend on the proper recombination of carrier and sidebands in the detection or demodulation process. It is therefore essential for perfect reproduction that all frequencies in the signal spectrum be present in their proper relative magnitude.

Since the desirable audio frequencies are produced by the beating of the carrier and side frequencies, if it should so happen that the carrier frequency fades disproportionately greater and the general received signal be brought up by automatic volume control, the undesired beats of the other frequencies present will be greatly magnified out of proportion and a very distorted signal will result.

An object of my present invention is to overcome this which, briefly, I do by separating and amplifying the carrier and side frequencies individually, controlling their volumes or level individually by automatic volume controls and recombining them in the detector. With this method the relative strength of the carrier and side frequencies is maintained at a fixed value and the effects of selective frequency fading will be materially reduced.

It will be noted that the percentage modulation, is readily controllable by varying either volume control independently of the other. This constitutes a great advantage in that the greater the relative strength of the carrier, the more nearly perfect will be the quality of the detector output, inasmuch as the desired beat between carrier and sideband will be increased in ratio over the undesired beats between side frequencies.

As my receiving system involves the use of very sharp filters and as adjustable filters are difficult to construct and operate, a superheterodyne type of receiver is, preferably, employed.

My present invention is described in greater detail with the aid of the accompanying drawing, wherein,

Figure 1 is a block diagram of a receiver embodying the principles of my present invention; and,

Figure 2 is similar to Figure 1 and illustrates a modification of my present invention.

Turning to Figure 1, modulated carrier energy collected by antenna 2 is fed to a tuned radio frequency amplifier 4. The output of the tuned radio frequency amplifier 4 is heterodyned with waves from a local oscillation generator 6 in a first detector 8. Intermediate frequency energy is fed from the first detector 8 to a tuned intermediate frequency amplifier 10 whose output is fed into a filter system 12. Intermediate frequency carrier energy fed into the filter 12 is separated out and fed, as indicated, into the intermediate carrier amplifier 14. If desired, amplifier 14 may be made to have a narrow pass-band so as to further selectively amplify the separated carrier energy. Amplifier 16, on the other hand, is fed with side frequency energy or sideband energy and should, of course, be of a wider band pass type. Amplifier 14 is provided with an independent volume controlling unit or system 18 and similarly volume control unit 20 operates upon the output of the amplifier 16. Preferably, the output of amplifier 14 produces a relatively large output so that the carrier strength fed to the second detector 22 is always higher than the sideband strength or amplitude fed from the intermediate radio frequency amplifier 16.

A phase corrector unit 24 is provided for correcting the relative phase of carrier or side frequencies when the intermediate frequency amplifier 16 is of such a pass width as to pass both sidebands. Preferably, by making amplifier 16 pass only one sideband of the intermediate frequency energy, the phase corrector 24, which corrects for phase shifts in the circuits and incidentally for phase fading, may be omitted. The output of the second detector 22 is fed into an audio frequency amplifier 24 and the output of the latter amplifier is utilized in any desired

way, for example, feeding the same into a loudspeaker (not shown).

As might be gathered from what has gone on herebefore, the units indicated are all standard as a consequence of which the individual wiring diagrams are not given. The filter for the carrier is preferably of the piezo-electric crystal type. Also, as pointed out before, the filter 12 may be made to eliminate one sideband which would not only simplify the filter but improve the quality of the final output.

The foregoing system is particularly useful in conditions of bad fading of the carrier. If desired, where conditions are normal the carrier amplifier 14 and its associated circuits may be omitted as the carrier could then be handled along with the side frequencies in the intermediate frequency amplifier 16.

In the modification shown in Figure 2, the antenna 2 as before feeds modulated carrier energy to a tuned radio frequency amplifier 4, which, however, is provided with its own automatic volume controlling circuit 26. The volume controlled output of the tuned radio frequency amplifier 4 is then fed into a first detector 8 with local oscillations from a local oscillation generator 6. The intermediate frequency energies appearing in the output circuit of the first detector 8 are then fed into an intermediate frequency amplifier 10 whose output in turn is fed into a filter 28, preferably designed as to pass the intermediate frequency carrier and one sideband. The output of the filter is fed into an intermediate frequency amplifier 30 provided with an independent automatic volume controlling circuit 32. The volume controlled output of the intermediate frequency amplifier 30 is then fed into a second detector 34. The second detector 34 is also supplied with filtered volume controlled carrier energy derived from the filter 28 by means of an intermediate frequency carrier filter 36, preferably of the piezo-electric crystal type. The output of the carrier filter is fed into a highly selective carrier amplifier 38 provided with its own automatic volume controlling circuit 40. The output of the carrier frequency amplifier 38 is fed into the second detector 34, adjustments preferably being made such that the carrier energy being fed into the second detector 34 is maintained at a volume or intensity or amplitude greater than the maximum intensity volume or amplitude of energy supplied thereto from the intermediate frequency amplifier 30.

The output of the second detector 34 is then fed into an audio frequency amplifier 36 whose output may be utilized in telephone receivers, in a loudspeaker, a recording mechanism or in any other suitable way.

Having thus described my invention, what I claim is:

1. In a system for reducing fading effects, means for collecting transmitted modulated carrier energy, means for amplifying the collected energy, automatic control means for regulating the amplitude of the carrier, means for deriving from the amplified energy carrier energy, means for bringing the carrier energy to substantially constant volume despite variations in transmission conditions, means for filtering from the collected energies sideband energies, means for bringing the filtered sideband energies to constant volume despite variations in transmission conditions, means for combining the energies of constant volume, means for detecting the combined energies, and means for translating the detected energies.

2. A radio receiver for reducing fading effects comprising an antenna, a tuned radio frequency amplifier coupled to said antenna, means for volume controlling the output of said tuned radio frequency amplifier, means for heterodyning the volume controlled output of said tuned radio frequency amplifier, a filter coupled to the output of said heterodyning means for filtering therefrom intermediate frequency carrier energy, filtering means coupled to the output of said heterodyning means for filtering therefrom intermediate frequency sideband energy, means for separately volume controlling said filtered energies, means for combining and detecting the filtered volume controlled energies, and means for translating the detected energies.

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