SELECTIVE FADING CONTROL SYSTEM

George L. Beers, Haddonfield, N. J., assignor to Radio Corporation of America, a corporation of Delaware

Application April 25, 1939, Serial No. 269,854

11 Claims. (Cl. 250—20)

This invention relates to a selective fading control system for radio receiving apparatus and the like, and has for its object to provide an improved system of that character which is effective in eliminating the usual undesirable operating characteristics when receiving signals subject to selective fading.

By selective fading is meant that the carrier wave fades or loses intensity with respect to the carrier side bands, having the effect of greatly increasing the percentage modulation of the received signal or carrier wave.

The control potential in a conventional A. V. C. system is a function of the strength of the received carrier wave. When selective fading occurs, the sensitivity of the receiver is caused to increase because the carrier amplitude decreases with respect to the side bands. Thus, the reproduction obtained from a receiver equipped with conventional A. V. C. system not only contains disagreeable distortion, but the output is made louder than usual.

It is a further object to provide an improved selective fading control system so arranged and connected with signal amplifying circuits that the foregoing operating characteristics including a tendency to increase the signal volume output is minimized during a cycle of selective fading. It is also a further object of the present invention to provide a selective fading control system which accentuates the received carrier wave fading, and which operates effectively to minimize the effects of selective fading in modulated carrier wave signal reception.

In accordance with the invention, a plurality of A. V. C. systems are provided in a signal amplifier having a plurality of signal amplifying channels, and the control potentials derived from certain of the said A. V. C. systems as a function of the strength of the received carrier wave are applied to separate amplifying portions of the receiving system while the control potential derived from another of said A. V. C. systems as a function of the voltage modulation of the received signal or carrier wave is applied to other portions of the signal amplifying system when the percentage modulation exceeds the predetermined value.

The invention will, however, be better understood when considered in connection with the accompanying drawing and its scope will be pointed out in the appended claims.

In the drawing, Figure 1 is a block diagram with suitable legends and single line connections of a selective fading control system embodying the invention; and

Figure 2 is a schematic circuit diagram of the signal amplifying portion of a radio receiving system arranged in accordance with the diagram of Fig. 1 for a more complete understanding of the functioning and operation of said selective fading control system.

Referring to the drawing, a portion of the intermediate frequency amplifier of a superheterodyne receiver is indicated at 5 and comprises a pair of cascade-connected intermediate frequency amplifier tubes 6 and 7 connected with an input circuit 8 and with a first detector. The modulated signal output from the amplifier portion 5 is coupled to a suitable A. V. C. means 9 comprising a rectifier signal output circuit 11 for the application of the D. C. output potential to the tubes 6 and 7 in the input portion 5 of the intermediate frequency amplifier.

This A. V. C. means may be termed the intermediate frequency amplifier A. V. C. means or carrier A. V. C. means and the portion 5 may be termed the A. V. C. controlled intermediate frequency amplifier. The A. V. C. means 8 serves to maintain the signal output of the amplifier 5 at the terminal 12 substantially constant.

The signal output from the L. F. amplifier 5 is also supplied to the L. F. amplifier 13 which is the succeeding portion of the same intermediate frequency amplifier channel as that containing the intermediate frequency amplifier 5. The amplifier 13 of the present example also includes two cascade-connected intermediate frequency amplifier tubes 15 and 16, the tube 15 being cascade-connected to the tube 7 to receive the substantially constant signal output therefrom, and the tube 15 being coupled through a suitable intermediate frequency output transformer 17 with the second detector 18 of the receiving system which comprises two diode rectifier devices 19 and 20. As indicated in Fig. 2, and as shown in diagram 4 in Fig. 1, the receiving portion 18 includes an audio frequency amplifier in conjunction with the second detector which amplifier is coupled to an output device such as the loudspeaker indicated at 21 in Fig. 1.

The tuned intermediate frequency coupling transformer 22 between the voltage output terminal 12 of the amplifier 5 and the input circuit of the tube 15 is also utilized to couple the channel 5 to a branch channel 26 containing a detector 27. The coupling is effected from the secondary of the transformer 22 through a coupling or buffer amplifier tube 28 which in
The output of the amplifier channel 42 is normally arranged to be greater than that of the amplifier channel including the amplifier 13 whereby the effective percentage modulation of a received signal at the second detector is relatively low.

With the foregoing arrangement, the limitations of conventional A. V. C. systems with signals subject to selective fading are received are substantially overcome. In operation, if the received carrier wave fades, the channel 42 receives substantially no signal because of its selectivity, and the main I. F. amplifier channel 5—13 is increased in sensitivity in this portion A decrease of the loss of the carrier wave, but the A. V. C. means 33 receiving as it does the side bands, greatly amplified in the section 5 of the intermediate frequency amplifier and in the amplifying and detecting channel preceding it, serves to apply to the amplifier 43 a relatively high bias, thus reducing the signal applied to the second detector through the output transformer 13 and thereby eliminating the undesirable increase in sound output or increase in volume which ordinarily occurs during a cycle of selective fading. The gain of the side band output of the amplifier 43 or by means of the carrier accentuation amplifier 42 keeps the effective percentage modulation of the signal applied to the diodes 18 and 28 well below 100% and thereby prevents the disagreeable distortion normally encountered during periods of selective fading.

I claim as my invention:

1. In a radio receiving system for modulated carrier wave signals, the combination of a signal detector having an audio frequency output circuit, signal-amplifying means with said detector to apply incoming signals thereto and including a plurality of signal-amplifying portions, gain-control means for varying the gain of one portion of said signal-amplifying means in response to a change in the strength of a received carrier wave, and gain-control means for varying the gain of another portion of said signal-amplifying means in response to an increase in the percentage modulation of received signals above a predetermined value, of the order of one hundred percent.

2. In a radio receiving system for modulated carrier wave signals, the combination of signal-amplifying means including a plurality of signal-amplifying portions, a signal detector coupled to one of said signal-amplifying portions, means for varying the gain of one portion of said signal-amplifying means in response to a change in the strength of a received carrier wave, gain-control means for varying the gain of another portion of said signal-amplifying means in response to the percentage modulation of received signals, and a third portion of said signal-amplifying means for increasing the carrier wave amplitude with respect to the side band amplitude of received signals in said detector.

3. In a radio receiving system for modulated carrier wave signals, the combination of signal-amplifying means including a plurality of signal-amplifying portions, gain-control means for varying the gain of one portion of said signal-amplifying means in response to a change in the strength of a received carrier wave, gain-control means for varying the gain of another portion of said signal-amplifying means in response to an increase in the percentage modulation of received signals above a predetermined value.
said detector for reducing the effective percentage modulation of a received signal at said detector.

4. The method of minimizing the effects of selective fading in a radio receiver, which comprises causing the receiver gain to vary in response to a change in the amplitude of a received carrier wave, causing the receiver gain to vary in response to a predetermined change in the percentage modulation of received signals and, in addition, accentuating the carrier wave amplitude with respect to the side band amplitude.

5. The method of minimizing the effects of selective fading on the output of a radio receiver which comprises causing the receiver gain to increase in response to a decrease in the amplitude of a received carrier wave, causing the receiver gain to decrease in response to an increase in the percentage modulation of received signals and, in addition, accentuating the carrier wave amplitude with respect to the side band amplitude.

6. The method of minimizing the effects of selective fading in a radio receiver, which comprises deriving a control potential proportional to the amplitude of a received signal carrier wave, utilizing said potential for controlling the gain of one portion of the receiver, deriving an additional control potential the magnitude of which is determined by the percentage modulation of the received signal, utilizing said last-named control potential to control the gain of another portion of the receiver, and accentuating the carrier wave amplitude with respect to the side band amplitude.

7. The method of receiving modulated carrier wave signals, which comprises amplifying said signals, amplifying the carrier wave to a greater degree than the side bands, detecting the amplified signals and carrier wave, automatically regulating the amplification of said signals and the carrier wave in response to variations in the amplitude of said carrier wave, and automatically reducing the amplification of said signals in response to the percentage modulation of a received signal increasing above 100 per cent.

8. In a radio receiving system comprising a plurality of received carrier wave signals, the combination of a carrier wave amplifying channel, automatic volume control means for said channel responsive to variations in the amplitude of a received carrier wave, a second signal amplifying channel comprising two amplifying portions in series for passing the carrier wave and side bands, means for applying received signals to said amplifying channels, a detector connected with the output ends of said amplifying channels, automatic volume control means for one portion of said second signal amplifying channel means for reducing the gain of another portion of said second signal amplifying channel in response to the percentage modulation of a received signal increasing beyond a predetermined value.

9. In a radio receiving system for modulated carrier wave signals, the combination of a carrier wave amplifying channel, automatic volume control means for said channel responsive to variations in the amplitude of a received carrier wave, means in said channel for restricting the passage of signals therethrough to a received carrier wave without side bands, a second signal amplifying channel comprising two amplifying portions in series for passing the carrier wave and side bands, means for applying received signals to said amplifying channels, means for deriving therefrom the modulation component of a received signal comprising a detector connected with the output ends of said amplifying channels, automatic volume control means for one portion of said second signal amplifying channel, means for reducing the gain of another portion of said second signal amplifying channel in response to the percentage modulation of a received signal increasing beyond a predetermined value, whereby the signal output of said receiving system is caused to be reduced substantially to zero in response to a predetermined degree of selective fading.

10. In a superheterodyne radio receiver, a selective fading control system comprising in combination an intermediate frequency amplifier having a plurality of cascade-connected amplifier tubes, means for deriving a gain-controlling potential responsive to carrier wave amplitude variations from an intermediate point in said amplifier to control the gain of certain preceding amplifier tubes, means for deriving from said intermediate point a second gain-controlling potential for certain of the succeeding amplifying tubes responsive to variations in percentage modulation of received signals above a predetermined percentage modulation, a second detector coupled to the output of said intermediate frequency-amplifying channel, a second intermediate frequency-amplifying channel including means for selectively passing the carrier wave without side bands, said last-named amplifying channel being coupled to said second detector, whereby the effective percentage modulation of a received signal at the second detector is relatively low.

11. In a superheterodyne receiver, a system for the control of selective fading comprising in combination an intermediate frequency amplifier, a second intermediate frequency amplifier and a second detector connected in series in the signal channel of the receiver in the order named, a carrier wave accentuating and selecting intermediate frequency amplifier coupled to said second detector jointly to supply signals to said detector with the first-named intermediate frequency amplifiers, automatic volume control means for said first-named intermediate frequency amplifier and for said carrier wave intermediate frequency amplifier, amplifier gain-control circuit for said second intermediate frequency amplifier, a detector, audio frequency amplifier and audio frequency rectifier connected in the order named between the main signal channel at a point between said first and second intermediate frequency amplifiers and said gain-control circuit for causing the gain of said second intermediate frequency amplifier to be reduced in response to an increase in the percentage modulation of a received signal above a predetermined value, whereby the tendency of said receiving system to increase the signal volume output during a cycle of selective fading is minimized.

GEORGE L. BEERS.