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AUTOMATIC SELECTIVITY CONTROL

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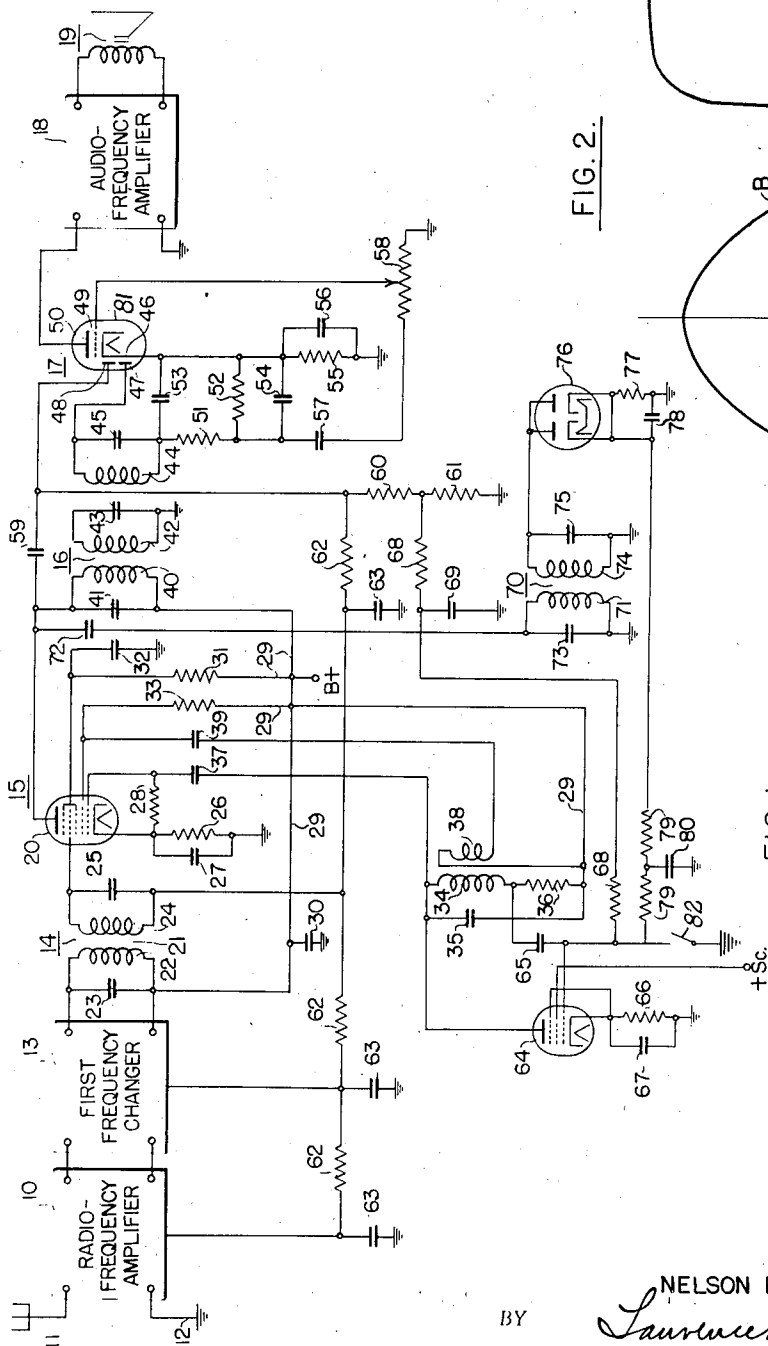
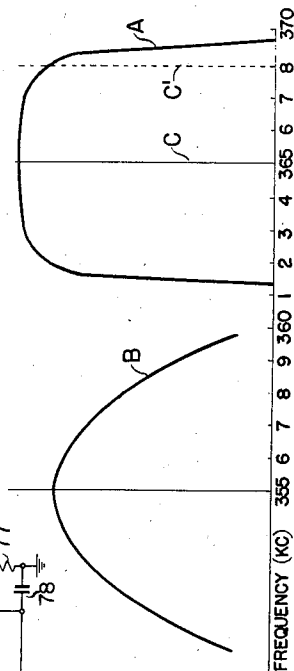


FIG. 1.

FIG. 2.



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AUTOMATIC SELECTIVITY CONTROL

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19 Claims. (Cl. 250—20)

This invention relates to signal-selecting systems for modulated-carrier signal receivers, and particularly to a method of, and means for, controlling the selectivity of such systems in accordance with received signal conditions.

Various types of systems have heretofore been devised, particularly for use in radio receivers, for passing a band of desired signal frequencies including the carrier and modulation frequencies thereof while greatly attenuating undesired signals on carrier frequencies adjacent the desired signal carrier, as well as static and other so-called background noises at the outer sideband frequencies of the desired signal, thereby to prevent the interference and consequent impairment of reception which would otherwise be occasioned by such undesired signals and noise. However, since such attenuation tends to impair the fidelity of reception of the desired signal by suppressing the outer sideband frequencies thereof, which correspond in radio broadcasting to the higher audio frequencies, it is highly desirable that the selectivity of a signal-translating system be automatically adjustable in accordance with the received signal conditions to procure a maximum fidelity of reproduction consistent with such conditions of reception.

Certain arrangements have heretofore been devised for the purpose of automatically controlling the selectivity of signaling systems in accordance with the condition of reception. Such arrangements, however, have usually been relatively complex, involving a large number of parts including auxiliary tubes and apparatus.

It is the primary object, therefore, of the present invention to provide a novel and improved method of, and means for, automatically controlling the selectivity of a modulated-carrier signal-selecting system to procure maximum fidelity of reproduction consistent with conditions of reception and which is simple and economical in construction and operation.

More particularly, it is an object of the present invention to provide for a modulated-carrier signal receiver a novel and simplified method of, and means for, automatically controlling the selectivity of the receiver to obtain the optimum fidelity of reproduction permitted by the relative intensities of the desired signal and received undesired signals on carriers adjacent the carrier of the desired signal and capable of causing appreciable interference.

For a better understanding of this invention together with other and further objects thereof, reference is had to the following description.

taken in connection with the accompanying drawing, and its scope will be pointed out in the appended claims.

In accordance with a preferred embodiment of the present invention there is provided, in a modulated-carrier signal receiver, a band-pass selector comprising a plurality of coupled tuned circuits for selecting a desired signal comprising a carrier and at least one modulation side-band and having a response characteristic substantially uniform over the selected band. The selector is designed to pass a band of frequencies preferably of approximately eight kilocycles in width with the main frequency of the selector equal to the normal carrier frequency of the desired signal. For received signals of relatively low amplitudes, the system is so adjusted that the signal has the normal carrier frequency and the system is, therefore, rendered highly selective; that is, the selector passes a relatively narrow band of frequencies including the desired signal carrier and equal portions of both of its sidebands. Means substantially unresponsive to the frequency of desired received signal carriers are provided for shifting the carrier frequency of the desired signal away from the mean frequency of the band passed by the selector, in accordance with the amplitude of the desired received signal carrier, to increase the width of one of the modulation sidebands passed by the selector; that is, to pass a greater portion of one of the sidebands of modulation frequencies, providing increased fidelity of reproduction. Preferably, means are also provided for shifting the desired signal-carrier frequency in an opposite direction in accordance with the amplitude of an undesired signal on a frequency adjacent to the desired signal carrier at the side thereof away from which the shift was effected by the desired signal, thereby to decrease the width of the modulation sideband passed by the selector and avoid interference from such undesired signal. However, the broad idea of controlling the selectivity in accordance with undesired interfering signals forms no part of the present invention but is described and claimed in a copending application of Harold A. Wheeler, Serial No. 46,081, filed October 22, 1935.

The invention, as described hereinafter, is embodied in a triple-detection superheterodyne receiver. In such an arrangement, a band-pass selector is coupled to the output circuit of the second frequency changer including a normally fixed frequency oscillator and designed to pass a relatively narrow band of frequencies having a mean resonant frequency equal to the normal carrier

frequency of the second intermediate-frequency signal. There is provided means responsive to the amplitude of the desired signal for adjusting the frequency of the oscillator to shift the second intermediate-carrier frequency away from the mean resonant frequency of the selector so that a greater portion of one of the signal sidebands will be passed by the selector and increased fidelity of reproduction will be obtained. There is also provided means most responsive to undesired signals on a carrier frequency adjacent the desired signal carrier and at the side thereof away from which the desired signal carrier is normally shifted by the control means described above. This means is effective to shift the oscillator frequency in a direction opposite to that effected by the first control means and back toward the mean resonant frequency of the selector. The selectivity of the system is thus decreased in response to the amplitude of the undesired signal and interference from such undesired signal is avoided.

In the accompanying drawing, Fig. 1 is a circuit diagram of a complete superheterodyne receiver, partly schematic, embodying the present invention; and Fig. 2 comprises a pair of graphs representing certain operating characteristics of the receiver to aid in the understanding of the invention.

Referring now more particularly to Fig. 1, there is shown schematically a superheterodyne receiver embodying the invention in a preferred form. In general, the receiver includes a tunable radio-frequency amplifier 10, having its input circuit connected to an antenna 11 and ground 12 and its output circuit connected to a first tunable frequency changer 13. The tuning elements of the amplifier 10 and frequency changer 13 (not shown) are preferably arranged for unicontrol in accordance with conventional practice so that the intermediate frequency developed by the frequency changer 13 is substantially constant. The output circuit of frequency changer 13 is connected to a first intermediate-frequency selector 14 which is broadly tuned to pass the first intermediate-frequency carrier and its sideband modulation frequencies. There is connected to the output circuit of the selector 14, in cascade, in the order named, a second frequency changer indicated generally at 15, a second intermediate-frequency band-pass selector 16, and a rectifier and audio-frequency amplifier 17. An additional audio-frequency amplifier 18 and a loud-speaker 19 are connected to the output circuit of the amplifier 17.

It will be understood that the radio-frequency amplifier 10, first frequency changer 13, audio-frequency amplifier 18, and loud-speaker 19 may be of conventional construction and operation, the details of which are well known in the art, rendering description thereof unnecessary herein.

Neglecting for the moment the particular operation of the frequency changer 15, selecting system 16, rectifier and amplifier 17 and the apparatus associated therewith, constituting the principal features of the present invention as described hereinafter, the system described above comprises the elements of a conventional triple-detection superheterodyne receiver. The operation of such a superheterodyne receiver being well understood in the art, a detailed explanation thereof is deemed unnecessary herein. In brief, however, signals intercepted by the antenna are selected and amplified in the tunable radio-frequency amplifier 10 and delivered to the tun-

able first frequency changer 13, wherein they are converted into a first intermediate-frequency signal, which is translated by the selector 14 to the second frequency changer 15. In the frequency changer 15 the signal is again converted to a second intermediate-frequency signal which, in turn, is translated by the selector 16 to the rectifier and amplifier 17, wherein the audio-frequency signals are derived and amplified and from which they are supplied to the audio-frequency amplifier 18 and loud-speaker 19 for further amplification and reproduction in the usual manner.

In accordance with the present invention, the selectivity of the system is controlled by means of the frequency changer 15, the selector 16 and control means associated therewith.

The selector 14 serves to couple the output current of the frequency changer 13 to the signal input grid of an oscillator-modulator tube 20 included in the frequency changer 15 and preferably comprises an intermediate-frequency transformer 21, including a primary winding 22 tuned to the first intermediate-carrier frequency by a condenser 23 and a secondary winding 24 tuned to the first intermediate-carrier frequency by a condenser 25.

The oscillation circuit of the frequency changer 15 comprises an inductance 34 tuned to the frequency lower than the first intermediate frequency required for deriving the normal second intermediate frequency by a condenser 35. The oscillation circuit is connected to the oscillator input circuit of the tube 20 by way of grid condenser 37, lead 29, condenser 30, and ground, as shown. A feed-back winding 38 is inductively coupled to the winding 34 and is connected to the third grid or oscillator anode of the tube 20 by way of blocking condenser 39.

A suitable biasing resistor 26 and a by-pass condenser 27 is included in the cathode circuit of the tube 20, the first grid of the tube being connected to the cathode by way of a grid leak 28 in conventional manner. Operating potentials for the tube 20 are supplied from a suitable source, indicated as +B, by way of the leads 29 which are grounded for signal currents by way of a condenser 30. A resistor 31 by-passed by a condenser 32 is included in the potential supply lead to the screen grid of the tube 20 and a resistor 33 is included in the potential supply lead to the second grid or oscillator anode thereof.

The selector 16 comprises three coupled resonant circuits including an input, an output and a tertiary circuit, each of which is tuned to the second intermediate-carrier frequency. The input circuit comprises a primary winding 40 connected in the output circuit of the tube 20 and tuned by a condenser 41. The tertiary circuit comprises a tertiary winding 42 tuned by a condenser 43 and the output circuit comprises a secondary winding 44 tuned by a condenser 45.

The selector 16, as thus described, comprises a band-pass selector for the second intermediate-frequency signal, and is designed so that its mean resonant frequency is equal to the normal second intermediate-carrier frequency.

The rectifier and amplifier 17 comprises a double-diode triode tube 81 having a cathode 46, diode anodes 47 and 48, a control grid 49, and output anode 50. This tube serves to detect the audio frequencies of modulation from the second intermediate-frequency signal, to amplify the

audio frequencies, and to derive a unidirectional control bias voltage.

In order to detect the audio frequencies, the diode anode 47 and cathode 46 are connected to the circuit 44, 45 of the selector 16 by way of a suitable load circuit including resistors 51 and 52, condenser 53 which by-passes both resistors, and condenser 54 which by-passes only resistor 52. A suitable biasing resistor 55 by-passed by condenser 56 is included in the cathode circuit of the tube 81. The audio frequencies of modulation are developed across the resistor 52 and applied, by way of a suitable coupling condenser 57 and voltage divider 58, to the control grid 49 of the tube 81. The cathode 46, control grid 49, and anode 50 comprise a conventional audio-frequency amplifier tube. The output circuit of this amplifier is connected, as mentioned above, to the amplifier 18. By suitably adjusting the voltage divider 58, the desired output volume level for the receiver may be obtained.

For the purpose of deriving unidirectional bias voltages for controlling the amplification as well as the selectivity of the system, the diode anode 48 of the tube 81 is coupled by means of a condenser 59 to the anode of the tube 20 and is provided with a suitable load circuit including resistors 60 and 61. Unidirectional voltages proportional to the amplitude of the second intermediate-frequency signal are developed across the resistors 60 and 61 in the well-known manner.

In order to control automatically the amplification of the receiver to maintain the output amplitude of the signal within a relatively narrow range for a wide range of received signal amplitudes, the unidirectional voltage developed across the resistors 60 and 61 is applied by way of suitable filters, including series resistors 62 and by-pass condensers 63, to the control grids of one or more of the tubes included in the radio-frequency amplifier 10 and the frequency changers 13 and 15, in accordance with conventional automatic amplification control practice.

The voltage developed across the resistor 61 is utilized to control the selectivity of the system in accordance with the amplitude of the desired signal. To this end, there is provided a resistor 36 included in the inductance arm of the oscillation circuit 34, 35. The impedance of this resistor is small at the normal oscillation frequency compared to the impedances of the reactance elements of the circuit, and has only a small effect on the oscillation circuit. A vacuum tube 64 is arranged with its input circuit connected across the resistor 36 by way of a suitable coupling condenser 65 and its output or anode circuit connected across the oscillation circuit 34, 35. Operating voltages are supplied to the tube from the source, indicated at +B, by way of the lead 29 and the resistor 36 and inductance 34 of the oscillation circuit, the cathode of the tube being grounded by way of a bias resistor 66 by-passed by a condenser 67 in conventional manner. The anode impedance of the tube 64 is preferably high as compared with the tuned circuit impedance at resonance so that the phase of the plate current is substantially unaffected thereby. While the tube 64 is preferably a pentode, because of the high plate impedance of such a tube, it will be understood that any suitable type of high impedance tube may be employed.

Since the input circuit of the tube 64 is connected across the resistor 36 in the inductance arm of the oscillation circuit, the oscillation-frequency voltage on the grid of the tube lags the

voltage across the oscillation circuit 34, 35 by approximately 90 degrees. Hence, the plate current of the tube 64 lags the voltage across the oscillation circuit substantially 90 degrees and the tube 64 simulates a low power factor inductance and may be used to vary the tuning of the oscillation circuit by adjusting the amplitude of its plate current, as by adjustment of the grid-bias potential applied to the tube.

In order, therefore, to control the frequency of the oscillation circuit in accordance with the amplitude of the received desired signal, the negative bias voltage developed across the resistor 61 in the load circuit of the diode rectifier 46, 48 is applied to the control grid of the tube 64 by way of a suitable filter including series resistors 68 and shunt condenser 69.

For the purposes of controlling the selectivity of the system in accordance with the amplitude of an undesired signal on a frequency adjacent and below the desired signal-carrier frequency, a selector 70 is connected to the output circuit of the frequency changer 15. The selector 70 comprises a primary winding 71, connected across the output circuit of the tube 20 by way of coupling condenser 72 and tuned to the normal second intermediate-carrier frequency of the undesired signal by a condenser 73, and a secondary winding 74 tuned to the same frequency by a condenser 75. The secondary winding 74 is connected across a diode rectifier 76 provided with a load circuit comprising a resistor 77 in its cathode circuit by-passed by a condenser 78. A positive unidirectional voltage will thus be developed across the resistor 77 which is proportional to the amplitude of the undesired signal to which the selector 70 is tuned. This positive voltage is applied to the control grid of the tube 64 by way of a filter including series resistors 79 and by-pass condenser 80. A switch 82 is connected between the grid of the tube 64 and ground, closure of this switch serving to render the automatic frequency control inoperative to permit the receiver to be initially tuned to exact resonance with a desired signal.

In considering the operation of the features of the above-described system embodying the present invention, it will be assumed that, for receiving a weak desired signal, the oscillation circuit 34, 35 is initially adjusted and the tube 64 is suitably biased to provide an oscillation frequency such that a second intermediate-frequency carrier of the selected signal will be developed by the frequency changer 15 having a normal value of, for example, 365 kilocycles. Where the word "normal" is employed herein and in the appended claims to define the operating conditions, it is intended to denote the condition of reception when either a very weak or no desired signal is being received. The selector 16, as previously explained, is adjusted to pass a relatively narrow band of frequencies, the mean frequency of which is equal to the predetermined or normal second intermediate-frequency carrier, so that the system is highly selective under this condition. These relationships are shown in Fig. 2, wherein the abscissae represent frequency and the ordinates represent amplitude. The normal second intermediate-frequency carrier of 365 kilocycles is indicated by the line C and the characteristic of the selector 16 is indicated by the curve A as passing approximately only three kilocycles of each of the signal sidebands.

When a relatively strong desired signal is re-

ceived, however, the amplitude of the desired second intermediate-frequency signal impressed upon the diode rectifier electrodes 46 and 48 of the tube 81 will increase. Under this condition, the negative control bias voltage, developed across the resistors 60 and 61 and applied to the control grids of the tubes in the amplifier 10 and frequency changers 13 and 15, increases to provide automatic amplification control in the conventional manner, as above explained. The negative bias voltage developed across the resistor 61 is also applied to the control grid of the tube 64 by way of the resistors 68 and serves to effect an increase in the apparent inductance in parallel with the oscillation circuit 34, 35. The resonant frequency of the oscillation circuit is shifted to a lower frequency and, consequently, the second intermediate-frequency carrier developed by the frequency changer 15 is shifted to a higher frequency, in accordance with the amplitude of the desired signal, so that the selector 16 passes a greater portion of the lower modulation sideband of the desired signal, thus providing increased fidelity of reception. The extreme frequency shift of the second intermediate-frequency carrier, upon reception of a strong desired signal, is indicated by the broken line C' of Fig. 2. Here the carrier has been shifted approximately three kilocycles and, while only the lower sideband of the desired signal is passed by the selector, modulation frequencies thereof, extending out as far as six kilocycles from the carrier, are included in the selected band, resulting in high fidelity reproduction.

It will be assumed, for the purposes of explanation, that the system is thus adjusted for the reception of a relatively strong desired signal. If, under these conditions, an undesired signal of appreciable intensity is received on an adjacent carrier 10 kilocycles below the desired signal carrier, to which the selector 70 is most responsive, an increased positive bias voltage will be developed across the load resistor 77 of the rectifier 76. This voltage is applied to the control grid of the tube 64 through resistors 79, thereby tending to counteract the effect of the negative bias voltage developed by the desired signal and serving to decrease the apparent inductance in parallel with the oscillation circuit so as to effect a shift in the second intermediate frequency to a lower frequency; that is, in a direction opposite to that effected by the desired signal. Hence, the portion of the lower modulation sideband of the desired signal passed by the selector 16 is decreased and the undesired signal is shifted in a direction away from the band of frequencies passed by the selector 16 in accordance with the amplitude of this undesired signal, thereby avoiding interference therefrom. Obviously, if this undesired signal is of sufficient amplitude, the desired signal carrier may be shifted to a frequency lower than its normal value, so that an increasingly less amount of the lower modulation sideband of the desired signal will be passed through the selector 16.

It is to be noted that, for the purpose of clarity in the above explanation, it was assumed, first, that a strong desired signal was received effecting the frequency shift as described and, then, that an undesired signal was received causing a frequency shift in the opposite direction. Under actual operating conditions, however, the undesired signal will ordinarily be present at the same time as the desired signal is tuned in, so that its effect will be to prevent the shift of the

intermediate frequency in response to the desired signal, or, in other words, to maintain the system in the highly selective adjustment to a greater or less extent according to the relative amplitudes of the desired and undesired signals. The switch 82 will, of course, be closed only when the receiver is being tuned, initially to provide a second intermediate-frequency carrier which coincides with the mean resonant frequency of the band-pass selector, the automatic control being effective, as above described, when the switch is open. Obviously, the required delay of the automatic control action to permit proper tuning may be obtained in various other suitable manners, as by so proportioning the control circuit elements as to have a large time constant.

It will be apparent that the band passed by the signal selector 16 is to be sufficiently narrow so that an undesired signal on a carrier frequency adjacent and above the desired signal-carrier frequency will have no appreciable interfering effects even when a desired signal of low amplitude is being received and the desired signal-carrier frequency is equal to the mean resonant frequency of the selector. When a strong desired signal is received, the intermediate frequencies of adjacent undesired signals, as well as the desired signal, are shifted in such direction that the frequency difference between an upper undesired signal and the band of frequencies passed by the selector is increased, thus further avoiding any interference from the upper undesired signal under this condition.

Since the oscillation frequency of the second frequency changer 15 is normally fixed; that is, remains constant except for adjustments thereof to control the selectivity of the system, such adjustments will be entirely independent of the tuning of the receiver. This, of course, would not be the case if the tunable first frequency changer were utilized for the selectivity control, since a variable impedance employed in connection with the tunable oscillation circuit thereof would, in the absence of special provisions, vary in its effectiveness in accordance with the frequency to which the oscillation circuit was tuned.

While the operation of the system has been explained above in connection with the reception of the usual modulated-carrier signal having two modulation sidebands, it will be obvious that the system is equally well adapted for the reception of signals carrying only one modulation sideband, it being essential only that the circuits be arranged so that the shift in the desired signal carrier to increase the fidelity of reception will be in the proper direction to include a greater portion of the single sideband being received in the band passed by the selector.

While there has been described what is at present considered to be the preferred embodiment of this invention, it will be obvious to those skilled in the art that various changes and modifications may be made therein without departing from the invention, and, therefore, it is aimed in the appended claims to cover all such changes and modifications as fall within the true spirit and scope of the invention.

What is claimed is:

1. In a modulated-carrier signal receiver, a band-pass selector comprising a plurality of coupled tuned circuits for selecting a desired signal comprising a carrier and at least one modulation sideband and having a response characteristic substantially uniform over the selected band, and means responsive to the amplitude

but substantially unresponsive to the frequency of a desired received signal carrier for shifting the frequency of said carrier with respect to the mean resonant frequency of said band-pass selector to increase the width of said modulation sideband passed by said selector while maintaining the carrier-frequency response of said selector substantially constant.

2. In a modulated-carrier signal receiver, a band-pass selector comprising a plurality of coupled tuned circuits for selecting a desired signal comprising a carrier and at least one modulation sideband and having a response characteristic substantially uniform over the selected band, means responsive to the amplitude but substantially unresponsive to the frequency of a desired received signal carrier for shifting automatically the frequency of said carrier with respect to the mean resonant frequency of said band-pass selector to increase the width of said modulation sideband passed by said selector while maintaining the carrier-frequency response of said selector substantially constant, and manual control means for rendering said automatic means inoperative.

3. In a modulated-carrier signal receiver, a band-pass selector comprising a plurality of coupled tuned circuits for selecting a desired signal comprising a carrier and at least one modulation sideband, and having a response characteristic substantially uniform over the selected band, means responsive to the amplitude but substantially unresponsive to the frequency of a desired received signal carrier for shifting the frequency of said carrier with respect to the mean resonant frequency of said band-pass selector to increase the width of said modulation sideband passed by said selector while maintaining the carrier-frequency response of said selector substantially constant, and means for introducing a time delay in the operation of said frequency-shifting means.

4. In a modulated-carrier signal receiver, a band-pass selector comprising a plurality of coupled tuned circuits for selecting a desired signal comprising a carrier and at least one modulation sideband, said selector passing a band of frequencies the mean frequency of which coincides with the normal frequency of said carrier and having a response characteristic substantially uniform over the selected band, and means responsive to the amplitude but substantially unresponsive to the frequency of a desired received signal carrier for shifting the frequency of said carrier with respect to the mean resonant frequency of said band-pass selector to increase the width of said modulation sideband passed by said selector while maintaining the carrier-frequency response of said selector substantially constant.

5. In a modulated-carrier signal receiver, a band-pass selector comprising a plurality of coupled tuned circuits for selecting a desired signal comprising a carrier and at least one modulation sideband, means responsive to the amplitude of a desired received signal for shifting the frequency of said carrier with respect to said mean frequency of said band-pass selector to increase the width of said modulation sideband passed by said selector, and means responsive to the amplitude of an undesired received signal on a frequency at one side of said carrier for shifting the frequency of said carrier with respect to said mean resonant frequency of said band in an opposite sense to decrease the width of said modulation sideband passed by said selector.

6. In a modulated-carrier signal receiver, a band-pass selector comprising a plurality of coupled tuned circuits for selecting a desired signal comprising a carrier and at least one modulation sideband, means responsive to the amplitude of a desired received signal for shifting automatically the frequency of said carrier with respect to said mean frequency of said band-pass selector to increase the width of said modulation sideband passed by said selector, means responsive to the amplitude of an undesired received signal on a frequency at one side of said carrier for shifting automatically the frequency of said carrier with respect to said mean resonant frequency of said band in an opposite sense to decrease the width of said modulation sideband passed by said selector, and manual control means for rendering said two automatic means inoperative.

7. In a modulated-carrier signal receiver, a band-pass selector comprising a plurality of coupled tuned circuits for selecting a desired signal comprising a carrier and at least one modulation sideband, means responsive to the amplitude of a desired received signal for shifting the frequency of said carrier with respect to said mean frequency of said band-pass selector to increase the width of said modulation sideband passed by said selector, means responsive to the amplitude of an undesired received signal on a frequency at one side of said carrier for shifting the frequency of said carrier with respect to said mean resonant frequency of said band in an opposite sense to decrease the width of said modulation sideband passed by said selector, and means for introducing a time delay in the operation of said two frequency-shifting means.

8. In a modulated-carrier signal receiver, frequency-changing means including an oscillation circuit for deriving from a desired modulated-carrier signal of a given frequency a second modulated-carrier signal normally of a predetermined different frequency, a band-pass selector coupled to said frequency-changing means comprising a plurality of coupled tuned circuits and having a response characteristic substantially uniform over the selected band, and means responsive to the amplitude but substantially unresponsive to the frequency of a desired received signal carrier for adjusting the frequency of said second modulated-carrier signal with respect to the mean resonant frequency of said band-pass selector while maintaining the carrier-frequency response of said selector substantially constant, thereby to adjust the width of one of the modulation sidebands passed by said selector directly in accordance with the amplitude of the desired signal.

9. In a modulated-carrier signal receiver, frequency-changing means including an oscillation circuit for deriving from a desired modulated-carrier signal of a given frequency a second modulated-carrier signal normally of a predetermined different frequency, a band-pass selector coupled to said frequency-changing means, means responsive to the amplitude of a desired received signal for adjusting the frequency of said oscillation circuit to shift the frequency of said second modulated-carrier signal relative to the mean resonant frequency of said band-pass selector, thereby to increase the width of one of the modulation sidebands passed by said selector, and means responsive to the amplitude of an undesired received signal on a frequency at

one side of said carrier for changing the frequency of said carrier relative to the mean resonant frequency of said band in an opposite sense to decrease the width of said modulation sideband passed by said selector.

10. In a modulated-carrier signal receiver, frequency-changing means including an oscillation circuit for deriving from a desired modulated-carrier signal of a given frequency a second modulated-carrier signal normally of a predetermined different frequency, a band-pass selector coupled to said frequency-changing means comprising a plurality of coupled tuned circuits and having a response characteristic substantially uniform over the selected band, means for rectifying said second signal to derive a control bias voltage variable in accordance with the amplitude but substantially unresponsive to the frequency of said second signal carrier, and means for utilizing said bias voltage for adjusting the frequency of said oscillation circuit to shift the frequency of said second modulated-carrier signal with respect to the mean resonant frequency of said band-pass selector while maintaining the carrier-frequency response of said selector substantially constant, thereby to adjust the width of one of the modulation sidebands passed by said selector directly in accordance with the amplitude of the desired signal.

11. In a modulated-carrier signal receiver, frequency-changing means including an oscillation circuit for deriving from a desired modulated-carrier signal of a given frequency a second modulated-carrier signal normally of a predetermined different frequency, a band-pass selector coupled to said frequency-changing means, means for rectifying said second signal to derive a control bias voltage variable in accordance with the amplitude of said second signal, means for utilizing said bias voltage for adjusting the frequency of said oscillation circuit to shift the frequency of said second modulated-carrier signal relative to the mean frequency of said band-pass selector to increase the width of said modulation sideband passed by said selector, means for rectifying an undesired signal on a frequency at one side of the carrier of said second signal for deriving a second control bias voltage variable in accordance with the amplitude of said undesired signal, and means for utilizing said second control bias voltage for adjusting the frequency of said oscillation circuit to shift the frequency of said second modulated-carrier signal relative to said mean resonant frequency, thereby to decrease the width of said modulation sideband passed by said selector.

12. In a modulated-carrier signal receiver, frequency-changing means including an oscillation circuit for deriving from a desired modulated-carrier signal of a given frequency a second modulated-carrier signal normally of a predetermined different frequency, a band-pass selector coupled to said frequency-changing means, a vacuum tube connected in circuit with said oscillation circuit to simulate an apparent variable reactance effective to shift the frequency of said oscillation circuit thereby to shift the frequency of said second modulated-carrier signal relative to the mean frequency of said band-pass selector, means responsive to the amplitude of a desired received signal for controlling said tube in such sense as to change the frequency of said second modulated-carrier signal so as to increase the width of one of the modulation sidebands passed by said selector directly in accordance

with the amplitude of said second signal, and means responsive to the amplitude of an undesired signal on a frequency at one side of the carrier of said desired signal for controlling said tube in a sense opposite to that of said first control means to shift the frequency of said oscillation circuit to adjust the frequency of said second modulated-carrier signal so as to decrease the width of said modulation sideband passed by said selector directly in accordance with the amplitude of said undesired signal.

13. In a modulated-carrier signal receiver, frequency-changing means including an oscillation circuit for deriving from a desired modulated-carrier signal of a given frequency a second modulated-carrier signal normally of a predetermined different frequency, a band-pass selector coupled to said frequency-changing means, a vacuum tube connected in circuit with said oscillation circuit to simulate an apparent variable reactance effective to shift the frequency of said oscillation circuit thereby to shift the frequency of said second modulated-carrier signal relative to the mean frequency of said band-pass selector, means for rectifying said second signal to derive a control bias voltage variable in accordance with the amplitude of said second signal, means for applying said voltage to a control electrode of said tube in such sense as to shift the frequency of said oscillation circuit to adjust the frequency of said second modulated-carrier signal so as to increase the width of one of the modulation sidebands passed by said selector directly in accordance with the amplitude of said second signal, means for rectifying an undesired signal on a frequency at one side of the carrier of said desired signal for deriving a second control bias voltage variable in accordance with the amplitude of said undesired signal, and means for applying said second control bias voltage to a control electrode of said tube in a sense opposite to that of said first-named control bias to shift the frequency of said oscillation circuit to adjust the frequency of said second modulated-carrier signal relative to the mean resonant frequency of said band-pass selector so as to decrease the width of said modulation sideband passed by said selector directly in accordance with the amplitude of said undesired signal.

14. In a modulated-carrier signal receiver, a band-pass selector comprising a plurality of coupled tuned circuits for selecting a desired signal comprising a carrier and at least one modulation sideband, means responsive to the amplitude of a desired received signal for shifting the frequency of said carrier with respect to said mean frequency of said band-pass selector to increase the width of said modulation sideband passed by said selector, and means including a selective circuit most responsive to the amplitude of an undesired received signal on a frequency at one side of said carrier for shifting the frequency of said carrier with respect to said mean resonant frequency of said band-pass selector in an opposite sense to decrease the width of said modulation sideband passed by said selector.

15. In a modulated-carrier signal receiver, frequency-changing means including an oscillation circuit for deriving from a desired modulated-carrier signal of a given frequency a second modulated-carrier signal normally of a predetermined different frequency, a band-pass selector coupled to said frequency-changing means, means for rectifying said second signal to derive a control bias voltage in accordance with the ampli-

tude of said second signal, means for utilizing said voltage to control said oscillation circuit for changing the frequency thereof, thereby so to shift the frequency of said second modulated-carrier signal relative to the mean frequency of said band-pass selector as to increase the width of said modulation sideband passed by said selector, a selective circuit most responsive to an undesired signal on a frequency at one side of the carrier of said second signal, rectifying means coupled to said selective circuit for deriving from said undesired signal a second control bias voltage in accordance with the amplitude of said undesired signal, and means for utilizing said second control bias voltage to control said oscillation circuit for changing the frequency thereof, thereby so to shift the frequency of said second modulated-carrier signal relative to the mean frequency of said band-pass selector as to decrease the width of one of the modulation sidebands passed by said selector.

16. An electric circuit arrangement for controlling the selectivity of a modulated-carrier signal receiver inversely in accordance with the amplitude of a desired signal, comprising a band-pass selector comprising a plurality of coupled tuned circuits for passing a band of frequencies including the carrier of said desired signal and at least one modulation sideband thereof and having a response characteristic substantially uniform over the selected band, and means responsive to the amplitude but substantially unresponsive to the frequency of said desired signal carrier for shifting the frequency of said carrier in a direction away from the mean resonant frequency of said band-pass selector while maintaining the carrier-frequency response of said selector substantially constant.

17. An electric circuit arrangement for controlling the selectivity of a modulated-carrier signal receiver inversely in accordance with the amplitude of a desired signal and directly in accordance with the amplitude of an undesired

signal on a frequency adjacent said desired signal carrier, comprising a band-pass selector comprising a plurality of coupled tuned circuits for passing a band of frequencies including the carrier of said desired signal and at least one modulation sideband thereof, means responsive to the amplitude of said desired signal for shifting the frequency of said carrier in a direction away from the mean resonant frequency of said band-pass selector, and means responsive to the amplitude of said undesired signal for shifting the frequency of said carrier in the opposite direction.

18. The method of adjusting the selectivity of a modulated-carrier signal receiver which comprises selecting a desired signal comprising a carrier and at least one modulation sideband, passing with substantially equal attenuation a band of frequencies which includes the normal frequency of said carrier and the frequencies of said sideband, and shifting the frequency of said carrier in a direction away from the mean frequency of said band directly in response to the amplitude of but independently of the frequency of said desired signal carrier while maintaining the carrier-frequency response of said selector substantially constant.

19. The method of adjusting the selectivity of a modulated-carrier signal receiver which comprises selecting a desired signal comprising a carrier and at least one modulation sideband and passing with substantially equal attenuation a band of frequencies which includes the normal frequency of said carrier and the frequencies of said sideband, shifting the frequency of said carrier in a direction away from the mean frequency of said band directly in response to the amplitude of said desired signal, and shifting the frequency of said carrier in the opposite direction directly in response to the amplitude of an undesired signal on a frequency adjacent said desired signal carrier.

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