

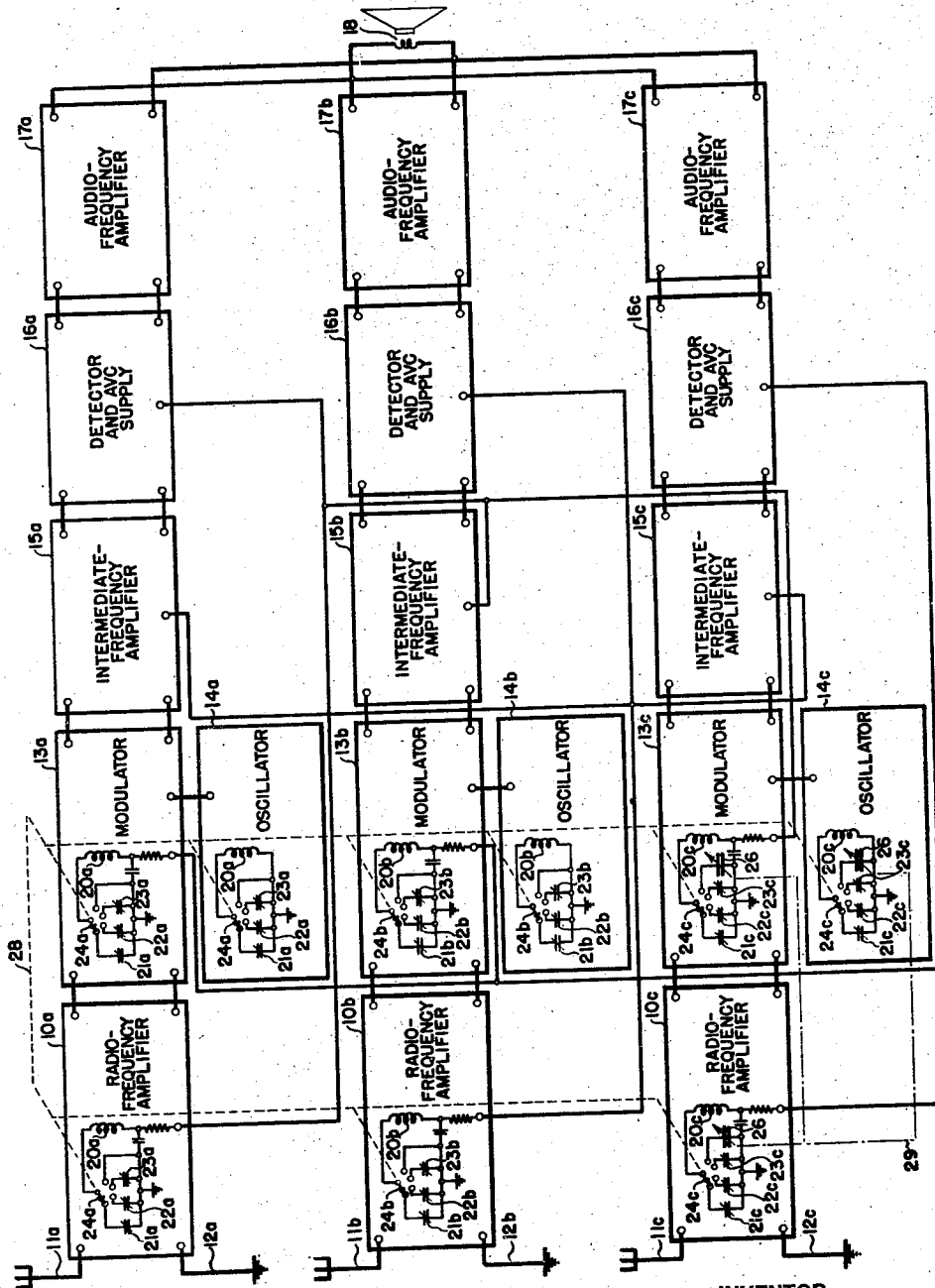
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RECEIVER FOR DIVERSITY RECEPTION

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RECEIVER FOR DIVERSITY RECEPTION

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This invention relates to a receiver for diversity reception and particularly to such a receiver comprising means to provide preset tuning for particular stations.

Transmitted modulated-carrier signals are subject to fading which varies in an unpredictable manner both in frequency and degree. The fading at any instant may differ very widely geographically or in different planes of polarization. It has been suggested to provide a modulated-carrier wave-signal receiver with a number of physically spaced or electrically diverse antennas having, consequently, different fading characteristics, the signals received by the several antennas being reproduced by a single reproducing means. Transmitted modulated-carrier energy fluctuates not only in intensity, but in phase, so that there may be considerable relative phase fluctuation at the several antennas of such a system. For this reason, it is impracticable directly to combine the received radio-frequency energies. In some instances, it has been found to be practicable to combine the detected energies of such received signals. However, if there is a phase difference between the carrier frequencies of the signals at the different antennas, phase fluctuations in the beat notes of the carrier and the sideband frequencies are produced which may preclude satisfactory operation of a receiver of the last-mentioned type. In order to eliminate this difficulty, it has been proposed to reproduce only the signal which is received with maximum amplitude by means of an arrangement which instantaneously effectively shifts the reproduction to the channel receiving the strongest signal. Means comprising tubes or relays for accomplishing this purpose cause a temporary variation in the volume of the reproduced signal when the transfer between channels is made and for this reason it has been proposed to utilize an arrangement in which the automatic volume control of each receiving channel is also effective upon each of the other receiving channels of the system. With such an arrangement, it is possible to tune the several channels of the receiver to different stations carrying the same program and procure a reception which is generally satisfactory. Such a system, however, requires tuning of several channels in addition to those of conventional modulated-carrier signal receivers. For this reason, the operation of the receiver is very difficult for anyone other than a skilled operator. It is first necessary to determine independently the various stations which are carrying the same pro-

gram and then separately to tune each of the receiving channels to one of these stations and thereafter provide for combining the output of the three channels in a single reproducing means.

It is an object of this invention to provide a modulated-carrier wave-signal receiver of the character described in which the above-mentioned difficulties are eliminated.

It is still another object of the invention to provide a diversity receiver comprising a preset tuning arrangement for simultaneously tuning a plurality of channels of the receiver to various predetermined stations carrying a common program.

In accordance with the present invention, there is provided in a diversity broadcasting system including a plurality of carrier-wave signal-transmitting stations which are geographically spaced, which transmit on different carrier frequencies, and which carry a common program, a diversity receiver comprising a plurality of signal-translating channels. A preset tuning arrangement is included in each of the channels adapted to tune each of the channels to a different predetermined one of the stations of the system. There is also provided unicontrol means for the tuning arrangements adapted to tune each of the channels to its respective predetermined station carrying the common program.

In accordance with a preferred embodiment of the invention, there is provided means for causing reproduction of signals in the channel receiving signals of greatest amplitude and for suppressing reproduction in the other receiving channels. In the preferred embodiment of the invention, preset tuning condensers are provided for each of the channels adapted to be switched by the unicontrol means to condition the receiver for diversity reception; one position of the unicontrol means providing for the use of one of the receiver channels as a conventional modulated-carrier signal receiver manually tunable to any frequency within a predetermined band of frequencies, such as the normal broadcast band.

The novel features which are believed to be characteristic of this invention are set forth with particularity in the appended claims. The invention itself, however, both as to its organization and method of operation, together with further objects and advantages thereof, will best be understood with reference to the following specification taken in connection with the accompanying drawing, the single figure of which is a circuit

diagram of a complete superheterodyne receiver utilizing the present invention.

Referring now more particularly to the drawing, there is shown a circuit diagram, partly schematic, of a diversity receiver of the superheterodyne type including unicontrol means for conditioning the several channels of the receiver for diversity operation. Briefly described, the receiver includes three separate receiving channels, each of which contains the conventional elements of a modulated-carrier signal receiver of the superheterodyne type. Similar circuit elements in the three signal channels have been given identical reference numerals, subscripts *a*, *b*, and *c* being utilized to identify a particular element with a particular receiving channel. Thus, one of the channels, specifically channel *a*, comprises a radio-frequency amplifier 10*a* having input terminals connected to an antenna 11*a* and ground 12*a* and output terminals coupled to a frequency changer or modulator 13*a* including an oscillator 14*a* which may be separate, as shown, or a unitary part of the modulator 13*a*. Connected in cascade with the output circuit of the frequency changer unit 13*a*, in the order named, are an intermediate-frequency amplifier 15*a*, a detector and automatic amplification control unit 16*a*, an audio-frequency amplifier 17*a*, and a sound reproducer 18 which is common to the three signal-translating channels of the receiver.

Considering first the operation of the channel *a* of the receiver as a whole, without regard to the details of the arrangement for adapting the receiver for diversity operation, a desired received signal is selected and amplified in radio-frequency amplifier 10*a* and is converted to a modulated intermediate-frequency signal in frequency changer 13*a*. The signal, as thus converted, is further amplified in the intermediate-frequency amplifier 15*a* and detected by detector 16*a*, thereby producing the audio frequencies of modulation which are, in turn, amplified by audio-frequency amplifier 17*a* and reproduced by the sound reproducer 18.

Referring now more particularly to the details of the system comprising the present invention, there is provided a preset tuning arrangement for each receiving channel of the receiver. Only the essential elements of the selector circuits of the radio-frequency amplifier, the modulator, and the oscillator of each of the receiving channels are illustrated in the drawing. Thus, the selective circuit of radio-frequency amplifier 10*a* includes an inductance 20*a*, adapted to be tuned by a selected one of condensers 21*a*, 22*a*, and 23*a* which may be switched into the receiver circuit by means of switch 24*a*. The corresponding elements of modulator 13*a* and oscillator 14*a* are similar and have been given identical reference numerals. Channel *c* differs slightly from that of the other two channels in that, in the fourth position of switches 24*c*, variable tuning condensers 26 are switched into the receiving channel *c* so that it may be continuously tuned, thereby to select any signal within a predetermined band of frequencies, usually the conventional broadcast band. In order that the receiver channels *a* and *b* may be rendered inoperative when receiver channel *c* is conditioned for continuous tuning, there is provided, in the fourth position of switches 24*a* and 24*b*, means for short-circuiting the tuning inductances 20*a* and 20*b*, respectively. A unicontrol mechanism indicated by dashed lines 28 is provided for simultaneously

operating all of the selector switches 24*a*, 24*b*, and 24*c*. A separate unicontrol mechanism 29 is provided for the variable condenser 26 of channel *c*. In order that only that receiver channel receiving signals of greatest amplitude may be effective at any time, a system of automatic volume control is utilized. As shown, the volume control bias of each channel is effective upon one or more stages of its respective channel and is also effective upon one or more stages of each of the other channels.

In considering the operation of the system just described, it will be assumed that the several corresponding sets of condensers 21*a*, 21*b*, 21*c*; 22*a*, 22*b*, 22*c*; and 23*a*, 23*b*, 23*c* are initially preset to such adjustments as to tune the three channels to different stations which generally transmit the same program, that is, to different stations of a network of stations which are geographically spaced, which transmit on different carrier frequencies, and which carry a common program. Under such conditions, by operation of unicontrol mechanism 28, each of the channels may be simultaneously adapted to receive signals of a different station, the several stations carrying a common program. Additionally, the third channel may be conditioned to operate as a conventional continuously tunable carrier-frequency receiver by operation of unicontrol mechanism 28 to its last position. When operated to the said last position, channels *a* and *b* are made inoperative due to the fact that inductors 20*a* and 20*b* of the selector circuits are short-circuited by the switches 24*a*, 24*b*. By virtue of the cross connection of the automatic volume control circuits, that channel which at any given time is translating the signal with greatest amplitude not only automatically controls its own amplification in a normal manner, but also supplies to each of the other channels an amplification control bias which is abnormally large for the lower amplitude signals translated by such other channels so that their signal output is considerably less than that of the first channel. For even a very slight initial difference in the signal strengths at the antennas, the strongest signal is amplified normally but simultaneously weakens a weaker signal which, in turn, relaxes the amplification control of the stronger signal so that simultaneously the weaker signal is almost completely cut out and reception depends almost entirely upon the stronger signal. Thereafter, the arrangements will not reproduce energy received from an antenna which has been cut out even if its signal should grow stronger, except in the case where the signal which is being reproduced fades below a predetermined level, in which event the amplification control is shifted rapidly so as to amplify and reproduce the signal which is then a maximum. Thus there is selected for effective operation, from among the several antennas, that antenna at which the received signal is the strongest and the signal received thereby is amplified by its associated channel practically exclusively of, or at least predominantly over, those translated by the other channels. For this reason, there is little conflict of reception due to the different phase fluctuations of the different antennas, and automatic volume control for the effective receiver channel is thus provided in a conventional manner.

While there have been illustrated rotary switches for conditioning the receiver for diversity operation, it will be understood that push-button or other equivalent tuning can be utilized.

It will also be understood that, in case difficulty is experienced in finding three stations carrying the desired program, any one of the receiver channels, when conditioned for diversity operation, can be cut out of the system by operation of a suitable off-on switch, not shown.

While the invention has been illustrated in connection with the particular type of diversity receiver, it will be understood that the invention is not limited thereto but may be utilized in connection with any diversity receiver.

While there have been described what are at present considered to be the preferred embodiments 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 it is, therefore, 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 diversity broadcasting system including a plurality of modulated carrier-wave signal-transmitting stations which are geographically spaced, which transmit on different carrier frequencies, and which carry a common program, a diversity receiver comprising, a plurality of signal-translating channels, a preset tuning arrangement for each of said channels adapted to tune each of said channels to a different predetermined one of said stations, and unicontrol means for said tuning arrangements adapted to tune each of said channels to its respective predetermined station carrying the common program.

2. In a diversity broadcasting system including a plurality of modulated carrier-wave signal-transmitting stations which are geographically spaced, which transmit on different carrier frequencies, and which carry a common program, a diversity receiver comprising, a plurality of signal-translating channels, a preset tuning arrangement for each of said channels adapted to provide selective tuning of each of said channels to any of a plurality of said stations, and unicontrol means for said tuning arrangements adapted, simultaneously to tune each of said channels to a different predetermined one of said stations carrying the common program.

3. In a diversity broadcasting system including a plurality of modulated carrier-wave signal-transmitting stations which are geographically spaced, which transmit on different carrier frequencies, and which carry a common program, a diversity receiver comprising, a plurality of signal-translating channels, a preset tuning arrangement for each of said channels adapted to provide selective tuning of said channels to any of a plurality of said stations, unicontrol means for said tuning arrangements adapted simultaneously to tune each of said channels to a different predetermined one of said stations carrying the common program, and means for causing translation of signals by the channel receiving signals of greatest amplitude and for substantially suppressing translation by the others of said channels.

4. In a diversity broadcasting system including a plurality of modulated carrier-wave signal-transmitting stations which are geographically spaced, which transmit on different carrier frequencies, and which carry a common program, a diversity receiver comprising, a plurality of signal-translating channels, a preset tuning arrangement for each of said channels adapted to

provide selective tuning of each of said channels to any of a plurality of said stations, unicontrol means for said tuning arrangements adapted simultaneously to tune each of said channels to a different predetermined one of said stations carrying the common program, and means responsive to the amplitudes of signals received by said channels for causing translation of signals by the channel receiving signals of greatest amplitude and for substantially suppressing translation by the others of said channels.

5. In a diversity broadcasting system including a plurality of modulated carrier-wave signal-transmitting stations which are geographically spaced, which transmit on different carrier frequencies, and which carry a common program, a diversity receiver comprising, a plurality of signal-translating channels, a preset tuning arrangement for each of said channels adapted to provide selective tuning of each of said channels to any of a plurality of said stations, unicontrol means for said tuning arrangements adapted simultaneously to tune each of said channels to a different predetermined one of said stations carrying the common program, and means for controlling the amplification in each of said channels partially inversely in accordance with the amplitude of the signal received by the channel and partially inversely in accordance with the amplitudes of the signals received by the other channels.

6. In a diversity broadcasting system including a plurality of modulated carrier-wave signal-transmitting stations which are geographically spaced, which transmit on different carrier frequencies, and which carry a common program, a diversity receiver comprising, a plurality of signal-translating channels, a preset tuning arrangement for each of said channels adapted to provide selective tuning of each of said channels to any of a plurality of said stations, a variable tuning means for one of said channels for continuously tuning said one of said channels to any frequency within a predetermined band of frequencies, and means comprising unicontrol means for selectively tuning each of said channels simultaneously to a different predetermined one of said stations carrying the common program or for inserting said variable tuning means in said one of said channels to condition said one of said channels to be tuned to any of said frequencies within said band.

7. In a diversity broadcasting system including a plurality of modulated carrier-wave signal-transmitting stations which are geographically spaced, which transmit on different carrier frequencies, and which carry a common program, a diversity receiver comprising, a plurality of signal-translating channels, a preset tuning arrangement comprising a plurality of adjustably fixed-tuned elements for each of said channels adapted to provide selective tuning of each of said channels to any of a plurality of said stations, and switching means for selectively including predetermined ones of said fixed-tuned elements simultaneously in their respective channels to tune each of said channels to the different predetermined one of said stations carrying a common program.

8. In a diversity broadcasting system including a plurality of modulated carrier-wave signal-transmitting stations which are geographically spaced, which transmit on different carrier frequencies, and which carry a common program, a diversity receiver comprising, a plurality of sig-

nal-translating channels, a preset tuning arrangement comprising a plurality of adjustably fixed-tuned condensers for each of said channels adapted to provide selective tuning of each of said channels to any of a plurality of said stations, and switching means for selectively including predetermined ones of said condensers simultaneously in their respective channels to tune each of said channels to a different predetermined one of said stations carrying the common program.

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