

April 4, 1939.

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2,153,052

RADIO BROADCASTING SYSTEM

Filed July 9, 1937

2 Sheets-Sheet 1

FIG. 1

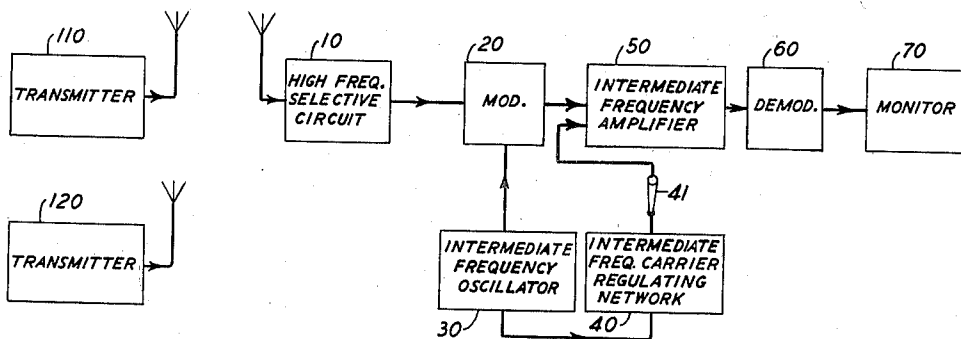
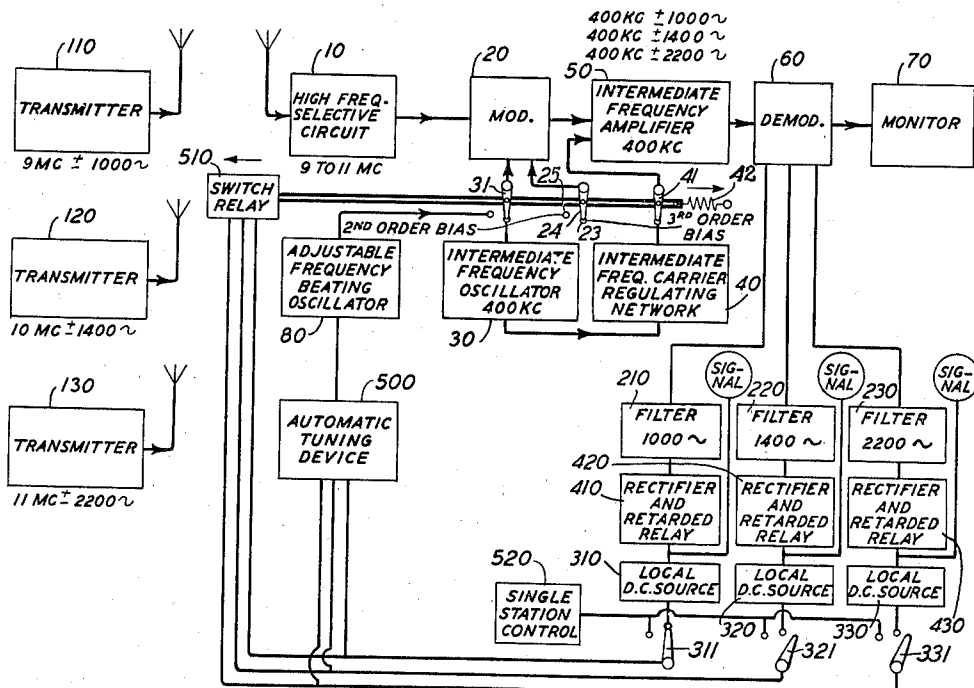


FIG. 4



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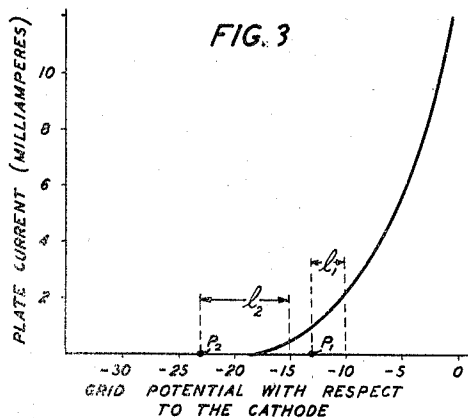
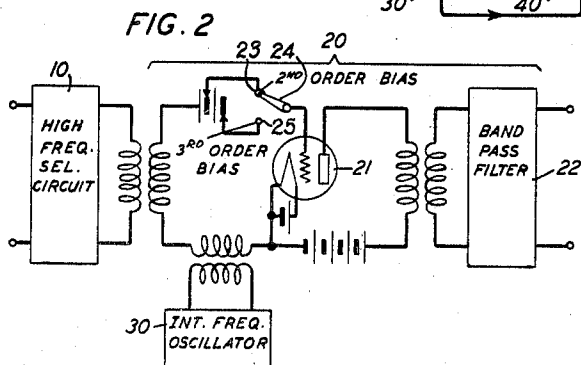
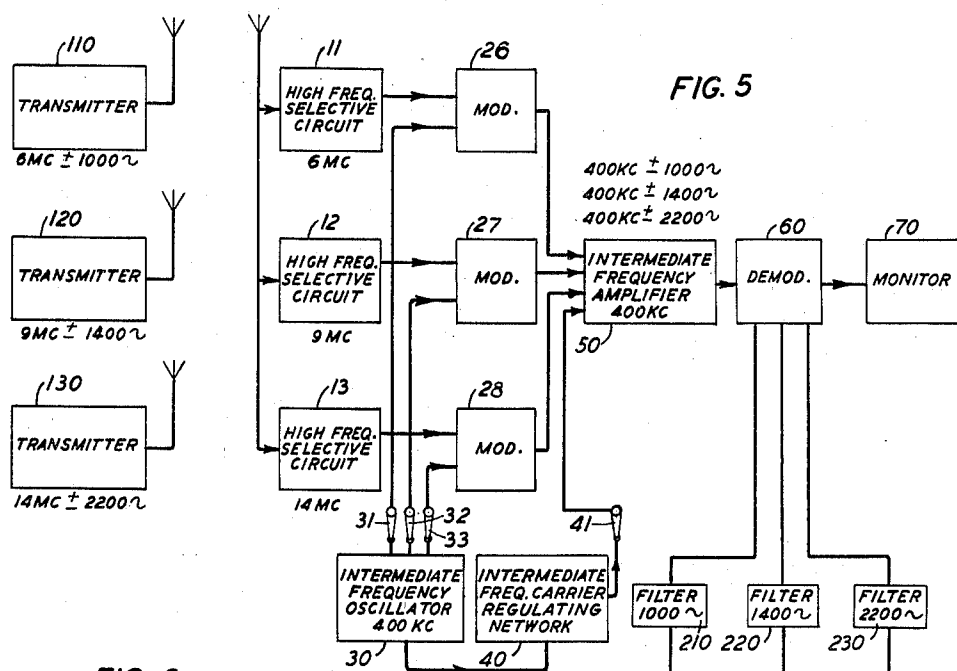
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2 Sheets-Sheet 2



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RADIO BROADCASTING SYSTEM

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Application July 9, 1937, Serial No. 152,689

13 Claims. (Cl. 250—9)

This invention relates to radio broadcast transmission and reception and more particularly to a multiple channel heterodyne radio receiver system.

5 An object of this invention is to provide a multistation radio broadcasting system in which when one or more of the transmitting stations are operating, the receiving stations may, without retuning, simultaneously pick up any transmitting station which may be operating.

10 Another object is to provide an improved and simplified radio receiver capable of selectively indicating the different stations simultaneously picked up.

15 Another object is to selectively receive any one of the different signals picked up and detect it to the exclusion of all other signals.

20 A further object is to provide means for preventing false indications from broadcast stations employing carrier currents having frequencies within the frequency band or bands employed in this system.

In the usual heterodyne radio receiving system for broadcast signals the incoming waves are 25 caused to interact with oscillations produced by a local oscillator whose frequency is adjustable so that the frequency of the resulting difference frequency oscillations may be made equal to that for which a high gain intermediate frequency 30 amplifier is selective. The high gain amplifier raises the signal level and transmits the amplified intermediate frequency currents to a second detector which yields a low frequency output current corresponding to the modulation present in 35 the original incoming radio broadcast signal waves. The band width of the intermediate frequency amplifier is usually adjusted so as to admit only the one desired broadcast transmission.

40 The system herein described employs a single local beating frequency of a value decidedly different from that used in the usual system and makes use of third order products in vacuum tubes to produce an intermediate frequency, the 45 value of which is determined wholly by the frequency of oscillations supplied by the local beating oscillator and not by the frequency of the incoming carrier wave.

When two waves are simultaneously impressed 50 on a third order modulator there is produced as a result of the intermodulation a complex resultant having a number of different components. Prominent among these components are those whose frequency is the sum or difference of the 55 frequency of one of the waves and twice the

frequency of the other and these components have been used in third order modulation systems of the prior art. Examples of such uses are disclosed in United States patent to E. Peterson, No. 1,678,163 issued July 24, 1928. However, 5 there is also produced in third order modulation a component of the frequency of each of the impressed waves and which does not involve the frequency of the other wave but which does exhibit any amplitude variations or modulations 10 which the other impressed wave possessed. Accordingly, if a local unmodulated wave and an incoming modulated wave are impressed together on a third order modulator, there will be present among the resulting components one having the 15 carrier frequency of the local unmodulated wave and a modulation corresponding to that of the incoming modulated wave. This may readily be selected to the exclusion of the remaining components and utilized as a carrier of the incoming 20 modulation.

This invention is directed to radio broadcast transmission and reception particularly where it is desired to separately or simultaneously pick 25 up a number of transmitting stations on a receiver without retuning and to indicate which station or stations are operating. This system is particularly adapted to point-to-point communication where a number of transmitting stations may at any time wish to call one or more receiving 30 stations.

In receivers constructed in accordance with the present invention, a third order modulation process is employed to transfer the individual identifying tone modulations present on a number of 35 different frequency incoming carrier waves to a single local carrier wave. After the local carrier wave has been so modulated it is demodulated to reproduce the individual tones which are then selected and utilized to indicate which one or ones of the distant transmitters are calling. The 40 first selective circuit of the radio receiver is selective for a band broad enough to receive carrier waves from any of the several transmitting stations and this circuit has a much broader band than the intermediate circuit. Several different frequency incoming waves simultaneously 45 received and transmitted by this first selecting circuit are impressed upon a modulator, sometimes designated as the first or high frequency detector, with which, as is indicated above, there is associated a local oscillator of a very different beating frequency from that used in the ordinary heterodyne receiving set. The output of the 50 modulator comprising the locally produced oscillations of the carrier frequency and the modulations of the incoming waves is then fed to a second selective circuit which is selective for a band broad enough to receive the carrier frequency and the modulations of the incoming waves. This second selective circuit is then demodulated to reproduce the individual tones which are then selected and utilized to indicate which one or ones of the distant transmitters are calling. 55

lations which now carry as modulations the identifying tones by which the incoming carrier waves were modulated is impressed upon the intermediate frequency amplifier and its output is in turn impressed upon a second or intermediate frequency demodulator from which the low frequency message signals are derived.

The system disclosed in this application differentiates between the several simultaneously received but different frequency incoming waves by using individual identifying low frequency tones, preferably within the audio range, to modulate the respective carrier waves at the different transmitting stations. The tones should be so chosen that harmonics of any tone or the beat between any two tones will not be so close to the tone of another channel as to cause interference. False indications from general broadcasting stations employing carrier waves within the frequency band of the input circuit of this system may be prevented by using two-tone identifying modulations or by using a slow-acting device such as a retarded relay in each tone indicating channel at the receiving station.

While most of the output due to the cross-modulation of the incoming broadcast waves and the locally applied oscillations comes from the third order products in the modulating device, all odd order products contribute something, the amount due to the higher order products usually becoming less as the order is increased.

This arrangement is particularly applicable in a standby signaling system where it is desired to have a single receiver capable of being excited by any one of a number of transmitters having respectively different carrier wave frequencies within a definite band width. While an ordinary receiver could be used provided the band which it is capable of receiving is sufficiently broad to admit all of the signals that may be desired, this is not easy to accomplish when any considerable amount of gain is required, and consequently, the arrangement shown in this invention is preferable.

A description of an embodiment chosen for illustrating this invention in which reference is made to the accompanying drawings follows:

Fig. 1 is a diagrammatic drawing showing a radio system having a plurality of transmitting stations employing different carrier frequencies respectively and one of a number of receiving stations arranged to receive from any of the transmitting stations without retuning the receiver;

Fig. 2 is a schematic diagram of the circuit of the modulator of Fig. 1;

Fig. 3 is a graph employed to explain the operation of the circuit of Fig. 2;

Fig. 4 shows a system like that of Fig. 1 with selective devices at the receiving station which may be left unattended and which indicate which one or ones of a number of distant transmitting stations may be calling, and

Fig. 5 shows a modification of the circuit of Fig. 4 adapted to receive any one of several different message waves which have their frequency bands spaced with any desired frequency separation from each other.

Fig. 1 shows a radio system having a plurality of transmitting stations 110 and 120 which may be operated separately or concurrently. The system may comprise a plurality of both transmitting and receiving stations. The modulated high frequency waves transmitted from the transmitting stations are admitted through the high fre-

quency selective circuit 10 of the receiver to a modulator 20 which is biased, as will be explained in connection with Fig. 2, to give high third order products. A local intermediate frequency oscillator 30 supplies oscillations of a fixed frequency to third order modulator 20. The modulator output circuit is selective of a frequency band centering around the fixed frequency. As a result of the third order modulation the modulations on the incoming carrier waves appear as modulations of the local fixed frequency carrier wave component at the output of the modulator 20. The relation between the amplitudes of the output side-bands of modulator 20 and of the unmodulated carrier wave component which is derived directly from the local oscillator 30 is controlled in the intermediate frequency carrier regulating network 40 connected between the oscillator 30 and the intermediate frequency amplifier 50 through switch 41 to supply unmodulated oscillations of the fixed frequency to the amplifier. This provides the correct magnitude of carrier wave for attaining proper detection in the final demodulator. The side-band components together with the unmodulated oscillations from the local oscillator 30 and network 40 are amplified in the intermediate frequency amplifier 50 and detected in the usual manner through the demodulator 60, the low frequency output therefrom being impressed upon any suitable output receiving or monitoring device 70 such as a loud-speaker. Only the signal modulating a carrier wave at a transmitter which is accepted by circuit 10 will appear in the output circuit of the demodulator and be impressed upon the receiving device, and if two or more transmitting stations are simultaneously operating their low frequency modulating signals will appear concurrently at the receiving device and be intermixed. Modifications of the output receiving devices are subsequently shown and described which provide for segregating the signals when more than one is being broadcast.

One circuit for obtaining a modulator rich in either second or third order components is shown in Fig. 2. It employs an ordinary three-electrode vacuum tube 21 with the grid bias and input adjusted to the correct operating conditions. To illustrate this idea a particular case will be shown in the graph of Fig. 3 which portrays the grid voltage-plate current characteristic of a Western Electric type 244A three-electrode vacuum tube with a plate voltage of 135 volts. A good operating condition to obtain high second order output is obtained by setting the grid bias to -13 volts at P_1 and impressing an input of 3 volts peak amplitude (I_1). In this condition the grid bias switch of tube 21 is connected to the switch point marked "2nd order bias" in Fig. 2. The change to a modulator with high third order output is made by increasing the grid bias to -23 volts at P_2 and impressing an input of 8 volts peak amplitude (I_2). In this condition the grid bias switch of tube 21 is connected to the switch point 25 marked "3d order bias" in Fig. 2. The peak amplitude of the alternating current input may be adjusted to these different conditions by varying the output electromotive force of local oscillator 30 in well-known manner. Band-pass filter 22 associated with the output of vacuum tube 21 serves to select the desired intermediate frequency band and to effectively attenuate and suppress components lying outside the desired band. The intermediate frequency band passed by the filter 22 may therefore be the same for both second

order and third order modulation, the principal distinction being that in the case of third order modulation the local oscillator 30 will be set at the intermediate frequency while, in the case of second order modulation, it will be set at a frequency differing from that of the desired incoming carrier waves by the magnitude of the intermediate frequency.

Fig. 4 shows how this arrangement may be applied to provide a system in which the receiving stations may be left unattended and may be actuated to indicate which one or ones of a number of distant transmitting stations may be calling. Each transmitting station uses for calling, a distinctive frequency tone for modulating its fixed frequency carrier wave in order that the receiving station or stations may differentiate between the several calling stations. Regardless of the frequency of the transmitting carrier wave the identifying signal modulation which it carries will ultimately appear as a modulation of the oscillations generated at the receiving station by the local oscillator 30 provided the high frequency selective circuit 10 accepts the modulated transmitting carrier wave. As here shown, the plurality of transmitters 110, 120 and 130 each employ different transmitting carrier frequencies and different modulating signal tones, respectively. The frequencies of these tones are so chosen that harmonics of any one or the beats between any two will not produce the signal tone of any other, to avoid giving a false calling indication at a receiver. The apparatus at a receiving station comprises a high frequency selective circuit 10, a third order modulator 20, an intermediate frequency oscillator 30, an intermediate frequency carrier regulating network 40, an intermediate frequency amplifier 50, a demodulator 60 and a monitoring device 70, all of which may be similar to the receiving arrangement shown in Fig. 1. Filters 210, 220 and 230, respectively, connected in the output circuit of the demodulator, select the respective signal tones which may be used either to give an indication of a distant station calling or to actuate a signaling mechanism and in turn provide an operating channel as described later. The output circuits of these filters may be connected, respectively, to rectifier and retarded relay devices 410, 420 and 430 respectively, and to visual or audible signals or both but which in any event are distinctive in color and/or pitch to indicate the particular transmitting station which is then active. An incoming signal indicated by any of the signaling devices may be segregated from any of the other signals concurrently being transmitted by switching off the local intermediate frequency oscillator 30, disconnecting the carrier regulating network 40 and changing the bias of modulator 20 from its third order bias to its second order bias and switching onto modulator 20 adjustable beating oscillator 80, all by operating the mechanically interlocked switches 31, 41 and 24, and then adjusting the oscillator 80 to the correct frequency to tune in the desired or selected signal. The requisite bias voltages are supplied through circuits connected to contacts 23, and 25 of switch 24, as explained in connection with Fig. 2. The equipment then operates as a regular double detection receiver. When the transmitting station has completed its call the connection to the adjustable beating oscillator 80 is switched off and the normal standby connections are restored by returning the switches 31, 41 and 24 to their po-

sitions as shown in the drawings. When only one transmitting station is operating it may be heard as explained in describing Fig. 1 and the switching of the apparatus from its standby condition is then unnecessary. The switching and tuning operations may be either manually or automatically performed. Automatic tuning or adjustment of the apparatus may be controlled by an incoming signal which upon selectively energizing one of the output circuits will cause the switching off of the local intermediate frequency oscillator 30, the carrier regulating network 40 and the third order biasing means, and the switching on of the adjustable frequency beating oscillator 80 and the second order biasing means, and the adjusting of the beating oscillator 80 to the correct frequency to tune in the given incoming signal. The automatic or mechanical tuning means comprise the automatic tuning device 500 such as is used in tuning radio apparatus and the switch relay 510 arranged to adjust the beating oscillator 80 and to operate switches 24, 31 and 41. Mechanical tuning devices of types suitable for the purpose are described in U. S. Patent 2,034,708 of March 24, 1936, to Browne et al., U. S. Patent 2,046,910, July 7, 1936, to Barrett, and U. S. Patent 2,055,363, September 22, 1936, to Powell. The automatic tuning arrangement may be connected in or out of service by a set of switches 311, 321, 331 associated, respectively, with the local direct current sources 310, 320 and 330. It may be connected to any one or all of the signaling devices as desired. Each switch 311, 321 and 331 is in circuit with a local direct current source such as 310, 320 and 330 and the switch relay 510. If only one of the switches such as 311 is connected to its associated current source as shown in the drawings, whenever a carrier wave is received on the channel distinguished by the 1000 cycle tone, the automatic tuning device 500 and the switch relay 510 are operated over the circuit of the local direct current source which is closed by a contactor on the retarded relay 410, thus tuning the system to receive the single carrier wave coming in over the one selected and connected channel. As soon as the incoming carrier wave ceases, switch relay 510 releases and a biasing spring 42 associated with their common operating handle restores the switches 24, 31 and 41 to their normal positions as shown in the drawings thus causing the system to operate as a third order modulation standby system which permits any transmitting station of the system to call the receiving station. However, when the switch 311 is connected as shown in the drawings, signals may come in over the other two channels, if the channel with which switch 311 is associated is not receiving a signal since in that condition the switch relay 510 is deenergized and the receiver is in standby condition and operates by virtue of third order modulation. Also, if it is desired to receive signals over one channel to the exclusion of all others, this may be accomplished by throwing one of the switches 311, 321 or 331 to the extreme left position to connect with the single station control element 520. The single station control element 520 operates continuously in lieu of an energized rectifier retarded relay and local source to supply a steady electromotive force to the switch relay 510 and automatic tuning device 500 so that when one of the switches 311, 321 and 331 is connected to the device 520 the other two switches must be in open position.

Ordinarily, all of the switches 311, 321 and 331

are open so that signals from any transmitting station may call a receiving station. It is obvious from the foregoing that if more than one transmitting station is calling at the same time the station whose signal it is desired to receive may be tuned in by throwing the proper one of the switches 311, 321 or 331 into connecting position, with its local direct current source, so that the automatic tuning mechanism will release just as soon as the signal ceases and thus allow the receiver to indicate the calling of other transmitting stations. An attendant would normally, upon cessation of an incoming message, open the switches 311, 321, 331 which had been employed to tune in a station for selective reception unless it were desired that this station have preference as described above.

In the system shown in Fig. 4, the different carrier frequencies and the different signaling tone modulating frequencies employed by the different transmitting stations may be, for example, for station 110 a carrier of 9 megacycles modulated by a tone of 1000 cycles, for station 120 a carrier of 10 megacycles modulated by a tone of 1400 cycles, and for station 130 a carrier of 11 megacycles modulated by a tone of 2200 cycles. Each of these modulated carriers is accepted by the high frequency selective circuit 10 of each receiving station having a band width between 9 and 11 megacycles and upon being modulated with a local carrier frequency of, for example, 400 kilocycles generated by the local intermediate frequency oscillator 30 at the receiving stations, the several signals are impressed upon the intermediate frequency amplifier 50 and appear as 400 kilocycles ± 1000 cycles, 400 kilocycles ± 1400 cycles and 400 kilocycles ± 2200 cycles. These several signals are after amplification impressed upon the demodulator 60 and the resulting demodulated tones are segregated by means of the filters 210, 220 and 230 passing, respectively the 1000, 1400 and 2200 cycles.

The several frequencies mentioned above are given merely as examples to assist in more readily describing the arrangement. Instead of employing a single signaling tone for modulating the carrier at each transmitting station for differentiating it at a receiving station, a plurality of distinctive tones may be used at each transmitting station and in such modification the filters would, of course, be designed to transmit the respective distinctive tones of each transmitting station. The use of a plurality of tones for each station would obviously make its determination more certain and distinctive. In order to further avoid a possibility of having the signal and tuning apparatus actuated by the same tone coming from an outside station the retarded relays 410, 420 and 430 may be given such an operating time that they will operate only after the tone has persisted for a given duration of time or the tone may be transmitted in accordance with some code arrangement and there may be included in the rectifier and relay units 410, 420 and 430 a code selector unit of the type disclosed in the United States patent to Demarest and Almqvist No. 1,657,498 issued January 31, 1928.

Fig. 5 diagrammatically shows a modification of the invention, comprising a plurality of transmitting stations and one of a number of receiving stations admitting a plurality of widely separated signal modulated carrier currents. The signal modulated carrier currents each have a comparatively narrow frequency band and the bands are spaced at any desired frequency distance from

each other. A plurality of high frequency selective circuits and modulators, one for each different signaling frequency band may be employed. Each transmitting station 110, 120 and 130 employs a distinctive carrier frequency and a distinctive signaling tone or tones, in the same manner as described in connection with Fig. 4, with the exception that the carrier frequencies may be widely separated and in order to exclusively receive or accept them at a receiver and avoid receiving or accepting signals on intermediate carrier frequencies, a plurality of high frequency selective circuits 11, 12 and 13 are employed at the receiver, each having a comparatively narrow frequency band width centering around the frequency of a respective carrier and only wide enough to include a desired communication band. Each of these high frequency selective circuits may be connected either with a common third order modulator or individual third order modulators. The drawings show individual modulators 26, 27 and 28, respectively. A local intermediate frequency oscillator 30 is common to all channels and supplies carrier current of the same frequency to each of the modulators. The oscillator is also connected through an intermediate frequency carrier regulating network 40 to the intermediate frequency amplifier 50. The output circuit of each modulator connects with the single intermediate frequency amplifier 50 and the output terminals of this amplifier are connected to the input terminals of the demodulator 60. The intermediate frequency amplifier and the demodulator are common to all channels and any suitable output devices such as described for Fig. 4 may be employed. While a separate modulator for each channel, as shown in Fig. 5, has the advantage of eliminating undesirable products which might arise due to the beating of the side-bands of two or more signals, a single common modulator as stated above may be used particularly where the frequencies of the several signals are so chosen as to minimize this interference. Further, a combination of the arrangements of Figs. 4 and 5 may be used, in which case each selective high frequency circuit may admit a band of carrier frequencies instead of just the one and a multiplicity of such band admitting selective circuits may be provided at the receivers. Any one of the transmitting stations may be separately selected by changing the connections to convert the equipment into a regular double detection receiver as described for Fig. 4. Switches 31, 32, 33 and 41 provide means for making such changes in the connections. The adjustable frequency beating oscillator while not shown in this figure may be included by suitable switching connections similar to the arrangement shown in Fig. 4. Another way of selecting any one station and receiving only the signal from this station is to disconnect the intermediate frequency oscillator 30 from the modulators receiving the undesired signals. For example, if only the 14 megacycle signal were desired, switches 31 and 32 would be opened.

As an example illustrating different frequencies for which the arrangement shown in Fig. 5 is adapted, the transmitting stations 110, 120 and 130 may respectively have a carrier frequency of 6 megacycles modulated by a tone of 1000 cycles, a carrier frequency of 9 megacycles modulated by a tone of 1400 cycles and a carrier frequency of 14 megacycles modulated by a tone of 2200 cycles, respectively. Each of the modulated carrier waves is accepted by a corresponding se-

lective high frequency circuit at a receiver and upon being modulated with a local carrier wave having a frequency of, for example, 400 kilocycles in the respective modulators 26, 27 and 28, the several signals are impressed on a common intermediate frequency amplifier and appear as 400 kilocycles $\pm$ 1000 cycles, 400 kilocycles $\pm$ 1400 cycles and 400 kilocycles $\pm$ 2200 cycles. From this point the action is similar to that described above for Fig. 4.

This system obviously may have both a plurality of transmitting stations and of receiving stations. The respective transmitting carrier frequencies and the calling tones may be so chosen and the equipment so designed that any transmitting station may call any or all of the receiving stations.

What is claimed is:

1. A multiple channel radio signal system comprising means for simultaneously transmitting a plurality of carrier current signals modulated respectively by definite relatively low frequency signals, and heterodyne receiving means comprising a high frequency selective input circuit, a third order modulator, and an oscillator supplying a carrier current of substantially fixed frequency to said modulator.

2. A multiple channel radio signal system comprising means for simultaneously transmitting a plurality of carrier current signals modulated respectively by definite relatively low frequency signals, and heterodyne receiving means comprising a high frequency selective input circuit, a modulator, an oscillator supplying a carrier current of substantially fixed frequency to said modulator, and means for biasing said modulator to give third order products.

3. A multiple channel radio signal system comprising means for simultaneously transmitting a plurality of carrier current signals modulated respectively by definite relatively low frequency signals, and heterodyne receiving means comprising a high frequency selective input circuit, a modulator, an oscillator supplying a carrier current of substantially fixed frequency to said modulator, means for biasing said modulator to give third order products, and means for tuning the output circuit of said modulator to a frequency band centering around the frequency of said oscillator.

4. A multiple channel radio signal system comprising means for simultaneously transmitting a plurality of carrier current signals modulated respectively by mutually exclusive relatively low frequency signals, and heterodyne receiving means comprising a high frequency selective input circuit having a frequency band width inclusive of said plurality of carrier current signals, a modulator, an oscillator supplying a carrier current of substantially fixed frequency to said modulator, means for biasing said modulator to give third order products, means for tuning the output circuit of said modulator to a frequency band centering around the frequency of said oscillator, an intermediate frequency amplifier, a demodulator, and selective circuits connected with the output circuit of said modulator.

5. A double detection multiple channel pick-up radio receiving system using third order modulation in a substantially fixed frequency heterodyne receiver comprising a high frequency selective input circuit having a frequency band width inclusive of signals receivable over a plurality of channels, a modulator receiving signals from said input circuit, an oscillator supplying to said modulator a carrier current of sub-

stantially fixed frequency, means for biasing said modulator to give high third order products, means for tuning the output circuit of said modulator to a frequency band centering around the frequency of said oscillator, an intermediate frequency amplifier, a demodulator, selective circuits connected with the output circuit of said demodulator, and a plurality of selective signal receiving means terminating said selective circuits.

6. A multiple channel radio signaling system comprising means for simultaneously transmitting a plurality of distinctive carrier currents modulated respectively by different relatively low frequency signals, and heterodyne receiving means comprising a plurality of high frequency input circuits, a plurality of modulators, an oscillator supplying a carrier current of substantially fixed frequency to said modulators, and means for biasing said modulators to give third order products.

7. A multiple channel radio signal system comprising means for simultaneously transmitting a plurality of distinctive carrier currents modulated respectively by different relatively low frequency signals, and heterodyne receiving means comprising a plurality of high frequency selective input circuits tuned respectively to each receive the frequency band of a different one of said modulated carrier currents, a corresponding plurality of modulators each connected with the output of a different one of said selective circuits, an oscillator supplying a carrier current of substantially constant frequency to each of said modulators, and means for biasing said modulators to give third order products.

8. A heterodyne radio receiver comprising a plurality of high frequency selective input circuits, a corresponding plurality of modulators each connected with the output of one of said selective circuits, an oscillator generating carrier current of substantially constant frequency connected to each of said modulators, means for causing said modulators to generate high third order products, means for tuning the output circuits of said modulators to a frequency band centering around the frequency of said oscillator, an intermediate frequency amplifier connected with the output circuits of said modulators, an intermediate frequency carrier regulating network connecting the output terminals of said oscillator with said amplifier, a demodulator connected with the output of said amplifier, and a selective monitoring device connected with the output circuit of said demodulator.

9. A heterodyne receiver comprising a plurality of high frequency selective input circuits, a corresponding plurality of modulators each connected with the output of one of said selective circuits, an oscillator generating carrier current of relatively low constant frequency connected to each of said modulators, means for causing said modulators to generate high third order products, means for tuning the output circuit of said modulators to a frequency band centering around the frequency of said oscillator, an intermediate frequency amplifier connected with the outputs of said modulators, an intermediate frequency carrier regulating network connecting the output of said oscillator with said amplifier, a demodulator connected to the output of said amplifier, selective signal indicating devices connected with the output circuit of said demodulator, means for adjusting the frequency of said oscillator to relatively high beating frequencies to cause the re-

ceiver to tune in any one of several incoming signals, and means for disconnecting said carrier regulating network.

10. A heterodyne radio receiver comprising a high frequency selective input circuit, a modulator, an oscillator generating carrier current of substantially constant frequency, means for causing said modulator to generate high third order products, means for tuning the output circuit of said modulator to a frequency band centered around the frequency of said oscillator, an intermediate frequency amplifier, an intermediate frequency carrier regulating network, a demodulator, and a monitoring device connected with the output circuit of said demodulator.

11. A radio signal system comprising a plurality of transmitting stations each transmitting a signal modulated carrier wave of distinctive frequency, a receiving station arranged for receiving said distinctive carrier frequency signals, means for locally generating a single carrier current, means for producing third order products in vacuum tubes at said receiving station for transferring the modulations present on said carrier waves to said single carrier current, means for amplifying said modulated single carrier current, and means for detecting the signal modulations of said single carrier current.

12. A carrier wave system comprising a third

order modulator, means for impressing a modulated carrier wave and independent unmodulated oscillations simultaneously thereon whereby there is produced a resultant output wave including a component having the carrier frequency of the unmodulated oscillations and having a modulation corresponding to that of the impressed modulated carrier wave, and means associated with the modulator for selecting said component from the output wave to the exclusion of other components of the output wave.

13. In a receiver for modulated carrier waves, a frequency selective input circuit, a modulating device adapted to produce strong third order modulation products, a heterodyne oscillation generator, circuits coupling said input circuit and said oscillation generator to said modulating device to impress thereon received signal waves and heterodyne oscillations, whereby there is produced in said modulating device oscillations of the frequency of the heterodyne generator modulated in accordance with the modulations of the received carrier waves, an output circuit connected to said modulating device and a frequency selective network in said output circuit for selectively transmitting the modulated oscillations of the heterodyne oscillation frequency.

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