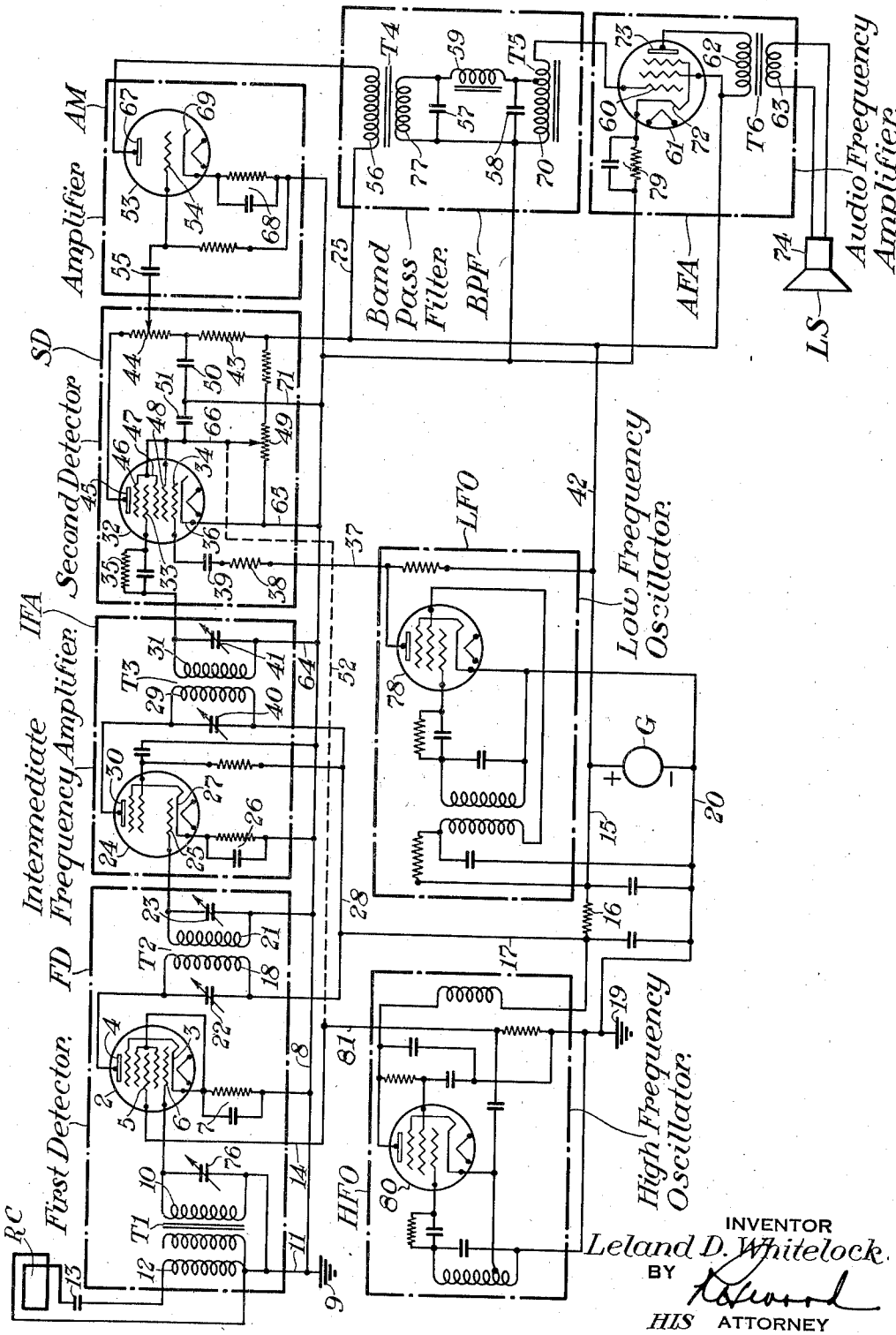
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RECEIVING APPARATUS FOR COMMUNICATION SYSTEMS

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## RECEIVING APPARATUS FOR COMMUNICATION SYSTEMS

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My invention relates to receiving apparatus for communication systems, and particularly to receiving apparatus for communication systems using carrier suppressed single side band transmission.

I shall describe one form of apparatus embodying my invention, and shall then point out the novel features thereof in claims.

A feature of my invention is the provision of communication system receiving apparatus which uses the superheterodyne principle and includes novel and improved means of frequency combination for demodulation. Another feature of my invention is the provision of receiving apparatus of the type here involved having a high degree of sensitivity and selectivity. Still another feature of my invention is the provision of receiving apparatus using the superheterodyne principle which is susceptible of superregeneration. Other features and advantages of my invention will appear as the specification progresses.

Modulation means that the amplitude of a carrier voltage varies as the amplitude of a modulation voltage. Such variation can be obtained by impressing simultaneously voltages of the carrier and the modulation frequencies upon a device whose response is not proportional to the voltage applied. When using multi-electrode electron tubes with carrier voltage on one grid and modulation voltage on another grid, direct multiplication of the carrier and modulation voltages results. In general, according to my invention, a carrier suppressed single side band communication current, such as an upper side band carrier telephone current, is mixed with a high carrier frequency in a first detector or mixer tube. The output of the first detector tube is fed through selecting circuits, preferably including an intermediate frequency amplifier, and in which circuits one of the side bands resulting from modulation of the high frequency carrier with the incoming communication current energy is selected and amplified and the remaining side band is rejected. A small portion of the high frequency carrier may be passed by the selecting circuits and amplified along with the selected side band. Such selection is accomplished easily as the two side bands appearing in the output of the first detector are separated from each other by twice the value of the frequency of the original carrier of the received communication current. In a second detector or demodulator tube, the frequencies passed by the selecting circuits are mixed with the energy supplied from a local oscillator which generates a carrier having a frequency corresponding to the original carrier of the received current. The resulting products of demodulation are passed through a band pass filter which is proportioned to pass the band of the original modulation frequencies and to suppress frequencies both above and below such band. Superregeneration can be effected at the second detector.

For a better understanding of my invention, reference may be had to the accompanying drawing, which is a diagrammatic view of one form of apparatus embodying my invention.

To assist in the understanding of the apparatus, I shall assume by way of illustration that the communication current to be received is an upper side band carrier telephone current, the carrier being of 7000 cycles per second and the voice frequency range extending from 500 to 2500 cycles per second. Under such conditions, the communication current has a frequency range of 7500 to 9500 cycles. Furthermore, I shall assume that the local high frequency carrier is of say, 500,000 cycles per second. The local low frequency carrier is of 7000 cycles, the same as the original carrier of the telephone current. It is to be understood, of course, that my invention is not limited to these frequencies, and other frequencies may be used, if desired.

Referring to the drawing, the apparatus in the form here illustrated, consists of eight distinctive units or devices, together with a receiving circuit and an output circuit. The apparatus also includes, of course, proper sources of current and circuit connections. These eight units or devices are, for the sake of clearness, shown each enclosed by dash and dot lines and can be identified as a first detector FD, an intermediate frequency amplifier IFA, a second detector SD, an amplifier AM, a band pass filter BPF, an audio frequency amplifier AFA, a high frequency oscillator HFO and a low frequency oscillator LFO. These several units will be taken up in turn and described, after which the operation of the apparatus as a whole will be pointed out.

The circuits for heating the filaments of the electron tubes of the several different units are not shown for the sake of simplicity, and it will be understood that the filament of each electron tube is heated so that the tube is in an active condition, the several filaments being connected with a proper source of current either in parallel or in series, as desired.

The first detector FD comprises an electron tube 2, an input transformer T1 and an output

transformer T2. The electron tube 2 may be of any one of several different types, and in this instance is a heptode provided with a cathode 3, an anode 4 and five grids, grids 5 and 6 being used as control grids, and the other three grids being used as suppressor and screen grids. The cathode 3 is connected over a grid biasing unit 7 with a common ground wire 8, which in turn is connected with a ground electrode 9 to form a ground connection common to the several units. The control grid 6 of tube 2 is connected with one terminal of the secondary winding 10 of the input transformer T1, the other terminal of which winding is connected over wire 11 with the common ground wire 8 to complete a circuit for the control grid 6. A condenser 16 is preferably connected across the secondary winding 10 of transformer T1. The primary winding 12 of transformer T1 is interposed in a receiving circuit which also includes a receiving coil RC and a condenser 13. The receiving coil RC would be coupled in any convenient manner with the transmitting circuit, not shown, over which the communication current is sent out from a remote transmitter. In case the communication current is the assumed upper side band carrier telephone current, the coil RC would be coupled with the metallic telephone circuit. In case the transmission is effected by means of radiated electromagnetic waves, the receiving coil RC would be coupled to or made an integral part of the antenna system. Again, the coil RC may be of the customary loop antenna type. The condenser 13 and the coil RC are proportioned to tune the receiving circuit for efficient reception of the specific communication current. The control grid 5 of tube 2 is connected over wire 14 with one output terminal of the high frequency oscillator HFO, to be described later on, the other output terminal of oscillator HFO being connected with the ground to complete a grid circuit for the grid 5.

The plate circuit of tube 2 can be traced from the positive terminal of a generator G over wire 15, resistor 16, wire 17, primary winding 18 of the output transformer T2, plate 4, intervening tube space to cathode 3, biasing unit 7, wire 8, ground electrodes 9 and 19, and wire 20 to the negative terminal of generator G.

On the assumption that the communication current is an upper side band carrier telephone current of a frequency range of 7500 to 9500 cycles, and that the high frequency carrier impressed on the grid 5 of tube 2 is of 500,000 cycles, the resulting modulation gives in the plate circuit of tube 2 the carrier frequency of 500,000 cycles, a lower side band of 492,500 to 490,500 cycles and an upper side band of 507,500 to 509,500 cycles. These three products resulting from modulation are available for inducing electromotive forces of corresponding frequencies in the secondary winding 21 of the output transformer T2.

The intermediate frequency amplifier IFA comprises an electron tube 24 and an output transformer T3. The control grid 25 of tube 24 is provided with a circuit including the secondary winding 21 of the output transformer T2 of the first detector FD, the grid 25 being connected with one terminal of winding 21 and the circuit being completed through a biasing element 26 interposed between the ground wire 8 and the cathode 27 of tube 24 and the lower terminal of secondary winding 21 being connected with wire 8. The plate circuit for tube 24 extends from the generator G over wire 15, resistor 16, wires 17 and 28, primary winding 29 of transformer T3, plate 30 of tube 24, intervening tube space to cathode 27, biasing unit 26, wire 8, ground electrodes 9 and 19, and wire 20 back to the generator G.

Condensers 22 and 23 are connected across the primary winding 18 and the secondary winding 21, respectively, of transformer T2, and are proportioned and adjusted to tune the associated circuits for selecting the upper side band frequencies of 507,500 cycles to 509,500 cycles appearing in the plate circuit of the first detector tube and to substantially suppress the lower side band. These circuits may be proportioned so that a small amount of the carrier frequency of 500,000 cycles is passed from the first detector tube to the intermediate frequency amplifier, for use in the second detector as will later appear. In this instance, I shall assume that a small amount of the high frequency carrier is passed. It is not essential that a part of the high frequency carrier be passed through the intermediate frequency amplifier IFA, since the high frequency carrier may be fed directly from the high frequency oscillator HFO to the second detector SD, in a manner to appear hereinafter. Condensers 40 and 41 are connected across the windings 29 and 31, respectively, of transformer T3, and are proportioned to aid the selectivity of the circuits associated with tube 24. It follows, therefore, that the upper side band resulting from modulation in the first detector and a portion of the high frequency carrier are selected and amplified at amplifier IFA and appear in the primary winding 29 of transformer T3 where they are available for inducing electromotive forces of corresponding frequencies in the secondary winding 31 of that transformer.

The second detector SD comprises an electron tube 32 and associated input and output circuits. The tube 32 is preferably a heptode similar to the tube 2 of the first detector, the grids 33 and 34 of tube 32 being used as control grids. The control grid 33 is connected with one terminal of the secondary winding 31 of transformer T3 over a grid leak unit 35, and the other terminal of secondary winding 31 is connected with the cathode 36 of tube 32 over wires 64, 8 and 65. Consequently, the upper side band of 507,500 to 509,500 cycles and the carrier frequency of 500,000 cycles passed and amplified through the intermediate frequency amplifier IFA are impressed upon the control grid 33 of tube 32. The control grid 34 of tube 33 is connected with the low frequency oscillator LFO, to be described later, over wire 37, a resistor 38 and a condenser 39 being interposed in the connection. Wire 37 is connected with one output terminal of the low frequency oscillator LFO and a second output terminal of oscillator LFO is connected with the ground and in turn with the ground wire 8 to complete the circuit for the control grid 34. Thus, the carrier frequency of 7000 cycles from oscillator LFO is impressed upon the control grid 34 of tube 32.

The plate circuit of tube 32 extends from generator G over wire 42, resistors 43 and 44 in series, plate 45 of tube 32, intervening tube space to cathode 36, wires 65 and 8, ground electrodes 9 and 19, and wire 20 to the generator G.

Since the frequencies impressed upon the control grid 33 of tube 32 consist of the upper side band resulting from modulation of the high frequency carrier by the received telephone current together with the high frequency carrier, and since the frequency impressed upon the control grid 34 is the carrier of the low frequency oscil-

lator, there is produced in the plate circuit of tube 32 a series of thirteen different main products of demodulation. It is believed unnecessary to itemize these various products of demodulation and that it is sufficient to point out that one of the products is the selected upper side band minus the sum of the two carrier frequencies, and which product is the voice frequency band, that is, the upper side band of 507,500 to 509,500 cycles minus the sum of high frequency carrier of 500,000 cycles and low frequency carrier of 7000 cycles leaving voice frequencies of 500 to 2500 cycles. In other words, one of the products of demodulation is the original voice modulation frequencies of the telephone current. The product of demodulation nearest in frequency to the voice frequency band is the low frequency carrier of 7000 cycles. There is sufficient frequency separation, therefore, to allow isolation of the voice frequency band by means of a band pass filter designed to pass the voice frequencies. It should also be noted that the impedance of the plate circuit of tube 32 will be so low to all demodulation products containing the high frequency carrier of 500,000 cycles that little or no voltage of these frequencies will appear in the output of the second detector SD.

The second detector SD can be made superregenerative by making the detector oscillate weakly at the frequency of 500,000 cycles and by using the low frequency of 7000 cycles as a quench frequency, as well as for detection. To accomplish superregeneration, the grids 46, 47, and 48 of tube 32 are tied together and connected over wire 66 to an intermediate terminal of a resistor 49 connected between wire 42 of the plate circuit and wire 65 leading to the cathode 36; two condensers 50 and 51 are interposed between the mid terminal of the resistors 43 and 44 of the plate circuit and the wire 66 connecting the grids 46, 47, 48; and the ground wire 6 is connected to the mid terminal of the condensers 50 and 51 over a wire 71.

These feed-back connections between the plate circuit of tube 32 and the grids of the tube are so proportioned and adjusted that oscillations of 500,000 cycles are generated. The high frequency carrier impressed upon the grid 32 through the intermediate frequency amplifier holds the detector oscillations in step so that there is no audible beat note from this source. As stated above, the low frequency carrier of 7000 pycles impressed upon the grid 34 of tube 32 acts as a quench frequency.

If desired, the high frequency carrier can be rejected in the output of the first detector FD along with the lower side band. In this case, the high frequency oscillator HFO would be connected with the second detector over a connection indicated by the dotted line 52 connected between the wire 14 leading from the high frequency oscillator HFO, and the wire 66 connected to the grids 46, 47, and 48 of tube 32.

The amplifier AM is a single-stage amplifier interposed between the second detector SD and the band pass filter BPF. The amplifier AM includes a triode electron tube 53, the control grid 54 of which is coupled with the plate circuit of the second detector SD. As here shown, the grid 54 is connected through a condenser 55 with an intermediate terminal of the resistor 44 interposed in the plate circuit of the second detector SD. The circuit for grid 54 is completed through a biasing unit 68 interposed between the cathode 69 and the common ground wire 8. Plate voltage is obtained for plate 67 of tube 53 from the generator G over wires 42 and 75 and the primary winding 56 of a transformer T4 which is part of the band pass filter BPF, as will be readily understood by an inspection of the drawing. Hence, the output of the second detector SD is amplified by amplifier AM and passed to the input side of the band pass filter BPF.

The band pass filter BPF comprises windings 56 and 7 of transformer T4, winding 70 of an output transformer T5, condensers 57 and 58, and an inductance 59. These windings and condensers are arranged in the usual manner for band pass filters and are adjusted so as to pass the voice frequency band extending from 500 to 2500 cycles and to substantially suppress frequencies outside of such band. As pointed out hereinbefore, in the products of demodulation produced at the second detector, the nearest frequency to the voice band is that of the low frequency carrier of 7000 cycles. Consequently, a high degree of selectivity at the band pass filter BPF is obtained.

The audio frequency amplifier AFA consists of an electron tube 61 and an output transformer T6. The voice frequencies appearing in the winding 70 of transformer T5 of the filter BPF are impressed between the control grid 60 of tube 61 of amplifier AFA and the cathode 72, a biasing unit 79 being interposed in the connection. Plate voltage is obtained for the plate 73 of tube 61 from the generator G, the circuit being readily understood by an inspection of the drawing and need not be further described except to point out that it includes the primary winding 62 of the output transformer T6. The final output circuit includes the secondary winding 63 of transformer T6 and the operating winding 74 of a loud speaker LS. It is clear that the voice frequencies passed by the filter BPF are further amplified at the amplifier AFA and reproduced at the loud speaker LS.

The high frequency oscillator HFO is of the electron tube type comprising an electron tube 80, having coupled plate and grid circuits. The parts are so proportioned that the alternating current component of the plate circuit persists and has a frequency, in the case here assumed for illustration, of 500,000 cycles per second. The specific structure of the oscillator HFO may take any of the well-known forms, and it is thought that it will be readily understood by an inspection of the drawing and a detailed description thereof is unnecessary except to point out that one output terminal is connected by wire 81 with wire 14 leading to the first detector FD and the other output terminal is connected with the ground electrode 19 and in turn with the ground wire 8. Also, the output of the high frequency oscillator HFO may be connected with the second detector SD through the medium of wires 81 and 52, if desired.

The low frequency oscillator LFO is also of the electron tube type and includes a pentode 78. The specific structure of this oscillator LFO may be that of any of the well-known types and will be readily understood by an inspection of the drawing. It is to be pointed out that the parts are so proportioned that the oscillator LFO generates a carrier frequency of 7000 cycles, which frequency is impressed upon the control grid 34 of the second detector SD.

In describing the operation of the apparatus,

it is to be understood that normally the electron tubes are all heated and are in an active condition. A carrier telephone current of 7500 to 9500 cycles, when picked up by the coil RC of the receiving circuit, is in turn impressed upon control grid 6 of the first detector tube 2 for modulation of the high frequency carrier of 500,000 cycles impressed upon the control grid 5 of tube 2. The resultant upper side band of 507,500 to 509,500 cycles is selected by virtue of the tuning of the circuits coupling the first detector FD with the intermediate frequency amplifier IFA. A small portion of the high frequency carrier is also passed by the coupling between the first detector and the intermediate frequency amplifier. Such selection is accomplished easily as the two side bands resulting from modulation in the first detector are separated from each other by twice the value of the original carrier frequency of the telephone current. After amplification of the selected frequencies at the intermediate frequency amplifier IFA, such frequencies are impressed upon the control grid 33 of the second detector tube 32. The local carrier frequency of 7000 cycles is impressed upon the control grid 34 of the tube 32. As a result of the mixing of these three frequencies, namely, selected upper side band, high frequency carrier and low frequency carrier, a series of products of demodulation are produced in the plate circuit of the second detector tube 32. One of these products of demodulation is the original modulating voice frequency of the telephone current. Superregeneration is accomplished at the second detector, as well as demodulation by feed-back connections between the plate circuit and certain of the grids of the tube 32. These several products of demodulation of the second detector SD are amplified by the single-stage amplifier AM and are impressed upon the input side of the band pass filter BPF proportioned to pass the voice frequency band. Of the products of demodulation of the second detector, the one having frequency nearest to the voice frequency band is that of the low frequency carrier. This being so, almost complete isolation of the voice frequencies is effected in the output of the filter. The voice frequencies appearing in the output of the filter are further amplified at the audio frequency amplifier AFA and are reproduced at the loud speaker LS. It is to be noted that the amplifiers AM and AFA may not be required, and also additional stages of amplification may be inserted, if desired. Furthermore, superregeneration can be omitted at the second detector. Again, the high frequency carrier may be suppressed in the output of the first detector FD and energy from the high frequency oscillator HFO supplied directly to the second detector SD, if desired.

Although I have herein shown and described only one form of receiving apparatus for communication systems embodying my invention, it is understood that various changes and modifications may be made therein within the scope of the appended claims without departing from the spirit and scope of my invention.

Having thus described my invention, what I claim is:

1. Receiving apparatus comprising, a first electron tube detector, a second electron tube detector, a source of high frequency carrier current, a source of low frequency carrier current, a receiving circuit proportioned for response to a carrier suppressed single side band communication current having a given signaling frequency band and the carrier of which is of the same frequency as said low frequency carrier, means to couple the receiving circuit and said source of high frequency carrier with the input electrodes of said first detector tube to modulate said high frequency carrier by the communication current picked up by the receiving circuit, coupling means to couple the output electrodes of said first detector tube with the input electrodes of said second detector tube, said coupling means proportioned to select a particular side band resulting from said modulation, other coupling means to couple said source of low frequency carrier and said source of high frequency carrier with the input electrodes of said second detector tube to produce as a product of demodulation the signaling frequency band of said communication current, a signaling device responsive to such signaling frequency band, and means to couple said device with the output electrodes of said second detector tube including a band pass filter proportioned to pass such signaling frequency band.

2. Receiving apparatus comprising, a first electron tube detector, a second electron tube detector, a source of high frequency carrier current, a source of low frequency carrier current, a receiving circuit proportioned for response to a carrier suppressed single side band communication current having a given signaling frequency band and the carrier of which is of the same frequency as said low frequency carrier, means to couple the receiving circuit and said source of high frequency carrier with the input electrodes of said first detector tube to modulate said high frequency carrier by the communication current picked up by the receiving circuit, coupling means to couple the output electrodes of said first detector tube with the input electrodes of said second detector tube, said coupling means proportioned to select a particular side band resulting from said modulation and to pass a portion of the high frequency carrier, other coupling means to couple said source of low frequency carrier with the input electrodes of said second detector tube to produce as a product of demodulation, the signaling frequency band of said communication current, a signaling device responsive to such signaling frequency band, and means to couple said device with the output electrodes of said second detector tube including a band pass filter proportioned to pass such signaling frequency band.

3. Receiving apparatus comprising, a first electron tube detector, a second electron tube detector, a source of high frequency carrier current, a source of low frequency carrier current, a receiving circuit proportioned for response to a carrier suppressed single side band communication current having a given signaling frequency band and the carrier of which is of the same frequency as said low frequency carrier, means to couple the receiving circuit and said source of high frequency carrier with the input electrodes of said first detector tube to modulate said high frequency carrier by the communication current picked up by the receiving circuit, coupling means to couple the output electrodes of said first detector tube with the input electrodes of said second detector tube, said coupling means proportioned to select a particular side band resulting from said modulation, other coupling means to couple said source of low frequency carrier and said source of high frequency carrier with the input electrodes of said second

detector tube to produce as a product of demodulation the signaling frequency band of said communication current, circuit means to couple the anode electrode of the second detector tube with a grid electrode of the tube including resistance and capacitance as required to effect superregeneration for said second detector, a signaling device responsive to such signaling frequency band, and means to couple said device with the output electrodes of said second detector tube including a band pass filter proportioned to pass such signaling frequency band.

4. Receiving apparatus comprising a first electron tube detector, an intermediate frequency electron tube amplifier, a second electron tube detector, a source of high frequency carrier current, a source of low frequency carrier current, a receiving circuit proportioned for response to a carrier suppressed single side band communication current having a given signaling frequency band and the carrier of which is of the same frequency as said low frequency carrier, means to couple the receiving circuit and said source of high frequency current with the input electrodes of said first detector tube to modulate said high frequency carrier by the communication current picked up by the receiving circuit, coupling means to couple the output electrodes of said first detector tube with the input electrodes of said amplifier tube, said coupling means proportioned to select a particular side band resulting in said modulation and to pass a portion of the high frequency carrier, other coupling means to couple the output electrodes of said amplifier tube and said source of low frequency carrier with the input electrodes of said second detector tube to produce as a product of demodulation the signaling frequency band of said communication current, a signaling device responsive to such signaling frequency band, and means to couple said device with the output electrodes of said second detector tube including a band pass filter proportioned to pass such signaling frequency band.

5. Receiving apparatus comprising, a first electron tube detector provided with two control grids, a second electron tube detector provided with two control grids, a receiving circuit proportioned for response to a given carrier suppressed single side band communication current having a given signaling frequency band, a first source of carrier current of a frequency different from the frequency of the carrier of the communication current, a second source of carrier current of the same frequency as the carrier of the communication current, means to connect the receiving circuit with one control grid and said first source with the other control grid of the first detector tube to produce side bands of the first carrier and the communication current picked up by the receiving circuit, coupling means to couple the plate circuit of the first detector tube with one control grid of the second detector tube, said coupling means proportioned to select a particular one of said side bands only and to pass a portion of the first carrier, means to connect said second source with the other control grid of the second detector tube to produce as a product of demodulation the signaling frequency band of said communication current, a signaling device responsive to such signaling frequency band, and means to couple said device with the plate circuit of said second detector tube including a band pass filter proportioned to pass such signaling frequency band.

6. Receiving apparatus comprising a first and a second electron tube detector, said tubes each provided with a plurality of control grids, a receiving circuit proportioned for response to a given carrier suppressed single side band communication current having a given signaling frequency band, a first and a second source of carrier current, said first source of a frequency different from the frequency of the carrier of the communication current and said second source of the same frequency as the communication current carrier, means to connect the receiving circuit with one control grid and said first source to a second control grid of the first detector tube to produce in the plate circuit of said tube the side bands of the first carrier and the communication current picked up by the receiving circuit, means including an amplifier and tuned circuits to couple the plate circuit of said first detector tube with one control grid of the second detector tube, said means proportioned to select and amplify a particular one of said side bands only, other means to connect said second source with a second control grid and said first source with a third grid of said second detector tube to produce in the plate circuit of said second tube a series of products of demodulation, a signaling device responsive to the signaling frequency band of the communication current, and means including a filter to couple said device with the plate circuit of said second tube, and said last mentioned means proportioned to pass only said signaling frequency band.

7. Receiving apparatus comprising a first and a second electron tube detector, said tubes each provided with a plurality of control grids, a receiving circuit proportioned for response to a given carrier suppressed single side band communication current having a given signaling frequency band, a first and a second source of carrier current, said first source of a frequency different from the frequency of the carrier of the communication current and said second source of the same frequency as the communication current carrier, means to connect the receiving circuit with one control grid and said first source to a second control grid of the first detector tube to produce in the plate circuit of said tube the side bands of the first carrier and the communication current picked up by the receiving circuit, means including an amplifier and tuned circuits to couple the plate circuit of said first detector tube with one control grid of the second detector tube, said means proportioned to select and amplify a small portion of the first carrier and a particular one of the side bands only, other means to connect said second source with a second grid of said second detector tube to produce in the plate circuit of said second detector tube products of demodulation of the first and second carrier and said particular side band, a signaling device responsive to the signaling frequency band of the communication current, and means including a filter to couple said device with the plate circuit of said second tube and said filter proportioned to pass such signaling frequency band only.

8. Receiving apparatus comprising a first and a second electron tube detector, said tubes each provided with a plurality of control grids, a receiving circuit proportioned for response to a given carrier suppressed single side band communication current having a given signaling fre-

quency band, a first and a second source of carrier current, said first source of a frequency higher than the frequency of the carrier of the communication current and said second source of the same frequency as the communication current carrier, means to connect the receiving circuit with one control grid and said first source to a second control grid of the first detector tube to produce in the plate circuit of said tube the side bands of the first carrier and the communication current picked up by the receiving circuit, means including an amplifier and tuned circuits to couple the plate circuit of said first detector tube with one control grid of the second detector tube, said means proportioned to select and amplify a small portion of the first carrier and a particular one of the side bands only, other means to connect said second source with a second grid of said second detector tube to produce in the plate circuit of said second detector tube products of demodulation of the first and second carrier and said particular side band, circuit means including resistance and capacitance to couple the plate and a selected grid of the second tube as required to effect superregeneration for which the second carrier acts as the quench frequency, a signaling device responsive to the signaling frequency band of the communication current, and means including a filter to couple said device with the plate circuit of said second tube and said filter proportioned to pass only a band equal to said signaling frequency band.

9. The method of detecting a carrier suppressed single side band signaling current by the superheterodyne reception principle of generating a first local carrier current of a frequency different from the frequency of the carrier of the signaling current and modulating said first local carrier current with the received signaling energy, selecting a particular side band resulting from such modulation, generating a second local carrier current of a frequency the same as that of the carrier of the signaling current and mixing the selected side band and the first local frequency carrier with said second local carrier and filtering out the signaling frequency from the products of demodulation.

10. The method of detecting a carrier suppressed single side band signaling current by the superheterodyne reception principle of generating a first local carrier current of a frequency different from the frequency of the carrier of the signaling current and modulating said first local carrier current with the received signaling energy, selecting and amplifying a particular side band resulting from such modulation and a small amount of the first local frequency carrier, generating a second local carrier current of a frequency substantially the same as that of the carrier of the signaling current and mixing the amplified energy with said second local carrier and filtering out the signaling frequency from the products of demodulation.

11. The method of detecting a carrier suppressed single side band signaling current by the superheterodyne reception principle of generating or first local carrier current of a frequency higher than the frequency of the carrier of the signaling current and modulating said first local carrier current with the received signaling energy, selecting a particular side band resulting from such modulation, generating a second local carrier current of a frequency the same as that of the carrier of the signaling current and mixing the selected side band and said first local carrier with said second local carrier for producing a series of products of demodulation, amplifying selected ones of said products of demodulation by superregeneration and filtering out the signaling frequency from the products of demodulation.

12. The method of detecting an upper side band carrier telephone current of generating a first local carrier current of a frequency different from the frequency of the carrier of the telephone current and modulating said first local carrier current with the received telephone current energy, selecting the upper side band resulting from such modulation, generating a second local carrier current of a frequency the same as that of the carrier of the telephone current and mixing said selected upper side band and some of the first local frequency carrier energy with said second local carrier and filtering out the voice frequency band from the products resulting from the demodulation.

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