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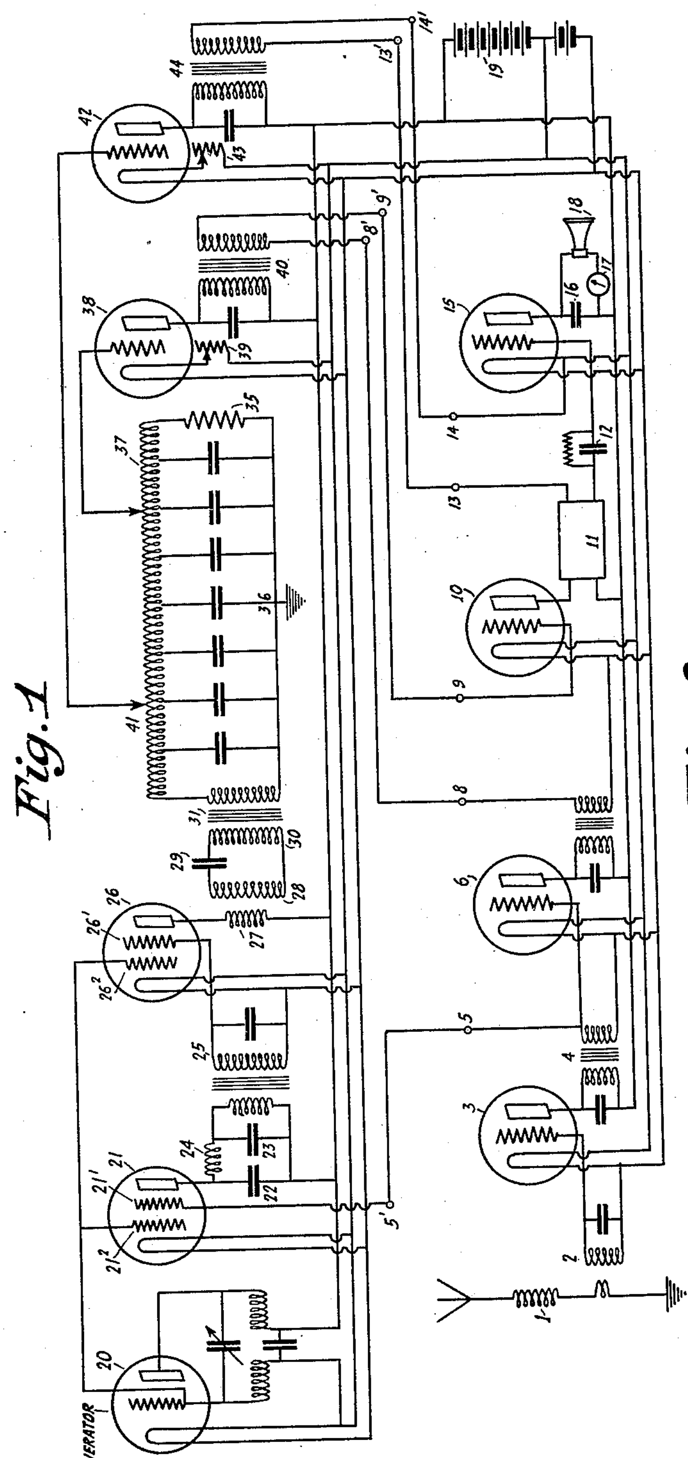
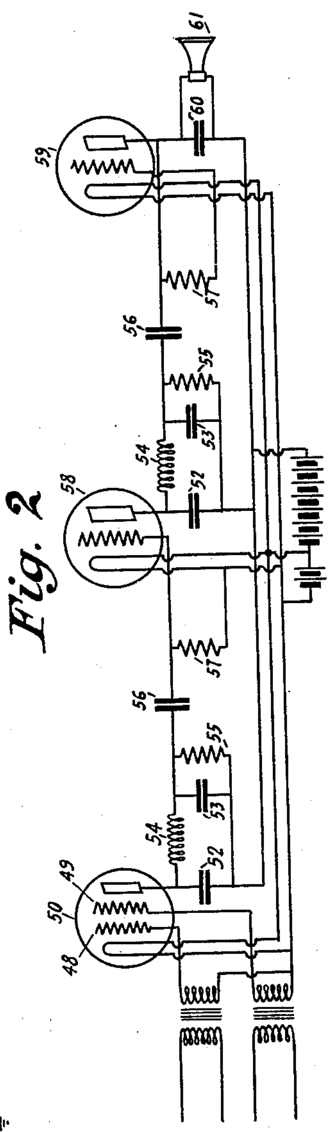
RECEIVING SYSTEM

Filed April 22, 1927





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RECEIVING SYSTEM

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It is the general object of this invention to provide a receiving system adapted for the reception of high frequency currents and especially such types of currents as are used in wireless telegraphy.

It is a still further object of the invention to provide a receiving system in which the signal wave is freed of the carrier wave and in which such resultant wave may be further modified, when desired, by a wave corresponding to the carrier wave. Further objects of the invention will be apparent as the description proceeds and are pointed out in the appended claims.

In the drawings, Fig. 1 is a diagrammatic view of a receiving circuit made according to the invention.

Fig. 2 is a diagrammatic view of a circuit showing a modified form of the invention.

Certain long-distance transmission means are operated by more or less marked modulation of a carrier wave or else by alternate interruptions and re-establishments (chopping) of the wave. For certain purposes some of which shall be mentioned in what follows, it may be necessary to pick up or obtain the carrier wave separated not only from the modulations which form the mode of signalling properly so-called, but also from the various disturbances and interfering agencies such as atmospherics, jamming, etc.

This result, fundamentally speaking, could be obtained by picking up these oscillations in a shunt comprising, among other elements, a resonator sufficiently perfect and selective in order that its time constant may attain, for instance, the order of magnitude of one second. The effect of accumulation thus realized would result in a regular oscillation freed from all alterations. In telephony, for instance, this would be the carrier wave itself, a means covering several times ten or hundreds of dots, dashes and intervals (spaces). But this method is practically unserviceable in this simple form so that it is necessary to have recourse to an artifice which forms the subject-matter of the present invention.

The means in question consist of double modulation by the aid of one and the same local modulator, the first modulation reducing the frequency to a sufficiently low value, and the second modulation restoring the original frequency. Between the two modulations, there is passed the low frequency serving as an intermediary in a resonator having a high time-constant which results in transformation of the incident oscillation broken by intentional or unintentional causes, into another one whose amplitude is stable. Of the first modulation, there is retained only the pulsation $\Omega=\omega o-\omega l$, that is, the difference between that of the signal ωo and that of the local oscillator ωl. Of the second modulation, there is preserved the pulsation $\omega o=\Omega+\omega l$, the sum total of that of the low intermediate frequency, and that of the local generator ωl. It will be readily understood that the unknown phase of the generator disappears in the course of such successive subtractions and additions, so that the oscillation picked up has the necessary properties, i. e., a constant amplitude, the frequency of the carrier wave and a well-defined phase.

Such an operation could be repeated several times without it being necessary to follow any fixed order for the consecutive reductions and elevations of frequency, provided that each local generator is used an even number of times, one-half for the reduction and the other for the raising.

It will be understood that the incidental oscillations may be priorly transformed, as is true, for instance, in the case of superheterodyne receivers used in radio communication. More specifically, this invention provides a local generator successively employed, that is, first for diminishing the frequency, and secondly to raise the resultant frequency so that there results the same initial frequency as at the beginning. The original frequency is provisionally reduced so as to cause the signal to resonate in a circuit which has a high time constant whereupon the carrier wave is rid of amplitude flunctuations due to signalling or strays. In other words, after the second modulation there is obtained a perfectly sinous carrier wave having exactly the frequency and the phase it had at the start.

In Fig. 1, the receiver being of any desired kind comprises an aerial 1, a secondary 2, and a certain number of stages 4, 7 . . . . . for amplifying the magnitude, transformed or not, of the incoming oscillations. By way of example, there is moreover shown a device 11 whose operation has been assumed to be improved by ridding the signal of its carrier ware, and an ordinary detector 15—12 whose operation, as is well known, is improved by the reinforcement of this wave.

For each of the two modulations intended to bring out the carrier wave, recourse may be had to any desired methods. As shown in Fig. 1, point 5 of the receiver acts upon a controlling electrode 21′ of a tube 21, another electrode 21^2 of which, is subject to excitation from a local oscillator 20 generating pulsations ωl, the incoming signal pulsations being denoted by ωo. Filter 22—23—24 is for the purpose of stopping all oscillations having a pulsation $\omega o+\omega l$, whereas those of pulsation $\Omega=\omega o-\omega l$ actuate the resonator 25 whose time-constant is adequately high (if required, by the aid of regeneration not shown in the drawings). The said resonator, in turn, acts upon one, 26′, of the control electrodes of tube 26, another electrode 26^2 of which is subject to the action of generator 20. After this second modulation, by means of selector 27—28—29—30 only such oscillations as have pulsations ωo of the carrier wave are allowed to pass. In order to employ these separated oscillations for useful purposes, all that is necessary is to provide ways and means adapted to modify them conveniently in both phase and amplitude, and each such utilization, for instance, comprises a pair of tubes 38, 42, the grids of which are connected with a suitable point of an artificial wire 36 corresponding to a length of wave of the oscillations ωo, and provided at one end with a resistance 35 to avoid reflections, this being done for phase regulation. Regulation of the amplitudes is effected by adjusting the sensitivity of tubes 38, 42 by the aid of heating rheostats 39, 43.

Fig. 1 shows two cases of practical utilization.

In one scheme of practical use shown by way of example, it is indicated in what way the carrier wave's effect susceptible of inconveniencing the operation of a device 11 is avoided. It is sufficient for this purpose that the carrier wave obtained in pure shape at 8′ 9′ should compensate both in size and phase that superposed upon the signal as supplied from the transformer 7. Hence, transformers 7 and 40 are of the differential kind. Thus, the grid of tube 10 will receive only alterations of the carrier wave constituting the signal properly so called.

A second practical application shows in what way, on the contrary, the action of the carrier wave upon a device such as a detector 12—15 whose operation is improved, can be reinforced. Instead of having a diminishing effect, the action of 13—14 will then be additive by virtue of choosing a convenient connection 41 with the artificial line. However, such reinforcement of the carrier wave in detector operation involving the well-known inconvenience of not producing a linear action, improves the faithfulness of reproduction especially in telephony. When effected artificially at the receiving station, such reinforcement, at the same quality, allows of more extensive modulation of the sending stations whose sending range is thus increased.

Another mode of utilization of the carrier wave, according to the present invention, is represented in Fig. 2. It consists in using this oscillation for modulating the signal, instead of a local oscillator. The carrier wave, after having been separated in a manner as hereinbefore described, from the oscillations forming the signal and adjusted to the desired phase, is applied, for instance, to a control electrode 48 in a vacuum tube 50, another electrode 49 of which receives the action of the signal. The plate circuit is then passed by a unidirectional current whose alterations reproduce those impressed upon the carrier wave by the signaling apparatus, voice, key, or the like. The action upon the next tube 58 is effected, for instance, by the aid of well-known coupling means comprising resistance 55 and capacity 56. If the variations to be reproduced are too slow (as is true of telegraphy work), condenser 56 is replaced by a convenient source of potential. The filter 52—53—54 causes the variations comprised in the signal band to flow into the resistance 55, but shunts those of a higher frequency; for instance, jamming having pulsation ωB transformed by modulation due to the carrier wave of the signal into oscillations having a pulsation $\omega B-\omega o$ is eliminated by the filter, if this new pulsation is outsde the above band. If this arrangement is repeated in as many stages as are required, it thus has the properties of the usual heterodyne arrangement, while it is free from the well-known inconvenience according to which the modulations by local oscillators cause jamming effects whose frequency is symmetrical to that of the signal with relation to that of the local generator, since the local generator is here replaced by the carrier wave itself the frequencies will be the same.

This arrangement offers this additional advantage which is well-known in theory, though inapplied in practice, of eliminating jamming actions and disturbances whose phases are in quadrature with relation to that of the carrier wave of the signal.

What I claim is:

1. In wireless systems a method for isolating and purifying the carrier wave of a re-

ceived signal which comprises modulating the received signal twice by means of a single local oscillator, the first modulation lowering the frequency for the object of establishing conditions of resonance with a circuit possessing a high time constant and the second modulation restoring the original frequency.

2. In wireless systems a device for isolating the signal carrier wave of a received signal which comprises a receiving and amplifying system, means comprising a local oscillator for modulating the incoming signal whereby the frequency is lowered, a resonating circuit for purifying said modulated signal and means comprising said local oscillator for restoring said original frequency.

3. The steps in the method of wireless communication which comprise receiving and amplifying a desired signal, heterodyning said signal for reducing the frequency thereof, resonating the beat in a circuit having a relatively large time constant and modulating the resultant energy by means of a local oscillator so that the original frequency may be restored.

4. The steps in the method of wireless communication which comprise receiving and amplifying a desired signal, heterodyning said signal by means of a local oscillator for reducing the frequency thereof, resonating the beat in an approximately undamped circuit and modulating the resultant energy by means of said local oscillator so as to restore the original frequency.

5. In a wireless signalling system in combination, means for receiving and amplifying transmitted signal energy, means comprising a local source of oscillations for heterodyning said amplified energy and altering the frequency thereof, means comprising a resonating circuit having a low damping characteristic for resonating said altered frequency and means comprising said local source of oscillations for restoring the resultant energy to its signal frequency and rectifying means for obtaining the signal therefrom.

6. A method of wireless communication which comprises receiving energy of desired signal frequency, heterodyning part of said received energy for reducing the frequency thereof, resonating the beat frequency resulting from said heterodyning, heterodyning said resonated beat note for restoring the resulting energy to the frequency of the received signal energy, adjusting the phase and amplitude of part of said last named restored energy and combining said part with the unused portion of said received energy, limiting the amplitude of the resulting combined energy within predetermined limits, combining said limited energy with the unused portion of said restored energy and rectifying the energy resulting therefrom.

7. In a wireless communication system, in combination, means for receiving energy of desired signal frequency, means for heterodyning part of said received energy for reducing the frequency thereof, means for resonating the resultant beat note in a circuit having a relatively high time constant, means for heterodyning said resonated beat note for restoring the resulting energy to the frequency of the received signal energy, means for adjusting the phase and amplitude of part of said last named restored energy and means for combining said part with the unused portion of said received energy, an amplitude limiting device for limiting the amplitude of the resulting combined energy within predetermined limits, and means for combining said limited energy with the unused portion of said restored energy and rectifying the energy resulting therefrom.

8. In a receiving circuit of a wireless communication system, an energy absorption circuit for receiving energy of any desired signal frequency, a local oscillation generator adapted to heterodyne part of said received energy for reducing the frequency thereof, means for resonating the resultant beat note comprising a filter circuit having a relatively high time constant, means for heterodyning said resonated beat note comprising said local oscillation generator, said last named means being adapted to restore the resulting resonated beat note energy to the frequency of the received signal energy, means for adjusting the phase and amplitude of part of said last named restored energy and a triode for combining said part with the unused portion of said received energy, means for limiting the amplitude of the resulting combined energy within predetermined limits, and a rectifying circuit for combining said limited energy with the unused portion of said restored energy and rectifying the energy resulting therefrom.

9. A method of receiving wireless communication which comprises receiving energy of desired signal frequency, deriving a purified carrier wave by heterodyning part of said received energy for changing its frequency, resonating the resultant beat note, heterodyning said resonated beat note for restoring the resulting energy to the frequency of the received signal energy, altering the characteristics of part of said last named restored energy and combining said altered portion with the unused portion of said received energy, modifying the shape of the resulting combined energy wave, combining said modified energy wave with the unused portion of said restored energy and rectifying the energy resulting therefrom.

10. A method of receiving signals in wireless communications which comprises receiving energy of a desired signal frequency, heterodyning part of said received energy for

reducing the frequency thereof, resonating the beat frequency resulting from said heterodyning, heterodyning said resonated beat note for restoring the resulting energy to the frequency of the desired signal, adjusting the phase and amplitude of part of said last named restored energy so that it will be opposite in phase and equal in amplitude to the carrier wave of the unused portion of said received energy combining said unused portion of received energy with said adjusted energy, limiting the amplitude of the combined energy, combining the limited energy with the unused portion of said restored energy and rectifying the energy resulting therefrom.

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