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METHOD OF AND SYSTEM FOR RADIOSIGNALING

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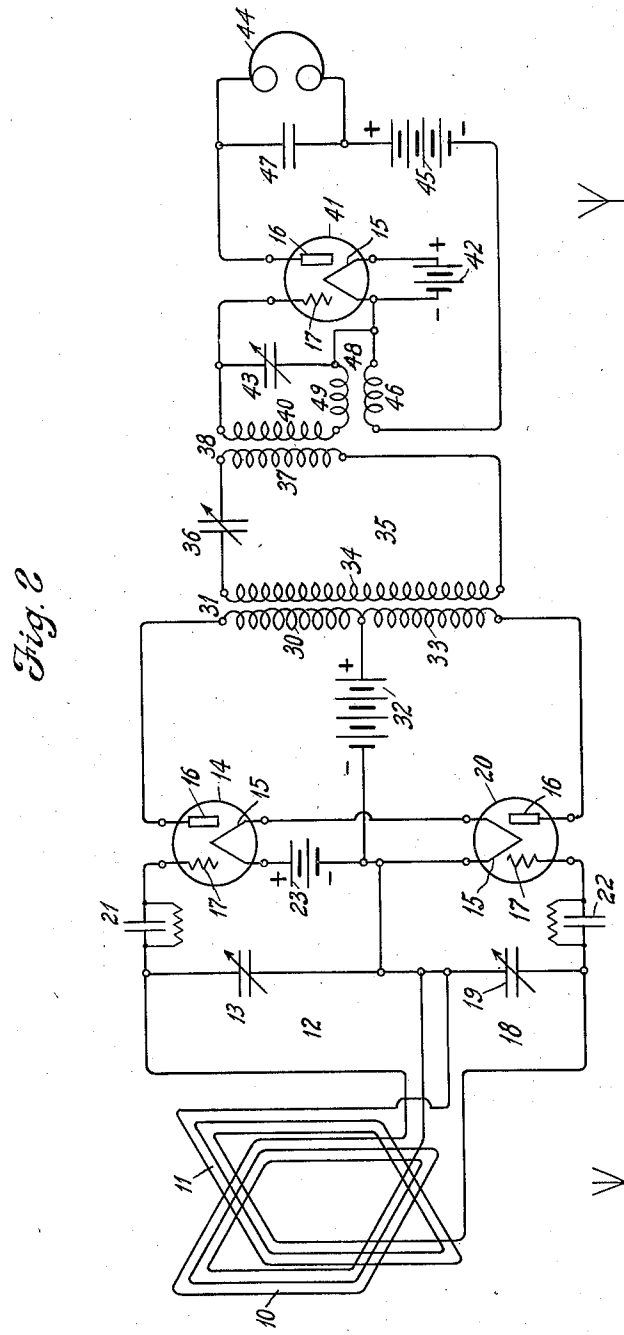


Fig. 2

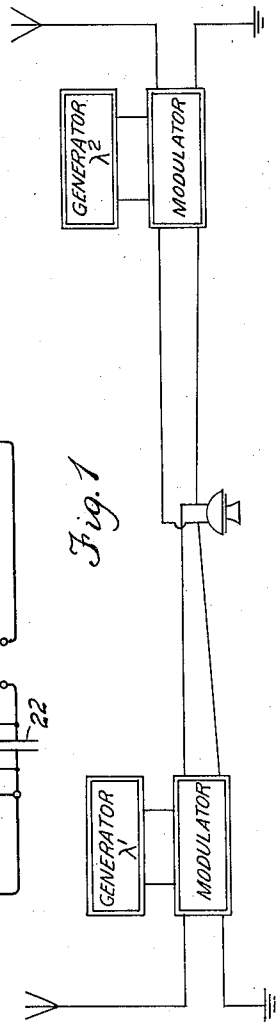


Fig. 1

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METHOD OF AND SYSTEM FOR RADIOSIGNALING

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This invention relates to methods of and systems for transmitting intelligence by radiant energy and has for some of its objects the provision of an improved method and means for transmitting a message without interference by others; the elimination of effects of static and other atmospheric strays; and the provision of a plurality of message channels over which the message may be transmitted in variously characterized forms, whereby the message may be transmitted over any of the channels independently of the other or others. Still other objects of the invention will appear hereinafter.

In the drawings there is shown diagrammatically so much of a radio system embodying the present invention as is necessary to an understanding of the present invention.

Fig. 1 represents a transmitter and Fig. 2 represents a receiver.

In systems for radiant signaling it has been the practice to provide means at the sending station for modulating a fundamental frequency or carrier wave, commonly known as the "A frequency", by a second oscillating current commonly designated the "B frequency". The B frequency current may be a current of voice frequency, that is, may be produced by a usual telephone transmitter in accordance with voice waves. It is understood that the system of the present invention may employ such a sender which is shown, for example, in Fig. 1, provision being made for the production of a plurality of A frequency currents 1, 2, etc., of relatively different frequencies, all modulated in accordance with the same B frequency. In the specific embodiment shown and described for the purpose of illustration a pair of channels is provided and it is understood that the phase of modulation at the sender is to be opposite so that the modulation frequency effects at the receiving station are additive, in the filter circuit. This will be more fully brought out in the following detailed description of the receiving apparatus.

Referring to Figure 2, there is shown so much of a so-called "wireless" receiving system as is necessary to an understanding of the invention. As shown, the said receiving station comprises a pair of loops 10 and 11 positioned at an angle of substantially 45° with respect to the direction from which the radiant energy is expected to be received. Each of these loops forms a part of a receptive radio channel and is suitably wound and proportioned to most efficiently respond to Hertzian waves of frequencies assigned to the respective channels.

The loop 10 forms part of a closed oscillatory circuit 12 including an adjustable condenser 13, by which it may be tuned to one of the A frequencies. The circuit 12 of the loop 10 is operatively connected to a three electrode thermionic device 14 having a usual heated filament 15 forming a hot cathode for emitting electrons, a plate 16 upon which the electrons impinge, and a grid or potential gradient varying means 17 for controlling the passage of electrons. The grid or input circuit is thus arranged to be controlled by electrical oscillations in the loop 10 and the oscillatory circuit 12. In series with the grid or input circuit there is provided a blocking condenser 21 and a usual grid leak resistance whereby the device 14 is caused to operate as a detector.

Similarly, the loop 11 forms part of a closed oscillatory circuit 18, including an adjustable condenser 19 by which it may be tuned to the other one of the A frequencies. The circuit 18 of the loop 11 is operatively connected to a second three-electrode thermionic device 20 similar to the device 14 and having a usual filament 15, plate 16 and grid 17. The grid or input circuit of the device 20 is arranged to be responsive to the electrical oscillations in the loop 11 and closed oscillatory circuit 18. In series with the grid circuit there is provided a blocking condenser 22 and usual grid leak resistance whereby the device 20 is caused to operate as a detector. A filament heating battery 23 serves to incandesce the filaments 15 of the thermionic devices 14 and 20.

The output circuit of the thermionic device 14 includes a winding 30 of a transformer 31 and a plate potential battery 32. The output circuit of the thermionic device 20 includes another winding 33 of the

transformer 31 and also the plate potential battery 32. The plate potential battery 32 determines the normal plate voltage of the plates 16 of the devices 14 and 20, its polarity being such that said plates are positive with respect to the hot cathodes. A third winding 34 of the transformer 31 forms part of a filter or resonant circuit 35 which as shown includes a suitable condenser 36 and a winding 37 of a second transformer 38. The capacity of the condenser 36 and the inductance of the windings 34 and 37 are such that the filter circuit 35 permits flow of current of the modulation frequency selected, but effectually blocks or prevents the flow of currents of other frequencies.

A second winding 40 of the transformer 38 is connected to the input or grid 17 of a third thermionic device 41, having a usual filament 15 and plate 16. A filament heating battery 42 is arranged to incandesce the filament 15. A condenser 43 is provided in the grid or input circuit of the device 41 for a purpose which will be subsequently set forth. The output or plate circuit of the thermionic device 41 includes an indicating device 44, a plate potential battery 45, and a winding 46 of a transformer 48. The potential of battery 45 is such that the plate 16 of the device 40 is made positive with respect to the hot cathode. A by-pass condenser 47 is provided in shunt with the indicating device 44 for currents of relatively high frequency. The secondary winding 49 of the transformer 48 is included in the grid circuit of the device 41 for feeding back energy thereto.

In the operation of the embodiment shown in Figure 2 the sending station impresses on the ether a plurality of fundamental or A frequencies, differing from each other and modulated in accordance with the same B frequency current (which may be super audible or may be audible as in voice modulation). The respective oscillations produce currents in the coils 10 and 11, and these currents are respectively rectified or detected by means of the thermionic devices 14 and 20. The rectified or detected currents flow through the respective windings 30 and 33 of the transformer 31, the direction of winding being such that they produce additive effects upon the winding 34. A local current flows in the filter circuit 35 which is inductively coupled to the winding 40 of the transformer 38 and thus to the input circuit of the thermionic device 41. The windings 46 and 49 are arranged so that energy is fed back from the plate or output circuit of the amplifying device 41 to the input or grid circuit. If the modulation frequency is super audible device 41 is used as an autodyne. The frequency of the current fed back is then such that it differs from the frequency of current flowing in the filter circuit 35, by a relatively small amount, there being thus produced a series of beats which are sufficiently low in frequency to actuate the low frequency indicating device or telephone receiver 44.

If the modulation of the A frequencies is audible or voice modulated, device 41 is operated as a regenerative amplifier; or it is omitted entirely, the indicating device 44 being then connected directly to the winding 40.

It will be seen that the effects of the true message currents are additive in the circuit 35 while the effects of strays and static disturbances will be subtractive. Thus the true message will be reliably received with substantially no interference thereto by strays or static disturbances, or by other interfering messages.

Thus it will be seen that I have provided a receiving system for receiving telephone or telegraph messages which is essentially proof against interference from atmospheric strays or so-called "static" or other radio disturbances. Furthermore, the system provides two channels through either of which the message is received, each of said channels being adapted to receive the message independently. Danger of block by malicious outsiders is thus minimized since each of the channels will operate independently of such outside interference to actuate the indicating device, and thus the message will be received in spite of the attempted interference. Furthermore, the system is relatively free from interference by strays or so-called "static."

Illustrative apparatus and circuits have been shown for the purpose of showing some of the ways in which the invention may be practiced; but it is expressly understood that the scope of the invention is not to be limited thereby, reference being had to the appended claims for that purpose.

What is claimed is:—

1. A method of electrical communication which consists in transmitting two series of waves modulated in opposite phase relation, receiving said series of waves, producing at the receiver currents corresponding in frequency with said modulations, additively combining said currents, and indicating them.

2. A method of electrical communication which consists in transmitting two series of waves modulated in opposite phase relation, impressing signal variations on the modulated series of waves, receiving said series of waves, producing at the receiver currents corresponding in frequency with said modulations, additively combining said currents, and reproducing the signals from the combined currents.

3. In a receiving system for radiant energy, a plurality of receiving channels responsive respectively to a plurality of series of radi-

ant oscillations having different predetermined high frequencies, said series of oscillations being modulated according to a series of variations impressed thereon differing in phase for each of said series of oscillations, means for demodulating said series of oscillations to produce currents corresponding in frequency with the modulations thereof, means for additively combining said currents, an indicating device, and means for causing said combined currents to actuate said device.

4. A radio receiving system comprising two channels for the reception respectively of two carrier waves having unlike frequencies and modulated in opposite phase relation, a detector operatively connected with each of said channels, an indicating device operated by said detectors, and a filter circuit connected oppositely to the output circuits of the detectors and interposed between said detectors and said indicating device for permitting the passage of currents of a selected frequency band.

5. A radio receiving system comprising a plurality of channels for the reception of a plurality of carrier waves having unlike frequencies and modulated at the same frequency but in different phase relation, a detector operatively connected with each of said means, an indicating device operated by said detectors, and a single filter circuit differentially connected with the output sides of the detectors and interposed between said detectors and said indicating device, said filter circuit being responsive only to a predetermined frequency band.

6. A multi-channel radio receiving system comprising a pair of loops arranged at an angle of substantially 90° to each other and at angles of substantially 45° to the direction of propagation of a signal wave, a corresponding pair of closed, oscillatory circuits each including one of said loops, a detector operatively connected with each of said closed, oscillatory circuits, an indicating device operated by said detectors, and a filter circuit interposed between said detectors and said indicating device.

7. In a receiving system for radiant energy, a plurality of receiving channels tuned to energy of different frequencies respectively, means for producing currents of like frequencies but of different phases from the received energy, an indicating device, and means interposed between said channels and the indicating device for causing said currents to combine additively and to simultaneously actuate said device.

8. A method of wireless communication which consists in transmitting two series of waves having unlike frequencies and modulated in opposite phase relation according to a single series of variations impressed thereon, receiving and detecting the energy of each of said waves independently, additively combining the currents produced by said detection, combining the resultant current with current of a different frequency to produce beat currents, and indicating the beat currents.

9. Means for receiving the energy of a plurality of waves modulated in out-of-phase relation according to a single series of variations, comprising an indicating device, means for producing currents from said waves of frequencies corresponding to said variations and of similar out-of-phase relation, and means for additively combining said currents to actuate said device and for differentially combining the effects of other waves.

10. Means for receiving the energy of two waves modulated in opposite phase relation according to a single series of variations, comprising an indicating device, means for producing currents from said waves of frequencies corresponding to said variations and of opposite phase relation, and means for additively combining the energy of said waves to actuate said device and for differentially combining the effects of other waves.

11. Radio receiving apparatus selectively responsive to the energy of two waves differing in a frequency characteristic and each modulated in opposed phase relation by a single signal current, comprising an indicating device, means for producing currents from said waves of frequencies corresponding to the frequencies of modulations of the waves, means for impressing said currents on the indicating device cumulatively, and means for differentially combining the energy of waves otherwise modulated to effectively prevent the actuation of said device thereby.

12. Radio receiving apparatus selectively responsive to the energy of two waves differing in a frequency characteristic and each modulated in opposed phase relation by a single signal current, comprising an indicating device responsive to the energy of such waves, means for producing current from said waves of frequencies corresponding to the frequencies of modulations of the waves, means for causing said currents to operate the indicating device, and means for differentially combining the energy of waves otherwise modulated to effectively prevent the actuation of the indicating device thereby.

13. A method of electrical communication which consists in transmitting a plurality of series of waves modulated in out-of-phase relation, receiving said series of waves, producing at the receiver currents corresponding in frequency with said modulations respectively and additively combining said currents to produce a signal, but differentially combining the energy of waves not so characterized.

14. A method of electrical communication

which consists in transmitting two series of waves modulated in out-of-phase relation, receiving said series of waves, producing at the receiver currents corresponding in frequency with said modulations respectively and additively combining said currents to produce a signal, but differentially combining the effects of static.

15. In a system of radio communication, a pair of radio transmitters of different radio frequencies, modulating means affecting the two transmitters in opposite senses, means for radiating differentially modulated waves of the two frequencies, receiving and integrating means discriminating between the two transmitted frequencies and means for applying the integrated currents in opposite senses to a common receiver whereby the differential modulation acts cumulatively on the receiver.

16. In a transmitting system for radiant energy, two radio frequency generators simultaneously emitting waves of different frequencies, a telephone transmitter, and means operated by the telephone transmitter for modulating the two transmitted waves simultaneously in opposite senses.

17. The method of transmitting and receiving radio intelligence which consists in generating and radiating two waves of different radio frequencies, modulating these waves in opposite sense, separately receiving the waves of different frequencies and combining their effects in opposite senses to produce a cumulative result.

In testimony whereof I hereunto affix my signature.

EMORY LEON CHAFFEE.