

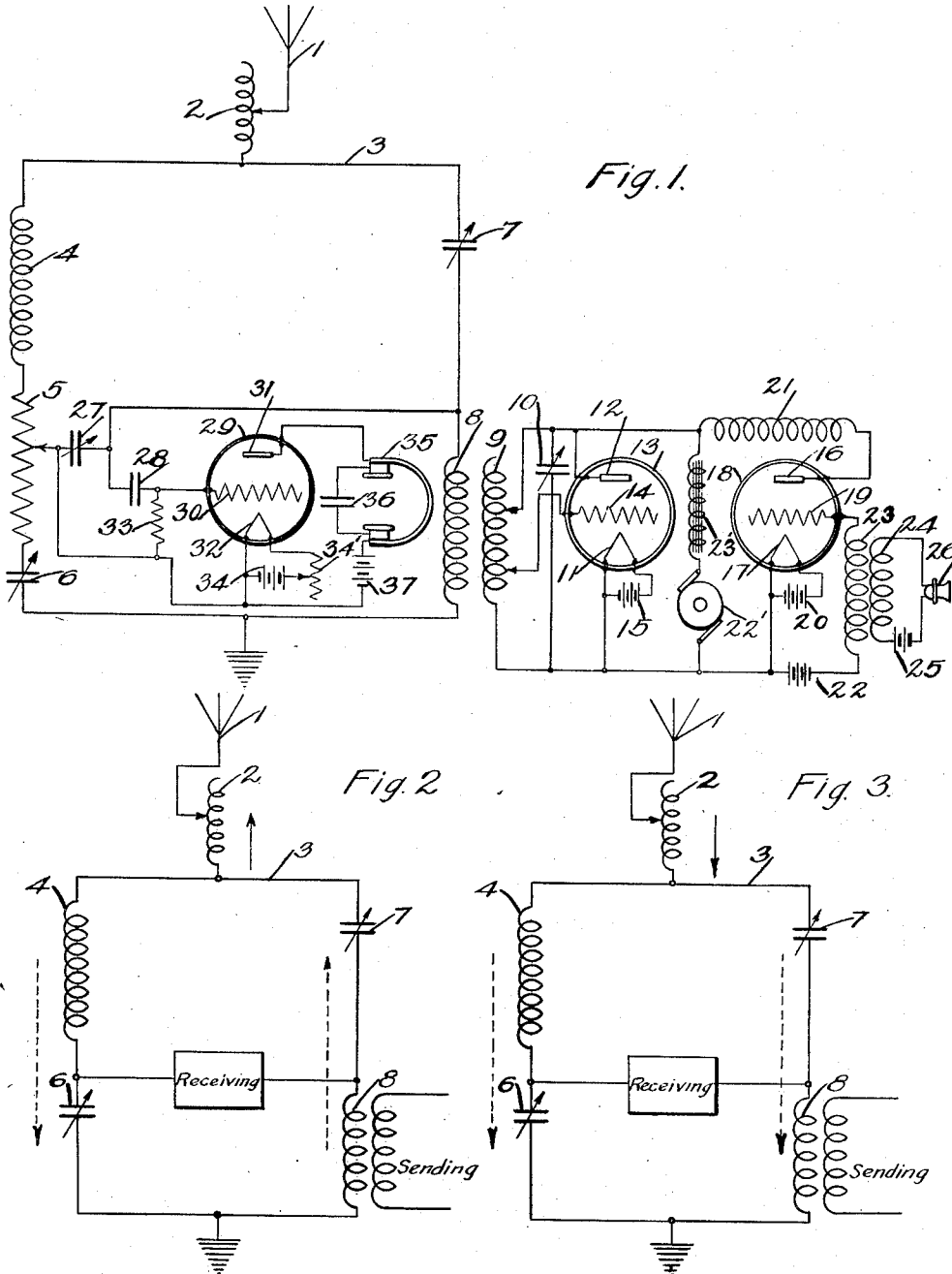
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COMBINED WIRELESS SENDING AND RECEIVING SYSTEM

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COMBINED WIRELESS SENDING AND RECEIVING SYSTEM.

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To all whom it may concern:

Be it known that I, ALEXANDER NYMAN, a citizen of the United States, and a resident of Wilkesburg, in the county of Allegheny and State of Pennsylvania, have invented a new and useful Improvement in Combined Wireless Sending and Receiving Systems, of which the following is a specification.

My invention relates to simultaneously sending and receiving messages on the same apparatus, so that the same antenna may be used to both send and receive without necessitating switching.

More particularly, my invention relates to an apparatus using a single antenna in combination with a balanced net work, so that there are equi-potential points set up when messages are being sent, and to a receiving circuit connected across the equi-potential points, so that the sending of a message will not interfere with the simultaneous receipt of incoming oscillations.

It has been most difficult to both send and receive at the same time, where communications were being transmitted and received from the same station, for the reason that the waves sent from the home station are tuned to the length of those received and the receiving apparatus responds to both. It has not been possible to successfully send and receive simultaneously under the above outlined conditions.

This invention is conceived with the idea of rendering the simultaneous use of a wireless apparatus both as a sending and as a receiving station feasible, and, at the same time, to accomplish that result while using the same antenna.

An object of my invention is to provide means for simultaneously sending and receiving wireless messages without necessitating any switching operations.

With these and other objects in view, which may be incident to the improvements, my invention consists in the parts and combinations to be hereinafter set forth and claimed, with the understanding that the several necessary elements comprising my

invention may be varied in their proportions and arrangement without departing from the spirit and scope of the appended claims.

In order to make my invention more clearly understood, I have shown, in the accompanying drawings, means for carrying it into practical effect without limiting the improvements in their useful applications to the particular constructions which, for the purpose of explanation, have been made the subject of illustration.

Figure 1 is a diagrammatic view of a complete sending and receiving station;

Fig. 2 is a diagrammatic view illustrating the flow of the current in the net work during the sending of a message;

Fig. 3 is a diagrammatic view illustrating the flow of current in the net work during the receiving of a message.

Referring to Fig. 1, I have shown an antenna 1 having a variable inductance 2 in circuit therewith. The variable inductance 2 is connected, through a net work 3, to the ground. As illustrated in Fig. 1, the net work 3 consists of two groups but it is to be understood that, though but two are shown in this embodiment of my invention, a plurality of groups in the net work could be utilized to accomplish the same result and that such construction would be within the spirit of this invention. One group of the net work 3 consists of an inductance 4, a resistance 5 and a variable capacitance 6. The other group of the net work 3 comprises a variable capacitance 7 and an inductance 8. The antenna group consists of an antenna 1 and an inductance 2. The two net-work groups and the antenna group are all tuned to the same frequency.

The net work 3 receives its power input of sending current, through the inductive coupling of the inductance 8, to a variable inductance 9 of a generator circuit to be described. Connected across both sides of the variable inductance 9 is a variable capacitance 10. By changing the values of the inductance 9 and the capacitance 10, the sending circuit may be tuned to any desired wave length. In circuit with the induc-

tance 9 is a filament element 11 and a plate element 12 of an electron tube 13 having a grid element 14 inductively and variably coupled to the inductance 9, so that there is
 5 the feed back between grid and plate circuits necessary for sustained oscillation.

A suitable "A" battery 15 provides current for heating the filament element 11. The arrangement is the customary one for
 10 using an electron tube as a generator of radio-frequency alternating current.

In circuit with the plate circuit of the electron tube 13 is a plate 16 and a filament 17 of an electron tube 18, acting as a modulator and having a grid element 19. The filament 17 is heated by an "A" battery 20. Within the plate circuit of the modulator tube 18, is an inductance 21. In circuit with the grid 19 is provided a battery 22, the
 15 negative terminal of which applies its potential to the grid 19. Within the grid circuit is located an inductance 23. Within the circuit of the electron tubes 13 and 18 is provided a generator 22' having a high-reactance coil 23' that acts as a constant source
 20 of current and delivers power to the antenna circuit.

Coupled inductively to the inductance 23 is an inductance 24 of a microphone circuit that includes a battery 25 and a microphone 26. Variation of the microphone circuit by reason of the voice causes a variation in potential of the grid 19 of the modulator tube and this variation of potential of the
 25 grid 19 causes the tube 18 to absorb power in accordance with the change in potential.

While, for convenience of illustration, I have shown a generator tube coupled with a modulator tube as a generator of radio-frequency oscillations, the amplitude of which is controlled by the voice, any method of generating sending oscillations may be used, such as a Poulsen arc or a high-frequency generator, and it is to be expressly
 30 understood that my invention is not limited to any particular type of apparatus for generating the radio-frequency waves to be transmitted.

Variably coupled to the resistance 5 of the net-work is a variable capacitance 27 of a receiving circuit so placed that the sent oscillations will balance in their effect on said receiving circuit. This action will be fully explained later.

In circuit with the variable capacitance 27 and a stopping condenser 28, is an electron tube 29, acting as a detector and having a grid element 30, a plate element 31 and a filament element 32. In the circuit of the
 35 grid element 30 is provided the customary resistance 33 which performs the usual function of a grid leak in tubes when used as detectors of radio-frequency current.

To heat the filament 32 an "A" battery 34 is provided. The amount of current flowing

through the filament 32 is controlled by the insertion of a variable resistance 34'. Within the plate circuit of the electron tube 29 are located telephone receivers 35 having a capacitance 36 shunted between them. A
 70 suitable "B" battery 37 applies positive potential to the plate 31.

There should be no mutual inductance, as will be apparent, between certain of the coils. To obviate this mutual inductance, these coils may be placed at right angles to each other. To avoid the effect of stray fields upon the coils they should be encased within metal containers or boxes. It is necessary to the efficient operation of this system that the inductances be free from the effect of stray fields and that certain of the coils should not have mutual inductance between them. Any methods may be used to obtain these results, the above outlined methods being but two of many that will occur to those skilled in the art.

In operation, the sending currents traverse the paths diagrammatically indicated in Fig. 2; the sending currents in the two groups of the antenna net-work flowing in opposite directions. The receiving circuit is located at such position that the electromotive force across its terminals, when a message is being sent, is zero, the inductance 4 and the capacitance 7 being so adjusted that this result is possible. This state of affairs exists by reason of the fact that the current flows in opposite directions, with respect to the antenna, through the variable capacitance 7 and through the inductance 4. The resistance 5 is placed in one of the groups of the net-work in order to limit the wasted sending energy passing through this circuit. The correct point of connection of the receiving circuit with the resistance 5 may be determined by experiment and such a point found as will produce a zero difference of potential between the two terminals of the receiving circuit.

The tube 13 is arranged to act as a generator of radio-frequency current, there being mutual inductance between the plate and grid circuits. The capacity 10 is variable and, likewise, the inductance 9 may be made of variable quantity, so that the sent oscillations may be tuned to the desired frequency.

The tube 18 acts as a modulator of the radio-frequency current generated by the generator tube 13. The microphone 26 causes oscillations of audio frequency in inductance 24 and this, in turn, induces oscillations of audio frequency in inductance 23. By reason of the change in the grid potential of the grid 19, audio-frequency oscillations are set up within the plate circuit of the modulator tube 18. In accordance with the well-known principles of radio transmission, these audio-frequency oscillations absorb power from the
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input to the antenna, and the amplitude of the radio-frequency oscillations set out will be affected. This effect produces audio pulses necessary for the transmission of a message.

From an inspection of Fig. 3 it is apparent that the received oscillations flow in like direction in both groups of the net-work. This has a contrary effect to that produced in the sending circuit, since the total electromotive force across the condenser 27 is the arithmetical sum of the electromotive forces across the inductance 4 and the condenser 7. The received oscillations cause the potential of the grid 30 of the electron tube 29 to vary, and, as the proper conditions for the use of this tube 29 as a detector are present, oscillations are set up in the plate circuit corresponding to the received oscillations, and messages may be taken through the telephone receivers 35. By adjusting the variable capacitance 27, the receiving circuit may be tuned to any desired wave length.

I wish it understood that any method of detecting the received oscillations may be employed and that I have shown an electron tube used as a detector of radio-frequency current solely for the purpose of illustration and to make clear its use and application to the problems of wireless communication.

It is obvious that, because of the arrangement of the sending and receiving circuits to the net-work, currents are caused to flow in an entirely different manner through the net-work upon sending and receiving messages. The oscillations set up in sending a message cause the reactances to produce equipotential points. Across the equipotential points just mentioned are connected the terminals of the receiving apparatus. However, when oscillations are received, the currents traverse the net-work in a different manner than during the operation of sending, and the operative electromotive force on the receiving circuit is the arithmetical sum of the electromotive forces in the groups of the net-work. By my invention, the same antenna may be used simultaneously for both sending and receiving from the same or different stations without switching and without interference or confusion in signals.

While I have described but one embodiment of my invention, it is apparent that many modifications may be made therein by those skilled in the art without departing from the spirit thereof, and I desire, therefore, that my invention shall be limited only as set forth in the appended claims or by the showing of the prior art.

I claim as my invention:

1. A wireless apparatus for simultaneously sending and receiving messages comprising a sending circuit having a net-work of two groups of impedance elements, each group tuned to the same frequency, an antenna cir-

cuit also tuned to the same frequency and a receiving circuit in balanced relation to the two groups of the net-work.

2. A wireless apparatus for simultaneously sending and receiving messages, comprising a sending circuit having a net-work of two groups of impedance elements, one group having capacitance and inductance, the other group having capacitance and having inductance of a value to balance at the sending frequency the capacity of the first-mentioned group, an antenna circuit, and a receiving circuit in balanced relation to the last-mentioned inductance and capacity.

3. The combination with a translating device adapted both to send and to receive modulated radio-frequency currents, of a sending circuit having a net-work of two groups of impedance elements, one group having capacitance and inductance in which the sending current flows in one direction with respect to said translating device, the other group having capacitance and having inductance of a value to balance the capacitance of the first-mentioned group and in which the current flows in an opposite direction to the first-mentioned group with respect to said translating device, and a receiving circuit conductively connected in balanced relation to the two groups of the net-work.

4. A wireless apparatus for simultaneously sending and receiving messages comprising an antenna, a sending circuit having a net-work of two groups of impedance elements, one group having capacitance and inductance in which the sending current flows in one direction with respect to the antenna, the other group being tuned to the frequency of the first-mentioned group and having capacitance and having inductance of a value to balance the capacitance of the first-mentioned group and in which the current flows in an opposite direction to the first-mentioned group with respect to the antenna, an antenna circuit tuned to the frequency of the groups and a receiving circuit in balanced relation to the two groups of the net-work.

5. A wireless apparatus for simultaneously sending and receiving messages comprising a sending circuit having a net-work of two groups of impedance elements, in which the sending current flows to produce substantially equipotential points, one point in each group, a resistance in one of the groups, an antenna circuit, and a receiving circuit conductively connected across substantially equipotential points.

6. A wireless apparatus for simultaneously sending and receiving messages comprising a sending circuit having a net-work of two groups of impedance elements, one group having inductance and capacitance and the other group having inductance,

capacitance and a resistance, all so arranged that the sending currents flowing in the two groups produce substantially equi-potential points, one point within each group, an antenna circuit, and a receiving circuit connected across said points.

7. In a signaling system for simultaneously sending and receiving messages, a quadrilateral circuit including, in order, a capacitive reactor, an inductive reactor, a second capacitive reactor and a second inductive reactor, a signaling circuit for carrying both incoming and outgoing messages connected to one diagonal of said quadrilateral circuit, a sending translating device, a receiving translating device, means for connecting one of said translating devices to the other diagonal of said quadrilateral circuit, and means for so connecting the other of said translating devices to said quadrilateral circuit that current therefrom will not reach the first translating device.

8. In a signaling system for simultaneously sending and receiving messages, a quadrilateral circuit including, in order, a capacitive reactor, an inductive reactor, a second capacitive reactor and a second inductive reactor, a signaling circuit for carrying both incoming and outgoing messages connected to one diagonal of said quadrilateral circuit whereby said quadrilateral network is divided into two groups of impedance elements, a receiving translating device connected to the other diagonal of said quadrilateral circuit, a sending translating device coupled to a portion of one of said groups, and a resistor included in the other of said groups and adjustably proportioned between two sides of said quadrilateral.

9. In a signaling system for simultaneously sending and receiving messages, a quadrilateral circuit including, in order, a capacitive reactor, an inductive reactor, a second capacitive reactor and a second inductive reactor, a signaling circuit for carrying both incoming and outgoing messages

connected to one diagonal of said quadrilateral circuit, a receiving translating device connected to the other diagonal of said quadrilateral circuit, and a sending translating device coupled to one of said reactors.

10. In a signaling system for simultaneously sending and receiving messages, a quadrilateral circuit including, in order, a capacitive reactor, an inductive reactor, said reactors constituting a group of impedance elements, a second capacitive reactor and a second inductive reactor, said second reactors constituting a second group of impedance elements, the path comprising said second reactors being tuned to substantially the same frequency as the path comprising said first-mentioned reactors, a signaling circuit for carrying both incoming and outgoing messages connected to one diagonal of said quadrilateral circuit, a receiving translating device connected to the other diagonal of said quadrilateral circuit, a sending translating device coupled to a portion of one of said groups, and a resistor included in the other of said groups the connection to said receiving translating device adjustably dividing said resistor.

11. In a signaling system for simultaneously sending and receiving messages, a quadrilateral circuit including, in order, a capacitive reactor, an inductive reactor, a second capacitive reactor and a second inductive reactor, the path comprising said second reactors being tuned to substantially the same frequency as the path comprising said first-mentioned reactors, a signaling circuit for carrying both incoming and outgoing messages connected to one diagonal of said quadrilateral circuit, a receiving translating device connected to the other diagonal of said quadrilateral circuit, and a sending translating device coupled to one of said reactors.

In testimony whereof, I have hereunto subscribed my name this 10th day of July 1920.

ALEXANDER NYMAN.