J. R. CARSON.

WIRELESS SIGNALING SYSTEM.

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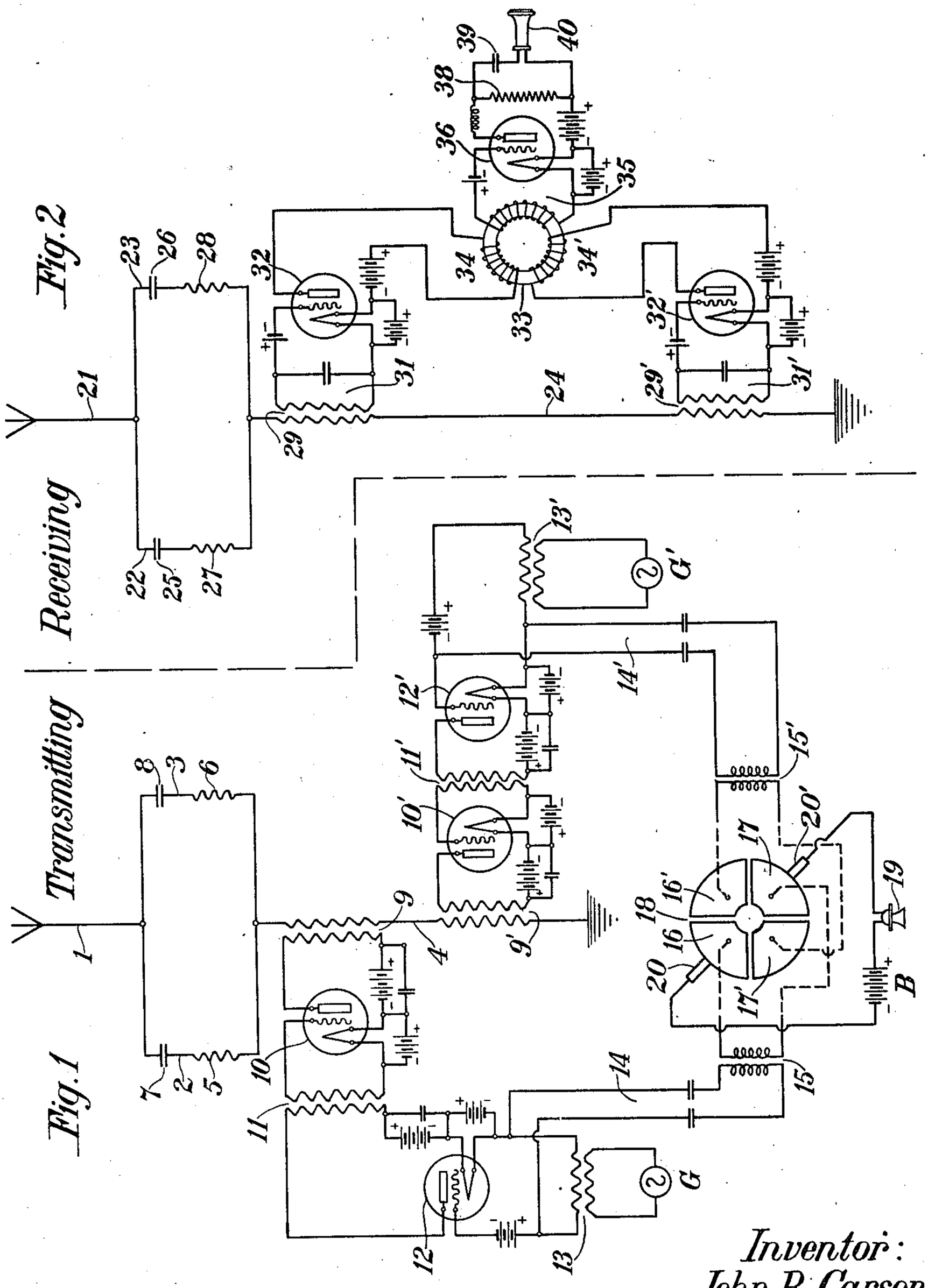

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UNITED STATES PATENT OFFICE.

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WIRELESS SIGNALING SYSTEM.

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Application filed November 10, 1915. Serial No. 60,739.

To all whom it may concern:

Be it known that I, JOHN R. CARSON, residing at New York, in the county of New York and State of New York, have invented certain Improvements in Wireless Signaling Systems, of which the following is a specification.

This invention relates to a signaling system wherein signals are transmitted by the agency of a high frequency wave modulated in accordance with said signals, and more particularly to a wireless signaling system employing a plurality of electromagnetic waves. Its object is to provide a system of wireless communication whereby secret communications between stations may be had to the end that stations, other than that designed to receive, may not receive complete, intelligible signals.

Heretofore, signals both in wireless telegraphy and telephony have been transmitted by means of electromagnetic waves of a definite high frequency or wave length and any station tuned to the wave length of said signals is capable of receiving said signals. In such systems secret communication can only be had by the employment of a secret code.

In the present invention secrecy is obtained by the transmission of signals on a plurality of waves of different frequencies, successive portions of a message being transmitted on waves of different frequencies, whereby a station tuned to one of said waves receives only a partial and therefore unintelligible disclosure of the communication. The invention may be employed in connection with any wireless signaling system but is particularly adapted for use with a wireless telephone system.

The invention may be more readily understood by reference to the accompanying drawings in which Figures 1 and 2 are diagrams showing the transmitting and receiving stations, respectively, of a system embodying the invention.

Referring to Fig. 1, 1 is an antenna or radiating structure, connected to earth through parallel branch circuits 2 and 3 and a common grounding conductor 4. It will be observed that the antenna system shown has two degrees of freedom and is therefore resonantly responsive to two waves of different lengths, and it is intended, as more fully hereinafter set forth, to employ both of said waves for the simultaneous radiation of energy of two different frequencies from the antenna 1. These wave lengths may be adjusted by means of tuning inductances 5 and 6 and tuning condensers 7 and 8. 9 and 9′ represent oscillation transformers by means of which two generating systems are coupled to said antenna system. G and G′ conventionally represent high frequency generators, it being understood that the invention is not limited to any particular form of high frequency source of energy. 12 and 12′ are modulating devices, preferably of the well-known vacuum tube type, whose input sides are connected, respectively, through transformers 13 and 13′ to generators G and G′. The output sides of said modulating devices are connected, respectively, to the input sides of amplifiers 10 and 10′ through transformers 11 and 11′. The output sides of said amplifiers operate on and energize the antenna system through coupling transformers 9 and 9′.

Bridged across the input side of the modulating device 12 is a circuit 14 including the secondary of a repeat coil 15 preferably designed to operate at telephonic frequencies. Similarly the input side of the modulating device 12′ has bridged across it a circuit 14′ containing the secondary of a repeat coil 15′. The primary of said repeat coil 15 is connected permanently in any suitable manner to the two segments 16 and 17 of a motor driven commutator 18, while the primary of the repeat coil 15′ is similarly connected to segments 16′ and 17′ of the same commutator. A transmitting device, shown conventionally as a telephone transmitter 19 in series with a battery B, is connected to brushes 20 and 20′ of said commutator. By means of said brushes said transmitter is alternately inductively connected to circuits 14 and 14′ during the revolution of commutator 18.

The operation of the transmitting system shown in Fig. 1 will now be readily understood. Generators G and G′ are sources of energy at different frequencies, said frequencies being those to which the antenna is resonant. Said frequencies are amplified by amplifiers 10 and 10′ as well as the modulators 12 and 12′ and then simultaneously impressed on antenna 1 through transformers 9 and 9′, and hence said antenna simultaneously radiates energy continuously at two wave lengths, one that of generator G and

the other that of generator G′. Assuming that the transmitter 19 is bridged across segments 16 and 17 and energized, for example, by sound waves produced by the voice, then the waves generated by generator G are modulated in amplitude accordingly, and hence the energy radiated by the antenna consists of a pure unmodulated wave generated by G′ and a wave generated by G and modulated in accordance with the variation of the transmitter 19. Similarly when the transmitter 19 in the course of revolution of commutator 18 is bridged across segments 16′ and 17′, the waves generated by G′ are modulated while those generated by G are unmodulated. It is thus apparent that the transmitting system of the invention, as shown in Fig. 1, is characterized by the continuous simultaneous radiation of energy at two wave lengths, the amplitude of energy radiated at each wave length being alternately modulated in accordance with the signal to be transmitted; and while both of said resonant wave lengths act continuously as the carriers of radiant energy, they serve alternately as the carriers of modulated energy, so that signals are transmitted on the said waves alternately although both said waves are radiated continuously and simultaneously. It should be observed further that during the fraction of time when the brushes 20 and 20′ are each in contact with two segments both high frequency waves are modulated so that during said fraction of time signals are transmitted on two waves.

By this transmitting arrangement it should be noted that the only interruption occurs in the circuit of the modulating current, which is a low energy circuit so that the commutation of large quantities of energy is avoided. Moreover the carrier wave is generated and modulated at small amplitude, so that the modulation, whether it be a mere variation of amplitude, or an absolute interruption, involves only small quantities of energy which are afterward amplified to the value necessary for radiation.

A receiving system adapted to receive signals from the transmitting station shown in Fig. 1, is shown in Fig. 2. In Fig. 2, 21 is a receiving antenna connected to ground through the parallel branch circuits 22 and 23 and the branch 24. 25 and 26 are tuning condensers while 27 and 28 are tuning inductances. The branch circuit 24 contains the primaries of oscillation transformers 29 and 29′. The receiving antenna system of Fig. 2 is tuned to the same two frequencies as the transmitting system of Fig. 1 and hence is resonantly responsive to the waves radiated from said transmitting system. 31 is an oscillation circuit tuned to one of said frequencies or wave lengths, while oscillation circuit 31′ is tuned to the other of said frequencies. It will be understood, therefore, that circuits 31 and 31′ are responsive, respectively, to the two waves radiated from the transmitting station hereinbefore described, and it will be remembered that one of said waves is modulated and the other unmodulated at any particular instant of time. Assuming that at a particular instant under consideration circuit 31 is responsive to the modulated wave, then by means of a detecting device 32, preferably of the vacuum tube type, a low frequency oscillatory current is set up in winding 34 of transformer 33 in response to said modulated high frequency wave. At the same instant of time the high frequency wave to which circuit 31′ is responsive, being unmodulated, a steady current flows in winding 34′ of said transformer 33. Hence an alternating voltage is induced in winding 35 of said transformer by said oscillatory current in winding 34, while said steady current in winding 34′ has no inductive action on winding 35. The said voltage induced in winding 35 is impressed on the input side of an amplifier 36, preferably of the vacuum tube type, and hence transmitted to a receiving device 40, conventionally represented as a telephone receiver, said receiving device being in series with a condenser 39 and in parallel with a non-inductive resistance 38.

Detectors 32 and 32′ may be so connected to windings 34 and 34′ that their simultaneous inductive action on winding 35 either assists or opposes. From the point of view of the elimination of interference it is preferable that opposing connections be employed while considerations relating to the fraction of time during which both radiated waves are modulated may make it desirable to employ assisting connections.

In practice, in order to secure the requisite amount of power, it is customary to couple the amplifier at the transmitting station not directly to the antenna but to a plurality of amplifiers or power tubes which operate in parallel. When the arrangements of the present invention are embodied in such a system it is obviously undesirable and unnecessary to duplicate said plurality of power tubes. In such a system I therefore contemplate connecting the output sides of amplifiers 10 and 10′ in parallel to said plurality of power tubes, the output sides of said power tubes being connected to said antenna.

It will be understood that, although the specific structures in the drawings show two radiated and alternately modulated waves, the invention contemplates the radiation of any suitable number of waves of different frequencies, said waves being modulated in any complicated cycle which may be desired. It will also be understood that, except where otherwise set forth in the claims, the inven-

tion is not limited to the simultaneous radiation of the waves of different frequencies, the important feature of the invention being that which involves impressing successive portions of a message successively upon waves of different frequencies and employing a receiving system that is responsive to the frequencies at which the different portions of the message is transmitted. It should be further understood that while this invention is described in terms of a wireless telephone system, it is not so limited in its scope, but is applicable to and finds useful embodiment in any signaling system wherein signals are transmitted by the agency of a high frequency wave modulated in accordance with the signals to be transmitted.

The manner in which secrecy of communication is realized in this invention will be clear from the foregoing description. Since, as hereinbefore pointed out, a plurality of radio-frequency waves are successively modulated in amplitude in accordance with signals to be transmitted, and since, therefore, each of said radio-frequency waves acts as the carrier wave for only a fraction of the message or signal, it follows that any wireless station which is not tuned to receive all of said waves, can receive only a partial and unintelligible signal.

What is claimed is:

1. In a signaling system wherein signals are transmitted by the agency of a continuous high frequency wave, means for generating and continuously radiating a plurality of high frequency waves of different frequency, and means for modulating said waves in cyclic order.

2. A wireless signaling system for the secret transmission of intelligence consisting of a transmitting station and a receiving station, said transmitting station comprising an antenna means for generating and simultaneously radiating electromagnetic waves of a plurality of frequencies, means for successively modulating each of said high frequency currents, and said receiving station comprising a receiving antenna system resonantly responsive to waves of said plurality of frequencies.

3. A wireless signaling system for the secret transmission of intelligence consisting of a transmitting station and a receiving station, said transmitting station comprising an antenna continuously resonant to a plurality of frequencies, a plurality of sources respectively generating currents of said plurality of frequencies and means for modulating successively, in accordance with signals to be transmitted, the energy of each of said frequencies; and said receiving station comprising an antenna resonant to said plurality of transmitted frequencies, detectors connected to said antenna, and a receiving device connected to said detectors.

4. A wireless signaling system consisting of a transmitting station and a receiving station, said transmitting station comprising an antenna structure resonant to a plurality of frequencies, a plurality of sources respectively, generating and simultaneously impressing energy at a plurality of said frequencies on said antenna, modulating devices connecting said generators to said antenna, a transmitter, and a commutator connecting said transmitter in turn to each of said modulating devices; and said receiving station comprising an antenna structure having a plurality of degrees of freedom and tuned to the same frequencies as said transmitting antenna structure, a plurality of oscillation circuits operatively connected to said antenna structure, each of said plurality of oscillation circuits being tuned to one of said frequencies, a plurality of detecting devices, each of said detecting devices being connected to one of said oscillation circuits, and a receiving device connected to all of said oscillation circuits through said detecting devices.

5. The method of transmitting messages, which consists in generating and continuously radiating electromagnetic waves of different frequencies, and modulating said different frequency waves in succession in accordance with successively different portions of a message to be transmitted.

6. The method of transmitting messages, which consists in simultaneously generating and continuously radiating a plurality of electromagnetic waves of different frequencies, and modulating said waves in cyclic order in accordance with the successively different portions of a message to be transmitted.

7. In a signaling system wherein signals are transmitted by the agency of a continuous high frequency wave, means for continuously radiating a plurality of high frequency waves of different frequency, means for modulating said waves in cyclic order, and means for amplifying the modulated waves.

8. A wireless transmitting station comprising an antenna for simultaneously radiating electromagnetic waves of a plurality of frequencies, a plurality of energy sources generating current of said plurality of frequencies, means for successively modulating said high frequency currents, and means including amplifiers for impressing said energy on said antenna.

9. The method of transmitting messages which consists in generating electromagnetic waves of different frequencies, modulating said different waves in succession in accordance with successively different portions of a message to be transmitted, and amplifying said modulated waves.

10. The method of transmitting messages

which consists in simultaneously generating a plurality of electromagnetic waves of different frequencies, modulating said waves in cyclic order in accordance with the successively different portions of a message to be transmitted, and amplifying the modulated waves.

11. In a signaling system, a transmitting circuit continuously resonant to a plurality of frequencies, a plurality of sources respectively generating currents of said plurality of frequencies, and means for modulating, in accordance with signals to be transmitted, the energy of said currents in cyclic order.

12. A transmitting apparatus comprising a plurality of sources of current of different frequencies, means for simultaneously and continuously radiating oscillations from said sources, a modulating means common to said sources, means for associating said modulating means with said sources in cyclic order, and means for amplifying the modulated current.

13. A transmitting apparatus comprising a plurality of sources of current of different frequencies, a source of modulating current, and means to associate said modulating source with said first mentioned sources in cyclic order.

In testimony whereof, I have signed my name to this specification in the presence of two subscribing witnesses, this 3d day of November 1915.

JOHN R. CARSON.

Witnesses:

GEORGE E. FOLK,

P. I. WOLD.