No. 785,803. PATENTED MAR. 28, 1905.

C. D. EHRET.

ART OF TRANSMITTING INTELLIGENCE.

APPLICATION FILED FEB. 10, 1902.

Fig I

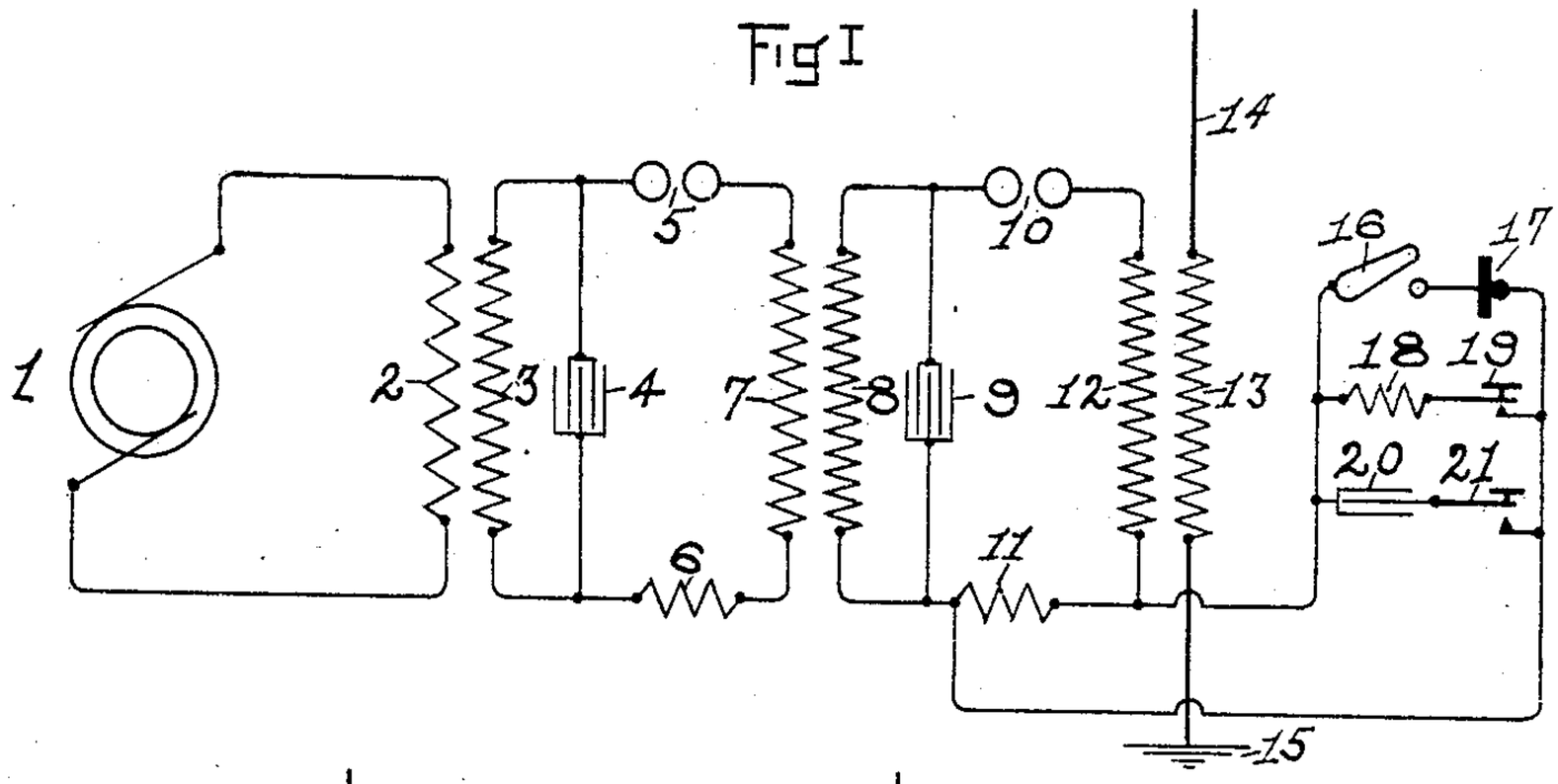


Fig II

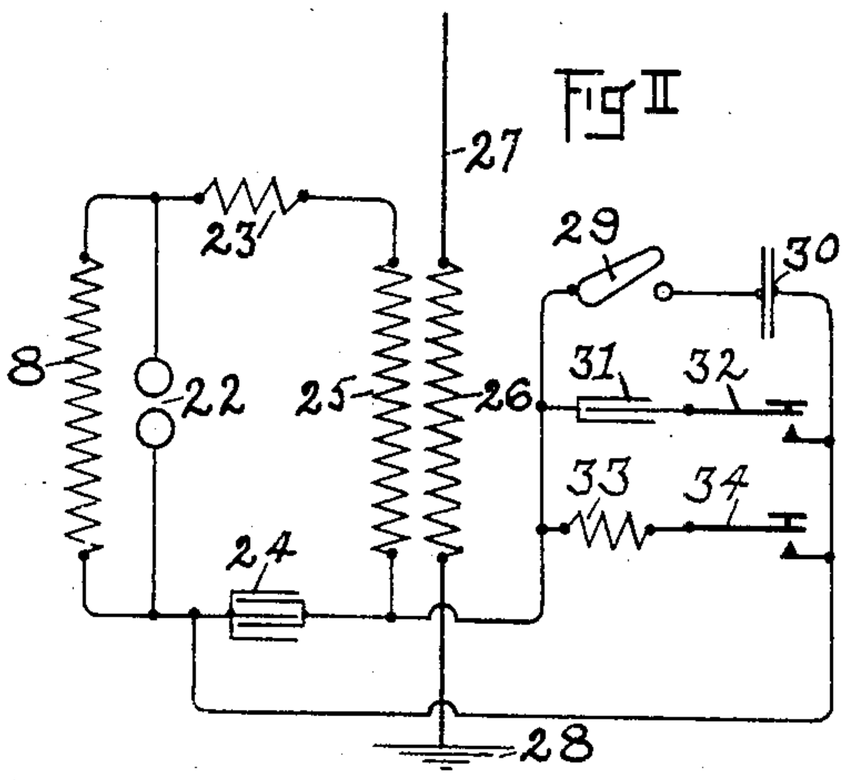


Fig III

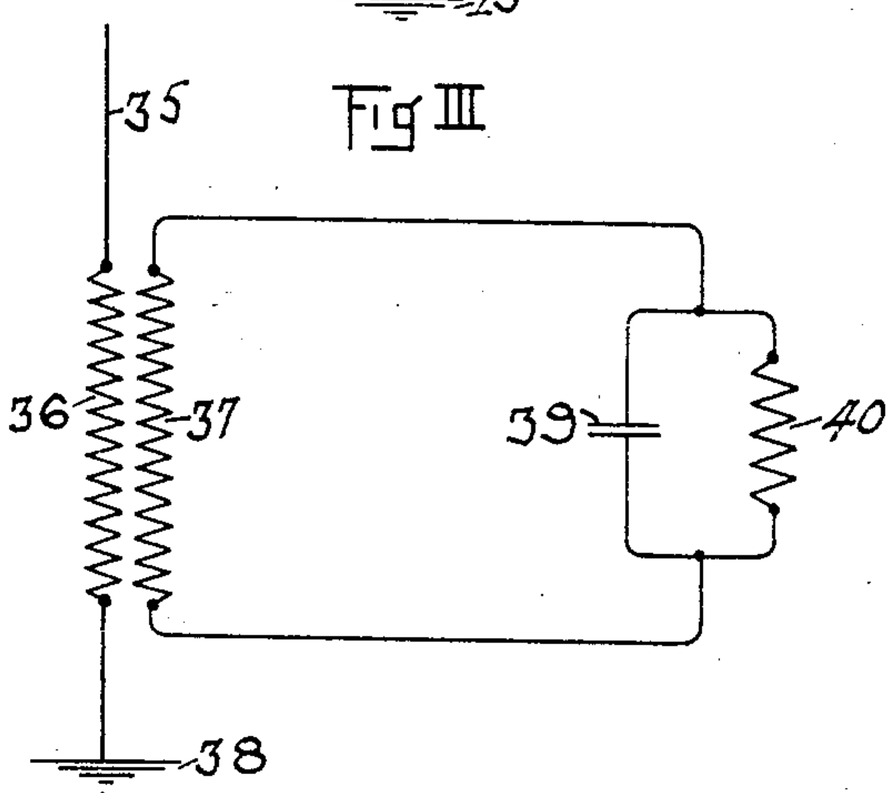


Fig IV

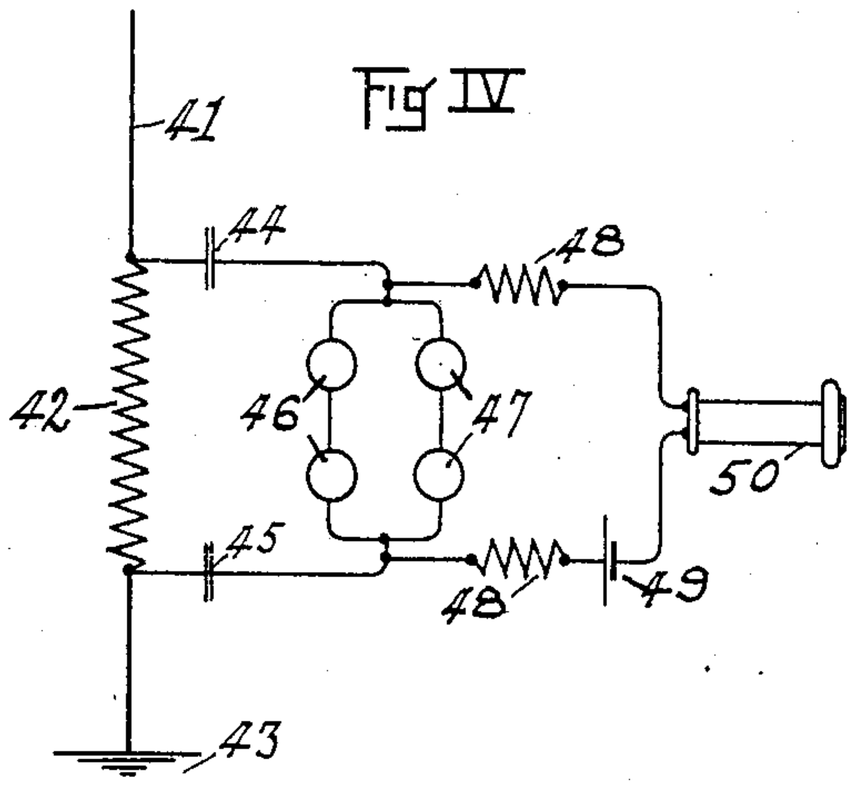
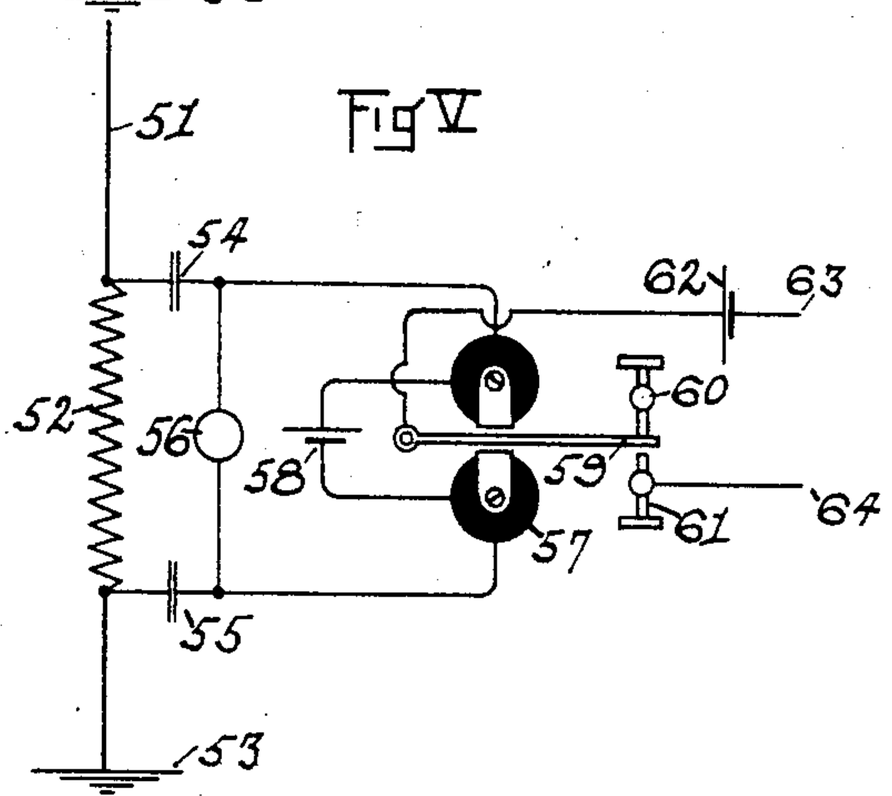


Fig V



WITNESSES:

Thos Truesdale
Mae. Hofmann

INVENTOR.

Cornelius D. Ehret.

No. 785,803. Patented March 28, 1905.

UNITED STATES PATENT OFFICE.

CORNELIUS D. EHRET, OF PHILADELPHIA, PENNSYLVANIA.

ART OF TRANSMITTING INTELLIGENCE.

SPECIFICATION forming part of Letters Patent No. 785,803, dated March 28, 1905.

Application filed February 10, 1902. Serial No. 93,298.

To all whom it may concern:

Be it known that I, CORNELIUS D. EHRET, a citizen of the United States, residing at Philadelphia, in the county of Philadelphia and State of Pennsylvania, have invented a new and useful Art of Transmitting Intelligence, of which the following is a specification.

My invention comprises a method of transmitting intelligence through the natural media through the agency of electroradiant energy.

It comprises a method of generating the energy to be transmitted and modifying the properties of such energy in accordance with the signal to be transmitted.

It comprises, further, a method of modifying and varying the frequency of the electroradiant energy in a manner corresponding and in accordance with the signal to be transmitted.

It resides also in an additional step of modifying the energy to be transmitted and received by and in accordance with sound-waves, such as speech.

It comprises, further, a method of receiving the modified transmitted energy and causing the reproduction of speech and other signals by the effects of variations or changes in the frequency of the received energy.

The signals to be sent by the hereinafter-described system may be either audible or visible, being either speech or simple telegraphic signals transmitted by code characters.

The energy generated, transmitted, and received in this system is of the electroradiant kind, comprising electrostatic or electromagnetic energy-waves, or a combination of both, in which either the electrostatic or the electromagnetic may predominate or in which they are equal.

A charged electric circuit or conductor will under certain conditions oscillate electrically for a period of time, the oscillations dying out more or less rapidly according to conditions and obeying a logarithmic law. The periodicity or frequency of such oscillations is dependent upon the electrical constants of the circuit—namely, resistance, capacity, and inductance. With the resistance less than a certain amount with relation to the inductance and capacity the circuit is oscillatory and for best effects it is desirable that the resistance be a minimum. Changing the amount of inductance, amount of capacity, or amount of resistance, or of the amount of any combination of them, will change the natural period of oscillation of the circuit. It is upon this principle that the hereinafter-described system is based and in its essential feature comprises a system in which energy representing the message to be sent has its frequency varied or changed in accordance with such message.

For the transmission through the natural media the frequency of the electrostatic and electromagnetic energies is very high, ranging from one hundred thousand periods per second to several millions. To obtain circuits which will vibrate at such high frequencies, the amounts of capacity, resistance, and inductance need be quite small, and therefore the variation of any one of these factors to even a moderate degree will greatly affect the periodicity of the circuit.

My invention comprises a method of varying the capacity, the resistance, or the inductance, or any combination of them, in such an oscillating circuit for procuring a substantial variation in the frequency of the transmitted energy.

Reference is to be had to the accompanying drawings, in which—

Figure 1 is a diagram representing the circuit arrangements at a transmitting-station. Fig. 2 is a modified arrangement of the circuits at a transmitting-station. Fig. 3 is a diagrammatic view of a receiving-circuit responsive to changes in frequency of the transmitted energy and adapted to reproduce a signal due to such variation. Fig. 4 is a diagrammatic view of a modified form of a receiving-circuit also responsive to variations in the frequency of the received energy and adapted to produce audible signals. Fig. 5 is a diagrammatic view of a further modification in the receiving-circuit, responsive to variation in the frequency of the received energy and adapted to record signals telegraphically.

At 1 is shown a source of alternating current—such as an alternating generator, transformer, or equivalent—furnishing current at commercial frequency and voltage—for ex-

ample, one hundred and thirty-three periods per second at one hundred and ten volts. In the preferred arrangement, however, the periodicity of the current supplied by the source 1 is much higher than employed upon commercial circuits, in order that the trains of electromagnetic energy-waves emitted from a radiating conductor 14 shall succeed each other at a rate which is high with respect to the more essential frequencies of the sound-waves found in human speech. For example, for telephony by the hereinafter-described system it is preferred that the frequency of the current delivered from the source 1 shall be about fifteen hundred cycles per second, though the frequency may with advantage be made much higher, and the higher the better. For telegraphy, however, the lower frequency previously mentioned is satisfactory. The energy derived from such source 1 is passed through the primary 2 of a transformer whose secondary 3 delivers current at a higher voltage to the terminals of condenser 4. When such condenser is charged to a sufficiently-high potential, it discharges across the spark-gap 5, through the inductance 6 and primary 7 of a second transformer. The condenser, air-gap, transformer, primary, and inductance form a circuit which oscillates at its own frequency, and the resistance, capacity, and inductance of such circuit is so chosen that the frequency will be very high as compared with the frequency of the source 1. Such frequency may be in the neighborhood of ten thousand per second. The secondary 8 delivers then a high frequency and still higher potential current to condenser 9, which stands in the same relation to spark-gap 10, inductance 11, and primary 12 that condenser 4 bears to the oscillating circuit just described. The capacity, resistance, and inductance of the circuit 9 10 12 11 is so chosen as to procure a natural vibration of such circuit still higher than that in the previous circuit and may be taken in the neighborhood of two hundred and fifty thousand or five hundred thousand per second or higher, if desired. As previously stated, the variation of the effect of any of the frequency-determining factors will change the frequency of the radiated energy which is developed, as shown in this figure, in the aerial radiating-conductor 14, supplied from secondary 13, whose lower terminal connects to earth-plate 15.

The inductance 11 is shown as shunted by a telephone-transmitter 17, which may be brought into circuit by the closure of switch 16. Any variation of the resistance or other electrical property of such telephone-transmitter varies the effect of the inductance 11 in the circuit 9 10 12 11 and correspondingly changes the frequency of the energy impressed by the secondary 13 upon the radiating-circuit. This variation of frequency will follow closely and obey all slight variations occurring in the electrical properties of the combination of the inductance 11 and the telephone-transmitter 17.

At 18 is shown an inductance controlled by key 19 in parallel also to inductance 11. Upon the closure of key 19 the total inductance of the circuit 9 10 12 11 is changed, resulting in the change of the frequency of the radiated energy, as above described. Furthermore, 11 and 18 may represent resistances simply, the circuit 9 10 12 11 depending upon the property of primary 12 for its inductance.

At 20 is shown a condenser controlled by key 21 in shunt to the device 11, which, as previously stated, may be either an inductance or a resistance; but, as stated above, it is preferable to keep the resistance of the oscillating circuit as low as possible. The closure of the key 21 throws condenser 20 in parallel with inductance or resistance 11, and thereby changes the combined effect of all the factors in the oscillating circuit, which results in a change of the frequency of the radiated energy. It is to be noted also in connection with this figure that condenser 4 and spark-gap 5 may be interchanged in their positions, as also condenser 9 and spark-gap 10.

In Fig. 2 the circuit of the source 1 and of the secondary 3 has been omitted and simply the secondary coil 8 is shown as furnishing high-frequency high-potential current to the oscillating circuit 22 23 25 24, in which 22 is a spark-gap, 23 an inductance, 24 a condenser, and 25 a primary, of a transformer whose secondary 26 furnishes the high-frequency high-potential charge to the aerial radiating-conductor 27, whose lower terminal connects to earth-plate 28.

At 29 is shown a switch which when closed throws the condenser telephone-transmitter 30 in shunt with the condenser 24. By speaking into the transmitter 30 the capacity of the condenser 30 is changed or varied in virtue to the relative motion of the plates of the condenser and there results a consequent change in the total capacity of the oscillating circuit 22 23 25 24, procuring a variation in the frequency of the transmitted energy corresponding closely to the modulations of the voice speaking into transmitter 30. In other words, the frequency of the transmitted energy is changed or varied by and in accordance with sound-waves uttered by the speaker.

At 31 is shown a condenser which upon the closure of key 32 is likewise thrown into parallel with condenser 24 and has a like effect as condenser-transmitter 30, except that upon closure of key 32 a perfectly definite and single change in the frequency of the transmitted energy is obtained.

At 33 is shown an inductance or resistance which upon closure of key 34 is likewise thrown into parallel relation with the condenser 24. This results also in a change of the constants of the oscillation-circuit 22 23 25 24

with a corresponding change in the frequency of the transmitted energy.

Operating any one of the keys 19, 21, 32, and 34 according to any telegraph code will therefore modify the frequency of the transmitted energy in like manner, and speaking into transmitter 17 or 30 varies the frequency of the transmitted energy by and in accordance with the sound-waves uttered by the speaker.

At Fig. 3 is shown a receiving-circuit in which 35 is the aerial receiving-conductor, connected through primary 36 to ground-plate 38. The electrical constants of the conductor 35 and primary 36 may be such as to be in tune, syntony, or resonance with the normally-transmitted energy—that is, the energy transmitted from the stations described when no keys are depressed and no transmitter spoken into. In the circuit of the secondary 37 are the condenser 39 and inductance 40 in parallel with each other and forming a closed resonant circuit. Normally, therefore, there exists across the terminals of 39 and 40 a maximum potential, and upon any variation from the normal frequency of the arriving energy this potential is varied from the maximum by and in accordance with such frequency change. This results in a corresponding fluctuation of the large current-flow in the local circuit embracing the condensers 39 and the inductance 40 only, or the electrical constants of 35 and 36 may be so chosen as not to be in tune, syntony, or resonance with the received or the normally transmitted energy nor with any frequency that may result from speaking into the transmitters 17 or 30 or depressing any of the keys 19, 21, 32, and 34. The arriving energy when representing a signal or message therefore simply causes a fluctuation of the potential at the terminals of 39 and 40, which in this case need not be adjusted, as in the case above, and upon the fluctuations of such potential at the terminals of 39 and 40 there results a corresponding fluctuation in the current flowing in the local circuit embracing condenser 39 and inductance 40 only.

The device 39 may be arranged as an electrostatic telephone-receiver in which the fluctuation of the charges upon its plates cause a fluctuation or change in the positions of the plates with respect to each other, and thereby reproduce speech.

In Fig. 4 is shown a receiving-conductor 41 in conjunction with the inductance 42, joined at its lower terminal to earth-plate 43. In shunt to the inductance is the local circuit embracing condenser 44, wave-responsive devices 46 and 47 in series-parallel arrangement, and the condenser 45. In shunt to the wave-responsive devices is a local circuit embracing the choke-coils 48, source of energy 49, and telephone-receiver 50. Upon the arrival of energy at conductor 41, the frequency of such energy varying from instant to instant, the potential at the terminals of inductance 42 fluctuates correspondingly and there is in consequence a fluctuating potential difference exerted at the terminals of the self-restoring detector or similar devices 46 and 47. This results in a fluctuation of the current in the local circuit including the devices 46 and 47 and source of energy 49 and telephone-receiver 50, reproducing in consequence sound-waves or speech at the receiver 50. The condensers 44 and 45 are of very small capacity and are so chosen as to have but slight or no effect upon the constants of the circuit 41 42 43. The object of these condensers is to prevent a flow of current from battery 49 through inductance 42 and telephone-receiver 50. These condensers, however, do not exclude the variations in potential existing across the terminals of inductance 42. The devices 46 and 47 may be the electrolytic wave-responsive devices or those in which metallic trees are formed and broken down, or the carbon detector or the combined carbon and steel wave-responsive devices. These wave-responsive devices have the property of restoring themselves to their normal condition immediately upon the cessation of the energy causing a change in their condition or resistance, requiring no tapping, as in the case of the ordinary coherers. This property of self-restoration renders these devices capable of responding to the energy varying, as hereinbefore described, so that, in effect, their condition or resistance varies in a manner according to the fluctuations found in speech. Those enumerated and many more known as anticoherers have in general the property of varying their resistance in proportion to the energy or potential impressed upon their terminals, provided, however, they be properly chosen in their dimensions and arrangement with respect to the energy which fluctuates in amount or pressure. It is for this reason several in series and in parallel groups are chosen, so that the impressed potential will not operate, as might be the case, to cause a sudden and great change in resistance which would not be proportional to the potential impressed upon the terminals. Upon the arrival of energy at the station shown in Fig. 4 such energy fluctuating in frequency according to sound-waves uttered against the transmitters 17 or 30 there is a fluctuation of potential at the devices 46 and 47, which results in a corresponding fluctuation of current in the circuit of the telephone-receiver 50, which in turn results in the reproduction of the speech uttered against transmitters 17 or 30.

In Fig. 5 is shown an arrangement of circuits corresponding to Fig. 4, except that a single wave-responsive device 56 is shown, which may be either of the coherer or anticoherer type and which controls a local circuit

embracing the relay 57 and battery 58, such battery being connected between the coils of the relay, which then operate as the usual choke-coils. The tongue 59 rests normally against back-stop 60 and upon energization of the relay contacts with post 61, thereby permitting a flow of current from battery 62, whose local circuit is shown at 63 and 64. The device 56, if a coherer, is tapped in the usual way by a device controlled by the relay. In circuit 63 and 64 is included the usual telegraph recording mechanism.

From the foregoing description it is apparent that I have disclosed a method of transmitting speech electrically without the employment of conductors joining the transmitting and receiving stations; that speech is transmitted by this method by the agency of electroradiant energy, as employed heretofore for telegraphy only; that the transmission of speech by this method results from the control of the frequency of the transmitted electroradiant energy by and in accordance with the speech-waves uttered at the transmitter; that the method does not depend upon increasing or diminishing the amount of energy transmitted with the frequency of such energy remaining constant, and that my method depends for its operation upon the variation by and in accordance with speech-waves of the frequency of the transmitted electroradiant energy-waves, which is the only characteristic of electroradiant energy which may be varied, inasmuch as mere quantity or magnitude of energy is not a property or characteristic.

While I have shown a specific embodiment of my invention, I do not wish to be limited to the precise arrangement of circuits or apparatus used, inasmuch as many equivalents are found in the art to which my invention appertains, and it is within the scope of my invention to make such changes as are readily made by one skilled in such art, who can easily adopt the system herein shown and described to systems previously known, in which several aerial conductors are used or where the transmitting-circuit connects to several ground-plates, &c.

The system and apparatus herein shown and described are claimed in my divisional application filed July 8, 1902, and bearing Serial No. 114,753.

What I claim is—

1. The method of transmitting intelligence, which consists in generating electroradiant energy, modifying the frequency of said energy in accordance with the signal to be sent and receiving the energy in a device responsive to changes in the frequency of the transmitted energy.

2. The method of transmitting sounds which consists in generating electroradiant energy, modifying the frequency of said energy by and in accordance with sound-waves, and receiving energy in a device responsive to changes in the frequency of the transmitted energy.

3. The method of transmitting intelligence, which consists in generating electroradiant energy, modifying the frequency of said energy in accordance with the signal to be sent and operating the signal-reproducing device by changes in frequency of the transmitted energy.

4. The method of transmitting sounds, which consists in generating electroradiant energy, modifying the frequency of said energy by and in accordance with sound-waves and controlling a sound-reproducing device by changes in frequency of the transmitted energy.

5. The method of transmitting intelligence which consists in generating electroradiant energy, modifying the frequency of said energy in accordance with the signal to be sent, and causing the received energy to reproduce the signal.

6. The method of transmitting intelligence, which consists in generating electroradiant energy, varying the frequency of said energy by and in accordance with the message to be sent, and reproducing the message by the varying effects of the received energy.

7. The method of transmitting speech electrically, which consists in generating electroradiant energy, modifying the frequency of said energy by and in accordance with speech, and receiving the energy in a device responsive to changes in the frequency of the transmitted energy.

8. The method of transmitting speech electrically, which consists in generating electrical energy, modifying the frequency of said energy by and in accordance with speech, and causing the received energy to vary the condition of a circuit to reproduce speech.

9. The method of transmitting speech electrically, which consists in generating electrical energy, modifying the frequency of said energy by and in accordance with speech, subjecting a wave-responsive device to the varying effects of the received energy, and reproducing speech by the effect of the variations in condition of said wave-responsive device.

10. The method of transmitting speech electrically, which consists in generating electroradiant energy, modifying the frequency of said energy by and in accordance with speech, transforming said energy into the energy of electric currents of varying frequency, and controlling the reproduction of speech by said currents.

11. The method of transmitting intelligence, which consists in generating electrical energy, modifying the frequency of said energy in accordance with the signal to be sent, subjecting a wave-responsive device to the effects

of the received energy, and controlling a signal-producing circuit by said wave-responsive device.

12. The method of transmitting intelligence, which consists in generating electrical energy of normally practically constant frequency, modifying the frequency of said energy in accordance with the signal to be sent, and causing the reproduction of a signal by the effects of the change in frequency of the received energy.

13. The method of transmitting intelligence, which consists in generating electrical energy, modifying the frequency of said energy in accordance with the signal to be sent, subjecting a wave-responsive device to the varying effects of the received energy, and controlling the reproduction of the signal by said wave-responsive device.

14. The method of transmitting speech electrically, which consists in generating electroradiant energy, modifying the frequency of said energy by and in accordance with speech, subjecting a wave-responsive device to the varying potential differences resulting from the variation of the frequency of the received energy, and controlling the reproduction of speech by said wave-responsive device.

15. The method of transmitting intelligence electrically, which consists in generating electrical energy, modifying the frequency of said energy in accordance with the signal to be sent, and reproducing the signal at the receiver by the effects of the variation in frequency of the received energy.

16. The method of transmitting intelligence electrically, which consists in generating electrical energy, impressing said energy upon a freely-oscillating circuit, modifying the natural period of said circuit in accordance with the signal to be sent, impressing the energy of resulting modified frequency upon a medium, and reproducing the signal at the receiver by the effects of the variation in frequency of the energy received from said medium.

17. The method of transmitting speech electrically, which consists in generating electrical energy, impressing said energy upon a circuit, modifying the natural period of said circuit by and in accordance with speech, impressing the energy of said circuit upon a medium, and operating a speech-reproducing means by changes in the frequency of the energy received from said medium.

18. The method of transmitting speech electrically, which consists in generating electrical energy, impressing said energy upon a circuit, modifying the natural period of said circuit by and in accordance with speech, impressing the energy of said circuit upon a medium, and reproducing speech at the receiver in virtue of the effects of the variations in frequency of the energy received from said medium.

19. The method of transmitting speech electrically, which consists in generating electrical energy fluctuating at a rate higher than the rate of fluctuation of the more essential components of human speech, impressing said energy upon an oscillating circuit, modifying the natural period of said circuit by and in accordance with speech, impressing the energy of resulting modified frequency upon a medium, and reproducing the speech at the receiver by the effects of the variation in frequency of the energy received from said medium.

20. The method of transmitting messages or signals which consists in continuously generating trains of waves of electroradiant energy of practically uniform frequency, modifying the frequency of said waves in accordance with the message or signal to be transmitted, and reproducing the message or signal by the effects of the modification of the frequency of the received electroradiant energy.

21. The method of transmitting speech electrically, which consists in continuously generating trains of waves of electroradiant energy, said wave-trains succeeding each other at a rate high as compared with the frequencies found in speech and said waves having practically uniform frequency, modifying the frequency of said waves by and in accordance with speech, and reproducing speech at a receiver by the effects of the modification of the frequency of the received electroradiant energy.

22. The method of transmitting signals electrically, which consists in generating primary electrical energy, converting said energy into electroradiant energy, and changing the frequency of said electroradiant energy in accordance with the signal to be sent without interrupting the generation of said primary energy.

23. As an improvement in the art of electrical signaling, the method which consists in producing electroradiant energy, and changing the frequency of said energy in accordance with a signal to be sent.

24. As an improvement in the art of electrical communication, the method which consists in producing electroradiant energy, and varying the frequency of said energy by and in accordance with speech.

25. As an improvement in the art of electrical signaling, the method which consists in continuously producing trains of electroradiant-energy waves, and changing the frequency of said waves to represent a signal.

CORNELIUS D. EHRET.

Witnesses:
JNO. P. C. WASDALE,
MAE HOFMANN.