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C. L. FARRAND

METHOD OF AND APPARATUS FOR THE RECEPTION OF RADIOSIGNALS

Filed May 14, 1919

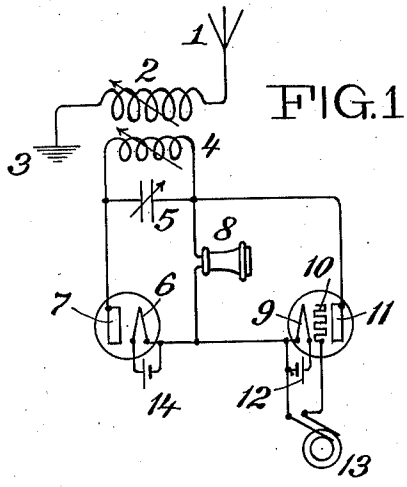


FIG. 1.

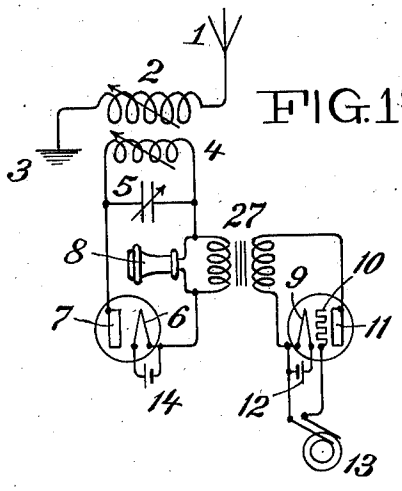


FIG. 1a.

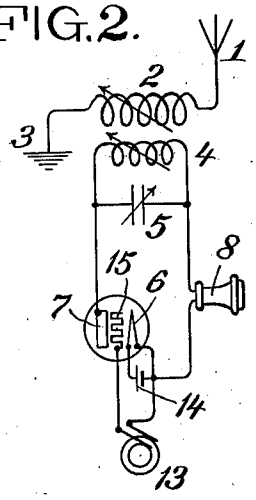


FIG. 2.

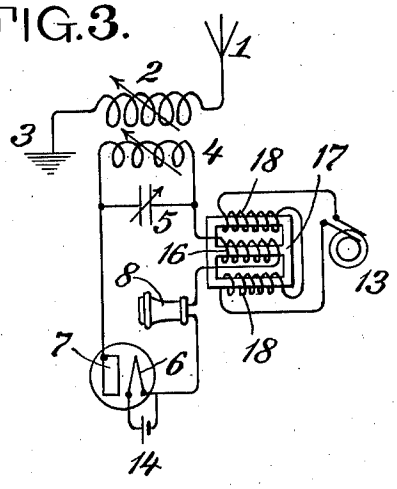


FIG. 3.

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METHOD OF AND APPARATUS FOR THE RECEPTION OF RADIOSIGNALS.

Application filed May 14, 1919. Serial No. 296,960.

To all whom it may concern:

Be it known that I, CLAIR L. FARRAND, a citizen of the United States, residing at the city of Elizabeth, in the county of Union and State of New Jersey, have invented a Method of and Apparatus for the Reception of Radiosignals, of which the following is a specification.

The object of this invention is to provide a means for the reception of radio telegraphic signals, particularly signals of undamped waves.

My invention depends upon the discoveries first, that the rate of rectification of high frequency currents can be periodically regulated so as to produce audible tones when the frequencies used are above the range of audibility; second, that the direct current produced by a rectifier of high frequency currents can be periodically regulated in amplitude so as to produce audible tones when the frequencies used are above the range of audibility.

The following is a description of the method of and apparatus for attaining the above results, and will best be understood by referring to the accompanying drawings, wherein the same numerals refer to corresponding parts in all figures. Fig. 1 shows diagrammatically the method of practicing my invention involving a means of extracting energy from the rectified wave impulses; Fig. 1ª shows diagrammatically the same means as in Fig. 1, excepting that a transformer is used between the energy extracting circuit and the detector circuit; Fig. 2 shows diagrammatically the method involving the periodic regulation of the rate of rectification of the high frequency wave impulses; Fig. 3 shows diagrammatically the method utilizing a reactance for periodically regulating the amplitude of the rectified high frequency current.

Referring to Fig. 1, the numeral 1 is the antenna, 2 is the primary inductance, 3 is the earth, 4 is the secondary inductance, 5 is the secondary condenser, comprising the usual two circuits of the receiver, 6 is the cathode, and 7 is the anode of a high frequency rectifier here shown as a two electrode vacuum valve, although any desired form of rectifier may be used; 8 is the telephone receiver, 9 is the filament, 10 is the grid, and 11 is the plate of a three electrode vacuum valve; 12 is the filament battery, 13 is a source of alternating voltage which may be an alternator, buzzer-generator, valve-generator, or other suitable source; 14 is the filament battery for the two electrode rectifying vacuum valve. In operation the electromotive force of the high frequency signal is applied to the rectifying valve and produces a direct current in the telephone 8, across which is shunted the plate-filament circuit of the three electrode valve. The resistance of this plate-filament circuit is relatively high when the grid is at a negative potential with respect to the filament. When an alternating potential is applied to the grid with respect to the filament, the resistance of the plate-filament circuit periodically varies, periodically extracting current from the telephone, and producing, in effect, an alternating current in the telephone. It will be understood that sound is produced by the telephone only when the signal is applied to the circuit. It is sometimes advisable to connect a transformer between the telephone and the plate-filament circuit of the regulating valve in order to compensate for the difference of impedance which may exist, as shown by 27 in Fig. 1ª.

Referring to Fig. 2, the numeral 15 is a grid placed between the filament 6 and the plate 7 of the rectifier, comprising a three electrode valve, the hot and cold elements of which are used to rectify the high frequency signal current, and the third influencing member or grid 15 is used to control the rate of rectification. The operation is as follows: The uni-directional current produced in the telephone by the rectification of high frequency signal current is of constant amplitude when the grid 15 is at a constant potential with respect to the filament. If alternating potential from the source 13 is applied, periodically varying the potential of the grid, the rate of rectification is periodically varied, periodically changing the amplitude of the uni-directional current in the telephone, producing an audible signal.

The note produced in the telephone corresponds to the frequency of the source 13, when the frequency of that source is in the range of audibility. If the frequency of the source 13 is above the range of audibility

and approaches the frequency of the signal waves in value, a periodic rectification occurs, changing the amplitude of the unidirectional rectified waves at a rate corresponding to the difference between the frequency of rectification and the frequency of the signal waves, and producing an audible signal corresponding in frequency to said difference.

Referring to Fig. 3, the numeral 16 is an inductance in series with the telephone 8, and so disposed on a common core 17 with respect to the windings 18 that the potential produced in winding 16 by windings 18 are equal and opposite. Alternating current from the source 13 is applied to windings 18, periodically varying the permeability of the core 17 and the inductance of winding 16, but not inducing potential therein. The rectified high frequency current will periodically correspond in amplitude, producing in effect an alternating current in the telephone, and consequently an audible signal. Other methods may be used to periodically vary the value of the inductance 16, such as passing the teeth of a sectored metallic disc periodically through the magnetic field produced by said inductance.

Other methods of attaining the same results are objectionable in that they involve the use of motors which cause disturbances in the receiver circuits or depend upon a difference of frequency, as in the case of the autodyne, which involves detuning and a resultant low power factor.

In the present invention the same result is accomplished without necessity for use of the objectionable motor, and the signal can be received with the circuits adjusted to substantially unity power factor with reference to the frequency of the signal wave.

It is not intended to limit the invention to the figures and apparatus as described, as the invention is susceptible of various modifications capable of regulating the amplitude of the rectified high frequency impulses by the periodic extraction of energy with resistance or by the periodic regulation of current flow with inductive or capacitive reactance. Figs. 1, 1ª, and 3 indicate the possibilities of these applications, or as in Fig. 2, methods of periodically regulating the rate of rectification involving electrostatic or electromagnetic fields of, first, high frequency or, second, low frequency.

Impedance variation of the character herein described at frequency above audibility or at radio frequency is claimed in my application Serial No. 330,488, filed October 13, 1919.

Having thus described my invention, I claim:

1. The method of receiving and translating into a signal radio frequency signal-representing energy, which comprises receiving the signal-representing energy, and rectifying the current thereof in a circuit whose impedance is always finite, independently varying the impedance of said circuit at predetermined frequency by variations of an electrostatic field, and translating into a signal the rectified current as modified by said impedance variation.

2. The method of receiving and translating into a signal radio frequency signal-representing energy, which comprises receiving the signal-representing energy, and rectifying the current thereof in a circuit, independently generating an electro-motive-force varying in amplitude at predetermined frequency, producing variations of impedance of said circuit by varying an electrostatic field produced by said electro-motive-force, and translating into a signal the rectified current as modified by said impedance variation.

3. The method of receiving and translating into a signal radio frequency signal-representing energy, which comprises receiving the signal-representing energy, and rectifying the current thereof in a circuit whose impedance is always finite, independently generating an electro-motive-force varying in amplitude at predetermined frequency different from the frequency of said current, producing variations of impedance of said circuit by varying an electrostatic field produced by said electro-motive-force, and translating into a signal the rectified current as modified by said impedance variation.

4. The method of receiving and translating into a signal radio frequency signal-representing energy, which comprises receiving the signal-representing energy, impressing the same upon the anode-cathode circuit of a thermionic impedance, independently varying the impedance of said circuit at predetermined frequency by varying an electrostatic field, and translating into a signal the current in said circuit as modified by said impedance variations.

5. The method of receiving and translating into a signal radio frequency signal-representing energy, which comprises receiving the signal-representing energy, impressing the same upon the anode-cathode circuit of a thermionic impedance, independently varying the impedance of said circuit by varying an electrostatic field at predetermined frequency different from the frequency of the current in said circuit, and translating into a signal the current in said circuit as modified by said impedance variations.

6. The method of receiving and translating into a signal radio frequency energy, which comprises impressing the received energy upon a circuit with which is operatively related a thermionic device comprising an anode, cathode and control electrode,

periodically varying the potential of said control electrode independently of the received energy, and translating the resultant current into a signal.

7. The method of receiving and translating into a signal radio frequency energy, which comprises impressing the received energy upon a circuit with which is operatively related a thermionic device comprising an anode, cathode and control electrode, periodically varying the potential of said control electrode at audio frequency independently of the received energy, and translating the resultant current into a signal.

8. The method of receiving and translating into a signal radio frequency signal-representing energy, which comprises receiving the signal-representing energy, impressing the same upon the anode-cathode circuit of a thermionic impedance, varying the discharge between said anode and cathode by an electrostatic field fluctuating at a predetermined frequency, causing said field fluctuation by an independent source of fluctuating current, and translating into a signal the current in said circuit as modified by said variation of said discharge.

9. The method of receiving and translating into a signal radio frequency signal-representing energy, which comprises receiving the signal-representing energy, impressing the same upon the anode-cathode circuit of a thermionic impedance, varying the discharge between said anode and cathode by an electrostatic field fluctuating at a predetermined frequency different from the frequency of the current in said circuit, causing said field fluctuation by an independent source of fluctuating current, and translating into a signal the current in said circuit as modified by said variation of said discharge.

10. Receiving apparatus for translating radio frequency current comprising a thermionic device comprising an anode and a cathode, means for impressing the received current upon the anode-cathode circuit, a translating instrument subjected to the rectified current, and electrostatic means for independently varying the impedance of said circuit for varying the amplitude of the rectified current traversing said translating instrument.

11. Receiving apparatus for translating radio frequency current comprising a thermionic device comprising an anode, grid and cathode, means for impressing the received current upon the anode-cathode circuit, a translating instrument subjected to the rectified current, and means for varying independently of control by said circuit the potential of said grid at a different frequency.

12. Receiving apparatus for translating radio frequency current comprising a thermionic device comprising an anode, grid and cathode, means for impressing the received current upon the anode-cathode circuit, a translating instrument subjected to the rectified current, and a source of alternating current of different frequency for varying independently of control by said circuit the potential of said grid.

13. Receiving apparatus for translating radio frequency current comprising a circuit, a thermionic device comprising an anode and cathode in said circuit, said circuit being normally without current, means for impressing the received current upon said anode-cathode circuit, a translating instrument subjected to the modified received current in said circuit, and means producing an electrostatic field for independently varying the impedance of said circuit for varying the amplitude of said current.

14. Receiving apparatus for translating radio frequency current comprising a circuit, a thermionic device comprising an anode, cathode and electrostatic field-producing means for varying the discharge between said anode and cathode, said anode and cathode being disposed in said circuit and said field-producing means being external to said circuit, means for independently varying said field for varying the amplitude of the modified current in said circuit, and a translating instrument subjected to said modified current of varying amplitude.

15. Receiving apparatus for translating radio frequency current comprising a circuit, a thermionic device comprising an anode, cathode and grid, said anode and cathode being disposed in said circuit and said grid being independent of control by said circuit, said circuit being normally without current, and means for independently varying the potential of said grid for varying the amplitude of the modified current in said circuit, and a translating instrument subjected to said modified current of varying amplitude.

16. Receiving apparatus for translating radio frequency current comprising a circuit, a thermionic device comprising an anode, cathode and grid, said anode and cathode being disposed in said circuit and said grid being independent of control by said circuit, said circuit being normally without current, means for independently varying the potential of said grid at a uniform frequency differing from the frequency of the current in said circuit, and a translating instrument subject to the modified current in said circuit.

17. Receiving apparatus for translating radio frequency waves comprising a thermionic device comprising an anode, cathode and a control electrode, means for controlling the anode-cathode circuit by said

waves, and means for varying independently of control by said circuit the potential of said control electrode.

18. Receiving apparatus for translating radio frequency waves comprising a thermionic device comprising an anode, cathode and a control electrode, means for controlling the anode-cathode circuit by said waves, and means for varying independently of control by said circuit the potential of said control electrode at a frequency independent of the frequency of said waves.

19. Receiving apparatus for translating radio frequency waves comprising a thermionic device comprising an anode, cathode and a control electrode, means for impressing said waves upon the anode-cathode circuit, and means for varying independently of control by said circuit the potential of said control electrode.

20. Receiving apparatus for translating radio frequency waves comprising a thermionic device comprising an anode, cathode and a control electrode, means for impressing said waves upon the anode-cathode circuit, and means for varying independently of control by said circuit the potential of said control electrode at a frequency independent of the frequency of said waves.

21. In the art of receiving and rendering intelligible radio frequency waves, the method which comprises effecting rectification of the waves by asymmetrically conducting thermionic impedance, and independently varying the rate of rectification by an electrostatic field varying at a frequency independent of the frequency of said waves.

22. Receiving apparatus for translating radio frequency waves comprising a thermionic device comprising an anode, cathode and electrostatic field-producing means for varying the discharge between said anode and cathode, a circuit including said anode and cathode, means for causing in said circuit current fluctuations of a frequency corresponding with the frequency of the received energy, and means so-acting with said field-producing means for independently periodically varying the impedance of said anode-cathode circuit at a predetermined frequency differing from the frequency of said current fluctuations.

23. The method of receiving and translating into a signal radio frequency signal representing energy, which comprises receiving the signal representing energy, rectifying the current thereof in a circuit whose impedance is always finite, independently generating an electromotive force varying in amplitude at a predetermined frequency, utilizing the electromotive force thus generated to produce an electrostatic field which is entirely independent of any field produced by signal representing energy, producing by means of this field variations in the impedance of said circuit and translating into a signal the rectified current as modified by said impedance variation.

24. Receiving apparatus for translating radio frequency current comprising a circuit, means for impressing signal representing radio frequency currents upon said circuit, a thermionic device comprising an anode and a cathode included in said circuit, electrostatic field producing means which are external to said circuit, means for varying said field exclusively by a local source of currents, and independently of any signal representing currents, and thereby varying the amplitude of the current in said circuit, and a translating instrument subjected to said current of varying amplitude.

25. Receiving apparatus for translating radio frequency waves comprising a circuit upon which the energy of the received radio frequency waves is impressed, a thermionic rectifier comprising an electron-emitting cathode and an anode connected in said circuit, a signal-translating instrument affected by the rectified current, a control electrode, and means for varying at audio frequency and independently of the received energy the potential of said control electrode for varying the impedance of said thermionic device.

26. Receiving apparatus for translating radio frequency waves comprising a circuit upon which the energy of the received radio frequency waves is impressed, said circuit being substantially devoid of electrical energy other than said received energy, a thermionic rectifier comprising an electron-emitting cathode and an anode connected in said circuit, a signal-translating instrument affected by the rectified current, a control electrode, and means for varying at audio frequency and independently of the received energy the potential of said control electrode for varying the impedance of said thermionic device.

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