G. W. PICKARD.

RECEIVER FOR WIRELESS TELEGRAPHY AND TELEPHONY.

APPLICATION FILED MAR. 9, 1910.

1,185,711. Patented June 6, 1916

Fig. 1.

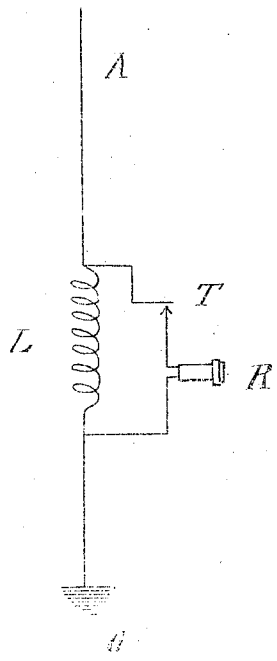
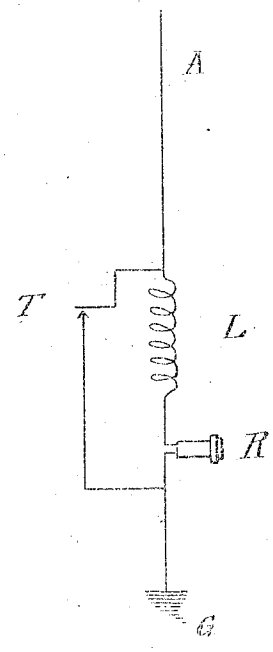


Fig. 2.



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RECEIVER FOR WIRELESS TELEGRAPHY AND TELEPHONY.

1,185,711. Specification of Letters Patent. Patented June 6, 1916.

Application filed March 9, 1910. Serial No. 548,130.

To all whom it may concern:

Be it known that I, GREENLEAF W. PICKARD, a citizen of the United States of America, and a resident of Amesbury, Massachusetts, have invented certain new and useful Improvements in Receivers for Wireless Telegraphy and Telephony, the principles of which are set forth in the following specification and accompanying drawings, which disclose the form of the invention which I now consider to be the best of the various forms in which the principles of the invention may be embodied.

This invention relates to means for receiving intelligence communicated by electric waves.

The object of the invention is to provide a commercially useful means for translating the energy of minute high frequency oscillations or alternating electric currents into a form capable of efficiently actuating an indicating mechanism.

I have previously shown ("The measurement of received energy at wireless stations", *Electrical Review*, December 15th, 1906; "Solid rectifiers", *Electrical Review*, February 20th, 1909) that the minute oscillatory currents in the receiving circuits of a wireless telegraph or telephone station are of sufficient energy to directly actuate a sensitive indicating mechanism, such as a telephone receiver, if only this energy be converted into a form (*i. e.*, direct current) suitable for operating the indicating mechanism. The truth of this statement has been amply demonstrated by the successful commercial use of several forms of my detector, the solid rectifier detector, in which, by means of rectification, the received oscillations are converted into a direct current form capable of operating the indicating mechanism.

In my improved form of receiving circuit, rectification is no longer used as a means of transformation, the received oscillations being converted into direct current by means of an abrupt change in the character or constants of the receiving circuit during the receipt of oscillations.

Of the accompanying drawings, Figure 1 is a diagrammatic illustration of a wireless telegraphy or telephony receiving station in which the invention is embodied. Fig. 2 is a modified form of the invention.

In Fig. 1 the aerial conductor, or antenna, A, is connected to earth, G, through an inductance L, which should be variable to permit of tuning. In shunt around this inductance L is connected the indicating mechanism or signal-producing device such as a telephone receiver, R, and an intermittent make-and-break device, or vibrator T, by means of which the telephone receiver R is intermittently and abruptly shunted around the inductance L. The device T neither need be operated at extremely high speeds nor make actual contact at exactly the peak of the high frequency oscillation.

Fig. 2 shows another arrangement of circuits embodying the invention. Here the telephone receiver R is placed in series in the antenna-ground circuit A, L, R, G, and the inductance L and telephone R are shunted intermittently and abruptly by the vibrator.

In operation, Fig. 1, the passing trains of electric waves set up electric current oscillations in the tuned circuit A, L, G. This circuit, containing both inductance and capacity, is a resonant circuit, and the energy therein alternates from the static to the kinetic form, being alternately in the shape of an electrostatic field around the antenna A, and of a magnetic field in and around the inductance L. At definite intervals, therefore, the received energy is stored in the magnetic field of the inductance L. If at such time the telephone receiver R is abruptly connected, by the operation of T, around the inductance L, this stored energy is prevented from swinging back to the capacity element of the circuit, (such as the capacity of the wire of antenna A), but instead, as the magnetic field collapses, is discharged through the telephone receiver, causing the production of a click or sound. The rate at which a given discharge takes place is, of course, entirely governed by the resistance and inductance of the telephone receiver R, and the inductance L, and not at all by the frequency of the oscillations in the resonant circuit which produce the field about L. The discharge is therefore such as to effectively operate the telephone receiver R. The action of T is in effect to cut out the inductance L from the resonant circuit in which the oscillations were produced, and preferably at a time when L has the maximum

amount of energy about it in the form of its magnetic field; and the claims hereof are intended to include just this action, to the end of discharging the energy through R. The effect of connecting R in shunt to L is to cause the energy of the field to produce a pulse of current which passes through R. This is a direct current pulse and therefore highly efficient in operating the telephone receiver. The compulsion of the current through the telephone circuit permanently removes this energy from the resonant circuit, but the inductance L is connected in the resonant circuit ready to be again charged by the oscillations of energy therein newly received from additional ether waves. In brief, starting with an inductance coil in a suitable or known oscillation circuit, the invention includes such combination therewith of an interrupter (*i. e.*, intermittently-acting device) and a direct-current signal-producing instrument such as a telephone and of low resistance, as will cause the operation of the signal-producer by the pulse of current caused by the collapse of the magnetic field about the inductance. This is accomplished by the action of the interrupter in connecting together the inductance and signal-producer at a time when the energy yet exists in kinetic form in the field of the inductance, and before such energy has reverted to the static form in the capacity element of the oscillation circuit so that the current pulse produced by the resulting collapse of the field conveys the energy which was stored in the field over to the low resistance and therefore efficient signal-producer instead of permitting such energy to revert to the static form in the capacity element of the oscillation circuit.

While the invention is operative with spark sending, it is not so well adapted for that as for undamped wave sending, on account of the difficulty in shunting L by R at the time of efficient strength of field about L corresponding to the efficient amount of energy in the damping oscillations and wave-train. When, however, undamped waves are used for sending, all that is necessary is that vibrator T be operated during the receipt of a wave-train as in wireless telegraphy, or during a continuous train of varying waves as in wireless telephony, without especial reference to the rate of T relative to the parts of the wave-train or trains. Also the energy in the field of L is efficiently tapped into R at comparatively low rates of vibration of T, because that action not only occurs when T actually makes contact, but continues through the minute spark across the contacts of T when they are separated by a distance of a fraction of a micron. The operation of T for telegraphic use at a rate only a few times greater than the operation of the sending key produces very good results in telephone R, and even from spark sending, I have received signals by the use of the invention, without any vibrator at all, but simply by the manual operation of a key in the place of T. Of course, the use of the invention does not cause the diversion of all the energy of the field of L to R, because a large amount of it is shut off from R when the contacts of T are wide apart; but the action is very efficient as compared with the best detectors, and the invention possesses the great advantage over the use of detectors in that it is stable under static and interference. Of course T, when it is a vibratory make-and-break device, may be operated in any way customary with vibrating make-and-break devices.

When it is not desired or is inconvenient to employ the auxiliary energy, required to operate T when it consists of a vibrating make-and-break device, T consists of a device having no parts required to be moved, such as a finely-adjustable minute spark-gap, or a microphonic contact. Any such device may be used in the circuit of either Fig. 1 or Fig. 2, being operated by the rise of potential across its terminals to cause the effective shunting of R around L. If a microphonic contact be used, instead of the spark-gap, then a preferable form is one of the various well-known self-restoring devices, so that the telephone R is automatically de-shunted from inductance L, the device then being, like the vibrator or minute spark-gap, an intermittently-acting device.

The device T may be used with any form of antenna, including my magnetic loop antenna of Letters Patent No. 876,996. In that specific case the inductance of the loop itself acts as the inductance L hereof. In fact in any case the inductance need not be in the form of a winding, although that form will generally be preferred.

The ordinary present-day telephone receiver is believed to be at the present time the best device for use at R. But it should be of low resistance, and the one I have used successfully in the invention had a resistance of only one ohm.

As above suggested, this invention possesses the great advantage that the device T, particularly in the form of a vibrator, is not affected, as to stability, by static or interference.

The modified circuit shown in Fig. 2 operates in almost exactly the same manner as that of Fig. 1. Here, however, the telephone receiver R is normally a part of the oscillation circuit A, L, R, G, but closure of T throws the inductance L, the telephone receiver R, and T in series, just as with the circuit shown in Fig. 1, and the discharge of the inductance takes place in the same manner, and with the same result, *i. e.*, a click or sound from the telephone receiver. Thus

far in my use of the invention, this modification of Fig. 2 produces better results than that of Fig. 1.

I claim:

1. The method of receiving intelligence by electric waves, which consists in storing the energy of the wave-generated oscillations around an inductance in the form of a magnetic field, and then discharging said stored energy in the form of a pulse of current, through a signal-producing device, by abruptly closing a circuit including said device and inductance.

2. The method of receiving intelligence transmitted by electric waves, which consists in intermittently causing, first, the establishment of a magnetic field about an inductance by the passage of oscillating currents generated by said waves, and second, the passage through a direct current signal producing instrument, of a pulse of direct current generated by the collapse of said magnetic field.

3. Means for receiving intelligence communicated by electric waves, which consists of an inductance; a direct current signal producing instrument; and means for intermittently causing, first, the establishment of a magnetic field about the inductance by the passage of oscillating currents generated by said waves, and second, the passage through said signal-producing instrument, of a pulse of direct current generated by the collapse of the magnetic field about said inductance.

4. Means for receiving intelligence communicated by electric waves, which consists of an inductance; a direct current signal producing instrument, included in an oscillating current circuit in series with said inductance; and means for intermittently causing, first, the establishment of a magnetic field about the inductance by the passage of oscillating currents generated by said waves, and second, the passage through said signal-producing instrument, of a pulse of direct current generated by the collapse of the magnetic field about said inductance.

5. Electric wave receiving apparatus which comprises an inductance, a telephone receiver, and an interrupter, connected in series with each other, the interrupter being arranged to intermittently connect the telephone receiver in circuit with the inductance and thereby operate the telephone receiver by the pulse of current from the collapse of the field about the inductance.

6. Electric wave receiving apparatus which comprises an inductance and a telephone receiver connected in series with each other in an oscillating circuit, and an interrupter connected around them both and arranged to effectively connect the telephone receiver in shunt to the inductance and thereby operate the telephone receiver by the pulse of the current from the collapse of the field about the inductance.

7. Electric wave receiving apparatus, which comprises an inductance, a low resistance direct-current signal-producing instrument, and an interrupter acting to shunt through the signal-producing instrument the pulse of current produced by the collapse of the magnetic field about the inductance.

8. Electric wave receiving apparatus, which comprises an inductance device in a circuit including capacity, a signal-producing device, and means for intermittently disconnecting the signal-producing device from the inductance and connecting it therewith when energy exists in a magnetic field about the inductance.

9. Means for receiving intelligence communicated by electric waves, which consists of an inductance coil and a signal-producing instrument both permanently connected together in a circuit in which oscillations are set up by the signaling waves; and means for intermittently closing a circuit other than said oscillating circuit, but which also contains said coil and instrument.

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