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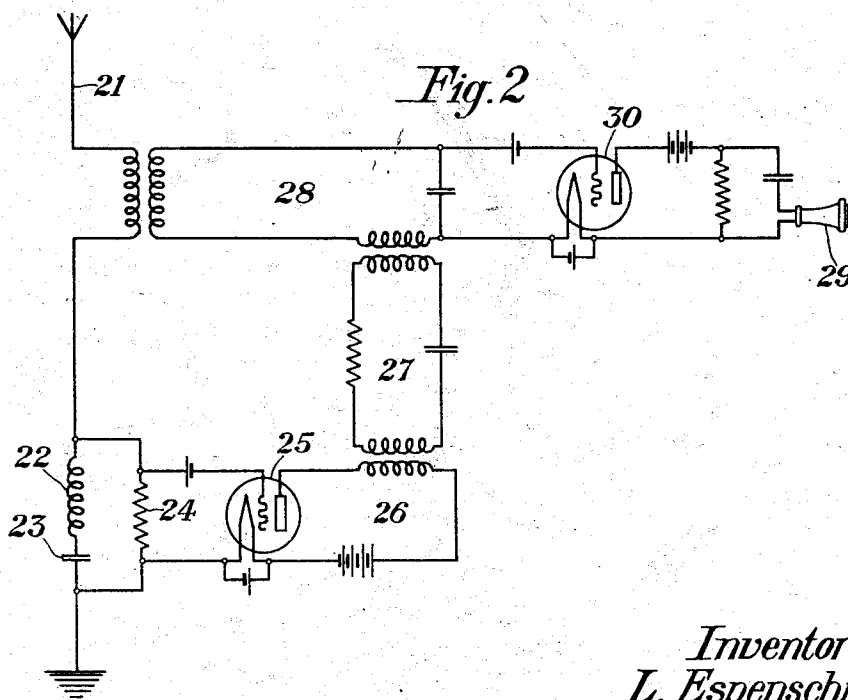
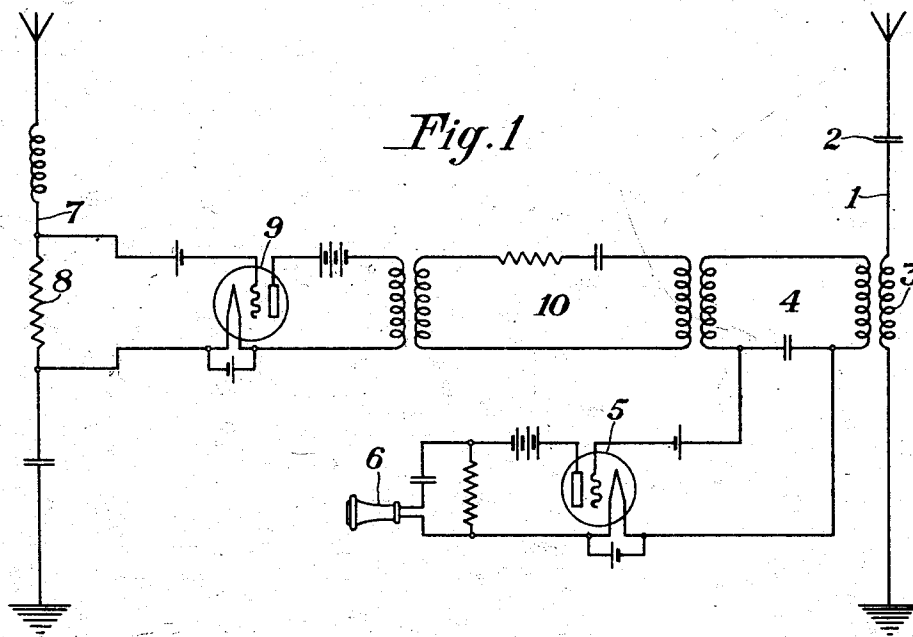
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L. ESPENSCHIED.
WIRELESS RECEIVING SYSTEM.
APPLICATION FILED MAY 15, 1916.

1,362,612.

Patented Dec. 21, 1920.



Inventor :
L. Espenschied
per Thomas D. Lockwood
Attorney.

UNITED STATES PATENT OFFICE.

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WIRELESS RECEIVING SYSTEM.

1,362,612.

Specification of Letters Patent.

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Application filed May 15, 1916. Serial No. 97,566.

To all whom it may concern:

Be it known that I, LLOYD ESPENSCHIED, residing at Hollis, Long Island, in the county of Queens and State of New York, have invented certain Improvements in Wireless Receiving Systems, of which the following is a specification.

My invention relates to a wireless signaling system and more particularly to a system for the reception of wireless signals. Its object is to provide a receiving system in which the receiving instrument shall be protected from disturbing oscillations, such as those due to atmospheric or static disturbances, which might interfere with the efficient receipt of signals. The invention finds its use in connection with a wireless telegraph or telephone system.

It is well known to those acquainted with the art that atmospheric or static interference constitutes a very serious menace to the satisfactory reception of wireless messages and that the elimination of said interference is a problem of great difficulty. This difficulty inheres in the fact that the frequency to which the receiving system is tuned, and is therefore most responsive, is very closely the same as the frequency of the natural oscillations set up by the incidence of an atmospheric disturbance on the receiving antenna. The natural oscillations are therefore of substantially the frequency to most strongly affect the receiving device, and cannot be eliminated by tuning as can persistent disturbances from a foreign station.

This invention contemplates an arrangement by which the receiving device in addition to being operatively connected to the receiving antenna is also connected to an auxiliary circuit which simulates the receiving antenna as regards natural oscillations, means being provided for exciting natural oscillations in said auxiliary circuit simultaneously with the excitation of natural oscillations in the receiving antenna by transient disturbances.

My invention is best understood by reference to the accompanying drawings in which Figures 1 and 2 are diagrams of wireless receiving systems embodying arrangements of my invention.

Referring to Fig. 1, 1 is a receiving antenna, tuned by means of condenser 2 and inductance 3 to resonance with the waves it is desired to receive. A receiving system

comprising a resonant receiving circuit 4, a detector 5, and a receiving device 6 is connected to antenna 1. The detector 5, preferably of the vacuum tube type has its input side connected to resonant receiving circuit 4, and its output side connected to receiver 6. Receiving circuit 4 is resonant to the receiving frequency. 7 is an auxiliary antenna preferably aperiodic. Across an impedance element 8, which may be a non-inductive resistance element, and which is in series with antenna 7, is connected to the input side of an amplifier 9, preferably of the vacuum tube type. To the output side of amplifier 9 is coupled, preferably very loosely, an oscillation circuit 10 which is also connected to the resonant receiving circuit 4. Circuit 10 contains resistance, capacity, and inductance elements which are to be given such values that said oscillation circuit 10 has the same natural periodicity as antenna 1, and also the same characteristic damping factor. When this condition is satisfied the natural oscillations executed by oscillation circuit 10 when excited by an impulsive disturbance are similar to those executed under like conditions by antenna 1. The connections of antenna 1 and oscillation circuit 10 to circuit 4 are differential and therefore simultaneous oscillations in antenna 1 and oscillation circuit 10 oppose and tend to neutralize with respect to receiving circuit 4.

The operation of the organization shown in Fig. 1 in protecting receiver 6 from interference will now be readily understood. When the system is receiving relatively sustained oscillations of the frequency to which antenna 1 and receiving circuit 4 are attuned, antenna 7 is unresponsive and consequently oscillation circuit 10 is not energized. The reception of signals is therefore unaffected by the auxiliary arrangement whose function is exclusively to reduce interference. When, however, an atmospheric or arbitrary disturbance strikes antenna 1 it simultaneously strikes antenna 7 and both antennae are excited. Antenna 1 executes characteristic damped oscillations while antenna 7 impresses an impulsive potential difference across the input circuit of amplifier 9. As a consequence oscillation circuit 10 is impulsively excited and executes characteristic damped oscillations of the same periodicity and damping as those simultaneously

executed by antenna 1. Due to the nonlinear characteristic of the vacuum tube amplifier the waves of the static impulses received from the antenna 7 are distorted so as to
 5 present steeper wave fronts which increases the transient or impulsive excitation of the oscillation circuit 10. Receiving circuit 4 is therefore excited by oscillations of the same form in antenna 1 and oscillation circuit 10
 10 respectively and in consequence of differential connection said oscillations oppose and tend to neutralize. Since the magnitude of the oscillations excited by oscillation circuit 10 is controllable by the amplifying power
 15 of amplifier 9, proper adjustment of said amplifying power will make the resultant induction in receiving circuit 4 substantially zero. Said resultant induction may also be varied and reduced to practically zero value
 20 by adjustment of the relative connections between receiving circuit 4 and antenna 1, and between receiving circuit 4 and oscillation circuit 10 respectively.

Fig. 2 is an arrangement incorporating
 25 the same fundamental principle in an organization employing a single antenna. This arrangement is particularly adapted to a system for the reception of undamped waves of a definite frequency. Referring to
 30 Fig. 2, 21 is a receiving antenna tuned to the frequency of the signals to be received. Antenna 21 includes an inductance coil 22 and a condenser 23 adjusted so that their joint serial impedance at the frequency of recep-
 35 tion is zero. A non-inductive resistance 24 is connected in parallel with inductance 22 and condenser 23 and across the terminals of said resistance is connected the input side of an amplifier 25, preferably of the vacuum
 40 tube type. The function of non-inductive resistance 24 is merely to provide a conductive path between filament and grid of said amplifier. Connected to output circuit 26 of amplifier 25 is oscillation circuit 27, said
 45 oscillation circuit containing resistance inductance and capacity elements so adjusted that the natural oscillations characteristic of said circuit are of the same frequency and damping as those characteristic of an-
 50 tenna 21. Resonant receiving circuit 28 is differentially connected to antenna 21 and oscillation circuit 27. A receiving device 29 is connected to receiving circuit 28 through a detector 30, preferably of the vacuum tube
 55 type.

The operation of the organization of Fig. 2 will be readily understood in the light of the explanation of the operation of that of Fig. 1. When continuous waves of the con-
 60 templated frequency are being received the potential difference across the terminals of resistance 24 is zero in consequence of the fact that inductance 22 and condenser 23 are serially resonant at this frequency. Oscilla-
 65 tion circuit 27 is therefore not excited

through amplifier 25. When a transient or arbitrary disturbance strikes antenna 21, amplifier 25 and therefore oscillation circuit 27 are impulsively excited, oscillation
 circuit 27 oscillating in the same manner as
 70 antenna 21. The natural oscillations in antenna 21 and oscillation circuit 27 oppose with respect to the receiving circuit and by a proper adjustment of connections and am-
 75 plifying power they may be made to neu-
 tralize approximately completely

My invention will be seen to be directed broadly to reducing interference by provid-
 ing an oscillation circuit simulating the receiving antenna as regards natural oscil-
 80 lations, differentially connecting a receiving circuit to the receiving antenna and to said simulative circuit, providing means for ex-
 citing natural oscillations in said simulative circuit simultaneously with the natural os-
 85 cillations excited in the receiving antenna, and providing means for controlling the magnitude of the natural oscillations in said simulative circuit.

What is claimed is:

1. A wireless system comprising a receiv-
 ing antenna; a shock excited oscillation cir-
 cuit having the same periodicity and damp-
 ing characteristic as said antenna; a receiv-
 ing device; connections between said receiv-
 95 ing device and said antenna and between said receiving device and said oscillation circuit adapted to oppose the current from said antenna against the current from said
 oscillation circuit; and means for substan-
 100 tially equalizing the amplitude of the natural oscillations in said oscillation circuit and in said antenna.

2. A wireless system comprising a receiv-
 ing antenna; a shock excited oscillation cir-
 105 cuit having the same periodicity and damping characteristic as said antenna; a receiving device connected to said antenna and said oscillation circuit so as to oppose the current from said antenna against the cur-
 110 rent from said oscillation circuit; means for rendering said oscillation circuit unresponsive to sustained waves of the frequency of those it is desired to receive; an aperiodic auxiliary antenna for exciting natural os-
 115 cillations in said oscillation circuit simultaneously with the excitation of natural oscillations in said receiving antenna and for controlling the relative amplitude of the natural oscillations in said oscillation cir-
 120 cuit.

3. A wireless system comprising a receiv-
 ing antenna, a receiving system connected with said antenna, an oscillation circuit
 125 having the same natural periodicity and damping characteristic as said antenna, said oscillation circuit being associated with said receiving system, and an aperiodic antenna operative when said receiving antenna os-
 cillates in response to a natural disturbance 130

to produce neutralizing oscillations by shock excitation in said oscillation circuit, whereby said receiving system is unaffected by such disturbances.

5 4. A wireless system comprising a receiving antenna, a receiving system connected with said receiving antenna, an auxiliary aperiodic antenna, and an oscillation circuit having the same periodicity and damp-
10 ing characteristic as said receiving antenna and associated with said receiving system and said auxiliary antenna.

5 5. A wireless system comprising a receiving antenna, a receiving system connected
15 therewith, an oscillation circuit associated with said receiving system, and an auxiliary aperiodic antenna associated with said oscillation circuit operating in response to natural disturbances to set up oscillations
20 by shock excitation in said oscillation circuit when said auxiliary antenna responds to natural disturbances, to neutralize the effect of the receiving antenna natural oscillations upon said receiving system.

25 6. A wireless system comprising a receiving antenna, a receiving system connected therewith, an oscillation circuit, said antenna and oscillation circuit having the same
30 periodicity and damping characteristics, aperiodic means unresponsive to signaling frequencies associated with said oscillation circuit, said means operating in response to natural disturbances to set up oscillations
35 by shock excitation in said oscillation circuit, and a distortionless amplifier to equalize the amplitude of the oscillations of the said oscillatory circuit and the natural oscillations of the said receiving antenna, where-
40 by the effect of said disturbances with respect to said receiving system may be substantially eliminated.

7. A wireless system comprising a receiving antenna tuned to reception frequency,
45 an auxiliary aperiodic antenna, an oscillation circuit having the same periodicity and damping characteristics as said receiving antenna and adapted to be shock excited by said auxiliary antenna, a resonant receiving system connected with said receiving

antenna and also with said oscillation circuit, the latter connection being differential whereby the natural oscillations set up in said receiving system by said receiving antenna may be substantially neutralized by the oscillations set up in said receiving system by the said oscillation circuit when excited by impulses from said auxiliary antenna.

8. In wireless signaling systems, the method for suppressing static interference
60 which consists in permitting static impulses to be impressed on a tuned antenna and an aperiodic antenna amplifying the impulses from said aperiodic antenna, producing by the said amplified impulses shock excited
65 oscillations having the same natural periodicity and damping characteristic as those oscillations to which said tuned antenna is resonant, and impressing the natural oscillations from said tuned antenna and the
70 said shock excited oscillations upon a receiving circuit in such manner that the two sets of oscillations will be opposed and neutralized.

9. In a wireless signaling system, the
75 method for suppressing static interference which consists in permitting static impulses to be impressed on a tuned antenna and an aperiodic antenna, producing by the im-
80 pulses of the said aperiodic antenna shock excited oscillations having the same periodicity and damping characteristic as the natural oscillations to which the said tuned antenna is resonant, and impressing the nat-
85 ural oscillations from said tuned antenna and the shock excited oscillations upon a receiving circuit in such manner that the two sets of oscillations will be opposed and neutralized.

In testimony whereof, I have signed my
90 name to this specification in the presence of two subscribing witnesses, this 4th day of May 1916.

LLOYD ESPENSCHIED.

Witnesses:

RALPH W. WOLF,
FREDK. S. ROBINSON.