G. W. PIERCE.

WIRELESS TELEGRAPHY.

APPLICATION FILED OCT. 17, 1906.

923,699. Patented June 1, 1909.

3 SHEETS—SHEET 1.

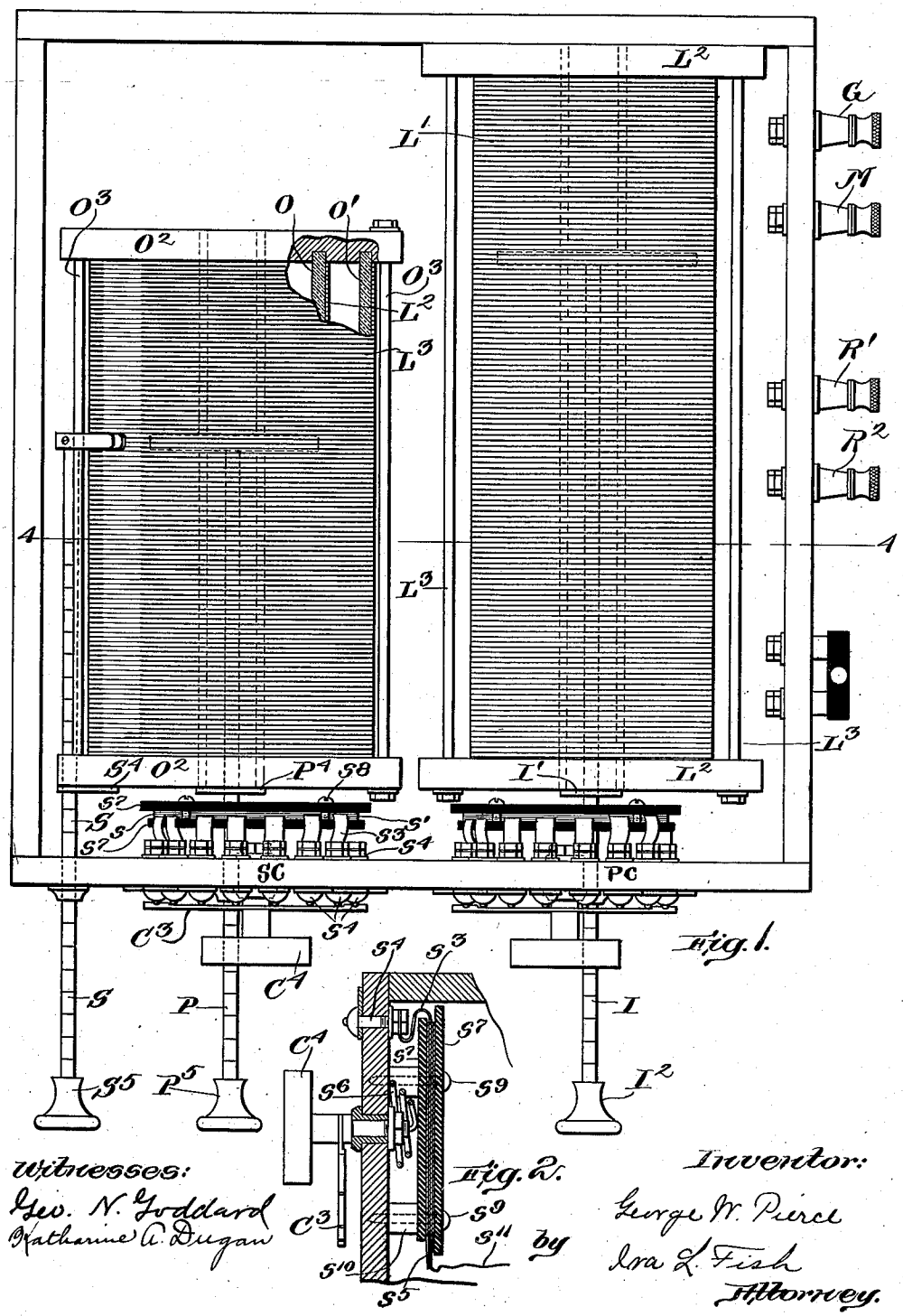

Fig. 1.

Fig. 2.

Witnesses:
Geo. N. Goddard
Katharine A. Dugan

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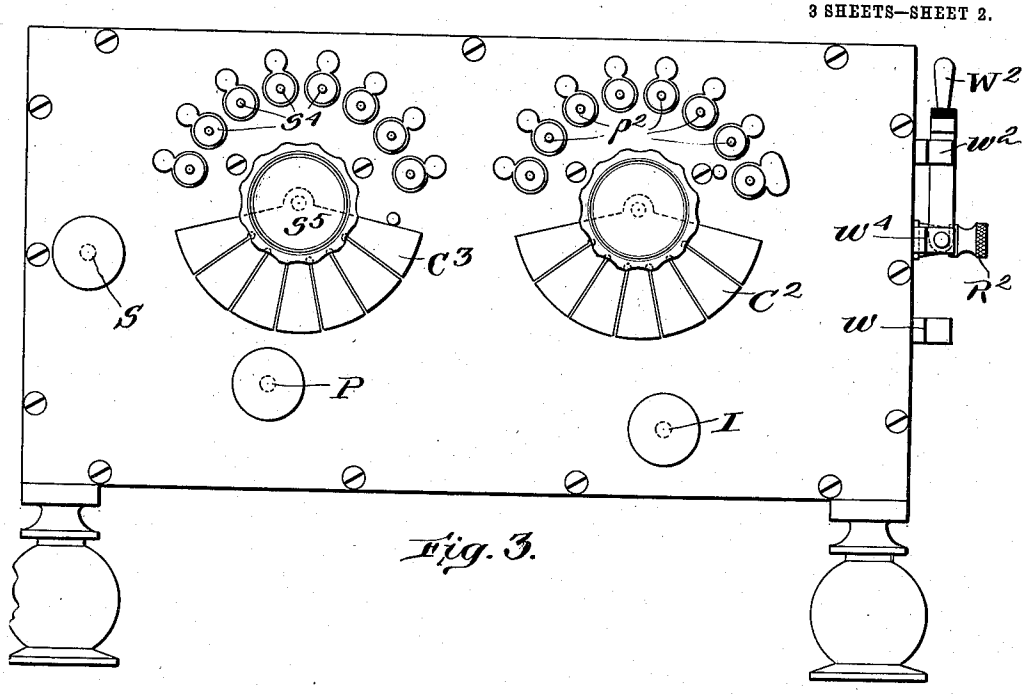

Fig. 3.

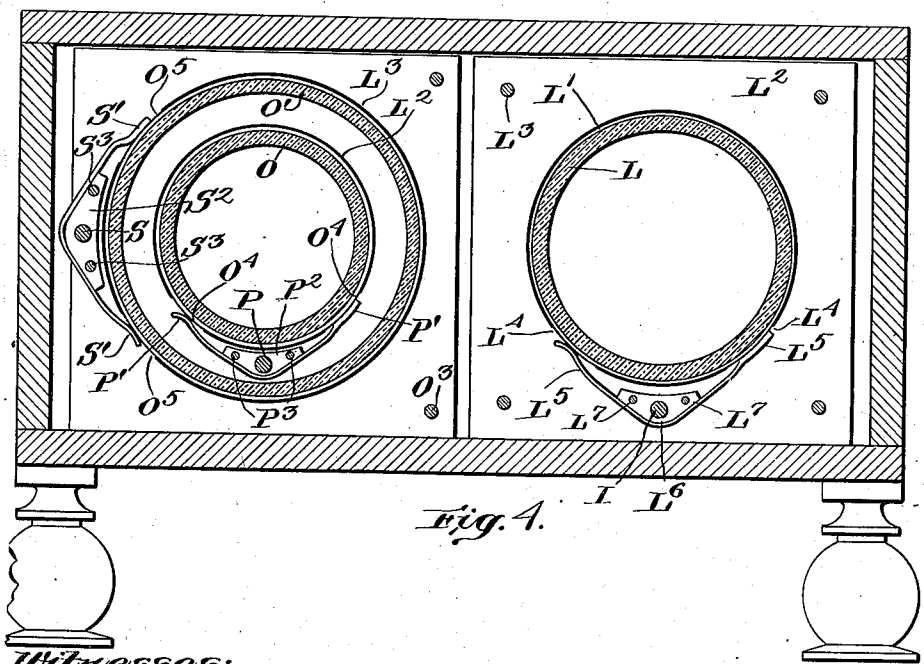

Fig. 4.

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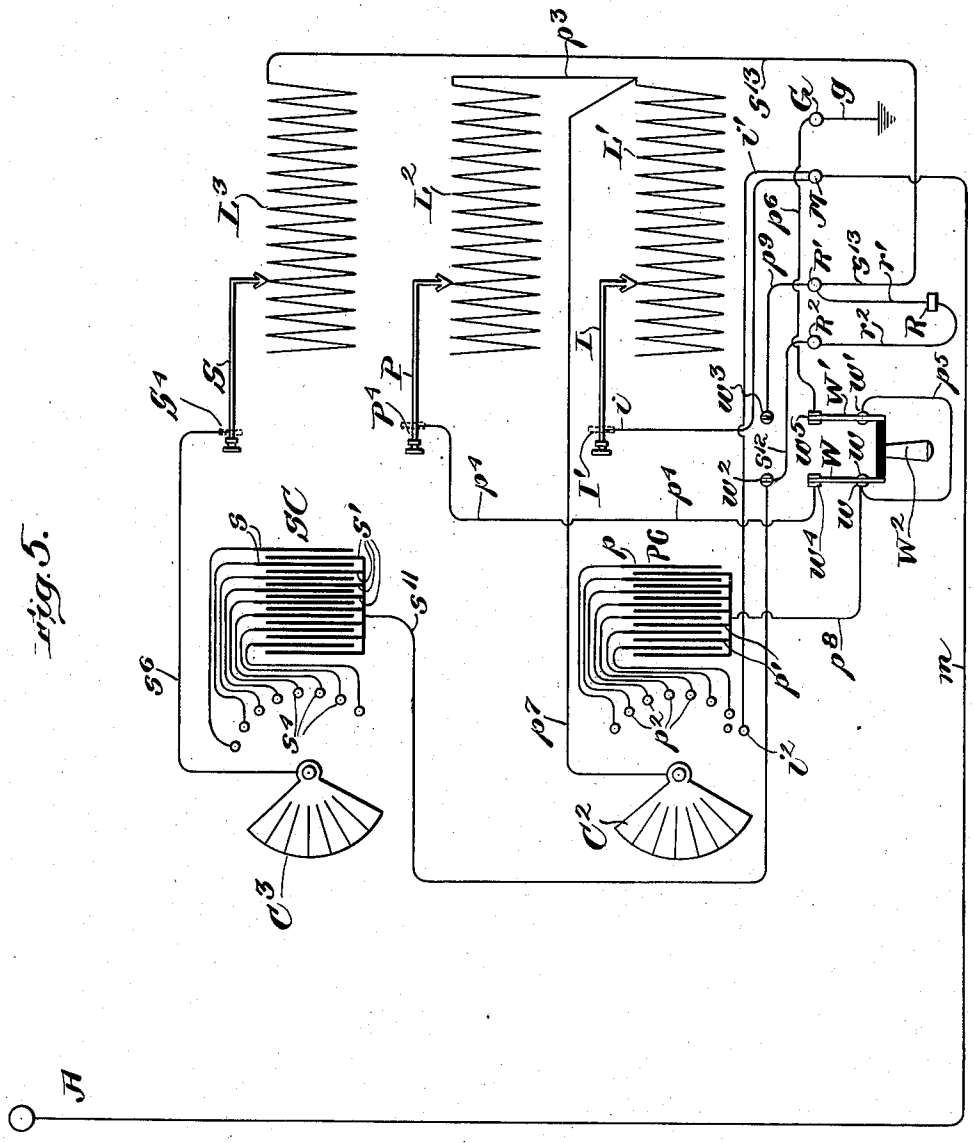

Fig. 5.

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UNITED STATES PATENT OFFICE.

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WIRELESS TELEGRAPHY.

No. 923,699. Specification of Letters Patent. Patented June 1, 1909.

Application filed October 17, 1906. Serial No. 339,295.

To all whom it may concern:

Be it known that I, GEORGE W. PIERCE, citizen of the United States, and resident of Cambridge, county of Middlesex, Massachusetts, have invented certain new and useful Improvements in Wireless Telegraphy, of which the following is a specification.

The invention relates to wireless telegraphy and more especially to the receiving station of a wireless telegraph system.

The object of the invention is to provide at the receiving station simple and efficient apparatus by which the operator may quickly and conveniently bring a sharply resonant receiving circuit into resonance or tune with electro-magnetic waves of widely varying length or may utilize a dully resonant circuit in listening for signals of which he does not know the periodicity or may eliminate to a great extent the interference due to strong disturbances as of nearby stations whose messages are not desired.

In producing an apparatus of simple and compact form which may be conveniently adjusted to secure any of the conditions specified, I employ certain constructions and combinations of parts which may be employed with advantage in systems which do not embody all the features of the invention and which may or may not be provided with means for securing all the conditions specified.

The various parts and connections included in the apparatus embodying the various features of my invention may be constructed as a permanent part of a receiving station or may be so constructed and arranged that the apparatus may be independently manufactured and may be readily connected with the coöperating parts of any receiving station.

In the drawings the various features of the invention are shown embodied in an apparatus which may be independently manufactured and which is so mounted and arranged that it may be readily connected with the other parts of the receiving system.

In these drawings—Figure 1 is a plan view of the box or casing by which the parts of the apparatus are carried, the top of the box being removed and the wiring connecting the various parts being omitted for the sake of clearness. Fig. 2 is a sectional detail through one of the condensers. Fig. 3 is a front elevation of the box. Fig. 4 is a sectional view on line 4—4 Fig. 1; and Fig. 5 is a diagrammatic view showing the wiring by which the various parts are connected.

In the form of apparatus illustrated the various parts of the apparatus are mounted in and upon a box or casing which may be placed or secured in any convenient position with relation to the parts with which connection is to be made. This apparatus comprises an inductance coil which may be connected in circuit with the antenna; a transformer, the primary coil of which is in series with the inductance coil; a condenser in series with the secondary coil of the transformer; a condenser which may be connected in shunt about the primary coil of the transformer; and various connections and devices for varying the number of active turns of wire in the inductance and transformer coils, for varying the number of active plates in the condensers, and for regulating the use of the various parts.

The inductance coil which may be connected with the antenna is indicated at L^1. This coil consists of a wire wound upon a cylinder L of insulating material such for instance as glass. The cylinder is supported between two heads L^2 which are connected together by suitable tie rods L^3.

The turns of wire in the coil L^1 are separated and covered with insulating material, except along the spaces L^4 which extend longitudinally of the coil and form bearing surfaces for the sliding contacts L^5. The contacts L^5 are secured upon a slide L^6 which is mounted upon guide rods L^7 and is connected to the inner end of an operating rod I. The rod I extends through a metal plate I′ secured to the outer face of head L^2 and extends beyond the front of the box where its outer end is provided with a knob I^2 by which the rod may be conveniently manipulated by the operator. The plate I′ is connected by a wire *i* (Fig. 5) with the inner end of a binding post M which is mounted upon the side of the box. This binding post may be connected by means of a wire *m* with an elevated conductor or antenna indicated at A (Fig. 5).

By sliding the rod I in and out the contacts L^5 may be moved longitudinally of the coil L^1 to vary the number of active turns in the coil. The rod may be graduated for conven-

ience in resetting the contacts for the purpose of securing any given condition or adjustment of parts in using the apparatus.

The inner end of the inductance coil L′ is connected by means of a wire p^3 (Fig. 5) with the inner end of a coil L^2 which forms the primary coil of a high-frequency transformer.

The construction of the high-frequency transformer is clearly shown in Figs. 1 and 4. This transformer consists of two cylinders O O′ of insulating material such as glass mounted one within the other between two heads O^2. The heads O^2 are secured together by binding rods O^3. The primary coil L^2 of the transformer is wound upon the inner cylinder O, while the secondary coil L^3 of the transformer is wound upon the outer cylinder. The insulation which covers and separates the turns of wire in the coil L^2 is removed from the periphery of the coil at the points O^4 to form bearing surfaces for the contacts P′. The contacts P′ are secured upon a slide P^2 which is mounted upon guide rods P^3 and is secured to the inner end of the operating rod P. The operating rod extends through a plate P^4 secured to the face of the head O^2 and projects through the front of the box where its outer end is provided with a knob P^5 by which it may be conveniently manipulated by the operator. By sliding the rod P in and out the number of active turns of wire in the primary coil of the transformer may be varied.

The secondary coil L^3 of the transformer is wound upon the outer cylinder O′ and the insulation separating and covering the coil is removed at the points O^5 to form longitudinally extending bearing surfaces for the contacts S′. The contacts S′ are secured upon a slide S^2 which is mounted upon guide rods S^3 and is secured to the inner end of an operating rod S. The rod S extends through a plate S^4 secured to the head O^2 and extends beyond the front of the box where its outer end is provided with a knob S^5 by which it may be conveniently manipulated by the operator. By adjusting the rod S the number of active turns of wire in the secondary coil of the transformer may be varied.

The rods P and S may be graduated for convenience in setting the parts to give any desired adjustment.

Upon the front end of the box two condensers indicated at SC and PC in Fig. 5, are mounted. These condensers are similar in construction and only one of these condensers will therefore be described in detail. The condenser SC consists of a number of thin metallic plates s s' superimposed one upon the other and separated by thin sheets of insulating material. Any suitable metal and any suitable insulating material may be employed but I prefer to use thin copper plates separated by thin sheets of mica. In the construction shown the condenser is provided with 16 metallic plates and each plate is provided with an extending strip through which electrical connection with the plate is made. The 16 plates of the condenser are divided into two series, the plates in one series alternating with the plates in the other series. The strips s^3 which extend from the plates s of one series are connected with the inner ends of a corresponding series of contacts s^4 which are mounted in a circular series upon the front of the box. The strips s^5 which project from the other series of plates s' are bound together so that all the plates in this series are continually in electrical connection with each other.

The number of active plates in the condenser is varied by means of a fan switch C^3 which is arranged to coöperate with the outer ends of the contacts s^4. The switch C^3 is provided with a series of spring plates corresponding in number to the number of contacts s^4 and is connected with an operating handle C^4 mounted in the front of the box. The inner end of the operating handle C^4 is connected by means of a wire s^6 (Fig. 5) with a plate S^4 and through it with the rod S. By turning the switch C^3 therefore to engage one or more of the contacts s^2 the condenser may be connected in series with the secondary coil L^3 of the transformer and by varying the number of contacts engaged by the switch the number of active plates in the condenser and therefore the capacity of the condenser may be varied.

The metallic plates and interposed insulating sheets forming the condenser are held firmly in contact with each other between two plates s^7 of insulating material which are bound together by screws s^8 and are supported upon the inner surface of the box by screws s^9 and blocks s^{10}.

The strips s^5 which project from the series of plates s' are connected by a wire s^{11} with the inner end of a post w^2. The outer end of this post forms one of the contacts of a switch which will be described hereinafter. From the post w^2 a wire s^{12} leads to the inner end of a binding post R^2. This binding post projects beyond the side of the box where it may be conveniently connected through a wire r^2 with an indicator for electro-magnetic waves indicated at R (Fig. 5). Through these connections therefore the condenser SC may be connected in series with an indicator for electro-magnetic waves. The circuit through the secondary coil of the transformer, condenser SC and indicator R, may be completed by connecting the wire r' which leads from the indicator to the outer end of a second binding post R′ mounted upon the side of the box, the inner end of which is connected through a wire s^{13} with the inner end of the secondary coil L^3.

The condenser PC is similar in construction to the condenser SC and comprises a

series of plates q connected with the contacts p^2 and the series of plates p' connected together, the plates being separated by sheets of insulating material. The condenser may be thrown into and out of action and the number of active plates in the condenser may be varied by means of a fan switch C^2 similar in construction and mode of operation to the switch C^3.

The switch C^2 is connected by means of a wire p^7 with the inner end of the inductance coil L' or with the wire p^3 leading from this coil to the primary coil of the transformer. The plates p' of the condenser are connected by a wire p^8 with the inner end of a post w mounted upon the side of the box, the outer end of the post forming one of the contacts for a switch to be described.

The rod P through which the number of active turns of wire in the primary coil of the transformer is varied, is connected through a wire p^4 with a post w^4 secured in the side of the box. To the outer end of the post w^4 one arm W of a double switch W^2 is pivoted. The other arm W' of this switch is pivoted to a post w^5 secured on the side of the box and this post is connected by a wire p^6 with the inner end of a binding post G. This binding post projects beyond the side of the box where it may be conveniently connected by means of a wire g with the earth or with an artificial ground or with a wire leading back and connected to the antenna to form a closed circuit.

The contact arms W W' of the switch W^2 are arranged to engage contact posts w w' or contact posts w^2 w^3. The posts w w' are connected by a wire p^5 and when the contact arms of the switch are in engagement with these posts the wire p^4 leading from the primary coil of the transformer is connected with the binding post G through the wire p^5 and wire p^6. When the contact arms of the switch are in engagement with the posts w^2 w^3 the wire p^4 is in connection with the wire s^{12} leading to the binding post R^2 to which the indicator R is connected, while the binding post R' to which the indicator is also connected is in electrical connection with the binding post G through the wire p^9, switch arm W' and wire p^6. When the parts are thus connected therefore the secondary coil L^2 is connected with the ground through the indicator R.

For the purpose of short circuiting the inductance coil L' a wire i' (Fig. 5) leads from the binding post M to a contact i^2 so arranged that it may be engaged by the switch C^2. When the switch C^2 is in engagement with the contact i^2 the condenser PC is out of action and the inductance coil L' is also out of action being short circuited through the wire i', contact i^2, switch C^2 and wire p^7.

In adjusting the apparatus to secure a sharply resonant circuit in tune with a sending station, the switch W^2 will be in such position that the arms W W' engage the contact posts w w' as indicated in Fig. 5. The switch C^3 will be turned to engage one or more of the contacts s^2. With the parts thus adjusted the detector R will be in a closed circuit in which it is connected in series with the secondary coil L^3 of the transformer and with the condenser SC. This circuit will be inductively connected with the antenna circuit through the primary and secondary coils of the transformer. In tuning the apparatus to resonance with a sending station sending out comparatively short waves, the switch C^2 will be engaged with the contact i^2 thus rendering the condenser PC inactive and short circuiting the inductance coil L'. The tuning will then be done by adjusting the rod P to vary the number of active turns in the primary coil L^2 and the secondary circuit will be adjusted in resonance with the primary circuit by adjusting the rod S to vary the number of active turns of wire in the secondary coil L^3 and by adjusting the switch C^3 to vary the number of active plates in the condenser SC. In bringing the apparatus into resonance with stations sending longer waves, the switch C^2 will be disengaged from the contact I^2 so that the inductance L' will be in circuit. The tuning will be done by adjusting the bars I and P to vary the number of active turns of wire in the inductance coil L' and the primary coil L^2 of the transformer. The secondary circuit will be adjusted to resonance with the primary circuit as before. In tuning the apparatus to resonance with stations sending still longer waves, the switch C^2 will be engaged with one or more of the contacts p^2 thus bringing the condenser PC into circuit shunted about the primary coil L^2 of the transformer. The tuning of the primary circuit will be effected by adjusting the rods P and I and also adjusting the switch C^2 to vary the number of active plates in the condenser PC. The apparatus may thus by the various adjustments and by bringing into action of the various parts of the apparatus, be tuned to resonance with waves of widely varying length.

A circuit of dull resonance may be secured for use in listening for signals the periodicity of which is unknown to the operator by swinging the switch W^2 into position to engage the posts w^2 w^3 and opening the switch C^3. With the parts thus adjusted the detector R is connected with the antenna circuit in series with two inductance coils L' L^2 which are connected in series between the antenna and the detector. This circuit includes the antenna A, connecting wire m, wire i, coil L', wire p^3, coil L^2, wire p^4, switch arm W', wire s^{12}, wire r^2, detector R, wire r' wire p^9, switch arm W', wire p^6, and wire g. In tuning this circuit to resonance with the

waves to be received, the rods I and P may be adjusted to vary the number of active turns of wire in the inductance coil L′ and in the coil L^2 which under these conditions is also an inductance coil.

If it is desired to cut down the effect on the receiving instrument of sources of strong disturbances as of nearby stations whose messages are not desired, this may be done by engaging the switch W^2 with the contact pieces w^2 w^3 and adjusting the switch C^3 to bring the condenser SC into circuit. With the connections thus made the currents in the primary circuit will pass through the detector R and the currents induced in the secondary circuit will also pass through the indicator R but in the opposite direction. By proper adjustments of the parts included in the primary and secondary circuits, the currents may be thrown into or out of phase and their relative intensities varied so that currents produced by undesired signals will tend to neutralize each other while the desired signals may be intensified.

While I prefer to employ the specific form and arrangement of devices shown and described and to connect the various parts in the manner indicated, it will be understood that these specific forms and arrangements and these specific connections may be varied without departing from my invention.

Without attempting to set forth in detail the various forms in which the features of the invention may be embodied what I claim and desire to secure by Letters Patent is:—

1. A tuning apparatus for wireless receiving stations, provided with a variable inductance coil, means for connecting the same with the antenna, a high frequency transformer having a variable primary coil in series with said inductance coil, a condenser, connections for shunting the condenser about the primary coil of the transformer, connections for short circuiting the inductance coil, means for bringing either of these connections into circuit, and connections for connecting the secondary coil of the transformer with a detector for electro-magnetic waves.

2. A tuning apparatus for wireless receiving stations, provided with an inductance coil, means for connecting the same with the antenna, means for varying the number of active turns of wire in the coil, a primary coil of a high frequency transformer in series with the inductance coil, means for varying the number of active turns of wire in the primary coil, a secondary coil for the transformer, means for varying the number of active turns of wire in the secondary coil, a condenser in series with the secondary coil consisting of a series of metallic plates, means for varying the number of active plates in the condenser, connections for connecting the condenser and secondary coil in series with a detector for electro-magnetic waves, a second condenser consisting of series of metallic plates, means for varying the number of active plates in the condenser, connections for connecting the primary of the transformer with the ground either directly or through the detector and for either connecting the latter condenser in shunt about the primary of the transformer or throwing it out of action, and connections for short circuiting the inductance coil at will.

3. A tuning apparatus for wireless receiving stations, provided with an inductance coil, means for connecting the same with the antenna, means for varying the number of active turns of wire in the coil, a primary coil of a high frequency transformer in series with the inductance coil, means for varying the number of active turns of wire in the primary coil, a secondary coil for the transformer, means for varying the number of active turns of wire in the secondary coil, a condenser in series with the secondary coil consisting of a series of metallic plates, means for varying the number of active plates in the condenser, connections for connecting the condenser and secondary coil in series with a detector for electro-magnetic waves, a second condenser consisting of series of metallic plates, means for varying the number of active plates in the condenser, connections for connecting the primary of the transformer with the ground either directly or through the detector and for either connecting the latter condenser in shunt about the primary of the transformer or throwing it out of action.

In witness whereof, I have hereunto set my hand, this 15th day of October 1906.

GEORGE W. PIERCE.

In the presence of—
IRA L. FISH,
KATHARINE A. DUGAN.