J. L. HOGAN, Jr.

APPARATUS FOR WIRELESS SIGNALING.

APPLICATION FILED SEPT. 9, 1910.

1,014,002. Patented Jan. 9, 1912.

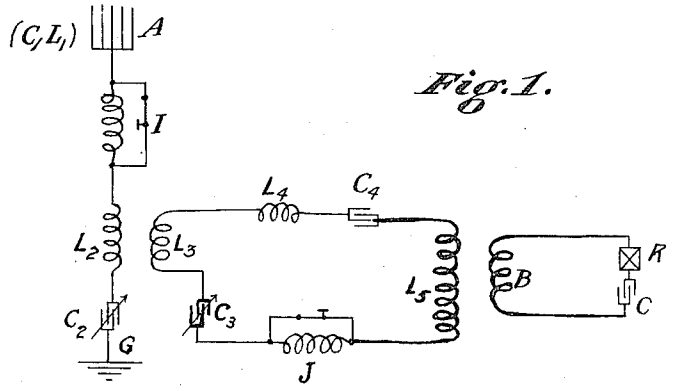

Fig. 1.

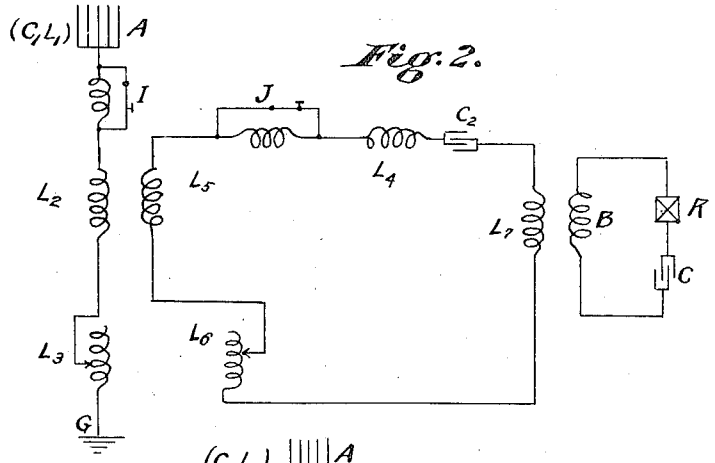

Fig. 2.

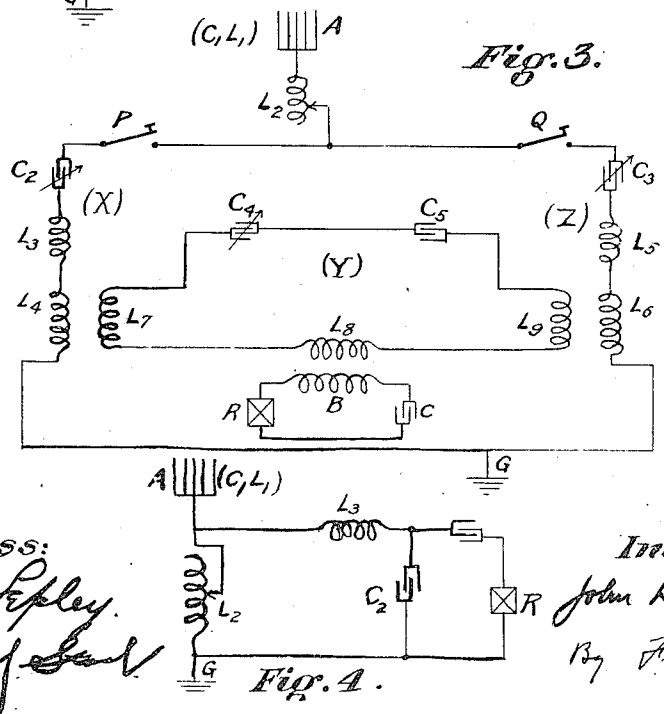

Fig. 3.

Fig. 4.

Witness:
Chas. S. Lepley.
F. W. Lee

Inventor:
John L. Hogan Jr.
By F. W. H. Clay
his Atty.

UNITED STATES PATENT OFFICE.

JOHN L. HOGAN, JR., OF BRANT ROCK, MASSACHUSETTS, ASSIGNOR TO NATIONAL ELECTRIC SIGNALING COMPANY, OF PITTSBURGH, PENNSYLVANIA, A CORPORATION OF NEW JERSEY.

APPARATUS FOR WIRELESS SIGNALING.

1,014,002. Specification of Letters Patent. Patented Jan. 9, 1912.

Application filed September 9, 1910. Serial No. 581,334.

To all whom it may concern:

Be it known that I, JOHN L. HOGAN, Jr., a citizen of the United States, residing at Brant Rock, in the State of Massachusetts, have invented certain new and useful Improvements in Apparatus for Wireless Signaling, of which the following is a specification.

My invention relates particularly to the tuning of circuits for transmitting energy by electromagnetic waves, and its primary object is to render more easy and accurate the manipulation of the tuning elements.

I have illustrated the invention as applied to several wireless telegraphy circuits in the accompanying drawing, in which—

Figure 1 is a diagram representing a simple circuit of a receiving station arranged to employ my invention. Figs. 2 and 3 are alternative forms having certain further advantages which will hereafter be explained, and Fig. 4 is a simplified diagram representing a simple form convenient for explanation of the principles of the invention.

Heretofore the associated electrical circuits employed in wireless telegraphy have been independently tuned by varying the tuning elements such as capacity and inductance, in each circuit separately, whereby to give the several associated circuits the same natural electrical period. The necessity of moving several indicating devices and making several adjustments has introduced errors and also has required considerable skill in the user of the instruments. By my invention I avoid this difficulty, and incidentally make it possible to more delicately adjust the apparatus, as well as reduce the liability of error.

Referring first to the diagram Fig. 4, it will be understood that when the circuit A, L_2, G, has the same electrical period as, (*i. e.*, is in resonance with), the circuit L_2, L_3, C_2, the electrical condition is, that the product of the effective capacity multiplied by the effective inductance, is the same in each of the circuits. Otherwise expressed, if we let "L" stand for inductance, and "C" for the capacity, as usual, the condition is

$$C_1(L_1+L_2)=C_2(L_2+L_3),$$

where L_1 and C_1 represent the capacity and inductance of the antenna independent of the inductance L_2. If now the product $C_2L_3=C_1L_1$ (C_1 being equal to C_2) then the above condition in fulfilled, since L_2 is common to both circuits. Therefore if in Fig. 4, after having found the product of the effective capacity and inductance of the antenna circuit independent of L_2, we adjust the elements L_3 and C_2 in the second circuit so that their product has the same value, then by simply varying the element L_2 which is common to both circuits, we may change the electrical period of both circuits simultaneously and similarly without destroying the condition of perfect resonance between them.

In practice I construct the tuning box containing the elements L_2, L_3 and C_2 with leads arranged to connect the antenna and ground in circuit with L_2, and use but a single variable pointer or indicator, that is, the slide of the coil represented by L_2 in this particular figure. Of course, I may thus vary any kind of tuning element so long as it is common to both circuits.

Fig. 1 shows a preferred form of circuits for use of the invention. Neglecting the coils I and J which may or may not be used, and whose use does not change the matter; the antenna circuit A to G includes inductance L_2 and variable capacity C_2, and this is inductively connected to the resonant circuit including inductance L_3 similar to L_2 and variable capacity C_3 similar to C_2, in addition to inductances L_4, and L_5 and capacity C_4. The coil L_5 may be used as the primary of a transformer connecting to another circuit, or to any detector circuit as for example B, C, R, having the receiver R therein.

Again supposing the independent inductance and capacity of the antenna to be respectively L_1 and C_1, the condition for resonance here is,—

$$\left(\frac{C_1C_2}{C_1+C_2}\right)(L_1+L_2)=\left(\frac{C_3C_4}{C_3+C_4}\right)(L_3+L_4+L_5).$$

If we make $C_4=C_1$ and $L_1+L_2=L_3+L_4+L_5$ then the circuits will be in resonance whenever $C_2=C_3$ and therefore varying the latter similarly and simultaneously will change the periods of both circuits alike without destroying resonance. The component parts of capacities C_2 and C_3 can be mounted on the same movable support.

Again, and similarly, in Fig. 2 where the capacities C_2 and C_3 in Fig. 1 are replaced by inductances L_3 and L_6, since

$$C_1(L_1+L_2+L_3)=C_2(L_4+L_5+L_6+L_7)$$

for resonance, we may equalize C_1 and C_2 and also the sum of L_1 and L_2 with the sum $L_4+L_5+L_6$, and then resonance will result, for some one degree of coupling between the members L_2 and L_5, whenever $L_3=L_6$. However, if L_5 is made equal to L_2, (*i. e.*, the primary and secondary of the transformer are given equal self-inductances), the condition of resonance between the associated circuits will hold for all degrees of coupling; because the electrical reactions on and between the primary and secondary coils will be equal for all couplings. That is, while the numerical value of L_5 or of L_2 may vary somewhat as the coupling is changed, yet L_5 will remain equal to L_2 for all couplings. Thus in making L_5 numerically equal to L_2 in the construction of any particular instrument, I am not limited to a single value of coupling in the apparatus.

In Fig. 3 representing an interference preventer circuit, the same symbols are used as before to represent capacity and inductance; and here the condition of resonance between circuits X and Y is,—

$$\left(\frac{C_1C_2}{C_1+C_2}\right)(L_1+L_2+L_3+L_4)=\left(\frac{C_4C_5}{C_4+C_5}\right)(L_7+L_8+L_9);$$

and if $C_1=C_2$ and the sum $L_1+L_2+L_3+L_4$ equals the sum $L_7+L_8+L_9$, then when we make $C_2=C_4$ the condition is fulfilled for any period and circuits X and Y are tuned. Also if $C_1=C_5$ and the sum $L_1+L_2+{}_5+L_6=L_7+L_8+L_9$, and we make $C_3=C_4$ the circuits Y and Z are tuned. Therefore if we let $C_1=C_5$ and $L_1+L_2+L_5+L_6=L_1+L_2+L_3+L_4=L_7+L_8+L_9$, then by giving the capacities C_2, C_3 and C_4 the same value we will have all the three circuits in resonance and balanced. Evidently C_2, C_3, and C_4 may be mounted to be similarly and simultaneously varied.

In the operation of the arrangement of Fig. 3, one of the switches P or Q as for example switch P, is opened, and the mechanism simultaneously altering condensers C_2, C_3 and C_4 are varied until maximum signals are heard. Switch P is then closed, so causing all signals to vanish; (since the entire interference preventer has been placed in balance by the previous operation of tuning). Next the value of either C_2 or C_3 is changed slightly, so unbalancing the interference preventer for the desired signals, but leaving it balanced as regards impulsive disturbances. Of course such operation of the interference preventer is familiar in this art, but by the addition to it of the present invention the facility with which it may be handled is increased.

My invention is not limited to any particular embodiment of the tuning elements, but comprises broadly tuning apparatus in which at least one tuning element is common to several circuits, but arranged and adjusted so that the variation of this one element will similarly alter the period of several circuits while still preserving resonance.

Having thus described my invention and illustrated its use, what I claim is,—

1. The combination with several adjustable oscillation circuits, of a tuning device connecting the several circuits and having an adjustable tuning element arranged to equally and simultaneously vary the electrical periods of the several circuits, substantially as described.

2. The combination with several interdependent resonant circuits of a tuning device having an element common to said circuits and adjusted so that the variation of said element changes equally the electrical periods of all the said circuits at once and alike.

3. The combination of several associated resonant circuits, each of said circuits having a plurality of tuning elements, one of said tuning elements being variable and common to all the circuits, and the other tuning elements in the respective circuits being equalized, so that the variation of said common element will equally and simultaneously change the electrical period of all the circuits, substantially as described.

4. A tuning instrument serving to connect two interdependent resonant circuits, the tuning elements in said two circuits being equalized, and having one tuning element common to both circuits and variable, substantially as and for the purpose described.

In testimony whereof I have hereunto signed my name in the presence of the two subscribed witnesses.

JOHN L. HOGAN, JR.

Witnesses:
H. M. CORWIN,
F. W. H. CLAY.

DISCLAIMER.

No. 1,014,002.—*John L. Hogan, Jr.*, Brant Rock, Mass. APPARATUS FOR WIRELESS SIGNALING. Patent dated January 9, 1912. Disclaimer filed March 23, 1915, by *Samuel M. Kintner* and *Halsey M. Barrett*, receivers of the assignee, the *National Electric Signaling Company*.

Enter this disclaimer—

"To that part of the claim in said specification which is in the following words, to wit, claims 1 and 2 of the patent, as follows:

"1. The combination with several adjustable oscillation circuits, of a tuning device connecting the several circuits and having an adjustable tuning element arranged to equally and simultaneously vary the electrical periods of the several circuits, substantially as described.

"2. The combination with several interdependent resonant circuits of a tuning device having an element common to said circuits and adjusted so that the variation of said element changes equally the electrical periods of all the said circuits at once and alike."

[*Official Gazette, March 30, 1915.*]