

R. A. FESSENDEN.
 APPARATUS FOR WIRELESS SIGNALING.
 APPLICATION FILED JAN. 6, 1906.

1,059,666.

Patented Apr. 22, 1913.

3 SHEETS—SHEET 1.

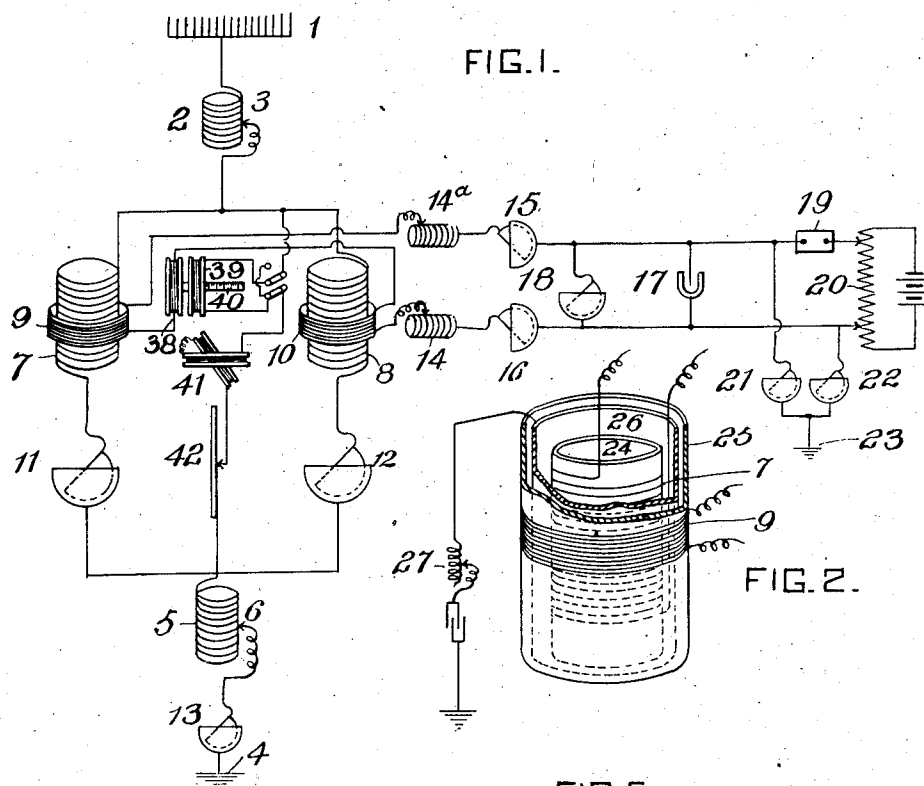


FIG. 1.

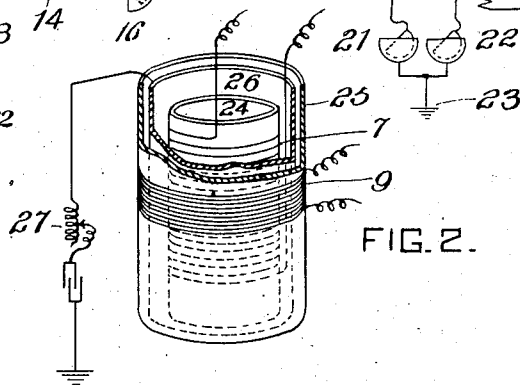


FIG. 2.

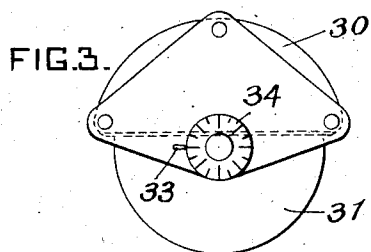


FIG. 3.

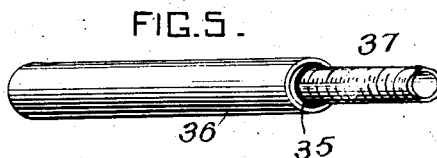


FIG. 5.

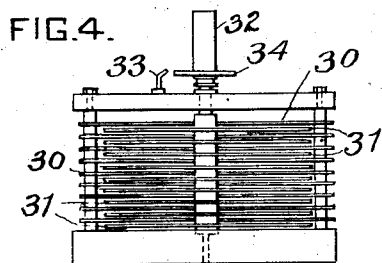


FIG. 4.

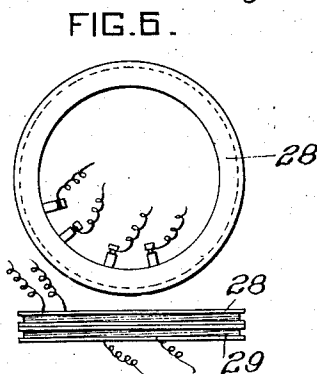


FIG. 6.

WITNESSES:

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INVENTOR

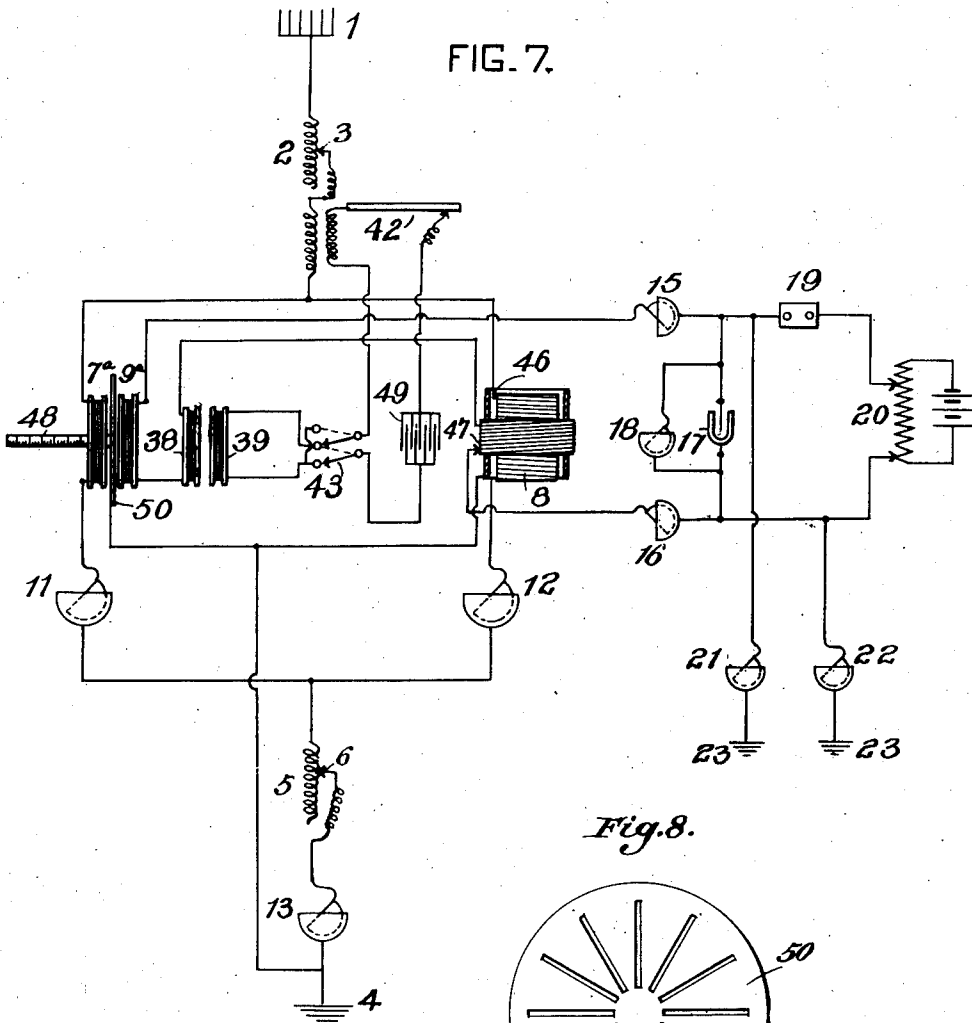
Reginald A. Fessenden
 by *Daniel B. Wolcott* Atty

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3 SHEETS-SHEET 2.



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3 SHEETS—SHEET 3.

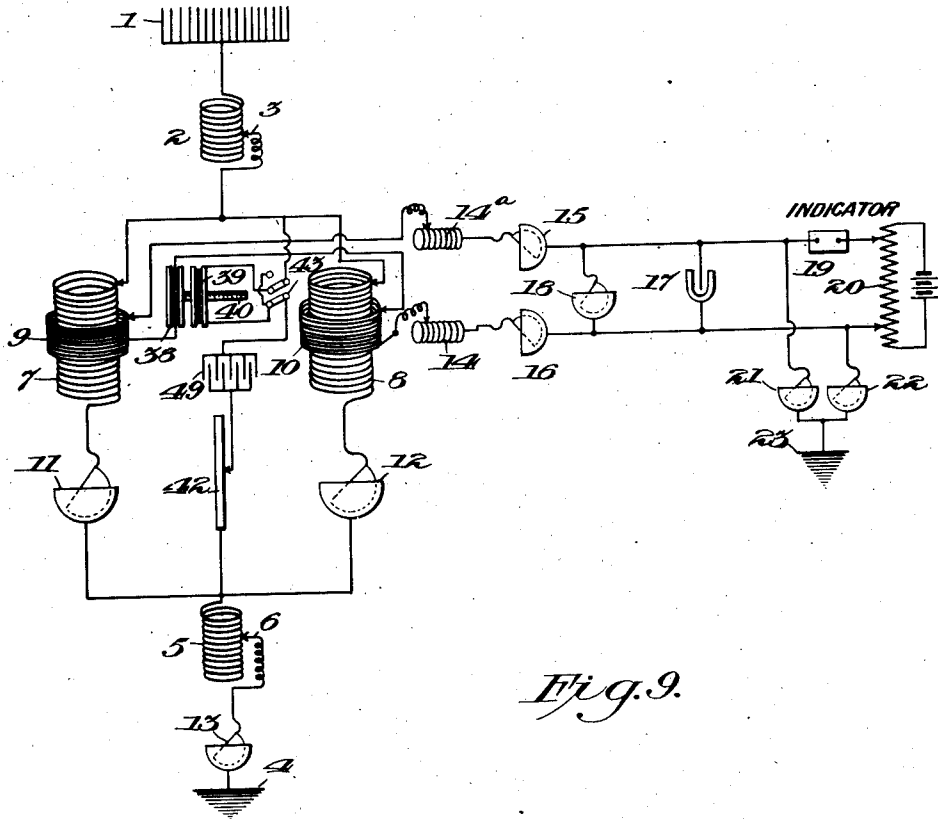


Fig. 9.

Witnesses:

Chas. S. Pley.
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Inventor:

Reginald A. Fessenden

By J. W. H. Clay
 his atty.

UNITED STATES PATENT OFFICE.

REGINALD A. FESSENDEN, OF WASHINGTON, DISTRICT OF COLUMBIA, ASSIGNOR, BY MESNE ASSIGNMENTS, TO SAMUEL M. KINTNER, OF PITTSBURGH, PENNSYLVANIA, AND HALSEY M. BARRETT, OF BLOOMFIELD, NEW JERSEY, RECEIVERS.

APPARATUS FOR WIRELESS SIGNALING.

1,059,666.

Specification of Letters Patent.

Patented Apr. 22, 1913.

Original application filed January 9, 1905, Serial No. 240,269. Divided and this application filed January 6, 1906. Serial No. 294,928.

To all whom it may concern:

Be it known that I, REGINALD A. FESSENDEN, residing at Washington, in the District of Columbia, a citizen of the United States, have invented or discovered certain new and useful Improvements in Apparatus for Wireless Signaling, of which improvements the following is a specification.

The invention described herein relates to improvements in the art of preventing interference with receipt of telegraphic signals at a station whether such interference is caused by atmospheric disturbance or by the generation of waves at other stations.

In the accompanying drawings forming a part of this specification, Figures 1 and 7 are diagrammatic views illustrating receiving stations constructed in accordance with my improvement. Fig. 2 is a detail view illustrating the preferred form of transformer. Figs. 3 and 4 are plan and side elevation respectively, illustrating the preferred form of adjustable capacity. Fig. 5 illustrates another form of adjustable capacity. Fig. 6 shows in plan and elevation a desirable construction of transformer, Fig. 8 is a view showing in detail a portion of the apparatus shown in Fig. 7, and Fig. 9 shows a modification of the arrangement in Fig. 1, as hereinafter described.

In Fig. 1, 1 is a receiving antenna, grounded at 4, 2 and 5 represent inductances adjustable by means of the sliding contacts 3 and 6, 7 and 8 represent primaries and 9 and 10 secondaries of transformers, 11 and 12 and 13 represent condensers, preferably adjustable. The secondaries 9 and 10 are preferably arranged in series with each other and in operative relation to the receiver 17. The circuit including the secondaries 9 and 10 and the receiver preferably contain the variable inductances 14 and 14*, and the adjustable condensers 15, 16 and 18. 19 is an indicating mechanism and 20 a potentiometer. 21 and 22 are capacities for adjusting the capacity to ground of a point on the receiving circuit, preferably one of the terminals of the receiver, though both may be so connected; and preferably consisting of adjustable condensers connected to ground at 23.

Figs. 2 and 6 show suitable forms of transformers. In Fig. 2, 7 is a primary and 9 a secondary. The primary may consist for example of 100 turns of #18 copper wire wound on a glass jar 24, five inches in diameter and the secondary may consist of 35 turns of #32 D. S. C. wire wound on a glass jar 25, six inches in diameter. The inside of the glass jar 25 is preferably covered with a conducting material 26 so arranged as to shield the secondary from electrostatic effects caused by the primary but at the same time not to prevent electromagnetic inductive effects between the two. One suitable method of arranging this is by painting the inside of the jar with metallic paint such as bronze or gold paint or by coating it with gold-leaf or by placing a cylinder of copper slotted vertically, between the two jars. This conducting shield may be connected to ground with good results and the conducting shields of both transformers may be connected together as shown in Fig. 7. The shield for the construction of transformers shown in Figs. 6 and 7 is indicated at 50 in Fig. 7. A high resistance or inductance 27 may be placed in the circuit to ground when the shield is grounded.

Another form of transformer is shown in Fig. 6 where 28, 29 are hard rubber rings having grooves cut in them and the primary wound in the groove of one ring and the secondary wound in the groove of the other ring. These rings may also be covered with metallic paint or gold-foil or a metallic disk 50 radially slit, as shown in Fig. 8, may be placed between the two coils. This construction is especially adapted for use where it is desired to obtain large inductance with small capacity.

Figs. 3 and 4 show one form of variable condenser consisting of intercalating metal plates 30 and 31, preferably semicircular or approximately so in contour. Alternate plates are movable in and out between the other plates so that the one set of plates may be made to overlap the other plates more or less as required. It is preferred to secure the movable plates 31 to a shaft 32 and it may be provided with an operating handle. The shaft has its axis coinciding with the

center of the arcs forming the perimeters of the plates, so that by the rotation of the shaft one set of plates may be moved to a position in which they are entirely overlapped by the other plates and to a position in which there is not any material overlapping of one set of plates by the other. One set of plates is insulated from the other. A dial 34 and indicating finger 33 are so arranged that one or the other will be shifted with the movable plates.

Fig. 5 shows another form of variable condenser, consisting of a tube 36 of conducting material, an insulating tube, 35, inside the conducting tube, 36, and a tube, 37, inside the insulating tube, 35. The conducting tubes are arranged so that one may be moved longitudinally of the other. A scale is arranged as on one of these tubes so as to indicate capacity in different relative positions of the tubes.

Both the primaries 7 and 8 should have the same number of turns and both the secondaries 9 and 10 should have the same number of turns, these turns may be altered, as for example, by the movable contacts 46 and 47, shown in Fig. 7. By sliding these contacts the circuits may be tuned by varying the inductances instead of by varying the capacity. The primary 7^a and the secondary 9^a may also be made movable relative to each other by sliding 7^a along the graduated arm 48 so as to vary the mutual inductance between primaries and secondaries, as shown in Fig. 7.

The circuits 1, 2, 8, 12, 5, 13, 4, and 1, 2, 7, 11, 5, 13, 4, are tuned in such a way that when an impulse of the desired periodicity is received on the receiving conductor, it generates strong currents through one of these circuits, for example 1, 2, 8, 12, 5, 13, 4 but very weak currents through the other and consequently, the secondaries 9 and 10 being wound in opposite directions the receiver 17 is strongly affected; but said circuits are so tuned that impulses which have not the desired periodicity will divide evenly through both circuits and consequently produce equal and opposite effects which being thus neutralized, produce no effect on the receiver. This is generally accomplished empirically and I have found a suitable method would be to turn the variable capacity 11 to the position of zero capacity and to then turn the variable capacity, 12, until the maximum effect is produced by the waves it is desired to receive. The variable capacity, 11, is then turned until the interfering signals or disturbances are cut out.

It may happen that the neutralization cannot be rendered quite complete, on account of there being a phase difference in the currents flowing through the two primaries, and this is more especially apt to happen with interference preventers in which two

transformers are used instead of three or four transformers.

In order to insure complete neutralization, a device which may be called a phase-correcter may be used, consisting of a circuit adapted to generate a voltage equal and in opposite phase to the non-compensated voltage impressed upon the secondaries 9 and 10 and opposite in direction. I do not limit myself to any specific method of effecting this compensation, but a suitable method is shown in Fig. 1, where 38 and 39 are coils in inductive relation to each other and preferably capable of being adjusted to different distances apart by sliding on the graduated arm 40. Coil 38 is in series with the secondaries 9 and 10, (Fig. 1) and coil 39 is operatively connected to an adjustable inductance 41, and adjustable resistance 42. A current will therefore flow through the circuit 39, 41, 42, and the phase of this current can be altered by varying the adjustable inductance 41, which consists of two coils capable of relative angular movement or by changing the resistance 42 which is preferably of very small capacity. The intensity of the voltage which would be impressed on the circuit containing the secondaries 9, 10 and the coil 38 may be varied by varying the position of the coil 39. In this way a voltage may be impressed on the circuit of the secondaries 9 and 10 which will have the proper phase and the proper value to neutralize the unbalanced component of the interfering signals or disturbances. Many other ways will suggest themselves of accomplishing this result. For example, the phase compensator may be inductively connected to the vertical instead of directly connected, as shown in Fig. 7. Also a variable capacity 49 may be substituted for the variable inductance 41 of Fig. 1, and as here shown, in Fig. 9, in which case a leading current will be obtained instead of a lagging one, and the winding of the coil 39 must be reversed. The connections of the coil 39 may be so arranged that they may be changed by means of a switch shown at 43, according as the unbalanced component is a leading or lagging one.

It has been experimentally demonstrated by the applicant that this apparatus for protecting a receiver from undesired effects may without necessary change be employed in wire telegraphy, and the claims are to be understood as not limited to signaling by electromagnetic waves. The method herein described is claimed in my co-pending application No. 240,269 filed January 9th, 1905, of which application this one is a division.

I claim as my invention:

1. In wireless telegraphy, apparatus for preventing interference comprising two antenna-to-ground circuits, each containing the primary of a transformer, a receiver circuit

connected through the secondaries to both of said transformers, and a phase adjusting device connected to the said antenna-to-ground circuits, substantially as described.

5 2. Apparatus for wireless telegraphy, comprising two antenna-to-ground circuits each containing the primary of an adjustable transformer, means for adjusting both the coupling and the inductance in said trans-
10 formers, and separately grounded secondary circuits connected to a receiver, substantially as described.

3. In wireless telegraphy apparatus the combination with an antenna-to-ground circuit containing a transformer, a secondary
15 circuit inductively coupled to the first circuit and separately grounded through a condenser and a receiver in the secondary circuit.

20 4. In wireless telegraphy apparatus, the

combination with an antenna-to-ground circuit, containing the adjustable primary of a transformer, of a secondary circuit containing a receiver grounded through a condenser and connected to the first by a secondary, 25 said antenna-to-ground circuit having an additional inductance and all said inductances being variable by single turns, substantially as described.

5. In a system of wireless signaling, an antenna, a transformer operatively connected thereto, and an electrostatic shield between the primary and secondary of said transformer.

In testimony whereof, I have hereunto set
35 my hand.

REGINALD A. FESSENDEN.

Witnesses:

DOROTHY O. THURMAN,
JESSIE E. BENT.