N° 20,466 A.D. 1908

(*Under International Convention.*)

Date claimed for Patent under Patents and Designs Act, 1907, being date of first Foreign Application (in the United States), 10th Oct., 1907

Date of Application (in the United Kingdom), 29th Sept., 1908

At the expiration of twelve months from the date of the first Foreign Application, the provision of Section 91 (3) (a) of the Patents and Designs Act, 1907, as to inspection of Specification, became operative

Accepted, 29th Oct., 1909

COMPLETE SPECIFICATION.

"Improvements in Wireless Signalling".

I, REGINALD AUBREY FESSENDEN, of Brant Rock, in the State of Massachusetts, United States of America, Engineer, do hereby declare the nature of this invention, and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention relates to a system of wireless electric signalling in which a continuous locally produced indication, *e.g.* a sound, is normally annulled, either absolutely or substantially, by impulses received from the transmitting station, and signalling is effected by interrupting or modifying the annulling impulses at the sending station so that the locally produced indication becomes effective. It will be obvious that the character of indications so produced is determined locally and is quite independent of the character of the transmitted impulses. For example, if the locally produced indication is a musical note its pitch is not dependent on the frequency of the waves received from the transmitting station which therefore may have a frequency beyond the range of audibility, so that they are inaudible with a receiver of the ordinary type, and do not interfere with the operation of stations working on the ordinary plan.

It will be seen that with this system of signalling, while the emitted waves correspond with the spaces and not with the dots and dashes of ordinary code signalling, since the signals are effected by interrupting or modifying the character of continuously emitted impulses, the indications received are the dots and dashes and not the spaces, and this re-inversion is effected without the interposition of a relay as has been necessary in systems hitherto proposed of inverted sending and receiving.

The system also differs in respect to both of the above mentioned features from that system in which a weak and continuous sound is produced locally by causing a wire of magnetic material to vibrate longitudinally in response to a locally produced alternating or interrupted current, and signals are effected by the variable currents in the receiving circuit due to the received impulses, giving rise to vibrations which are superposed on those due to local causes and produce acoustic signals which increase in distinctness as the periods of the locally generated current and the current supplying the transmitting apparatus approximate.

[*Price* 8*d.*]

In the accompanying drawings,

Figures 1 and 2 show circuits for sending,

Figures 3 and 4 arrangements of circuits for receiving, and

Figures 5 and 6 sectional and plan views of apparatus for generating the electromagnetic waves.

In Figure 1, 11 is a high frequency alternating current generator, 12 a tuning inductance, 13 an antenna which otherwise if desired may be of the loop type in which case it is preferably though not necessarily ungrounded, or it may be of the vertical type as shown and preferably grounded at 14. 15 is the field winding for the high frequency dynamo. 16 the course of current exciting the field, and 17 a telegraph key, which on being depressed to form a dot or dash, opens the field circuit and stops the emission of the high frequency waves.

It will be seen that when the key is in its normal position waves are being sent out and when depressed waves are not sent out, consequently with this apparatus the spaces are sent and not the dots and dashes as in the usual method.

Figure 2 shows an alternative method in which 13 is the antenna, 18 the secondary of a transformer, 19 the primary, 20 a capacity, 21 and 22 inductances, 23 a key short circuiting the inductance 22, 24 the secondary of a second transformer, 25 its primary, 26 a capacity, 27 an inductance, 29 a compressed gas spark gap, 30 an adjustable resistance, 31 a source of continuous current.

With this apparatus, the coupling of the transformers 18, 19 and 24,, 25 is preferably different, though not necessarily so, *i.e.* the coupling in one of the transformers say 18, 19, may be a tight coupling while that in the other transformer is a loose coupling, or conversely. The waves are generated continuously but by depressing the key 23 the frequency of the waves is altered.

Instead of using the spark gap 29, a high frequency alternating current dynamo 33 may be used by throwing the switch 32 to the position shown in dotted lines.

The electrical constants of the circuit are preferably so arranged that the frequency will be less than 100,000 where it is desired to send over long distances, as applicant has discovered that absorption of the emitted waves does not increase with the wave length as hitherto maintained but rather reaches a maximum for a certain wave length which varies with the conditions but may be roughly stated as intermediate between waves having frequencies of 100,000 and 200,000, and then decreases with great rapidity as the wave length is increased. Thus the absorption of waves having a frequency of 50,000 is comparatively small up to distances of 2,000 miles during daylight whereas with frequencies of 200,000 there is almost total absorption under like conditions. I therefore use waves of a length greater than that of maximum absorption—as a rule waves of a frequency lower than 100,000—but not so great as to prevent efficient signalling.

In Figure 3, 34 is a receiving antenna grounded at 37 and 35, 36 are the primary and secondary of a transformer, the secondary 36 being connected to the demagnetizing coil 38. 39 is an adjustable capacity and 40 an inductance. 41 is a soft iron wire revolving in the direction indicated on pulleys 42, 43, the pulleys being driven by the motor 44. 45 is a coil for magnetizing the iron wire by means of the local battery 46. 47 is a string vibrator which through the primary 48 and secondary 49 and coil 50 impresses an alternating magnetism on the iron wire 41.

The iron wire having thus a musical note impressed upon it traverses the poles of the coil 38 and whenever a space is sent by the key 17, the musical note is wiped off from the wire leaving a totally or partially silent space.

The portions of the wire where the musical note has not been wiped off, *i.e.* those portions passing between the poles of coil 38 at times corresponding with the depression of transmitter key 17, travel on and passing beneath the

poles of the coil 51 produce a musical note in the telephone receiver 52, while the portions where the musical note has been wiped off produce no note.

In this way it will be seen that the inverted sending is corrected by an inverted receiving and dots and dashes come out as musical notes, and this without the interposition of a relay.

In Figure 4, 34 is the receiving antenna grounded at 37, 35 and 36 are the primary and secondary of a transformer, 39 a variable capacity, 40 an inductance, 53 a receiver, for example a liquid barretter or tellurium receiver, 54 a tuning fork vibrator producing a musical note, through the primary 48 and secondary 49, in the divided transformer circuit 55, 53, 56 and 55, 57, 58, 56; 57 being a capacity and 58 an adjustable resistance.

60 and 61 are secondaries of the transformer connected to the telephone receiver 62.

The resistance 58 and capacity 57 are so adjusted that a continuous sound is produced in the telephone 62 when no signals are being received, but when signals of the strength produced by the proper sending station are received the two divided circuits become balanced and no sound is heard in the telephone 62.

This accomplishes the same purpose as the device shown in Figure 3, *i.e.* re-inverting the signals.

In Figure 5 I show an alternator of the Mordey type, designed to give high frequencies and having two air gaps with armatures; in these 63 is a revolving field inductor disc which may have the same number of field teeth on both edges but preferably has $^1/_5$ of one *per cent.* more on one side than on the other, so as to make the frequencies generated by the two armatures also differ as by $^1/_5$ of one *per cent.* from each other. 64, 65 are two armatures supported by the bearings 66 and 67 so as to be always concentric with the shaft 68, and 69 is a field coil. 70 and 71 are capacities. The armature 65 is in series with the coil 72 and the armature 64 with the coil 73. These coils are grounded as shown at 75, and the other terminals of the armature are grounded on the frame of the machine which is grounded at 76.

The two coils 72, 73 are at right angles to one another so as to exert no inductive effect on each other. 77 is a movable coil capable of being rotated on the depression of the key 78, which by means of the local battery 79 excites the coil 80 and pulls the magnet 81 and lever arm 82 thereby turning the coil 77 from being parallel to the coil 73 so that it is parallel with the coil 72, so changing the frequency while keeping the intensity constant.

One terminal of the coil 77 is grounded at 74 and the other is connected through the tuning inductance 83 to the antenna 84.

In this way on depressing the key 78, the frequency is changed.

Figure 6 is a side view of the alternator shown in Figure 5 and shows the springs 85, 86 and dash pots 87, 88 whereby the armature is supported flexibly and yet concentrically on the shaft 68. The armature windings are indicated at 89 in Figure 6.

By the invention herein disclosed no disturbance is produced by a sending station on other stations unless they are exactly on the same tune to $^1/_5$ of one *per cent.* Also it is practically impossible to interfere with a receiving station operating by this method, and very difficult to read messages, since they are sent in inverted form.

This method may also be used in conjunction with other devices of applicant's, such as the heterodyne receiver and mechanical group tuning, but these are not here described or claimed.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is:—

1. A system of wireless electric signalling in which indications produced by locally generated sustained impulses are normally annulled or modified by

received impulses continuously emitted from another station, and signalling is effected by interrupting or modifying these emitted impulses at the sending station so that the locally produced indications become effective.

2. In wireless electric signalling the method which comprises the continuous generation at the receiving station of impulses for producing sound indications, normally silencing these indications, and signalling by annulling the silencing means.

3. A system of wireless electric signalling in which while the impulses transmitted from the sending station correspond with the spaces of the usual signalling code the signals are re-inverted at the receiving station directly and without the interposition of a relay so as to produce indications corresponding with the dots and dashes of the signalling system.

4. A system of wireless electric signalling according to the preceding claims in which the electric constants of the sending circuit are so proportioned that the frequency of the emitted waves is less than 100,000.

5. Apparatus for wireless electric signalling comprising means at the receiving station for producing a continuous flow of impulses and means for normally annulling their effect by impulses received from the sending station except when the normal character of the sent impulses is altered.

6. Apparatus for wireless electric signalling comprising electric means at a receiving station for continuously producing a musical sound, means at the sending station for the continuous generation of impulses, and means at the receiving station whereby these impulses silence the locally produced sound except when the sent impulses are interrupted or modified for signalling.

7. In apparatus for wireless signalling according to the preceding claim, means for generating sustained electric impulses of two different frequencies and means for operatively coupling the sending antenna at will with either whereby the frequency of the transmitted impulses may be changed without changing their intensity, substantially as described.

8. In apparatus according to the preceding claim, an alternating current generator having two armatures which are coupled at will with the sending antenna through a transformer having two primary coils set at right angles to each other and connected with the respective armature coils and one secondary connected with the antenna and adapted to be shifted into inductive relation with either of the primary coils, substantially as described.

Dated this 29th day of September, 1908.

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Agents for the Applicant.

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FESSENDEN'S Complete Specification.

(2 SHEETS)

SHEET 1.

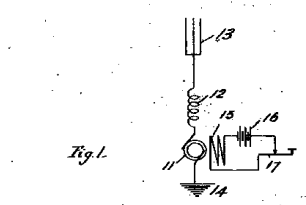

Fig. 1.

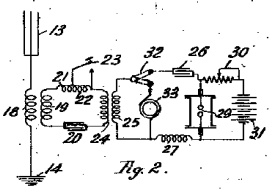

Fig. 2.

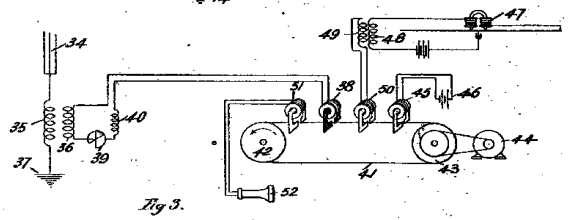

Fig. 3.

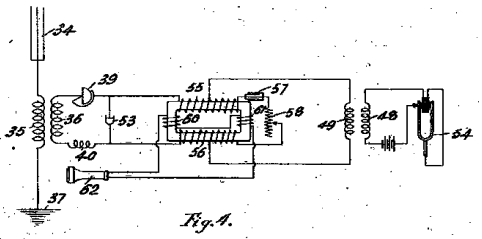

Fig. 4.

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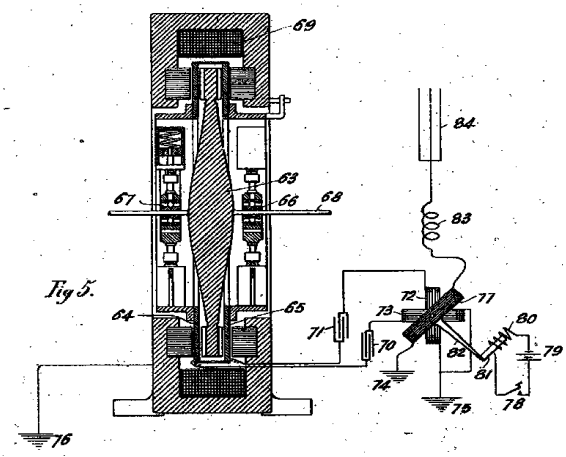

Fig. 5.

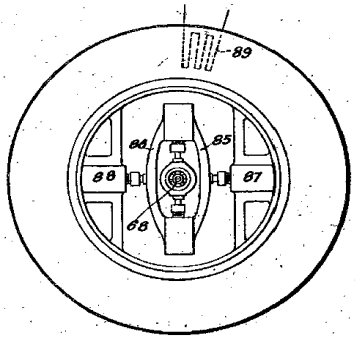

Fig. 6.

BIRMINGHAM

Malby & Sons, Photo-Litho.

[This Drawing is a reproduction of the Original on a reduced scale.]

A.D. 1908. Sep. 29. Nº 20,466.
FESSENDEN'S Complete Specification.

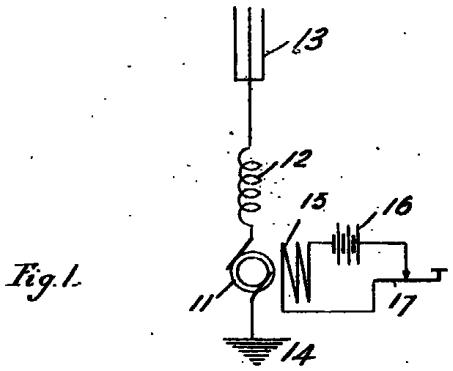

Fig. 1.

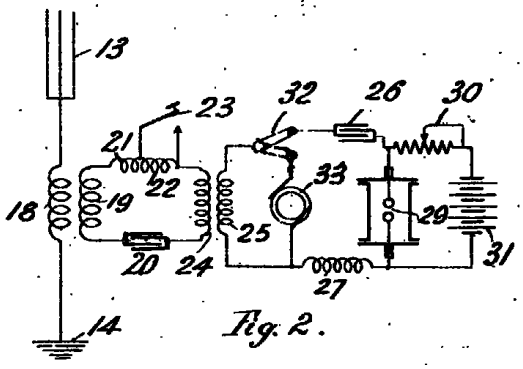

Fig. 2.

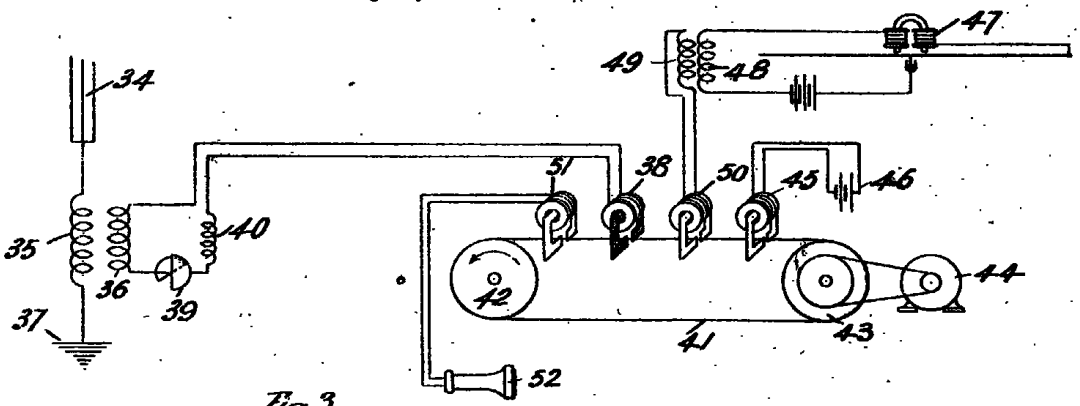

Fig 3.

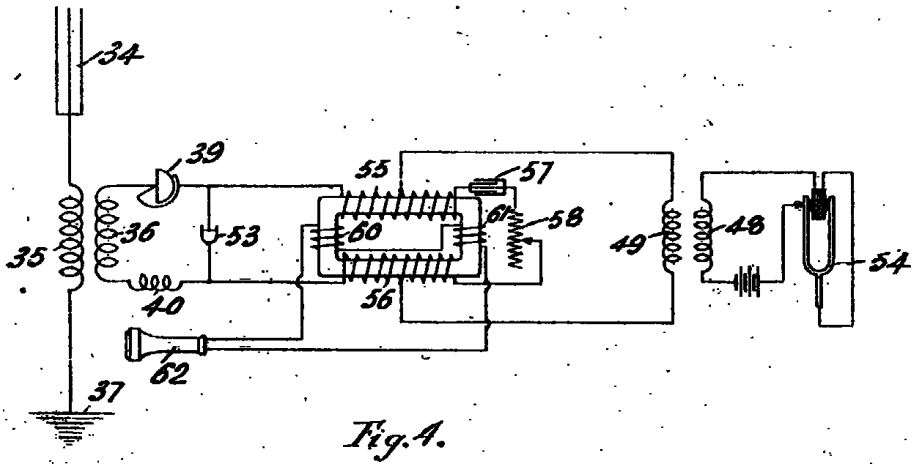

Fig. 4.

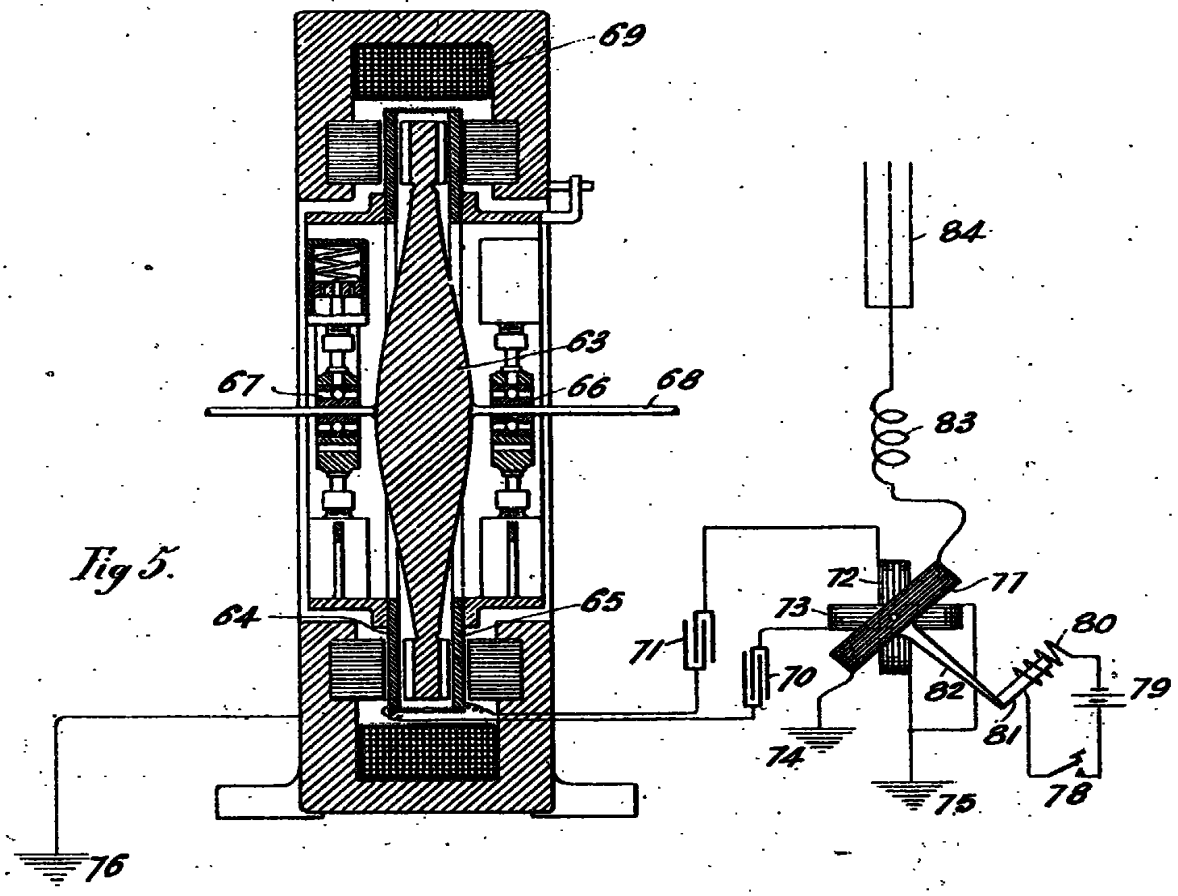

Fig 5.

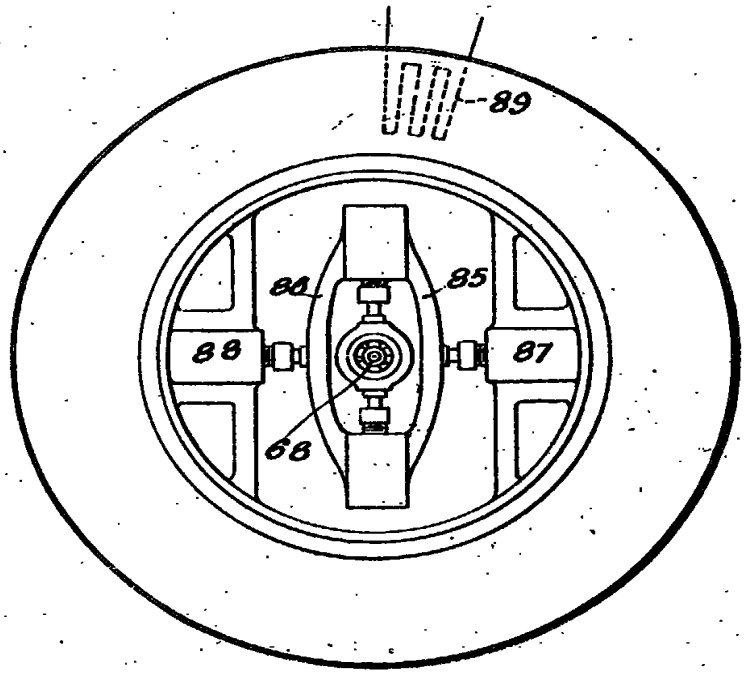

Fig 6.

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