N° 25,305 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), } *23rd Dec., 1907*

Date of Application (in the United Kingdom), 24th Nov., 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, 24th Nov., 1909

COMPLETE SPECIFICATION.

"Improvements in Wireless Signaling."

I, REGINALD AUBREY FESSENDEN, of Brant Rock, in the County of Plymouth and State of Massachusetts, United States of America, Electrical 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:—

My invention relates to electric signaling and more particularly to wireless signaling by electromagnetic waves.

The invention herein disclosed has for its object the securing of absolute secrecy and freedom from interference with neighbouring installations in the transmission of wireless messages, the attainment of high speed, and the transmission and receipt of messages simultaneously.

In the practice of my invention, instead of sending dots and dashes I send dots only, which are to be interpreted as dots and dashes according to the time of their receipt at the receiving station, the determination of whether a signal is a dot or dash being thus impossible without a knowledge of the exact time interval employed. By this means in addition to absolute secrecy greater speed is obtained.

I also prefer to use my method of sending by generating oscillations continuously and producing a signal by varying the frequency. I also prefer, at the receiving end to use my heterodyne method of receiving. The method of operation can, however, obviously be used with other well known methods of transmitting and receiving signals and I do not therefore limit myself to the particular arrangement herein described.

In the accompanying drawings forming a part of this specification,

Figure 1 shows diagrammatically an arrangement for carrying out the object of this invention.

Figure 2 shows an alternative arrangement.

In Figure 1, 11 is an antenna grounded at 12; 13, 14 are primaries of transformers connected to a source for continuously generating waves, for example the spark gap 15, continuous current dynamo 16 and variable resistance 17. 18 is a condenser and 19 an inductance used for tuning the high frequency oscillating circuit. 20 and 21 are metallic discs with insulating segments so arranged that one connects its brush in advance of the other but the

[*Price 8d.*]

two overlap in position, their shaft 20^a being driven by the electric motor 22, whose field current is produced and regulated by the battery 23, and adjustable resistance 24. This motor is maintained at constant speed by any suitable means such as the tuning fork 25, by the method described in Patent Specification No. 26,552 of 1902. 26 and 27 are brushes mounted on the arm 28. This arm is attached to the gear disc 29 in such a way that on depressing the keys 30 and 31, and so closing the circuits containing the local battery 33 and the clutch mechanism 34, the disc 29 will be revolved by the threaded shaft 34^a to the left or right, according to which one of the friction discs 34^c is in engagement with the disc 34^b, and thus the position of the brushes is advanced or brought back.

35, 36, 37 are taps from the inductance 19. 38, 39, 43 are switches electrically actuated by the keys 40 and 41 and the local battery 42. 44 is a coil attached to the diaphragm of the receiver 45 and 46 is a fixed coil operated by the secondary coil 47^1 of the transformer whose primary is the coil 14. 48^1 is the secondary coil of a transformer whose primary is 13. 47, 48, 49 are adjustable resistances.

In operation the keys 40 and 41 being in the released position, the switch 50 being open and the circuit closer 43 being pulled over to the left by the spring 51, and the switches 38, 39 closed, the commutator discs 20 and 21 in revolving cause electromagnetic waves of three different frequencies to be radiated:

1) The normal frequency which we will call 100,000.

2) A higher frequency when the brush 27 is on the metallic part of the disc 21, thereby short circuiting one portion of the inductance 19 by wire 49^a connected to the shaft 20^a, which frequency we will take as 100,100.

3) A still higher frequency when the brush 26 also comes on to the metallic portion of the disc 20, thereby short circuiting a still larger amount of the inductance 19. This we may take as 100,200.

Three frequencies of 100,000, 100,100, and 100,200 are therefore radiated continuously in sequence with each other.

On depressing the key 41 the switch 39 is opened and the sequence then becomes 100,000, 100,000, and 100,200. The depression of this key we may take as the sending of a dot.

On depressing the key 40 the switch 38 is opened and the sequence becomes 100,000, 100,100 and 100,000. The depression of this key we may take as the sending of a dash.

In this way the signals are transmitted.

Assume now that messages are being transmitted by a station using this arrangement and being received at a station using a similar arrangement.

At the receiving station the keys 40 and 41 are still in a released position but the switch 50 is closed and the circuit closer 43 is thrown over as shown to the right.

Obviously, locally generated oscillations will flow continuously through the coil 46, the oscillations being uninterrupted but the frequency varying in the sequence 100,000, 100,100, and 100,200.

The received signals will flow from the antenna 11 through the coil 44 to ground, and no indication will be produced if the discs 20 and 21 rotate at the same frequency and have the same angular position as the discs at the sending station.

If, however, the discs are not in synchronism musical chords will be produced and the operator at the receiving station depresses one of the keys 30 or 31 and so rotates the brushes 26, 27 until silence is obtained. If after a short period the chords begin to be heard again the operator moves the adjusting nut 52 on the tuning fork 25 in such a way as to obtain synchronism.

In actual operation it is found extremely difficult even by the use of compressed air condensers, constant temperature boxes, *etc.*, to maintain the high

frequency circuits at the sending and receiving station absolutely constant, but this is not necessary, as the operator, instead of adjusting the brushes to zero sound, adjusts them until a single note is heard instead of a chord, since when this is the case the discs are in synchronism and phase.

Also it is impossible to maintain this synchronism absolutely, and after a longer or shorter period of time the chords begin to be audible again, and gradually swell in intensity, but the operator controls this by depressing the keys 30 and 31, so that the chords never rise above a barely audible intensity and so maintain synchronism.

Assume now that the operator at the sending station depresses the key corresponding to the key 41. The oscillations transmitted by the sending station will then have the sequence 100,000, 100,000 and 100,200, and this will be the sequence received by the coil 44.

As the sequence in the fixed coil 46 is 100,000, 100,100, and 100,200 beats of 100 per second will be formed between the second members of the two series, *i.e.* a musical note having that frequency will be heard by the ear of the operator, the receiver 45 being attached to the operator's head.

A note of this frequency is recognised by the operator as representing a dot.

On the key corresponding to 40 being depressed at the sending station, the sequence sent out will be 100,000, 100,100 and 100,000 and beats will now be produced between the third members of the series having a frequency of 200 per second, and the musical note of this frequency will be understood by the operator to represent a dash.

In the operation therefore, when the high frequency circuits are identical in frequency spaces will be represented by silence, dots by a musical note of 100 per second and dashes by a musical note of 200 per second. Should the frequencies differ by say 150 per second, spaces will be represented by a musical note of 150 per second, dots by a musical note of 250 per second and dashes by a musical note of 350 per second.

The following points are obvious:

1) That no other station can interpret the message transmitted without knowing the number of commutator segments and their exact speed of revolution, and as there is no means whereby an outside station can determine this, absolute secrecy is obtained.

2) Also that since the oscillations are generated continuously and of constant strength (the resistances 47, 48, 49 being used to regulate this where necessary) and merely the tune is slightly changed, no disturbance will be produced on other stations unless they are using exactly the same range of tune. This is for the reason that even if the electrical oscillations are received by the other station, no sound will be produced on account of the oscillations being continuous and uninterrupted.

3) Also that greater speed can be obtained, since there is no difference in the duration of the dot and dash elements and no space necessary between them in sending a letter.

Figure 2 shows the apparatus adapted to sending and receiving simultaneously. Elements identical with Figure 1 are numbered identically. Instead of the oscillatory circuit containing the discharge gap 15, condenser 18, and inductance 19, acting directly on the secondary 48^1, it acts through the primaries 53, 54, 55, 56 on the circuit containing the secondaries 57, 58, 59, 60 the variable capacity 61, the resistances 62, 63, the fixed coil 64 and the primary 65. The coil 44 instead of being attached to the antenna is connected as shown to the middle point of the above mentioned circuit through the inductance 66 and variable capacity 67.

With this arrangement it is possible for the operator to listen at the same time that he is sending, since the coil 44 being in a neutral position is unaffected to any extent by the currents induced by the high frequency source.

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. The method of electric signaling which consists in generating continuously at the sending and receiving ends electric oscillations of definitely varied frequencies, in normally securing synchronism at the two ends of the recurrence of the different frequencies, and in varying the order of recurrence at the sending end so as to produce signals at the receiving end.

2. In a system of signaling, the method of transmitting and receiving messages which consists in maintaining two circuit controlling elements in synchronism with each other at the sending and receiving station respectively, emitting and receiving the elements of the signals at different phases of the movement of the circuit controlling elements, and thereby differentiating the signals.

3. The method of electrical signaling, which consists in continuously generating oscillations at the sending station and keeping them uniform, maintaining at the receiving station a continuous stream of oscillations, and controlling them independently of the oscillations from the sending station but synchronously with the latter, and signaling by changing the frequency of the oscillations emitted at different phases of the movement of the synchronising device, substantially as described.

4. In a system of electric signaling as claimed in the preceding claims, a circuit controlling device in uniform motion at a sending station, a circuit controlling device in uniform motion at a receiving station the motion of the latter device being synchronous with but independent of the former device, and means whereby an impulse emitted from the sending station is caused to produce different effects at the receiving station, according to the position of the synchronous device at the time of emission or receipt.

5. Electric signaling apparatus comprising means for continuously sending a series of cycles of impulses, means to maintain independently at another station a series of similar cycles, and means to produce a signal by altering the character of the individual impulses in the transmitted cycle.

6. Electrical signaling apparatus comprising means to locally maintain a stream of cycles of impulses, means to annul their effects by independent but synchronous cycles of impulses sent from another station, and means to sensibly indicate changes in the character of the individual impulses in the cycles sent.

7. Electrical signaling apparatus comprising sending and receiving circuits having independent means to maintain synchronous streams of orderly cycles of impulses in each circuit, means to normally annul their effects on each other, means to variously alter the character of the impulses in a cycle in one circuit, and means in the other by which said alterations produce sounds of predetermined character for signaling.

Dated this 24th day of November, 1908.

ABEL & IMRAY,
Birkbeck Bank Chambers, London, W.C.,
Agents for the Applicant.

Redhill: Printed for His Majesty's Stationery Office, by Love & Malcomson, Ltd.—1909.

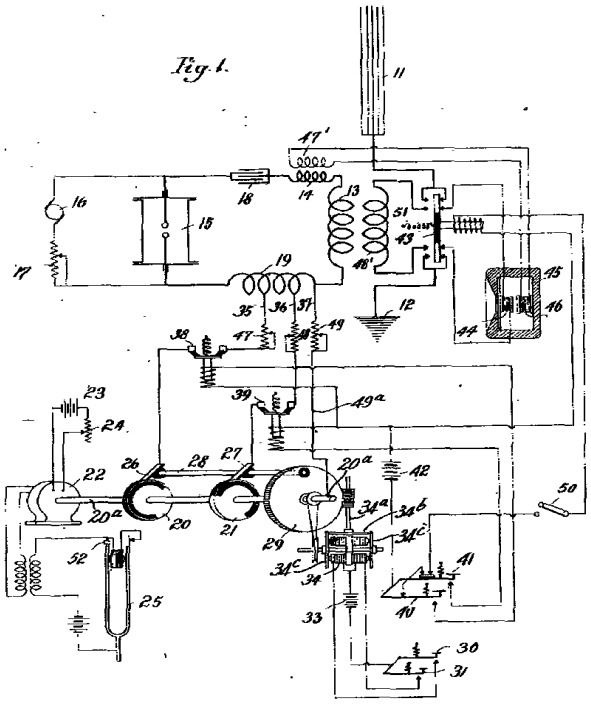
A.D. 1908. Nov. 24. N° 25,305.

FESSENDEN'S COMPLETE SPECIFICATION.

(2 SHEETS)

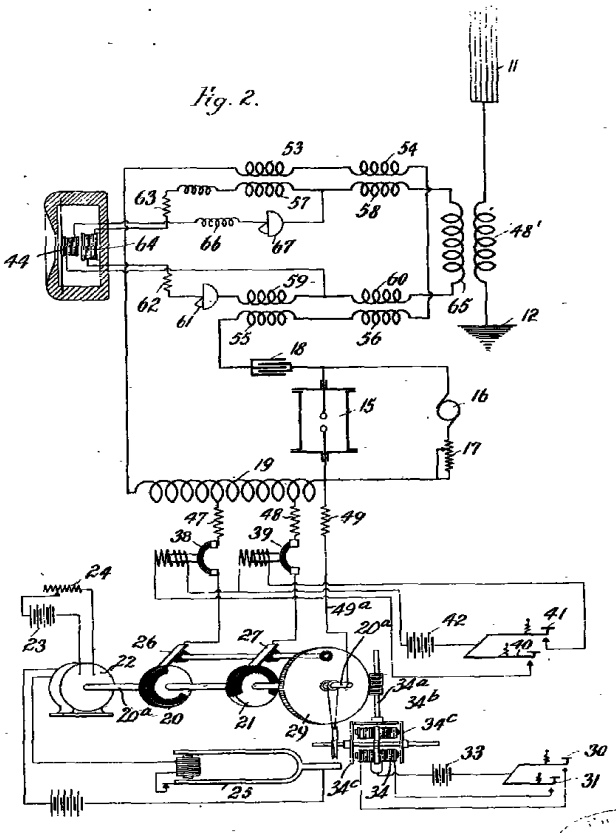
SHEET 1

Fig. 1.



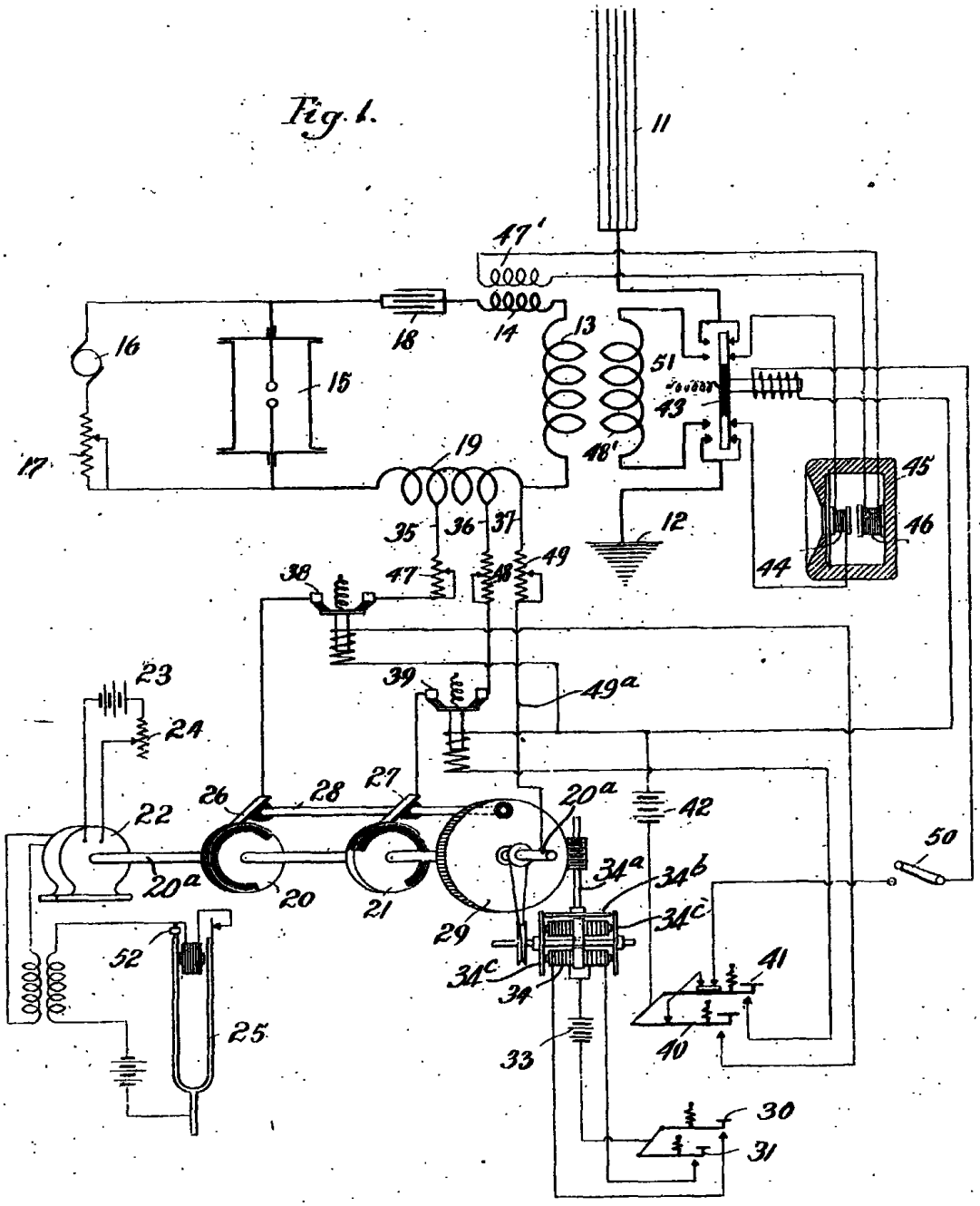
SHEET 2.

Fig. 2.



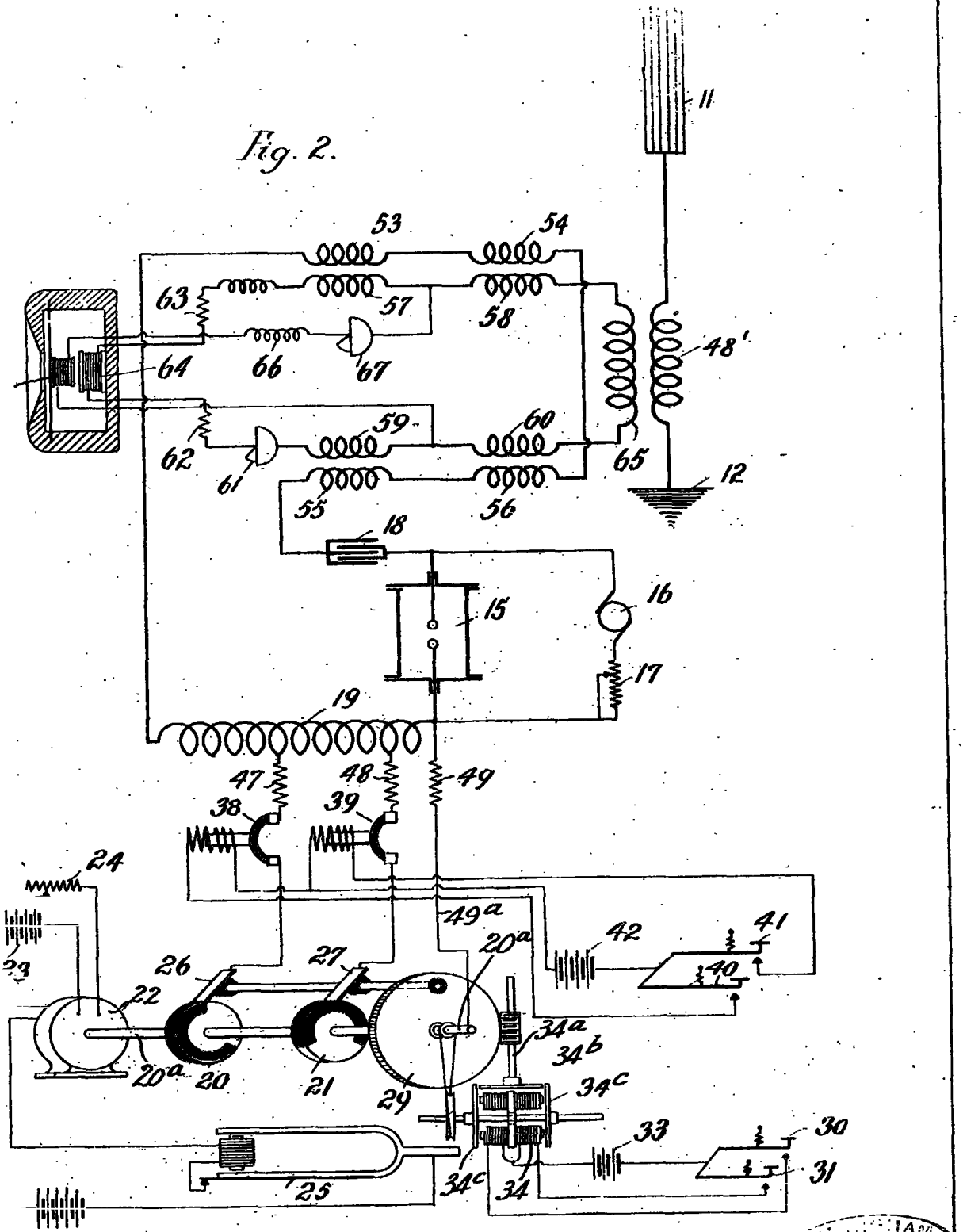
Malby & Sons, Photo-Litho

Fig. 1.



This drawing is a reproduction of the original on a reduced scale.

Fig. 2.



Malby & Sons, Photo-Litho.