R. A. FESSENDEN.

WIRELESS SIGNALING.

APPLICATION FILED OCT. 10, 1907.

960,631.

Patented June 7, 1910.

2 SHEETS—SHEET 1.

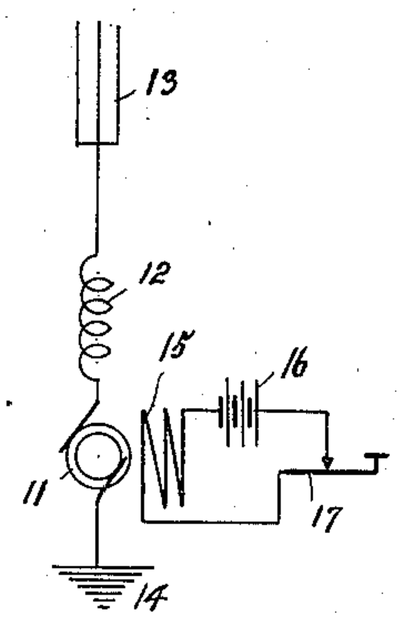

Fig. 1.

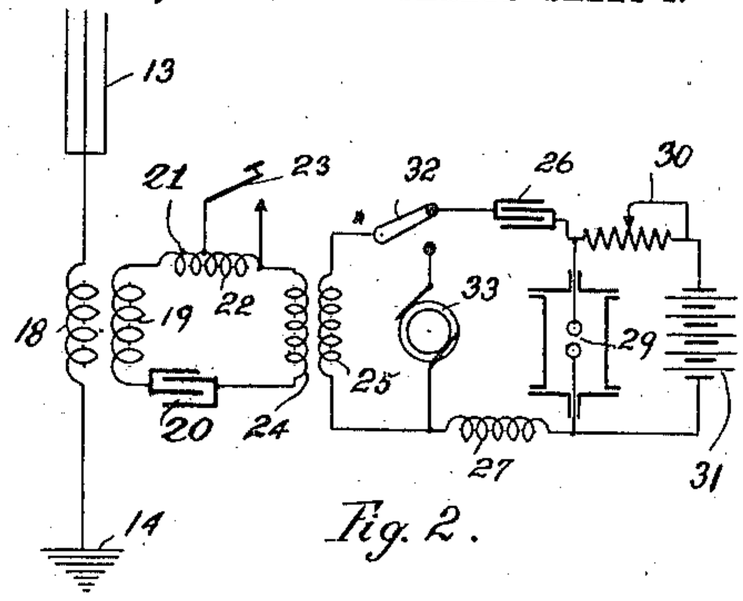

Fig. 2.

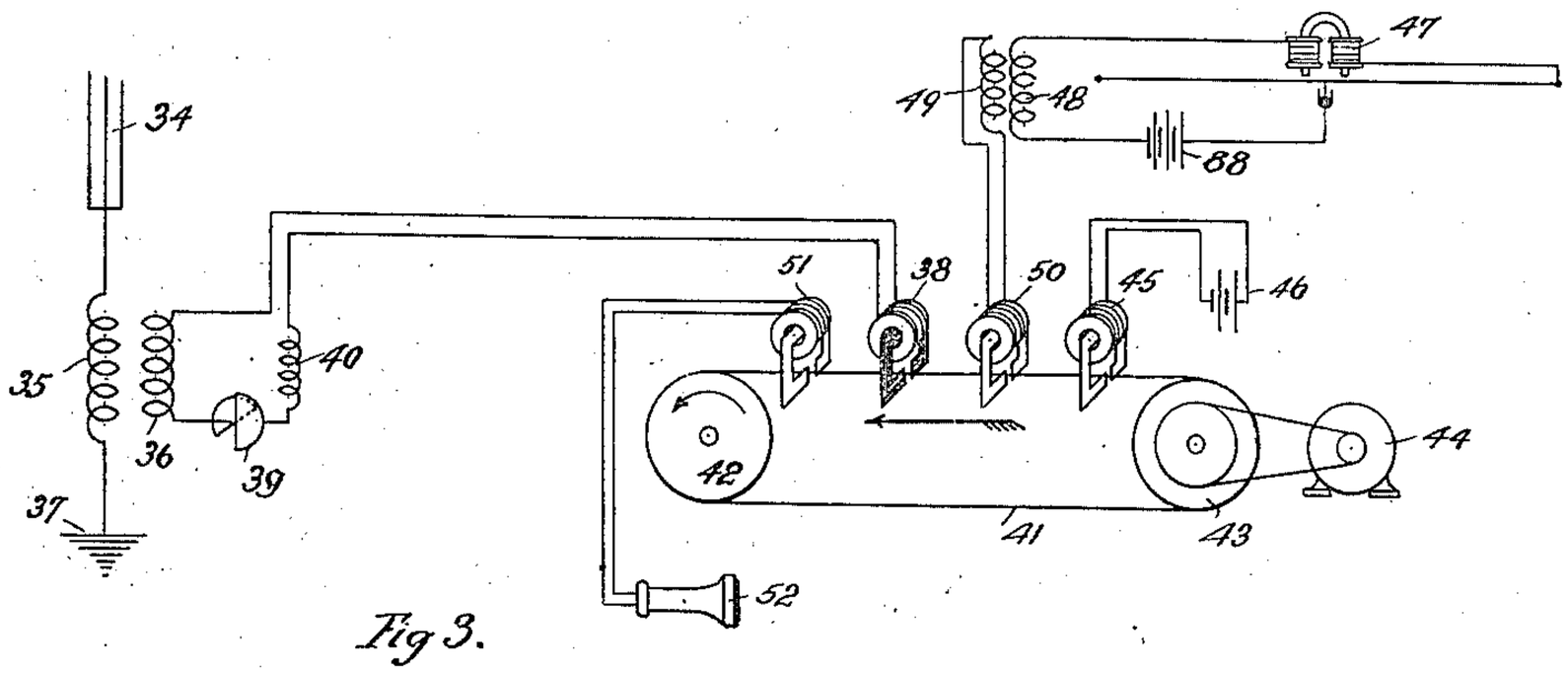

Fig 3.

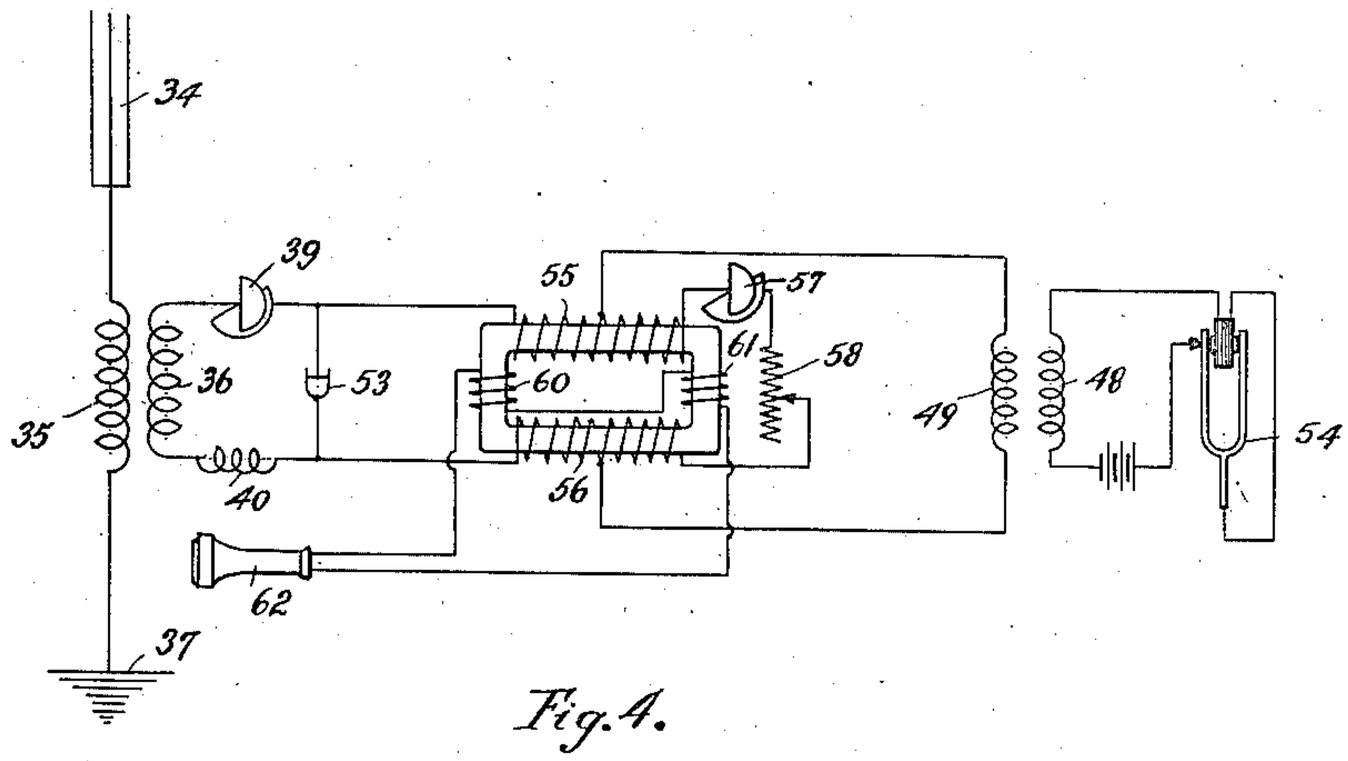

Fig. 4.

WITNESSES:

Jessie E. Bent.

Adelene Wolene

INVENTOR:

Reginald A. Fessenden.

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R. A. FESSENDEN.

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2 SHEETS—SHEET 2.

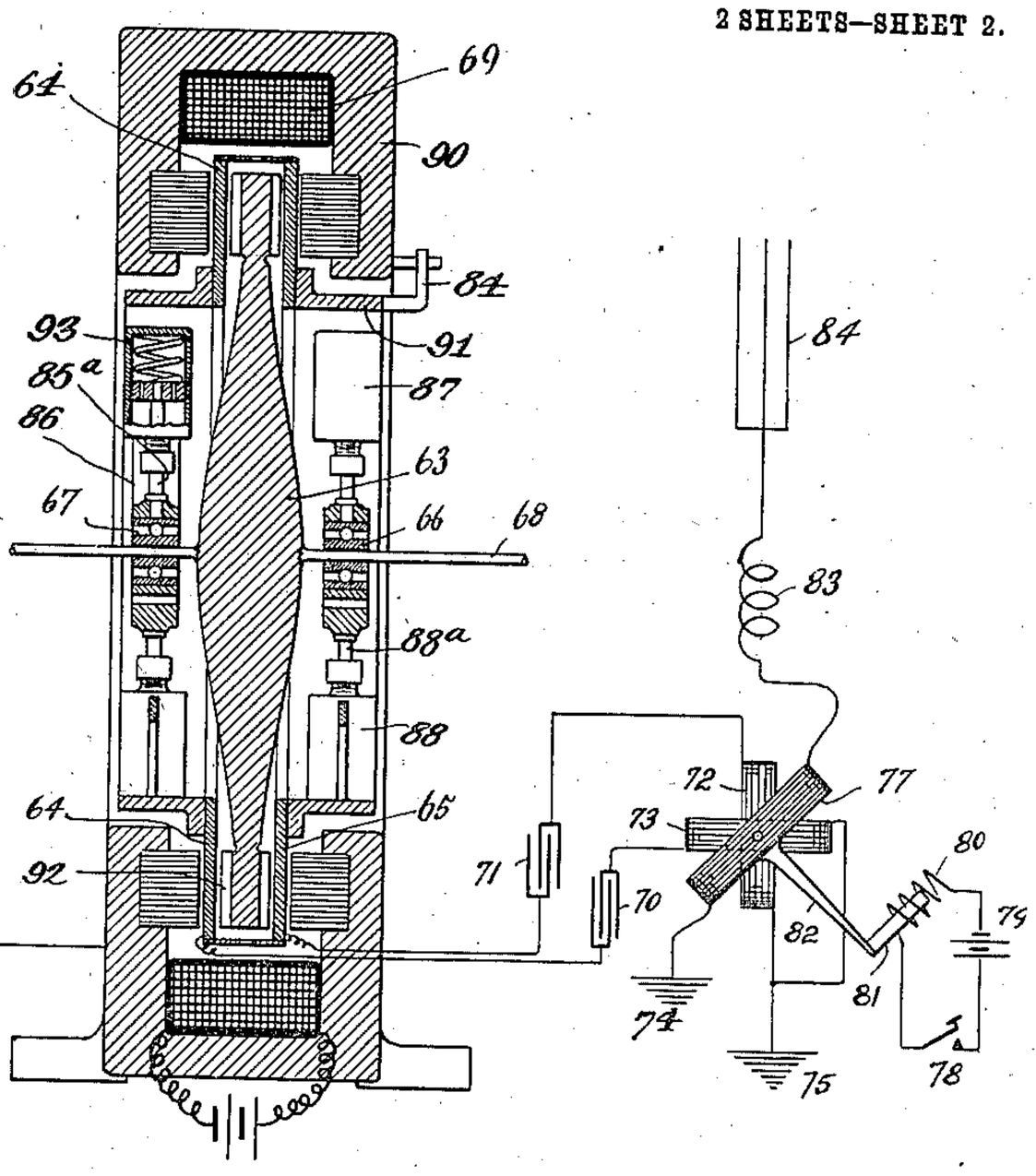

Fig 5.

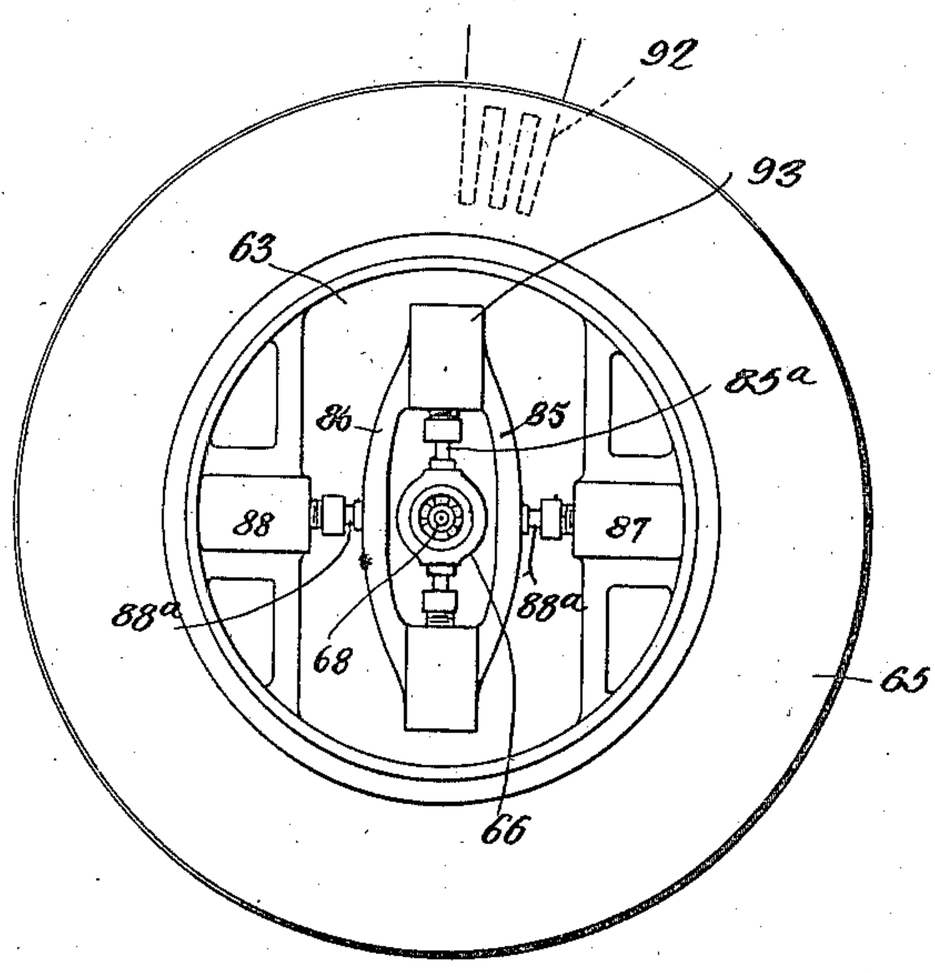

Fig 6.

WITNESSES:

Jessie E. Bent

Adeline Wolens

INVENTOR:

Reginald A. Fessenden

UNITED STATES PATENT OFFICE.

REGINALD A. FESSENDEN, OF BRANT ROCK, MASSACHUSETTS.

WIRELESS SIGNALING.

960,631. Specification of Letters Patent. Patented June 7, 1910.

Application filed October 10, 1907. Serial No. 396,817.

To all whom it may concern:

Be it known that I, REGINALD A. FESSENDEN, a citizen of the United States, residing at Brant Rock, in the State of Massachusetts, have invented certain new and useful Improvements in Wireless Signaling.

My invention relates to wireless signaling and more especially to means for the prevention of interference.

In the accompanying drawings forming a part of this specification Figures 1 and 2 are diagrams of circuits for sending. Figs. 3 and 4 are diagrams of modified arrangements of circuits for receiving. Figs. 5 and 6 show respectively a central section and a side elevation of a form of generator for generating the electromagnetic waves.

The invention herein described has for its object the more efficient production and receipt of wireless signals, and the production of such signals without interfering with other stations, and the receipt of such signals without interference from other stations.

In Fig. 1, 11 is a high frequency alternating dynamo, 12 a tuning inductance, 13 an antenna which may be either of the loop type, in which case it is preferably though not necessarily ungrounded, or of the vertical type as shown, being in this case preferably grounded as at 14. 15 is the field of the high frequency dynamo, 16 the source 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.

Fig. 2 shows an alternative method in which 13 is the antennæ, 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 couplings of the transformers 18 19 and 24, 25, respectively, are preferably different, though not necessarily so. That is, preferably, the coupling in one of the transformers may be tight and the other loose; as for example, the coupling between 18 and 19 may be tight and that between 24 and 25 may be loose, or vice versa. 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 as shown. 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 the absorption over long distances is very much less for frequencies of 100,000 and under, and that with frequencies of 50,000 for example, there is comparatively little absorption up to distances of 2,000 miles during daylight, whereas with frequencies of 200,000 there is almost a total absorption.

Applicant's invention includes the broad discovery that, contrary to the statement by Fleming and Marconi at page 618 in the former's work on electric wave telegraphy, the absorption does not increase with the wave length, but instead, it reaches a certain maximum varying with the conditions but roughly between 100,000 and 200,000, and then decreases with great rapidity as the wave length is increased. Applicant therefore uses wave lengths beyond the point of maximum absorption and as a rule lower than 100,000 per second, though not so low as to prevent efficient signaling.

In Fig. 3, 34 is a receiving antenna grounded at 37; 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 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 controls the current from battery 88, and thus through the primary 48 and secondary 49 and coil 50 impresses an alternating magnetism on the iron wire 41 preferably of an audible frequency. The iron wire 41, having thus impressed upon it a succession of variations of magnetism of a frequency to form a musical note, traverses the poles of the annulling magnet 38 and under normal

conditions the magnetism is wiped off so as to produce no effect in the coil 51 and the telephone 52. But when the key 17 in Fig. 1 is depressed, and the transmitted impulses interrupted, the portions of the wire upon which the musical note has not been wiped off travel through the poles of the magnet 51 and produce a musical note in the telephone 52. 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.

In Fig. 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 circuit 55, 53, 56 and 55, 57, 58, 56. 57 is 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 Fig. 3, *i. e.* reinverting the signals.

Fig. 5 shows an alternator of the well known Mordey type, but designed to give high frequencies and having two air gaps and armatures. In this figure 63 is a revolving field inductor disk 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, say 1/5 of one per cent., from each other. 64, 65 are two armatures supported by frame 91 carrying, on rods 88[a] and 85[a], dash pots 87 and 93 the bearings 66 and 67 so as to be always concentric with the shaft 68. 69 is a field coil and the position of the armature winding 92 is shown in dotted lines in Fig. 6. 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 antennæ 84. In this way on depressing the key 78, the frequency is changed.

Fig. 6 is a side view of the alternator shown in Fig. 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. 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.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent, is the following:

1. In apparatus for transmission of electric energy, the combination with a generator of practically continuous impulses at the sending station and a device to modify them, of a receiving station comprising a generator of continuous impulses and devices by which the combined effects of the locally generated and the received impulses normally annul each other's effects, whereby when the sent impulses are modified in character, an indicating effect is produced by interrupting said normal mutual annulment.

2. Apparatus for wireless telegraphy comprising a generator of continuous electric impulses at the sending station and a device for modifying them, a generator of continuous impulses at the receiving station, and devices operated by the combined effects of the locally generated and the received impulses to produce a musical note only when the impulses are modified in character, substantially as described.

3. Apparatus for wireless signaling comprising a generator of practically continuous impulses of inaudible frequency at the sending station and a device to alter their normal character, a generator of practically continuous impulses at the receiving station, and devices operated thereby to effect a normal suppression of effect, but permitting an indication by the received waves when the same are altered in character, substantially as described.

4. In apparatus for wireless telegraphy, including a sending station having a generator of sustained oscillations operatively connected to the sending antenna, and a key for controlling the emission of the electromagnetic waves so produced, a receiver operatively connected to a receiving antenna, and devices to produce a musical note corresponding to the signals sent from the sending station, but the pitch of the musical

note being determined by the apparatus at the receiving station and being independent of the apparatus at the sending station.

5. Apparatus for wireless signaling comprising means for practically continuous generation of electromagnetic waves, means at the receiving station for producing a continuous flow of impulses and means for normally annulling their effect by impulses received, except when the normal character of the sent impulses is altered, substantially as described.

6. Apparatus for wireless signaling comprising electric means at a receiving station for continuously producing a musical sound, means at the sending station to continuously generate impulses and means at the receiving station whereby said impulses silence said locally produced sound, except when the sent impulses are interrupted for signaling.

7. Apparatus for signaling comprising means at a sending station to continuously generate impulses, means at a receiving station to continuously generate impulses and means by which the sent impulses normally annul their effects, whereby a signal is made by altering the normal character of the sent impulses.

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

REGINALD A. FESSENDEN.

Witnesses:
JESSIE E. BENT,
ADELEINE WOLEVER.