No. 706,740. Patented Aug. 12, 1902.

R. A. FESSENDEN.

WIRELESS SIGNALING.

(Application filed Sept. 28, 1901.)

(No Model.)

FIG. 1.

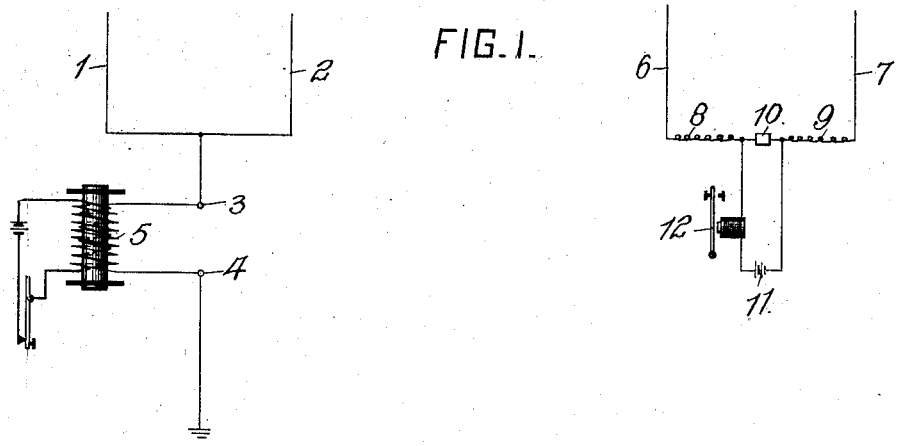


FIG. 2.

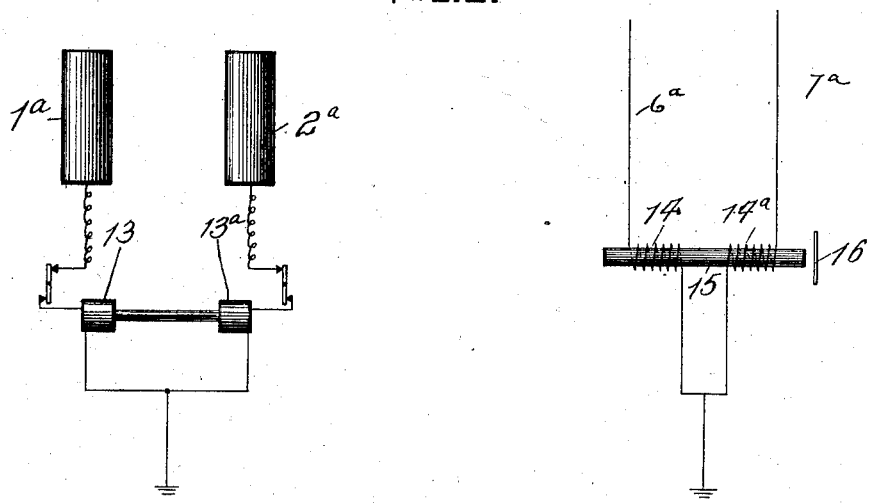
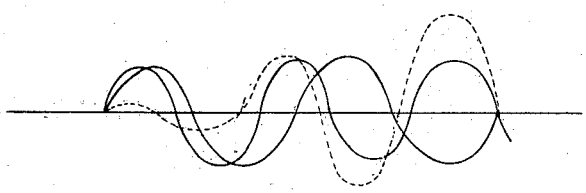


FIG. 3.



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UNITED STATES PATENT OFFICE.

REGINALD A. FESSENDEN, OF MANTEO, NORTH CAROLINA.

WIRELESS SIGNALING.

SPECIFICATION forming part of Letters Patent No. 706,740, dated August 12, 1902.

Application filed September 28, 1901. Serial No. 76,836. (No model.)

To all whom it may concern:

Be it known that I, REGINALD A. FESSENDEN, a citizen of the United States, residing at Manteo, in the county of Dare and State of North Carolina, have invented or discovered certain new and useful Improvements in Wireless Signaling, of which improvements the following is a specification.

The invention described herein relates to certain improvements in selective signaling in systems where the signal is transmitted by waves or impulses, and has for its object the generation at one station of persistent signaling impulses or waves differing in character—*e. g.*, period—and to the generation of beats by the waves or impulses and the employment of suitable receiving apparatus at the other station responsive only to the combined action of waves or impulses corresponding in period or other characteristics to those generated.

The invention is hereinafter more fully described and claimed.

In the accompanying drawings, forming a part of this specification, Figure 1 is a diagrammatic view of a form of apparatus adapted to the practice of my invention. Fig. 2 is a similar view of a modification of the apparatus shown in Fig. 1, and Fig. 3 is a graphic illustration of the method of signaling.

In the practice of my invention I employ at the sending-station two or more sources of radiation constructed to generate persistent waves or impulses, the waves or impulses proceeding from one of the sources of radiation differing in character from those produced by the other source. At the receiving-station I employ a corresponding number of suitably tuned or adjusted receiving-conductors which by their conjoint action produce beats of any suitable character to operate an indicator, but are incapable of operating it except by conjoint action. The terms "sending-conductor" and "receiving-conductor" as herein employed include all of circuits from top to ground, if grounded, or, if not grounded, from one extreme end to the other extreme end of the circuits, including all apparatus in series with the circuits, while the term "radiating portion" includes all of sending-conductor from top or extreme end of the same to point of junction with apparatus for effecting the oscillatory charging and discharging thereof—such as sparking-terminals, transformer-coils, armature-windings, &c. By the term "electromagnetic waves" as used herein is meant electromagnetic waves long in period compared with what are called "heat-waves" or "radiant heat." The terms "tuned" and "resonant" are used herein as one to include the other. A convenient apparatus for this purpose is shown in the drawings and consists at the sending-station of two or more conductors having radiating portions 1 and 2, each being connected to a terminal or knob of an induction-coil, while the opposite terminal of the coil is connected to ground. In the form shown both the radiating portions of conductors are connected to the terminal or knobs 3 of the induction-coil 5, the other knob or terminal 4 being grounded. By any suitable means known in the art persistent oscillations are produced. This persistence can be effected by so proportioning the resistance, self-inductance, and capacity that only a small portion of the energy is radiated at each oscillation. This proportioning can be conveniently effected in the manner described in the application for Letters Patent filed May 29, 1901, Serial No. 62,301. When two conductors are employed, they should be so constructed and proportioned as to have different periods of oscillations—as, for example, the period of conductor 2 should be twenty-five (25) per cent. greater than that of conductor 1. This difference is taken here for convenience in illustrating by Fig. 3; but in general a smaller difference, as five per cent., is preferred.

At the receiving-station I employ two or more conductors 6 and 7, which are tuned to the respective sending-conductors by any suitable means, as by wires 8 and 9, which connect the conductors to a coherer 10 or other suitable wave-responsive mechanism. Each of the wires 8 and 9 is preferably of approximately the same length as the conductor to which it is connected. A grounding of the receiving-conductors is not necessary, as efficient signaling can be effected without a ground. When employing a coherer, it is connected, as usual, in the circuit of a battery 11 and with a relay or other translating mechanism 12.

When a spark passes between 3 and 4, waves of different periodicities are generated by the respective sending-conductors at the sending-station, and such waves will produce in the respective receiving-conductors 6 and 7 correspondingly varying but persistent oscillations of potential.

The first few oscillations of the series of waves will generate nearly the same potential at the ends of the coherer or translating device; but as the oscillations persist there will be a rise in the potentials at the ends of the coherer, the rise at one end being greater than that at the opposite end. The approximate equality of the potential during the first few oscillations is graphically shown in Fig. 3 (where the full lines represent graphically the potential at the terminals of the wave-responsive device and the dotted line represents on somewhat smaller scale the difference of potential between the terminals of the wave-responsive device) and also the disproportionate rise produced by one of the series of oscillations due to the persistence of the oscillations. As the coherer or other translating device is so constructed as to be unresponsive to approximately equal potentials or the potentials so nearly neutralize each other as to produce no operative effect on the coherer or wave-responsive device, it follows that the apparatus at any receiving-station will not respond to any waves or series of waves or impulses which will not produce or generate at the coherer or other wave-responsive device potentials differing to a predetermined degree, so that by properly adjusting the sending and receiving apparatus at the several stations any one of said stations can be signaled to the exclusion of all others.

In the form of apparatus shown in Fig. 2 the sending-conductors are constructed with large capacity and self-induction, and the period of one of them, as 2^a, is greater than that of the other. I have found that good results can be produced if the period of 2^a be made about three (3) per cent. greater than that of 1^a; but I do not limit myself to any particular difference in period. One of the radiating portions, as 1^a, is connected to one terminal of a high-frequency alternator 13, which has its other terminal grounded. An alternator 13^a, having a higher frequency—*e. g.*, three per cent., more or less—than the alternator 13, thus corresponding to the period of the sending-conductor, of which it forms a part, has one terminal connected to the radiating portion 2^a and the other terminal grounded. While not essential, it is preferred that these alternators, which are preferably constructed as described in application, Serial No. 62,301, filed May 29, 1901, should be driven from the same shaft or at the same rate. The receiving-conductors 6^a and 7^a are tuned, respectively, to the sending-conductors and their radiating portions are connected, respectively, to the terminals of two coils 14 14^a, surrounding a core 15, said coils and core, with the diaphragm 16, forming a telephonic receiver. The opposite ends of the coils are connected to ground. By connecting the alternators to the radiating portions, such connection being preferably effected by a double-pole switch, waves or impulses are generated by the sending-conductors and corresponding oscillations of potential are produced in the receiving-conductors and the telephone-coils, and owing to the shifting of phase, as shown in Fig. 3, beats or signals will be heard in the telephone.

Broadly my invention consists in the production of electrical "beats" analogous to sound-beats and their utilization in receiving-conductors tuned to the sending-conductors for wireless selective signaling.

It is obvious that, as shown in Fig. 1, the sending-conductors employed as radiating sources may have a portion of their length formed by a common conductor. The construction here shown, while resembling in a slight degree that shown by Marconi, United States Patent No. 676,332, differs essentially from it in that though two conductors are used they are worked in parallel with one another and not in series, as shown by Marconi, and hence instead of being insulated from each other are preferably (and where a spark-gap is used almost necessarily) electrically connected together, as shown in Figs. 1 and 2. The method of operation is also essentially different, as instead of producing a single periodicity from two conductors in series and using an inductance in such series circuit to prevent one conductor from neutralizing by causing an initial change of phase the effect of the other in the method here shown two frequencies are used and there is no necessary initial change of phase.

It is characteristic of the invention described herein that if two series of waves differing in periodicity and simultaneously generated are caused to persist the difference in phase will increase, so that if the receiving instruments be constructed to respond to only a particular difference in phase signaling will not be effected by a shorter persistence than necessary to produce the desired difference of phase.

The selective system herein described is to be differentiated from that described in my applications No. 18,878, filed June 2, 1900, and No. 53,441, filed March 29, 1901, in that in this system the indication is produced by the conjoint action of two or more sets of waves of different periodicities and not by the conjoint action of two mechanisms each separately actuated by a set of waves, the sets of waves being of different periodicities.

I claim herein as my invention—

1. In a system of signaling by electromagnetic waves, the combination of a source of waves of different periodicities and two or

more receivers responsive respectively to the differing waves or impulses and a wave-responsive device operative when the waves or impulses attain a certain predetermined phase relation, substantially as set forth.

2. In a system of signaling by electromagnetic waves, the combination of two or more sources producing waves of different periodicities, two or more receiving-conductors responsive respectively to the differing waves or impulses and a wave-responsive device operative when the waves or impulses attain a certain predetermined difference in phase, substantially as set forth.

3. In a system of signaling by electromagnetic waves, the combination of two or more sources producing waves or impulses of different periodicities and two or more receiving-conductors responsive respectively to the differing waves or impulses and a wave-responsive device operative by such waves or impulses when they attain a certain predetermined difference in phase, substantially as set forth.

4. In a system of signaling by electromagnetic waves, the combination of a generator, two or more sending-conductors adapted to produce waves or impulses differing in periodicity, two or more receiving-conductors tuned to the sending-conductors, and wave-responsive device operative by the oscillations in the receiving-conductors when the oscillations attain a certain predetermined difference in phase, substantially as set forth.

5. In a system of signaling by electromagnetic waves, the combination of two or more sources of persistent waves or impulses of different periodicities, two or more receiving-conductors responsive respectively to waves or impulses produced by the generators, and a wave-responsive device operative by the oscillations in the receivers only when said oscillations attain a predetermined difference in phase, substantially as set forth.

6. In a system of signaling by electromagnetic waves, the combination of means at the sending-station for generating two or more sets of waves of different periodicities and a wave-responsive device at the receiving-station operative by the conjoint action of such sets of waves, substantially as set forth.

7. In a system of signaling by electromagnetic waves, the combination of a source of waves of different periodicities, two or more receiving-circuits reponsive respectively to the different waves or impulses, and a current-operated, wave-responsive device operative when the waves or impulses attain a certain predetermined phase relation, substantially as described.

8. In a system of signaling by electromagnetic waves, the combination of two or more sources producing waves of different periodicities, two or more receiving-conductors responsive respectively to the different waves or impulses, and a current-operated, wave-responsive device operative when the waves or impulses attain a certain predetermined difference in phase, substantially as set forth.

9. In a system of signaling by electromagnetic waves, the combination of means at the sending-station for generating two or more sets of waves of different periodicities, and a current-operated, wave-responsive device at the receiving-station operative by the conjoint action of such sets of waves, substantially as set forth.

In testimony whereof I have hereunto set my hand.

REGINALD A. FESSENDEN.

Witnesses:
DARWIN S. WOLCOTT,
THEO. S. MUKINS.