No. 749,434. PATENTED JAN. 12, 1904.

L. DE FOREST.

WIRELESS SIGNALING APPARATUS.

APPLICATION FILED JUNE 4, 1903.

NO MODEL.

Fig. 1.

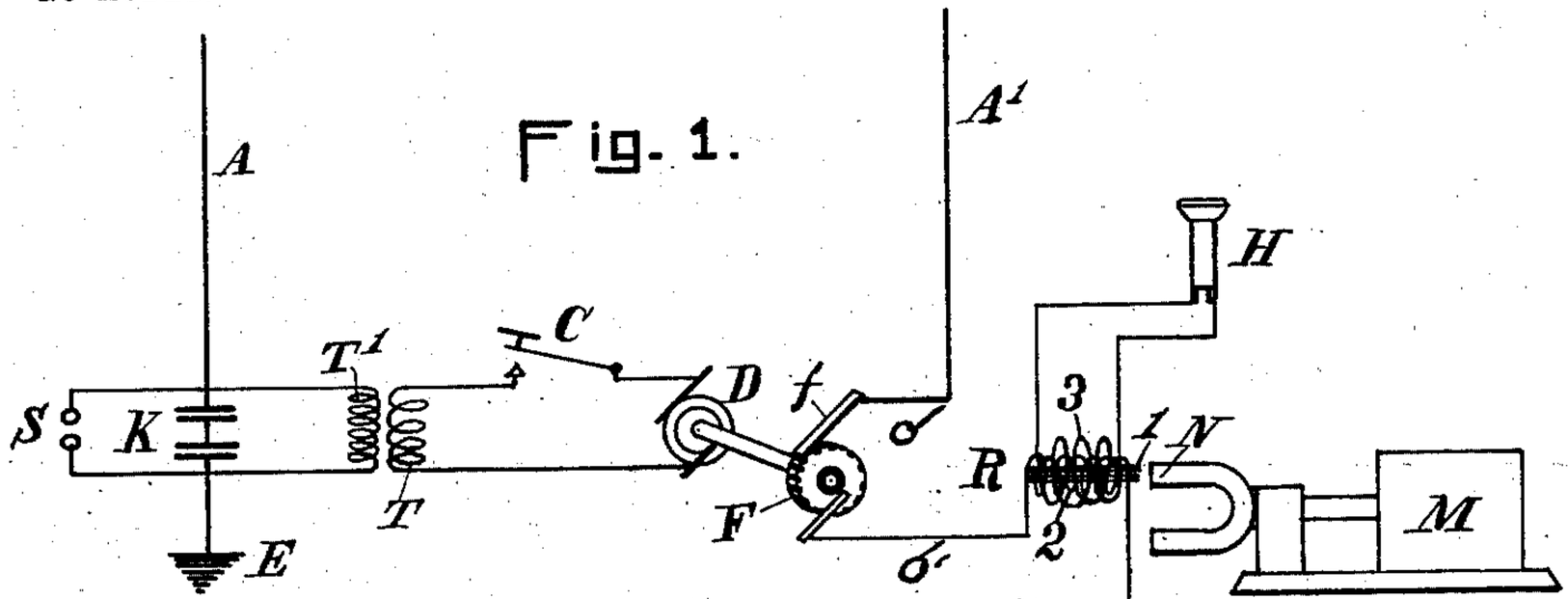


Fig. 2.

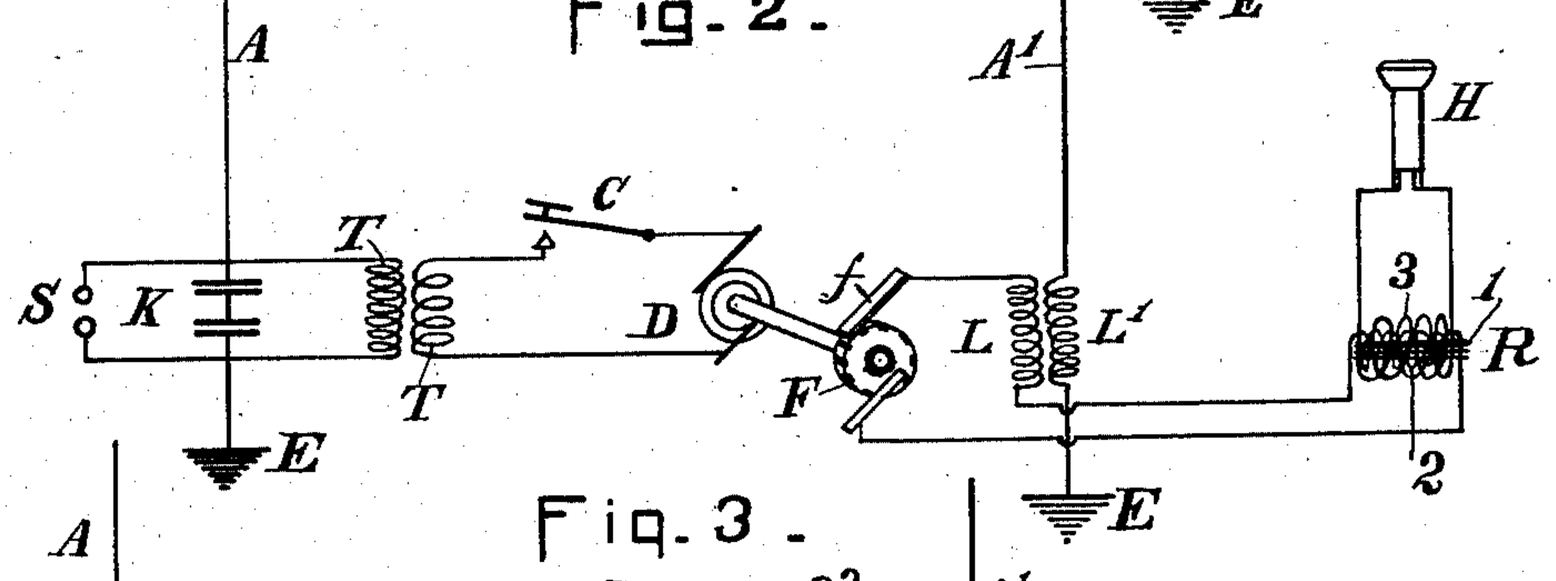


Fig. 3.

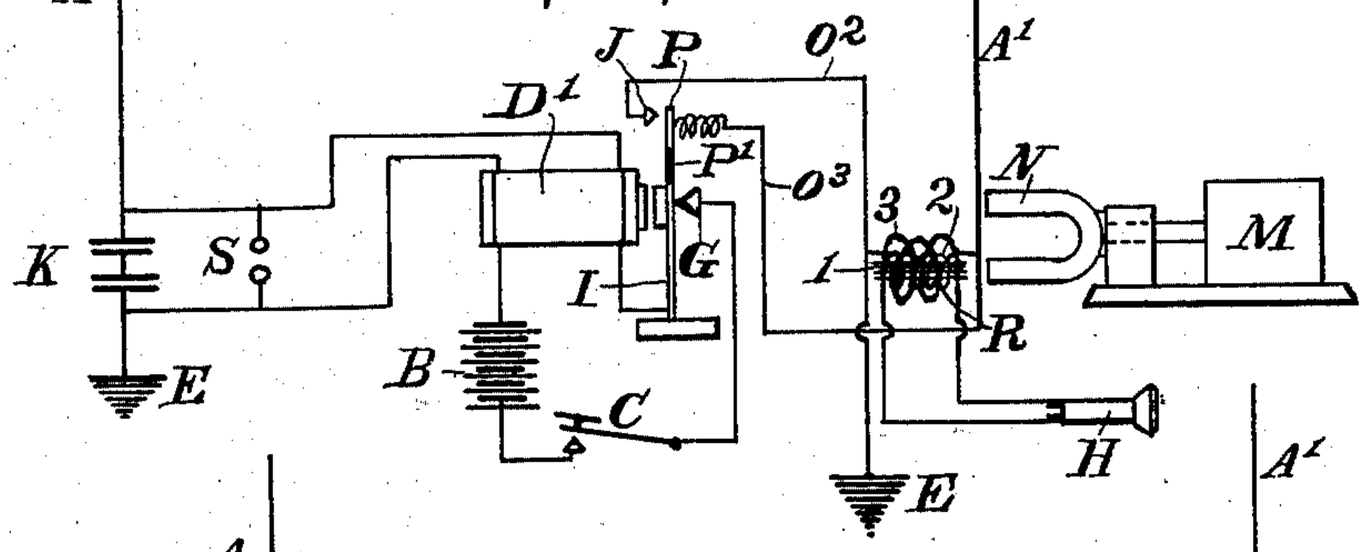
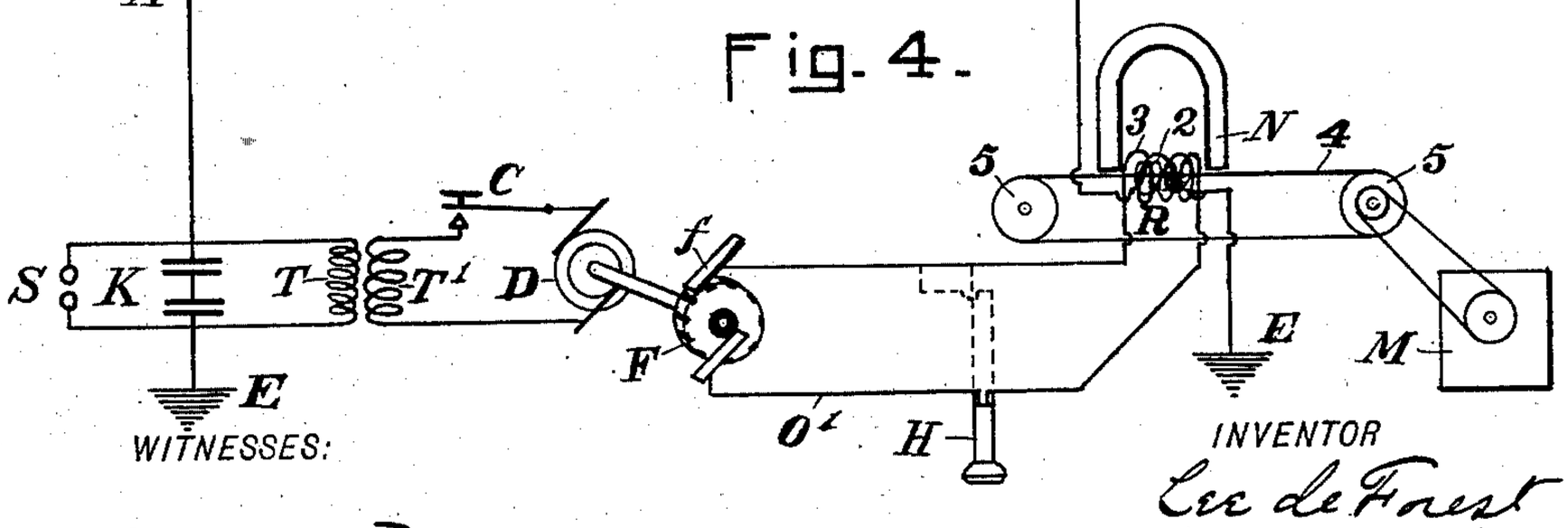


Fig. 4.



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No. 749,434. Patented January 12, 1904.

UNITED STATES PATENT OFFICE.

LEE DE FOREST, OF NEW YORK, N. Y.

WIRELESS SIGNALING APPARATUS.

SPECIFICATION forming part of Letters Patent No. 749,434, dated January 12, 1904.

Application filed June 4, 1903. Serial No. 160,026. (No model.)

To all whom it may concern:

Be it known that I, LEE DE FOREST, a citizen of the United States, and a resident of the city, county, and State of New York, have invented certain new and useful Improvements in Wireless Signaling Apparatus, of which the following is a specification.

My invention relates to certain improvements in wireless signaling apparatus whereby I am enabled to simultaneously send and receive messages from the same station.

My invention also comprises other novel features, which will be hereinafter described, and particularly pointed out in the claims.

The drawings accompanying herewith and forming a part of this specification show my invention embodied in some of the forms now preferred by me.

Figures 1, 2, and 4 show methods of constructing and connecting the parts when an alternating-current generator is used as the source of electromotive force, and Fig. 3 shows a construction adapted for use with an induction-coil.

It is not pretended that the figures show all the forms of devices and methods by which my invention may be utilized; but they do show enough to make clear the principle and spirit of my invention and how it may be practically applied.

In the drawings, A represents the transmitting-antenna, A′ the receiving-antenna, and E the earth connections for the same. The receiving apparatus also includes wave responsive and indicating devices of any suitable construction. The wave-responsive device should be of a type which is not injured by the strong impulses from the adjacent transmitter and is preferably a device of negligible resistance and one which is self-restoring or always operative, requiring no decohering or adjusting to restore it to operative condition. I have herein shown the same as a Rutherford magnetic detector or responder of negligible resistance R, which fulfils these requirements, and the indicating device as a telephone-receiver H. This magnetic detector, as shown in Figs. 1, 2, and 4, consists of a core of fine magnetizable needles or wires 1, a coil 2, which is in the antenna-circuit, and means for producing a variable magnetic field—such, for instance, as the magnet N, which is revolved by any suitable means, such as a motor M, either electric or mechanical. The solenoid R is surrounded by a coil 3, which is in the circuit of the telephone-receiver H or such other form of indicating device as may be employed. These are, however, to be only taken as indicative of any suitable form or type of devices which serve to indicate or transmit into signals the impulses received by the antenna A′.

The transmitting apparatus may also be of any desired form which serves to produce in the antenna A impulses designed for the production and radiation of proper signal-transmitting waves. Each dot or dash of a signal as produced by the transmitter consists of a series of sparks, often or generally having a regular frequency of recurrence which may be controlled or predetermined. Each individual spark produces a wave-train or series of electric oscillations, and each signal element (dot or dash) consists of a large number of such wave-trains separated by an interval of time which is large as compared with the time of duration of the spark.

If the signal-indicating member or members of the receiving apparatus be cut out of the circuit from the antenna to the earth or if a shunt be established about these members for a time coinciding with the duration of each individual spark—that is, during the time of radiation of the transmitting-wave—and if the normal condition be restored between each individual spark, then the influence which the heavy radiation from the closely-adjacent transmitting antenna would otherwise have upon the receiving apparatus will be prevented. As the duration of the spark is very short—say, one one-millionth of a second—the interruption in the receiving-circuit need be of but a very brief duration and the chance of the receiving apparatus losing a signal is very small, as for this to occur the spark frequency must be equal to that of the received impulses and be in phase therewith. To further guard against this, it is preferred that one set of

apparatus, consisting of a transmitting apparatus at one station and a receiving apparatus at the other station, have a spark frequency differing from the other set of apparatus. As an illustration, one transmitter may have a spark frequency of forty per second, while the transmitter at the other station may have a frequency of sixty-five per second. In this case it is impossible for the two to get permanently into step or phase, and if the impulses produced by one or two sparks at a transmitting-station are thus rendered ineffective at the other receiving-station this will be insufficient to cover all of any signal element, and the remaining impulses will be sufficient to render the signal audible.

In Fig. 1 the transmitting apparatus comprises an alternating-current generator D, switch C, step-up transformer T T', spark-gap S, and condensers K, inserted between antenna A and earth E. Any other suitable type of transmitting apparatus may, however, be employed. To the shaft of the alternating-current generator is secured a commutator or switch F, which, as shown, consists of a wheel or disk placed in circuit with the wave-responsive device and having insulated segments in its periphery. A brush *f*, also in the same circuit, engages the periphery of this disk as it revolves. Conductors O and O' repectively connect the brush with the antenna and the shaft or body of the disk with the solenoid-coil of the magnetic detector or to whatever type of wave-responsive device is employed. When the brush *f* bears upon an insulating-section, the receiver is momentarily disconnected from the antenna. When the brush rests upon the metal parts between the insulating-sections, the receiver is momentarily connected to the antenna.

Fig. 2 shows the same construction except that here the antenna is always connected to earth through the primary of a transformer, the secondary of which includes the detector or receiver R and the brush and commutator *f* F.

Fig. 3 shows a construction employing an induction-coil D' and battery B, in which the wave-responsive device or receiver is shunted at the instant of sparking of the transmitter by a shunt of zero resistance and zero impedance, so that by the shunting no sound is made in the telephone-receiver H, and any impulse received at this time by the antenna A', whether from the nearby or distant transmitter, passes to earth by said shunt and without producing a signal. The vibrating member I of the interrupter carries a section or plate P, which is insulated from the body thereof, as by an insulating-section P', and forms one terminal of a shunting-circuit O^2 O^3. A contact-point J, constituting the other terminal of the shunting-circuit, is so placed as to be engaged by the plate or section P in its vibration to momentarily close the circuit.

Fig. 4 shows a construction like that in Fig. 1, except that the magnetic detector is of somewhat different construction. In this case the core consists of a band 4 of magnetizable material which passes over wheels 5 5, turned from a motor M in any suitable manner. The magnet N in this case need not turn. This closing of the circuit or cutting out of the indicating instrument should be so timed as to occur with or but little preceding the beginning of the spark at S and to terminate with or but little after the spark. Numerous other ways of securing this momentary cutting out or shunting of the indicating instrument at the instant of sparking of the nearby transmitter may be employed. For example, if an alternating generator situated at a distance from the receiving mechanism be employed a synchronous motor, energized from this alternating current, and therefore always in phase with the transmitter-current, may be employed to drive the switching or shunting commutator. It is not necessary to further illustrate the same here.

I do not wish to be limited to the exact forms of device herein shown, but desire to broadly cover the essential features of my invention in whatever form of apparatus they may be embodied. The scope of my invention is to be determined by an inspection of the claims hereunto appended, in which the omission of any element or any qualification of an element is to be taken as a specific statement that said element or qualification is not considered essential in that particular combination.

What I claim is—

1. In a wireless signaling apparatus the combination with a transmitting and a receiving apparatus at the same station, of means controlled by the spark-determining member of the transmitting apparatus to cut the indicating member of the receiving apparatus out of the circuit during the time of each spark in the transmitting apparatus.

2. In a wireless signaling apparatus the combination with a transmitting and a receiving apparatus at the same station, of means automatically controlled by the spark-producing mechanism of the transmitting apparatus to cut off the local indicating instrument of the receiving apparatus during the time of each spark.

3. In a wireless signaling apparatus the combination with a transmitting and a receiving apparatus at the same station, of means for automatically cutting out the indicating device during the time of each spark of the transmitting apparatus.

4. In a wireless signaling apparatus the combination with a transmitting apparatus containing a spark-producing device and a re-

ceiving apparatus, of a switch adapted to cut off the receiving apparatus from the receiving-conductor, and means controlled by the spark-producing device for operating said switch at each instant of sparking and for reëstablishing connection of the receiver with the receiving-conductor at other times.

In testimony whereof I have hereunto affixed my signature, this 16th day of May, A. D. 1903, in the presence of two witnesses.

LEE DE FOREST.

Witnesses:
P. A. HALL,
H. L. REYNOLDS.