No. 894,378. PATENTED JULY 28, 1908.

L. DE FOREST.

WIRELESS SIGNALING APPARATUS.

APPLICATION FILED JAN. 17, 1903.

Fig. 1.

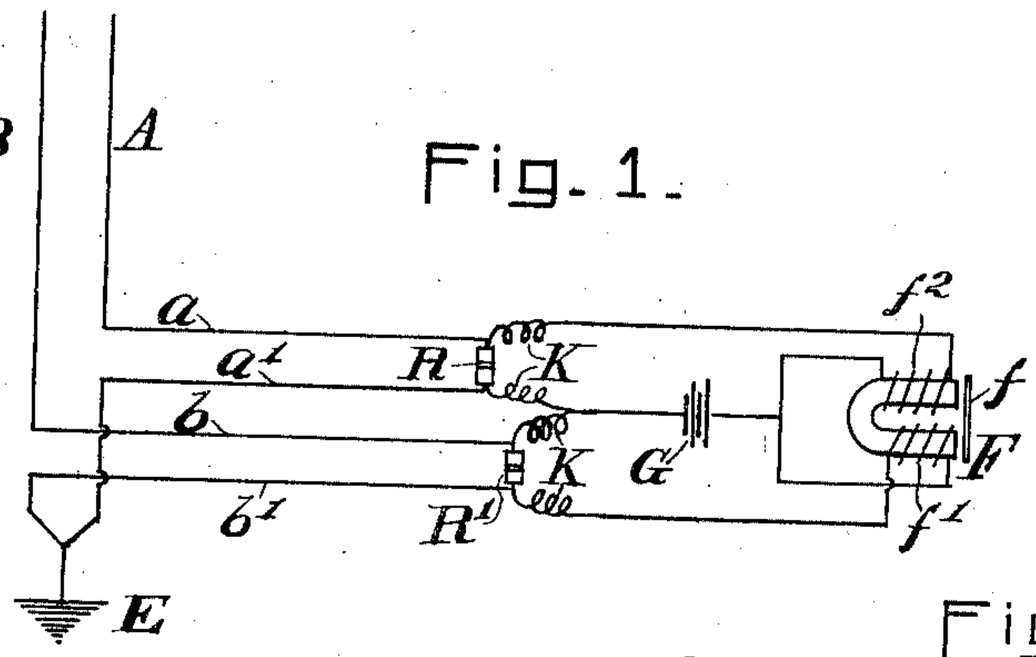


Fig. 2.

Fig. 3.

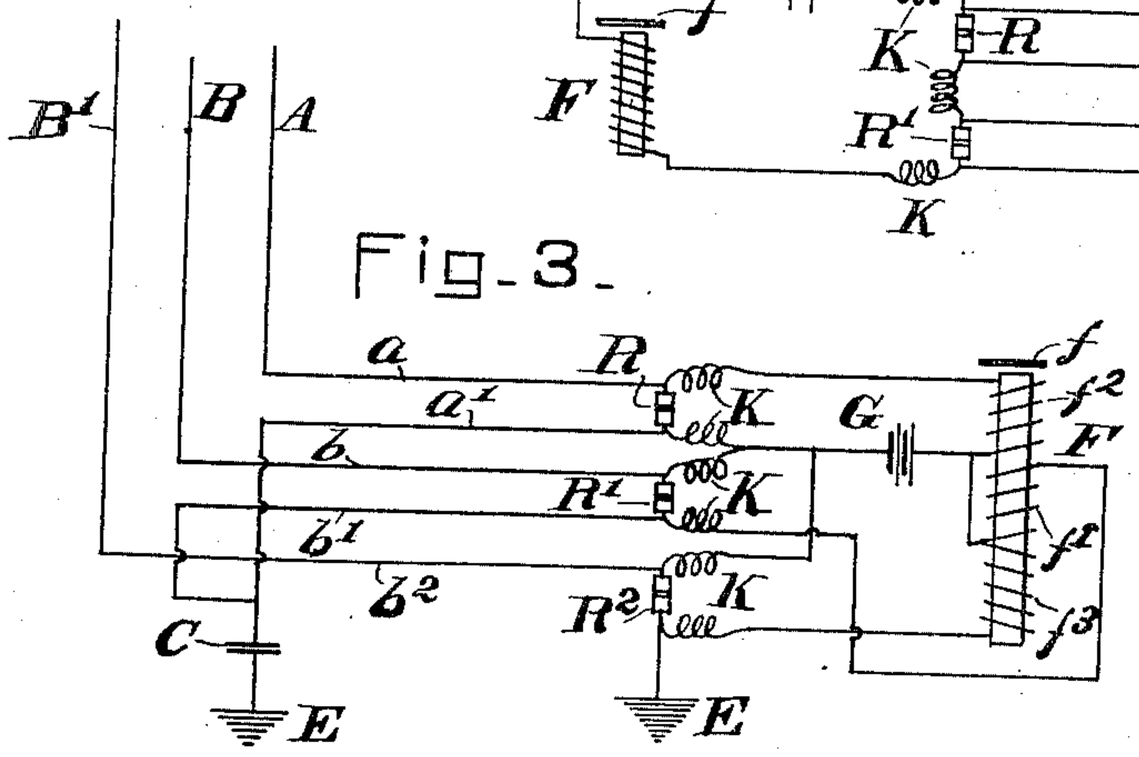
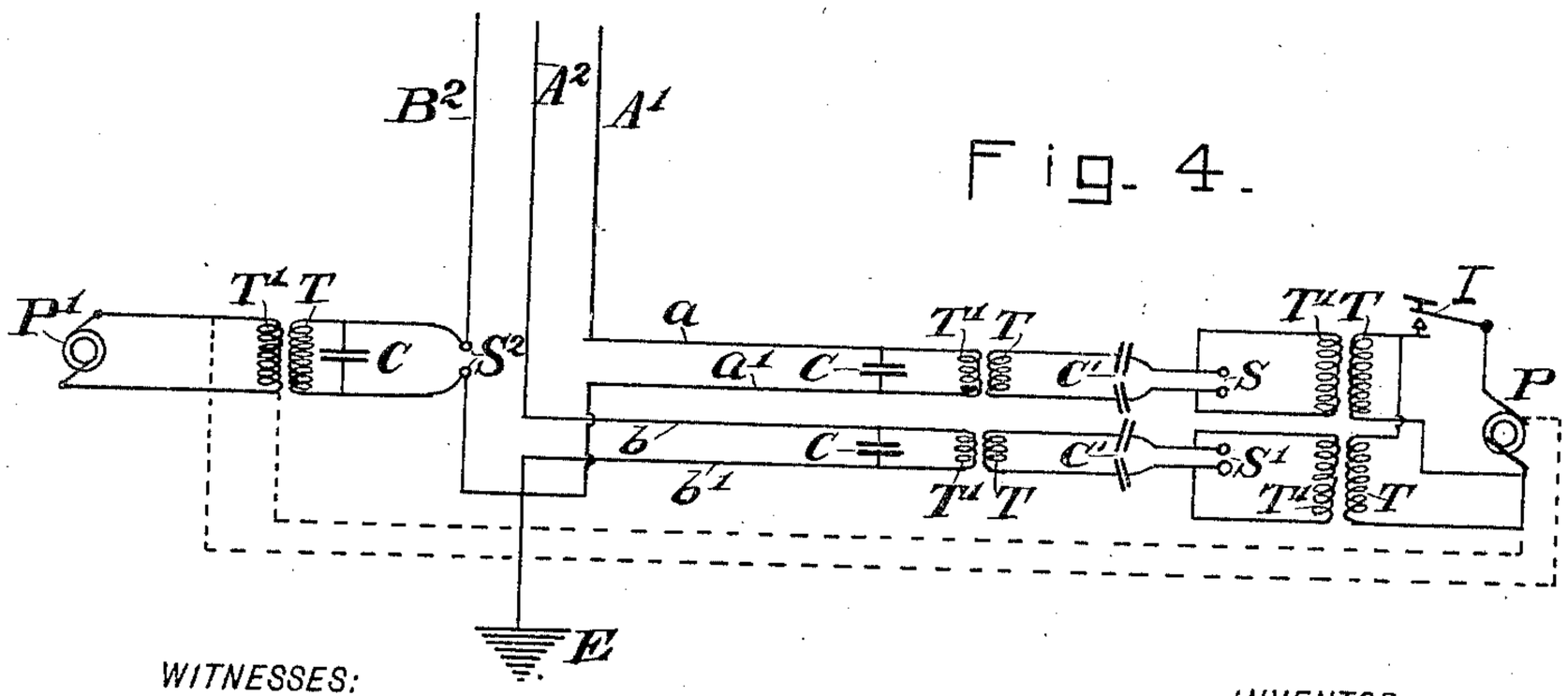


Fig. 4.



WITNESSES:

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UNITED STATES PATENT OFFICE.

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WIRELESS SIGNALING APPARATUS.

No. 894,378. Specification of Letters Patent. Patented July 28, 1908.

Application filed January 17, 1903. Serial No. 139,404.

To all whom it may concern:

Be it known that I, LEE DE FOREST, a citizen of the United States, and resident of the city of New York, borough of Manhattan, in the 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 improvements in wireless signaling apparatus whereby a multiple syntony may be employed in communicating signals, that is more than one set of differently tuned wave trains may be used, the receiving apparatus responding only when wave trains of both frequencies are received.

My invention consists of the novel parts and combinations thereof hereinafter described and particularly pointed out in the claims.

Figures 1, 2 and 3 show different forms of receiving apparatus embodying the principle of my invention, and Fig. 4 shows a form of transmitting or sending apparatus adapted for use with my invention.

The accompanying drawings illustrate my invention in forms now preferred by me but do not illustrate all the forms in which it may be embodied. They are however sufficient to make clear the principles of my invention. These each show a plurality of separate and differently tuned wave collecting systems, a corresponding number of coherers or other wave-responsive devices and a common receiving or indicating instrument which is so designed and connected with the various wave-responsive members that it is operated only when all of them are affected, each by waves of the frequency corresponding with that for which its receiving system is designed. By this plan the number of sets of instruments or stations within the same field of influence which may be simultaneously operated without interference, may be largely increased. I have herein only shown apparatus designed for operation by two sets of tuned waves of different periods but it is evident that the principle may be amplified so as to require a greater number of sets of wave trains to operate the apparatus.

Referring to Fig. 1, A and B represent two wave collecting or receiving conductors, each designed to be syntonic with a wave train of a particular period, but such wave trains differing in period from each other. To each of these antennæ or wave-collectors is connected a receiving circuit or conductor tuned to the same frequency. The form of this receiving circuit or conductor is immaterial provided that it has the selective quality which causes it to respond to waves of its particular frequency while being unresponsive or poorly responsive to wave trains of other frequency. I have herein shown for such receiving circuits, parallel conductors as a, a^1 and b, b^1, constituting what is known in the art as Lecher conductors, as I have found such conductors to possess the desired selective quality in a high degree. The corresponding ends of the two conductors forming the Lecher conductors are connected, one with the antenna and the other with the earth or other capacity. Between these conductors at their other ends or at any other point where occurs a loop of waves of the kind (electro-static or electro-magnetic) by which the wave-responsive device is designed to operate, is placed such wave-responsive device as R, R^1, R^2.

A single indicating or receiving instrument is shown which is common to all the wave-responsive devices. This receiving instrument may be of any desired form. That herein shown is a telephone receiver. In Fig. 1 I have shown two local circuits having a common branch in which is located the local battery G. I have also shown choke coils K in such circuits adjacent the wave-responsive devices. The local circuit or circuits may contain any desired or necessary apparatus of the usual construction except as otherwise herein stated.

The indicating or receiving instrument contains a coil or coils adapted, when energized as the result of waves received from the respective receiving circuits, to similarly affect said instrument to produce a signal. This is designed so that a single set of waves received through one of the receiving circuits is not of sufficient power to clearly produce the signal, while if wave trains of the frequency of both receiving circuits are simultaneously received they will act alike upon the receiving instrument to produce a clear signal.

In the receiver F of Fig. 1 the two coils f^1 and f^2 are each in their respective circuits

and act alike upon the diaphragm *f*. In Fig. 2 a single local circuit is used, in which are both wave-responsive devices R and R^1 in series and a single coil is used. In this figure as well as in Fig. 3 when more than one ground E is shown, one ground connection is provided with a condenser C to permit passage of the aerial waves, while preventing short circuiting the local battery by way of the grounds.

The apparatus of Fig. 3 is like that of Fig. 1, except that a third antenna B^1 and its receiving system is employed, this system being a-periodic or untuned, while the others are periodic or tuned after the manner previously described. This third antenna is connected with the earth by an a-periodic conductor b^2 which contains a wave-responsive device R^2. The local circuit for this a-periodic system contains the coil f^3 which should be of sufficient power to overcome the added effect of the coils f^1 and f^2 in both tuned circuits.

A powerful, strongly damped or a-periodic wave train possesses the power of forcing vibrations in any circuit whether tuned or untuned. It will therefore produce an effect in each of the coils tending to operate the receiving instrument. As the effect of the coil f^3 of the a-periodic circuit is equal to that of the coils in both or all the other circuits, the operative effect caused by such a-periodic wave train is nothing. The apparatus will then be protected against the disturbing effect of untuned or a-periodic wave trains.

The transmitting apparatus shown in Fig. 4 is indicative only of a type of such apparatus which may be employed. In this I have shown three separate radiating antennæ A^1, A^2, and B^2. The antennæ A^1 and A^2 are differently tuned, each corresponding with its receiving circuit or system, which are herein shown as consisting of Lecher conductors *a*, a^1 and *b*, b^1. Period adjusting or controlling devices such as condensers C or any other form of device may be connected with these receiving systems.

I have shown an alternating generator P as the source of electro-motive force, this being connected with each of the tuned systems consisting of the Lecher conductors by means of two sets of transformer coils T, T^1. The spark gaps S and S^1 are placed in the conductors between the two transformers. The oscillating circuit which is connected with the spark gap is shown as provided with condensers C^1 by which its period may be determined. By this or any other suitable means the two systems are tuned to different periods. Both of these tuned circuits may, if desired, be connected with the same radiating antenna. The key I for producing the signal is placed in the primary leading from the generator.

The a-periodic radiating system, when one is used, is substantially the same as above described, the antenna B^2 being however directly connected with the sparking circuit and no key being used. This antenna thus sends out a continuous series of a-periodic waves which will interfere with the receipt of a signal by any apparatus not protected after the manner shown in Fig. 3 and herein described. If desired the a-periodic antenna may be connected with the same generator as is employed to energize the periodic systems, as is indicated by dotted lines.

By the use of apparatus embodying the principles above set forth, the scope of syntonic telegraphy is vastly enlarged inasmuch as in practice it has been found impossible to use a large number of stations having different frequencies in the same zone of influence, since, unless these frequencies differ from each other by a very considerable number of frequencies per second, one set of signal waves will overlap or intrude upon those nearest in tune with itself.

By the method of double tuning herein described, I can however, simultaneously operate in the same zone and without interference, a number of additional systems equal to the number of sets or combinations of pairs possible from all the non-interfering single systems. It is obvious that the same principle may be extended to embrace three or even more distinct resonic systems connected to one and the same receiving or recording device, said device not operating save when the required number of wave trains properly attuned, be simultaneously received. The number of stations thereby capable of being operated in the same zone of influence is made practically unlimited.

At the sending station it is only necessary to employ an equal number of resonic systems, similarly attuned, each with its own or a common radiating antenna, and to energize all from a common source of power through a common key.

Having thus fully described my invention, what I claim as new and desire to secure by Letters Patents is:

1. In a space signaling apparatus, the combination with a sending device having a plurality of wave producers, each having a period differing from the others, of a receiving apparatus having a plurality of and complemental wave responsive devices, and an indicating device connected with all of said wave responsive devices.

2. In a space signaling apparatus the combination with a sending device having a plurality of wave producers each having a period differing from the others, of a receiving apparatus having a plurality of and complemental wave responsive devices, an indicating device and connections therefrom to all of said wave responsive devices adapted to operate the indicating device only when a

plurality of the wave producing devices are energized, each by its corresponding wave train.

3. In space telegraphy the combination in a sending apparatus of a plurality of coöperating wave producing devices, one adapted to produce a series of a-periodic waves, and the others adapted to produce periodic waves.

4. In space telegraphy, the combination with a plurality of differently tuned receiving systems, and an a-periodic receiving system, of a receiving or indicating instrument, means whereby said receiving instrument is operated by the joint action of waves simultaneously received upon all the tuned systems, and means whereby waves received by the untuned system affect the receiving instrument oppositely to those received by the tuned systems.

5. In a receiving system of space communication, the combination with a plurality of antennæ each made syntonic with a wave train of a particular period, of a plurality of Lecher receiving conductors each connected to and tuned to the same frequency as the respective antennæ; a corresponding number of wave-responsive devices; and common indicating means connected therewith to be operative only by all of said wave-responsive devices.

6. In a sending system of space communication, the combination with a plurality of relatively frequency-adjustable closed oscillation producing circuits, of a plurality of wave-producing means coöperating and resonant with the respective oscillation-producing circuits, at least one of said wave-producing means including a Lecher conductor.

In testimony whereof, I have hereunto affixed my signature this 9th day of January 1903, in the presence of two witnesses.

LEE DE FOREST.

Witnesses:
I. R. D. PHELPS,
W. B. BROOKE.