H. SHOEMAKER.

SIGNALING APPARATUS.

APPLICATION FILED NOV. 15, 1910.

997,515.

Patented July 11, 1911.

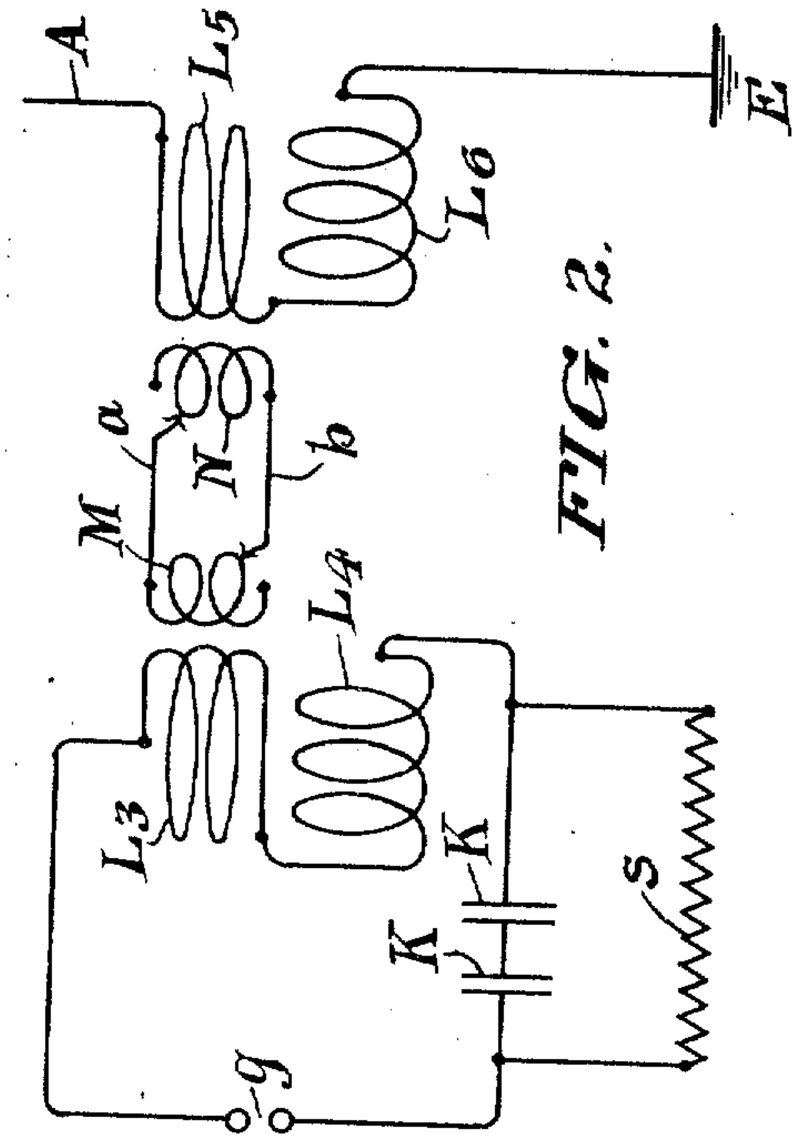

FIG. 2.

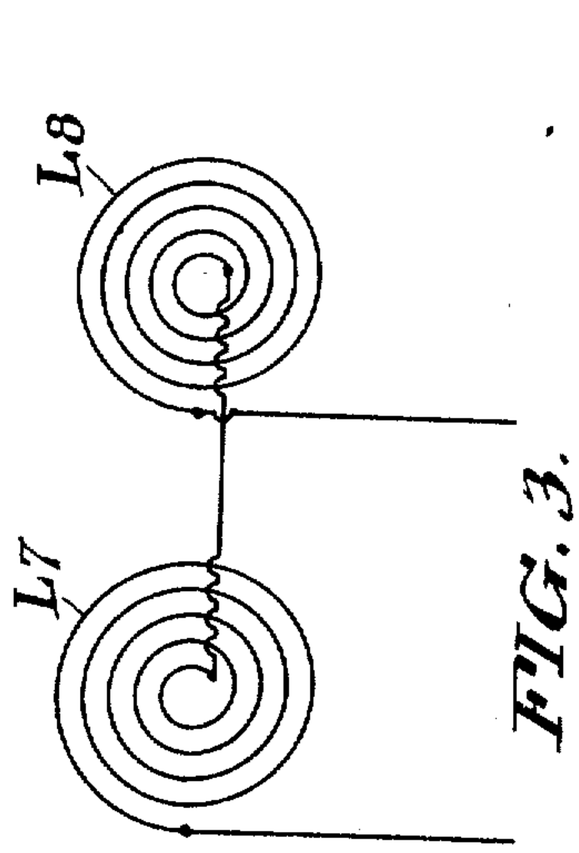

FIG. 3.

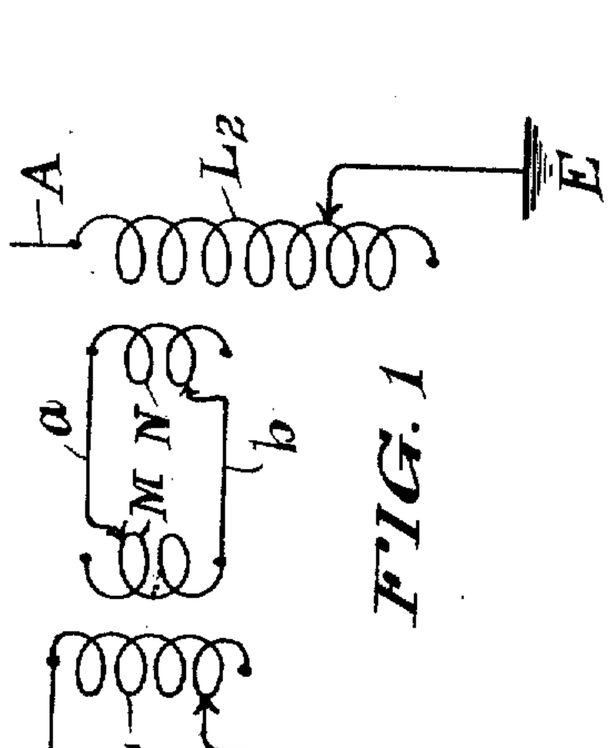

FIG. 1

WITNESSES

Daniel Webster, Jr.

Anna E. Steinbock

INVENTOR

Harry Shoemaker

BY Arthur L. Elliot

His ATTORNEY

UNITED STATES PATENT OFFICE.

HARRY SHOEMAKER, OF JERSEY CITY, NEW JERSEY.

SIGNALING APPARATUS.

997,515. Specification of Letters Patent. **Patented July 11, 1911.**

Application filed November 15, 1910. Serial No. 592,462.

To all whom it may concern:

Be it known that I, HARRY SHOEMAKER, a citizen of the United States, residing at Jersey City, county of Hudson, and State of New Jersey, have invented a new and useful Signaling Apparatus, of which the following is a specification.

My invention relates to signaling apparatus, and particularly to apparatus employed in space signaling, such as wireless telegraphy, wireless telephony and the like, in which electro-radiant energy represents the signals or messages in transmission through space.

More particularly my invention relates to improved transmitting apparatus wherein the oscillation or exciting circuit and the radiating path or circuit are coupled or interrelated in such way that the oscillation or exciting circuit determines the frequency of the waves radiated through space from the radiating circuit, such waves being simple and of the frequency determined by the exciting or oscillation circuit, and not being complicated by waves of other frequencies due to the action of the radiating circuit; nor is there any reaction by the radiating circuit or path upon the exciter or oscillation producer.

For an illustration of some of the forms my invention may take, reference is to be had to the accompanying drawing, in which:

Figure 1 is a diagrammatic view of one form of transmitting apparatus illustrative of my invention. Fig. 2 is a diagrammatic view of a modified form of transmitting apparatus. Fig. 3 is a fragmentary view illustrating a form of inductance that may be used.

In Fig. 1, G is a suitable source of current, here shown, by way of example merely, as an alternating current generator of any desired or suitable frequency depending upon the number of sparks or trains of waves desired. This generator G is connected in circuit with the operator's key *k* and the primary *p* of a transformer, preferably a step-up transformer, whose secondary delivers energy to the oscillation circuit or exciting circuit comprising the spark gap *g*, the condensers K, K and the adjustable inductance L. A is the usual aerial or radiating conductor, and, by way of example, may be an aerial conductor which extends a considerable distance into the air above the earth's surface, in the manner well understood in the art. Between the aerial conductor A and the earth connection E is connected an adjustable inductance L^2. In inductive or transformer relation with the inductance L, and preferably without iron core, is the secondary winding M connected in circuit by conductors *a* and *b* with the primary winding N, which is in inductive or transformer relation with the inductance L^2, preferably without iron core. The inductances L and L^2 are disposed so remotely from each other that, their mutual inductance is substantially *nil*, so that there is substantially no transfer of energy directly from L to L^2; or in order that their mutual inductance shall be *nil* or substantially so, said inductances may be otherwise disposed, as, for example, with their planes at right angles to each other. The oscillatory energy due to the high frequency oscillations in the circuit *g*, K, K, L is transferred from L to the winding M by simple inductive or transformer action, and the energy developed in the winding M is led directly to the winding N through conductors *a* and *b* which are preferably disposed as shown, and not twisted upon each other. And the energy from this link circuit M, N is transferred to the aerial circuit A, L^2, E by the simple inductive or transformer action between the winding N and the inductance L^2. The capacity of the circuit M, N is substantially *nil*, and is even less than in the case where the conductors joining the windings M and N are twisted upon each other. By the employment of such link circuit M, N and with the inductances L and L^2 sufficiently widely separated, as described, there is no reaction by the radiating or antenna circuit or path upon the exciting or oscillation circuit including the inductance L, that is, there will be no reaction such that a complex wave will be radiated through space from the antenna or aerial conductor A, but a simple wave will be radiated and that wave will have the frequency or length determined by the oscillation circuit *g*, K, K, L, when uncoupled with or entirely separated from the antenna or aerial circuit or path. By adjusting the inductance L^2, the aerial-to-earth path may be adjusted for the same wave length or frequency as the oscillation or exciting circuit including the inductance L, or to a different frequency or length. By this arrangement greater amounts of energy may be transferred from the exciting or

oscillation circuit to the antenna or aerial circuit with consequent greater radiation of energy through space. In practice, the coils M and N in the link circuit may have any desirable number of turns, so long as their distributed capacity and the distributed capacity of the conductors *a* and *b* connecting them do not give to such link circuit any appreciable value for its oscillation constant. The object is to reduce the capacity of the link circuit to zero, or as near thereto as possible, so that such link circuit shall not have capacity enough to tend to give the link circuit a natural oscillation period anywhere nearly approaching the oscillation period of either of the oscillation or exciting circuit or the aerial-to-earth circuit. There being no capacity in this link circuit there will be no damping effect produced therein but it will, nevertheless, tend to dampen the oscillations in the exciting and antenna-to-earth circuits if the resistance of the link circuit be not kept low. Accordingly, it is desirable that the resistance of the link circuit M, N be made very low as by using conductors of low specific resistance and of relatively great surface, considering the amount of energy which is to be transmitted over them or through them. Thus the link circuit M, N may be made of large wire or of a great number of strands of small wire, to minimize resistance. The mutual inductance between L, L^2 should be practically zero, as aforesaid, by separating these inductances to relatively great distances from each other to insure the transfer of energy between them through the link circuit M, N only.

In Fig. 2 a modified form of transmitting apparatus is shown, in which the oscillation circuit receives energy from the transformer secondary *s*, similar to that shown in Fig. 1, such oscillation circuit including the spark gap *g*, the condensers K, K and the inductometer or dynamometer inductance comprising the serially connected coils L^3 and L^4 movable with respect to each other to change the inductance of the oscillation or exciting circuit. The coil M of the link circuit M, N is preferably wound close to the inductance L^3 which may be the stationary coil of the inductometer inductance, the coil L^4 only being movable. And the link circuit coil N is preferably similarly wound in close inductive relation to the preferably stationary inductance coil L^5 connected in series between the antenna or aerial conductor A and the earth E through the inductance coil L^6 which is movable with respect to L^5. Here, again, the link circuit M, N should be constructed as described in connection with Fig. 1 and the pair of coils L^3, L^4 should be situated remotely from the coils L^5, L^6, so that the mutual inductance between these pairs of coils shall be zero or substantially zero. The action is similar to that described in connection with Fig. 1, the movement of the coils L^3 and L^4 serving to change the inductance of the exciting or oscillation circuit and the coils L^5 and L^6 serving to change the inductance of the aerial-to-earth path.

The inductometer or dynamometer inductance may take the form shown in Fig. 3, where the two coils L^7 and L^8 are connected in series with each other and consist respectively of spirals having substantially equal number of turns. They are to be so connected that when they are close together and their planes parallel and with axes coinciding, they will have minimum inductance, and when moved apart their inductance will increase. When this type of inductance is used in either or both the exciting and aerial-to-earth circuits, the coils of the link circuit may each be closely coupled to one of the flat spirals.

By the employment of the link circuit, as above described, in connection with Figs. 1, 2 and 3, the oscillation or exciting circuit completely controls the frequency of the oscillations in the antenna or radiating circuit. For example, if the exciter circuit produces oscillations corresponding with a wave length of 400 meters and the antenna-to-earth circuit be adjusted to correspond with a wave length of 400 meters, then simple waves will be radiated to space from the antenna A and will have 400 meter lengths. If the radiating or antenna circuit is then changed to correspond with 350 meters wave length, the radiated waves will, nevertheless, remain simple and of 400 meter lengths, though the current or energy in the antenna-to-earth circuit will then be less; and similarly if the natural period of the exciting or oscillation circuit be changed from the figures above given, the waves radiated will, nevertheless, be simple and will be of the same length as the waves corresponding with the oscillation frequency in the exciting or closed oscillation circuit. Thus to whatever wave length the oscillation or exciting circuit may be adjusted the energy radiated from the antenna will be simple waves of the same wave length.

By preference, the coils of the link circuit are very closely coupled to the inductances or coils with which they are inductively related. The coils M and N of the link circuit are not inductively affected by each other but are in simple conductive relation and are remote from each other.

It is to be understood that my invention is not limited to the arrangement of transmitter here shown, but that the link circuit may be employed with any known transmitting circuits, it being remembered that the coils of the link circuit shall be so far apart that there shall be no re-action between the circuits or paths between which the link cir-

cuit transfers energy, and that the capacity of the link circuit should be a minimum and that its resistance should be as low as possible, and the lower the better.

While the transmitting apparatus shown herein has been illustrated as telegraphic apparatus, it is to be understood that my invention is equally applicable to telephonic transmitting apparatus which usually employ sustained oscillations.

While in the transmitting apparatus I have, by way of example, illustrated an open radiating conductor, it is to be understood that my transmitting apparatus is adaptable as well to looped or closed circuit radiating conductors.

It is to be understood that the number of turns in either or both coils of the link circuits herein shown may be varied or adjusted; or, that with a given number of turns the turns may be spread apart or brought close together as may be desired.

What I claim is:

1. The combination with a producer of high frequency oscillations, of a radiating conductor, a link circuit transferring energy from said high frequency oscillation producer to said radiating conductor, said link circuit having inductance and substantially no capacity.

2. The combination with a high frequency oscillation producing circuit, of an inductance included therein, a radiating conductor, an inductance associated therewith, and a link circuit in inductive relation with said high frequency oscillation circuit and said last named inductance, said link circuit having substantially no capacity and very low resistance, said inductances being so far separated that their mutual inductance is substantially zero.

3. The combination with a high frequency oscillation producing circuit, of a radiating conductor, an inductance in said oscillation circuit comprising inductance coils movable with respect to each other, a link circuit for transferring energy from said high frequency oscillation circuit to said radiating conductor, and a coil of said link circuit being in close inductive relation with one coil only of said relatively movable coils.

4. The combination with a high frequency oscillation producing circuit, of a radiating conductor, a link circuit for transferring energy from said high frequency oscillation producing circuit to said radiating conductor, said link circuit having substantially no capacity and very low resistance, and a coil of said link circuit closely inductively related with said high frequency oscillation circuit.

5. The combination with a high frequency oscillation producing circuit, of a radiating conductor, a link circuit for transferring energy from said high frequency oscillation producing circuit to said radiating conductor, said link circuit having substantially no capacity and very low resistance, and a coil of said link circuit in close inductive relation with said radiating conductor.

6. The combination with a high frequency oscillation producing circuit, of a radiating conductor, a link circuit for transferring energy from said high frequency oscillation producing circuit to said radiating conductor, said link circuit having substantially no capacity and very low resistance, and the coils of said link circuit being closely inductively related respectively with said high frequency oscillation circuit and said radiating conductor.

7. The combination with a high frequency oscillation producing circuit, of a radiating conductor, a link circuit for transferring energy from said high frequency oscillation producing circuit to said radiating conductor, said link circuit having substantially no capacity and very low resistance, and the coils of said link circuit being closely inductively related respectively with said high frequency oscillation circuit and said radiating conductor being so remote from each other that their mutual inductance is substantially zero.

8. The combination with a radiating conductor, of an inductance associated therewith comprising relatively movable coils, a high frequency oscillation producing circuit including an inductance comprising relatively movable coils, said high frequency oscillation circuit and said radiating conductor being so remote that their mutual inductance is substantially zero, and a link circuit in inductive relation with said inductance of said high frequency oscillation circuit and said radiating conductor, said link circuit having substantially zero capacity and very low resistance.

9. Transmitting apparatus comprising in combination a closed oscillating circuit having capacity and inductance, an open oscillation circuit adapted to radiate energy, both of said circuits having the same time period, and a third circuit having inductance and practically no capacity linking said circuits together.

10. The combination with an open oscillating circuit, of a variable inductance therein, a closed oscillating circuit, a variable inductance therein, and a third circuit having inductance and practically no capacity linking said circuits together.

11. The combination with an open oscillating circuit, of an inductance therein, said inductance being variable and the resistance of said circuit remaining constant, a closed oscillating circuit including capacity and inductance, said inductance being variable and the resistance of said closed oscillating

circuit remaining constant, and a third circuit having inductance and practically no capacity linking said circuits.

12. The combination with an open oscillation circuit, of a closed oscillation circuit including capacity and inductance, a third circuit including inductance and practically no capacity linking said circuits, and means for varying the inductance of said link circuit.

13. The combination with a transformer, of a source of energy and signaling key in the primary circuit thereof, a closed oscillating circuit associated with the secondary thereof, said closed circuit including a spark gap, capacity and an inductance variable and the resistance of said closed circuit remaining constant, a radiating circuit including an inductance variable and the resistance of said radiating circuit remaining constant, and a link circuit having inductance and practically no capacity having coils in inductive relation respectively with said radiating and closed circuits.

In testimony whereof I have hereunto affixed my signature in the presence of the two subscribing witnesses.

HARRY SHOEMAKER.

Witnesses:
MARY SHOEMAKER,
J. M. SAWYER.