No. 827,524. PATENTED JULY 31, 1906.

L. DE FOREST.

WIRELESS TELEGRAPH SYSTEM.

APPLICATION FILED JAN. 2, 1906.

2 SHEETS—SHEET 1.

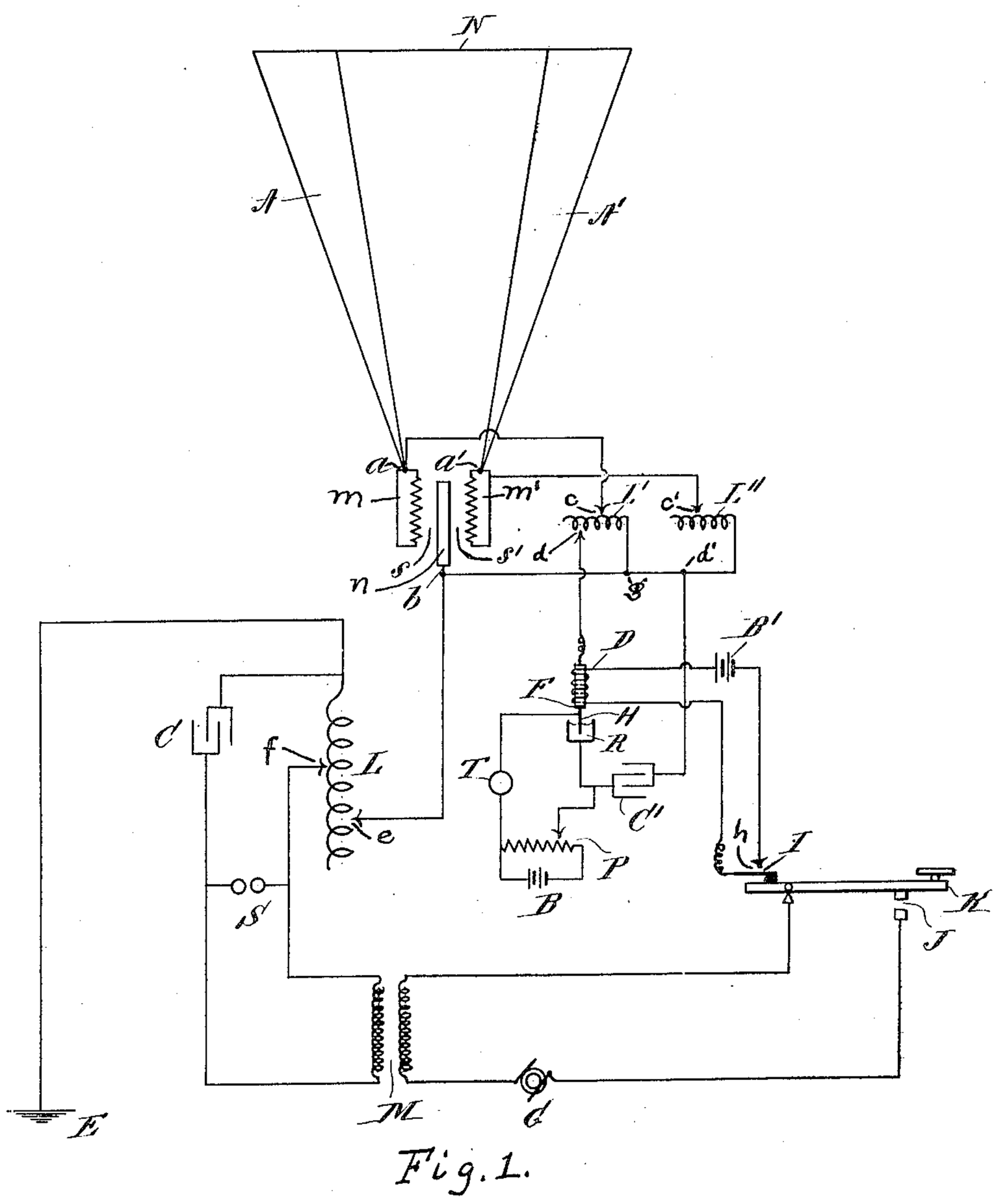

Fig. 1.

WITNESSES=
Adolph G. Kaiser.
John Buckler,

INVENTOR=
Lee de Forest
by
Geo. K. Woodworth
atty.

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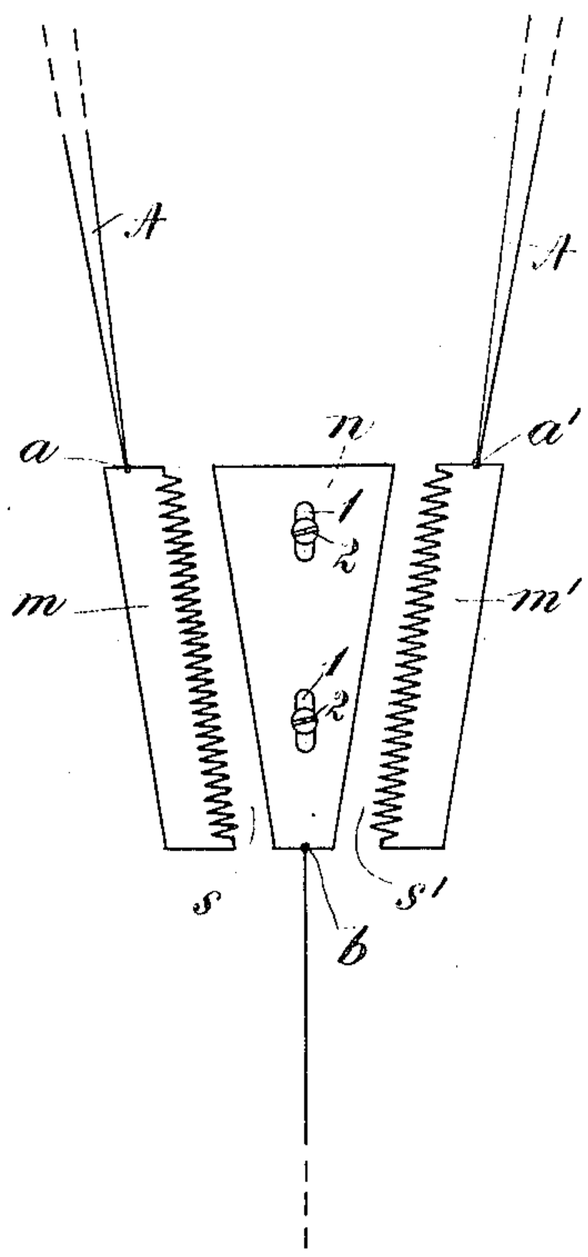

Fig. 2.

WITNESSES=
Frank G. Parker.
John Buckler,

INVENTOR=
Lee de Forest
by Geo. K. Woodworth.
Atty.

UNITED STATES PATENT OFFICE.

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

WIRELESS-TELEGRAPH SYSTEM.

No. 827,524. Specification of Letters Patent. Patented July 31, 1906.

Application filed January 2, 1906. Serial No. 294,098.

To all whom it may concern:

Be it known that I, LEE DE FOREST, a citizen of the United States, and a resident of New York, in the county of New York and State of New York, have invented a new and useful Improvement in Wireless-Telegraph Systems, of which the following is a specification.

My invention relates to wireless telegraphy and has for its object a system which is provided with a transmitting and a receiving apparatus, both associated with one antenna, and with means whereby a receiving operator is enabled to cut in upon and interrupt a transmitting operator at another station.

In the drawings, which accompany and form a part of this specification and which illustrate diagrammatically one system of circuits whereby my invention may be carried into effect, Figure 1 represents a wireless-telegraph transmitting and receiving system, and Fig 2 represents a modification of a detail of construction.

Heretofore I have described a wireless-telegraph system which is provided with separate transmitting and receiving antennæ at the same station and associated apparatus operated by the transmitting-key whereby a receiving operator may interrupt the transmission for a distant station; but it is obvious that in certain locations,—for example, on shipboard,—only one antenna is permissible, and with the system which forms the present invention the advantage is arrived at that by means of one antenna, employed alternately for transmitting and receiving, a receiving operator may cut in upon a message which is being sent from a distant transmitting-station.

The system which I shall describe in this application for the purpose of more fully disclosing my invention embodies in general the principles set forth in my prior patents, although it will be obvious that my invention may be employed with any other suitable system and that it is not limited to the system shown herein.

The conductors A, A′, which are uninsulated at the top, being conductively connected by the wire N, constitute the two sides of a receiving-loop antenna, the loop being closed by the conductors *a c* L′ *g* and *a′ c′* L″ *g*, respectively. Instead of grounding the receiving system by connecting the point *g* directly to earth as heretofore has been the practice in systems of this general type, in which one antenna is employed alternately for transmitting and receiving, I find it desirable, and practically necessary, to connect the receiving-ground lead to the antenna directly below the anchor spark-gap and above the transmitting-helix L, so that said helix lies between the receiver and the earth. I find that the presence of the helix L in the earth connection *g b e* L E of the receiving system has practically no effect upon the operation of the receiving system. If, instead of grounding the receiving system as above set forth, it were grounded directly, as by connecting the point *g* directly to earth, a large difference of potential would exist across the responder when the sending system was in operation and switches of large separation would be required in the conductors *a c* and *a′ c′* in order to protect the responder.

The receiving-circuit *d′* C′ R *d* L′, including the condenser C′, responder R and any desired portion of the inductance L′, is attuned to the period of the aforesaid receiving-loop antenna by the adjustable inductance L′ or by the adjustable condenser C′, or by both; and the adjustable contacts *c*, *c′*, determine the amounts of the inductances L′, L″, respectively, which are to be included in the sides of said loop-antenna. The responder R may comprise a vessel containing an electrolyte and a glass-inclosed anode H, which is carried by an iron plunger F surrounded by the solenoid D. T is a telephone, B is a battery and P is a potentiometer. When the key K is depressed, and before it closes the circuit of the generator G at the contact J, the spring I, carried by and insulated from the key K, closes the circuit of the solenoid D and battery B′ at the point *h*, thereby energizing said solenoid and causing the plunger F to lift the anode H out of the electrolyte. When the key K closes the circuit of the generator G, the energy of the latter is translated by the transformer M to the condenser C, which, by discharging across the gap S, develops electrical oscillations in the oscillation-producing circuit C S *f* L. The energy of said oscillations is translated to the antenna by the auto-transformer L and their frequency is made to accord with that natural to said antenna by the adjustable contacts *e*, *f*, which determine the amounts of the inductance L which is to be included in the antenna and oscillation-producing circuit. The dielectric strength of

the anchor spark-gap *s*, *s'* is large enough to maintain the antenna as a loop while receiving; but the high tension at which the oscillations are delivered to the antenna by the oscillation-producing circuit readily bridges said gap by conducting arcs and causes the two sides of the antenna to operate in parallel after the manner of the well-known multiple antenna.

The anchor spark-gap *s*, *s'* consists preferably of two plates *m*, *m'* having a large number of fine teeth adjacent to a center plate *n*, to which the antenna lead to the inductance L is connected.

In Fig. 2, I have shown a form of adjustable anchor spark-gap which in practice I have found to be convenient and efficient. In Fig. 2, the members *m*, and *m'*, consist of two saw-blades set at an angle and adjacent to a center plate *n*, the sides of which preferably are parallel to the saw-blades. By means of the screws 2, 2, and the slots 1, 1, the position of the plate *n*, may be adjusted so as to vary the length of the gap *s*, *s'*. It is obvious, however, that the center plate might be made stationary and the members *m*, *m'*, made movable with respect thereto.

It will be obvious that when the gap *s*, *s'* is bridged by the conducting-arcs created by the oscillations, there is but negligible potential difference between the points *b* and *a*, and between the points *b* and *a'*, so that the oscillations practically short-circuit the receiving-circuit and consequently a very small difference of potential can exist between the points *d* and *d'* when the key K is closed. It follows, therefore, that a very slight lifting of the glass-covered anode from the electrolyte will suffice to protect the responder during transmission. When the transmitting-key is in normal position and the solenoid D is not energized, any signals which may be sent out from a distant station may be read by the operator at the station under discussion, who keeps the telephone T in position while sending.

It will be obvious that many different types of receiver may be employed in lieu of the particular type shown in the drawings and that many modifications may be made both in the transmitting and receiving systems, as well as in the antenna and other apparatus herein described, without departing from the spirit of my invention.

I claim—

1. In a wireless-telegraph system, a transmitting system, a key for energizing the same, a receiving system, a responder associated therewith, and magnetic means, energized by said key, for moving one element of said responder away from the other element thereof.

2. In a wireless-telegraph system, a transmitting system, a key for energizing the same, a receiving system, a responder associated therewith, a plunger carrying one element of said responder, a solenoid coöperating with said plunger and means associated with said key for energizing said solenoid.

3. In a wireless-telegraph system, a receiving-loop antenna, a closed receiving-circuit associated therewith, and an oscillation-producing circuit so associated with said antenna that the oscillations created thereby in said antenna practically short-circuit the said receiving-circuit and cause the two sides of the loop-antenna to operate in parallel.

4. In a wireless-telegraph system, a receiving-loop antenna, a closed receiving-circuit associated therewith, an oscillation-producing circuit and means so connecting the latter with the antenna that the oscillations created thereby in said antenna produce a practically negligible difference of potential between the terminals of said receiving-circuit.

5. In a wireless-telegraph system, an oscillation-producing circuit, means connecting said circuit to one member to an anchor spark-gap, an antenna connected to the other member of said spark-gap, a receiving-circuit, and a ground-lead for said receiving-circuit connected to said antenna below said spark-gap and above said oscillation-producing circuit.

6. In a wireless-telegraph system, an oscillation-producing circuit, a receiving-circuit, an antenna, means connecting said oscillation-producing circuit to said antenna, and means connecting said receiving-circuit to ground through said first-mentioned means.

7. In a wireless-telegraph system, an oscillation-producing circuit including a helix, an antenna, means connecting said antenna to ground through said helix, a receiving-circuit, and means connecting said receiving-circuit to ground through said helix.

8. In a wireless-telegraph system, an anchor spark-gap, an antenna connected to one member of said spark-gap, an oscillation-producing circuit connected to the other member of said spark-gap and a receiving-circuit connected to both members thereof.

9. In a wireless-telegraph system, an anchor spark-gap, an antenna connected to one member of said spark-gap, an oscillation-producing circuit, including a helix, connected to the other member of said spark-gap, a receiving-circuit connected to both members thereof, and a ground connection through said helix for said receiving-circuit.

10. In a wireless-telegraph system, an anchor spark-gap comprising a member provided with a plurality of teeth, a coöperating member adjacent thereto, means whereby the length of the spark-gap may be varied, an antenna connected to one member of said spark-gap, an oscillation-producing circuit connected to the other member of said spark-gap, and a receiving-circuit connected to both members thereof.

11. In a wireless-telegraph system, an anchor spark-gap consisting of two members, one member consisting of a plurality of parts each provided with a plurality of teeth, a cooperating member adjacent to said parts, means whereby the length of the spark-gap may be varied, an antenna connected to one member of said spark-gap, an oscillation-producing circuit connected to the other member of said spark-gap, and a receiving-circuit connected to both members thereof.

12. In a wireless-telegraph system, an anchor spark-gap comprising a member provided with a plurality of teeth and a coöperating member adjacent thereto, an antenna connected to one member of said spark-gap, an oscillation-producing circuit connected to the other member of said spark-gap, and a receiving-circuit connected to both members thereof.

13. In a wireless-telegraph system, a transmitting system, a key for energizing the same, a receiving system, a responder associated therewith, and electrically-operated means controlled by said key for moving one element of said responder away from the other element thereof.

14. In a wireless-telegraph system, a responder comprising two relatively movable elements, a transmitting-key, and electrically-operated means controlled by said key for producing relative movement between the elements of said responder.

In testimony whereof I have hereunto subscribed my name this 29th day of December, 1905.

LEE DE FOREST.

Witnesses:
GREENLEAF WHITTIER PICKARD,
GEO. E. TURNER.