

S. CABOT.
SPACE TELEGRAPHY.
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2 SHEETS—SHEET 2.

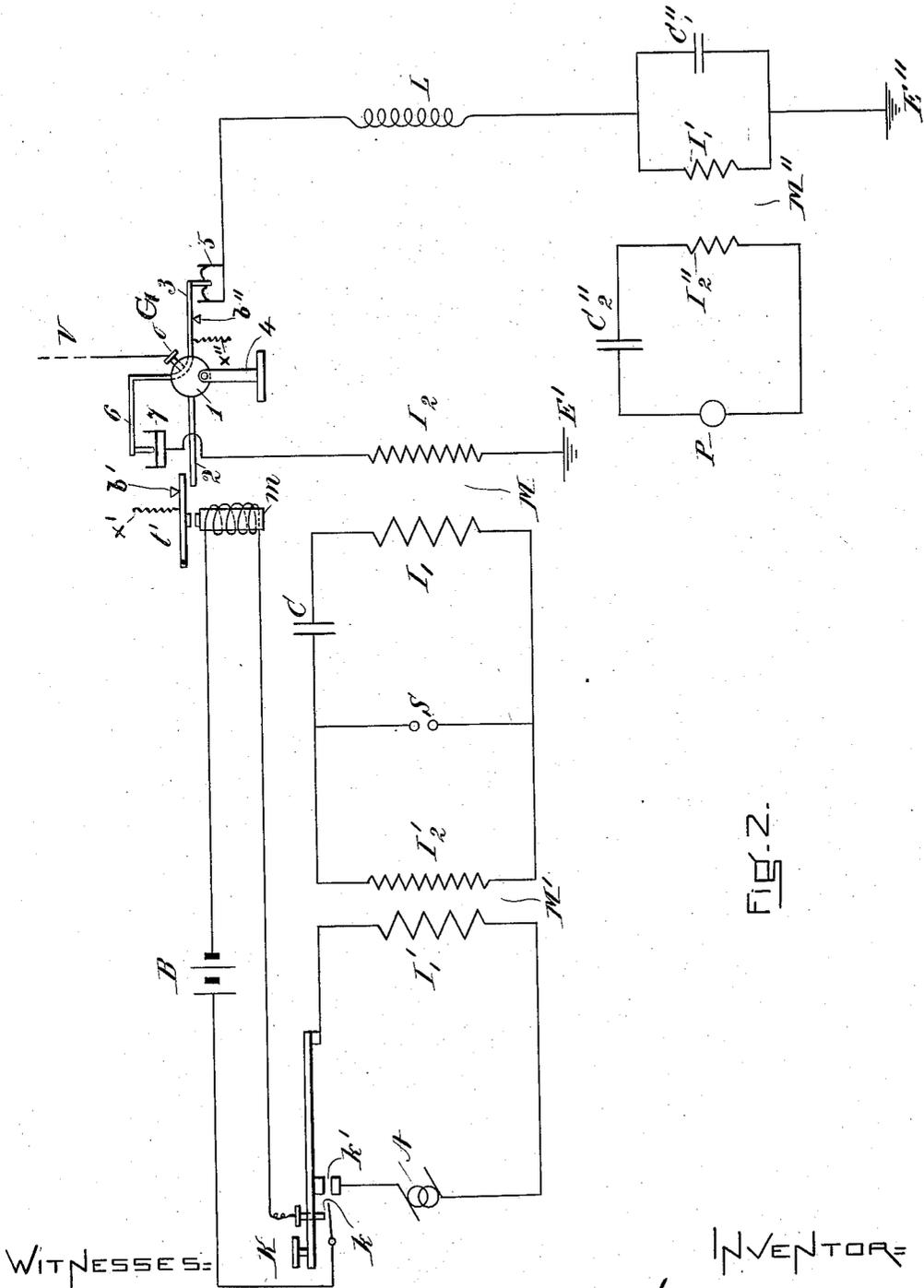


FIG-2.

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SPACE TELEGRAPHY.

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To all whom it may concern:

Be it known that I, SEWALL CABOT, a citizen of the United States, and a resident of Brookline, in the county of Norfolk and State of Massachusetts, have invented a new and useful Improvement in Space Telegraphy, of which the following is a specification.

My invention relates to the art of transmitting intelligence from one station to another by means of electromagnetic waves without the use of wires to guide the waves to their destination; and it relates more particularly to a complete system for transmitting and receiving such waves.

The object of the present invention is to provide a system whereby the well-known operation of "breaking" such as used to-day in wire-telegraph traffic, as worked out in duplex and quadruplex systems, may be applied to the handling of wireless-telegraph traffic.

With this object in view my invention comprises a receiving system connected to a transmitting system at a point other than one of zero potential; and it further comprises a key provided with means, whereby, at the commencement of the downward movement of said key, the receiver is rendered inoperative and the transmitting system is connected to earth, thereby automatically putting said transmitting system in condition for transmitting; whereby, at the completion of the downward movement of said key, the said transmitting system is energized; whereby, at the commencement of the upward movement of said key, the transmitting system is deenergized; and finally, whereby, subsequently to such deenergization the receiving system is put in condition for receiving by disconnecting the transmitting system from earth and rendering the receiver operative.

For the purpose of more fully disclosing my invention, I have illustrated and shall particularly describe one specific embodiment thereof, although it is to be understood that I do not limit myself thereto for my invention is capable of many other embodiments.

My invention may best be understood by having reference to the drawings which accompany and form a part of this specification, and in which the same reference charac-

ters are used to designate like parts in the figures.

In the drawings, Figure 1 is a diagram representing an organization of apparatus and circuits whereby the objects of my invention may be carried into effect and showing in plan view one form of the high-potential switch G; and Fig. 2 is a view identical to Fig. 1 with respect to the circuits shown therein, with the exception that the relay *r* has been omitted for clearness, and showing the said high-potential switch in end elevation.

In the figures, C C' C' are condensers.

L is an inductance-coil.

M is a transformer whose primary and secondary windings I₁ and I₂ are preferably so spatially related as to produce a transformer of large magnetic leakage. The separation of said windings is herein shown for the sake of clearness as a transverse separation, although in practice the separation is axial.

M' is a transformer adapted to raise the potential impressed upon its primary winding I'₁ to a very high potential in its secondary winding I'₂.

M'' is a transformer whose primary and secondary windings I''₁ and I''₂ are preferably so spatially related as to produce a transformer of large magnetic leakage. Here again the separation of the coils is, for the purpose of clearness, shown as a transverse separation, although in practice the separation is axial.

S is a spark-gap.

E' E'' are earth connections.

P is an oscillation responder or receiver of any suitable type and herein represented merely conventionally by a circle.

K is a key.

A is an alternating-current generator or other suitable source of power.

G is a high-potential switch hereinafter more fully described.

In wireless or space telegraphy, as in telegraphy by connecting-wires, it is often desirable for the receiving operator to interrupt the transmitting operator, that is to say, if the receiving operator should fail to get a portion of a message, it is desirable that he should be able to immediately notify the transmitting operator of the fact so that the latter may repeat that portion of the message which the former failed to get, in-

stead of having to wait until the transmitting operator has finished sending the message and then notifying him that a portion of the message had not been received.

5 In wire telegraphy, especially as developed in the practical operation of the duplex and quadruplex systems, this is accomplished very simply in a manner well known to those skilled in the art of telegraphy, but
10 in wireless telegraphy the peculiar difficulties involved in arranging the circuit connections in transmitting and receiving systems, as well as the differences between said circuit connections, and also the extreme sensitiveness of the oscillation-responder renders the
15 operation of breaking more difficult and, so far as I am advised, no system has yet been devised whereby such operation may be effected. In all the embodiments of the
20 present invention, I accomplish the hereinbefore-stated objects by means of a sending-key or other sending device provided with auxiliary apparatus and circuits whereby the following functions are performed in the
25 following order, viz: first, rendering the oscillation-responder inoperative at the beginning of the downstroke of the key and disconnecting the vertical, or elevated conductor *per se*, from the receiving system to
30 which it normally is connected and connecting the same to the transmitting system; and second, closing the power-circuit.

In that particular embodiment of the present invention which I have herein illustrated
35 and which I shall specifically describe for the purpose of more fully disclosing my invention, the receiver or responder is rendered inoperative by opening its circuit by means of a relay, the circuit of said relay being
40 closed by the sending-key, although it is obvious that many other means may be used for this purpose. By the term "rendering the receiver inoperative," as used in the specification and claims, I desire to be understood as meaning an operation whereby the
45 receiver is rendered incapable of performing its natural functions, and inasmuch as I consider any suitable means for accomplishing this result within the scope of my invention it is not my intention to limit myself to the particular means which I have shown in the drawings, and furthermore it is to be understood that my invention is not limited to any particular kind of oscillation-responder or to any particular type of transmitting or receiving system. By the term
50 "sending-key" as used herein I desire to be understood as meaning any device whereby the electromagnetic waves are broken up into groups representing signal elements such, for example, as the dots and dashes of the Morse code.

Referring now to Fig. 1, and particularly to the device represented by the character
65 G, 1 is a rod of insulating material mounted

pivotaly between the supports 4 4. This rod carries a series of contact members 3 3 the outer ends of which are normally maintained immersed in the mercury contained in the cups 5 by means of the spring x'' which
70 draws the members 3 3 against the back-stop b'' . As shown in Fig. 2 the rod 1 carries also the contact-strip 6 which coöperates with the mercury in the cup 7 when the rod 1 is slightly rotated in such direction as to break
75 the connection between the members 3 3 and the cups 5. Such rotation of the rod 1 may conveniently be effected by the magnet m , which is energized by the battery B when the key K closes the contact k . The energiza-
80 tion of the magnet m causes the armature t' to strike the member 2 which is rigidly secured to the rod 1 and thereby causes a slight rotation of the rod 1 and disconnects the members 3 3 from the cups 5 5 and con-
85 nects the member 6 with the cup 7.

In the normal position of the sending-key the circuit may be traced as follows: from the vertical V to the point o , through the members 3 3 and the mercury-cups 5 to the
90 receiving system and thence to earth at E'' . The key K being in its normal position, the contact k'' is open and the armatures $t t$ of the relay r are normally held against their coöperating contacts so that the circuit of
95 the receiver is normally closed. The receiving system therefore is in condition for receiving when the key is in its normal position.

When the transmitting operator depresses
100 his key, the first operations effected are the closure of the contact k'' thereby energizing the relay r which, by causing the attraction of the armatures $t t$ opens the circuit of the
105 receiver P, and the closure of the contact k , thereby energizing the magnet m , which by causing the attraction of its armature t' against the tension of the spring x' , effects a slight rotation of the rod 1. Such rotation of said rod disconnects the elevated conductor
110 from the receiving system by raising the contact-strips 3 3 from the cups 5 5 and connects said elevated conductor to the transmitting system by lowering the member 6 into the cup 7. The closures of the contacts
115 k and k'' may be simultaneous or successive, all that is necessary being that they occur prior to the closure of the contact k' and the consequent energization of the transmitting-circuit. The system is now in condition for
120 transmitting and the further depression of the key effects the closure of the contact k' and the energization of the transformer M'. The alternating current thereby developed in the primary of said transformer is trans-
125 formed into a high-potential current in the secondary thereof and such current in the usual well-known manner creates high-frequency, high-potential electrical oscillations in the sonorous circuit S C I₁ which by means
130

of the transformer M are translated to the elevated-conductor system $V o L_2 E'$. The aforesaid oscillations will be simple harmonic in form, if as set forth in United States Letters Patent Nos. 714,832 and 767,984, the windings of the transformer M are so spatially related as to render the sonorous circuit the equivalent of a circuit having a single degree of freedom. While such relation between the windings of said transformer is preferred, it will be understood that my invention is not limited thereto but is capable of application to any system irrespective of the form of the oscillations developed therein or the waves transmitted therefrom.

It is not deemed necessary to explain in detail the construction, proportionment or operation of the particular receiving-circuits herein shown inasmuch as such explanation may be found in United States Letters Patent No. 767,994. Said circuits are merely shown for the purpose of more fully illustrating this invention as it has been practiced by me and it will be obvious that it is independent of any particular arrangement of receiving-circuits.

It is well known that, other things being equal, a given difference of potential is required to break down a given length of air or other dielectric, and also that if a given length of dielectric such as air is divided into a number of portions separated by conductors, the dielectric strength of said given length of dielectric is greatly increased, as more fully set forth in United States Letters Patent No. 768,000. When the sending-key is depressed and the elevated conductor by means of the contact-strip 6 and mercury-cup 7 is connected with the transmitting system, there exists between the point o and the point E' , and consequently between the point o and the point E'' , an enormous difference of potential, large enough in many instances to break down one and one-half inches of air so that were the switch G constructed in the ordinary manner its switch member would necessarily have to be separated from its cooperating contact, such as the mercury-cup 5, a distance slightly greater than one and one-half inches. However, I find in view of the principle above set forth that by using eight switch members, the separation of each member from its cup being one-sixteenth of an inch, and thereby producing one-half inch of air separated by seven metallic bodies, the potential necessary to break down said half-inch of air so disposed is somewhat greater than that required to break down a gap consisting of one and one-half inches of air.

It will be observed that in the course of sending messages at even slow rates of speed the vibrations of the contact-strips 3 and 6 must necessarily be very rapid and therefore it would be quite impracticable to employ an

ordinary switch whose contact member was capable of the aforesaid large movement necessary in view of the large difference of potential between the points o and E'' , so that, therefore, in order to alternately connect the elevated conductor to the transmitting and receiving systems by the sending-key it is necessary to employ a switch which will have a very small range of movement and which notwithstanding said small range of movement will prevent the breaking down of the dielectric between its contact members. It will further be observed that the moving parts of the switch G must be extremely light so that the switch will have very small inertia in order to permit of the aforesaid rapid vibration thereof.

After the operator has depressed the sending-key to its full extent for a sufficient length of time to produce the desired signal element, the key is allowed to regain its normal position and the following cycle of operations is effected: First, the contact k' is opened thereby deenergizing the transformer M' ; and, second, the contacts k and k'' are opened an appreciable interval of time after the opening of the contact k' . When the contact k is opened the magnet m is deenergized, its armature t' is retracted against its back-stop b' by the spring x' and the switch is rotated slightly about its pivots until its contact members 3 3 are brought against their back-stops b'' and are immersed in the mercury of the cups 5 5, thereby disconnecting the elevated conductor from the transmitting system and connecting it to the receiving system. When the contact k'' is opened the relay r is deenergized and the circuit of the receiver is closed by the action of the springs $x x$ on the armatures $t t$. It will be understood of course that instead of opening the circuit of the receiver at two points, a single armature t may be used to open it at one point. The contacts k and k'' may be opened simultaneously or successively.

An appreciable interval of time must of course elapse between the sending of signal elements, and it is during such intervals of time when the key K is in its normal position that the sending operator, by means of the receiver P or the usual local circuit which may be associated therewith, may ascertain that the receiving operator at the distant station is signaling "break." Said receiving operator having failed to receive a portion of the message transmitted to his station, depresses his sending-key immediately upon such failure to receive a word or portion of the message and sends a predetermined signal indicating that he wishes the transmission stopped. The waves sent out by said receiving operator develop in the vertical at the station from which the message is being sent to said receiving operator electrical oscillations

tions which, during the interval of time between the signal elements when the key is in its normal position, pass to earth E" by way of the receiving system and so produce indications in the signal-indicating device. Such signal indications tell the transmitting operator that the receiving operator is signaling "break," and he thereupon ceases his transmission and receives from the receiving operator instructions concerning the repetition desired by the latter.

Although for the purpose of more clearly disclosing my invention I have specifically described one form of high-potential switch and one arrangement of transmitting and receiving systems, it will be understood that I do not limit myself thereto inasmuch as many modifications may be made therein without departing from the spirit of my invention.

I claim—

1. In a space-telegraph system, a transmitting system, a receiving system, an elevated conductor, a sending-key, a high-potential switch constructed and arranged to alternately connect said elevated conductor to said transmitting and receiving systems, said switch comprising means for augmenting the gap in the circuit beyond an air-gap formed between two contacts, and means controlled

by said sending-key for operating said switch.

2. In a space-telegraph system, a transmitting system, a receiving system, an elevated conductor, a sending-key, a switch comprising a number of series contact members constructed and arranged to alternately connect said elevated conductor to said transmitting and receiving systems; and means controlled by said sending-key for operating said switch.

3. In a space-telegraph system, a transmitting system, a receiving system, an elevated conductor, a sending-key, a switch normally connecting said elevated conductor to said receiving system through a number of series contact members, a contact carried by said switch constructed and arranged normally to disconnect said elevated conductor from said transmitting system, and means controlled by said sending-key for operating said switch.

In testimony whereof I have hereunto subscribed my name this 22d day of November, 1905.

SEWALL CABOT.

Witnesses:

FRANK C. BLAISDELL,
GEO. K. WOODWORTH.