No. 840,909. PATENTED JAN. 8, 1907.

S. CABOT.

SPACE TELEGRAPHY.

APPLICATION FILED NOV. 25, 1905.

2 SHEETS—SHEET 1.

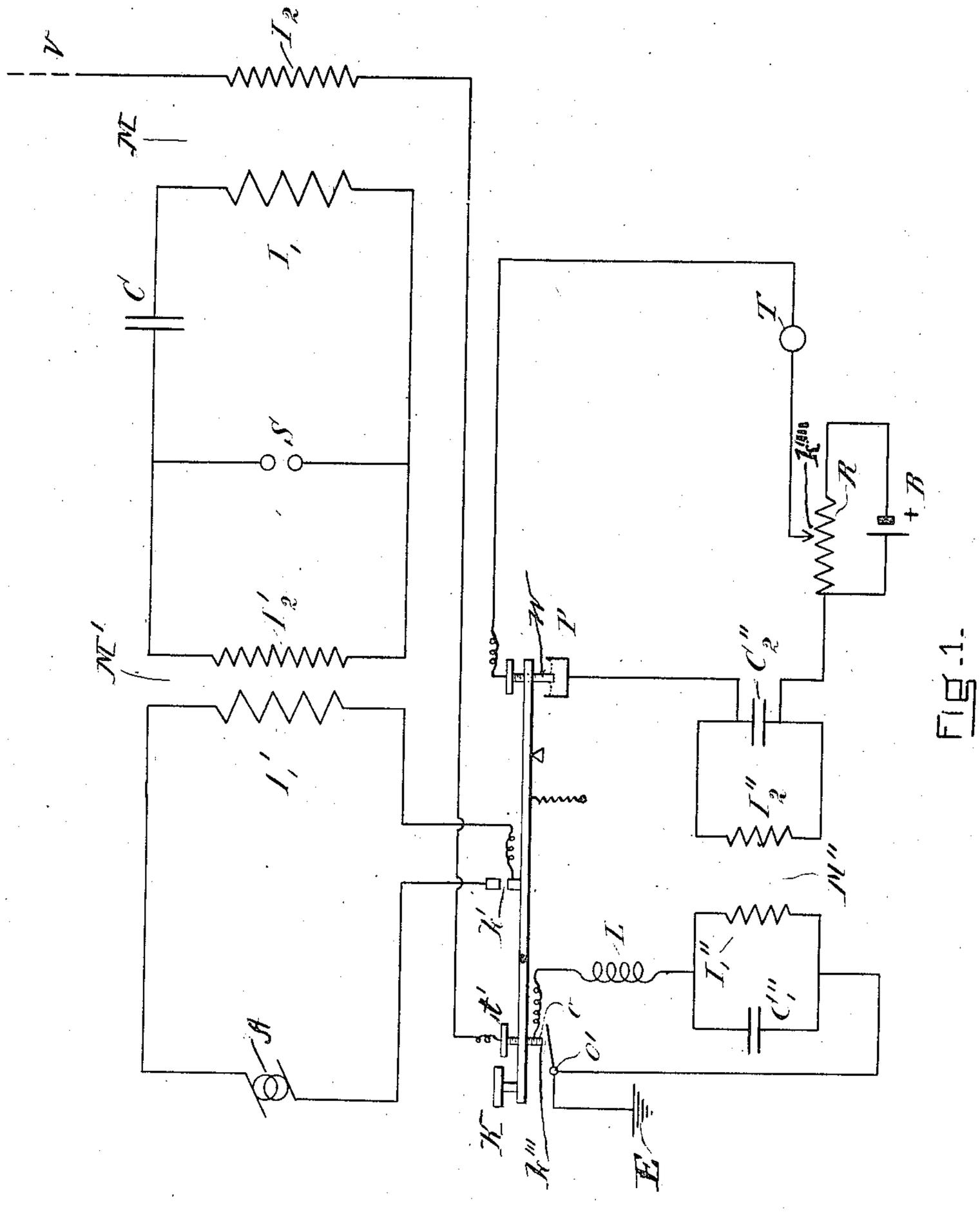

Fig. 1.

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2 SHEETS—SHEET 2.

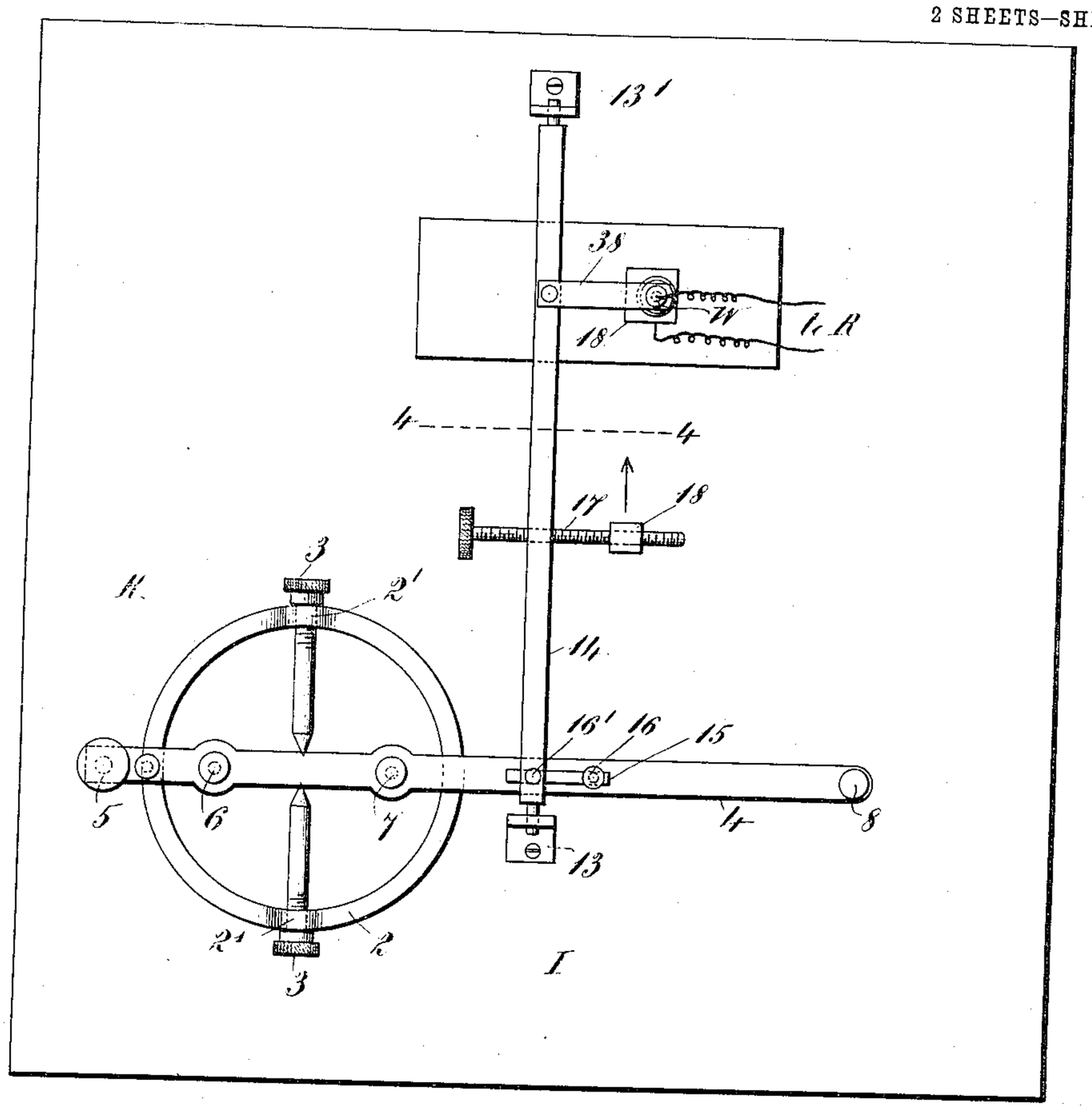

Fig. 2.

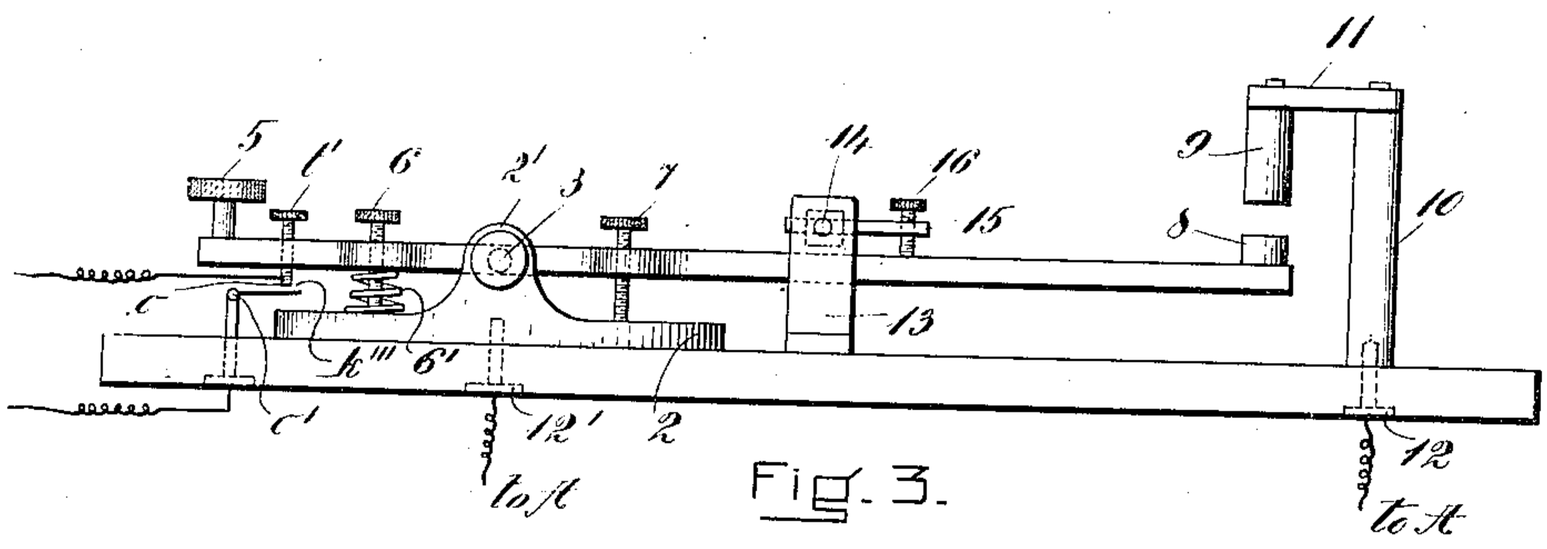

Fig. 3.

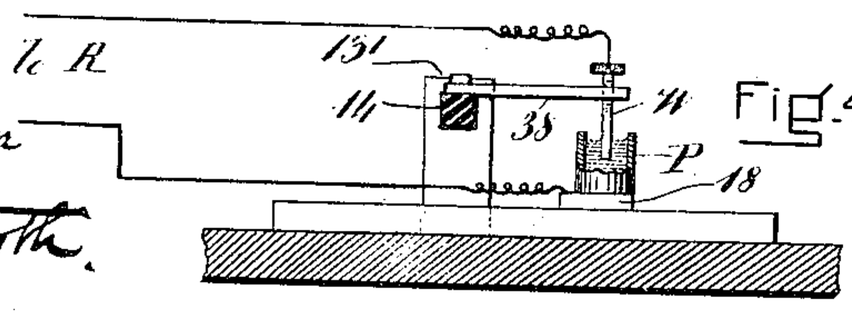

Fig. 4.

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UNITED STATES PATENT OFFICE.

SEWALL CABOT, OF BROOKLINE, MASSACHUSETTS, ASSIGNOR TO STONE TELEGRAPH AND TELEPHONE COMPANY, OF BOSTON, MASSACHUSETTS, A CORPORATION OF MAINE.

SPACE TELEGRAPHY.

No. 840,909. Specification of Letters Patent. Patented Jan. 8, 1907.

Original application filed November 18, 1905, Serial No. 288,032. Divided and this application filed November 25, 1905. Serial No. 238,989.

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 an elevated transmitting-conductor system at a point which, during the operation of the transmitting system, has practically zero potential to ground; 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, the receiving system is automatically short-circuited, 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 deënergized; and finally, whereby, subsequently to such deënergization the receiving system is put in condition for receiving by disconnecting the transmitting system from earth, automatically opening the short circuit around the receiving system, 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 characters are used to designate like parts in the several 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. Fig. 2 is a plan view of one form of key and associated apparatus which in practice I have found well suited for performing in the desired order the series of functions hereinbefore set forth. Fig. 3 is a side elevation of the key shown in Fig. 2; and Fig. 4 is a section taken on the line 4 4 of Fig. 2, looking in the direction of the arrow, and showing in end view an elevation of the coöperating parts of the receiver.

In the figures C C''_1 C''_2 are condensers.

L is an inductance-coil.

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. 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 is an earth connection.

P is an oscillation-responder of any suitable type which comprises separable coöperating parts and is herein illustrated as an electrolytic cell, the anode of which is a Wollaston electrode.

T is a telephone or other suitable signal-indicating device.

R is a resistance forming with the battery B and adjustable contact k'''' a potentiometer.

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, instead 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. 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 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 render the 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 present invention, I accomplish the hereinbefore-stated objects by means of a sending-key or other sending device provided with auxiliary mechanism whereby the key or sending device performs a series of functions in a definite order. These are, first, rendering the responder inoperative at the beginning of the downstroke of the key and connecting the transmitting system to ground, and then closing the power-circuit.

In that embodiment of the present invention shown in Fig. 1 the receiver or responder is rendered inoperative by physically separating the coöperating parts thereof. 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 receiver is rendered incapable of performing its natural functions, and although I have described in this specification only one way of effecting this result by separating the electrodes of the receiver, it will be obvious to those skilled in the art that many other simple expedients may be devised for this purpose so that it is not my intention to limit myself to the particular means disclosed for rendering the receiver inoperative as aforesaid, inasmuch as I consider any suitable means, whereby the coöperating parts of the receiver may be separated, within the scope of my invention. It is to be understood also that although I have herein shown for the purpose of more clearly illustrating my invention one particular form of oscillation responder or receiver, namely, an electrolytic receiver, nevertheless my invention is not limited in its use to a system provided with such a receiver but may be used in connection with any suitable receiver, the parts of which are capable of physical separation.

Referring now particularly to Fig. 1, upon the depression of the key K for the purpose of sending the signal, the first operations effected are the separation of the terminal W of the receiver P from its coöperating member, thereby rendering said receiver inoperative or incapable of responding, and the closure of the contact k''', thereby grounding the transmitting system and simultaneously short-circuiting the receiving system. The said terminal W is adjustably attached to the key so that the first slight movement of the latter will raise the terminal W out of the electrolyte contained in the cell P. The transmitting system now being earthed and the coöperating parts of the receiver being separated, the system is in condition for transmitting and the further depression of the key K effects such transmission by the closure of the circuit containing the source of energy A, the primary of the high-potential transformer M′ and the contact k'. By such closure of the contact k' the alternating current developed in the primary I'_1 is transformed into a high-potential current in the secondary I'_2 and such current charges the condenser C to a corresponding high potential. The discharge of said condenser across the gap S develops high potential, high-frequency electrical oscillations in the sonorous circuit C S I_1. These oscillations are 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.

At the point *o*, the receiving system is connected to the transmitting system. This receiving system for the purpose of more clearly illustrating my invention is shown as embodying the system of circuits described in United States Letters Patent No. 767,994 and reference may be had thereto for a more complete description than need be set forth herein of the manner in which the reactance of the elevated conductor *per se*, the coil I_2 and the coil L is balanced by the reactance of the parallel branch circuit C''_1 I''_1 for a persistent train of waves of the frequency to which the resonant receiving-circuit C''_2 I''_2

is attuned. It will be noted that the point of connection *o* of the receiving system to the transmitting system is a point having zero potential to ground because this point is connected to earth by a conductor of practically zero impedance so that even when oscillations of large current value are being developed in the elevated transmitting-conductor system E *o'* *o* *t'* I_2 V there exists between the points *o* and *o'* which form the terminals of the receiving system no difference of potential, or at least not a sufficient difference of potential to damage delicate parts of the receiving system. So far as I am aware no combined transmitting and receiving system has heretofore been devised in which the receiving system is connected at a point of zero potential with the transmitting system.

When 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 deënergizing the transformer M'; and second the contact *k'''* is opened an appreciable interval of time after the opening of the contact *k'* thereby ungrounding the transmitting system and automatically opening at the point *k'''* the short circuit around the terminals *o*, *o'* of the receiving system an appreciable interval of time after the opening of the aforesaid contact *k'*. The object of providing for the time interval between the opening of *k'* and *k'''* is to permit the complete subsidence of electrical movement in the transmitting system before breaking its connection to earth. Simultaneously with the opening of the contact *k'''*, or before or after such opening, the immersion of the anode W in the electrolyte contained in the cup or cell P is effected, thereby rendering the receiver operative.

An appreciable interval of time must elapse between the sending of signal elements and it is during such intervals of time when the key is in its normal position that the sending operator, who sends with the head-telephone T placed over his ears, 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 a 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 which pass to earth E by way of the secondary I_2, which for said oscillations operates merely as an inductance, the coil L and the parallel branch circuit, when the key K is in its normal position and the contact *k'''* accordingly is open. Said oscillations are of such frequency that for them the elevated conductor system V E has zero reactance, so that currents of relatively large amplitude are developed in the resonant receiving-circuit and create at the terminals of the condenser C''_2 a sufficient difference of potential to cause the oscillation-responsive device P to respond and produce a signal in the telephone. This signal is an indication to 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. If the oscillations created in the elevated conductor by the waves sent out from the distant receiving-station, whose operator desires to "break," are so created when the key K is down, it is obvious that such oscillations will not effect the operation of the receiver P, but it will be observed that as soon as the key is again in its normal position the oscillations will affect the receiver and the transmitting operator will then cease to send.

The device W in Figs. 1, 2 and 4 is known in the art as the Wollaston anode and consists of a wire, very large as compared with the silver-coated platinum Wollaston wire, inclosed in a capillary tube and having its end surface only exposed to an electrolyte contained in the cup of the receiver P. The construction of this Wollaston anode need not further be specified herein, inasmuch as full directions for making the same will be found in a paper by Dr. William H. Wollaston in the *Philosophical Transactions of the Royal Society of London*, Vol. 91, Part II, pp. 430 to 432, published 1801.

It will be noted that the signal-indicating device T and part of the potentiometer resistance R are included in the circuit of the oscillation-responder P, but such devices do not operate as "choking-coils," inasmuch as they have such large distributed capacity as to offer but small impedance to oscillations of the frequencies employed in space telegraphy.

I shall now describe one specific embodiment of the key K and auxiliary or associated devices whereby the aforesaid cycle of operations may be effected. Referring to Fig. 2, 1 is a base carrying the base-plate 2 of the key which is pivoted to the standards 2' by the screws 3 3 in the usual manner. The key-arm 4 is provided at one end with a finger-piece 5 and at the other end with a contact 8 made preferably of silver or other metal whose vapor is non-conducting. For the purpose of simplifying Fig. 2, the upper contact with which the lower contact 8 cooperates has been omitted from Fig. 2 and is shown in Fig. 3 supported from a cross-piece 11 which is mounted upon a standard 10 se-

cured to the base by screw 12. Supported by and pivoted to the standards 13 13′ is a rod 14 preferably of insulating material, carrying a projection 15 which is provided with an adjusting-screw 16, the end of which rests upon the key-arm 4. About midway between the standards 13 13′, a screw 17 carrying an adjustable weight 18 is passed through the rod 14, whereby the screw 16 is held in contact with the rod 4 and the anode W is, in the normal position of the key, maintained immersed in the electrolyte of the cell P. It will now be obvious that upon a very slight depression of the key *k*, the rod 14 will be rotated about its pivots and the member W which, in that particular embodiment of my invention illustrated in Fig. 2, is adjustably attached to the projection 38 secured to the rod 14, is moved out of operative relation with its coöperating member P. As shown in Figs. 2 and 4 the cell P is conductively connected to the metal plate 18 and said plate and the anode W are conductively connected to the potentiometer resistance R.

The means whereby the grounding of the transmitting system is effected, is herein illustrated as the contact-screw *o* which cooperates with the spring *o′* and thereby connects the transmitting system to earth at E and at the same time connects the receiving system to the transmitting system at the point *o* which has zero potential to ground. This operation is indicated in diagrammatic form in Fig. 1 likewise by the contact *k‴* between the screw *o* and spring *o′*.

The last of the aforesaid cycle of operations is effected when the key has been fully depressed and the silver block 8 brought into contact with the silver block 9, an operation indicated in diagrammatic form in Fig. 1 by the contact *k′*. It will now be obvious that as the key is brought to its normal position by the spring 6′ adjusted by the screw 6, such normal position being determined by the screw 7, the contact 8 leaves its coöperating member 9, thereby opening the power-circuit; and then the screw *o* leaves the spring *o′* thereby ungrounding the transmitting system and opening at the point *k‴* the short circuit around the terminals *o*, *o′* of the receiving system, and simultaneously or afterward the member W is brought into operative relation with its coöperating member P.

This application is a division of my application Serial No. 288,032, filed November 18, 1905.

Although for the purpose of more clearly disclosing my invention I have described with great particularity a specific system of circuits and a specific mechanical device, it is to be understood that I do not limit myself to said system or device, inasmuch as many modifications may be made in each without departing from the spirit of my invention.

I claim—

1. In a space-telegraph system, a transmitting system, a receiving system including a receiver, a sending-key and means operated by said key for automatically rendering said receiver inoperative by separating the coöperating parts thereof.

2. In a space-telegraph system, a transmitting system, a receiving system including a receiver, and means associated with said transmitting and receiving systems for rendering said receiver inoperative by separating the coöperating parts thereof, grounding said transmitting system and creating electrical oscillations in said transmitting system.

3. In a space-telegraph system, a transmitting system, a receiving system including a receiver, a sending-key and means for effecting the separation of the coöperating parts of said receiver by the movement of said key.

4. In a space-telegraph system, a transmitting system, a receiving system, an elevated conductor normally grounded through said receiving system, a sending device, and means directly connected with said sending device for short-circuiting said receiving system by the movement of said sending device.

5. In a space-telegraph system, a transmitting system including a sending device, an elevated conductor conductively connected to a contact member carried by said sending device, and a receiving system the terminals of which are conductively connected to said contact member and to a grounded member coöperating with said contact member, respectively, whereby the movement of said sending device will short-circuit said receiving system.

6. In a space-telegraph system, a transmitting system, a receiving system, an elevated conductor normally grounded through said receiving system, a sending device, and means conductively connected with said sending device for directly grounding said elevated conductor and short-circuiting said receiving system by the movement of said sending device.

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

SEWALL CABOT.

Witnesses:
FRANK C. BLAISDELL,
GEO. K. WOODWORTH.