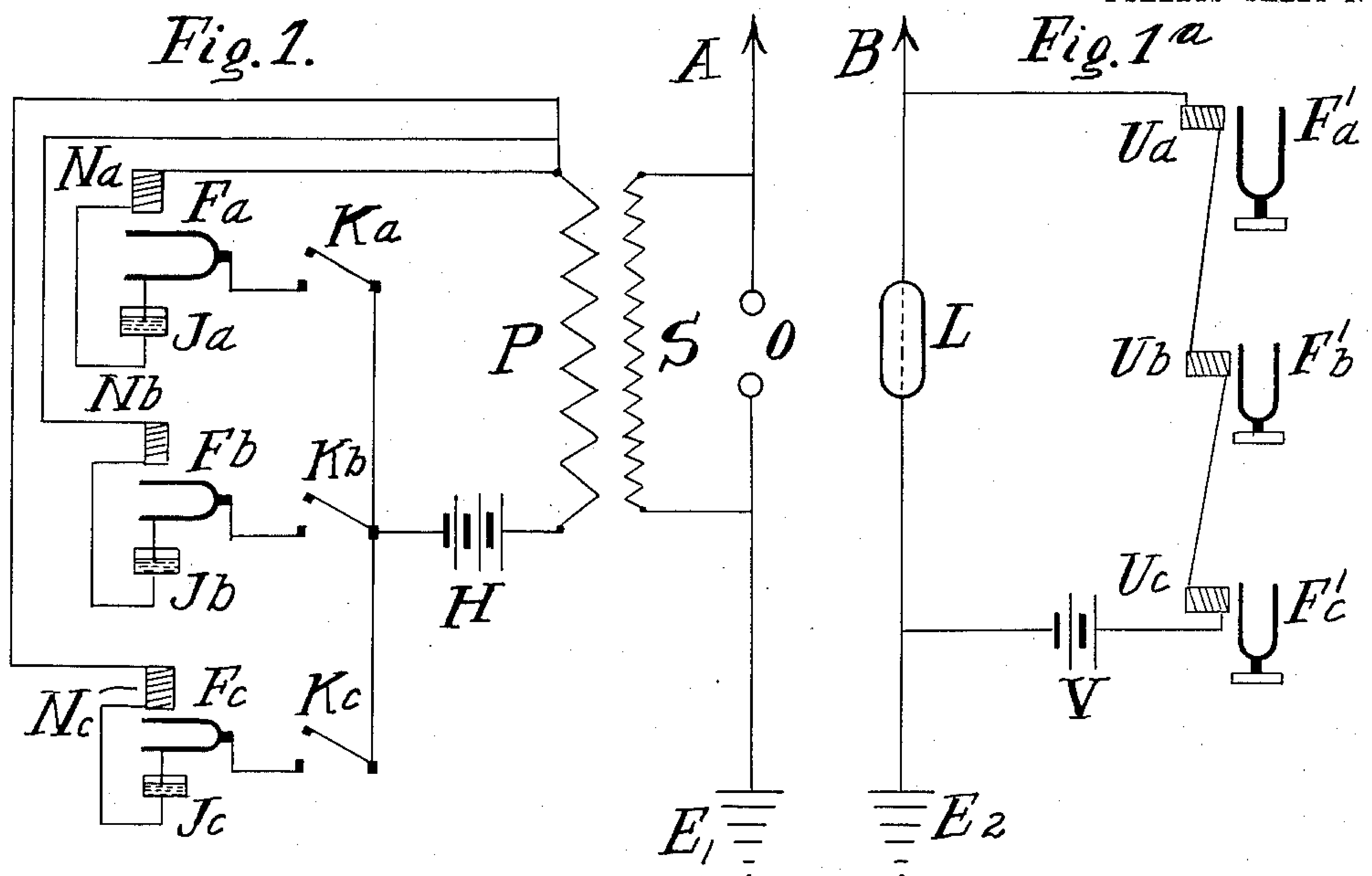
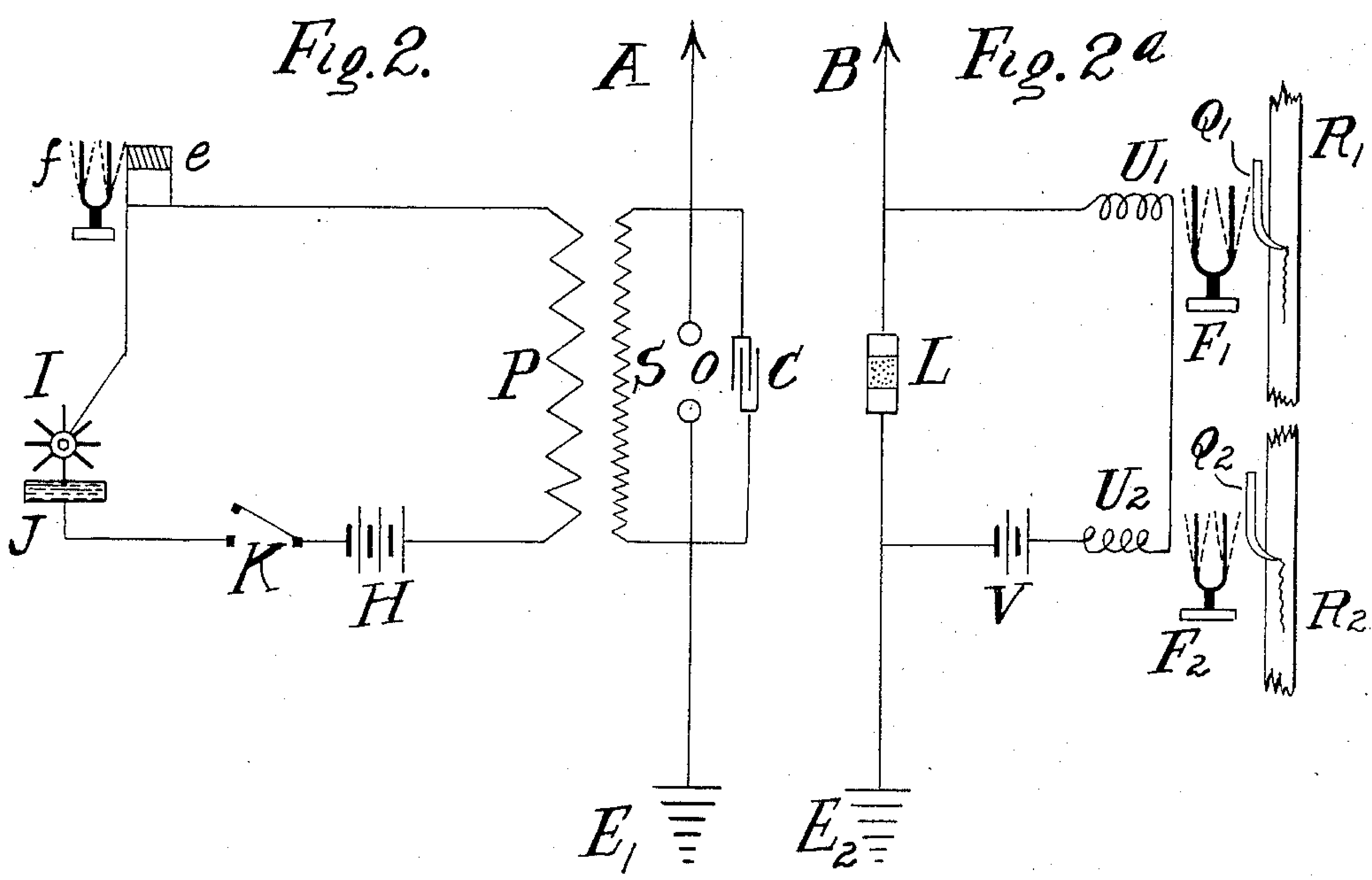
J. H. CUNTZ.
WIRELESS TELEGRAPHY.
APPLICATION FILED MAR. 16, 1903.

927,641. Patented July 13, 1909.

2 SHEETS—SHEET 1.





Witnesses
Ralph C. Davison
Wm. O. Ludlow

John H. Cuntz Inventor
By his Attorney Hermann F. Cuntz

J. H. CUNTZ.

WIRELESS TELEGRAPHY.

APPLICATION FILED MAR. 16, 1903.

927,641. Patented July 13, 1909.

2 SHEETS—SHEET 2.

Fig. 3.

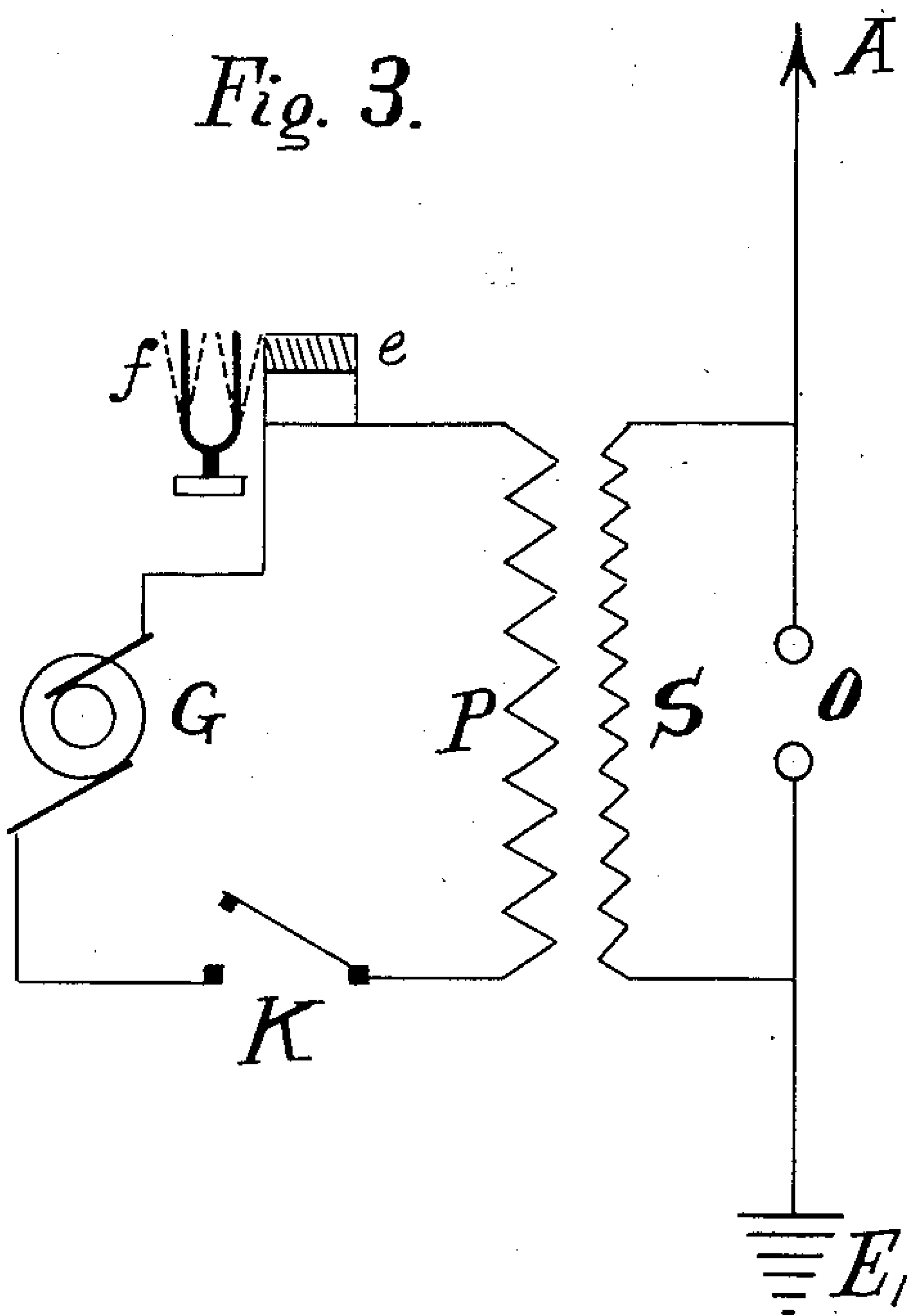


Fig. 3ª

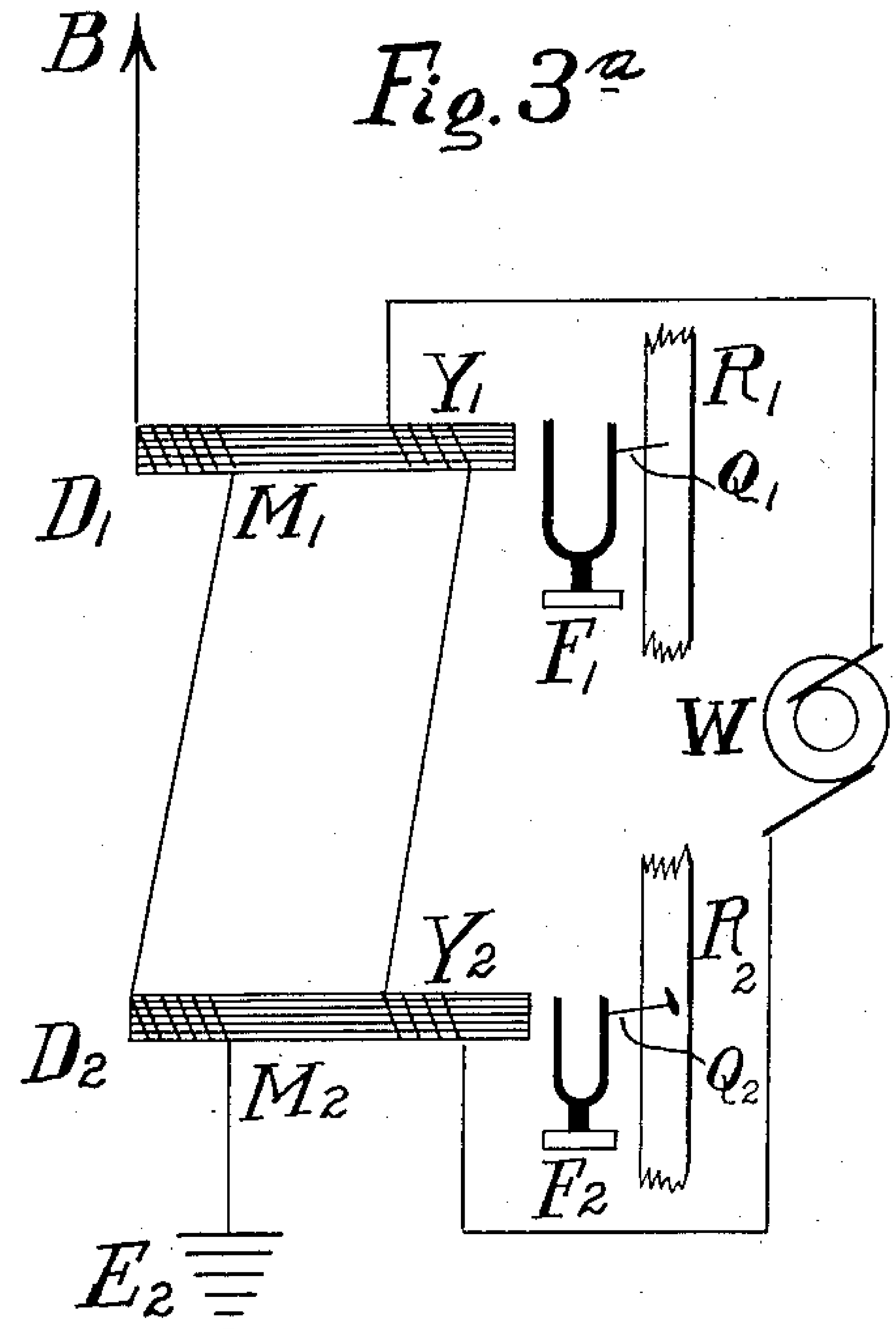
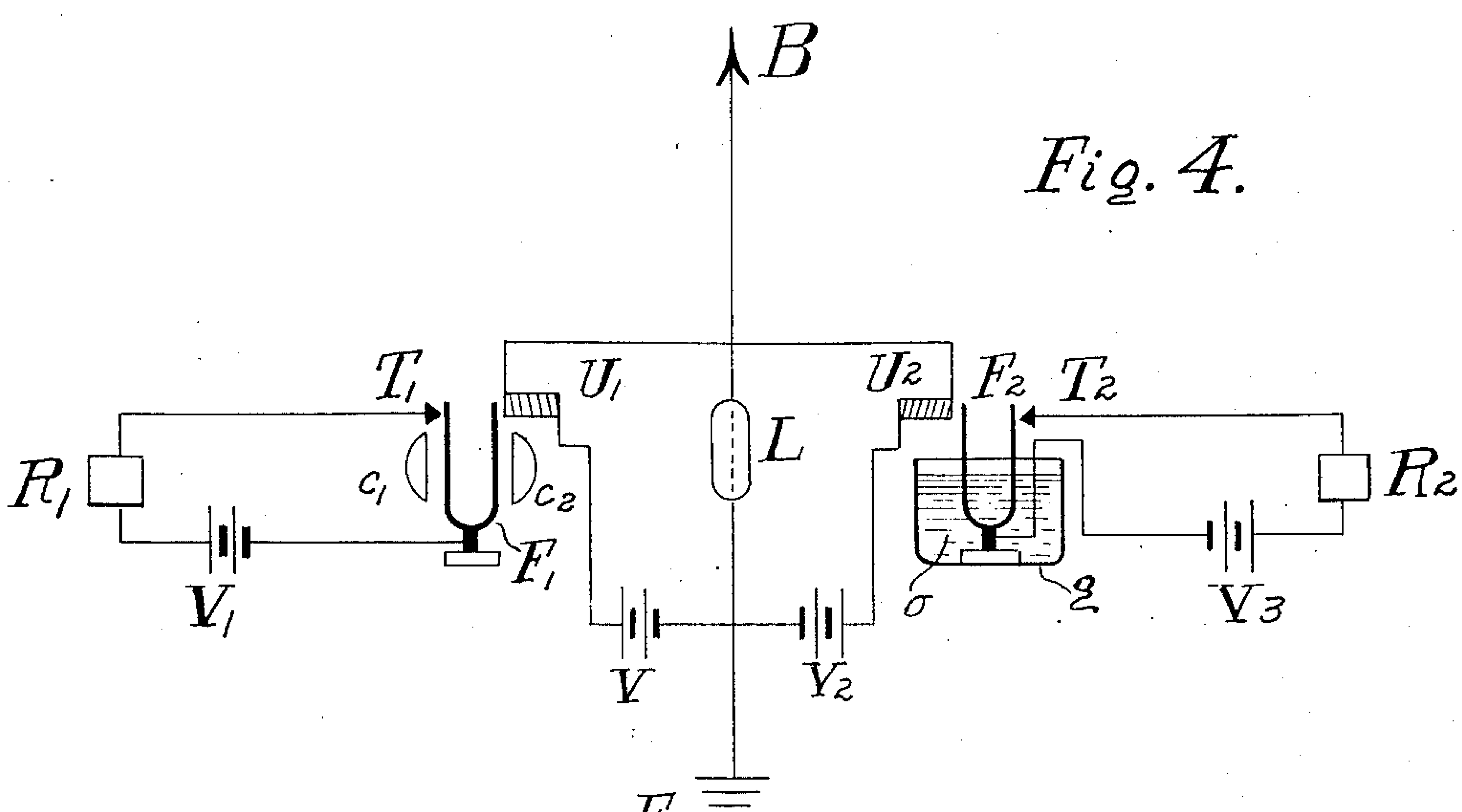


Fig. 4.



Witnesses
Ralph C. Davison
Wm. O. Ludlow

Inventor
John H. Cuntz
By his Attorney
Hermann H. Cuntz

UNITED STATES PATENT OFFICE.

JOHN H. CUNTZ, OF HOBOKEN, NEW JERSEY.

WIRELESS TELEGRAPHY.

No. 927,641. Specification of Letters Patent. Patented July 13, 1909.

Application filed March 16, 1903. Serial No. 148,085.

To all whom it may concern:

Be it known that I, JOHN H. CUNTZ, a citizen of the United States, and resident of Hoboken, in the county of Hudson and State of New Jersey, have invented certain new and useful Improvements in Apparatus for Wireless Telegraphy, of which the following is a specification, reference being had to the accompanying drawings, forming a part hereof.

This invention relates to systems of electric wireless communication.

Among its objects are simple, effective and otherwise advantageous methods of selective wireless signaling, the wireless transmission of sounds, and others which are more fully set forth hereafter.

In my apparatus for selective wireless communication, instead of the usual electrical tuning, the syntonization is accomplished by mechanical and acoustic methods.

When the customary transmitting apparatus of a wireless-telegraph system is set in operation, electromagnetic waves, with frequencies of the order of, say, 1,000,000 per second, are propagated. These waves, being started by the oscillatory discharge at a spark gap, decay rapidly, so that the number of waves due to a single original impulse is comparatively small, and the period of activity of these waves is only a small fraction of a second. If now, these impulses, caused by the interruption of the primary current of an induction coil, or by any other convenient method, instead of being given in a haphazard way, are regularly timed, at definite intervals, groups of high-frequency electromagnetic waves will be propagated, and by means of suitable transmitting apparatus, these wave-groups may be made to have any convenient periodicity, or frequency, of a lower order than the electromagnetic-wave frequency. For instance, these groups may be given the frequency of audible tones, of the order, say, of 100 or 1000 per second, each group being composed of a comparatively few electromagnetic waves of the order of 1,000,000 per second. If, now, at the receiving station there be placed suitable acoustic and mechanical receiving apparatus which will respond only to wave-groups with frequencies of a definite pitch, such apparatus will select and receive messages from only those transmitting stations which send out wave-groups of this same frequency, and will not be affected by any others.

My invention consists in the practical utilization of these principles and in means and methods of applying them, as will more fully appear from the following specifications, together with the drawings forming part hereof.

Figures 1 and 1ª show, respectively, a transmitting and a receiving station, each containing a plurality of corresponding selective devices. Fig. 2 shows a transmitting station with a single apparatus which can send out wave-groups of different frequencies. Fig. 2ª shows a receiving station with a plurality of selective receiving and recording devices in series. Fig. 3 shows a transmitting station with another form of apparatus for sending wave-groups of different frequencies. Fig. 3ª shows a receiving station with a plurality of magnetic selective receiving and recording devices in series. Fig. 4 shows a receiving station with a plurality of another form of selective receiving devices in parallel.

In Fig. 1, A is an aerial wire, or antenna; E_1 is a grounded wire; O is a spark gap, in circuit with the secondary winding, S, of an induction coil. P is the primary winding of the same induction coil; H is a battery, or other source of current; K_a is a key for making and breaking the primary circuit when signals are to be sent; F_a is a tuning fork having a definite pitch; J_a is a cup containing mercury, into which dips a small rod or needle point attached to the tuning fork; N_a is an electromagnet for maintaining the tuning fork at its natural rate of vibration. F_b is a tuning fork of a pitch different from F_a, and it is in circuit with key K_b, mercury cup J_b, electromagnet N_b, primary winding P, and battery H. F_c is a tuning fork of a pitch different from F_a and F_b, and it is in circuit with key K_c, mercury cup J_c, electromagnet N_c, primary winding P and battery H. It will be seen that F_a, F_b and F_c are in parallel circuit and are all connected with the battery H and the primary winding P through their respective keys K_a, K_b and K_c.

In Fig. 1ª, B is an aerial wire, or antenna; E_2 is a grounded wire; L is a device sensitive to high-frequency electric waves, such as a coherer, an anti-coherer or a responder, which, after being affected by the electric waves, returns immediately to its normal state. V is a battery or other source of current. U_a, U_b and U_c are electromagnets in series with each other and with V and L. F'_a is a tuning fork of the same pitch as F_a, in Fig. 1, placed near the electromagnet U_a. F'_b is a tuning fork of the same pitch as F_b, in Fig. 1, placed near the electromagnet U_b. F'_c is a tuning fork of the same pitch as F_c, in Fig. 1, placed near the electromagnet U_c.

In Fig. 2, A is an aerial wire, or antenna; E_1 is a grounded wire; O is a spark gap, in circuit with the condenser, C, and the secondary winding, S, of an induction coil. P is the primary winding of the same induction coil; H is a battery, or other source of current; K is a key for signaling; I is an interrupter which revolves at any determined speed and makes and breaks contact with the mercury in the cup J, or with some solid contact piece, not shown. *e* is an electromagnet in a shunt circuit, in which the current changes at the same rate as in the main circuit, H K J I P; *f* is a tuning fork of the same pitch as the one at the receiving station which it is desired to affect, and it (*f*) will be caused to vibrate by the changing current in the electromagnet *e* and will sound its characteristic note when the interrupter is working at the proper speed.

In Fig. 2^a, B is an aerial wire, or antenna; E_2 is a grounded wire; L is a device sensitive to high-frequency electric waves, such as a coherer, an anti-coherer or a responder, which, after being affected by the electric waves, returns immediately to its normal state. V is a battery or other source of current. U_1 and U_2 are solenoids in series with each other and with V and L. F_1 is a tuning fork of a definite pitch, placed near U_1; Q_1 is a marking point, or siphon recorder, in close proximity to F_1, and which is struck by F_1, when the latter vibrates; R_1 is a paper ribbon or tape, on which a record is made by Q_1. F_2 is a tuning fork of a pitch different from F_1, and is placed near U_2; Q_2 is a marking point, or siphon recorder, and R_2 is a tape, having functions similar, respectively, to Q_1 and R_1.

In Fig. 3, A is an aerial wire; E_1 is a grounded wire; O is a spark gap in circuit with the secondary winding, S, of a transformer. P is the primary winding of the same transformer; K is a key for signaling; G is an alternating-current generator which can be made to revolve at any determined speed. *e* is an electromagnet in a shunt circuit, in which the current varies at the same rate as in the main circuit, G K P; *f* is a tuning fork having the same function as *f* in Fig. 2.

In Fig. 3^a, B is an aerial wire; E_2 is a grounded wire. M_1 is a magnetic core composed, preferably, of a number of thin iron or steel wires; D_1 is a coil of insulated, conducting wire, wound on M_1 and in circuit with B and E_2. Y_1 is a coil of insulated, conducting wire, also wound on M_1, and in circuit with a source of alternating current, W. F_1 is a tuning fork of a definite pitch, placed near M_1; Q_1 is a marking point, or siphon recorder, attached to F_1; R_1 is a paper ribbon or tape, on which a record is made by Q_1. M_2 is a magnetic core similar to M_1; D_2 is a coil wound about M_2, and is similar to D_1, and is in series with the latter and with B and E_2. Y_2 is a coil similar to Y_1, wound on M_2 and in series with Y_1 and W. F_2 is a tuning fork of a pitch different from F_1, and is placed near M_2; Q_2 is a marking point, or siphon recorder, attached to F_2; R_2 is a paper ribbon or tape, on which a record is made by Q_2.

In Fig. 4, B is an aerial wire; E_2 is a grounded wire; L is a device sensitive to high-frequency electric waves, such as a coherer, an anti-coherer or a responder, which, after being affected by the electric waves, returns immediately to its normal condition. U_1 is an electromagnet in circuit with a battery, or other source of current, V, and with L. F_1 is a tuning fork of a definite pitch, placed near U_1; V_1 is a battery, or other source of current; T_1 is a contact point which is touched by F_1 when the latter vibrates, and a circuit is then completed through V_1, F_1, T_1 and R_1, the last being a recording apparatus which is simply indicated by a rectangle. c_1 and c_2 are masses of copper, or some other good conductor, placed near F_1, in order to damp the latter's movements. U_2 is an electromagnet in circuit with a battery, or other source of current, V_2 and with L. F_2 is a tuning fork, of a pitch different from F_1, placed near U_2; V_3 is a battery, or other source of current; T_2 is a contact point which is touched by F_2 when the latter vibrates, and a circuit is then established through V_3, F_2, T_2 and R_2, the last being a recording apparatus which is indicated simply by a rectangle. *g* is a vessel containing oil, or some other suitable liquid, *o*, in which F_2 is placed in order to damp its vibrations.

It will be seen that I embody my invention, as appears in Fig. 1, in a transmitting apparatus in which I use a steel or iron tuning fork, maintained in vibration at its natural frequency, while the signaling key is closed, by an electromagnet or otherwise, to interrupt the primary current of an induction coil. The secondary circuit of the induction coil is connected to a spark gap, or other source of high-frequency oscillations, as used in wireless telegraphy. The tuning fork makes and breaks the circuit by mechanical contact with solid contacts or, preferably, by means of a small rod or needle point dipping into a mercury cup. The primary current is furnished by a primary or secondary battery or in any other convenient way. In the apparatus shown in the figure, the electromagnet which maintains the tuning fork in vibration is in the main circuit with the sending key and the primary of the induction coil. The tuning fork will therefore only be in vibration while signals are actually being sent. But the tuning fork may be maintained continuously in vibration by any other suitable means. I use as many different tuning forks as is desirable, each in a separate circuit, but all in parallel. Each tuning-fork circuit is controlled by a key, with which the signals are sent, and the different circuits can be operated either separately or simultaneously, without interfering with each other. When they operate simultaneously, they can send out signals to different receiving stations, or they can send a combined signal, composed of a number of tones, or a chord, or even a combination of sounds which will form articulate speech, to one or more receiving stations.

In my receiving apparatus, I employ, in circuit with the customary aerial and earth wires, a coherer, or an anti-coherer, or a responder, which, after responding to high-frequency electric waves, returns immediately to its normal state. In a local circuit with this coherer, or anti-coherer, or responder, is a battery and a solenoid or an electromagnet. The current in this circuit changes every time a wave-group strikes the coherer, or anti-coherer or responder. A steel or iron tuning fork is placed in proximity to the solenoid or electromagnet, so that when the magnetic field of the latter is changed at regular intervals corresponding to the natural rate of vibration of the tuning fork, the latter will begin to vibrate and sound its characteristic note. There may be as many tuning forks, of various pitches, at a receiving station as is desired, each being of the same pitch as a corresponding tuning fork at a transmitting station. Each tuning fork is controlled by an electromagnet or solenoid, and these electromagnets may be in series with each other, or they may be in parallel. These tuning forks can operate singly or simultaneously. When they operate simultaneously, they can receive signals from different transmitting stations at the same time, or they can receive a combined signal, composed of a number of tones, or a chord, or even a combination of sounds which will form articulate speech, from one or more transmitting stations.

In another form of transmitting apparatus, shown in Fig. 2, I use a mechanical interrupter in place of the tuning-fork interrupter. This mechanical interrupter consists of a revolving wheel with contact pieces on its periphery, which make contact with a conducting brush or strip of metal, or of a revolving wheel with projecting points making contact with mercury in a suitable receptacle, or with a jet of mercury, or the interrupter may be constructed in some other way. When the wheel form is used it is made to revolve at a rate such that the number of interruptions of the circuit shall be of the frequency desired, and, in general, the mechanical interrupter is operated in a way to send out from the transmitting station wave-groups of the desired frequency. In transmitting apparatus such as is shown in Fig. 2, I use a tuning fork to determine the right frequency. This tuning fork has the same pitch as has the one at the receiving station I wish to communicate with, and it is placed near an electromagnet in a shunt circuit, where the current changes at the same rate as in the main circuit. When the right frequency is reached, this tuning fork will sound its characteristic note, and will continue to do so as long as the desired frequency is maintained. When another receiving station is to be communicated with, another tuning fork, of the proper pitch, is used to indicate synchronism. In this transmitting apparatus I use a condenser in circuit with the secondary of the induction coil and with the spark gap, but the apparatus will operate also without the condenser. The other forms of transmitting apparatus are shown without a condenser, but the latter may be used with any of them, when desirable.

In a third form of transmitting apparatus, shown in Fig. 3, I use an alternating-current generator in circuit with the primary of a step-up transformer, the secondary of which is in circuit with a spark gap or other means of producing high-frequency electrical oscillations, and there may also be a condenser arranged so as to be charged by the secondary current and discharged through the spark gap or other source of high-frequency electrical oscillations. The speed of the alternator can be varied so that it will generate currents of a suitable frequency. A tuning fork, *f*, or some other form of synchronization indicator, is used with this transmitting apparatus. A key, properly made to handle as large a current as may be necessary, is placed in the circuit of the alternator and the primary coil, and is used to make and break the circuit and so send signals, or some form of mechanical apparatus for sending signals may be used. In this transmitting apparatus, the secondary circuit is fixed once for all, and the tuning is accomplished by varying the frequency of the current in the primary circuit, which determines the group frequency or periodicity.

In the form of receiving apparatus shown in Fig. 2^a, I employ in circuit with the aerial and earth wires, a coherer, or an anti-coherer, or a responder, which, after being affected by the incoming high-frequency electric waves, returns immediately to its normal condition. In a local circuit with this coherer, or anti-coherer, or responder, is a battery, or other source of current, and solenoids or electromagnets. The current in this circuit changes whenever a group of electric waves strikes the coherer, and alters the resistance of the latter. The magnetic fields of the solenoids or electromagnets will undergo changes corresponding to those of the current in this local circuit. A tuning fork is placed near each solenoid or electromagnet, and when changes in the current of the local circuit occur at the natural rate of vibration of any of these tuning forks, such tuning fork will start to vibrate. In close proximity to each tuning fork, but independently supported, is a marking point, such as an ink siphon, a pencil or a pen, shown at Q_1 and Q_2, Fig. 2^a, which rests upon a paper ribbon or tape, shown at R_1 and R_2. The marking point is far enough from the tuning fork not to be influenced by slight movements of the fork, due to single impulses of current, or otherwise; but when the tuning fork is set in regular vibration by an incoming signal, it will strike the marking point, or ink siphon, or its support, and cause the marking point to make a record on the tape. The tape is moved by any suitable means, not shown. When the tuning fork strikes the marking point, its vibrations are stopped, unless its impelling signal is still being made, and it becomes ready to respond to the next signal. In this form of receiving apparatus, as in all the others, there may be as many tuning forks, of various pitches, with their accessory devices, as is desirable; each one responsive to a definitely-tuned transmitting apparatus. It should be noted, that when a device making a visible record is used, the impulses due to the incoming wave-groups may have frequencies below and above the limits of audibility.

In another form of receiving apparatus, shown in Fig. 3^a, instead of the coherer, or anti-coherer, or responder, I employ a magnetic detector of electric waves, which consists, preferably, of a bundle of thin iron or steel wires on which are wound a coil in circuit with the aerial wire and the earth wire, and a second coil through which flows a slowly-alternating current from an independent source. This alternating current slowly and gradually changes the magnetism of the iron wires, which are then in a state of peculiar sensitiveness to electric waves. The groups of electric waves, coming in over the receiving wires, make corresponding changes in the magnetism of the iron wires. A tuning fork, in proximity to this magnetic receiver, is affected by these changes, and if the wave-group impulses are of the same frequency as the natural one of the tuning fork, the latter will vibrate. Any of the apparatus heretofore described can be employed to make an audible or a visible record of the incoming signals, in the ways already indicated, but in the form of receiving apparatus shown in Fig. 3^a, the tuning fork has attached to it a light marking point, such as a pencil, a pen or an ink siphon, shown at Q_1 and Q_2, which rests upon a moving strip or ribbon of paper. When the tuning fork is set in vibration by the incoming groups of waves, as already described, the attached marking point makes a record on the paper ribbon, which record can be read in the usual telegraphic way. The marking point, besides its principal function, fulfils another one in the following way: By its friction on the paper it prevents the tuning fork from starting off at a single impulse; there must be several properly-timed impulses before the tuning fork can get under way; and, also, as soon as the impulses due to the wave-groups have ceased, the fork will be immediately brought to rest by the friction of the marking point on the paper, and will be ready to receive the next signal. Whenever the tuning fork has attached to it a marking point, small rod, needle point, or anything else, in the transmitting and receiving apparatus here described, proper allowance must be made for the change in its natural rate of vibration, caused thereby. The slowly-alternating current, or the slow changes of magnetism of the magnetic receiver, or both, will cause the tuning fork to execute corresponding slow, to-and-fro movements, but the tuning fork will emit no sound in consequence of these movements, as their frequency is below the limits of audibility; and when the tuning fork has a marking point attached, this point will trace on the paper ribbon a sinuous curve, of smooth regularity, upon which the sharp, sudden signals due to the natural responsive vibrations of the tuning fork will be superposed, and will be as easily distinguished from the smooth regular curve as from a straight line. When the tuning fork makes a record by striking against a marking point, or by making a contact, the regular marks and records, at comparatively long intervals, due to the slowly changing magnetism of the magnetic receiver, are easily distinguishable from the marks and records made by the signals. In this form of receiving apparatus, there may be as many magnetic detectors as is desirable, arranged in series or in parallel, with the corresponding tuning forks and accessory apparatus. The coils shown in the figure cover only part of the magnetic core, but they may cover the whole of it, and one coil may be wound over the other, properly insulated therefrom, and their relative positions on the core may be changed, so that the coil connected with the aerial and earth wires shall be next to the tuning fork. The magnetic core may have any desired shape, such, for instance, as a horseshoe form.

In still other forms of receiving apparatus, shown in Fig. 4, there is a device sensitive to high-frequency electric waves, such as a coherer, an anti-coherer or a responder, in circuit with the customary aerial and earth wires. In local circuit with the coherer are a battery, or other source of current, V, and an electromagnet or solenoid, U_1. Near the electromagnet is a tuning fork, set in vibration by the incoming signals as already described. When the tuning fork vibrates with sufficient amplitude, it strikes the contact point, T_1, and completes a secondary local circuit containing a battery and a recording apparatus. The recording apparatus is merely indicated by a rectangle, and may be of any kind, making an audible signal or a visible record. The contact point, T_1, is far enough from the tuning fork not to be touched when the tuning fork makes only slight movements, due to single wave impulses, or other causes. But when the tuning fork executes its regular vibrations it will strike the contact point. In so doing, it will be brought to rest, if the impelling signal is not continued, and will be in condition to receive the next signal. At c_1 and c_2 are shown masses of copper in proximity to the tuning fork. If the latter be magnetic, its movements will induce eddy currents in the copper masses, which will tend to stop these movements. The copper masses are used in this way, when necessary, to damp the movements of the tuning fork, to prevent it from starting off without a succession of sufficiently strong impulses, and to stop it when the impelling impulse has ceased this providing in effect a controlling device rendering the tuning forks self-restoring when the transmitted impulse has ceased and causing the same immediately to be restored to a responsive state in repose and in readiness for the next signal.

On the right-hand side of Fig. 4 is shown a receiving apparatus similar to that just described, except that in place of the copper masses, a liquid, such as oil, in which the tuning fork is immersed, wholly or partially, is used to damp its movements, to prevent it from starting off without sufficient cause and to bring it promptly to rest. This liquid is contained in a glass, or other kind of vessel. These various methods of damping or stopping the vibrations of the tuning fork can be employed in the other forms of receiving apparatus shown.

In Fig. 4, the electromagnets which influence the tuning forks are shown in independent parallel circuits, but they may also be in series. In all the receiving apparatus herein described, the individual sets of instruments may be either in series or in parallel.

When not otherwise specified, the tuning forks herein described are made of steel or iron or other magnetic material, or are of other material with pieces of magnetic material attached thereto, so as to respond to the influence of the solenoids, electromagnets and magnets which form part of the apparatus described in these specifications.

In the figures here given, only simple forms of wireless-telegraph transmitting and receiving circuits are shown, but I do not confine myself to these forms, as other forms of circuits may be used with my apparatus.

In the figures, only two or three sets of receiving apparatus are shown, but any number may be used, as in my system there is a wide range of selectivity.

Any of the receiving instruments here shown may be used with any of the transmitting apparatus, and vice versa.

The drawings are diagrammatic and, in order to avoid confusion, omit some of the details of the auxiliary apparatus. In general, I do not confine myself to the exact constructions here shown, but

What I claim as my invention and desire to secure by Letters Patent is:

1. In a wireless transmission system a transmitting apparatus embodying means for sending out electric wave groups having a definite frequency, receiving apparatus affected by wave groups of a definite frequency and electro-magnetic means for restoring the receiving apparatus to its responsive condition.

2. In a wireless transmission system receiving apparatus embodying means responsive to wave groups of a periodicity lower than that of the electric waves which compose the groups, and electric means tending to maintain the receiving devices in a responsive condition.

3. In a wireless transmission system receiving means maintained in a condition responsive to electric wave groups having frequencies substantially within the limits of audibility.

4. The combination in a receiving apparatus of a wireless system, of a device sensitive to electric waves, a tuning fork, and means for dampening the vibrations of the tuning fork.

5. The combination in a wireless receiving apparatus of a responder, and a controlled device responsive to waves of lower frequency than the frequency of the Hertzian waves.

6. The combination in a receiving apparatus of a wireless system, of a device responsive to electric waves of high frequency, and a device responsive to waves of lower frequency, and automatically electro-magnetic restoring means for the same.

7. In a wireless system the combination of a detector of high frequency electric waves,

and a plurality of self-restoring receiving devices in series responsive to waves of lower frequency.

8. The combination in a wireless system of a detector of high frequency electric waves, and a plurality of self-restoring dampened receiving devices responsive to waves of lower frequencies.

9. In a system of wireless communication a plurality of simultaneously operative selective receiving devices, and electro-magnetic means for restoring them to a responsive condition.

This specification signed and witnessed this twelfth day of March A. D., 1903.

JOHN H. CUNTZ.

In the presence of—
ANTHONY N. JESBERA,
LUCIUS E. VARNEY.