No. 777,014. PATENTED DEC. 6, 1904.

R. A. FESSENDEN.

APPARATUS FOR TRANSMITTING AND RECEIVING SIGNALS.

APPLICATION FILED MAR. 29, 1901.

NO MODEL. 3 SHEETS—SHEET 1.

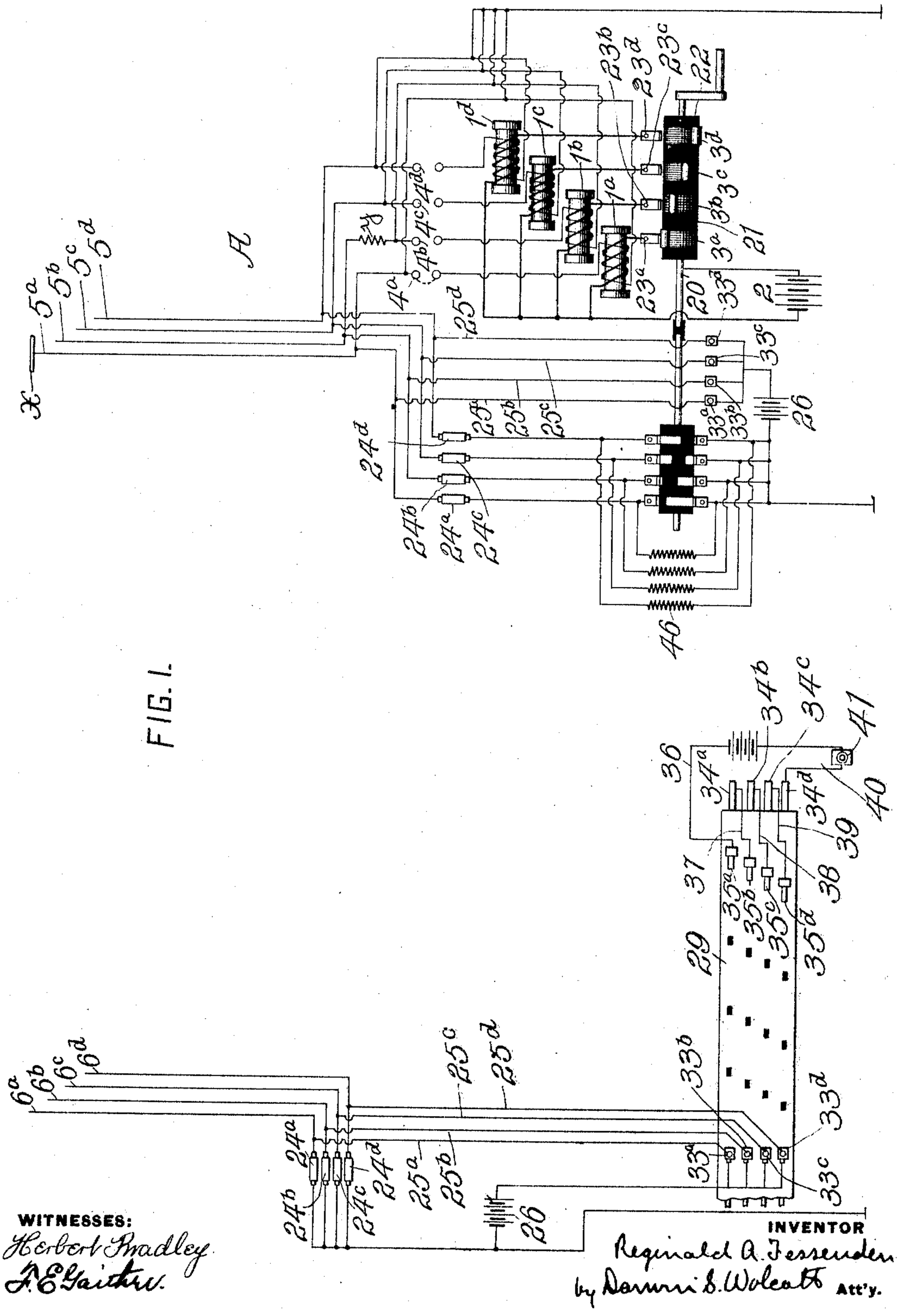

FIG. 1.

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NO MODEL. 3 SHEETS—SHEET 2.

FIG. 2.

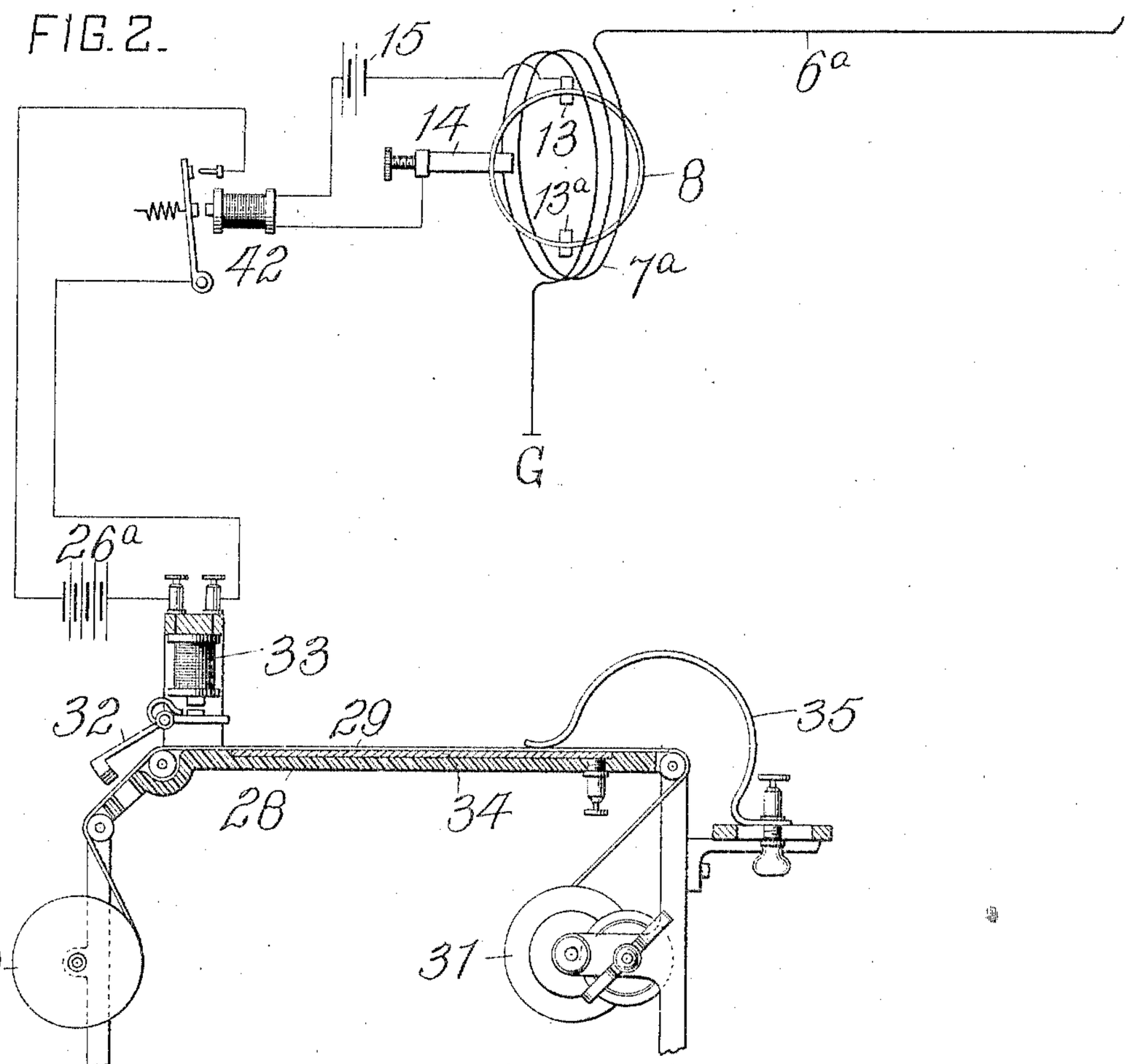


FIG. 3.

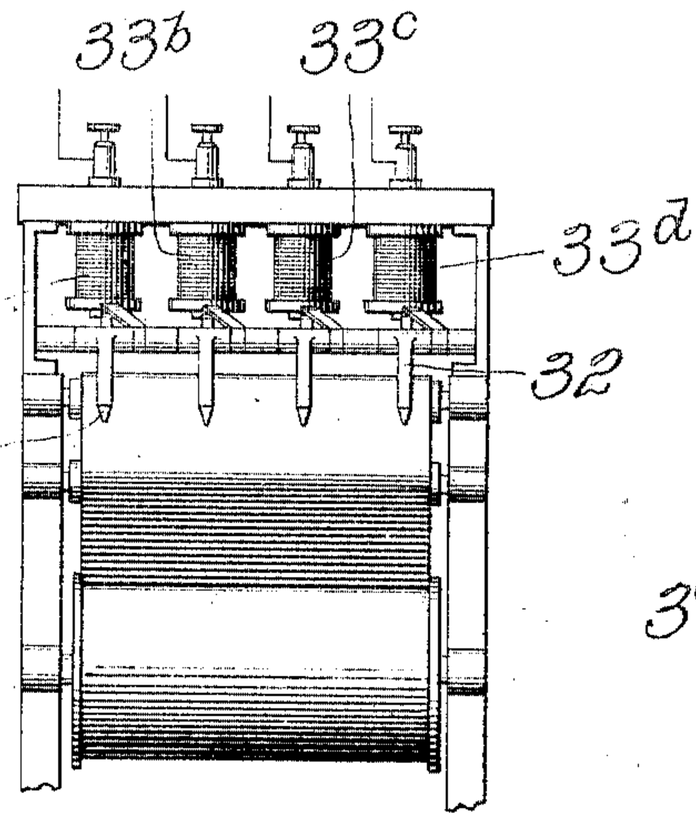


FIG. 6.

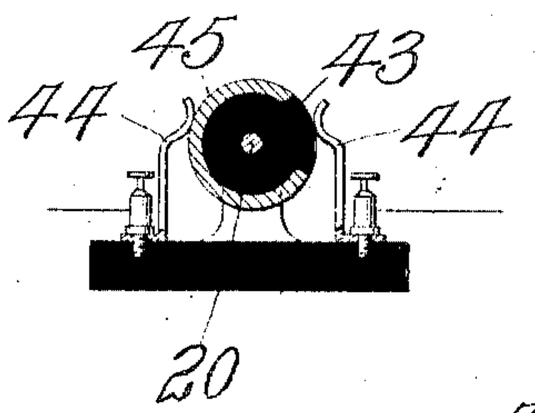


FIG. 5.

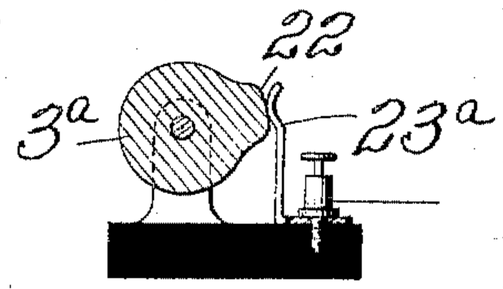
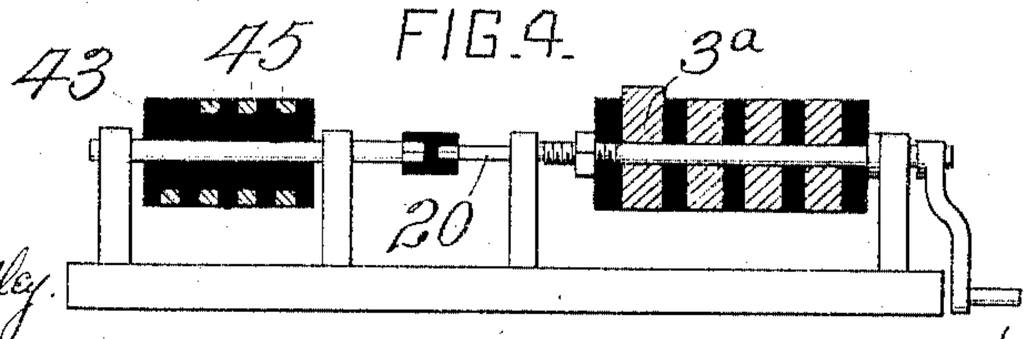


FIG. 4.



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NO MODEL. 3 SHEETS—SHEET 3.

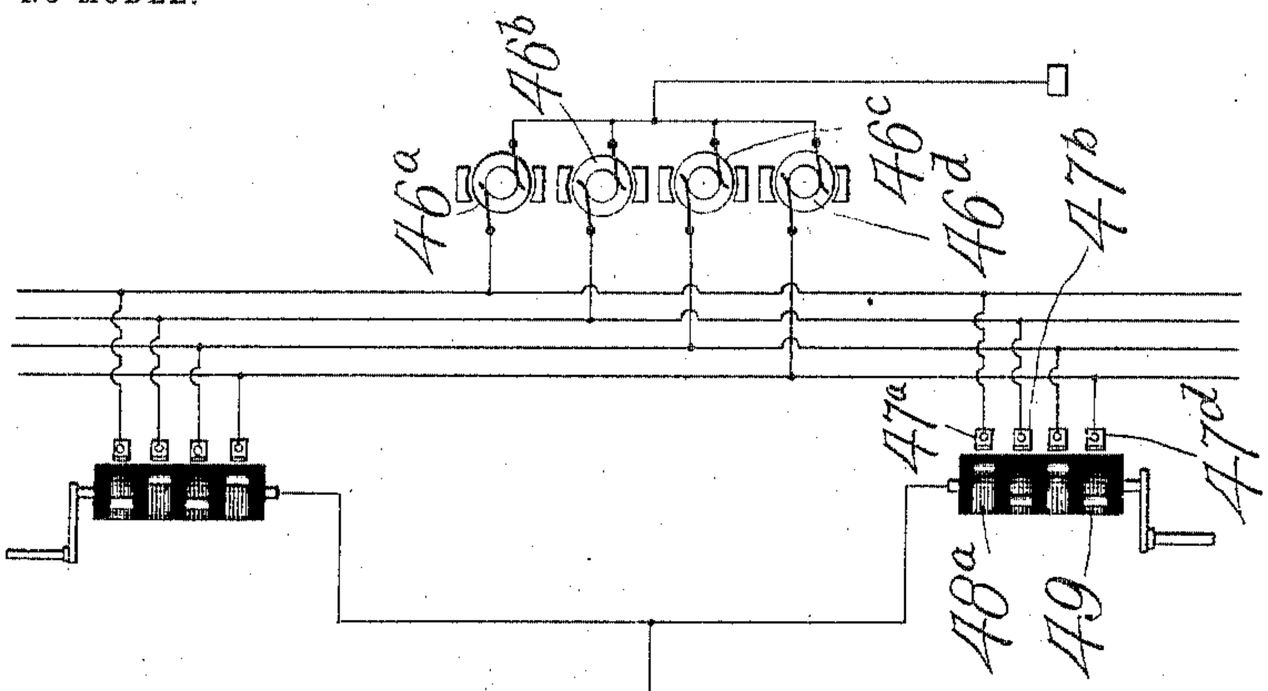

FIG. 7.

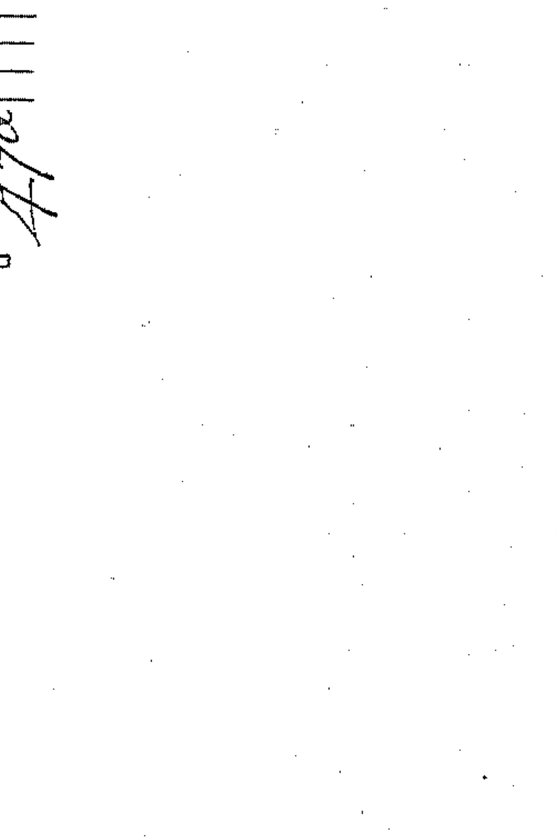

FIG. 8.

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No. 777,014. Patented December 6, 1904.

UNITED STATES PATENT OFFICE.

REGINALD A. FESSENDEN, OF ALLEGHENY, PENNSYLVANIA, ASSIGNOR TO THE NATIONAL ELECTRIC SIGNALING COMPANY, OF PITTSBURG, PENNSYLVANIA, A CORPORATION OF NEW JERSEY.

APPARATUS FOR TRANSMITTING AND RECEIVING SIGNALS,

SPECIFICATION forming part of Letters Patent No. 777,014, dated December 6, 1904.

Original application filed June 2, 1900, Serial No. 18,878. Divided and this application filed March 29, 1901. Serial No. 53,441.

(No model.)

To all whom it may concern:

Be it known that I, REGINALD A. FESSENDEN, a citizen of the United States, residing at Allegheny, in the county of Allegheny and State of Pennsylvania, have invented or discovered certain new and useful Improvements in Apparatus for Transmitting and Receiving Signals, of which improvements the following is a specification.

The invention described herein relates to certain improvements in the selective transmission and receipt of wireless messages or signals.

In the system of wireless telegraphy now in use difficulty is experienced in the selection of messages or signals. This difficulty arises from the fact that when magnetic waves are generated from one point they move equally in all directions and will be received at all stations reached by the waves.

The object of the present invention is to provide for the generation at the sending-station in varying order of two or more series of magnetic waves or electrical impulses, the waves or impulses of each of the series differing from those of the other series, the selective reception and transformation or utilization of each of the differing series, and finally the recording at each receiving-station of only such series of waves or impulses as are sent in a particular order. The selective reception of the differing series is obviously necessary and in the apparatus shown is secured by tuning or harmonizing various parts of the receiving system to the characteristic period of the particular series of energy fluctuations whereby they are designed to be actuated.

The invention is hereinafter more fully described and claimed.

In the accompanying drawings, forming a part of this specification, Figure 1 is a diagrammatic view illustrating my improved system of generating and receiving magnetic waves. Figs. 2 and 3 illustrate the mechanism employed at the receiving-stations. Figs. 4, 5, and 6 are detail views of the mechanism employed at the sending or generating station. Fig. 7 is a diagrammatic view illustrating the application of my improvement to systems employing a wire or other conductor for the transmission of the electrical impulses, and Fig. 8 illustrates a form of receiving mechanism and one of the parallel branch circuits.

In the practice of my invention a series of two or more vertical generating-wires or generating-surfaces 5^a 5^b, &c., are connected at the sending-station A to a series of two or more terminals or knobs 4^a 4^b, &c., of a series of two or more induction-coils 1^a 1^b, &c. The secondary coils are connected, as usual, to both discharge terminals or knobs of the inductions and also to ground. The primary coils of the inductions are each included in circuits of a generator or series of generators 2, and in each such circuit is included a circuit make and break mechanism. This part of the apparatus need not be more fully described, since it may be such as I have described in my Patent No. 706,735, August 12, 1902. A convenient form of make-and-break mechanism is shown in Figs. 1, 4, and 5 and consists of metal disks 3^a 3^b, &c., dependent upon the number of generating or sending wires employed, mounted upon a shaft 20, but preferably insulated from each other by disks 21, of insulating material. The shaft 20, which is rotated at a constant speed by a driving device (indicated at 20^a) of any suitable construction is electrically connected to one pole of the generator 2, and the disks 3^a 3^b, which are in electrical contact with the shaft, are provided with shoulders or knobs 22, adapted when the disks are shifted to strike against plates 23^a 23^b, &c., connected to the opposite pole of the generator 2. The disks 3^a 3^b, &c., are adjustably held in position on the shaft by suitable means—such, for example, as that shown in Fig. 4, consisting of a shoulder on the shaft and a nut screwing onto the shaft, whereby the disks may be clamped in any desired position.

By the rotation of the shaft the circuits of

the generator will be made and broken in any desired order or interval of time, dependent on the adjustment of the disks around the shaft and the speed of rotation of the shaft. The rate of rotation is not important, provided it be constant and not too low. It must be constant in order to avoid various objectionable if not insuperable complications in the receiving apparatus, for the said rate must bear a fixed ratio to the rate of movement of the tape at the receiving-station. As the periodicity of magnetic waves is dependent upon the

$$\sqrt{\text{self-induction}} \times \sqrt{\text{capacity}}$$

and as self-induction and capacity of the sending-wires varies with the length and the diameter of the wires, the latter are so proportioned relative to each other as by varying their lengths that the periodicity of the waves generated by one wire will differ from that of the waves generated by the other wires. By adjusting the disks 3^a 3^b, &c., on the shaft the series of waves may be sent out in any desired order—*i. e.*, *a b c d*—these letters designating the waves discharged, respectively, from wires 5^a, 5^b, 5^c, and 5^d.

The receiver comprises a series of selective collecting-wires or other suitable surfaces 6^a, 6^b, 6^c, and 6^d, &c., projecting upward preferably vertically, though they may be somewhat inclined. These collecting-wires are equal in number and are respectively electrically equivalent in height to the corresponding discharging or radiating wires 5^a 5^b, &c., at the sending-station—that is to say, corresponding radiating and receiving or collecting wires forming a pair are electrically tuned to each other and the tuning or equality of time period of free electrical oscillation may be brought about by making the electrical constant of the two either equal or equivalent, as by changing the length or surface of one of them. They are obviously equivalent when the quantity represented by

$$\sqrt{\text{capacity}} \times \sqrt{\text{inductance}}$$

is the same for each member of a pair.

The mechanisms controlled by the voltages or currents induced in the receiving-wires or operated directly thereby are also tuned to the period characteristic of the energy fluctuations to which they are subjected in accordance with practices and rules well-known in the art, so that the recording mechanism connected with each receiving-wire will be acted on or controlled only by the voltages or currents induced by the corresponding wire at the sending-station, the characteristics of the induced voltages varying with respect to their periodicities in the sense that the periodicities characteristic of a given sending-wire, though constant, differ from those of any other—as, for example, the recording mechanism connected to the receiving-wire 6^a will not be acted on or controlled by any voltages or currents other than those induced by magnetic waves having the characteristics of those generated by the sending-wire 5^a.

It is sufficiently obvious that in tuning the above-mentioned elements of a single selective receiving system the particular element tuned must be tuned to the frequency of the periodic flux to which it is subjected and that the specific well-known practices and rules adopted will be such as the nature of the case demands. Thus in tuning a collecting receiver-wire to the frequency of the oscillations of the corresponding transmitting system electrical tuning by properly-proportioned inductance and capacity is specified. The cases of mechanism controlled by voltages or currents induced in the receiving-wire and the case of mechanism operated by such voltages or currents are referred to hereinafter.

Any suitable form or construction of mechanism may be employed for recording the signals or electrical impulses received—as, for example, in Fig. 1 coherers 24^a 24^b, &c., are arranged in the circuits of the receiving-wires, which are grounded. These coherers are also included, as is customary, in circuits 25^a 25^b, &c., from a generator or generators 26, said circuits also including portions of the recording mechanism. Generally stated, the recording mechanism consists of a series of two or more electrically-actuated devices, which by their combined action will give an audible or visible indication, said devices being either controlled or operated by the voltages or currents induced by the magnetic waves, either directly or by being included in a circuit or circuits that is controlled by such induced voltages or currents, so that all such devices must be operated or the circuits completed in a certain predetermined order corresponding to the order in which the circuits of the generator at the sending-station are made and broken to produce an indication or signal by the indicating instrument.

Tuning of the coherers has not been attempted; but in lieu of coherers mechanism may be employed for transforming the current or voltages induced by the magnetic waves into energy of motion, as shown and described in Letters Patent No. 706,735, granted to me August 12, 1902. This mechanism is a current-operated low-resistance cumulatively-acting constantly-receptive receiver adapted to transform the energy of the received electromagnetic waves directly into the energy of motion. In Fig. 2 is shown a form of such mechanism which consists of a coil 7^a in series with the receiving-wire 6^a and a ring or element 8 so supported in the coil that a plane at right angles to the axis of the ring or element will be at an angle of approximately forty-five degrees (45°) with a plane at right angles to the axis of the coil. This ring is balanced on knife-edges or support-

ing-rods 13, one of which is formed of a good electrical conductor, as silver, the ring or element being preferably formed of aluminium, silver, or other good conductor. A carbon block 14 is so arranged that a portion of the ring will normally rest lightly thereon. This microphonic contact, the element 8, and the conducting pivotal support 13 for the latter form parts of a circuit from a generator 15. While the indicating or regulating mechanism may be directly controlled or operated by the circuit of the generator 15, it is preferred to include in the circuit of the generator 15^a relay 42, which in turn controls a circuit controlling or operating the indicating or recording mechanism. This apparatus is a very sensitive form of microphonic relay, and the ring 8 being the mechanism or mechanical element directly operated by the voltages or currents induced in the connected tuned receiving-wire should be tuned to the period of the flux to which it is subjected by following the principles and practices commonly employed in connection with relay apparatus of this delicate type—*i*, *e*., by making the time period of mechanical oscillation equal the time period of the flux. This may be done in any convenient way, as by adjusting the extent of projection or the weight or the elasticity of the unsupported side of the ring after the manner of the well-known wire loop of Evershed. Obviously the time period of the flux to which the ring is tuned is necessarily the time period of a train of waves and not the time period of a single wave or oscillation. This is necessarily so, because all displacements of the ring are in the same direction during all the period of continuous-wave activity and reaction to normal can only take place during discontinuities of the wave-trains.

A convenient form of mechanism for receiving indications is illustrated in Fig. 1, 2, and 3. This mechanism consists of a bed 28, over which is drawn a band or strip 29 of paper or other flexible non-conducting material. The strip is drawn from a spool 30 by a drum 31, driven at a regular speed by clockwork or other suitable driving mechanism. A series of perforating mechanisms dependent on the number of receiving-wires 6^a 6^b, &c., are arranged in such relation to the strip of paper that when actuated as hereinafter described the paper will be perforated.

While any form of electrically-controlled mechanisms may be employed, that shown in Figs. 2 and 3 is convenient for the purpose. Each of these mechanisms consists of a lever 32, having a punch at one and having its opposite end attached to the armature of an electromagnet 33, which is included in the circuit controlled by the coherer or by the circuit of generator 15. As each of the coherers are rendered conductive the perforating mechanism included in the circuit therewith will be operated and a hole formed through the strip. As the operation of the perforators corresponds in succession to the successive operations of the circuit make and break mechanism at the sending-station and as the strip is in constant uniform motion, it follows that the relative positions of the perforations in the strip will correspond to the relative times of operation of the make-and-break mechanisms. As the paper strip moves along the bed it will pass over metal bands 34^a 34^b, &c., and under contact springs or brushes 35^a 35^b, &c., in line with the bands. These bands are arranged in the several paths of movement of the perforations, so that the springs or brushes will contact with the bands as the perforated portions pass between them. These brushes are adjustably supported so that they can be positioned in accordance with the consecutive operation of the make-and-break mechanisms at the sending-station. When so adjusted, they will all be in contact with their respective bands 34^a 34^b, &c., at the same time completing an electric circuit formed as follows: wire 36, brush 35^a, band 34^a, wire 37, brush 35^b, band 34^b, wire 38, brush 35^c, band 34^c, wire 39, brush 35^d, band 34^d, wire 40, indicating instrument 41 to battery.

It is characteristic of my improvement that only such receiving station or stations as have their receiving mechanisms properly tuned and adjusted can receive intelligible indications. It is also necessary that the sequence of operation of the receiving mechanism should correspond to that of the sending mechanism and also that the time interval between the operations of the elements of the receiving mechanism should correspond to the time interval between the successive operations of the elements of the sending mechanism. In other words, to produce a dot or a dash or any other signal or indication at the receiving-station requires the conjoint action of waves from all the sending-wires and consequent operation of each and all the receiving mechanisms. In the form of apparatus shown the shaft 20 must be rotated to complete all the circuits from the generator 2, so that waves will be generated by all the wires 5^a 5^b, &c. Each series of waves will produce voltages or currents in one of the receiving-wires 6^a 6^b, &c., thereby operating in due sequence each of the perforating mechanisms to produce properly-arranged perforations in the moving strip. It is only when all these properly-spaced perforations pass simultaneously under the brushes that a circuit will be completed through the indicator 41 to produce a dot or a dash or other signal or indication. From the foregoing it will be understood that although all of the perforations may be operated by waves from other sources if the perforations are not in the predetermined order a closure of the circuit of the indicator will be effected.

It will be observed that the recording mechanism shown and described is in effect a circuit-closing mechanism whose parts or elements coöperate to effect a closure of the signaling or indicating circuit and are controlled by currents or voltages induced by magnetic waves generated at the sending-station.

As will be understood by those skilled in the art, a moving strip normally non-conductive, but capable of being rendered conductive by the action of an electric current or other electrically-controlled means, may be employed, the perforating mechanisms being replaced by mechanisms known in the art for rendering portions conductive.

As the wires or surfaces 5^a 5^b, &c., at one station are employed both for generating and receiving the magnetic waves as signals are sent or received, the indicating or receiving mechanism and the generating mechanism are connected to said wires or surfaces, as shown in Fig. 1. In order to protect the indicating or receiving mechanism when sending messages, a switch mechanism is interposed between the wires or surfaces 5^a 5^b, &c., and the indicating mechanism. A convenient form or construction of such switch consists of a cylinder 43 of insulating material mounted on the shaft 20 and metal springs 44 bearing on the shell. Metal bands 45 are placed on the cylinder in line with the springs 44, said bands extending around the cylinder except for a distance a little greater than the peripheral length of the knobs 22 on the disks 3^a of the circuit-breaker. The bands 45 are so arranged that the springs 44 will not be in contact with the bands when the knobs 22 are in contact with the plates 23. In lieu of entirely breaking the circuits of the coherers shunt-circuits 46, having suitable resistances, are arranged around the switch mechanism.

The character of the waves generated by the surfaces or wires can be varied by increasing the heights or diameters of the wires, thereby increasing the generating area. The character of the waves can also be varied by connecting to the wire or wires a condenser or capacity, as at x, or a self-inductance in the form of a coil, as at y.

As shown in Fig. 7, my improvement is applicable to the sending and receiving of signals through wires or other conductors. At the sending station a series of two or more generators 46^a 46^b, &c., constructed to generate currents of different periodicities, are connected to the terminals 47^a 47^b, &c., of a make-and-break mechanism. These terminals, which may be formed by springs, are constructed and arranged so that they will be normally out of contact with disks 48^a 48^b, &c., which are mounted on the shaft 49 and in electrical contact therewith, but insulated from each other. The shaft 49 is electrically connected to the line-wire 50, extending to another station, where the line-wire is connected to a series of two or more recording mechanisms 51^a 51^b, &c., each mechanism being tuned so as to be actuated only by a current of a certain periodicity.

Any construction of mechanism suitable for the purpose may be employed at the receiving-station—such, for example, as that shown in Figs. 2 and 3. When used for recording signals transmitted over a conductor, each of the magnets 33^a 33^b, &c., is connected to the line-wire and to ground or return wire and is constructed or arranged in accordance with rules well known in the art, so as to be responsive only to currents of certain predetermined periodicity, which in the absence of any element corresponding to the coherer or microphonic relay of the wireless system may be the periodicity of the current generated by one of the generators 46^a 46^b, &c.

As will be obvious to one skilled in the art, a magnet, such as 33^a, or a mechanism, such as 51^a, or the ring 8 cannot well be tuned as directed in any other way than in accordance with the practices well known in the art of harmonic reed telegraphy, the fundamental principle of which involves a vibrating member whose natural period of mechanical oscillation is the same as that of the periodic flux by which it is actuated. It will be equally obvious that though a magnet or mechanism cannot well be tuned by the other method—that is, by electrical tuning—somewhat similar functions may be served by tuning its supply-circuit to the period of the impressed flux by suitably proportioning the inductance and capacity of such circuit after the manner shown in Fig. 8, where one of the selective branches is shown tuned to the desired period by the addition of a condenser of proper capacity and where necessary an additional inductance-coil. As will be understood, the function of any tuning is primarily the syntonic cumulative action of successive periodic fluxes or manifestations of energy producing in the syntonic receiving apparatus a maximum instantaneous mechanical or electrical displacement greater than could be produced by any one of said fluxes or energies separately and secondarily selectivity of the energy of the predetermined single frequency to which the receiver must be syntonized. Where the available power is ample, the primary function is subordinate; but in wireless telegraphy it is very important.

In lieu of the mechanism shown in Figs. 2 and 3 a series of siphon-recorders may be employed. In such case the magnets 52 of such mechanisms would be tuned so as to be responsive only to such electrical impulses as have a certain periodicity. This apparatus of Figs. 2 and 3 necessarily includes the self-restoring wave-responsive microphonic relay, and the flux to which the magnets 52 must be tuned is a battery-flux corresponding in frequency to the time period of succession of the

wave-trains and not to the time period of the waves forming the train. The time period of the trains of waves is very much lower than the time period of the waves and corresponding to a secondary frequency of a lower order than the other. For this reason it is possible to tune the electromagnetic coil 52 in either of the ways described in connection with Figs. 7 and 8—that is, by directly tuning the magnet mechanism by the mechanical expedients of reed harmonic telegraphy or indirectly by tuning the circuit in which it is placed, as by the condenser and auxiliary inductance of Fig. 8.

I have mentioned specific ways in which the collecting receiving-wire, the mechanisms acted upon directly by the voltage or currents induced in the receiving-wire, and the mechanism or coils controlled indirectly thereby through a microphonic relay (acted on directly by battery fluctuations) may all be tuned to the period of the flux by which they are actuated; but I do not limit myself to any one of the specific ways mentioned, for it is obvious that the application of any of the practices and rules commonly employed to accomplish similar results would be within the spirit of my invention. Neither do I limit myself as to the number of tuned elements to be employed, though it is obviously desirable to tune all three of those mentioned, particularly where the coils 1^a 1^b, &c., have independent interrupters, for in that case the rings 8 may be tuned to the periods of such interrupters and the electromagnetic coils 52 to the periods of the interrupters 3^a 3^b, &c.

As the receiving mechanism is so constructed as to be responsive only to electrical impulses of certain predetermined periodicity and sent out in a certain predetermined order or with a certain predetermined time interval, it will be readily understood by those skilled in the art that a large number of sending instruments and a corresponding number of receiving instruments may be connected to the same line-wire, so that a large number of signals may be transmitted practically simultaneously without any liability of confusion or mixing up of signals. It is characteristic of my improved method that each signal or indication is formed by the conjoint action of two or more waves or impulses differing in periodicities.

While I have described and shown with some particularity mechanism for the practice of my improved method of signaling, no claim is made herein to such mechanism, as the same forms the subject-matter of another application, Serial No. 53,441, filed March 29, 1901.

I claim herein as my invention—

1. In a system of signaling by electromagnetic waves the combination with a receiver, means for generating electrical impulses, and means for making the receiver unresponsive during the time of generation of electrical impulses.

2. In a system of signaling by electromagnetic waves the combination with a receiver of means for generating electrical impulses, means for making the receiver unresponsive during the time of generation of electrical impulses, and means for rendering the receiver sensitive to receive impulses during the time when the sending impulses are not being emitted.

3. In a system of signaling by electromagnetic waves, the combination of means for generating electrical impulses, a receiver and a conductor so arranged that the receiver is not in operative relation to the conductor during the times when impulses are being generated in the station, but is operatively connected to the conductor during the intervals between the said times.

4. In a system of signaling by electromagnetic waves the combination of a commutator, apparatus for producing electrical impulses controlled thereby, and a receiver so arranged as to be put in an unresponsive condition during the time when electrical impulses are being produced.

5. In a system of signaling by electromagnetic waves a commutator controlling an apparatus for producing electrical impulses, and a receiver, so that during that portion of the travel of the commutator during which impulses are being generated the receiver is unaffected by received impulses, while during that portion of the travel of the commutator during which no impulses are being generated, the receiver is affected by received impulses.

6. In a system of signaling by electromagnetic waves a receiver, and means for generating electrical impulses at a uniform rate, and means for making the receiver unaffected by receiver impulses during the intervals between the generated impulses.

7. A system for utilizing the energy of electromagnetic waves including in combination a plurality of wave-responsive devices at the same station together with means for putting the latter out of operative relation to the former according to a predetermined time relation.

8. A system for utilizing the energy of electromagnetic waves including in combination a plurality of wave-responsive devices at the same station together with means for putting the latter out of operative relation to the former successively for predetermined periods.

9. A system of wireless signaling including in combination means operating to transfer to or impress high-frequency voltages upon the ether and a plurality of sources of voltage at the same station together with means for putting the latter out of operative relation to the former successively.

10. A system of wireless signaling including in combination means operating to trans-

fer to or impress high-frequency voltages upon the ether and a plurality of sources of voltage at the same station together with means for putting the latter out of operative relation to the former according to a predetermined time relation.

11. A system of wireless signaling including in combination means operating to transfer to or impress high-frequency voltages upon ether and a plurality of sources of voltages at the same station together with means for putting the latter out of operative relation to the former successively for predetermined periods.

12. A system of wireless signaling including in combination means operating to transfer to or impress high-frequency voltages upon the ether and a plurality of sources of voltage at the same station together with means for putting the latter out of operative relation to the former for a predetermined period.

13. A system of wireless signaling including in combination means operating to transfer to or impress high-frequency voltages upon the ether and a plurality of sources of voltage at the same station together with means for putting the latter into and out of operative relation to the former according to a predetermined time relation.

14. A system of wireless signaling including in combination means operating to transfer to or impress high-frequency voltages upon the ether and a plurality of sources of voltage at the same station together with means for putting the latter into and out of operative relation to the former for a predetermined period.

15. A system of wireless signaling including in combination means operating to transfer to or impress high-frequency voltages upon the ether and a plurality of sources of voltage at the same station together with means for putting the latter into and out of operative relation in a fixed order of succession.

16. A system of wireless signaling including in combination means operating to transfer to or impress high-frequency voltages upon the ether and a plurality of sources of voltage at the same station together with means for putting the latter into and out of operative relation to the former successively for predetermined periods.

17. A system of wireless signaling including in combination at the sending end a number of sending-circuits and means for exciting each of said sending-circuits independently of the others.

18. A system of wireless signaling including in combination at the sending end a number of sending-circuits and means for existing each of said sending-circuits according to a predetermined time relation.

19. In a system of wireless signaling including in combination at the sending end a number of sending-circuits and means for exciting each of said sending-circuits, a plurality of receiving-circuits together with means for disconnecting each of said receivers during the time of excitation of the corresponding sending-circuit.

20. A system of wireless signaling including in combination at the same station a number of sending and receiving circuits, means for exciting each of said sending-circuits independently of the others, receivers for each of said circuits together with means for putting said parts into operative relation for sending and for receiving, according to a predetermined time relation.

21. In a wireless signaling apparatus the combination with a transmitting and a receiving apparatus at the same station, of means controlled by the spark-determining member of the transmitting apparatus to cut the indicating member of the receiving apparatus out of the circuit during the time of each spark in the transmitting apparatus.

22. In a wireless signaling apparatus the combination with a transmitting and a receiving apparatus at the same station, of means automatically controlled by the spark-producing mechanism of the transmitting apparatus to cut off the local indicating instrument of the receiving apparatus during the time of each spark.

23. In a wireless signaling apparatus the combination with a transmitting and a receiving apparatus at the same station, of means for automatically cutting out the indicating device during the time of each spark of the transmitting apparatus.

24. In a wireless signaling apparatus the combination with a transmitting apparatus containing a spark-producing device and a receiving apparatus, of a switch adapted to cut off the receiving apparatus from the receiving-conductor and means controlled by the spark-producing device for operating said switch at each instant of sparking and for reëstablishing connection of the receiver with the receiving-conductor at other times.

25. A system of signaling by electromagnetic waves including in combination a receiving-conductor and a receiver operatively connected therewith together with means for rendering the receiving devices unresponsive without disconnecting from the receiving-conductor.

26. In a system of signaling by electromagnetic waves the combination with a receiver, means for generating electrical impulses, and means for making the receiver unresponsive during the time of generation of electrical impulses, without disconnecting the receiver from the receiving-conductor.

27. In a system of signaling by electromagnetic waves the combination with a receiver of means for generating electrical impulses, means for making the receiver unresponsive during the time of generation of electrical im-

pulses without disconnecting the receiver from the receiving-conductor and means for rendering the receiver sensitive to receive impulses during the time when the sending impulses are not being emitted.

28. In a wireless signaling apparatus the combination with a transmitting and a receiving apparatus at the same station, of means controlled by the spark-determining member of the transmitting apparatus to cut the indicating member of the receiving apparatus out of the circuit during the times of sparking of the transmitting apparatus.

29. In a wireless signaling apparatus the combination with a transmitting and a receiving apparatus at the same station, of means automatically controlled by the spark-producing mechanism of the transmitting apparatus to cut off the local indicating instrument of the receiving apparatus during each sparking period.

30. In a wireless signaling apparatus the combination with a transmitting and a receiving apparatus at the same station, of means for automatically cutting out the indicating device during each sparking period of the transmitting apparatus.

31. In a wireless signaling apparatus the combination with a transmitting apparatus containing a spark-producing device and a receiving apparatus, of a switch adapted to cut off the receiving apparatus from the receiving-conductor and means controlled by the spark-producing device for operating said switch at each sparking period and for reëstablishing connection of the receiver with the receiving-conductor at other times.

32. In a wireless signaling apparatus the combination with a transmitting and a constantly-receptive receiving apparatus at the same station, of means controlled by the spark-determining member of the transmitting apparatus to render the receiving apparatus unresponsive during the sparking period of the transmitting apparatus.

33. In a wireless signaling apparatus the combination with a transmitting apparatus and a constantly-receptive receiving apparatus at the same station, of means automatically controlled by the spark-producing mechanism to cut off the local indicating instrument of the receiving apparatus during the sparking period.

34. A system for utilizing the energy of electromagnetic waves including in combination a plurality of receiving circuits or conductors and a plurality of constantly-receptive wave-responsive devices at the same station together with means for putting the latter into operative relation to the former for predetermined periods.

35. A system for utilizing the energy of electromagnetic waves including in combination a plurality of receiving circuits or conductors and a plurality of constantly-receptive wave-responsive devices at the same station together with means for putting the latter into operative relation to the former successively for predetermined periods.

36. A system of wireless signaling including in combination a plurality of receiving circuits or conductors and a plurality of constantly-receptive current-operated wave-responsive devices at the same station together with means for putting the latter into and out of operative relation in a fixed order of succession.

37. A system of wireless signaling including in combination a plurality of receiving circuits or conductors and a plurality of constantly-receptive current-operated wave-responsive devices at the same station together with means for putting the latter into and out of operative relation to the former successively for predetermined periods.

In testimony whereof I have hereunto set my hand.

REGINALD A. FESSENDEN.

Witnesses:
W. BERTRAND ACKER,
DARWIN S. WOLCOTT.