No. 727,329. PATENTED MAY 5, 1903.

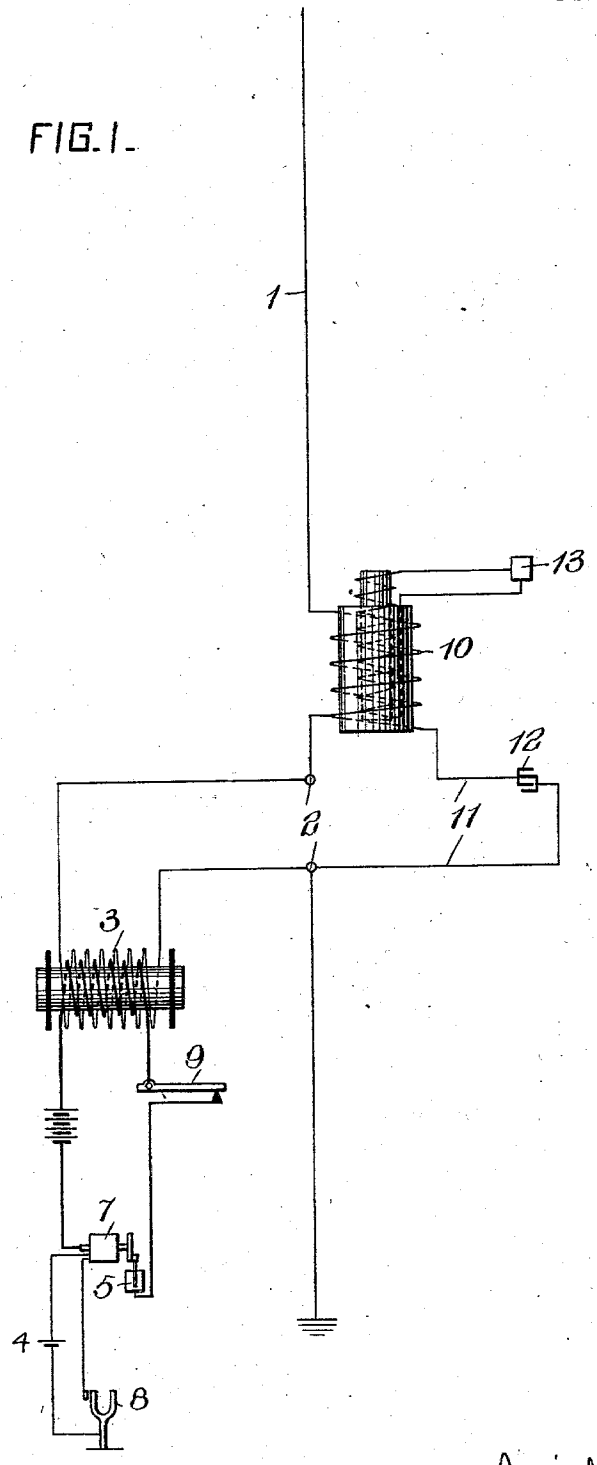
R. A. FESSENDEN.

SIGNALING BY ELECTROMAGNETIC WAVES.

APPLICATION FILED MAR. 14, 1903.

NO MODEL. 2 SHEETS—SHEET 1.

FIG. 1.



WITNESSES:
Herbert Bradley.
Fred Kirchner.

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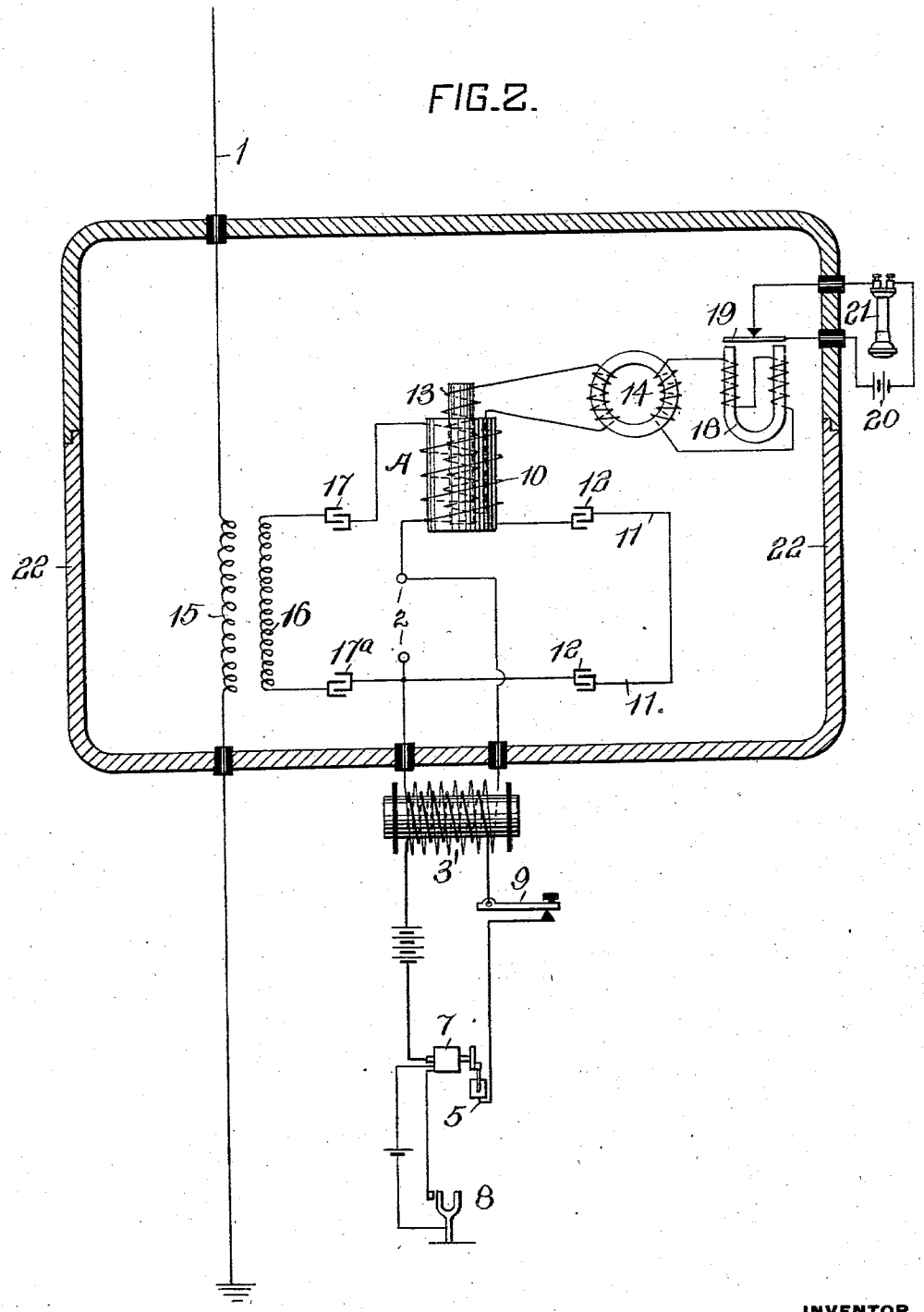
NO MODEL. 2 SHEETS—SHEET 2.

FIG. 2.



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UNITED STATES PATENT OFFICE.

REGINALD A. FESSENDEN, OF PITTSBURG, PENNSYLVANIA.

SIGNALING BY ELECTROMAGNETIC WAVES.

SPECIFICATION forming part of Letters Patent No. 727,329, dated May 5, 1903.

Application filed March 14, 1903. Serial No. 147,727. (No model.)

To all whom it may concern:

Be it known that I, REGINALD A. FESSENDEN, a citizen of the United States, residing at Pittsburg, in the county of Allegheny and State of Pennsylvania, have invented or discovered certain new and useful Improvements in Signaling by Electromagnetic Waves, of which improvement the following is a specification.

The invention described herein relates to certain new and useful improvements in the art of signaling by electromagnetic waves. In the methods heretofore employed the receiving and sending apparatus at a station have been so arranged and constructed that either one of them could be connected to the vertical wire, according as it was desired to send or receive. When it was desired to receive, the sending apparatus was disconnected or shifted from operative relation with the vertical, and when it was desired to send the receiving apparatus was changed from operative relation with the vertical. The object of this shift in operative relation between the vertical wire and the sending and receiving mechanisms was to prevent the very powerful voltages generated in the vertical while sending from affecting the delicately receiving mechanism at the sending-station and causing it to operate. Various means have been suggested for automatically changing the operative relations between the vertical and the sending and receiving mechanisms—as, for example, such as shown and described in English Patent No. 29,069 of 1897 to Lodge; but while this automatic disconnection or change in relation undoubtedly rendered the operation of a station more easy it did not permit of the simultaneous sending and receiving of messages at the station, for the reason that when the key was pressed down in sending the receiver will be cut out and a portion of the message which was being received necessarily lost.

The object of the present invention is to permit of the simultaneous sending and receiving of messages at a station. In the method herein described this is accomplished by so connecting the receiving and sending circuits to the vertical that the receiving mechanism will respond faintly or not at all to waves generated by the sending apparatus, but will be operated by waves generated at other stations. As herein shown, this is accomplished by so connecting the circuits that the effects produced by the operation of the sending apparatus on the receiving apparatus will tend to neutralize each other, while the effects produced by electromagnetic waves from another station will not neutralize each other. This may be conveniently accomplished by the use of two circuits, which act in parallel when sending and in series when receiving. The receiver is preferably arranged in inductive relation to these circuits in such a way that when sending the inductive effects will oppose each other, but will aid each other when receiving.

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 showing a sending and receiving apparatus for a station adapted to the practice of my invention, and Fig. 2 is a similar view illustrating a modification of a sending and receiving apparatus.

In the practice of my invention the radiating-conductor or vertical 1 is connected to one of the spark-terminals 2, the other terminal being connected to ground.

While any suitable form or construction of generator, such as an induction-coil or a dynamo and transformer, as described in my previous patents, may be employed, the invention is illustrated for convenience in connection with an induction-coil and battery. As shown, the terminals of the secondary of the induction-coil 3 are connected, respectively, to the spark-terminals 2. The terminal of the induction-coil forms a part of a circuit containing a battery 4 and a make-and-break mechanism independently operated at a predetermined rate. A convenient form of make-and-break mechanism consists of a cup 5, containing mercury, and a pin, which is movable into and out of the mercury. A suitable means for reciprocating the pin consists of a small electric motor 7, having a pin so connected to its armature-shaft as to

be moved into and out of the mercury during the rotation of the shaft. The rotation of the motor may be controlled in any convenient manner, as by a tuning-fork 8, which is electrically driven and controls by a coil on the armature-shaft of the motor the rotation of said shaft, said coil being included in the circuit with the tuning-fork. This method of control is well known in the art. A sending-key 9 or any suitable form or construction of make-and-break mechanism is included in the circuit of the primary of the induction-coil.

A portion of the turns of the primary 10 of a transformer are connected in series with a vertical or radiating-conductor 1 and a part of the turns in series with a local circuit 11, containing a condenser 12. A receiving device 13, which may be a magnetic receiver or other suitable form or construction of wave-receiver device, is included in the circuit of the secondary 14 of the transformer A. As described in Letters Patent heretofore granted me, this local circuit operates in parallel with the vertical or radiating-conductor when sending, but in series with it when receiving. Consequently by properly proportioning the number of turns of the primary 10 in series with the vertical and those in series with the local circuit the effects of the two circuits when sending upon the secondary of the transformer, and hence upon the receiver included in said secondary, can be made to neutralize each other, while the effects of any electromagnetic waves received upon the vertical or radiating-conductor may be made to aid each other. It is found that the best results will be obtained when the receiver is mechanically or electrically tuned to the group frequency of the outside station, as described in application, Serial No. 136,968, filed by me December 29, 1902.

It has been found in practice that with the construction and arrangement shown in Fig. 1 an adjustment is required from time to time, and for the purpose of avoiding such adjustment the arrangement shown in Fig. 2 is preferably adopted. As shown therein, the primary 15 of a transformer is arranged in series with a vertical or radiating-conductor 1, and the secondary 16 of the transformer is connected in series with a portion of the turns of the primary 10 of the transformer A and is also connected to the sparking terminals 2. Condensers 17 17ª are included in the circuit of this secondary 16. As in the construction shown in Fig. 1, a portion of the turns of the primary 10 are in series with a local circuit 11, containing the condensers 12. The secondary 13 of the transformer A is connected or arranged in operative relation to the receiver 14, such as a magnetic or mechanical receiver operating the group-tuned telephone 18, which in turn operates a microphonic contact 19, included in the circuit of the battery 20 and telephone 21. It is found that this arrangement needs less adjustment from day to day than that shown in Fig. 1, and this need of adjustment is rendered still less by inclosing the transformer which has its primary in series with the vertical, the transformer A, the local circuit, including the condenser, and the group-tuned telephone in a metallic box 22.

I claim herein as my invention—

1. As an improvement in the art of signaling by electromagnetic waves, the method herein described which consists in generating electromagnetic waves at a station, producing intelligible indications by such waves at the desired station, and neutralizing the effects of such waves on the receiving mechanism at the transmitting-station, substantially as set forth.

2. As an improvement in the art of signaling by electromagnetic waves, the method herein described which consists in generating electromagnetic waves at a station, producing intelligible indications by such waves at the desired station, and generating by such waves opposing currents in the receiving-circuit at the transmitting-station, substantially as set forth.

3. As a step in the art of signaling by electromagnetic waves, the method herein described which consists in neutralizing the effects produced by the generation of electromagnetic waves on the receiving mechanism at that station, substantially as set forth.

4. As an improvement in the art of signaling by electromagnetic waves, the method herein described which consists in simultaneously generating electromagnetic waves at a station, producing indications at the same station by electromagnetic waves generated at another station, and neutralizing the effects on the indicating or receiving mechanism produced by the generation of waves other than those producing such indications, substantially as set forth.

5. As an improvement in the art of signaling by electromagnetic waves, the method herein described which consists in generating electromagnetic waves at a station and neutralizing the effects of such waves on the receiving mechanism at said station, substantially as set forth.

6. As an improvement in the art of signaling by electromagnetic waves, the method herein described which consists in simultaneously generating electromagnetic waves at a station, producing indications at the same station by electromagnetic waves received from any direction, and neutralizing the effects on the indicating or receiving mechanism produced by waves other than those producing such indications, substantially as set forth.

7. As an improvement in the art of signaling by electromagnetic waves, the method

herein described which consists in generating electromagnetic waves at a station, neutralizing the effects produced on the receiving mechanisms of the station by the operation of the generator and producing an indication at that station by conjoining the effects produced by waves received from any direction.

In testimony whereof I have hereunto set my hand.

REGINALD A. FESSENDEN.

Witnesses:
T. L. SCLATER,
SIDNEY G. WALLER.