No. 715,203. Patented Dec. 2, 1902.

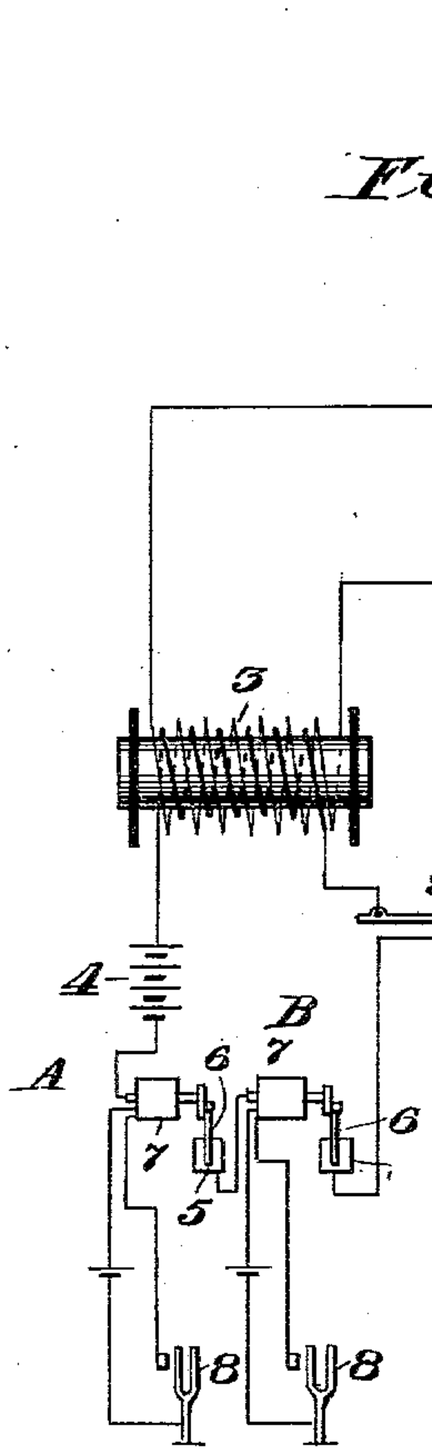
R. A. FESSENDEN.

SELECTIVE SIGNALING BY ELECTROMAGNETIC WAVES.

(Application filed Nov. 13, 1902.)

(No Model.) 2 Sheets—Sheet 1.

Fig. 1.



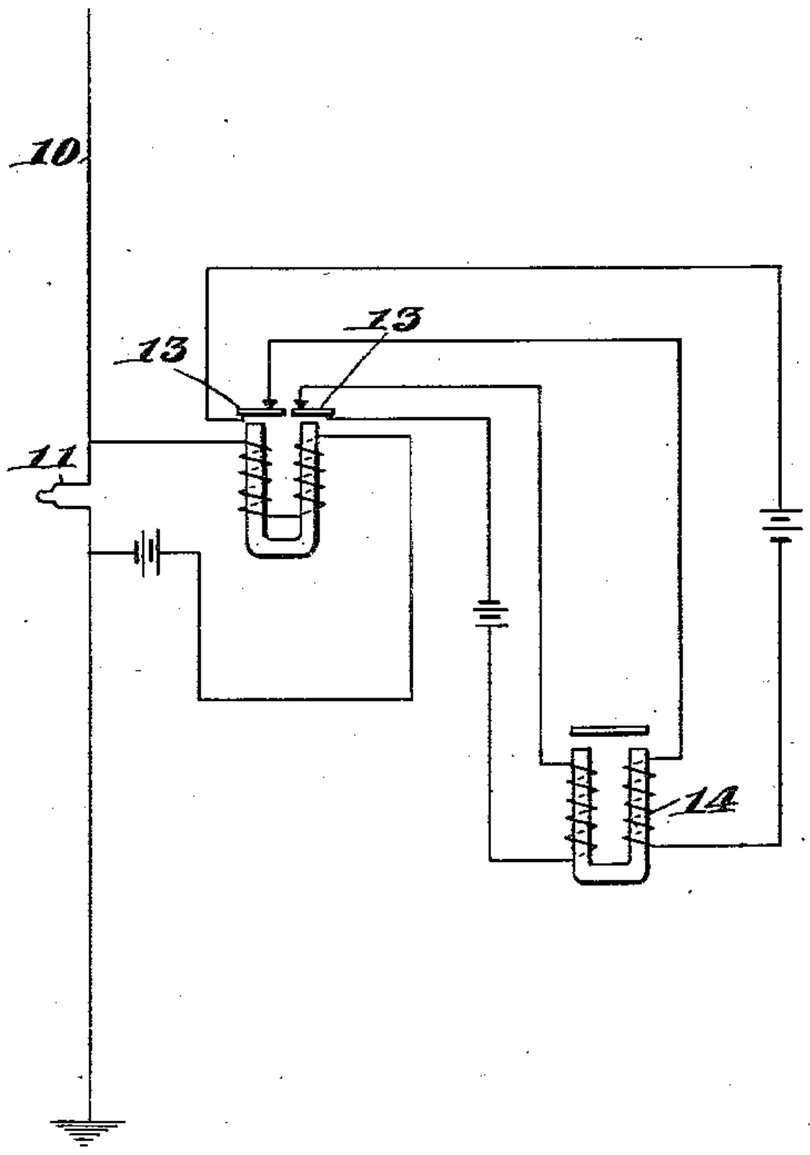
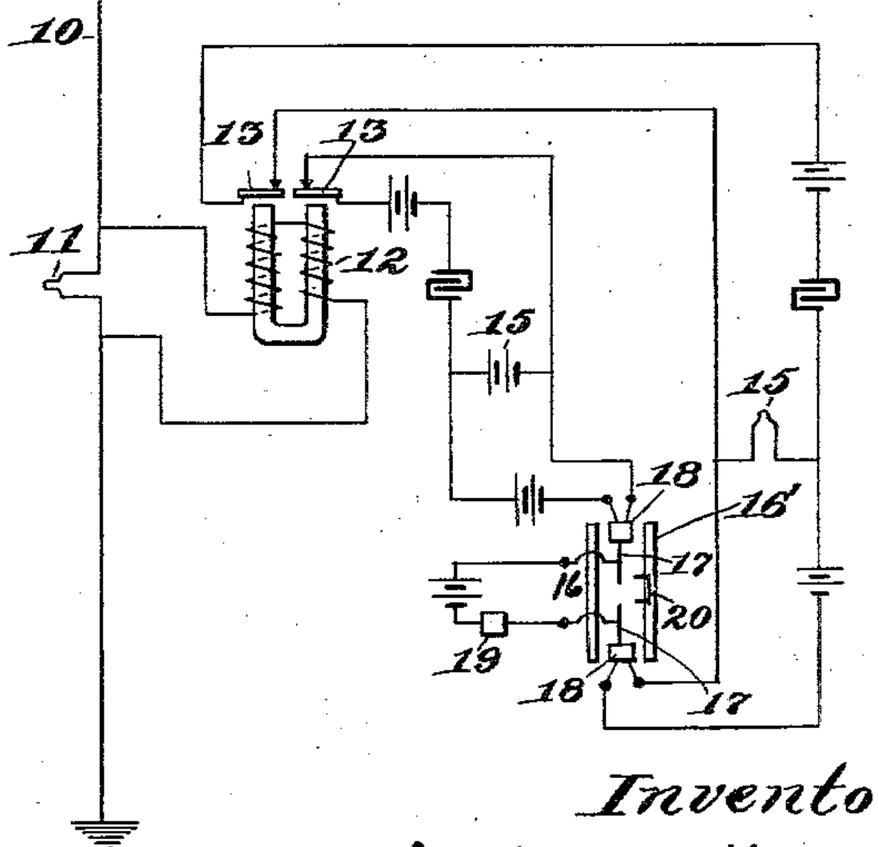


Fig. 2.



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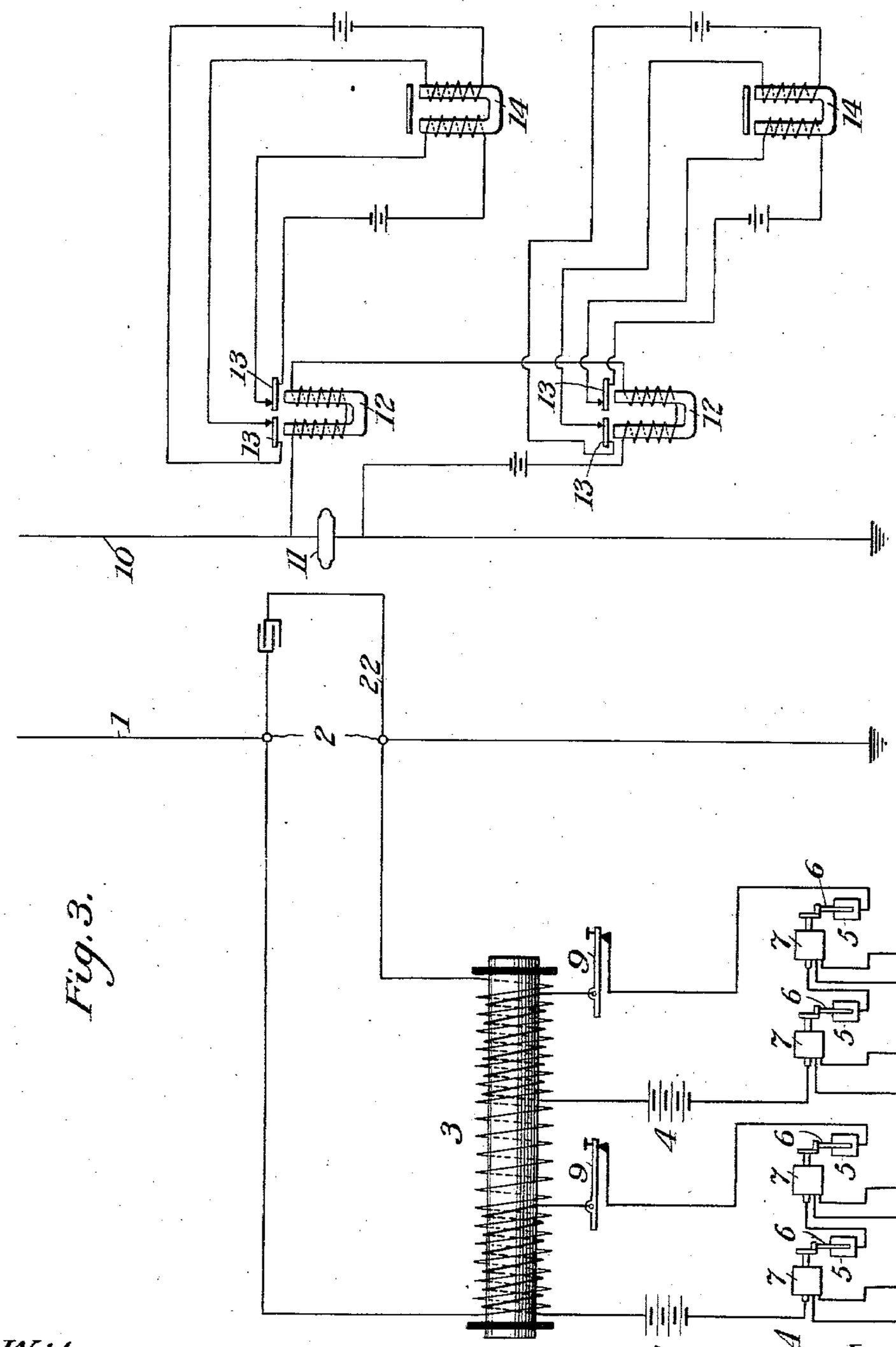

Fig. 3.

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UNITED STATES PATENT OFFICE.

REGINALD A. FESSENDEN, OF MANTEO, NORTH CAROLINA.

SELECTIVE SIGNALING BY ELECTROMAGNETIC WAVES.

SPECIFICATION forming part of Letters Patent No. 715,203, dated December 2, 1902.

Original application filed August 27, 1902, Serial No. 121,173. Divided and this application filed November 13, 1902. Serial No. 131,158. (No model.)

To all whom it may concern:

Be it known that I, REGINALD A. FESSENDEN, a citizen of the United States, residing at Manteo, in the county of Dare and State of North Carolina, have invented or discovered a certain new and useful Improvement in Selective Signaling by Electromagnetic Waves, of which improvement the following is a specification.

The invention described herein relates to methods of selective multiple and multiplex signaling by electromagnetic waves in which groups of electromagnetic waves of one kind are generated at the sending-station, the number of groups of electromagnetic waves per second being controlled by one or more controllers, each controller consisting of two or more mechanisms each adapted to cause groups of waves to be emitted at a predetermined rate per second, one emission rate being proper to each mechanism, while at the receiving-station I employ conductors tuned to the periodicity of the electromagnetic waves generated at the sending-station and one or more receivers each consisting of two or more mechanisms in operative relation to the conductor and arranged to produce a signal by conjoint action and each mechanism adapted to respond to one only of the emission rates of the sending end.

This application is a division of prior application, Serial No. 121,173, filed August 27, 1902.

In the accompanying drawings, forming a part of this specification, Figure 1 is a diagrammatic view illustrative of my invention. Fig. 2 is a similar view illustrating a modification of the apparatus at the receiving-station, and Fig. 3 is a diagrammatic view illustrating a form of apparatus for multiple sending and receiving.

In the practice of my invention the radiating-conductor 1 is connected to one of the sparking 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 or dynamo and transformer, as described in my previous patents—may be employed, for convenience the invention is illustrated and described in connection with an induction-coil and batteries. As shown, the terminals of the secondary of the induction-coil 3 are connected, respectively, to the sparking terminals 2. The primary of the coil forms part of a circuit containing battery 4 and two or more make-and-break mechanisms A and B, independently operated at predetermined but different rates of speed by any suitable means. A convenient form of make-and-break mechanism consists of a cup 5, containing mercury, and a pin 6, movable into and out of the mercury. A suitable means for shifting the pin consists of a small electric motor 7, having the pin so connected to its armature-shaft as to be moved up and down during the rotation thereof. The rotation of the motor may be controlled in any convenient manner, as by the tuning-fork 8, which is electrically driven and controlls 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 being well known in the art. If the tuning-fork of the make-and-break mechanism A is adjusted to a certain number of periods—say two hundred and fifty-six (256) per second—the motor will be so operated as to break the primary circuit of the induction-coil the same number of times per second. Similarly, the motor of make-and-break mechanism B will break the same primary circuit a predetermined number of times—say three hundred and eighty-four (384)—per second if the tuning-fork 8 of such mechanism be properly adjusted to such period. It is preferable that the height of mercury in the cup should be such (relative to the length of stroke of the pin) that the duration of contact should be several times the duration of break. A sending-key 9 or any suitable form of make-and-break mechanism is included in the primary circuit. The sending-conductor is proportioned and arranged so as to radiate waves of any desired single frequency—*e. g.*, two million (2,000,000) per second.

At the receiving-station the conductor 10 has a wave-responsive device, as the loop 11, arranged in operative relation thereto, said wave-responsive device being also included in a circuit containing two or more electromagnetic mechanisms adapted to operate in

unison, respectively, with the periods of the make-and-break mechanisms at the sending-station. The loop 11 is preferably constructed as described and shown in Letters Patent No. 706,744, granted to me August 12, 1902. A convenient construction of electromagnetic mechanism consists of a telephone 12, having two or more tongues 13, forming parts of microphonic contacts included in circuits which also include the coils of a telephone 14, having two or more poles. The make-and-break mechanisms A and B are preferably adjusted to operate at such rates as to produce notes which when combined will form a chord, and as the tongues of the telephone 12 are adjusted to respond only to groups of waves emitted at such rates a chord will not be produced by telephone 14 by groups of waves emitted at different rates.

In lieu of the construction shown in Fig. 1 the receiving apparatus shown in Fig. 2 may be used. As therein shown, the circuits having the microphonic contacts 13 also include controlling devices, (such as the loops 15,) which control the currents in the circuits of the double movable coil-relay 16, having permanent magnets 16′. Contact-fingers 17 on the movable coils 18 of the relay are connected in the circuit, including an indicating mechanism 19, said circuit being closed only when both fingers are brought simultaneously against the contact-plate 20. Condensers 21 are included in each microphonic circuit to cut out steady currents; but the circuits are not electrically tuned, as such tuning is not necessary.

The method of operation is as follows: The make-and-break mechanisms A and B being operated at predetermined but different rates, the key 9 is depressed for a sufficient length of time to form a dot or a dash of the Morse code. During this period the make-and-break mechanisms cause groups of electromagnetic waves of the same character and periodicity—*i. e.*, two million per second—to be emitted; but one set of groups of waves has an emission rate of two hundred and fifty-six per second and the other set of groups of waves an emission rate of, say, three hundred and eighty-four per second. These groups of waves acting on the receiving-conductor and receiving mechanism cause the tongues 13 of the electromagnetic mechanism to respond, said tongues being mechanically tuned to vibrate, respectively, at the rates corresponding to the rates of the make-and-break mechanisms A and B. These tongues actuate the microphonic circuits, which actuate the coils of the relay 16 to close the indicating-circuit and produce a dot or a dash. Where the loop 15 is used to operate the double relay shown in Fig. 2, the vibration of the microphonic contacts or tongues 13 generate a fluctuating or alternating current in the circuit 13 15, which fluctuating current heats up the loop 15, thereby changing the resistance in the local circuit 18 15, and thus changing the position of the coil 18 of the double relay to complete or close the contacts at 20, which contacts control the indicating-circuit.

Since only one character of electromagnetic waves is generated and the receiving-conductor is tuned to respond only to waves of that character, and since in addition the electromagnetic receiving mechanisms are mechanically tuned to respond only to the wave-emission rates at the sending end, and since also the conjoint action of the receiving mechanisms is also necessary to produce an indication, it will be seen that the system is strongly selective.

My improvement may also be used for multiple working, as by using a plurality of tongues 13 on the electromagnetic mechanism 12^a, as shown in Fig. 3, and grouping them in sets—each set controlling a bipolar telephone or a double movable coil-relay—two or more messages may be received at the same time, each set of tongues being mechanically tuned to different stations. It will be readily understood that each pair of make-and-break mechanisms A and B when operated by the key 9 may be used to send a message independently of every other pair, just as if each pair were alone operating a station. Similarly, at the receiving-station the tongues 13 of one telephone 12 may be tuned to correspond to one pair of make-and-break mechanisms A and B and receive the message sent by said pair, while a second pair of tongues may be tuned to a second pair of make-and-break mechanisms A and B, so as to receive the message sent by such pair. Similarly, by using a plurality of make-and-break mechanisms at the sending-station and grouping them in sets, each set being capable of actuating the coil, as by operating one primary of an induction-coil having several primaries and having a secondary common to all the primaries, several messages may be sent simultaneously, because, although both pairs of make-and-break mechanisms produce an effect on a wave-responsive device 11, the first pair of tongues will only be affected by the first set of make-and-break mechanisms, since the tongues are tuned to the first pair only and will not respond conjointly to any other pair of make-and-break mechanisms. Similarly, a second pair of tongues will only respond conjointly to a second pair of make-and-break mechanisms.

Where multiple working is used or generally in any case where heavy currents are received, it is preferred to employ two or more loops in parallel, as shown in Fig. 3, or other equivalent means—*e. g.*, a single loop of larger cross-section, which may be conveniently formed by ruling a line with an insulating-varnish about one one-hundredth ($\frac{1}{100}$) of an inch wide on a thin platinum or other metallic foil, plating the non-insulating surface of the foil to any desired thickness, dissolving off the insulation, and cutting the foil into slips of the desired width.

I claim herein as my invention—

1. In a system of signaling by electromagnetic waves, the combination at the sending-station of means for generating electromagnetic waves of the same character, means for causing the emission of such waves in two or more groups at different emission rates, and at the receiving-station an indicating mechanism operative by the conjoint action of the respectively responsive devices.

2. In a system of signaling by electromagnetic waves, the combination of means at the sending-station for generating electromagnetic waves of the same character means for causing the emission of such waves in two or more groups at different emission rates, means at the receiving-station responsive respectively to the groups of waves, and an indicating mechanism operative by the conjoint action of the respectively responsive devices.

3. In a system of signaling by electromagnetic waves, the combination of means at the sending-station for generating electromagnetic waves of the same character, means for causing the emission of such waves in two or more groups at different emission rates, means at the receiving-station electrically tuned to respond to electromagnetic waves of the character emitted, means mechanically tuned to respond respectively to the groups of waves in operative relation to the receiving means, and an indicating mechanism operative by the conjoint action of the mechanically-tuned respectively responsive devices.

4. In a system of signaling by electromagnetic waves, the combination at the sending-station of means for generating electromagnetic waves of the same character and means of causing the emission of sets of groups of waves, each set consisting of two or more groups of different emission rates.

5. In a system of signaling by electromagnetic waves, the combination of a plurality of devices at the receiving-station responsive respectively to groups of waves of different emission rates, and indicating mechanisms operative by the action of sets of the respectively responsive devices, each set consisting of two or more respectively responsive devices acting conjointly.

6. In a system of signaling by electromagnetic waves, the combination of means at the receiving-station electrically tuned to respond to electromagnetic waves of a single periodocity, means mechanically tuned to respond respectively to groups of different emission rates, in operative relation to the receiving means, and indicating mechanisms operative by the action of sets of the mechanically-tuned respectively responsive devices, each set consisting of two or more respectively responsive devices, acting conjointly.

7. In a system of signaling by electromagnetic waves, the combination of means at the sending-station for generating electromagnetic waves of the same character, means for causing the emission of sets of groups of waves, each set consisting of two or more groups of different emission rates, means at the receiving-station responsive respectively to the groups of waves, and indicating mechanisms operative by the action of corresponding sets of the respectively responsive devices, the components of each set acting conjointly.

8. In a system of signaling by electromagnetic waves, the combination of means at the sending-station for generating electromagnetic waves of the same character, means for causing the emission of sets of groups of waves, each set consisting of two or more groups of different emission rates, means at the receiving station electrically tuned to respond to electromagnetic waves of the character emitted, means mechanically tuned to respond respectively to the groups of waves in operative relation to the receiving means, and indicating mechanisms operative by the action of corresponding sets of mechanically-tuned respectively responsive devices, the components of each set acting conjointly.

In testimony whereof I have hereunto set my hand.

REGINALD A. FESSENDEN.

Witnesses:

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WM. H. DE LACY.