No. 752,894. PATENTED FEB. 23, 1904.

R. A. FESSENDEN.

SELECTIVE SIGNALING.

APPLICATION FILED DEC. 29, 1902.

NO MODEL. 2 SHEETS—SHEET 1.

FIG. 1.

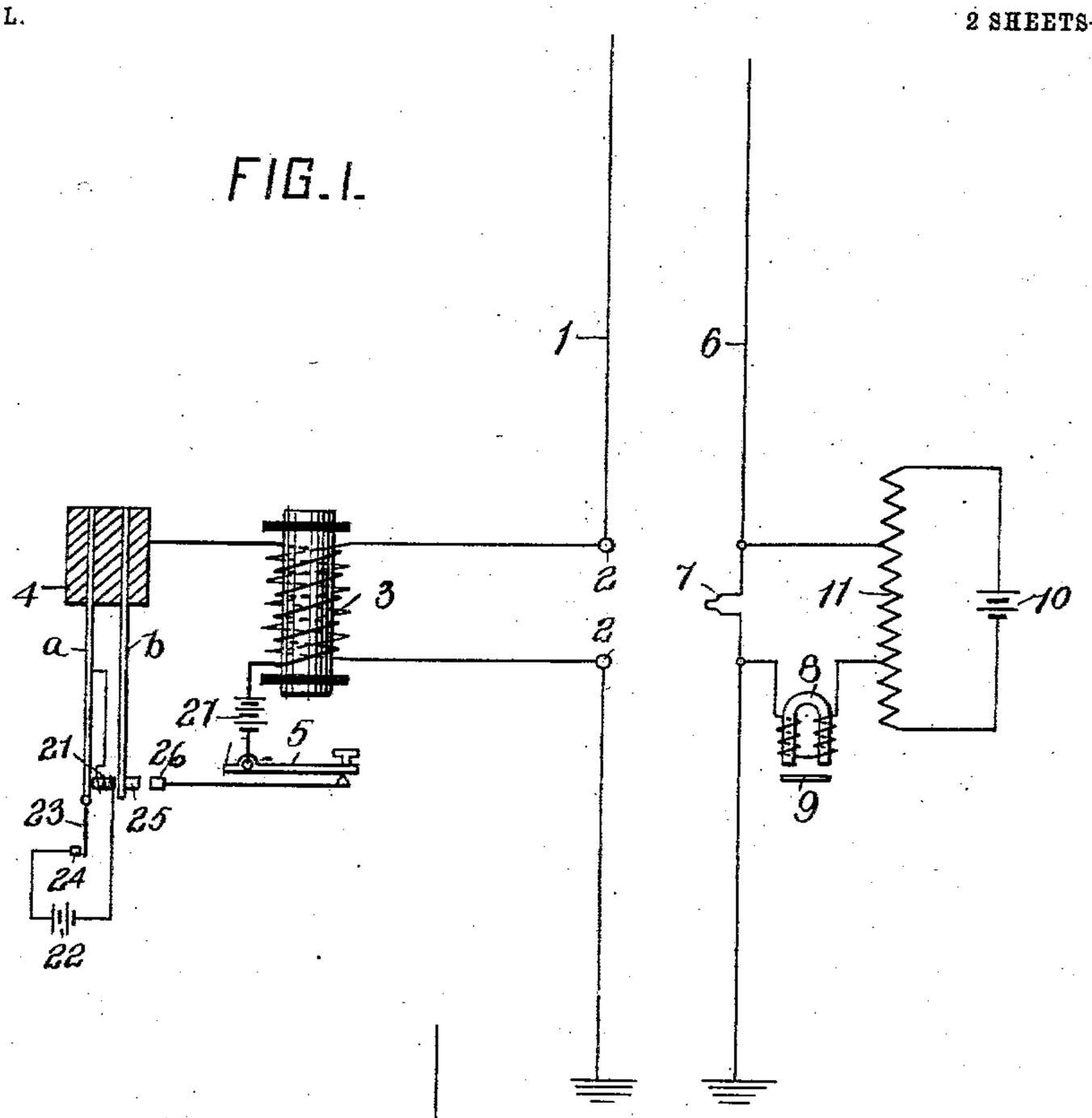
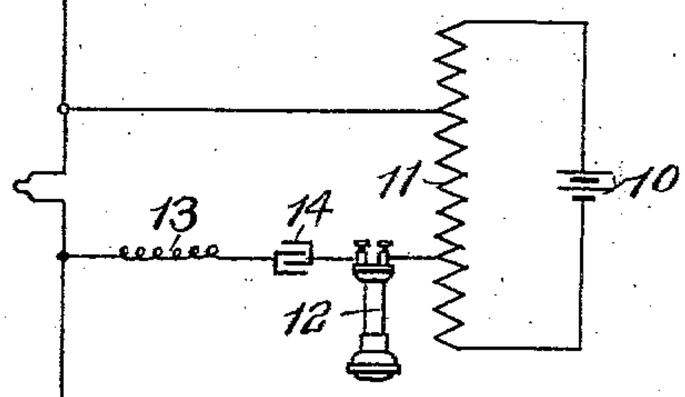


FIG. 2.



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SELECTIVE SIGNALING.

APPLICATION FILED DEC. 29, 1902.

NO MODEL. 2 SHEETS—SHEET 2.

FIG. 3.

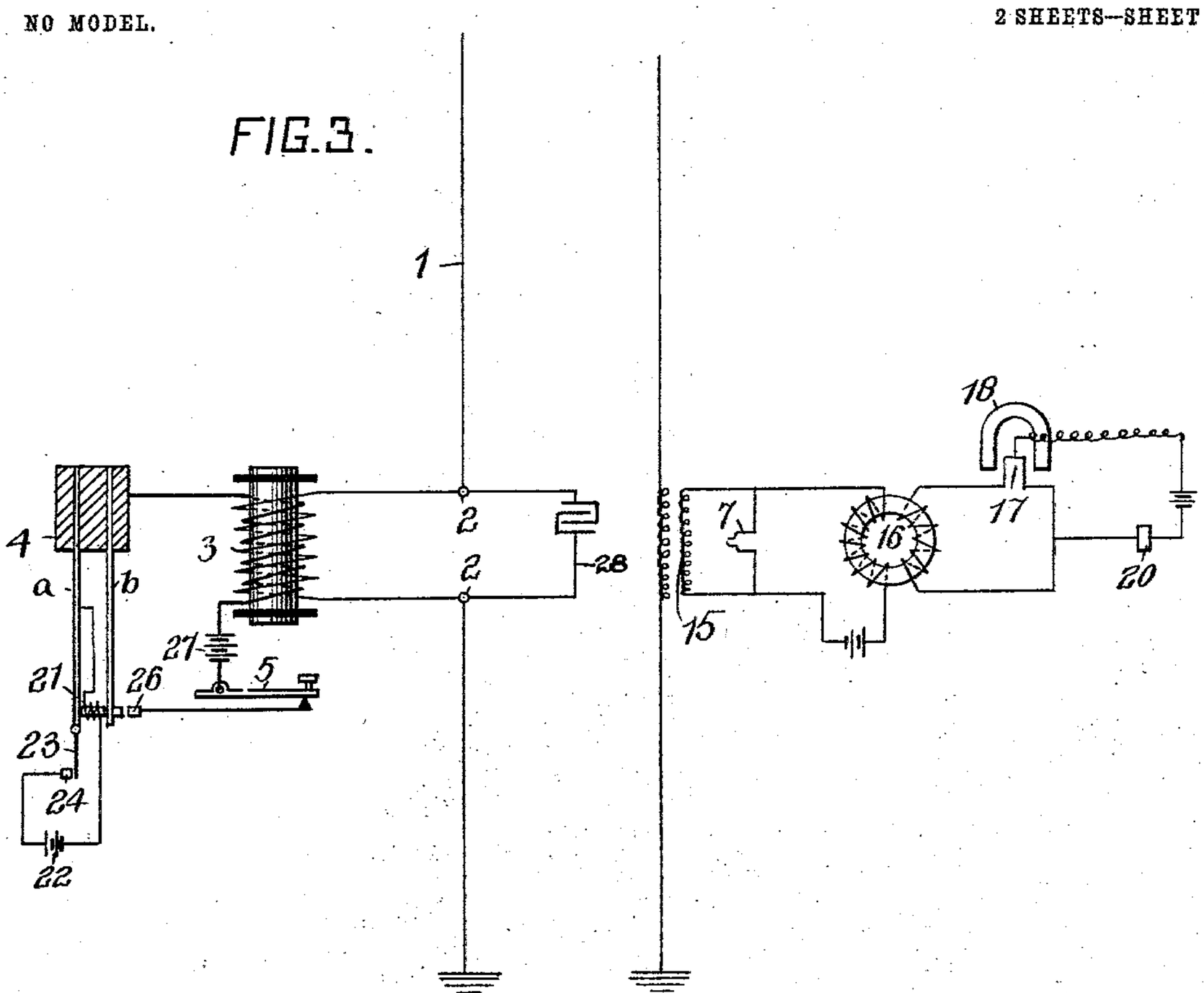
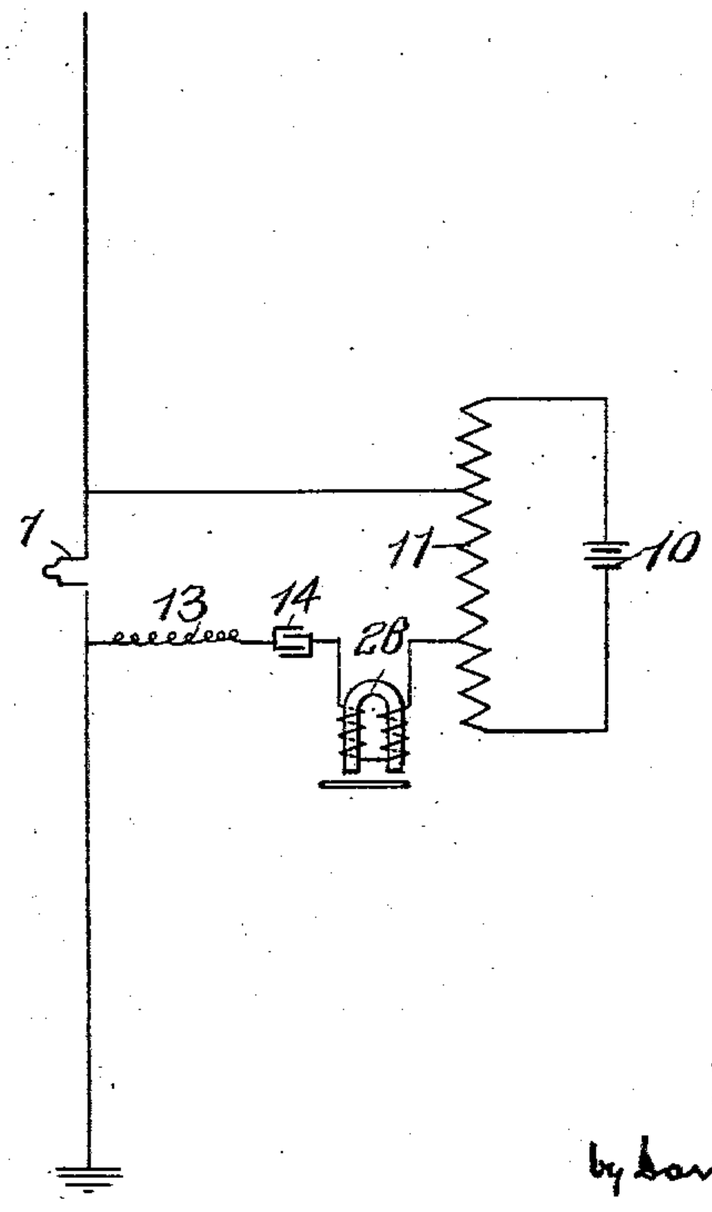


FIG. 4.



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No. 752,894. Patented February 23, 1904.

UNITED STATES PATENT OFFICE.

REGINALD A. FESSENDEN, OF FORT MONROE, VIRGINIA, ASSIGNOR, BY DIRECT AND MESNE ASSIGNMENTS, TO THE NATIONAL ELECTRIC SIGNALING COMPANY, OF PITTSBURG, PENNSYLVANIA, A CORPORATION OF NEW JERSEY.

SELECTIVE SIGNALING.

SPECIFICATION forming part of Letters Patent No. 752,894, dated February 23, 1904.

Application filed December 29, 1902. Serial No. 136,968. (No model.)

To all whom it may concern:

Be it known that I, REGINALD A. FESSENDEN, a citizen of the United States, residing at Fort Monroe, in the county of Elizabeth City and State of Virginia, have invented or discovered certain new and useful Improvements in Selective Signaling, of which improvements the following is a specification.

The invention described herein relates to certain improvements in communicating between stations by electromagnetic waves.

The invention relates more especially to a selective system of signaling whereby one station will receive its proper signals, other stations being cut out or non-responsive, and also to securing freedom from disturbing influences during signaling. In the methods heretofore employed freedom from disturbances and selectivity have been secured by electrically tuning the sending and receiving apparatus at the different stations, each station having a separate electrical tune. This method, while efficient for a great many purposes, requires a great deal of care in its operation and the adjustment of the mechanism in maintaining the stations in tune. A better selectivity and greater freedom from disturbances can be obtained by mechanical tuning or mechanical and electrical tuning.

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 a desirable form of apparatus and circuits for the sending and receiving stations. Figs. 2 and 3 illustrate modifications in the form of apparatus and circuits for receiving-stations, Fig. 3 also including a sending-station; and Fig. 4 is another form of selective receiving-circuits.

In the practice of my invention electromagnetic waves are generated with a certain predetermined frequency—as, for example, two million per second—in groups which have a frequency different from the frequency of the waves composing said groups—as, for example, a frequency of one hundred and twenty-six (126) per second. Any suitable form of construction of apparatus may be employed for thus generating the electromagnetic waves in groups—as, for example, an induction-coil having a spark-gap connected in the usual manner and a make-and-break mechanism for the induction-coil actuated by a tuning-fork or other suitable means operative at a rate corresponding to the group frequency desired—say one hundred and twenty-six (126) times per second.

At the receiving-station the wave-responsive device is connected to an indicating mechanism or apparatus capable of responding only to the group periodicity—*e. g.*, one hundred and twenty-six (126) per second—generated at the sending-station. Such a device, for example, may consist of an electrically-operated tuning-fork capable of responding to vibrations of the group period or of a tongue attached to a telephone tuned to that frequency, so that unless the indicating mechanism—*e. g.*, the tuning-fork or telephone at the receiving-station—is tuned to the group frequency no indications or signals will be produced at the receiving-station.

In the construction shown in Fig. 1 the vertical wire 1 is connected to one terminal of the spark-gap 2, the opposite terminal thereof being grounded. Both terminals of the spark-gap are connected to the terminals of the secondary of an induction-coil 3, and in the primary circuit of the induction-coil is included a tuning-fork make-and-break mechanism, which is operated by a local circuit, so as to vibrate by preference continuously.

As shown in Fig. 1, the prongs *a* and *b* of the tuning-fork 4 are arranged on opposite sides of an electromagnet 21, having one terminal connected to a battery 22 and the other terminal to the prong *a*, to which is secured a flexible spring 23 in such manner as to make and break contact with the stationary contact 24 as the prong vibrates, said contact being connected to the other terminal of the battery 22. The primary circuit of the induction-coil 3 includes the prong *b*, carrying a contact-point

25, a stationary contact-point 26, and a battery 27. By closing the key 5 in the primary of the induction-coil sparks will be produced at the spark-gap at the rate of one hundred and twenty-six (126) per second, and as long as the key 5 is kept closed the primary circuit of the induction-coil will be closed, and the induction-coil will operate to produce a spark at the spark-gap every time the circuit is broken and completed by the the tuning-fork make-and-break mechanism. As each spark causes a group of electromagnetic waves to be generated, it is evident that there will be one hundred and twenty-six (126) such groups of electromagnetic waves generated and radiated per second. At the receiving-station a wave-responsive device 7 is arranged in series with the receiving-wire 6, such wave-responsive device being preferably a barretter, such as described and claimed in Patent No. 706,744, granted to me August 12, 1902. A telephone 8, having a tongue 9 in place of a diaphragm and tuned so as to respond to one hundred and twenty-six (126) vibrations per second, is connected in the circuit of the barretter, said circuit also including a battery 10. A resistance 11 is so arranged in the circuit as to balance the normal resistance of the barretter. Normally the tongue of the telephone will not vibrate; but as soon as currents are generated by the electromagnetic waves in the receiving-wire the resistance of the barretter is changed, and if proper currents have been generated the tongue 9 will be caused to vibrate.

In the construction shown in Fig. 2 and in lieu of a telephone having a vibrating tongue an ordinary telephone 12 is employed, and the circuit including this telephone is tuned electrically, by means of the inductance 13 and capacity 14, to respond to a group frequency, such as is generated at the sending-station.

It is preferred to combine electrical tuning to group frequency with mechanical tuning to group frequency. A suitable method of accomplishing this result is shown in Fig. 4, where the vertical receiving-conductor 6 is connected to ground and includes in series therewith a barretter 7, which is also in series with a secondary circuit electrically tuned to the group frequency and contains a battery, an inductance, a capacity, and a telephone 28, having a tongue tuned mechanically to the group frequency. In this arrangement, the local or secondary circuit being tuned electrically and the mechanism 28 tuned mechanically, the selection is more pronounced. In practice it is found that a change of less than one-fifth of one per cent. in the group frequency will cause a change from maximum audibility to complete silence.

In addition to tuning to group frequencies I may also tune to wave frequencies, and in such case I prefer to employ an auxiliary circuit 28 at the sending-station, such as that shown in Fig. 3, said circuit operating in a manner well known in the art and fully described in Letters Patent No. 706,735, granted to me August 12, 1902, to prolong the electrical oscillations and permit of a sharp electrical tuning. At the receiving-station the wave-responsive device, as the barretter 7, is preferably placed in the circuit of the secondary of a transformer 15, the primary of said transformer being in series with the receiving-conductor. In the same circuit is included the primary of a second transformer 16 and a local battery. In the circuit of the secondary of this second transformer 16 is included a loop 17, preferably formed of silver or phosphor-bronze rolled out into a strip and arranged in a strong magnetic field produced by a permanent magnet 18. This loop is connected to one terminal of the indicating-circuit containing the indicating device 20 and is so arranged that when caused to vibrate it will make contact with the other terminal 19 of the indicating-circuit, closing the latter. On waves being received a current is generated in the secondary of the first transformer which alters the resistance of the barretter or wave-responsive device, causing a change of current in the primary of the second transformer. This causes a current in the secondary of the latter transformer, said secondary having, by preference, fewer turns than the primary, so causing the loop to vibrate and make or break the indicating-circuit, including the indicating or recording device 20. Where electrical tuning is used in addition to mechanical tuning, it is preferred that all the groups of stations which are intended to communicate with each other should be tuned to the same wave frequency, but to different group frequencies.

In many cases it is preferable to combine all three methods herein described—*i. e.*, a receiving-station having one circuit tuned electrically to the wave frequency, one circuit tuned electrically to the group frequency, and a mechanism tuned mechanically to the group frequency. Such a construction is shown in Fig. 4, where the receiving-conductor 6 is tuned electrically to the wave frequency, the secondary circuit is tuned electrically to the group frequency, and the mechanism 28, consisting of a telephone with tuned tongue, is tuned mechanically to the group frequency.

While the constructions herein described are suitable and for many purposes desirable, the invention is not limited to the particular forms or constructions shown; but any suitable form or construction whereby electromagnetic waves are generated in any desired group frequency and such waves are operative at the receiving-station to produce intelligible indications or signals may be employed—as, for example, an apparatus substantially similar to that shown in Fig. 10 of Letters Patent No. 706,742, granted to me August 12, 1902, may be used for generating electromagnetic waves

at the desired group frequency, and at the receiving-station I may employ apparatus substantially as that shown and described in Fig. 8 of said patent.

By the term "mechanical" frequencies as used herein is meant frequencies such as are found in or dealt with in mechanical problems, and more especially such frequencies as are concerned with the production of musical notes.

I claim herein as my invention—

1. As an improvement in the art of signaling by electromagnetic waves the method described herein which consists in generating electrical oscillations at a sending-station, radiating prolonged series of electromagnetic waves from the sending-station, in groups of a predetermined frequency lower than the frequency of the waves forming said groups, receiving said waves at a receiving-station, and producing indications or signals at the receiving-station by selecting groups of the predetermined frequency, substantially as set forth.

2. As an improvement in the art of signaling by electromagnetic waves the method described herein which consists in generating electrical oscillations at a sending-station, radiating prolonged series of electromagnetic waves from the sending-station, in groups of a predetermined frequency lower than the frequency of the waves forming said groups, receiving said waves at a receiving-station on a current-operated receiver, and producing indications or signals at the receiving-station by selecting groups of the predetermined frequency, substantially as set forth.

3. As an improvement in the art of signaling by electromagnetic waves the method described herein which consists of producing prolonged electrical oscillation in an auxiliary circuit at a sending-station, radiating prolonged series of electromagnetic waves from the sending-station, in groups of a predetermined frequency lower than the frequency of the waves forming said groups, receiving said waves at a receiving-station, and producing indications or signals at the receiving-station by selecting groups of the predetermined frequency, substantially as set forth.

4. As an improvement in the art of signaling by electromagnetic waves the method described herein which consists in generating electrical oscillations at a sending-station, radiating prolonged series of electromagnetic waves from the sending-station, in groups of a predetermined frequency lower than the frequency of the waves forming said groups, receiving said waves at a receiving-station tuned to the frequency of the electrical waves, and producing indications or signals at the receiving-station.

5. As an improvement in the art of signaling by electromagnetic waves the method described herein which consists of producing prolonged electrical oscillations in an auxiliary circuit at a sending-station, radiating prolonged series of electromagnetic waves from the sending-station, in groups of a predetermined frequency lower than the frequency of the waves forming said groups, receiving said waves at a receiving-station tuned to the frequency of the waves, and producing indications or signals at the receiving-station by selecting groups of the predetermined frequency, substantially as set forth.

6. As an improvement in the art of signaling by electromagnetic waves, the method herein described which consists in generating electromagnetic waves of a predetermined frequency in groups of a predetermined group frequency lower than that of the waves and producing signals or indications at the receiving-station by selecting electrically waves of a predetermined wave frequency, and selecting mechanically groups formed of such electrically-selected waves and of the predetermined frequency, substantially as set forth.

In testimony whereof I have hereunto set my hand.

REGINALD A. FESSENDEN.

Witnesses:
R. G. BAILEY,
T. L. SCLATER.