No. 768,002. PATENTED AUG. 16, 1904.

J. S. STONE.

SPACE TELEGRAPHY.

APPLICATION FILED MAR. 25, 1904.

NO MODEL.

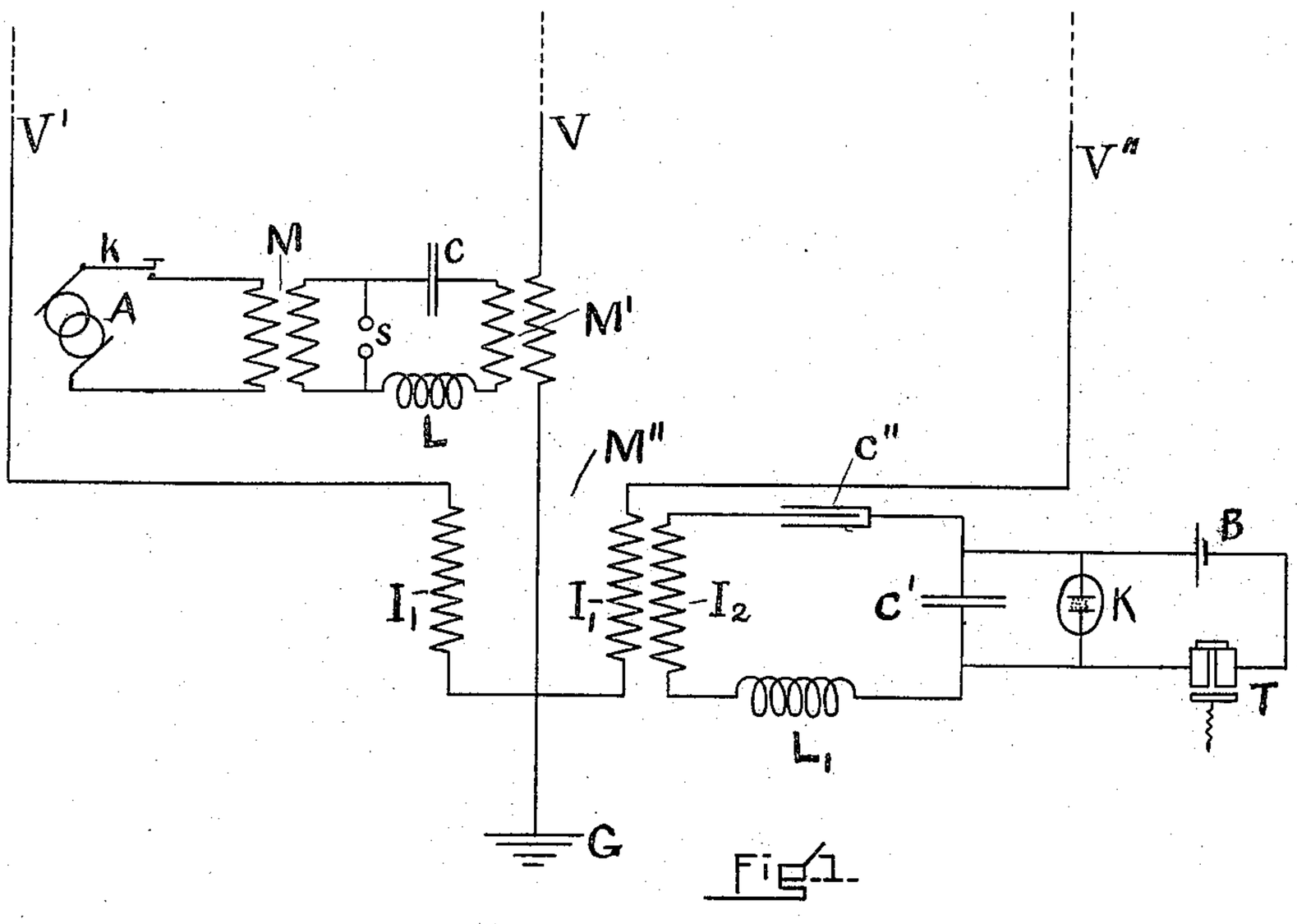

Fig. 1.

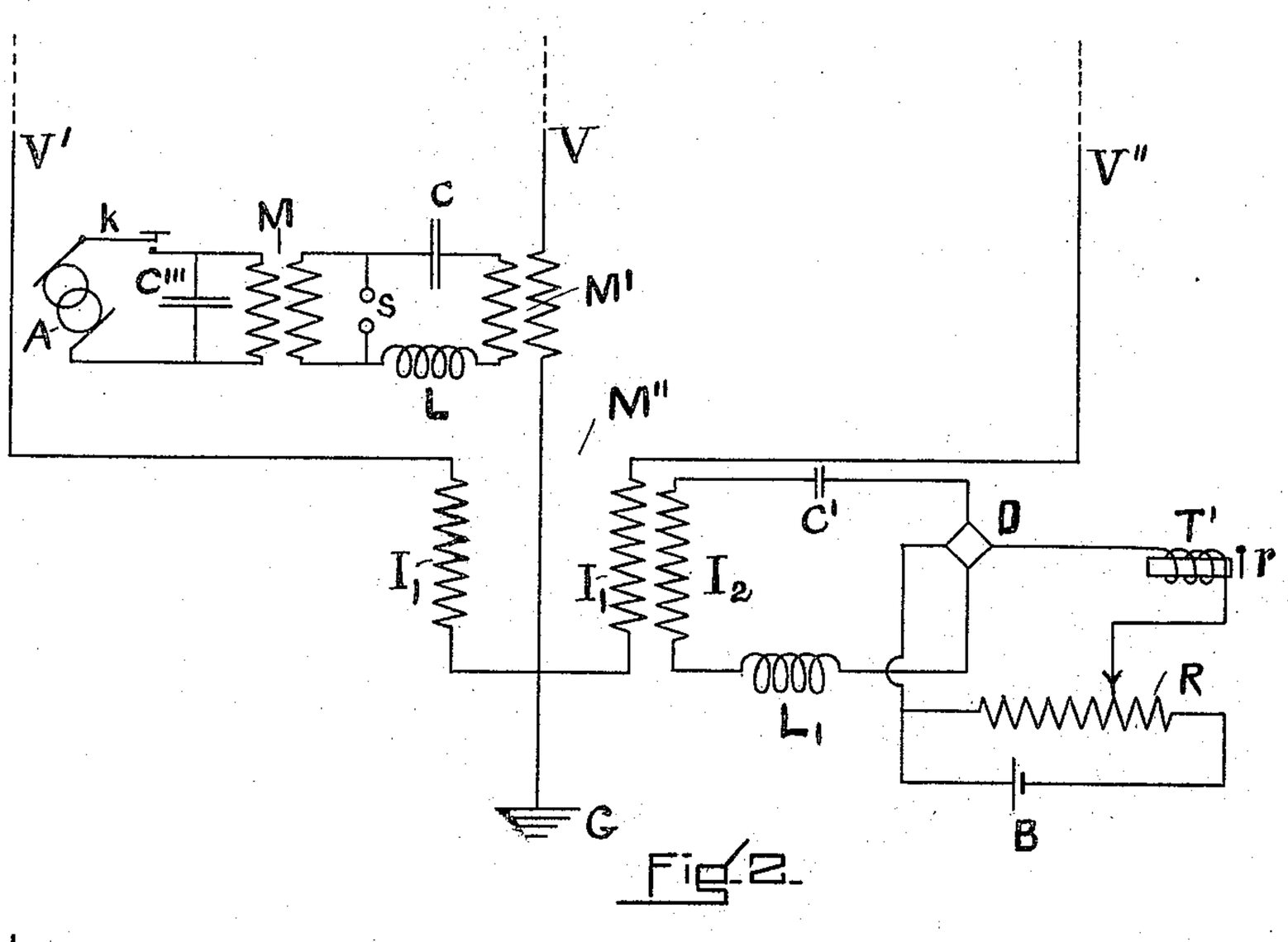

Fig. 2.

WITNESSES.
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No. 768,002. Patented August 16, 1904.

UNITED STATES PATENT OFFICE.

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SPACE TELEGRAPHY.

SPECIFICATION forming part of Letters Patent No. 768,002, dated August 16, 1904.

Original application filed November 25, 1903, Serial No. 182,627. Divided and this application filed March 25, 1904. Serial No. 199,924. (No model.)

To all whom it may concern:

Be it known that I, JOHN STONE STONE, a citizen of the United States, and a resident of Cambridge, in the county of Middlesex and State of Massachusetts, have invented a certain new and useful Improvement in Space Telegraphy, of which the following is a specification.

The present invention depends upon the fact that if in a vertical conductor or conductors lying in a plane equidistant at all points from two other vertical conductors there be developed electrical oscillations then the oscillations thereby developed in the last-named conductor or conductors will be equal in amplitude and phase. Further, if the effects of these oscillations upon a receiving device be opposed to one another their resultant effect upon said receiving device will be *nil*.

By my invention I utilize as a transmitting-conductor a conductor or conductors lying in a plane equidistant at all points from two other vertical conductors which are utilized as receiving-conductors, and I cause the oscillations developed in the receiving-conductors to be opposed to one another in their effect upon a receiving or translating device associated with them. This may be done by means of a variety of apparatus of the nature of induction-balances, some forms of which will be hereinafter described. Careful consideration will show that the two vertical receiving-conductors will be incapable of receiving signals from any transmitting-station in their equatorial plane, but will in general be capable of receiving signals from stations otherwise located. In order that they may be most sensitive to the signals from distant transmitting-stations, these two conductors should be placed at a distance apart of one-half a wave length and in the vertical plane including the distant transmitting-station to be communicated with. If it be desired to receive from more than one transmitting-station, the two receiving-wires may be mounted upon a frame capable of rotation around a central vertical axis.

In the drawings accompanying and forming a part of this specification, Figures 1 and 2 illustrate two forms of apparatus and circuit arrangements whereby the method hereinafter claimed may be carried into effect. My invention, however, is broader than mere apparatus and may be carried out by a variety of apparatus and circuit arrangements, while the particular apparatus herein described forms no part of the present invention, having been claimed in my application, Serial No. 182,627, filed November 25, 1903, of which this application is a division.

In the figures, V V′ V″ are vertical conductors. G is a ground connection. M M′ M″ are induction-coils or transformers. I_1 I_1 are the primaries, and I_2 is the secondary, of the transformer M″. C C′ C″ C‴ are condensers. B is a battery. R is a resistance. T is a relay or suitable signal-indicating device. T′ is an electromagnet with a mechanically-attuned armature *r*, such as is well known in reed telegraphy, or a monotelephone—*i. e.*, a telephone responding to impulses of current from the battery B of a definite predetermined frequency only. K is a receiver or wave-detector, which may be a coherer. D is a self-restoring wave-detector, which may be a bolometer. L L_1 are inductances. *k* is a key. A is an alternating-current generator or other source of periodically-varying electromotive force. *s* is a spark-gap.

In my Letters Patent No. 716,955, dated December 30, 1902, I have described a system for simultaneously transmitting and receiving space-telegraph signals identical in every respect with the system described herein except in this, that the closed circuit containing the receiver K, associated with the differential coil M″, is not described as attuned to absorb the energy of electrical oscillations of a frequency different from that of the oscillations developed by the sonorous circuit *s* C M′ L. Reference may therefore be had to said Letters Patent for details of apparatus and the operation thereof. Such attuning of said closed circuit is not absolutely necessary; but less care need be taken in the adjustment of the primary windings of the coil M″ if the

period of the circuit associated with the receiver be different from that of the oscillations developed in the elevated conductors V' V'' by electromagnetic waves radiated by the transmitting-conductor V, the frequency of said waves being determined by the electromagnetic constants of the sonorous circuit *s* C M' L.

The frequency to which the resonant circuit I_2 C'' C' L_1 is attuned is determined by the electromagnetic constants of said resonant circuit and is different from the frequency of the electrical oscillations developed by the sonorous circuit *s* C M' L and is therefore different from the frequency of the waves radiated by the elevated conductor V, with which said sonorous circuit is associated.

In Fig. 2 the receiver or wave-detector is diagrammatically illustrated as a bolometer, the fine wires or strips of which form a parallelogram the sides of which are identical in every respect, so that the parallelogram constitutes a balanced Wheatstone's bridge, to the equipotential points of which the local circuit containing the signal-indicating device is connected, thus avoiding the use of choking-coils, which would be necessary were a single fine wire or strip employed. Such bolometer has been described by me in my application Serial No. 119,211, in which I have pointed out that the thermal time constant, and therefore the mass—that is, the length and section—should be small compared with the thermal time constant and the mass of somewhat similar instruments heretofore used for determining the wave length of waves in wires. The bolometer diagrammatically illustrated in Fig. 2, however, is merely illustrative or typical of any suitable self-restoring wave-detector, and in lieu thereof I may employ the receiver described in the British patent to Brown, No. 28,955, of 1896, which consists of a metallic tripod resting upon a metallic plate. I may also employ the receiver, consisting of fine steel needles bridging two carbon electrodes, which has been described in the Russian patent granted to Alexandre Popoff, No. 6,066, June 14, 1899, and also described by said Popoff in the *Comptes Rendus de l'Academie des Sciences*, Tome 131, December 15, 1900, page 1296, and in the *Rapports du Congres International de l'Electricite*, August 18 to 25, 1900, page 460.

The signal-indicating device in this case is an electromagnet T', having a reed-armature *r* mechanically attuned to respond to a predetermined number of impulses of battery-current per second corresponding to the number of times per second the bolometer or other self-restoring wave-detector varies the flow of current from the potentiometer R through the windings of the magnet T'. The number of times per second that the wave-detector changes its resistance corresponds to the group or wave-train frequency of the electromagnetic waves transmitted from a distant station and absorbed by the resonant circuit I_2 C' D L_1, as explained in my application Serial No. 182,629. This group or wave-train frequency, sometimes called "spark frequency," is to be made different from the group or wave-train frequency of electromagnetic waves transmitted by the elevated conductor V at the home station—*i. e.*, different from the number of times per second that the condenser C is charged by the alternating-current generator A.

The operation of the system is as follows: If the electrical oscillations developed in conductors V' V'' by electromagnetic waves transmitted by conductor V are not completely neutralized as regards the secondary I_2 of the differential coils I_1 I_1, then the oscillations developed in the resonant circuit I_2 C'' C' L_1 or the resonant circuit I_2 C' D L_1, not being of the frequency to which said circuits are made resonant, are of too small amplitude to effect the response of the receiver. As an extra precaution if the electrical oscillations developed in said resonant circuit are of sufficient amplitude to effect the response of the receiver D, which if it be a bolometer is exceedingly sensitive to currents of very small amplitude, notwithstanding the fact that a resonant circuit strongly opposes the development therein of currents of frequencies different from that to which it is attuned, then by using the signal-indicating device T' attuned mechanically to a given spark frequency the generation or radiation of electromagnetic waves at a station can be accomplished without effecting any response of the signal-indicating device—*i.e.*, the receiver is maintained in a condition to receive signals from a distant transmitting-station at the same time that signals are being transmitted from the home transmitting-station.

I claim—

1. The method of simultaneously transmitting and receiving space-telegraph signals which consists in generating electromagnetic signal-waves of a definite frequency at a station, neutralizing the effects of such generation on an electroreceptive device at the same station, amplifying the electrical oscillations resulting from electromagnetic signal-waves received from a distant transmitting-station by means of a resonant circuit attuned to the frequency of said oscillations, and utilizing said oscillations to actuate said electroreceptive device and to thereby produce intelligible signals in a signal-indicating device.

2. The method of simultaneously transmitting and receiving space-telegraph signals which consists in generating electromagnetic signal-waves of definite group or wave-train frequency at a station, neutralizing the effects of such generation on an electroreceptive device at the same station, and utilizing the energy of electromagetic signal-waves of a different group or wave-train frequency

transmitted from a distant station to actuate said electroreceptive device and to thereby produce intelligible signals in a signal-indicating device, mechanically attuned to the group or wave-train frequency of the waves the energy of which is to be received.

3. In space telegraphy, the method herein described of preventing electromagnetic signal-waves the energy of which is not intended to be received from effecting the response of a signal-indicating device, which consists in absorbing the energy of said waves by two elevated receiving-conductors, neutralizing the effects of the resulting electrical oscillations on an electroreceptive device and attuning said signal-indicating device mechanically to respond to currents of a predetermined frequency different from the group or wave-train frequency of said waves.

4. The method of simultaneously transmitting and receiving space-telegraph signals which consists in generating or transmitting electromagnetic signal-waves of a definite frequency at a station, neutralizing the effects of such generation or transmission on an electroreceptive device at the same station, selectively receiving at said station the energy of electromagnetic signal-waves of a different frequency transmitted from a distant station, and utilizing the energy of the resulting electrical oscillations to produce intelligible signals.

5. The method of simultaneously transmitting and receiving space-telegraph signals which consists in generating or transmitting electromagnetic signal-waves of a definite frequency at a station, neutralizing the effects of such generation or transmission on an electroreceptive device at the same station, selectively receiving at said station the energy of electromagnetic signal-waves transmitted from a distant station, and utilizing the energy of the resulting electrical oscillations to produce intelligible signals.

6. The method of simultaneously transmitting and receiving space-telegraph signals which consists in generating or transmitting electromagnetic signal-waves of a definite frequency at a station, neutralizing the effects of such generation or transmission on an electroreceptive device at the same station, selectively receiving at said station the energy of electromagnetic waves transmitted from a distant station and, utilizing the dissipative energy of the resulting electrical oscillations to produce intelligible signals.

7. The method of simultaneously transmitting and receiving space-telegraph signals which consists in generating electromagnetic signal-waves of definite group or wave-train frequency at a station, receiving at said station the energy of electromagnetic signal-waves of a different group or wave-train frequency transmitted from a distant station, utilizing the energy of the resulting electrical oscillations to produce current impulses corresponding in frequency to the group or wave-train frequency of the waves received and selecting said current impulses to produce intelligible signals.

8. The method of simultaneously transmitting and receiving space-telegraph signals which consists in generating electromagnetic signal-waves of definite group or wave-train frequency at a station, receiving at said station the energy of electromagnetic signal-waves of a different group or wave-train frequency transmitted from a distant station, utilizing the energy of the resulting electrical oscillations to produce current impulses corresponding in frequency to the group or wave-train frequency of the waves received and utilizing said current impulses to produce intelligible signals in a signal-indicating device adapted to respond to current impulses of said frequency to the exclusion of current impulses of other frequencies.

9. The method of simultaneously transmitting and receiving space-telegraph signals which consists in generating electromagnetic signal-waves of definite group or wave-train frequency at a station, receiving at said station the energy of electromagnetic signal-waves of a different group or wave-train frequency transmitted from a distant station, utilizing the energy of the resulting electrical oscillations to produce current impulses corresponding in frequency to the group or wave-train frequency of the waves received and mechanically selecting said current impulses to thereby produce intelligible signals.

10. The method of simultaneously transmitting and receiving space-telegraph signals which consists in generating electromagnetic signal-waves of definite group or wave-train frequency at a station, selectively receiving at said station the energy of electromagnetic signal-waves of a different group or wave-train frequency and utilizing the energy of the resulting electrical oscillations to produce intelligible signals.

11. The method of simultaneously transmitting and receiving space-telegraph signals which consists in generating electromagnetic signal-waves of definite group or wave-train frequency at a station, receiving at said station the energy of electromagnetic signal-waves of a different group or wave-train frequency and utilizing the energy of the resulting electrical oscillations to produce intelligible signals.

12. The method of receiving space-telegraph signals which consists in absorbing the energy of electromagnetic signal-waves of a definite frequency and of predetermined group or wave-train frequency, amplifying the resulting electrical oscillations by means of a resonant circuit attuned to the frequency of said electrical oscillations, utilizing the energy of said oscillations to produce current impulses

corresponding in frequency to the group or wave-train frequency of the waves received and selecting said current impulses to produce intelligible signals.

13. The method of receiving space-telegraph signals which consists in absorbing the energy of electromagnetic signal-waves of a definite frequency and of predetermined group or wave-train frequency, amplifying the resulting electrical oscillations by means of a resonant circuit attuned to the frequency of said electrical oscillations, utilizing the energy of said oscillations to produce current impulses corresponding in frequency to the group or wave-train frequency of the waves received and utilizing said current impulses to produce intelligible signals in a signal-indicating device adapted to respond to current impulses of said frequency to the exclusion of current impulses of other frequencies.

14. The method of receiving space-telegraph signals which consists in absorbing the energy of electromagnetic signal-waves of a definite frequency and of predetermined group or wave-train frequency, amplifying the resulting electrical oscillations by means of a resonant circuit attuned to the frequency of said electrical oscillations, utilizing the energy of said oscillations to produce current impulses corresponding in frequency to the group or wave-train frequency of the waves received and mechanically selecting said current impulses to thereby produce intelligible signals.

15. The method of receiving space-telegraph signals which consists in selectively receiving the energy of electromagnetic signal-waves of definite frequency and of predetermined group or wave-train frequency, developing by the resulting electrical oscillations current impulses corresponding in frequency to the group or wave-train frequency of the waves received and selecting said current impulses to produce intelligible signals.

16. The method of receiving space-telegraph signals which consists in selectively receiving the energy of electromagnetic signal-waves of definite frequency and of predetermined group or wave-train frequency, developing by the resulting electrical oscillations current impulses corresponding in frequency to the group or wave-train frequency of the waves received and utilizing said current impulses to produce intelligible signals in a signal-indicating device adapted to respond to current impulses of said frequency to the exclusion of current impulses of other frequencies.

17. The method of receiving space-telegraph signals which consists in selectively receiving the energy of electromagnetic signal-waves of definite frequency and of predetermined group or wave-train frequency, developing by the resulting electrical oscillations current impulses corresponding in frequency to the group or wave-train frequency of the waves received and mechanically selecting said current impulses to thereby produce intelligible signals.

In testimony whereof I have hereunto subscribed my name this 23d day of March, 1904.

JOHN STONE STONE.

Witnesses:

ALEX. P. BROWNE,

BRAINERD T. JUDKINS.