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J. S. STONE.

APPARATUS FOR SIMULTANEOUSLY TRANSMITTING AND RECEIVING SPACE TELEGRAPH SIGNALS.

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NO MODEL.

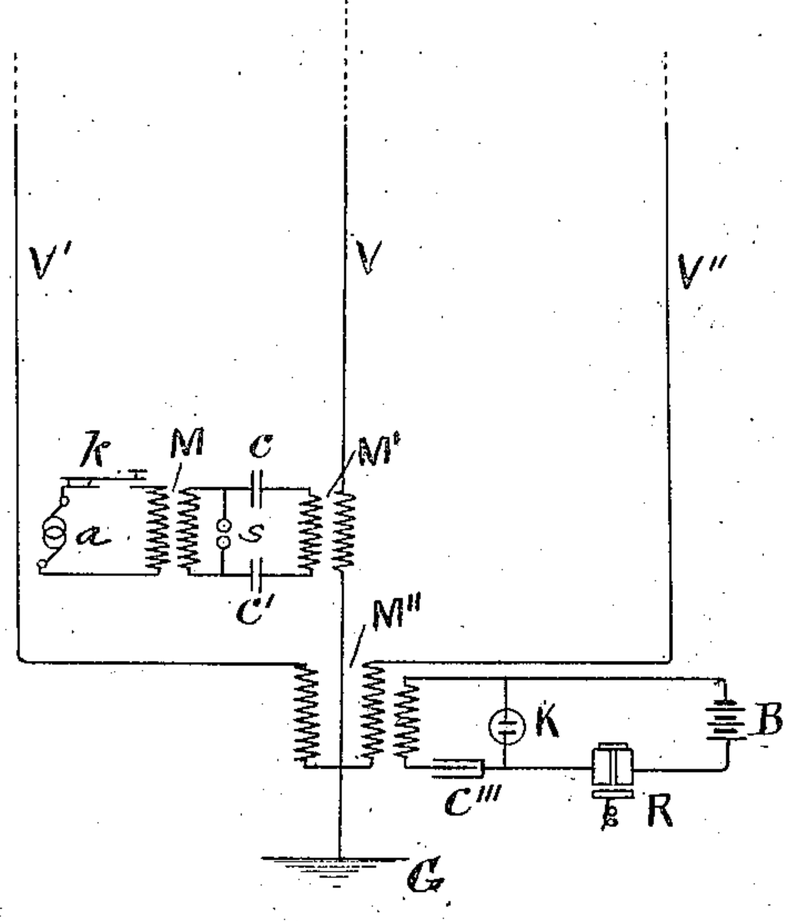

Fig. 1.

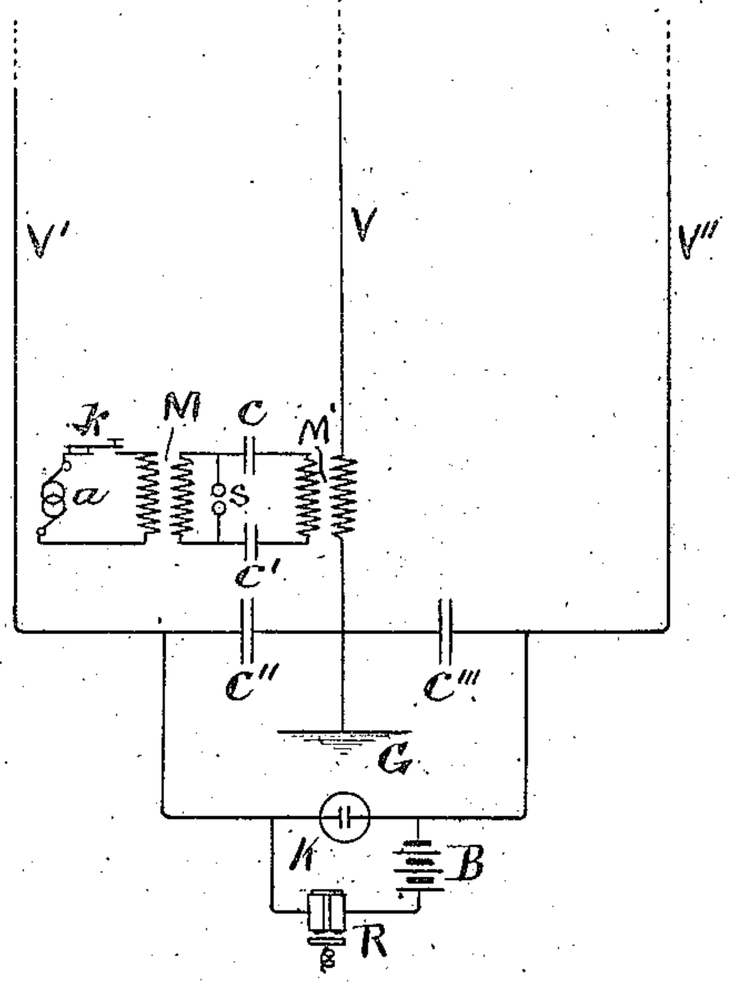

Fig. 2.

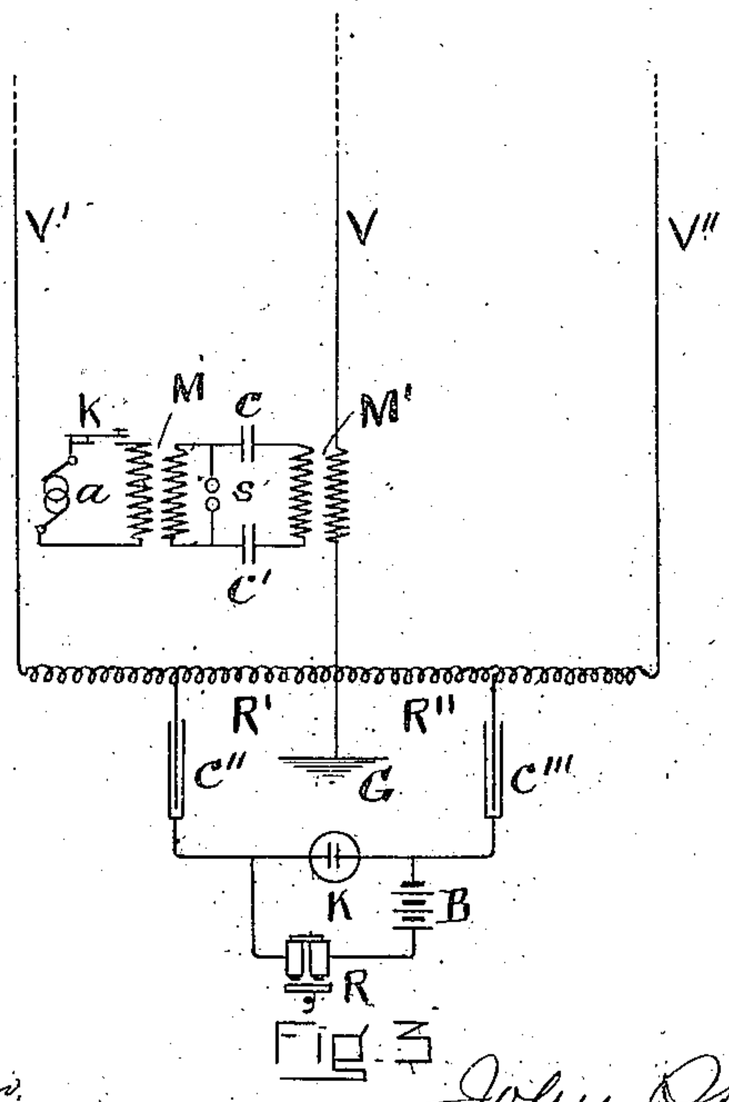

Fig. 3.

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APPARATUS FOR SIMULTANEOUSLY TRANSMITTING AND RECEIVING SPACE-TELEGRAPH SIGNALS.

SPECIFICATION forming part of Letters Patent No. 767,970, dated August 16, 1904.

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To all whom it may concern:

Be it known that I, JOHN STONE STONE, a citizen of the United States, and a resident of Boston, in the county of Suffolk and State of Massachusetts, have invented certain new and useful Improvements in Apparatus for Simultaneously Transmitting and Receiving Space-Telegraph Signals, 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 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 I utilize 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.

Figures 1, 2, and 3 show certain embodiments of the invention.

In the figures, V V′ V″ are vertical conductors. G is a ground. M M′ M″ are induction-coils. C C′ C″ C‴ are condensers. B is a battery. R is a relay or other signal-indicating device. K is a coherer. *a* is a generator of vibratory currents. *k* is a key. *s* is a spark-gap. R′ and R″ are equal resistances or inductances.

It is to be understood that the coherer herein described is merely illustrative of any receiver of electromagnetic waves or other electric translating device, and it is to be further understood that I do not desire my claims to be limited to any particular receiving means, but, on the contrary, that I consider any and all means to be covered by the terms used in the claims to designate the device whereby the reception of electromagnetic waves is effected.

Electrical oscillations may be developed in the transmitting-conductor V in any suitable manner, which need not further be considered here. When such oscillations are developed, corresponding oscillations equal in amplitude and phase will be produced in the receiving-conductors V′ V″ and their effects upon the coherer K neutralize each other, owing to the fact that the latter is, in effect, in a branch of an induction-balance, which branch is conjugate to the vertical transmitting-conductor V.

The three forms of induction-balance shown in the several figures are common forms, the one shown in Fig. 1 being merely an inductance-coil having similar but differentially-wound primaries, the one shown in Fig. 2 being merely the equivalent of substituting two equal condensers for the two bridge-arms of a Wheatstone bridge, and Fig. 3 being, in effect, a Wheatstone bridge. The electrical translating device or coherer shown in the drawings is always included in the "telephone" branch of the bridge or induction-balance.

The vertical transmitting-conductor may be garded in each case as the battery branch, d the intervening dielectric between this nductor and the two receiving-conductors ' V'' may be regarded as constituting the reáining two branches of the induction-balces.

In the operation of the organization shown Fig. 1 the signal-waves emanating from the ntrally-located vertical conductor V develop otentials in the two similar conductors V' id V'' which are equal in amplitude, form, id phase. The two primary coils of M'', rough which V' and V'' are grounded, are ual in every respect and disposed symmetcally with respect to the remaining or secdary coil of M''. Equal electric oscillations re therefore developed in the conductors V' I'' G and V'' M'' G; but the primary coils of I'' are so disposed as to oppose each other in eir action upon the secondary of M'', and e result upon this coil of the electric oscillaons in the two primaries is therefore *nil*. 'or this reason the coherer and its associated ignal-indicating device are not operated by ne signal-waves sent out from the vertical onductor V. The signal-waves from a disant transmitting-station in the plane of the ertical wires V' V'' will if their wave length e twice the distance which separates V' and '' develop in V' and V'' electric potentials qual in amplitude, but not in phase. The lectric oscillations in the two conductors V' I'' G and V'' M'' G will therefore be equal nd opposite, and their effect upon the secndary of M'' will be to produce electric osillations in the local circuit containing the oherer K, which is thereby operated and vhich consequently permits the battery B to perate the signal-indicating device R. Simiarly, in the operation of the organization hown in Fig. 2 the signal-waves from the conluctor V produce equal electric oscillations in he similar conductors V' C'' G and V'' C''' G. The condensers C'' and C''' being equal, the poential of the branch containing the coherer K is changed as a whole; but no difference of potential is developed therein, and therefore he coherer is not operated, and the associated signal-indicating device is not set in motion. As in the case of the organization shown in Fig. 1, the waves from the distant transmitterstation produce unequal electric vibrations in the conductors V' C'' G and V'' C''' G. This causes a difference of potential in the coherer branch, which operates the coherer, and thereby sets in motion the signal-indicating device R.

The operation of the organization shown in Fig. 3 is the same as that shown in Fig. 2, except that two equal resistances R' R'' are employed instead of the two equal condensers C'' C''' of Fig. 2.

I claim—

1. In a system of space telegraphy, means for transmitting and simultaneously or otherwise receiving signal-waves comprising means for developing electric vibrations in an elevated transmitting conductor or conductors situated in a plane equidistant at all points from two or more receiving elevated conductors, and means for conveying the energy of the vibrations from the receiving-conductors to an associated electrical translating device whereby the branch containing the electric translating device or receiver is rendered conjugate to the transmitting conductor or conductors.

2. In a system for simultaneously transmitting and receiving electromagnetic signal-waves, means for transmitting electromagnetic signal-waves, means at the transmitting-station for receiving electromagnetic signal-waves, and means for maintaining the receiving means in operative condition for the reception of waves from a distant station during the transmission of waves by the transmitting means.

3. In a system for simultaneously transmitting and receiving electromagnetic signal-waves, a generator of electromagnetic signal-waves, a receiver of electromagnetic signal-waves at the generating-station and means for rendering the receiver unresponsive to waves generated by said generator, without impairing its sensitiveness to waves which are generated by a distant generator simultaneously with waves generated by the first-mentioned generator.

4. In a system for simultaneously transmitting and receiving electromagnetic signal-waves, means for transmitting electromagnetic signal-waves, a receiver for electromagnetic signal-waves at the transmitting-station and means for causing the effects of the transmitted waves on the receiver to be neutralized.

5. In a system of space telegraphy, a receiving system responsive to electromagnetic signal-waves of predetermined wave length, comprising two elevated conductors and a receiver of electromagnetic waves, in combination with means for preventing electromagnetic waves of the same or of a different wave length, transmitted by a system situated approximately in a plane equidistant at all points from the receiving-conductors, from effecting the response of the said receiver without, at the same time, rendering such receiver unresponsive to the waves which it is intended to receive.

6. In a system of space telegraphy, a receiving system comprising two elevated conductors and means responsive to electromagnetic signal-waves when the terminals of such responsive means are subjected to a difference of electrical potential, in combination with means for maintaining an approximately zero

difference of potential at said terminals when electromagnetic waves are transmitted by another system situated approximately in a plane equidistant at all points from said receiving-conductors.

7. In a system for simultaneously transmitting and receiving electromagnetic signal-waves, means for transmitting electromagnetic signal-waves, two elevated receiving-conductors at the transmitting-station, a receiver associated therewith and means associated with said receiving-conductors and receiver, for maintaining the receiver in operative condition for the reception of waves from a distant station during the transmission of waves by the transmitting means.

8. In a system of space telegraphy, a plurality of elevated receiving-conductors situated a distance apart equal to one-half the wave length of the waves to be received and so situated in space that the distant transmitting-conductor and said receiving-conductors are approximately in the same vertical plane, in combination with a receiver and means associated with said receiver and said receiving-conductors for causing vibrations developed in said receiving-conductors by electromagnetic waves of predetermined wave length to be conjoined in their effect on the said receiver.

9. In a system of space telegraphy, a plurality of elevated receiving-conductors separated a distance apart which bears a certain definite relation to the wave length of the electromagnetic signal-waves to be received and whose position in space bears a certain definite relation to the position of the distant source of said waves, in combination with a receiver and means associated with said receiver and said receiving-conductors for causing the energies of the electromagnetic waves absorbed by said receiving-conductors to be conjoined in their effect on said receiver when the said electromagnetic waves are of a certain predetermined wave length.

10. In a system for simultaneously transmitting and receiving electromagnetic signal-waves, a receiving system comprising two oppositely-wound coils, a third coil in inductive relation thereto, and a receiver associated with said third coil.

11. In a system for simultaneously transmitting and receiving electromagnetic signal-waves, a transmitter and a receiver both at the same station, and means for causing the opposition of the effects of the transmitted waves on the receiver and for causing the coöperation of the effects of the received waves on said receiver.

12. In a system of space telegraphy, means for transmitting electromagnetic signal-waves and simultaneously or otherwise receiving other electromagnetic signal-waves without mutual interference, said means comprising means at a station for transmitting electromagnetic signal-waves, means at said station for receiving electromagnetic signal-waves and other means so related to the transmitting means and to the receiving means that mutual interference between the transmitting means and the receiving means is prevented when electromagnetic signal-waves are being transmitted by the said transmitting means at the same time that waves are being received from a distant station by the said receiving means.

13. In a system of signaling by electromagnetic waves, a receiver responsive to electromagnetic waves received at a station while at the same time unresponsive to effects produced by the generation of electromagnetic signal-waves at the station.

14. In a system of signaling by electromagnetic waves, a receiver more sensitve to electromagnetic waves received at the station than to effects produced by the generation of electromagnetic waves at the station at the same time.

15. In a system of signaling by electromagnetic waves, the combination at a station of a receiver for electromagnetic waves and means for generating electromagnetic waves, said elements being adapted to perform their functions simultaneously without interference one with the other.

16. In a system of signaling by electromagnetic waves, the combination at a station of a generator of electromagnetic waves, two conductors, and a receiver for electromagnetic waves in operative relation to said conductors, said conductors being adapted to oppose the effects on the receiver produced by the generation of electromagnetic waves at the station and to conjoin the effects on the receiver produced by electromagnetic waves received at the station.

17. In a system of signaling by electromagnetic waves, the combination at a station of two conductors, and a receiver for electromagnetic waves in operative relation to said conductors, said conductors being adapted to oppose the effects on the receiver produced by transmitting electrical impulses while permitting waves received from a distant station to affect the receiver.

18. In a system of signaling by electromagnetic waves, a radiating system, a receiving system, and a receiver so related to said systems as to be responsive to electromagnetic waves received at the station while at the same time unresponsive to effects produced by the generation of electromagnetic waves at the station.

19. In a system of signaling by electromagnetic waves, a radiating system a receiving system, and a receiver so related to said systems as to be more sensitive to electromagnetic waves received at the station than to effects produced by the generation of electromagnetic waves at the station at the same time.

20. In a system of signaling by electromag-

netic waves, the combination at a station of a system for receiving electromagnetic waves and a system for generating electromagnetic waves, said elements being so related as to perform their functions simultaneously without interference one with the other.

21. In a system of signaling by electromagnetic waves, the combination at a station of a generator of electromagnetic waves, two conductors, and a receiver for electromagnetic waves in operative relation to said conductors, said conductors being so related as to oppose the effects on the receiver produced by the generation of electromagnetic waves at the station and to conjoin the effects on the receiver produced by electromagnetic waves received at the station.

22. In a system of signaling by electromagnetic waves, the combination at a station of two conductors and a receiver for electromagnetic waves in operative relation to said conductors, said conductors being adapted to oppose the effects on the receiver produced by transmitting electromagnetic waves while permitting waves simultaneously transmitted from a distant station to affect the receiver.

23. In a system of signaling by electromagnetic waves, radiating and receiving systems and a receiver so related to said systems as to be unresponsive to effects produced by the generation of electromagnetic waves at the same station but responsive to electromagnetic waves received at the station.

24. In a system of signaling by electromagnetic waves, radiating and receiving systems and a receiver more sensitive to electromagnetic waves received at the station than to effects produced by the generation of electromagnetic waves at the station at the same time.

25. In a system of signaling by electromagnetic waves, radiating and receiving systems at a station and a receiver so connected to said receiving system as to be unresponsive to effects produced by the generation of electromagnetic waves at the same station but responsive to electromagnetic waves received at the station.

26. In a system of signaling by electromagnetic waves, radiating and receiving systems at a station and a receiver so related to said systems as to be responsive to electromagnetic waves received at the station while at the same time unresponsive to effects produced by the generation of electromagnetic waves at the station.

27. In a system of signaling by electromagnetic waves, the combination at a station of a system for receiving electromagnetic waves and a system for transmitting electromagnetic waves, said elements being so related as to perform their functions simultaneously without interference.

28. In a system for simultaneously transmitting and receiving electromagnetic signal-waves, a transmitting system in combination with a receiving system, said receiving system comprising a transformer having two primary windings, and a circuit containing a receiver inductively associated with said primary windings, said windings being so related and so proportioned that the transmitting and receiving systems are enabled to perform their functions simultaneously and without mutual interference.

29. In a system for simultaneously transmitting and receiving electromagnetic signal-waves, a receiving system comprising a differential coil, a secondary winding inductively associated with said differential coil and a receiver operatively connected with said secondary winding.

30. In a system of signaling by electromagnetic waves, radiating and receiving systems at a station and a receiver so related to said receiving system as to be unresponsive to effects produced by the generation of electromagnetic waves at the same station but responsive to electromagnetic waves received at the station.

31. In a system of signaling by electromagnetic waves, radiating and receiving systems at a station and a receiver so connected to said receiving system as to be more responsive to electromagnetic waves received at the station than to effects produced by the generation of electromagnetic waves at the station at the same time.

32. In a system of signaling by electromagnetic waves, an alternating or vibratory current generator, a transformer, electrical connections from said generator to the primary winding of said transformer, electrical connections from the secondary winding of said transformer to a circuit containing a condenser or a plurality of condensers and the primary winding of a second transformer, a conductor containing a spark-gap connected across the terminals of the secondary winding of said first-mentioned transformer and an elevated conductor serially connected to the secondary winding of said second transformer.

33. In a system of signaling by electromagnetic waves, an alternating-current generator, a transformer, electrical connections from said generator to the primary winding of said transformer, a signaling device in said electrical connections, electrical connections from the secondary winding of said transformer to a circuit containing a condenser or a plurality of condensers and the primary winding of a second transformer, a conductor containing a spark-gap connected across the terminals of the secondary winding of said first-mentioned transformer and an elevated conductor serially connected to the secondary winding of said second transformer.

34. In a system of signaling by electromagnetic waves, an alternating-current generator, a transformer, electrical connections from said generator to the primary winding of said transformer, a circuit containing a condenser or a

plurality of condensers connected to the secondary winding of said transformer, a conductor containing a spark-gap connected across the terminals of said secondary winding and an elevated conductor operatively connected with the aforesaid circuit so that the discharge of the condenser or the plurality of condensers therein across the said spark-gap will create electrical oscillations in the elevated conductor.

35. In a system of signaling by electromagnetic waves, an alternating-current generator, a transformer, electrical connections from said generator to the primary winding of said transformer, a signaling device in said electrical connections, a circuit containing a condenser or a plurality of condensers connected to the secondary winding of said transformer, a conductor containing a spark-gap connected across the terminals of said secondary winding and an elevated conductor operatively connected with the aforesaid circuit so that the discharge of the condenser or the plurality of condensers therein across the said spark-gap will create electrical oscillations in the elevated conductors.

36. In a system of signaling by electromagnetic waves, radiating and receiving systems at a station and a receiver so related to said receiving system as to be more responsive to electromagnetic waves received at the station than to effects produced by the generation of electromagnetic waves at the station at the same time.

37. In a system for simultaneously transmitting and receiving electromagnetic signal-waves, a receiving system comprising a plurality of primary windings, a secondary winding associated with said primary windings and a receiver operatively connected with said secondary winding.

38. In a system of space telegraphy, a receiving system comprising two elevated receiving-conductors and a receiver or wave-detector responsive to electromagnetic signal-waves when its terminals are subjected to a difference of electrical potential, in combination with means for maintaining an approximately zero difference of potential at said terminals when electromagnetic signal-waves are transmitted by another system.

39. In a system of space telegraphy, two elevated receiving-conductors situated a distance apart equal to a half-wave length or a multiple of a half-wave length of the electromagnetic waves to be received, a receiver or wave-detector associated with said conductors, and means associated with said conductors and said receiver or wave-detector for causing the energy of the electrical vibrations developed in said receiving-conductors by electromagnetic signal-waves of a definite predetermined wave length to combine to effect the response of said receiver or wave-detector.

40. In a space-telegraph receiving system, a signal-indicating device, and a plurality of elevated receiving-conductors associated therewith, in combination with means adapted to combine the energies of the electrical oscillations developed by electromagnetic waves in said elevated conductors for producing intelligible signals in said signal-indicating device.

41. In a space-telegraph receiving system, two elevated receiving-conductors, a receiver or wave-detector associated therewith, and means associated with said conductors adapted to oppose the effects, on said receiver or wave-detector, of electromagnetic waves or other ether disturbances the energy of which is not intended to be received while permitting waves the energy of which is intended to be received to affect the receiver or wave-detector.

42. In a space-telegraph receiving system, a receiver for electromagnetic waves and two elevated conductors, associated with said receiver and adapted to oppose the effects, on said receiver, of electromagnetic waves or other ether disturbances the energy of which is not intended to affect said receiver.

43. In a space-telegraph receiving system, a receiver for electromagnetic waves and a plurality of elevated conductors, associated with said receiver and adapted to oppose the effects, on the receiver, of electromagnetic waves or other ether disturbances the energy of which is not intended to affect said receiver.

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In presence of—
ALEX. P. BROWNE,
ELLEN B. TOMLINSON.