No. 767,999. PATENTED AUG. 16, 1904.

J. S. STONE.

SPACE TELEGRAPHY.

APPLICATION FILED FEB. 15, 1904.

NO MODEL.

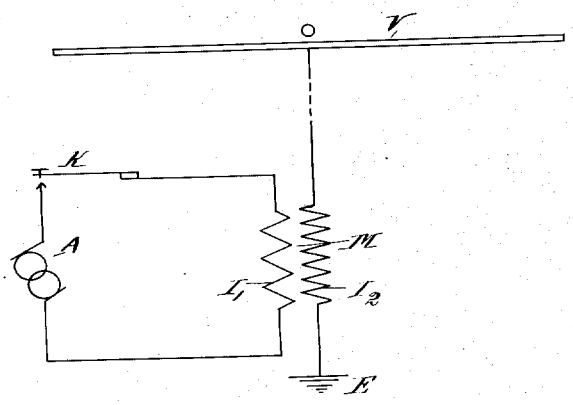

Fig. 1.

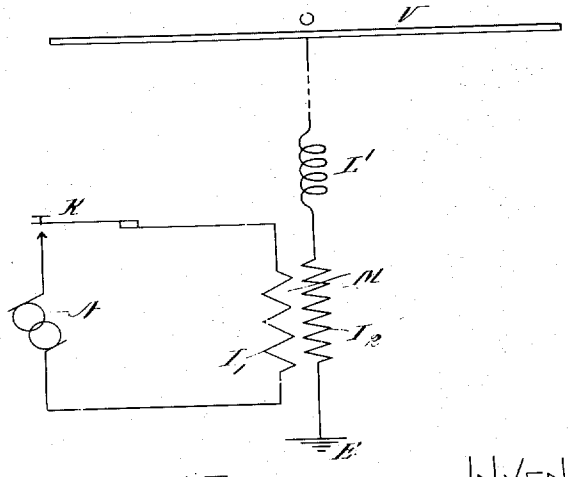

Fig. 2.

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No. 767,999. Patented August 16, 1904.

UNITED STATES PATENT OFFICE.

JOHN STONE STONE, OF CAMBRIDGE, MASSACHUSETTS, ASSIGNOR TO WILLIAM W. SWAN, TRUSTEE, OF BROOKLINE, MASSACHUSETTS.

SPACE TELEGRAPHY.

SPECIFICATION forming part of Letters Patent No. 767,999, dated August 16, 1904.

Original application filed November 25, 1903, Serial No. 182,634. Divided and this application filed February 15, 1904. Serial No. 193,594. (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.

This invention relates to the art of transmitting intelligence from one station to another by means of electromagnetic waves without the use of wires to guide the waves to their destination; and it relates more particularly to the system of such transmission in which the electromagnetic waves are developed by producing electric vibrations in an elevated conductor, preferably vertically elevated. In my Letters Patent No. 714,756, dated December 2, 1902, I have described such system of space telegraphy in which forced simple harmonic electric vibrations are developed in an elevated conductor by means of a sonorous or persistently-oscillating circuit associated therewith. In this system and in other systems of space telegraphy in operation to-day it has been found necessary to employ elevated transmitting or radiating conductors of considerable height in order to transmit appreciable amounts of energy by electromagnetic waves over commercial distances.

This invention consists of an apparatus for transmitting large amounts of energy by electromagnetic waves without the use of the high vertical conductors heretofore employed.

The invention may be best understood by having reference to the drawings which accompany and form a part of this specification.

In the drawings, Figures 1 and 2 represent two embodiments of my invention whereby the employment of a high vertical conductor is rendered unnecessary.

In the figures, A is an alternating-current generator adapted to develop currents of high frequency. *k* is a key. M is a transformer, which may be a step-up transformer. I_1 I_2 are the primary and secondary windings of the transformer M. L′ is an inductance. V is an elevated conductor consisting of a metal plate preferably circular in form and parallel to earth and whose diameter, and consequently whose periphery, is preferably great compared to its distance from the ground. However, a metallic plate of any other shape or any other suitable laterally-extending conducting member may be employed, and preferably its distance from the ground should be small compared to its smallest dimension. The member V and its connection *o* I_2 E to earth constitute an elevated-conductor system. However, any other suitable form of elevated-conductor system may be employed in combination with the high-frequency alternating-current generator A, as hereinafter pointed out.

The reactance at the driving-point *o* for slow frequencies is determined by the capacity of the plate V with respect to earth and varies as the area of this plate and inversely as its separation from earth. As the frequency is increased the reactance at the driving-point *o* is in the nature of a capacity reactance and diminishes as the frequency increases, finally becoming zero when the frequency is equal to the fundamental frequency *n* of the elevated-conductor system. For any further increase in frequency from this point the reactance at the driving-point *o* becomes in the nature of an inductance reactance, which increases as the frequency is further increased, the curve which shows the variation of reactance with frequency becoming asymptotic with the ordinate drawn in the positive direction from the point on the axis of abscissæ representing the first harmonic 2^n of the fundamental frequency *n*. As the frequency passes through the value 2^n the reactance at the driving-point *o* suddenly changes from an inductance reactance of infinite value to a capacity reactance of infinite value, the curve which shows the variation of reactance with frequency being asymptotic to the ordinate drawn in the negative direction from the point on the axis of abscissæ representing the first harmonic 2^n of the fundamental frequency *n*. When the frequency is

equal to the first harmonic 2" and the reactance at the driving-point o is infinite, the elevated-conductor system refuses to vibrate—*i. e.*, the elevated-conductor system is then equivalent in length to a half-wave length of the oscillations impressed upon it. As the frequency is further increased from the first harmonic the capacity reactance again wanes, becoming zero when the frequency is equal to the second harmonic 3" of the fundamental frequency n, and so on. In other words, the curve showing the variation of reactance at the driving-point o with frequency is a discontinuous curve, which is zero when the frequency is equal to the fundamental frequency n, which passes from plus infinity to minus infinity as the frequency passes through the value 2", which is zero when the frequency is 3", which passes from plus infinity to minus infinity as the frequency passes through the value 4", which is zero when the frequency is 5", and so on, the positive values of said curve representing inductance reactances and the negative values thereof representing capacity reactances.

An alternating-current generator A of frequency high compared with the alternating-current generators of commerce is connected in series with the primary winding I_1 of the transformer M, whose secondary I_2 has large inductance to reduce the frequency of the fundamental of the elevated-conductor system to the frequency of the currents developed by the generator.

Inasmuch as the frequency of the currents developed by the generator A is fixed, an inductance-coil L′ may be included in the conductor o I_2 E to attune the fundamental of the elevated-conductor system to such frequency or to some harmonic thereof—*i. e.*, to some multiple or submultiple thereof—and under certain conditions a condenser may be so employed, as explained in my application, Serial No. 182,634, filed November 25, 1903, of which this application is a division.

An alternating-current generator of the well-known type developed by Nikola Tesla may be used for the purposes of this invention.

I do not wish to be limited to the precise form of elevated-conductor or electromagnetic-wave-radiating system herein described, inasmuch as many modifications may be made therein without departing from the spirit of my invention.

It is obvious that an alternating-current generator of high frequency may be employed advantageously with many forms of elevated-conductor or electromagnetic-wave-radiating systems of the more usual type, and therefore I claim, broadly, the combination of such elevated-conductor or electromagnetic-wave-radiating systems with an alternating-current generator of high frequency for directly creating electrical oscillations therein without the interposition of the usual spark-producing apparatus.

I claim—

1. In a system of space telegraphy, an elevated-conductor system comprising a plate of periphery large compared with its distance above the earth and an alternating-current generator of high frequency associated therewith.

2. In a system of space telegraphy, an elevated-conductor system comprising a plate of periphery large compared with its distance above the earth, a conductor connecting said plate to earth, a transformer whose secondary winding is serially connected in said conductor and an alternating-current generator of high frequency connected with the primary winding of said transformer.

3. In a system of space telegraphy, an elevated-conductor system comprising a plate of periphery large compared with its distance above the earth, a conductor connecting said plate to earth, an inductance-coil and the secondary winding of a transformer serially included in said conductor and an alternating-current generator of high frequency connected with the primary winding of said transformer.

4. In a system of space telegraphy, an elevated-conductor system comprising a plate of periphery large compared with its distance above the earth, an alternating-current generator of high frequency associated therewith, and means for attuning the fundamental period of said elevated-conductor system to the frequency of the currents developed by said alternating-current generator or to some harmonic of said frequency.

5. In a system of space telegraphy, an elevated-conductor system comprising a laterally-extending conducting member and means connecting said member to earth, in combination with a high-frequency alternating-current generator for developing electric vibrations in said elevated-conductor system.

6. In a system of space telegraphy, an electromagnetic wave-radiating system and a high-frequency alternating-current generator associated therewith without the interposition of a spark-producing apparatus.

7. In a system of space telegraphy, an electromagnetic wave-radiating system and a high-frequency alternating-current generator connected directly therewith.

8. In a system of space telegraphy, an electromagnetic wave-radiating system, a high-frequency alternating-current generator adapted to develop currents of definite frequency associated therewith and means for attuning the fundamental period of said radiating system to the frequency of the currents developed by said alternating-current generator or to some harmonic of said frequency..

9. In a system of space telegraphy, an electromagnetic wave-radiating system, a high-

frequency alternating-current generator adapted to develop currents of definite frequency associated therewith and an inductance for attuning the fundamental period of said radiating system to the frequency of the currents developed by said alternating-current generator or to some harmonic of said frequency.

10. In a system of space telegraphy, an electromagnetic wave-radiating system serially connected with the secondary winding of a transformer in combination with a high-frequency alternating-current generator serially connected with the primary winding of said transformer.

11. In a system of space telegraphy, an electromagnetic wave-radiating system serially connected with the secondary winding of a transformer, a high-frequency alternating-current generator connected with the primary winding of said transformer and means for attuning the fundamental period of said radiating system to the frequency of the currents developed by said alternating-current generator or to some harmonic of said frequency.

In testimony whereof I have hereunto subscribed my name this 11th day of February, 1904.

JOHN STONE STONE.

Witnesses:
BRAINERD T. JUDKINS,
G. ADELAIDE HIGGINS.

Corrections in Letters Patent No. 767,999.

It is hereby certified that in Letters Patent No. 767,999, granted August 16, 1904, upon the application of John Stone Stone, of Cambridge, Massachusetts, for an improvement in "Space Telegraphy," errors appears in the printed specification requiring correction, as follows: On page 1, in lines 85, 87, and 95, the symbol "2^n" should read *2n;* on page 2, in lines 1 and 18, the symbol "2^n" should read *2n*, in lines 10 and 19 the symbol "3^n" should read *3n*, in line 21 the symbol "4^n" should read *4n*, and in line 22 the symbol "5^n" should read *5n;* and that the said Letters Patent should be read with these corrections therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 11th day of July, A. D., 1905.

[SEAL.]

F. I. ALLEN,
Commissioner of Patents.

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