No. 767,986. PATENTED AUG. 16, 1904.

J. S. STONE.

SPACE TELEGRAPHY.

APPLICATION FILED NOV. 25, 1903.

NO MODEL.

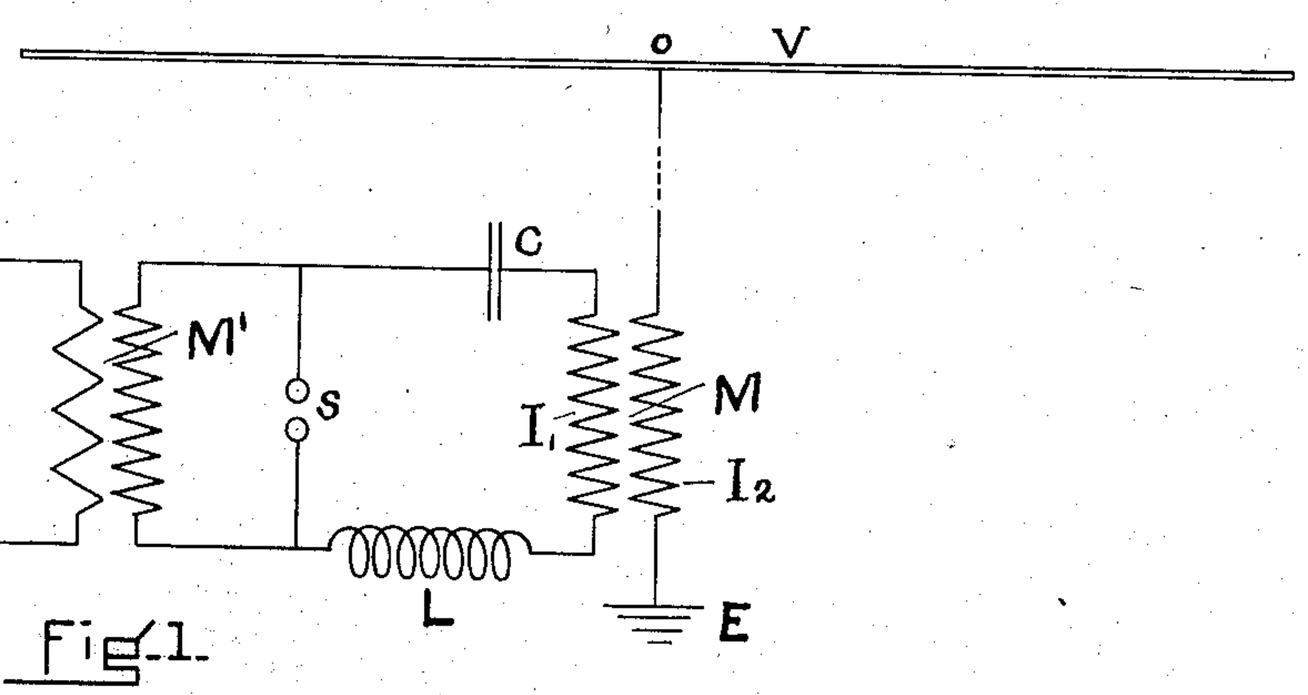

Fig. 1.

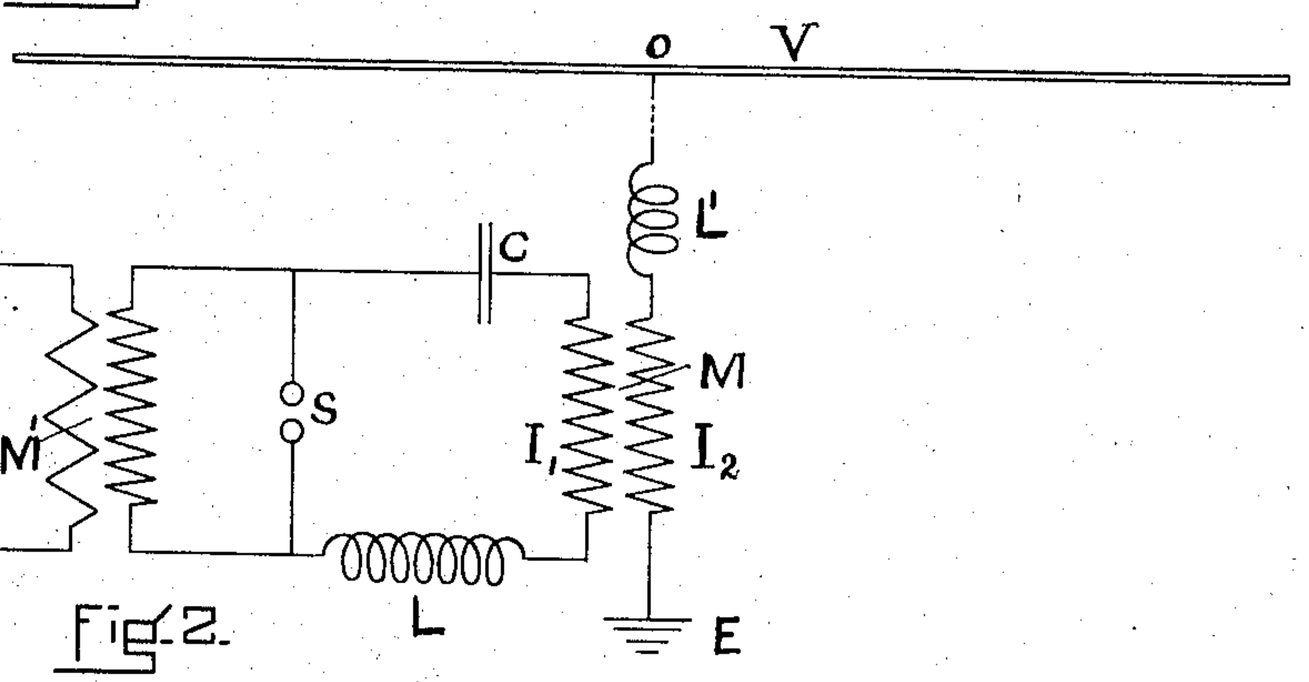

Fig. 2.

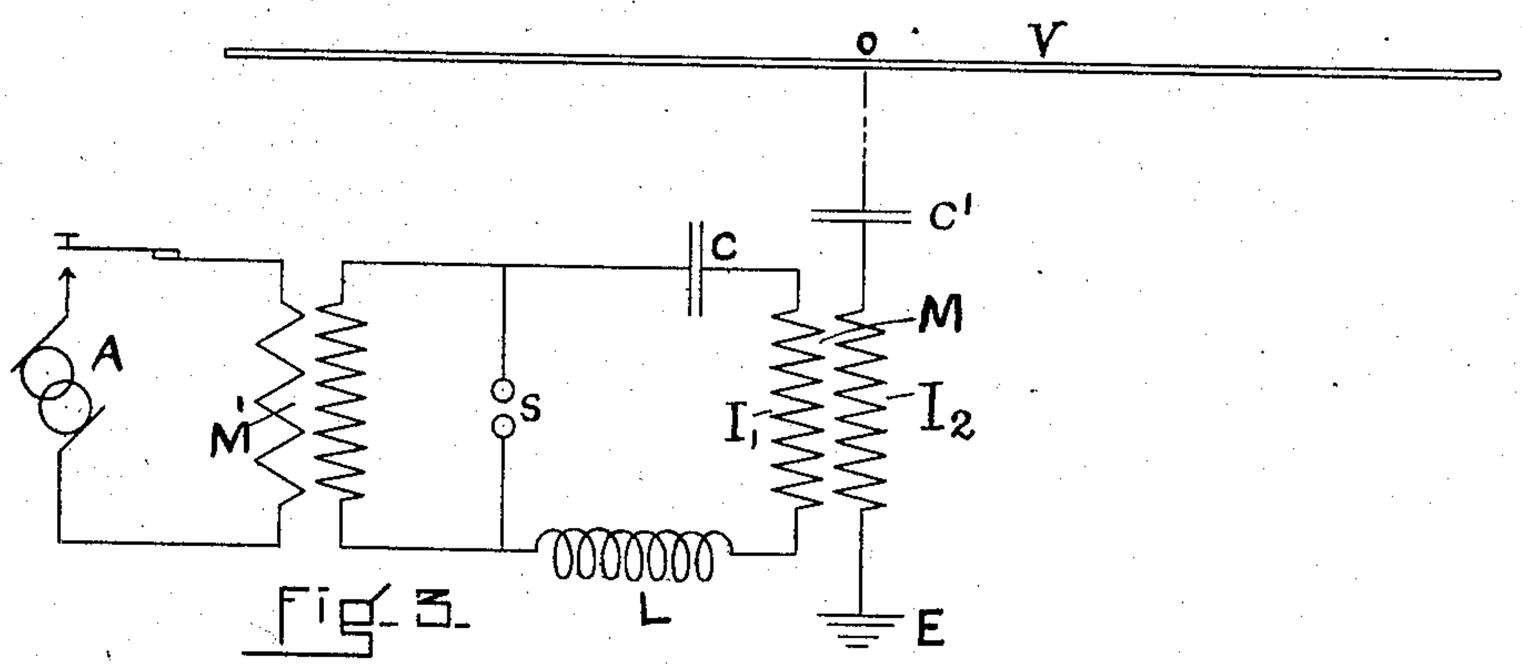

Fig. 3.

Fig. 4.

WITNESSES.

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No. 767,986. Patented August 16, 1904.

UNITED STATES PATENT OFFICE.

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SPACE TELEGRAPHY.

SPECIFICATION forming part of Letters Patent No. 767,986, dated August 16, 1904.

Application filed November 25, 1903. Serial No. 182,634. (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 new and useful Improvement in Space Telegraphy, of which the following is a specification.

My 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, 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-conductors of considerable height in order to transmit appreciable amounts of energy by electromagnetic waves over commercial distances.

This invention consists of a method of transmitting large amounts of energy by electromagnetic waves without the use of the high vertical conductor 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 the figures represent various forms of apparatus and circuit arrangements whereby my method may be carried into effect and whereby the employment of a high vertical conductor is rendered unnecessary. My invention, however, is broader than mere apparatus, being capable of being carried into effect by a great variety of apparatus and circuit arrangements, while the particular apparatus herein disclosed is claimed in my divisional applications Serial Nos. 184,283, 193,593, and 193,594.

In the figures, A is an alternating-current generator. *k* is a key. M M′ are transformers. I_1 I_2 are the primary and secondary windings of transformer M. L L′ are inductances. C C′ are condensers. *s* is a spark-gap. 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 other shape or any other suitable laterally-extending member may be employed, and preferably its distance from the ground should be small compared to its smallest dimension.

The natural period of the sonorous circuit *s* C I_1 L is made equal to the fundamental period of the elevated-conductor system, consisting of the metal plate V or other suitable laterally-extending member and its connection *o* I_2 E to earth or to some harmonic of such fundamental period, and for this purpose the electromagnetic constants of the sonorous circuit may be varied. An inductance L′ or a condenser C′ may be connected in the circuit *o* I_2 E for the purposes hereinafter set forth. The function of the auxiliary inductance L is, as explained in my hereinbefore-mentioned Letters Patent, to swamp the effect of the mutual inductance between the sonorous circuit and the elevated-conductor system and to thereby reduce the complex of interrelated circuits to the equivalent of a system of circuits each having a single degree of freedom, so that simple harmonic electromagnetic waves of a frequency determined by the capacity and inductance of the sonorous circuit may be radiated. 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 the 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 V. 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 fur-

ther 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 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^n 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^n 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^n, which is zero when the frequency is 3^n, which passes from plus infinity to minus infinity when the frequency passes through the value 4^n, which is zero when the frequency is 5^n, and so on, the positive values of said curve representing inductance reactances and the negative values thereof representing capacity reactances. When the reactance at the driving-point o is a capacity reactance, an inductance of suitable value is inserted in the conductor o I_2 E, connecting the center o of the plate V to earth, as shown at L', Fig. 2, in order to balance said reactance, so that the fundamental period of the elevated-conductor system will be equal to the frequency of the oscillations or vibrations developed by the sonorous circuit s C I_1 L or to some multiple or submultiple of such frequency. When the reactance at driving-point o is an inductance reactance, a condenser of suitable value is inserted in the conductor o I_2 E, as shown at C', Fig. 3, in order to balance said reactance, so that the fundamental period of the elevated-conductor system will be equal to the frequency of the oscillations or vibrations developed by the sonorous circuit s C I_1 L or to some multiple or submultiple of such frequency.

In Fig. 4 an alternating-current generator of frequency high compared with the alternating-current generators of commerce is connected in series with the primary 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 or to some harmonic of such frequency.

I claim—

1. The method of developing electromagnetic signal-waves which consists in producing forced electric oscillations in an elevated conductor of large area and parallel to the earth.

2. The method of developing simple harmonic electromagnetic signal-waves which consists in producing forced simple harmonic electric oscillations in an elevated conductor of large area and parallel to the earth.

3. The method of developing electromagnetic signal-waves which consists in producing electric oscillations of definite frequency, impressing said electric oscillations on an elevated conductor of large area and parallel to the earth and regulating the period of said oscillations to accord with the fundamental period of the elevated-conductor system or some harmonic of such fundamental period.

4. The method of developing electromagnetic signal-waves of definite frequency which consists in developing electrical oscillations of corresponding frequency in a sonorous circuit, and impressing said electrical oscillations upon an elevated-conductor system comprising a plate of periphery large compared to its distance above the earth and having a fundamental period equal to the period of said electrical oscillations.

5. The method of developing electromagnetic signal-waves of definite frequency which consists in developing electrical oscillations, impressing said electrical oscillations upon an elevated-conductor system, comprising a laterally-extending conducting member and having a definite fundamental period, and regulating the period of said electrical oscillations to accord with the fundamental period of said elevated-conductor system or with some harmonic of such fundamental period.

6. The method of developing electromagnetic signal-waves of definite frequency which consists in developing electrical oscillations in a sonorous or persistently-oscillating circuit, impressing said electrical oscillations upon an elevated-conductor system, comprising a laterally-extending conducting member and having a definite fundamental period, and regulating the period of said electrical oscillations to accord with the fundamental period of said elevated-conductor system or with some harmonic of such fundamental period.

In testimony whereof I have hereunto subscribed my name this 24th day of November, 1903.

JOHN STONE STONE.

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