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J. S. STONE.

SPACE TELEGRAPHY.

APPLICATION FILED DEC. 16, 1904. RENEWED JULY 8, 1905.

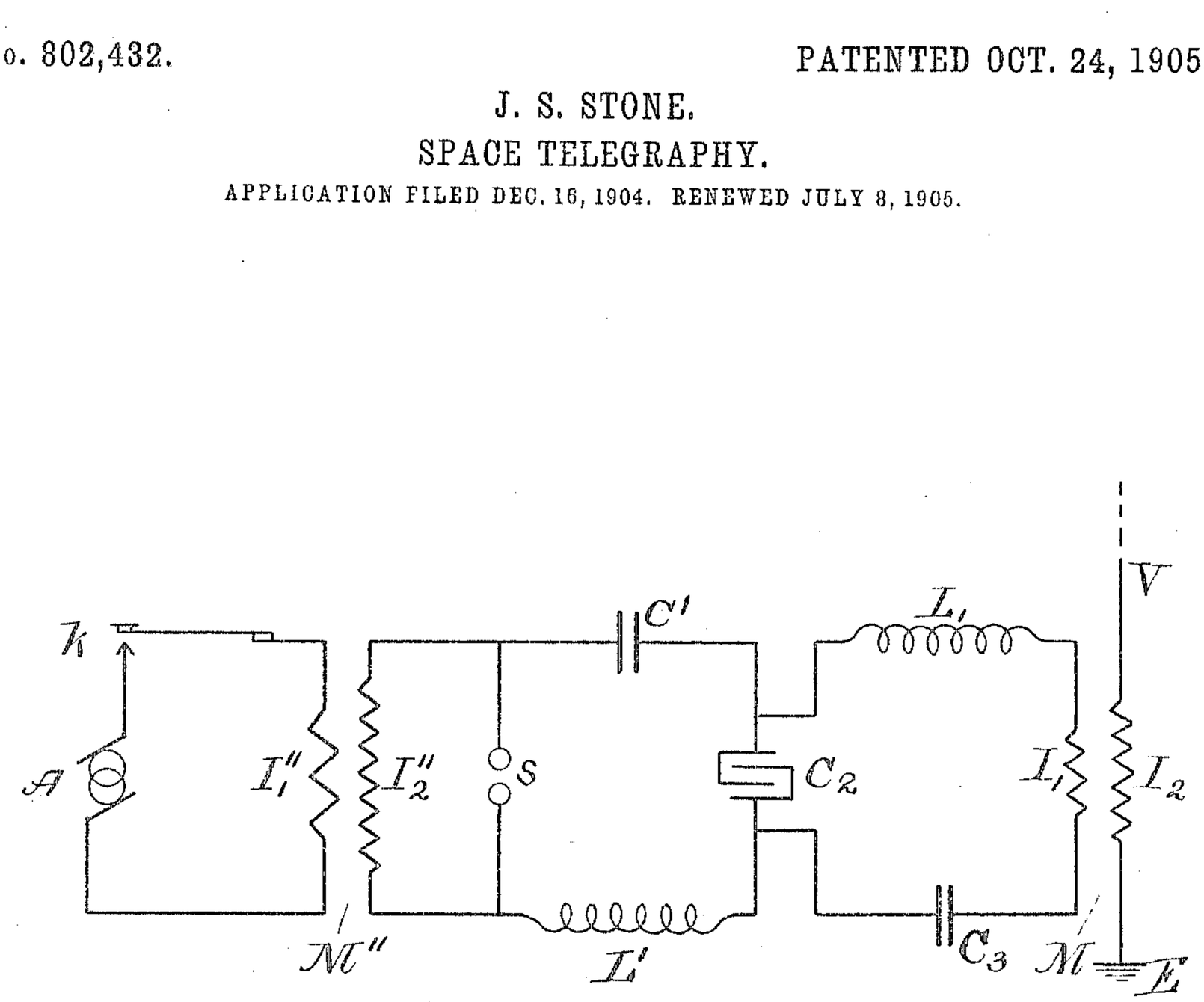

Fig. 1.

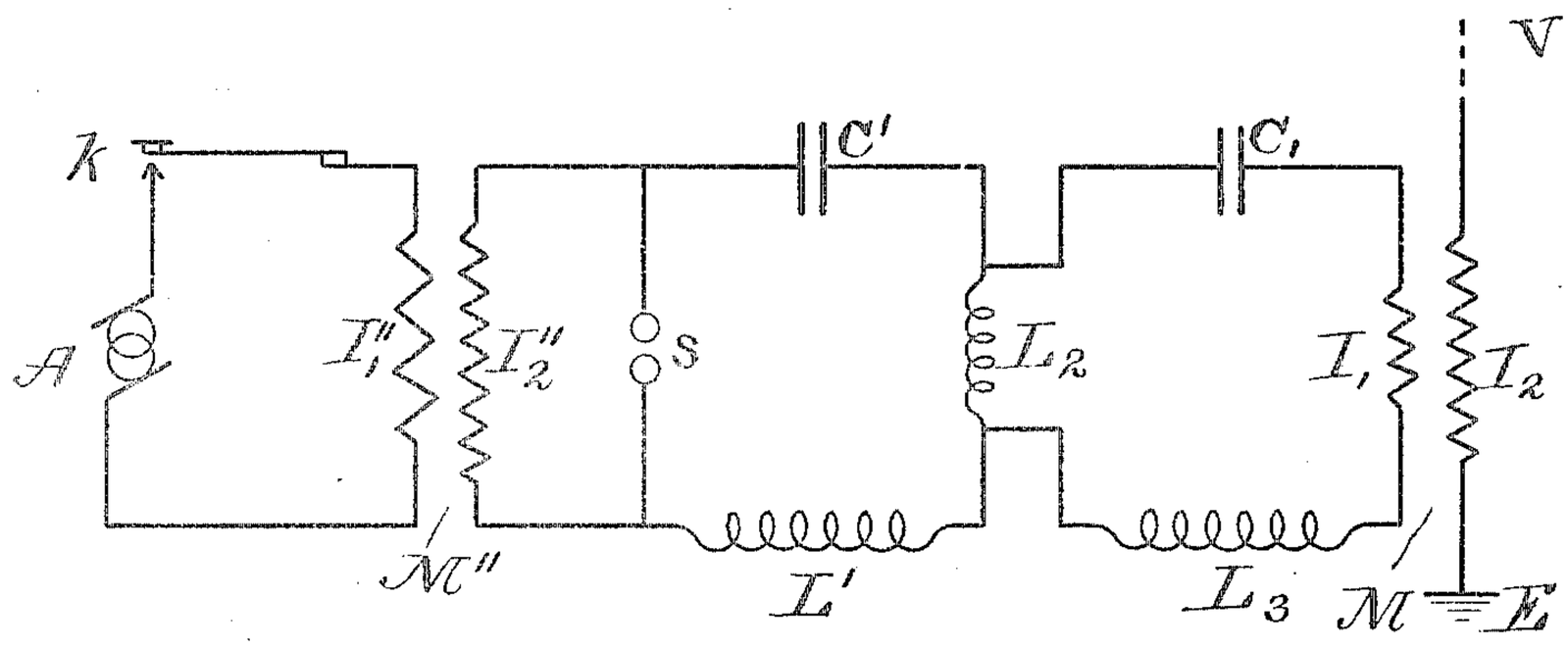

Fig. 2.

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SPACE TELEGRAPHY.

No. 802,432 Specification of Letters Patent. Patented Oct. 24, 1905.

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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 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.

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 or oscillations in an elevated conductor, preferably vertically elevated.

The object of the present invention is to increase the amplitude and the persistency of the electrical oscillations developed by suddenly disturbing the electrical equilibrium of a sonorous circuit of the kind described in my Letters Patent Nos. 714,756 and 714,831, dated Dec. 2, 1902.

The invention may best be understood by having reference to the drawings which accompany and form a part of this specification, and which illustrate diagrammatically two simple arrangements of apparatus and circuits embodying my invention.

In the drawings, Figs. 1 and 2 illustrate in diagram two forms of space telegraph transmitting systems embodying the present invention.

In these figures,

A is an alternating current generator;

k is a key;

M, M″ are transformers, preferably step-up transformers;

I_1, I_1'' are the primary windings of said transformers;

I_2, I_2'' are the secondary windings of said transformers;

s is a spark-gap;

C′, C_1, C_2, C_3 are condensers;

L′, L_1, L_2, L_3 are inductance coils;

V is an elevated conductor; and

E is an earth connection.

Reference may be had to my hereinbefore mentioned Letters Patent for a more detailed description of the apparatus and circuit arrangements, as well for the construction of parts and the operation thereof, than is necessary to set forth herein, it being sufficient for the purpose of clearly disclosing the present invention to describe the arrangement of circuits illustrated in the drawings and to set forth the relations of their electromagnetic constants.

In Fig. 7 of my Patent No. 714,756, I have shown a sonorous circuit *s* C′ I_1' L′ adapted to develop simple harmonic electrical oscillations of definite frequency. Interposed between said sonorous circuit and the elevated conductor, and inductively related to each, I have shown a resonant circuit C I_1 L I_2' attuned to said definite frequency. This resonant circuit has a dissipative resistance much lower than that of the sonorous circuit because it does not contain a spark-gap and therefore it is a much more persistent oscillator than said sonorous circuit.

One result of interposing the said resonant circuit between the sonorous circuit and the elevated conductor is that the oscillations in the resonant circuit persist long after the sonorous circuit ceases to vibrate and that, therefore, the oscillations conveyed to the elevated conductor persist long after the sonorous circuit ceases to vibrate.

In Fig. 1 of the drawings of the present application, the circuit *s* C′ C_2 L′ is a sonorous circuit corresponding to the aforesaid sonorous circuit of Patent No. 714,756, and the circuit C_2 L_1 I_1 C_3 is a resonant circuit, attuned to the frequency of the oscillations developed by the sonorous circuit with which it is conductively connected by means of the condenser C_2 of capacity great as compared with the capacity of the condenser C_3 of the resonant circuit.

In Fig. 2, the sonorous circuit is the circuit *s* C′ L_2 L′ and the circuit L_2 C_1 I_1 L_3 is a resonant circuit, attuned to the frequency of the oscillations developed by the sonorous circuit with which it is conductively connected by means of the inductance coil L_2 of inductance small as compared with the inductance of the coil L_3 of the resonant circuit.

However, in order that the resonant circuits may each be attuned to its respective sonorous circuit, it is necessary that each system shall be the equivalent of a system of a single degree of freedom.

In order that the individual circuits of each complex of conductively connected circuits may vibrate as circuits having a single degree

of freedom, it is necessary that the mutual-energy of each circuit with all of the interrelated circuits of the system shall be small compared with the self-energy of said circuit, as I have pointed out in my Patent No. 714,756; and this, in the case of conductively connected circuits, I effect by making the capacity of the condenser C_2 great as compared to the capacity of the condenser C_3, or the inductance of the coil L_2 small as compared to the inductance of the coil L_3, as more fully explained in my Letters Patent No. 767,984 and No. 767,994.

In the present case, by making the self-energy of each of the resonant circuits C_2 L_1 I_1 C_3 and L_2 C_1 I_1 L_3 large compared to the mutual energy between said circuits and their respective elevated conductor systems VI_2E, by means of an auxilliary inductance L_1 or L_3, as set forth in my Letters Patent hereinbefore referred to; or by so spatially relating the windings of the transformer M as to make the mutual inductance between the circuits small as compared to the square root of the product of the self-inductances of the two circuits; the natural period of each circuit of the complex of conductively connected circuits is not materially affected by the association therewith of the elevated conductor system. The elevated conductor system, under these conditions, may be attuned as to its fundamental in the manner hereinafter pointed out, to the frequency of the electrical oscillations developed in the resonant circuit, which frequency is the same as that of the electrical oscillations developed in the sonorous circuit. Under such conditions the oscillations developed in the elevated conductor are simple harmonic oscillations, and they are termed "forced oscillations" because their frequency is practically independent of the constants of the elevated conductor and is determined solely by the constants of the sonorous circuit. In like manner the oscillations developed in the conductively connected circuits C_2 L_1 I_1 C_3 and L_2 C_1 I_1 L_3 are simple harmonic oscillations, and they also are "forced oscillations" because their frequency is independent of the constants of each said circuit and is determined practically only by the constants of the sonorous circuit. Just as the amplitude of the forced simple harmonic oscillations developed in the conductively connected circuits is greatly increased by giving the conductively connected circuits a natural period equal to that of the oscillations developed in the sonorous circuits, so the amplitude of the forced simple harmonic oscillations developed in the elevated conductor system may be greatly increased by giving the elevated conductor system a natural fundamental period of vibration equal to the period of the oscillations developed in the sonorous circuit. This may be accomplished by varying the inductance of the secondary winding I_2 of the transformer M or by means of the combinations of coils and condensers described in my Patent No. 767,994; but it is preferred to give the elevated conductor system a definite fundamental period of vibration and then attune the sonorous circuit and the conductively-connected resonant circuit to said fundamental period, or to some harmonic or odd submultiple of such fundamental period, and for this purpose the electromagnetic constants of the sonorous and resonant circuits may be varied, as more fully set forth in my Letters Patent No. 767,986.

I claim—

1. In a system of space telegraphy, a sonorous circuit adapted to develop electrical oscillations of definite frequency, a resonant circuit attuned to said frequency and conductively connected to said sonorous circuit, an elevated conductor system associated with said resonant circuit, and means for causing each of the circuits to vibrate as circuits of a single degree of freedom.

2. In a system of space telegraphy, a sonorous circuit adapted to develop electrical oscillations of definite frequency, a resonant circuit attuned to said frequency and conductively connected to the terminals of a coil included in said sonorous circuit, a coil included in said resonant circuit of inductance great as compared with the inductance of the first mentioned coil, and an elevated conductor system associated with said resonant circuit.

3. In a system of space telegraphy, a sonorous circuit adapted to develop electrical oscillations of definite frequency, a resonant circuit attuned to said definite frequency and conductively connected to said sonorous circuit, and an elevated conductor system attuned as to its fundamental to the aforesaid definite frequency and associated with said resonant circuit.

4. In a system of space telegraphy, a sonorous circuit adapted to develop simple harmonic electrical oscillations of definite frequency, a resonant circuit attuned to said frequency and conductively connected to said sonorous circuit, and an elevated conductor system associated with said resonant circuit.

In testimony whereof I have hereunto subscribed my name this 14th day of December, 1904.

JOHN STONE STONE.

Witnesses:

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G. ADELAIDE HIGGINS.