No. 768,000. PATENTED AUG. 16, 1904.

J. S. STONE.

SPACE TELEGRAPHY.

APPLICATION FILED FEB. 23, 1904.

NO MODEL.

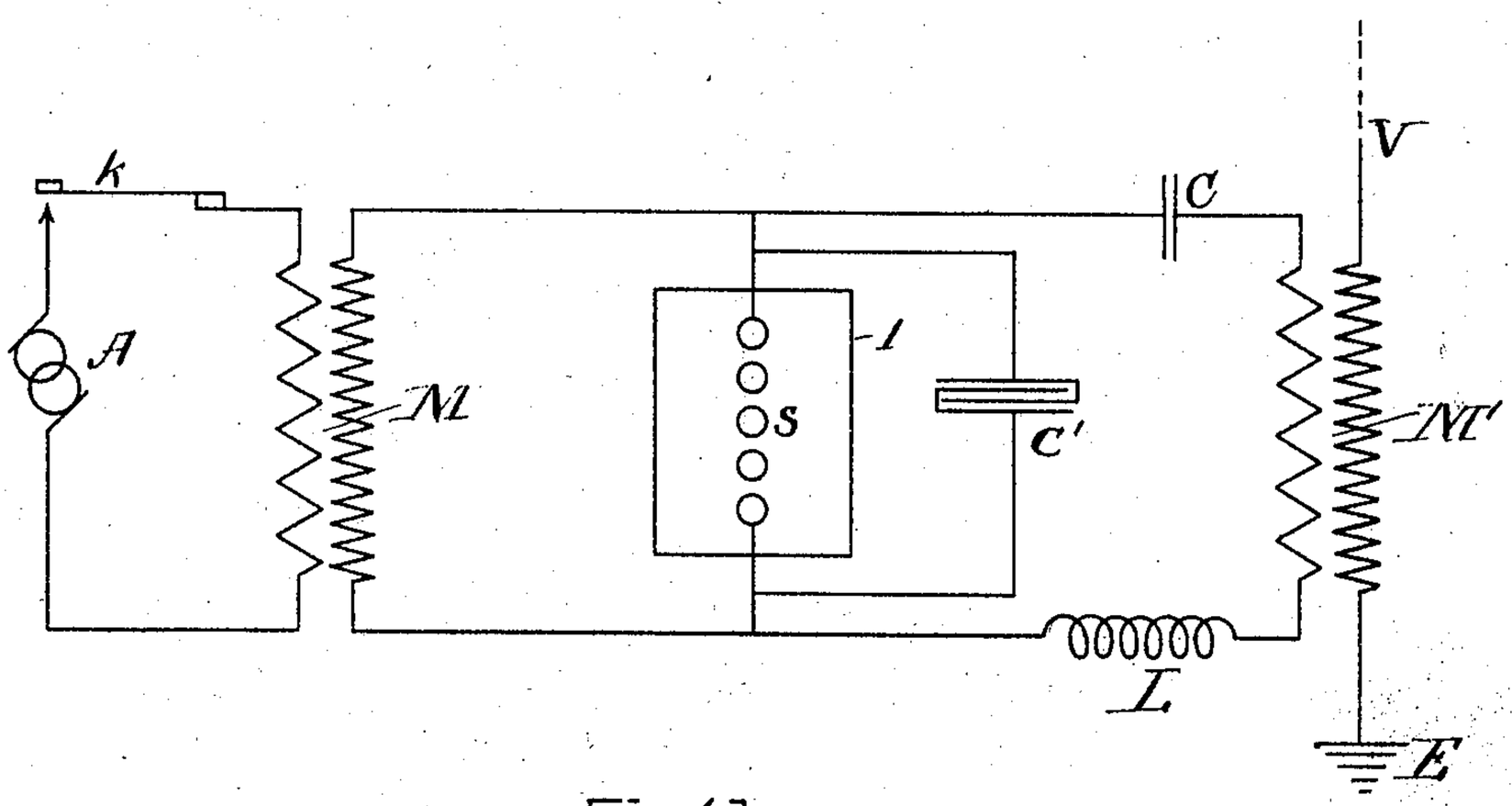

Fig. 1.

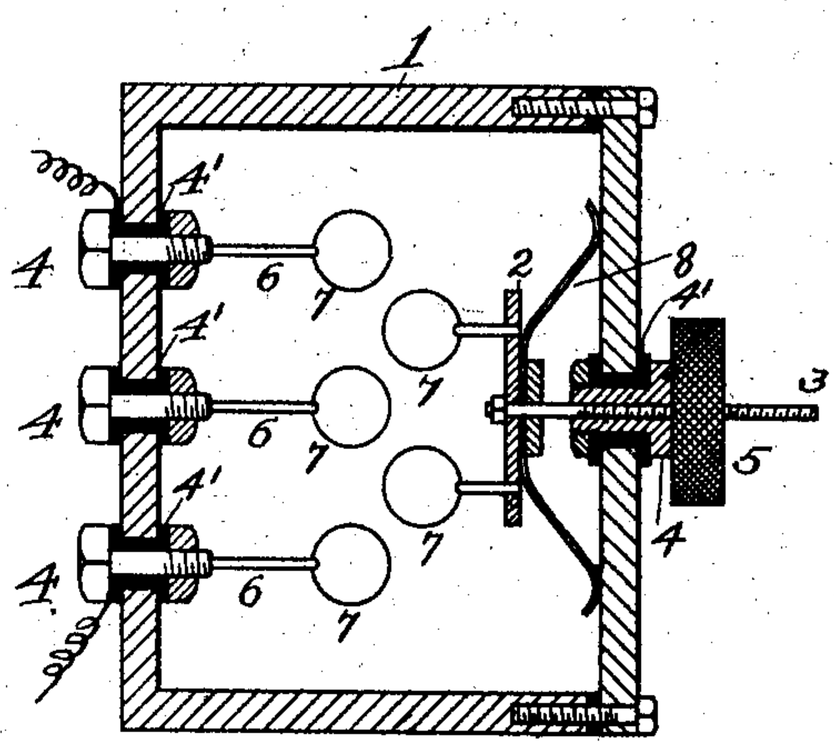

Fig. 2.

WITNESSES.

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No. 768,000. Patented August 16, 1904.

UNITED STATES PATENT OFFICE.

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SPACE TELEGRAPHY.

SPECIFICATION forming part of Letters Patent No 768,000, dated August 16, 1904.

Application filed February 23, 1904. Serial No. 194,650. (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 connecting-wires to guide the waves to their destination; and it relates more particularly to a system for developing and transmitting such waves.

In my Letters Patent No. 714,756, dated December 2, 1902, I have described a system of space telegraphy in which simple harmonic electrical vibrations developed in a sonorous or persistently-oscillating circuit are impressed upon an elevated transmitting-conductor, thereby causing the radiation of simple harmonic electromagnetic waves from said conductor, and in my Letters Patent No. 714,831, dated December 2, 1902, I have set forth the advantages accruing from the elevation of the potential of the electrical vibrations impressed upon said elevated transmitting-conductor. In the latter Letters Patent the means described and claimed for effecting such elevation of potential of said electrical vibrations is a step-up transformer associating the sonorous circuit with the elevated conductor. In my application, Serial No. 182,544, filed November 24, 1903, and in my application, Serial No. 182,631, filed November 25, 1903, I have described and claimed two other means for effecting this result. In my application Serial No. 182,544 the means whereby this result is effected is a circuit of low ohmic resistance and including a condenser of capacity large compared to the capacity of the condenser in the sonorous circuit shunted around the terminals of the spark-gap in the sonorous circuit. In my application Serial No. 182,631 the means whereby this result is effected is a second sonorous circuit of low ohmic resistance and containing a condenser of capacity large compared to the capacity of the condenser in the sonorous circuit which is associated with the elevated conductor shunted around the terminals of the spark-gap of the latter sonorous circuit.

In the present application I describe and claim a combination of means whereby the potential of the electrical oscillations or vibrations developed in the sonorous circuit may be amplified, said combination of means preferably being employed in conjunction with the systems above described, although it is capable of use in the systems described in my Letters Patent Nos. 714,756 and 714,831, and, in fact, it is capable of use in any system in which a spark-gap is employed, as will be obvious to those skilled in the art to which this invention appertains.

It is well known that the oscillatory restoration to electrical equilibrium of a circuit containing capacity, inductance, and resistance depends upon a certain critical relation of the resistance to the ratio of the inductance by the capacity, beyond which the restoration to electrical equilibrium is not oscillatory, but is aperiodic, and it is a matter of experience in this art that while the potential energy of an oscillatory system varies as the square of the impressed potential a limitation is imposed by the above-mentioned relation which must subsist between the resistance and the other electromagnetic constants of the circuit. In other words, with a circuit of given capacity and inductance there is a maximum length of spark-gap which must not be exceeded if the restoration to electrical equilibrium is to be oscillatory in character. It is also a matter of experience that with a single spark-gap of given length there is a maximum potential difference which may be developed between the terminals of the gap and which cannot be exceeded, said difference of potential depending, among other things, upon the dielectric strength of the medium intervening between the terminals of said gap.

While it is not possible to increase the resistance of the spark-gap of a sonorous or persistently-oscillating circuit beyond the critical value above referred to by increasing the length of the gap in order to develop a greater

difference of potential between the terminals thereof, there are nevertheless two ways, both old and well known, whereby the difference of potential which may be developed at the terminals of a spark-gap can be increased, and it is the novel combination of these two old and well-known means that constitutes my invention.

It is well known that if a spark-gap of given length be divided into a number of spark-gaps the dielectric strength of the total gap is much greater than a single gap of equivalent length, while the resistance of said gap is not appreciably increased. In other words, a greater difference of potential may be developed between the outer terminals of a series of small gaps than can be developed between the terminals of a single gap of equivalent length, and this permits greatly increasing the potential energy of the system without materially altering the resistance of the circuit or system containing the series of spark-gaps. Such a discharger for a sonorous circuit was described at an early date by Nikola Tesla and is now well known, although reference is herein made to a publication entitled *Experiments with Alternate Currents of High Potential and High Frequency*, in which said discharger is fully described.

It has long been known that the dielectric strength of a gas is a function of the pressure to which the gas is subjected and that such dielectric strength increases with such pressure. If, therefore, the gaseous medium intervening between the terminals of a spark-gap be highly compressed, a much higher difference of potential may be developed between said terminals than if the medium were at atmospheric pressure. This principle has been utilized by Nikola Tesla in an apparatus for producing currents of high potential and high frequency, and its advantages are set forth in his United States Letters Patent No. 611,719, dated October 4, 1898, and also in his Belgian Letters Patent No. 136,606, dated July 4, 1898, and it has been employed in an induction apparatus described in the German Letters Patent to Hans Boas, Nos. 95,003 and 95,004, dated November 15, 1897. I therefore do not claim either of the aforesaid means for increasing the potential difference developable at the terminals of a spark-gap of given length and resistance, but I propose to substitute for the single spark-gap surrounded by air at atmospheric pressure now employed in space telegraphy a discharger consisting of a plurality of relatively short spark-gaps surrounded by air or other gaseous media under heavy pressure, and I claim the combination so produced, broadly, and also in combination with other elements hereinafter described.

My invention may best be understood by having reference to the drawings which accompany and form a part of this specification and which illustrate one embodiment of my invention.

In the drawings, Figure 1 illustrates diagrammatically a space-telegraph transmitting system; and Fig. 2 illustrates, partly in section, a detail of construction.

In the figures, A is an alternating-current generator. *k* is a key. M M′ are transformers, preferably step-up transformers. C C′ are condensers. L is an inductance for swamping the effect of the mutual inductance between the sonorous circuit S C L M′ and the elevated conductor V, whereby the electrical oscillations developed in the elevated conductor are rendered simple harmonic in form. V is an elevated conductor. E is an earth connection. S is a discharger consisting of a series of spark-gaps.

For details of construction of those parts of the transmitting system illustrated in Fig. 1 which are not described herein and for the method of operation thereof reference may be had to my hereinbefore-mentioned Letters Patent.

A convenient way of carrying out my present invention is shown in Fig. 2, in which a plurality of rods 6, terminating in balls or knobs 7, are mounted in a base of a receptacle 1 by means of nuts 4, provided with insulating bushings and washers 4′ to insulate the nuts from the casing and to render the casing air-tight. Another set of rods, terminating in similar balls or knobs, is mounted in the insulating-strip 2. The strip 2 may be secured to a rod 3, passing through a nut 4, provided with the necessary packing to render the joint air-tight. For purposes of adjustment the upper end of the rod 3 is threaded and is engaged by the milled nut 5. A flat spring 8 forces the member 2 away from the top of the receptacle 1. The receptacle 1 may be filled with air or other gaseous media under great pressure by any suitable means, and this pressure may be any desired pressure greater than atmospheric pressure. The degree of pressure may conveniently be ascertained by a gage inserted into the receptacle.

The condenser C′, which, as before stated, may advantageously be connected in shunt to the discharger so formed, is a condenser of capacity great compared to the capacity of the condenser C, so that a great amount of energy may thereby be discharged across the spark-gap to reduce the resistance thereof. By this means the length of the gap may be increased and the potential energy of the condenser C correspondingly increased, because thereby a greater difference of potential may be developed at the terminals of the discharger, and consequently at the terminals of the condenser C, than could otherwise be so developed. The conductors connecting the condenser C′ to the spark-gap should be of the minimum resistance and inductance, so that when the potential difference at the terminals

of the condenser C is not sufficient to maintain sparking at the gap the oscillations may pass through the condenser C′ without encountering more than a minimum impedance, thereby increasing the persistency of the sonorous circuit.

I claim—

1. In a space-telegraph transmitting system, an elevated conductor, in combination with means for creating electrical oscillations therein, said means consisting of a source of electrical energy and a series of spark-gaps surrounded by a gaseous medium under pressure greater than atmospheric pressure.

2. In a space-telegraph transmitting system, an elevated conductor, in combination with means for creating electrical oscillations therein, said means consisting of a source of electrical energy, a series of spark-gaps surrounded by a gaseous medium under pressure greater than atmospheric pressure, and means for adjusting the lengths of said spark-gaps.

3. In a space-telegraph transmitting system, an elevated conductor, a sonorous circuit associated therewith and including a series of spark-gaps surrounded by a gaseous medium under pressure greater than atmospheric pressure.

4. In a space-telegraph transmitting system, an elevated conductor, a sonorous circuit associated therewith and including a series of spark-gaps surrounded by a gaseous medium under pressure greater than atmospheric pressure, and a condenser of capacity great compared to the capacity of the condenser of the sonorous circuit connected across the outer terminals of said series of spark-gaps.

5. In a space-telegraph transmitting system, an elevated conductor and means for creating simple harmonic electrical oscillations therein, said means consisting of a sonorous circuit including a series of spark-gaps surrounded by a gaseous medium under pressure greater than atmospheric pressure, and means for swamping the effect of the mutual inductance between the sonorous circuit and the elevated conductor.

6. In a space-telegraph transmitting system, an elevated conductor and means for creating simple harmonic electrical oscillations therein, said means consisting of a sonorous circuit including a series of spark-gaps surrounded by a gaseous medium under pressure greater than atmospheric pressure, a condenser of capacity great compared to the capacity of the condenser of the sonorous circuit connected across the outer terminals of said series of spark-gaps, and means for swamping the effect of the mutual inductance between the sonorous circuit and the elevated conductor.

7. In a space-telegraph transmitting system, an elevated conductor, in combination with means for creating electrical oscillations therein, said means comprising a source of electrical energy, a series of spark-gaps, and means for simultaneously adjusting the lengths of all of said gaps.

In testimony whereof I have hereunto subscribed my name this 16th day of February, 1904.

JOHN STONE STONE.

Witnesses:

BRAINERD T. JUDKINS,

G. ADELAIDE HIGGINS.