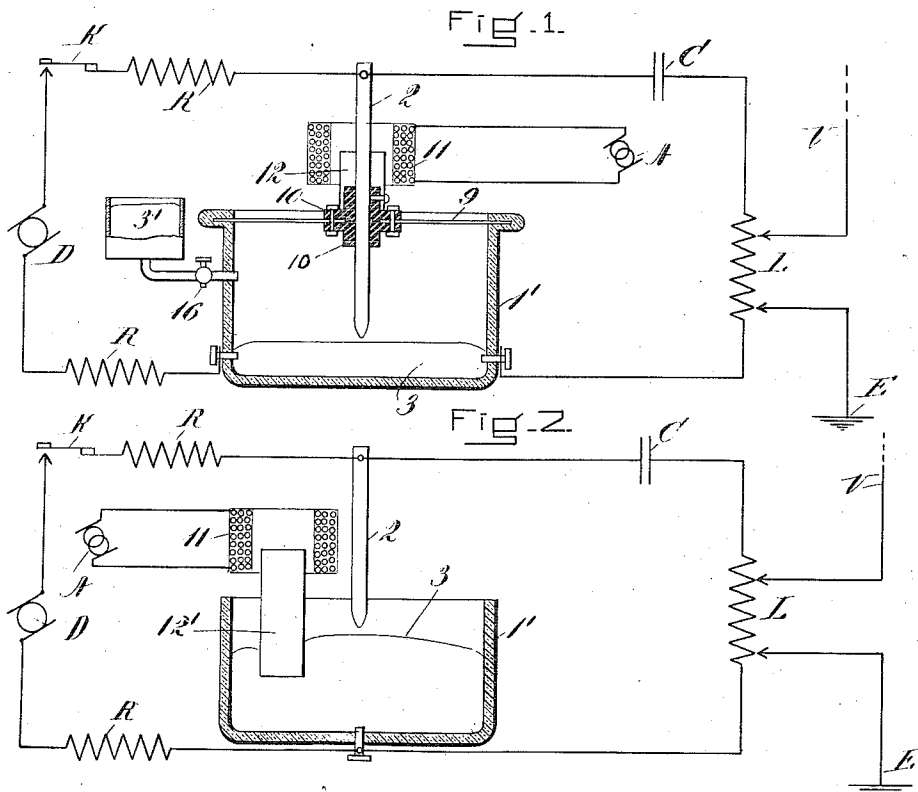


995,339.

Patented June 13, 1911.

2 SHEETS—SHEET 1.



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Georgia A. Higgins

INVENTOR=
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2 SHEETS—SHEET 2.

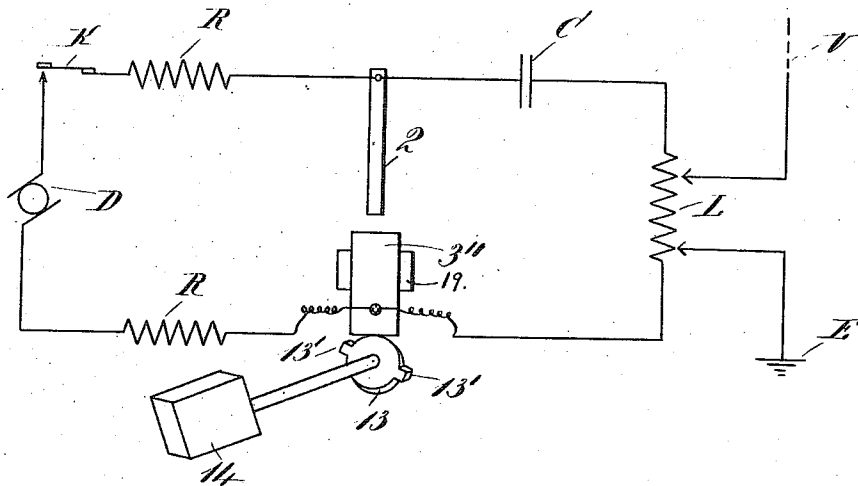


Fig-3-

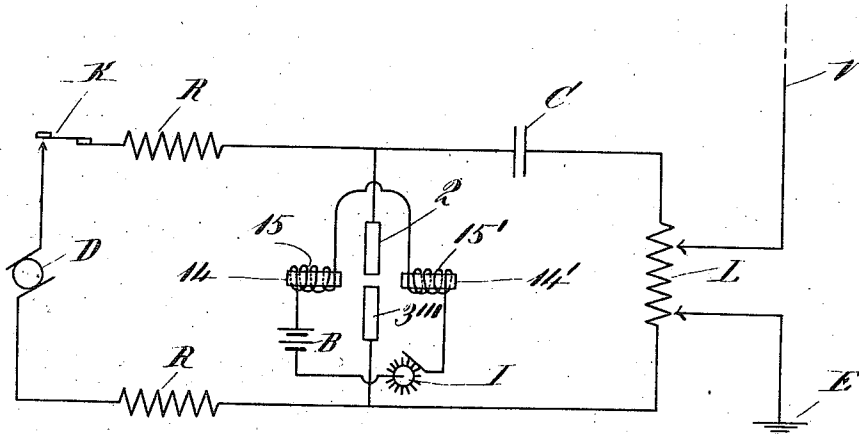


Fig-4-

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UNITED STATES PATENT OFFICE.

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SPACE TELEGRAPHY.

995,339.

Specification of Letters Patent. Patented June 13, 1911.

Application filed June 20, 1907. Serial No. 379,922.

To all whom it may concern:

Be it known that I, LEE DE FOREST, a citizen of the United States, and a resident of New York, in the county of New York and State of New York, have invented a new and useful Improvement in Space Telegraphy, of which the following is a specification.

My invention relates to systems for radiating electromagnetic waves for use in space telegraphy or telephony, and its object is to provide a system by means of which electromagnetic waves of great persistency, although not necessarily continuous, may be radiated.

In the employment of the usual sonorous or oscillating circuit comprising a capacity and an inductance, together with a spark-gap for discharging said capacity, there is a limit to which the persistence may be increased with a given frequency and a given amount of energy absorbed. It has been proposed therefore to employ continuously-oscillating circuits commonly called "singing-arc" circuits, or circuits resembling the singing arc circuit and consisting of an inductance and a capacity connected in series with a spark-gap and supplied by a source of direct current through leads of large ohmic resistance. In a wireless telegraph system employing such continuously oscillating circuits to energize the transmitting antenna it is necessary to employ a device at the receiving station to commutate the currents developed in the receiving circuit if a variable-zero indicating device, such as a telephone receiver, is employed.

By means of the present invention I am able to obtain as great a persistency as is desirable while at the same time reducing the energy output required for the radiation of continuous electromagnetic waves and obviating the necessity for commutating or interrupting the current in the receiving circuit.

It has been found that the adjustment of the arc electrodes which results in the production of oscillating currents when a singing arc circuit is energized by a source of direct current, is difficult to obtain and, when once obtained, is difficult to maintain, unless the arc of such circuit be surrounded by an atmosphere of hydrogen, as used at a very early date by P. E. M. Berthelot or by an atmosphere containing hydrogen as

employed long ago by Nikola Tesla. In general, if a special atmosphere be not employed, the circuit when properly adjusted, will oscillate for a brief period and then cease, or else the arc will flash out, thereby requiring the electrodes to be brought together and then separated to strike the arc and obtain again the oscillatory condition of the circuit.

By means of the present invention I am enabled to dispense with the employment of any special atmosphere surrounding the arc by intermittently and automatically interrupting the arc, thereby pulling it through the critical distance of separation of the electrodes which determines the high frequency oscillatory or singing condition. Thus while it is difficult to maintain the critical condition which determines oscillation in a singing arc circuit for even as long as thirty seconds without surrounding the arc with some special atmosphere, I find that by means of the present invention, I can interrupt the arc, for example, by opening and closing the same, and thereby secure at each interruption the point at which the circuit begins to oscillate. The condition of oscillation will persist for at least one-tenth second during which time a practically continuous train of oscillations having substantially uniform amplitude and comprising as many as fifty thousand oscillations will be developed, the frequency of such oscillations being assumed in this case as being five hundred thousand per second. Furthermore, by the present invention I am enabled to interrupt the prime source of energy, as by means of a key when the system herein described is employed for space telegraphy, and secure the instant production of oscillations, without redrawing or restriking the arc, upon the closure of said key, this being of great advantage in space telegraphy.

My invention may best be understood by having reference to the drawings which accompany and form a part of this specification and which illustrate conventionally various forms of apparatus and circuit arrangements which have been found to be well adapted for the purpose of effecting the advantages set forth above.

In the drawings Figure 1 represents a singing-arc circuit constructed in accordance with the present invention and applied

to a wireless telegraph transmitting system. Fig. 2 is a diagram similar to Fig. 1 and illustrating a modification. Fig. 3 represents a space telegraph transmitting system in which one of the arc electrodes of a singing arc circuit is moved with respect to the other. Fig. 4 shows a further modification in which a magnetic blow-out is employed for intermittently interrupting the arc.

10 In the figures, D is a source of direct current, A is a source of vibratory current, K is a key, R R are resistances, inductive or non-inductive, C is a condenser, L is an inductance, V is an antenna, and E is an earth connection.

In Fig. 1, the vessel 1' is provided with a thin diaphragm 9 to which is secured by the insulating bushings 10 the carbon anode 2. The solenoid 11, energized by vibratory currents from the generator A acts upon the magnetic core 12 which is secured to the diaphragm 9, and thereby creates relative movement between said anode 2 and liquid metal cathode 3. 3' represents a mass of metal, mercury for example, supported in a supply tank which is connected with the vessel 1' by a pipe having a valve 16.

In Fig. 2 relative movement between the electrodes of the arc is created by the movement of the iron plunger 12' acted upon by the solenoid 11.

By employing the apparatus shown in Figs. 1 and 2, the amplitudes of the oscillations in the singing arc circuit are periodically varied, or else interrupted, the arc being pulled through the critical point a number of times per second, in the latter case.

In Fig. 3, 3'' represents a metallic electrode periodically oscillated through the guide 19 by means of the cam 13, 13', which is driven by any suitable motor 14. In this case, for example, the arc may be struck and drawn, say, sixty times per second, so that the receiving operator will hear a note of sixty. Each time the arc is drawn, the critical condition during which the circuit oscillates will be maintained for say one one-hundredth second, and during this time a very large number of practically continuous oscillations of substantially uniform amplitude will be developed.

In the system shown in Fig. 4, the magnets 14, 14' energized by the current of the battery B, which is serially connected with

the coils 15 15' and the commutator I, serve to intermittently interrupt the arc which is produced between the electrodes 2, 3'''.

It will be understood that many modifications may be made both in the apparatus and in the circuit arrangements herein described, and therefore I do not desire to be limited to the exact apparatus and systems which I have illustrated for the purpose of more fully disclosing my invention.

I claim:

1. In a system for developing and radiating a practically continuous train of electromagnetic waves of substantially uniform amplitude, arc electrodes, a source of current connected in circuit with the electrodes, capacity and inductance shunting the electrodes, and means for automatically moving the electrodes relatively to each other.

2. In a system for developing and radiating a practically continuous train of electromagnetic waves of substantially uniform amplitude, arc electrodes, a source of electric energy connected in circuit with the electrodes, capacity and inductance connected in shunt circuit to the electrodes, and means for automatically interrupting the arc between the electrodes.

3. In a system for developing and radiating a practically continuous train of electromagnetic waves of substantially uniform amplitude, arc electrodes, a source of energy connected in circuit therewith, capacity and inductance connected in shunt circuit with the electrodes, means for establishing an arc between said electrodes, and means for automatically interrupting the arc intermittently.

4. In a system for developing and radiating a practically continuous train of electromagnetic waves of substantially uniform amplitude, arc electrodes, a source of energy connected in circuit therewith, capacity and inductance connected in shunt circuit with the electrodes, and means for automatically interrupting the arc between the electrodes at a rate within the limit of audibility.

In testimony whereof, I have hereunto subscribed my name this 17 day of June 1907.

LEE DE FOREST.

Witnesses:

THOMAS I. GALLAGHER,
ROSCOE KENT.