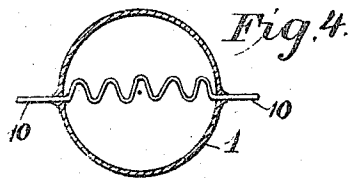
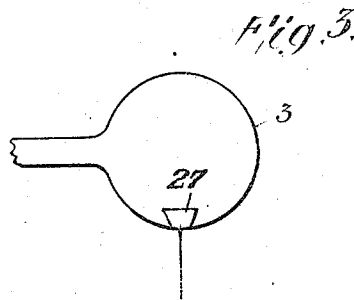
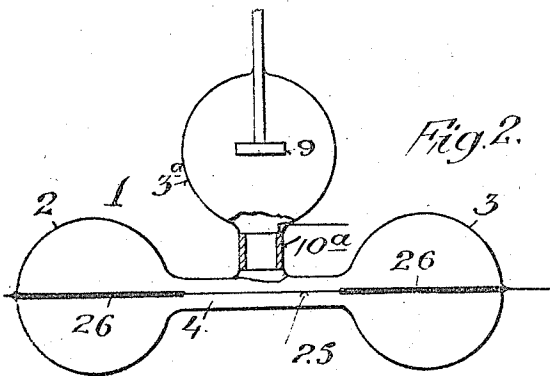
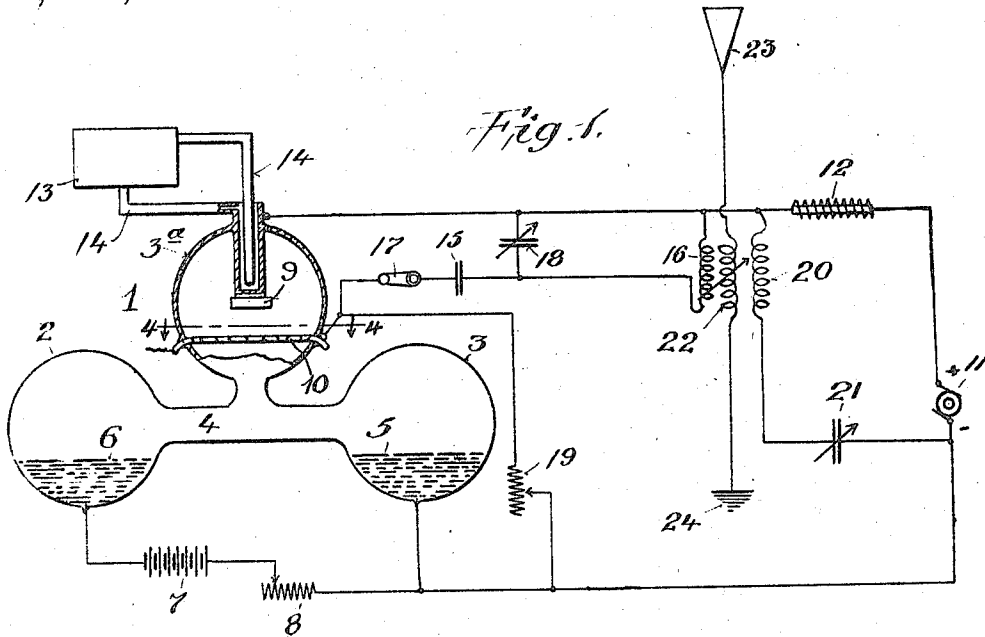


L. DE FOREST.
OSCILLATING CURRENT GENERATOR.
APPLICATION FILED MAR. 26, 1915.

1,221,034.

Patented Apr. 3, 1917.



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UNITED STATES PATENT OFFICE.

LEE DE FOREST, OF NEW YORK, N. Y., ASSIGNOR TO DE FOREST RADIO TELEPHONE AND TELEGRAPH COMPANY, OF NEW YORK, N. Y., A CORPORATION OF DELAWARE.

OSCILLATING-CURRENT GENERATOR.

1,221,034.

Specification of Letters Patent.

Patented Apr. 3, 1917.

Application filed March 26, 1915. Serial No. 17,225.

To all whom it may concern:

Be it known that I, LEE DE FOREST, a citizen of the United States, and residing at New York, county of Bronx, State of New York, have made a certain new and useful Invention in Oscillating-Current Generators, of which the following is a specification.

This invention relates to oscillating current generators.

The object of the invention is to provide a high frequency oscillating current generator which is simple and efficient.

Other objects of the invention will appear more fully hereinafter.

The invention consists substantially in the construction, combination, location and relative arrangement of parts all as will be more fully hereinafter set forth, as shown in the accompanying drawings, and finally pointed out in the appended claims.

Figure 1 is a circuit diagram showing one arrangement embodying my invention.

Figs. 2 and 3 are modified constructions of oscillation generators embodying my invention.

Fig. 4 is a sectional view taken on the line 4-4, Fig. 1, and looking in the direction of the arrows.

It is among the special purposes of my present invention to provide means for generating oscillating currents, and to so associate therewith a circuit arrangement as to cause intensification of the oscillating currents generated.

Referring to the drawings,—

1 designates generally an evacuated vessel which is provided with two chambers 2 and 3 which are united by a narrow passage 4. In these two chambers I place electrodes, which may be of any desirable material, but for illustrative purposes, I have shown the same to be of mercury or an amalgam thereof at 5, 6. A source of electromotive force, indicated at 7, supplies a current through a variable resistance 8 to the electrodes 5, 6, to heat the same and cause a vapor arc column to form in the passage 4.

In a chamber 3^a, forming part of the evacuated vessel 1 and communicating with the mercury arc passage 4, are located two cold electrodes 9 and 10, preferably arranged at different distances from the vapor arc column maintained in the passage 4.

The electrode 9 is electrically connected

to one terminal of a source of electromotive force 11. I have found it preferable to employ a direct current generator, as shown, but my invention is not to be limited thereto. One terminal of the current source 11 is connected to an electrode 9, and the other terminal of said current source 11 is connected to one of the cathode electrodes of the evacuated vessel, as, for instance, the electrode 5. The circuit connection between electrode 9 and source 11, preferably contains an "inertia" coil indicated at 12.

It is of advantage to maintain the electrodes 9 and 10, cool, and this may be accomplished in any suitable convenient manner. In the case of electrode 9 I have shown a simple arrangement wherein I employ a reservoir 13 which is provided with pipes 14 opening upon the electrode 9 and adapted to allow a cooling medium such as air, water, oil, or the like, to circulate therethrough.

The electrode 10 may be of any desired shape, or material, but I have found it advantageous to employ therefor a bent hollow grid. As shown in Fig. 1, the electrode 10 is a bent hollow grid with extensions projecting out of said evacuated vessel 1 to allow a cooling medium to circulate therethrough. My invention, however, is not to be limited or restricted in this respect.

In the usual and well known way, I associate an oscillating circuit with the two cold electrodes 9 and 10. This circuit consists of the usual condenser 15, and inductance 16, arranged in series with electrodes 9 and 10 and with each other. If desired, and as shown, a switch or other form of circuit make and break device 17 may also be placed in series in this oscillating circuit. If desired, and as shown, a variable capacity, such as a condenser 18, may be shunted around the inductance 16, but my invention in its broad scope is not to be limited or restricted to this detail.

I propose to connect a high resistance to the electrode 10 and the vapor arc column maintained in the passage 4, to form a high resistance "leak" path between said electrodes. The purpose of this leak path is to conduct off the excessive charge which may accumulate on the electrode 10 and thereby reduce the efficient operation of the oscillator.

I have discovered that if a second oscillating circuit be established including there-

in the electrode 9 and the vapor arc maintained in the passage 4, the inductance 20 and condenser 21 all in series with each other the oscillations set up in the original oscillating circuit 9, 16, 18, 15, 10, are increased in intensity provided the period of the second oscillating circuit is made equal to that of the first oscillating circuit. It is not essential, however, to employ this second oscillating circuit, and my invention, therefore, as defined by the claims, is not to be limited or restricted in this respect therefore, the elements 20, 21, may be omitted if desired. When the two oscillating circuits are employed, however, the inductance elements 16, 20, thereof, should be inductively associated.

A "load" or output circuit may be associated, either inductively or conductively with one or both of the above described oscillating circuits. In the arrangement shown, the load circuit is made up of a variable inductance 22 connected intermediate the radiating antenna 23 and the ground or earth 24 in the usual and well known manner for radio operation. The natural period of the load circuit should be equal to that of the first or original oscillating circuit.

In Fig. 2 I show a modified form of evacuated vessel oscillator, wherein the heated electrode may be a filament instead of a vapor arc above described. In this form of my invention the cold electrode 10^a is shown in section as a metal tube inserted in the constricted portion of the chamber 3^a of the vessel 1, immediately above the passage 4. Instead of employing a column of vapor, if desired, and as shown, a heavy filament of tungsten or platinum coated with oxid of calcium or other suitable material may be employed as indicated at 25. In this instance, heavy "leading in" wires 26 are employed to support the heating filament 25. The circuit connections and the operation of this modification of my invention is similar to the above described arrangement shown in Fig. 1.

If desired, instead of employing the mercury or other form of electrodes 6, 5 in chambers 2, 3 of Fig. 1, or the filament arrangement of Fig. 2, one of the chambers 2, 3, may be supplied with a mercury or other form of electrode such as 5 or 6, while the other associated chamber may be provided with a suitable non-vaporizable electrode such as indicated at 27, Fig. 3.

The exact operation involved in a generator having the construction shown in the drawing, and as above described I have not as yet been able to fully and completely understand. I have discovered however that such an arrangement or arrangements do operate as a generator of high frequency oscillations suitable for radio work, and,

whether correct or not the oscillatory phenomena involved in the operation of the apparatus may be described in a general way as follows:

If the generator 11 is a direct current source a negative current is set up across the oscillator by means of the thermions passing from the hot electrode 25, 27, or the vapor arc in passage 4 as the case may be, to the cold electrode 9. A charge impressed upon the cold electrode 10 will greatly reduce the flow of thermions from the hot electrode or vapor arc to the electrode 9, or, in other words, will increase the potential drop between the cold electrode 9 and the hot electrode. Therefore, if the electrical connection between the electrode 10 and the electrode 9 be suddenly established by closing the switch or circuit maker 17, the positive potential of the electrode 9 and of the positive terminal of condenser 18 will be suddenly increased. Further, any positive charge on the electrode 10 will be rapidly carried away by action of the negatively charged thermions from the hot electrode attracted thereto, inasmuch as the capacity of the "stopping" condenser 15 is small. Thus a difference in potential is quickly established between the two terminals of condenser 18. The inductance coil 16 prevents this difference of potential across the condenser 18 from immediately equalizing and in consequence an oscillatory discharge is set up through the inductance 16. At the end of a half period of this discharge the potential of one armature of the condenser 18 is therefore reduced or made negative, while that on the other side of the condenser is made positive relative thereto. The reduction of the positive potential at one terminal of condenser 18, and on the electrode 9 causes a sudden increase of positive current from source 11 which again charges one terminal of condenser 18 positively, and a negative current again sets up across coil 16 to the other terminal of said condenser and to the electrode 10. This inrush of negative charge to the electrode 10 will again reduce the passage of thermions from the hot electrode to the cold electrode 9, that is, will again still further increase the positive potential of 9 and the corresponding terminal of condenser 18 relative to the other terminal of said condenser. Thus condenser 18 will once more begin to discharge a positive current through the coil 16 and the entire phenomena as above described, will be repeated, growing in intensity as it proceeds, due to the electro-magnetic inertia of coil 16, up to a point where the losses in the circuits and in the oscillator are equal to any further increase in the energy representing the oscillations.

Having now described the objects and nature of my invention, and various arrange-

ments for accomplishing the same, what I claim as new and useful and desire to secure by Letters Patent, is,—

1. In a system for generating oscillating 5 current, a work circuit, and means for generating and transmitting the generated oscillations to said work circuit comprising a vapor arc and a plurality of cold electrodes, each located at a relatively different distance 10 from said arc and each directly conductively connected to said work circuit, and means for successively charging one of said cold electrodes.

2. In a system for generating oscillating 15 current, a work circuit, and means for generating and transmitting the generated oscillations to said work circuit comprising a vapor arc and a plurality of cold electrodes, each located at a relatively different distance 20 from said arc, a series oscillating circuit connecting said cold electrodes, and means for impressing an electromotive force upon the electrode in the space between said arc and the other cold electrode.

25 3. In a system for generating electrical oscillations, a work circuit, and means for generating and transmitting the generated oscillations comprising a vapor arc and a cold anode, a source of electromotive force in 30 series relation between said vapor arc and anode, a second anode, and a series oscillating circuit connecting said anodes.

4. An oscillator for generating high frequency oscillations comprising an evacuated 35 vessel and a vapor arc and two cold elec-

trodes contained therein, a current source connected between one of said cold electrodes and the vapor arc, and a series oscillating circuit connected between said cold electrodes to set up an alternating current 40 therebetween, a work circuit, and means to transmit the generated oscillations to said circuit.

5. An oscillating system consisting of a vapor arc and a cold anode, a source of elec- 45 tromotive force in series circuit relation between said vapor arc and anode, a second anode, and a series oscillating circuit connecting said anodes, a work circuit, and means to transmit the generated oscillations 50 to said work circuit.

6. An oscillating system consisting of a heated cathode and a cold anode, a source of electromotive force in series circuit relation 55 between said cathode and anode, a second anode, and a series oscillating circuit connecting said anodes, and a second oscillating circuit associated with said first mentioned oscillating circuit, an antenna system, 60 and means for transmitting the generated oscillations to said antenna system.

In testimony whereof I have hereunto set my hand in the presence of the subscribing witnesses, on this 24th day of March A. D., 1915.

LEE DE FOREST.

Witnesses:

WALTER A. DARBY,
SAMUEL G. DARBY, Jr.