J. BETHENOD.

ELECTRICAL OSCILLATION GENERATOR.

APPLICATION FILED NOV. 28, 1917.

1,294,326. Patented Feb. 11, 1919.

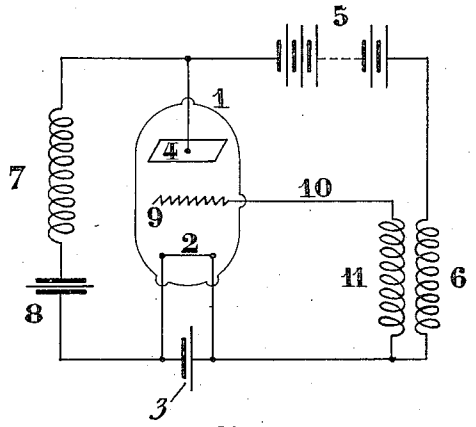



*Fig. 1*

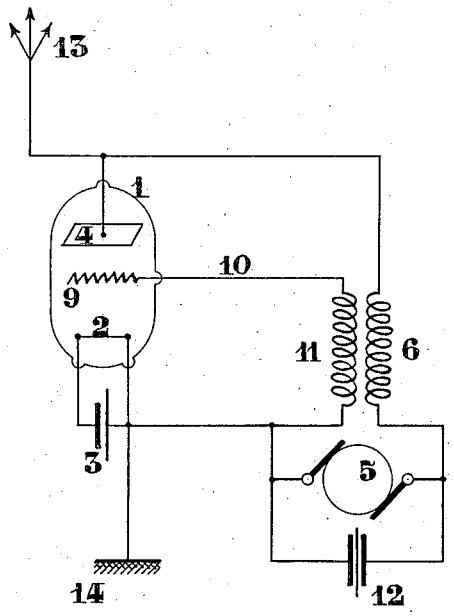



*Fig. 2*

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per Joseph Bethenod
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# UNITED STATES PATENT OFFICE.

JOSEPH BETHENOD, OF PARIS, FRANCE.

## ELECTRICAL-OSCILLATION GENERATOR.

1,294,326. Specification of Letters Patent. Patented Feb. 11, 1919.

Application filed November 28, 1917. Serial No. 204,467.

*To all whom it may concern:*

Be it known that I, JOSEPH BETHENOD, a citizen of the Republic of France, residing at 10 Rue Auber, Paris, in the Republic of France, have invented certain new and useful Improvements in Electrical-Oscillation Generators, of which the following is a specification.

Ever since the electric arc was suggested for the production of sustained oscillations of high frequency by connecting to its terminals an oscillating circuit consisting of an inductance and a capacity, numerous devices have been suggested for rendering this application practicable.

As a matter of fact if merely an ordinary arc is employed, without any connecting or constructional artifice, the oscillations are not stable, and it is impossible to employ the device in practice, especially as it is desired to attain a frequency that can be utilized in radiotelegraphy or radiotelephony.

Among the numerous improvements sought for in order to attain stability of operation, there is one that should here be called to mind, as it constitutes the starting point of the improvements forming the subject-matter of the present invention.

The reference is to Eisenstein's patent, applied for in France on the 31st December, 1907, and bearing the number 385875.

In this patent Mr. Eisenstein indicates that he replaces the arcs of various types previously suggested for the production of electrical oscillations by a Wehnelt cathode radiation tube.

As is known, the Wehnelt tube comprises an iron anode and a cathode consisting of a sheet of platinum foil heated and covered with alkaline oxids.

To the terminals of the anode and of the cathode are branched an inductance and a capacity connected in series and constituting the circuit in which the oscillations arise, just as is the case in a Duddell arc circuit.

Although this device constitutes a theoretically interesting improvement, experience has shown that the working still remains very unstable.

The problem of the production of sustained waves by means of gas or vapor tubes has been very satisfactorily solved by the invention described in the copending application Ser. No. 133,391 of my colleague Marius Latour.

In this patent stability of working is obtained for instance by the generator consisting of a vacuumized bulb or receptacle containing an incandescent filament, serving as cathode, and a mass of mercury serving as anode.

A suitably chosen difference of potential is applied between the two electrodes, and an oscillating circuit consisting of a capacity and an inductance in series is again branched between the anode and the cathode.

Under these conditions the characteristics of the discharge in the mercury vapor are the same as those of the arc, and sustained electrical oscillations of very regular amplitude are obtained in the capacity-inductance circuit.

The present invention relates to a new arrangement enabling the power and the stability of generators of the preceding type to be increased.

Figures 1 and 2 give by way of example two arrangements enabling the invention to be put into practice.

In Fig. 1 the generator is represented by the vacuumized bulb or receptacle 1 containing a filament 2, heated by a source of current 3, and an anode 4 which may consist either of a plate (coated if desired with alkaline oxids) or of a mass of mercury or of amalgam.

Between the anode and the cathode is applied the potential difference of a suitable source 5 branched in series with an inductance 6.

Finally across the terminals of the electrodes the oscillating circuit 7—8 is shunted.

Up to this point we find the ordinary connection of the singing arc, as in the Eisenstein patent and in the pending application Ser. No. 133,391 referred to above.

According to the present invention a supplementary electrode is added to the generator, which may consist of a metallic grid 9, and this electrode is connected to the filament 2 by means of a circuit 10 comprising an inductance 11 coupled with the inductance 6 of the feed circuit.

In the diagram it has been assumed that this coupling is due to a mutual induction

between the windings 6 and 11, but of course this coupling could be effected in any other known manner.

Experience proves that by virtue of the presence of the electrode 9 and of the circuit 10 coupled inductively with the feed circuit, a substantial reinforcement of the oscillations produced in the oscillating circuits 7—8 is obtained.

Fig. 2 indicates a modification of this arrangement. In this figure the same letters designate the same parts as in Fig. 1. It may be observed that the position of the source 5 has been altered, in such a way as to have one terminal in common with the source 3. This has the advantage of obviating the effect of the parasitical capacity which may exist between the source 5 and the source 3 in the arrangement of Fig. 1. This capacity effect may in particular be very marked, and may even bring about a serious disturbance in the working, if a single machine having on the same shaft two armatures one intended for feeding the filament and the other for feeding the main circuit, is employed for the sources 3 and 5.

In this figure a condenser 12 has also been indicated, which may if desired be connected to the terminals of the source 5, in order to protect the latter against the high-frequency currents.

The source 5 may be either a continuous-current machine or a battery of cells, or an alternator.

In Fig. 2 the antenna 13 and the earth 14 have been indicated branched directly to the terminals of the generator in place of the oscillating circuit 7—8. Of course this method of branching the antenna and the earth may equally as well be applied to Fig. 1.

It has already been suggested to utilize for the production of sustained waves the connections employed for establishing relays based on the properties of gases or ionized vapors.

In particular the patent applied for in France on the 27th January 1914 by the Gesellschaft fur Drahtlose Telegraphie, under No. 467747 may be mentioned.

The arrangements described in this patent differ essentially from my invention.

This may be ascertained in the following very simple manner:—

As has been seen, the connection described in the present invention is simply the ordinary arrangement, known under the name of Duddell circuit, to which has been added an auxiliary electrode connected to the cathode by a circuit coupled to the feed circuit.

If therefore it were similar to the arrangements described in the patent of the Gesellschaft fur Drahtlose Telegraphie, it ought to be possible to trace in the latter arrangements the arrangement of the Duddell circuit, by merely omitting the auxiliary circuit leading to the grid or auxiliary electrode. Now that is absolutely impossible.

Furthermore it is clearly specified in the patent in question that it is necessary, for the purpose of producing the oscillations, to constitute a closed oscillating circuit 31, see Fig. 6 of the said patent, that is to say, an oscillating circuit not comprising any gaseous conductor. The present application, on the contrary does not comprise any oscillating circuit of this type, since the cathode generator itself forms part of the oscillating circuit, just as is the case in a Duddell arc.

The connections described in the present application can be utilized with cathode generators in which the anode consists of a mere plate, or else with those in which this electrode consists of a mass of mercury or an amalgam. They also extend to arc lamp oscillation generators of all kinds, to which it suffices to add a supplementary electrode (playing the part of the electrode 9 of Figs. 1 and 2) in order to enable the arrangements indicated to be put into practice. The form and the nature of this auxiliary electrode remain arbitrary, and the same is the case with the medium existing in the vessel 1, this vessel admitting in particular of being subjected to as perfect a vacuum as possible.

What I claim and desire to secure by Letters Patent of the United States is:—

1. A generator of sustained electrical oscillations comprising a vacuumized bulb; an anode, a cathode and a supplementary electrode in said bulb; a supply circuit and an oscillating circuit separately branched across said anode and cathode and directly connected thereto; and a supplementary circuit directly connected to said cathode and supplementary electrode and inductively coupled with said supply circuit.

2. A generator of sustained electrical oscillations comprising a vacuumized bulb; an anode, a cathode and a supplementary electrode in said bulb; a source of electric current adapted to heat said cathode; a supply circuit and an oscillating circuit separately branched across said anode and cathode and directly connected thereto, said supply circuit including a source of current distinct from but having a common terminal with said first mentioned source of current; and a supplementary circuit directly connected to said cathode and supplementary electrode and inductively coupled with said supply circuit.

3. A generator of sustained electrical oscillations comprising a vacuumized bulb, an anode and a cathode therein, a source of electric current serving to heat said cathode, a second source of current and an inductance in series therewith connected to said anode

and cathode, the two aforesaid sources of current having one terminal in common, an external oscillating circuit comprising an antenna connection and an earth connection branched across the terminals of said anode and cathode, and a supplementary electrode in said bulb connected to the cathode by a circuit including an inductance coupled with the first mentioned inductance, substantially as described.

In testimony whereof I affix my signature in presence of two witnesses.

JOSEPH BETHENOD.

Witnesses:

EUGENE PETAIN,

CHAS. P. PRESSLY.