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SHORT WAVE GENERATOR

Filed Jan. 9, 1928

Fig. 1

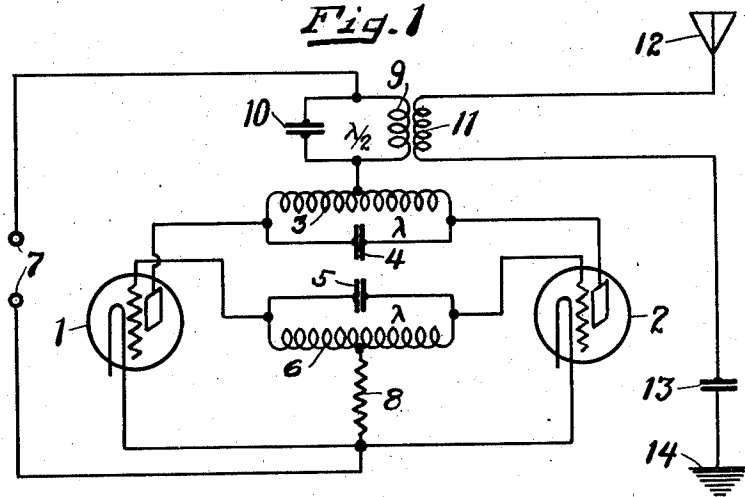


Fig. 2

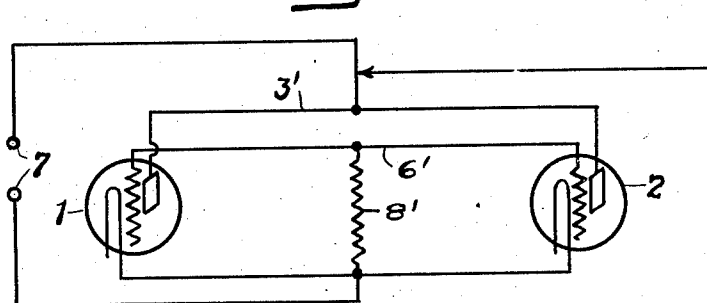
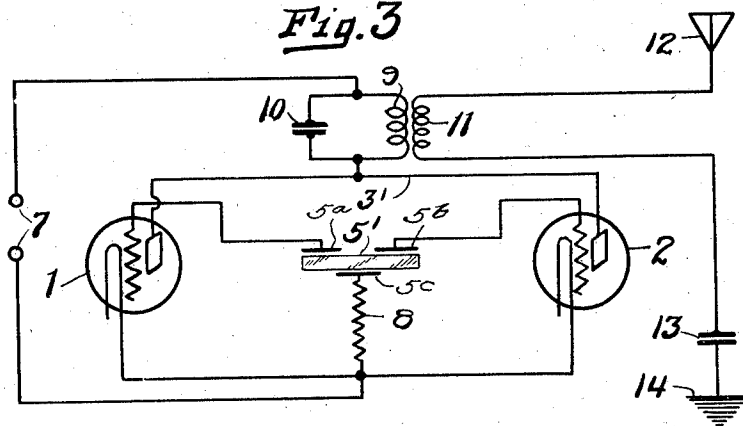


Fig. 3



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SHORT-WAVE GENERATOR

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This invention refers to an arrangement for the generation of oscillations by means of vacuum tubes. In particular it refers to an arrangement which permits going beyond the limit of shortest wave length generated by the usual means, and provides means for generating even shorter wave lengths.

A practical application of this invention is with a generator of oscillations controlled by means of a piezo-electric crystal, in which the wave lengths generated are dependent on the dimensions of the crystal and its orientation with regard to the optical axis. With previously known methods it was not practical to generate waves of less than 40 meters by means of crystals on account of the practical difficulties of making and grinding crystals of the necessarily small dimensions.

Another application of the present arrangement is to generators of ultra short waves, waves so short that the oscillation constants are determined by the inner capacity of the tubes and the inductance of the lead wires to the electrodes, which is practically the lowest possible limit.

In many other cases it may also be desired to procure a lower wave length with a definite set of conditions.

I have illustrated my invention in the accompanying figures as follows:—

Fig. 1 shows the use of my invention in a conventional short wave oscillating circuit of the push-pull type.

Fig. 2 is the use of my invention in an ultra short wave length generator, and

Fig. 3 illustrates the use of my invention in a generating set controlled by a piezo-electric crystal.

The invention is especially applicable to the so-called counter-connected or push-pull arrangement in which both the grids and the anodes of two three-electrode tubes are connected with tuned oscillating circuits while the anode current supply is attached to the zero potential point of these circuits, for instance, at the symmetry point of the oscillating coils. There is therefore no high frequency current in the leads to the anode current source, which therefore do not have to be tuned to the oscillating frequency.

A preferred embodiment of the invention is shown in Fig. 1, in which numerals 1 and 2 indicate two counter-connected or push-pull working tubes, 3 and 4 indicate an inductance and a capacity connected between the two anodes of the oscillation circuit, 5 and 6 indicate an inductance and a capacity between the two grids of the oscillation control circuit. The two oscillation circuits are tuned with respect to one another so that an oscillation is generated in the circuit 3, 4 of their wave length (λ), which may be applied in any well-known manner to the utilization circuit (antenna circuit). The anode current supply is connected into circuit at one side at the symmetry point or midpoint of the anode oscillation inductance 3 and on the other side at the point of a connection between the two cathodes, this middle point being connected by means of a leakage resistance 8 with the middle or symmetrical point of the grid oscillation coil 6.

According to the invention there is connected in the anode supply circuit a resonant circuit tuned to double frequency (that is, one-half wave length) consisting of inductance 9 and capacity 10. The above mentioned two tubes work in opposition; in other words, while during one half period of the oscillation in circuit 3, 4 the energy is supplied to tube 1, during the other half period it is supplied to the tube 2, with the result that the supply to the anode circuit 9, 10 consists of two current impulses during every oscillation period, resulting in an alternating current of double frequency (wave length equals $\lambda/2$) in the oscillation circuit 9, 10. This can be made use of in an antenna circuit having an antenna 12, coupling coil 11, an antenna shortening condenser 13 and a connection to the earth at 14.

Fig. 2 shows an arrangement for the sending of very short waves. The oscillation circuits are shrunk to the inner tube capacity between grid and anode and the inductance of the connecting wires 3 and 4, giving the shortest possible wave length. Numerals 1 and 2 indicate, as before, the two tubes, 3' the anode connection, 6' the grid connection, and 8' the resistance connection from the grids to

the cathodes. Numeral 7 indicates the supply terminals of the anode circuit, which are connected to the symmetrical or midpoints of both connecting wires 3' and 6', in the last case the connection to the cathode wire coincides with the point to which the resistance 8' is fastened. The high frequency current of double frequency generated in the anode supply leads is coupled conductively to the antenna, for instance, at one of the potential nodes, while the earth connection may be either conductive or capacitative as is usual with short wave circuits.

Fig. 3 shows the use of this arrangement with a piezo-electric crystal oscillator 5'. For this purpose the crystal 5' is provided with three conducting electrodes, two of which 5^a and 5^b are arranged at opposite sides of opposite electric or mechanical phase conditions to be connected to the grids of the tubes and a third electrode 5^c arranged intermediate between both to be connected to the filament of the tubes. In order to secure a symmetry point of oscillations this crystal is supplied with two cover plates as indicated in the drawing, corresponding to the similar elements of the oscillating circuit 5 and 6 according to Fig. 1. In this figure the oscillating circuit between the two anodes corresponding to the elements 3 and 4 of Fig. 1 are replaced by the capacities of the two tubes 1 and 2 and the inductance of the lead 3' connecting these two anodes in exactly the same manner as in Fig. 2. The anode supply circuit is connected similarly to the symmetry point of this connecting lead. It is evident, however, that for lower frequencies the inductance 3 and condenser 4 of Fig. 1 would have to be introduced for proper operation.

It is seen that 7 is the anode supply and 8 is the grid-leak resistance. Numerals 9 and 10 indicate the oscillation circuit tuned to the double frequency, in this case double the natural frequency of the crystal. This circuit is connected inductively with the antenna circuit consisting of antenna 12, the coupling coil 11, an antenna condenser 13, and earth connection 14.

Having described my invention, what I believe to be new and desire to secure and protect by United States Letters Patent is:—

1. In a push-pull tube generator, wherein, in addition to the normal frequency there is present a double frequency, an oscillating circuit connected in the anode circuit and tuned to this double frequency, and a utilization circuit to which said oscillation circuit is coupled.

2. An arrangement according to claim 1 wherein said normal frequency is controlled by a piezo-electric crystal.

3. An arrangement according to claim 1, wherein the constants of the oscillating circuits of said normal frequency are determined

solely by the internal capacity of the tubes and the inductance of the connecting leads.

In testimony whereof I have affixed my signature.

FELIX GERTH.

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