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DEVICE FOR GENERATING HIGH-FREQUENCY ELECTRICAL OSCILLATIONS

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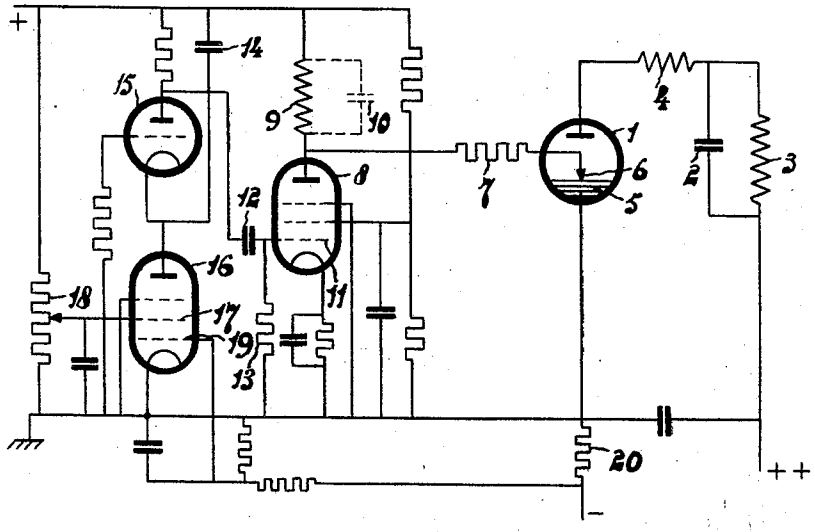

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DEVICE FOR GENERATING HIGH-FREQUENCY ELECTRICAL OSCILLATIONS

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For generating high-frequency electrical oscillations it is known to utilize devices adapted to excite an oscillatory circuit and comprising one or more controllable gas-discharge tubes, preferably gas-discharge tubes provided with an ignition electrode, which tubes are periodically ignited by, preferably impulse-shaped, ignition voltages.

With devices of this type, which may be used, for example, for the supply of high-frequency furnaces, each ignition results in the production of a damped wave-train in the oscillatory circuit included in the output circuit.

According to the invention, for counteracting variations in the output, a control-voltage varying with these variations is used for the control of the ignition frequency.

If an ignition frequency of so high a value is taken that oscillations of not-negligible amplitude still occur in the oscillatory circuit at the instant at which the next wave-train starts, the initial amplitude of this wave-train will depend upon the value of the voltage remained behind in the output circuit at the instant of ignition of the preceding wave-train, or in other words also in this case there exists a definite functional relation between the ignition frequency and the high-frequency energy dissipated in the output circuit. Even then variations in the ignition frequency or in the frequency of the high-frequency oscillations produced thus exert a great influence on the output energy.

In order to obtain a control-voltage which varies with the output, use may be made, for example, of a coil arranged in the field of the output circuit of the said device.

This control-voltage may likewise be taken from a resistance included in the supply circuit of the gas-discharge tube. Preferably a smoothing filter is provided in the control-voltage conductor.

In one particularly advantageous embodiment the periodic ignition voltages are taken from a relaxation generator provided with a grid-controlled electron tube to the control-grid of which the control-voltage is supplied to control the ignition frequency.

The invention will be explained more fully with reference to the accompanying drawing, which represents, by way of example, one embodiment thereof.

The generator consists of a gas-discharge tube 1, which comprises a mercury cathode and the output circuit of which includes an oscillatory circuit 2, 3, which is connected through a coil 4 to the anode of the tube. The presence of the

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coil 4 the self-induction of which is approximately one-fifth of that of the coil 3, has an increasing effect on the initial voltage of the wave-trains in the circuit 2, 3. The cathode of the tube is constituted by an amount of mercury 5, with which an ignition electrode 6 co-operates. For example, the ignition may be effected capacitatively in the known manner, in which event the electrode 6 is immersed in the mercury so as to be insulated therefrom. Spark ignition, however, is also possible.

The ignition electrode 6 is connected via a resistance 7 to the anode of a pentode tube 8, the anode circuit of which comprises a coil 9 tuned by its own capacity 10 to the ignition frequency. On the control-grid of the tube 8 are impressed via a condenser 12 provided with a leakage resistance 13, negative impulses originating from the periodic discharges of a condenser 14 through a thyratron 15. Each time the condenser 14 is again charged via a high-vacuum pentode 16, the conductivity of which experiences, on the one hand, the influence of the voltage at the screen-grid 17, which voltage may be controlled by means of a potentiometer 18, and, on the other hand, the influence of the voltage at the control-grid 19, which voltage is determined by the loss of voltage in a resistance 20 included in the cathode lead of tube 1.

The device functions as follows:

During each period the condenser 14 is charged through the tube 16 with a current intensity which depends upon the screen-grid- and control-grid voltages of this tube. As soon as the break-down voltage of the thyratron 15 is attained, the condenser is discharged with the result that via the grid-condenser 12 a negative voltage impulse is applied to the control-grid 11 of the pentode 8. The duration of this impulse may be adjusted by giving the product of the values of the elements 12 and 13 the value desired in each individual case. This results in that the current in tube 8 is suddenly interrupted for a moment and during this moment the potential energy present in the coil 9 begins to oscillate. However, this oscillation will at once be damped again by the tube 8 itself as soon as the latter again becomes conductive at the termination of the impulse impressed upon the control-grid 11. The number of periods or half-periods the oscillation in the circuit 9, 10 will last consequently depends entirely upon the duration of the last-mentioned impulse. At any rate the first half-wave will be positive and, if an impulse of about 20 volts is applied to the control-grid 11, this positive half-wave may attain a peak value

of 10 kv. and upwards and therefore in any circumstance suffices to ignite the tube 1. Whenever the tube is ignited, the energy in the circuit 2, 3 starts oscillating, the mercury arc in tube 1 being extinguished as soon as the anode voltage passes through zero in consequence of the oscillation in the circuit 2, 3. The tube 1 consequently has no damping effect on the circuit 2, 3 in which, irrespective of circuit-damping and load-damping, the energy is free to oscillate until the tube 1 is re-ignited and the same play recurs.

The ignition frequency is adjusted by means of the potentiometer 18 in such manner that upon increase of this frequency the voltage across the circuit 2, 3 also increases at the moments when the tube 1 is ignited. This is necessarily accompanied by an increase of the direct current taken from the source of supply, said current flowing inter alia through the resistance 20. The voltage across this resistance is applied, via a smoothing filter of negative sign, to the control-grid 19 so that the condenser 14 is charged more slowly and the ignition frequency decreases. The current in the resistance 20 and therefore the input and consequently also the output are thus automatically maintained constant with certain limits.

Instead of applying to the control-grid 19 the control-voltage originating from the smoothing filter, it is also possible to apply a modulation voltage to that grid. This results in modulation of the ignition frequency, which modulation is again converted at the oscillator into amplitude modulation of the oscillation in the circuit 2, 3.

Satisfactory results have been obtained with a circuit-arrangement wherein the tubes 8, 15 and 16 were of the types EL51, EL50 and EL6 respectively and wherein the following elements were given the following values:

Potentiometer 18: 50,000 ohms
Condenser 14: 50,000 pFs.
Condenser 12: 5600 pFs.
Leakage resistance 13: 1000 ohms
Resistance 7: 5000 ohms
Resistance 20: 1 ohm

What I claim is:

1. Apparatus for producing oscillations of high frequency comprising a shock excited oscillator including a gaseous discharge device having an ignition electrode and an oscillatory circuit connected in series with said device, a controllable impulse generator yielding periodic pulses, the output of said generator being applied to said ignition electrode to fire periodically said device thereby to excite said oscillatory circuit, means for deriving a control voltage from said oscillator varying in accordance with the output thereof, and means to apply said control voltage to said generator to control the periodicity thereof and thereby counter act variations in the output of said oscillator.

2. Apparatus for producing oscillations of high frequency comprising a shock excited oscillator including a gaseous discharge device having an ignition electrode and an oscillatory circuit connected in series with said device, a controllable impulse generator yielding periodic pulses, said generator including a relaxation circuit having an electron discharge tube provided with a control electrode, the output of said generator being applied to said ignition electrode to fire periodically said device thereby to excite said oscillatory circuit, means for deriving a control voltage from said oscillator varying in accordance with the output thereof, and means to apply said control voltage to said control grid to control the periodicity of said generator and thereby counteract variations in the output of said oscillator.

3. Apparatus for producing oscillations of high frequency comprising a shock excited oscillator including a gaseous discharge device having an ignition electrode, an oscillatory circuit connected in series with said device, a source of potential connected across said serially-connected oscillatory circuit and device and an impedance element interposed between said source and said device, a controllable impulse generator yielding periodic pulses, means to apply said periodic pulses to said ignition electrode to fire periodically said device and thereby excite said oscillatory circuit, means for deriving a control voltage from said impedance element varying in accordance with the output of said oscillator, and means to apply said control voltage to said generator to control the periodicity thereof accordingly thereby to counteract variations in the output of said oscillator.

4. Apparatus, as set forth in claim 3, wherein said means to derive a control voltage from said impedance element includes a filter network.

5. Apparatus, as set forth in claim 3, wherein said impulse generator comprises a charging capacitor, an electron discharge tube including a control grid and connected in series with said capacitor, a source of potential connected across said serially-connected capacitor and tube, a gaseous discharge tube, a resistance connected in series with said gaseous discharge tube across said capacitor, said control voltage derived from said impedance element being applied to said control grid whereby periodic impulses are developed across said resistance with a periodicity depending on said control voltage.

6. Apparatus for producing oscillations at high frequency comprising a shock excited oscillator including a gaseous discharge device having an ignition electrode, an oscillatory circuit connected in series with said device, a source of potential connected across said serially-connected oscillatory circuit and device, and an impedance element interposed between said source and said device, a controllable impulse generator yielding periodic pulses, said generator including a relaxation circuit having an electron discharge tube provided with a control grid, means to apply the output pulses of said generator to the said ignition electrode to fire periodically said device and thereby excite said oscillatory circuit, means including a filter network for deriving a control voltage from said impedance element varying in accordance with the output of said oscillator, and means to apply said control voltage to said generator to control the periodicity thereof accordingly thereby to counteract variations in the output of said oscillator.

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