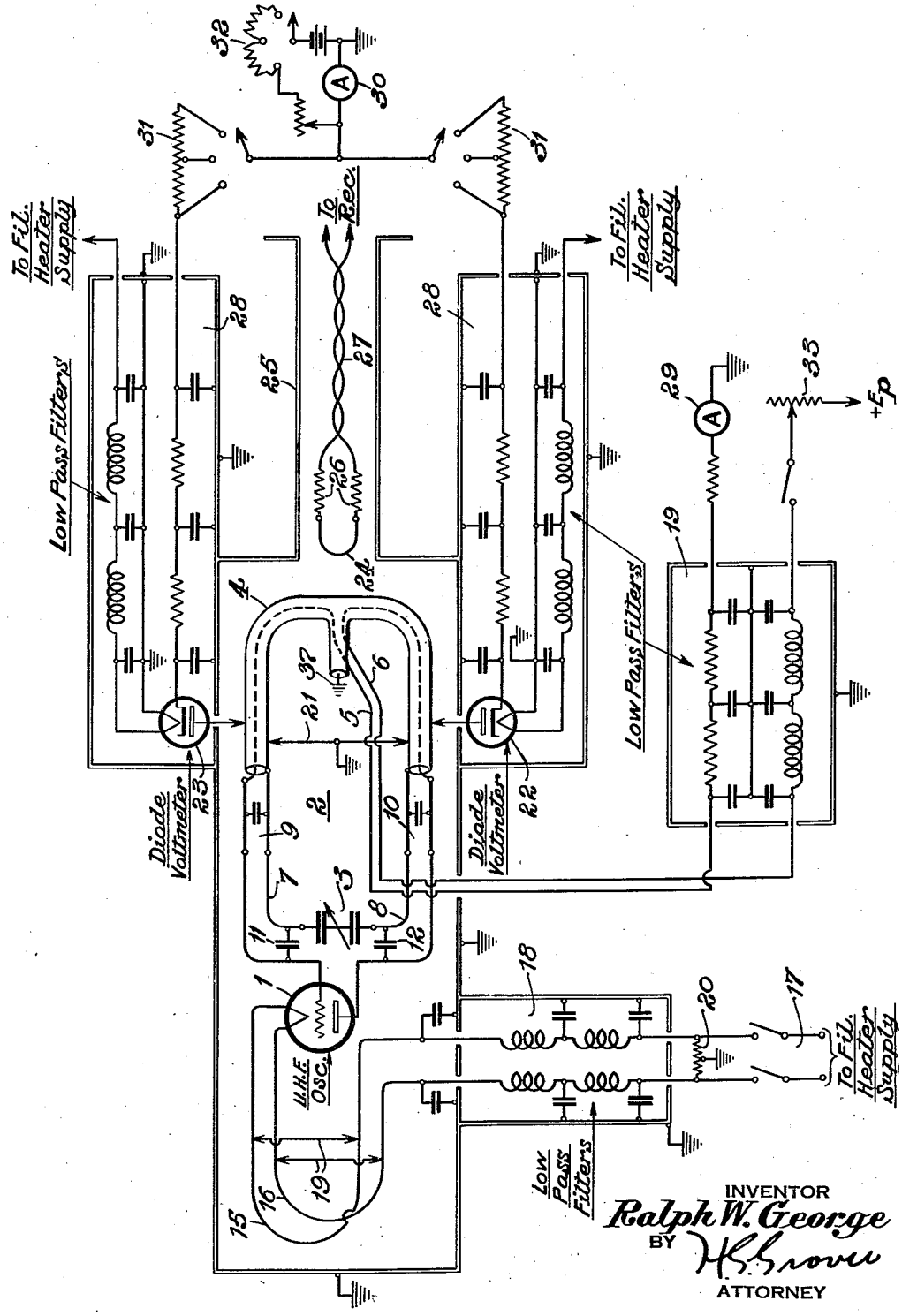
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OSCILLATION GENERATION SYSTEM

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OSCILLATION GENERATION SYSTEM

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The present invention relates broadly to improvements in signal generators and specifically to an ultra high frequency signal generator.

As is known, signal generators are used for the generation of radio frequency signals of known strength and are employed for making measurements of field strength and in the testing of radio receivers.

One of the objects of the present invention is to provide a simple and efficient signal generator for use with frequencies in the range substantially from 100 to 500 megacycles.

Another object of the present invention is to provide a signal generator having an oscillatory circuit coupled between the grid and anode of the oscillator thereof, with measuring means coupled symmetrically to both sides of the tank circuit, in order to avoid error caused by a possible unavoidable unbalance between the currents flowing in the two sides of the tank.

The signal generator of the present invention has for one of its features an attenuator which has a negligible frequency characteristic within the desired frequency range, and which is coupled symmetrically to both sides of the oscillatory circuit, which sides are oppositely disposed with respect to the voltage nodal point (current maximum). This attenuator is composed of a small semicircular loop whose reactance is negligible at the high frequencies, and which is movable along the axis of a metal cylinder.

Another feature of the present invention lies in the manner of connecting a pair of diode voltmeters to the two sides of the oscillatory circuit whose electrical midpoint is grounded, whereby the voltmeters indicate the sum of the voltages between each diode anode and ground.

A further feature lies in the use of the oscillator having an oscillatory circuit composed in part of a tubular conductor containing in the interior thereof energy supply leads whose extensions form an essential part of the radio frequency circuit.

Other objects and features will appear from a reading of the following description which is accompanied by a drawing whose single figure shows, by way of example only, an ultra high frequency signal generator in accordance with the invention.

Referring to the drawing, there is shown as my improved signal generator, a balanced ultra high frequency vacuum tube oscillator 1 whose oscillatory circuit 2 is essentially of the Hartley type and which employs a tuning condenser 3 having extremely low inductance, and a capacity variation of the order of 2 micromicrofarads. The inductance loop of the oscillatory circuit includes a U-shaped hollow tubular conductor 4 in whose interior extend the energy supply leads 5, 6 for the grid and anode electrodes of the oscillator 1. It should be noted that the terminals of tuning condenser 3 are connected through leads 7 and 8 to the ends of the tubular conductor 4. In order to take care of different frequency ranges, there are provided inductance stubs 9 and 10 which are placed between the ends of the hollow conductor 4 and the electrodes of the oscillator 1. One side of each stub is connected in series relation to the energy supply lead 5 or 6, while the other side of the stub is connected between one end of the tubular conductor 4 and a terminal of the tuning condenser 3. Stubs 9 and 10 are of the plug-in type and have equal values of inductance. It is contemplated that stubs having more or less inductance can replace the stubs 9 and 10 in plug-in fashion in order to change the frequency range of the oscillator. Each plug-in stub constitutes an inductance element composed of two flat strips of metal capacitively coupled with mica between them, in order to provide a low capacity path between the flat strips of each plug-in inductance element. Capacitors 11 and 12 are radio frequency by-pass capacitors; that is, capacitors of extremely low impedance to energy of the operating frequency. The voltage nodal point 37 of the oscillatory circuit is connected to ground by means of a very low inductance lead. This voltage nodal point occurs at a location of maximum current in the oscillatory circuit. The ground connection to voltage nodal point 37 actually consists of a heavy metallic bar at right angles to the immediately adjacent straight portion of the hollow tubular conductor 4, which constitutes part of the inductance loop of the oscillatory circuit 2.

The legs of the filament of the vacuum tube oscillator 1 are connected by means of a pair of hairpin connections 15 and 16 to the filament heater supply 17. In practice, these filament leads may be constituted by two flat metallic strips each in the shape of a hairpin and tightly coupled together by the capacity which is obtained by means of mica insulation between the two strips. Low pass filters 18 are inserted in the filament heater supply path. Tuning of the filament circuit is achieved by means of a pair of slider contactors 19 adapted to short circuit portions of the filament leads 15 and 16. These slider contactors 19 may be moved in either of

two directions by means of a gear arrangement, not shown. A resistor 20 is connected across the two filament leads at a location between the filters 18 and the filament heater supply 17, and grounded at its center in order to provide an anode current return path between the filament and ground.

In order to obtain the highest possible frequency from the oscillator circuit, it has been found practical to add a shunt contactor 21 to the oscillatory circuit in order to reduce the total inductance of the circuit. This contactor 21 is arranged to make contact with and to slide over the legs of the hollow tubular conductor 4 and is grounded at its center as shown. In the frequency range of 400 and 500 megacycles, this shunt arrangement 21 has sufficient impedance to permit adequate voltage to be obtained and measured by the diode voltmeters 22 and 23, which are connected to opposite sides of the inductance element constituted by the hollow tubular conductor 4.

The diode voltmeters 22 and 23 have their anodes connected to opposite sides of the tubular conductor 4 forming part of the inductance loop of the oscillatory circuit 2 at points which are oppositely and symmetrically coupled to the oscillatory circuit with respect to the voltage nodal point 37. In this manner the voltmeters can indicate the sum of the voltages between each diode anode and ground. Thus, if appreciable unbalance of radio frequency currents exists in the two halves of the fixed inductance element constituted by both sides of the tubular conductor 4, the two voltmeters will indicate the net voltage across this inductance loop. Such unbalance between the currents in both legs of the tubular conductor 4 may be unavoidable and sometimes caused by undesirable effects produced at different frequency ranges.

The output attenuator consists of a very small loop 24 coupled inductively to both sides of the hollow tubular conductor 4 with respect to the voltage nodal point 37. Because this voltage nodal point 37 is a point of maximum current in the fixed inductance element 4, there is assured maximum flux density in the region of the attenuator, and because of the voltage nodal point location there is assured a minimum of electrostatic coupling between the attenuator and the fixed inductance element. Because the currents flowing in the ground lead connected to voltage nodal point 37 (which is a heavy bar at right angles to the immediately adjacent straight portion of the fixed inductor 4) are at right angles to the attenuator coupling loop, they should give no appreciable induced currents in loop 24, thus avoiding resulting error. In practice, the grounding bar at voltage nodal point 37 supports the fixed hollow tubular conductor 4, and through a hole in it this grounding bar provides an exit means for the grid and plate leads 5 and 6, out of the radio frequency fields and into their respective filters 19. In other words, at least that portion of the ground connection which is electrically adjacent (i. e., close enough to produce an induced current in the coupling loop 24) is made to be at right angles thereto so that coupling between the ground lead and the loop 24 does not exist. By this arrangement there is obtained a substantially balanced output without the use of electrostatic shielding between the loop 24 and the fixed inductance element 4. The attenuator is located within a metallic cylindrical shield 25, and the loop 24 is arranged not to extend beyond the end of the cylinder 25. Directly at the terminals of the loop are connected low or negligibly reactive resistors 26 of equal value whose magnitudes are chosen to match the characteristic impedance of the line 27 to which a receiver (not shown) may be connected. With resistors 26 of a value of 37.5 ohms each, a balanced radio frequency transmission line of preferably 75 ohms impedance should be employed. By suitably choosing the diameter of cylinder 25, there may be obtained a flux distribution in its interior which varies substantially in a logarithmic manner to produce a logarithmic attenuator characteristic regardless of frequency. The length of the cylinder 25 within reasonable limits determines the attenuator range. In practice, the elements 24, 26 and 27 are located within a brass plunger, and attenuation is secured by withdrawing the plunger from the cylinder 25 by means of a combination nut and dial arrangement. In this connection, attention is invited to the disclosure in my United States Patent No. 2,204,179, granted June 11, 1940, which shows an ultra high frequency signal generator employing an attenuator system of a type identical with that described herein.

Separate low pass filter circuits are provided for the filament circuit of the oscillator 1, for the grid and anode energy supply leads for the oscillator 1, and for each of the cathode circuits of the diode voltmeters 22 and 23. These are labeled 18, 19, and 28, 28. Separate shield boxes are provided for the oscillator circuit and for the diodes, as well as for the filters 18 and 19, to prevent undesired coupling between the different circuit elements of the signal generator. These shield boxes are all grounded by means of low inductance leads. In the use of the filter inductance elements, where two such elements are used in the same lead, the two filter sections are designed to have different lengths of wire, in order to avoid resonance. These filter inductance elements may be composed of an insulated wire threaded through holes in a brass block which, in effect, is equivalent to an insulated wire of the same length inside a closely fitting well grounded cover pipe.

In the oscillator anode circuit there is provided a meter 29 for providing an indication of the anode current, while in the diode voltmeter circuit there is provided a microammeter 30 which is connected in the cathode lead circuits of the two voltmeters. The multiple voltage range circuits 31 of the diode voltmeters, and the diode emission current bucking circuit 32 at the microammeter 30 are, except for the switching arrangements, conventional. Variation in the intensity of the high frequency oscillations is obtained by control or adjustment of the anode voltage circuit by means of the potentiometer 33 which varies the magnitude of the positive polarizing potential applied to the anode of the oscillator.

It is possible to reduce the number of plug-in elements 9 and 10 required for a wide frequency range by providing an adjustable slider on each of the hairpin shaped elements or strips. The tuning range for any plug-in inductance element 9 or 10 should not be too large.

In one embodiment tried out in practice, there was obtained a frequency range in the signal generator from about 95 megacycles to 520 megacycles.

The term "ground" used in the specification

and in the appended claims is intended to include any point of zero or fixed alternating current potential, and is not limited to an actual earth connection.

What is claimed is:

1. A high frequency oscillation generator including a tuned circuit for determining the oscillations generated by said generator, said tuned circuit having a fixed inductor portion grounded at its voltage nodal point, and a pair of rectifiers coupled to said fixed inductor portion at locations symmetrically disposed on opposite sides of said voltage nodal point, and means for indicating the combined rectified outputs of said rectifiers.

2. In a signal generator of the type including a radio frequency oscillator tunable over a range of frequencies, said oscillator having a tuned circuit for determining the frequency of the oscillations generated by said oscillator, said tuned circuit having a fixed inductor portion grounded at its voltage nodal point, a pair of rectifiers coupled to said fixed inductor at points symmetrically disposed on opposite sides of said nodal point, a meter, and means connecting said meter to the outputs of said rectifiers for indicating the net current flowing in said fixed inductor.

3. In a signal generator, a radio frequency oscillator comprising a vacuum tube whose grid and anode electrodes are coupled to a tuned circuit, a portion of said tuned circuit being constituted by a hollow tubular electrically conducting loop, a movable element in shunt to said tubular loop for reducing the total inductance of said tuned circuit, means for supplying a suitable polarizing potential to said anode and a suitable bias to said grid, leads from said grid and anode electrodes also forming part of said tuned circuit and extending, respectively, within different portions of the interior of said tubular loop and connecting to said means, said tuned circuit having a variable capacitator connected to the ends of said tubular loop.

4. In a signal generator, a radio frequency oscillator including a frequency determining tuned circuit in the form of a loop, a connection from ground to a voltage nodal point on said loop, rectifiers coupled to said loop at locations symmetrically disposed on opposite sides of said voltage nodal point, and means for indicating the combined outputs of both of said rectifiers, said means including a switch for enabling an indication of the output of one of said rectifiers.

5. In combination, a tuned circuit having a fixed inductor portion grounded at its voltage nodal point, means for exciting said tuned circuit, and a pair of rectifiers coupled to said fixed inductor portion at locations symmetrically disposed on opposite sides of said voltage nodal point, a meter, and circuit elements including switching means for connecting said meter to measure the combined rectified currents of both rectifiers, said last means including a switching element for enabling a measurement of the output of either rectifier.

6. A high frequency oscillation generator including a tuned circuit for determining the oscillations generated by said generator, said tuned circuit having a fixed inductor portion grounded at its voltage nodal point, and a pair of rectifiers coupled to said fixed inductor portion at locations disposed on opposite sides of said voltage nodal point, and means for indicating the combined rectified outputs of said rectifiers.

7. In a signal generator, a radio frequency oscillator comprising a vacuum tube whose grid and anode electrodes are coupled to a tuned circuit, a portion of said tuned circuit being constituted by a hollow tubular electrically conducting loop, means for supplying a suitable polarizing potential to said anode and a suitable bias to said grid, leads from said grid and anode electrodes also forming part of said tuned circuit and extending, respectively, within different portions of the interior of said tubular loop and connecting to said means, said tuned circuit having a variable reactance for changing the tuning thereof, a low inductance connection in the form of a conducting element hollow for a substantial portion of its length connecting a voltage nodal point on said loop to ground, said hollow conducting element extending at right angles to the portion of the loop to which it is connected and forming in its interior a passage for the grid and anode leads.

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