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D. BASIM

2,111,086

OSCILLATION GENERATOR

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Fig. 1

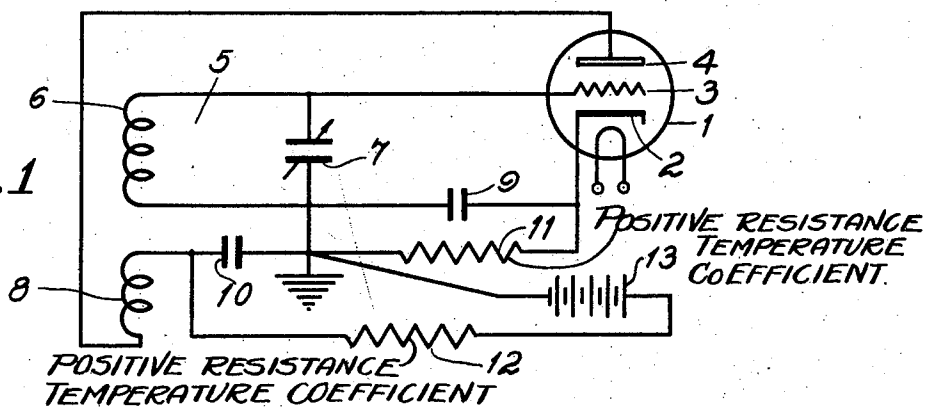


Fig. 2

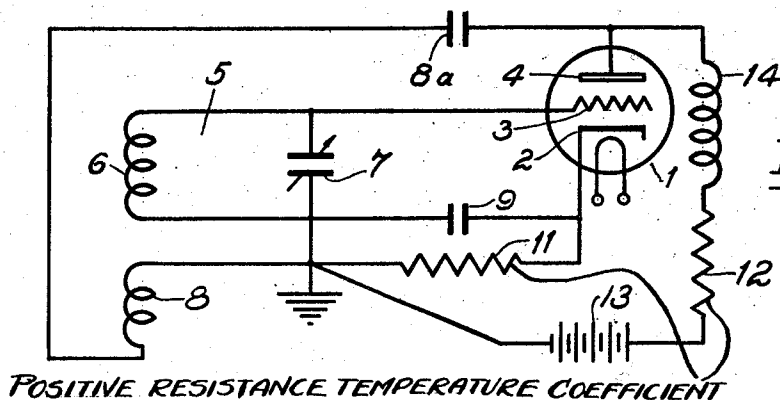
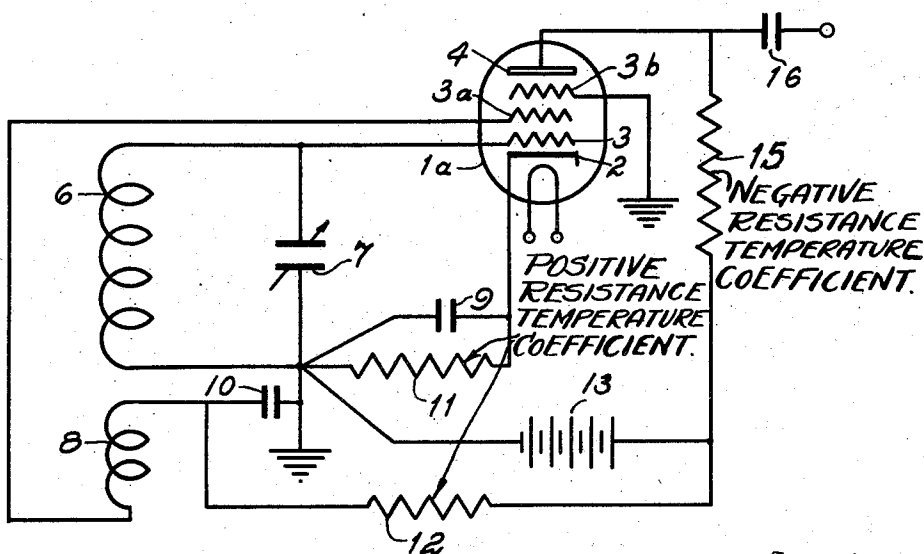


Fig. 3



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OSCILLATION GENERATOR

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6 Claims. (Cl. 250—36)

This invention relates to electrical discharge device oscillation generators generally. More particularly this invention relates to electrical discharge device oscillation generators of a high frequency stability.

An object of this invention is to provide an oscillation generator employing an electric discharge device adapted to generate electrical oscillations of extremely constant frequency without the use of any auxiliary frequency control means.

Another object of this invention is to provide an oscillation generator employing an electric discharge device adapted to generate electrical oscillations of extremely constant frequency over wide temperature variations of the discharge device without mechanical compensation or without the use of auxiliary frequency control means.

Still another object of this invention is to provide an electric discharge device oscillation generator of extremely high frequency stability by employing temperature-responsive-voltage-varying means to control the potential applied to electrodes of the discharge device in accordance with temperature variations.

Another object of this invention is to provide an electric discharge device oscillation generator of extremely high frequency stability in which electric potentials applied to selected electrodes of the discharge device are varied in response to temperature variations.

A further object of this invention is to provide an electric discharge device oscillation generator of extremely high frequency stability employing circuit components having substantially no temperature expansion throughout wide temperature ranges and employing means for counteracting effects of operating temperature variations in the electric discharge device.

Another object of this invention is to provide an electric discharge device oscillation generator of relatively high frequency stability employing a multiple grid electrode or a single grid electrode electric discharge device employing an oscillatory circuit having a temperature coefficient of substantially zero and employing temperature responsive voltage regulating means to adjust potentials applied to the electric discharge device to compensate for the effects of temperature on the frequency of the oscillations generated in the electric discharge device.

Other and further objects of this invention will be apparent from the following specification and the claims.

In accordance with this invention I provide an

oscillation generator adapted to generate electrical oscillations of substantially constant frequency. The arrangement of my invention employs an electric discharge device having a cathode, an anode and one or more gridlike electrodes. An oscillatory circuit, including inductance and capacity elements, is connected to selected electrodes of the electric discharge device. Suitable sources of current supply for energizing the cathode and anode circuits are also employed.

A resistor having a positive resistance-temperature coefficient is connected in series with the cathode and a resistor having a positive resistance-temperature coefficient is connected in series with the anode current supply. The values of these resistors are adjusted to give the proper variation in potentials applied to the discharge device electrodes throughout wide temperature ranges.

Each of these variations in the potentials caused by these resistors, considered separately or individually, would effect a certain frequency change in the oscillations generated by the oscillation generator. However, the effects of the variations are such, in the circuit arrangement of my invention, as to counteract and maintain the frequency generated substantially constant even though the electric discharge device frequency characteristics change slightly because of temperature changes.

Further details of this invention will be apparent from the following specification and the drawing in which, briefly, Fig. 1 illustrates an embodiment of my invention employing the series anode excitation three electrode electric discharge device; Fig. 2 shows an embodiment employing the parallel anode excitation three electrode electric discharge device; and Fig. 3 illustrates a multiple grid electric discharge device circuit arrangement embodying my invention.

Referring to Figure 1 in detail, reference numeral 1 designates a three-element electric discharge device having a cathode 2, a grid electrode 3, and an anode 4. This electric discharge device may be of any conventional design adapted to generate or control the production of electrical oscillations. The grid electrode 3 is connected to the oscillatory circuit 5 which includes the inductance 6 and the variable condenser 7. The inductance 6 is preferably wound with relatively fine wire on a form of ceramic material, such as, isolantite or other insulating materials such as, fused quartz, boro-silicate glass and vitreous compositions having a low coefficient of thermal expansion. The purpose of constructing

this inductance in this manner is to produce a unit, the physical dimensions of which do not vary appreciably with normal temperature changes. The wire or conductor of the inductance may be wound on a suitable form of vitreous or glass material and fused into the vitreous or glass form, thus producing an inductance unit with substantially permanent characteristics. The variable condenser 7 also is constructed to have a low temperature coefficient whereby the electrical capacity thereof does not vary appreciably with normal changes in temperature. The conducting plates of the condenser 7 are made of invar or similar alloy having a low coefficient of thermal expansion. The oscillatory circuit, comprising the inductance 6 and the condenser 7, when adjusted to a predetermined frequency, will maintain that adjustment accurately throughout wide ranges of temperatures. The inductance 8 which is coupled to the inductance 6 is also wound with relatively fine wire on a form of material, such as isolantite.

A high frequency by-pass condenser 9 is connected between the cathode 2 and the oscillatory circuit 5. Another condenser 10 is connected between the inductance 8 and the oscillatory circuit 5. The point at which the condensers 9 and 10 are connected to the oscillatory circuit 5 is also grounded to the metal chassis or frame which is employed to support the component parts of the oscillation generator. A resistor 11 having a positive resistance-temperature coefficient is connected across the condenser 9 between the cathode 2 and the oscillatory circuit 5. This resistor 11 is preferably wire wound on a suitable insulation form made of ceramic material or the like. Another resistance unit 12 is connected to a point between the inductance 8 and the condenser 10 and to the positive terminal of the source of anode current supply 13. This resistor is also made to have a positive resistance-temperature coefficient. The resistors 11 and 12 may be wound with wire made of nichrome, manganin, or other alloys suitable for electrical resistance units, having different temperature coefficients.

The purpose of the resistors 11 and 12 is to provide automatic compensation for frequency drift or change which occurs in the discharge device 1 due to changes in ambient temperature to which the discharge device is subjected during operation. It has been found that when the normal frequency drift or change in an oscillation generator, such as, shown in Figure 1, is in the negative direction, that is, when the frequency decreases as the temperature is increased, that compensation for this frequency change can be obtained either by increasing the voltage on the cathode or decreasing the voltage on the anode, or both. An increase in the ambient temperature will cause the resistors 11 and 12 to increase in value, thus increasing the voltage on the cathode and decreasing the voltage on the anode, causing the frequency of the oscillations generated to increase. By properly proportioning the characteristics of the resistors 11 and 12 so that the proper voltage change is obtained for given temperature changes, the frequency of the oscillations generated in the circuit of the electric discharge device may be made constant to a high degree.

It is, of course, obvious that when the frequency of the oscillations generated is to be maintained constant to an order of, for example, two parts in a million per degree centigrade temperature change, that the circuit components, such as the

oscillatory circuit 5, must be designed with extreme care, as outlined above in the description of this oscillatory circuit, for example.

The complete oscillator is enclosed in a suitable cabinet made of shielding materials such as aluminum and the like. Where desired, the cabinet may be made with heat insulating walls.

An oscillation generator of the parallel anode excitation type is illustrated in Figure 2. This oscillation generator employs an electric discharge device 1, an oscillatory circuit 5, and a pair of resistors 11 and 12 similar to the discharge device 1, oscillatory circuit 5 and resistors 11 and 12 shown in Figure 1. The distinction between this oscillation generator and that shown in Figure 1 is that the source of current supply 13 is connected in parallel with the anode-cathode circuit of the discharge device 1 through a high frequency choke coil 14 instead of in series with the anode-cathode circuit as shown in Figure 1.

An embodiment of this invention employing a multiple grid discharge device 1a is shown in Figure 3. This discharge device 1a is provided with a cathode 2, a plate 4, and grid-like electrodes 3, 3a, and 3b. The electrode 3 is connected to the oscillatory circuit 5 including the inductance 6 and the capacity 7. The electrode 3a is connected to the inductance 8 and functions as the anode of the oscillation generator. The electrode 3b is connected to ground, that is, to the metal chassis and cathode circuit. The plate 4 is connected to the resistor 15 and to the coupling condenser 16. The other terminal of the resistor 15 is connected to the positive terminal of the source of current supply 13 and to the resistor 12. The resistors 11 and 12 are made in substantially the same way as the resistors 11 and 12 of Figs. 1 and 2. However, the resistor 15 is made to have a negative resistance-temperature coefficient and is made of material such as carbon and the like, having negative temperature coefficients.

The purpose of the resistor 15 is to cause an increase in the voltage supplied to the plate or coupling electrode 4 as the ambient temperature increases. This is accomplished by making the resistor 15 of material having a negative temperature coefficient such that the resistance value of this resistor decreases as the temperature increases. The effect of increasing the voltage of the coupling electrode 4 is to increase the frequency of the oscillations generated by the discharge device 1a.

The coupling condenser 16 is provided for the purpose of coupling the oscillation generator to a work circuit, or a circuit in which the oscillations produced are to be utilized. Oscillations of considerable power and amplitude may be derived from the circuit of the generator shown in Figure 3 without endangering the frequency stability thereof. This does not appear to be the case with oscillation generators shown in Figures 1 and 2, inasmuch as the power output of these types is rather limited if the high frequency stability is to be maintained. However, the generators shown in Figures 1 and 2 may be employed to advantage in cases where low power output is desired.

The source of current supply 13, illustrated in each case as a battery, may be a suitable generator or a rectified alternating current source the voltage of which is maintained substantially constant.

Suitable heater electrodes are also provided to each of the electric discharge device cathodes as is conventional in indirectly heated type cathodes

of electric discharge devices. The heater may be energized from a battery or any other convenient source of current supply.

Various modifications in the details of my invention may be made therein without departing from the spirit and scope thereof and therefore I do not desire to limit this invention to the exact details described in the foregoing specification except insofar as they are defined by the claims.

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

1. An oscillation generator adapted to generate electrical oscillations of a high degree of frequency stability, comprising an electric discharge device having a cathode, a control electrode and an anode, an oscillatory circuit connected to said control electrode and said cathode, an inductance for coupling said anode to said oscillatory circuit, a source of current supply for energizing said anode, connections for connecting the negative terminal of said source of current to said oscillatory circuit, a resistor having a positive temperature coefficient connected in series with said source of current supply and said coupling inductance for decreasing the anode energizing potential with increase in ambient temperature and a second resistor having a positive temperature coefficient connected between said cathode of said discharge device and said oscillatory circuit, for increasing the potential of said cathode with increase in temperature said resistor being adapted to cooperate together to compensate for the effects of temperature changes on the frequency of the oscillations generated by said electric discharge device.

2. An oscillation generator adapted to generate electrical oscillations of a high degree of frequency stability, comprising an electric discharge device having a cathode, a control electrode and an anode, an oscillatory circuit having a substantially zero temperature-frequency coefficient, connections between said oscillatory circuit and said electric discharge device, a source of current supply connected to the anode of said electric discharge device, a pair of impedance elements having positive temperature coefficients, connections for connecting one of said impedance elements between said source of current supply, and said anode for decreasing the energizing potential applied to said anode as the ambient temperature increases and connections for connecting the other of said impedance elements between said cathode and said source of current supply for increasing the effective potential of said cathode as the said ambient temperature increases the voltage variations in said impedance elements being adapted to compensate the effects of ambient temperature variations on the frequency of the oscillations generated by said discharge device.

3. An oscillation generator adapted to generate electrical oscillations of a high degree of frequency stability, comprising an electric discharge device, means including said electric discharge device for generating electrical oscillations of a

predetermined frequency and means connected to said electric discharge device for varying the magnitude of selected potentials applied thereto in accordance with variations in ambient temperature for compensating for the effects of variations in said ambient temperature on the frequency of the oscillations generated.

4. An oscillation generator adapted to generate electrical oscillations of a high degree of frequency stability, comprising an electric discharge device having a cathode, a control electrode, an anode, and a coupling electrode, an oscillatory circuit having a substantially zero temperature-frequency coefficient, connections between said oscillatory circuit and said electric discharge device, a source of current supply connected to the anode of said electric discharge device, a pair of impedance elements having positive temperature coefficients, connections between said impedance elements and said source of current supply, and an impedance element having a negative temperature coefficient connected between said source of current supply and said coupling electrode, the voltage variations in said impedance elements being adapted to compensate the effects of ambient temperature variations on the frequency of the oscillations generated by said discharge device.

5. An oscillation generator adapted to generate electrical oscillations of a high degree of frequency stability, comprising an electric discharge device having a cathode, a control electrode, an anode, and a coupling electrode, an oscillatory circuit connected to said control electrode and said cathode, means for coupling said anode to said oscillatory circuit, a source of current for energizing said anode, a resistor having a positive temperature coefficient connected in series with said source of current supply and said means, a second resistor having a positive temperature coefficient connected in series with the cathode of said discharge device and said oscillatory circuit, and a resistor having a negative temperature coefficient connected between said coupling electrode and said source of current, said resistors being adapted to compensate for the effects of temperature changes on the frequency of the oscillations generated by said electric discharge device.

6. An oscillation generator adapted to generate electrical oscillations of a high degree of frequency stability, comprising an electric discharge device, means including said electric discharge device for generating electrical oscillations of a predetermined frequency and resistance means responsive to temperature changes, connections between said resistance means and said electric discharge device for varying the magnitude of selected potentials applied thereto in accordance with variations in ambient temperature for compensating for the effect of variations in said ambient temperature on the frequency of the oscillations generated.

DONALD BASSETT.