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OSCILLATOR

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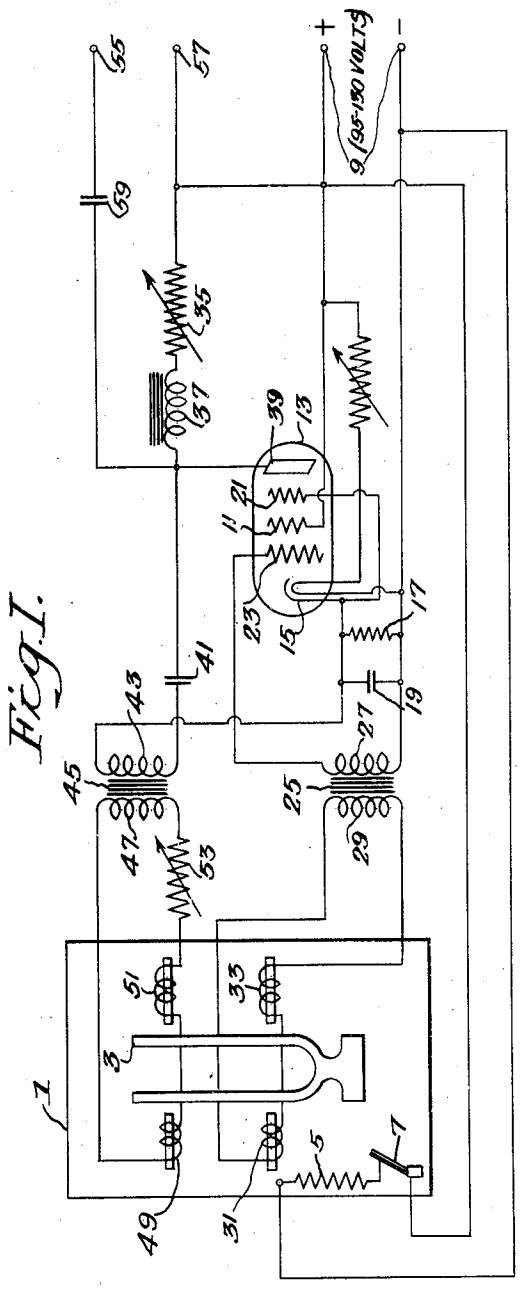


Fig. I.

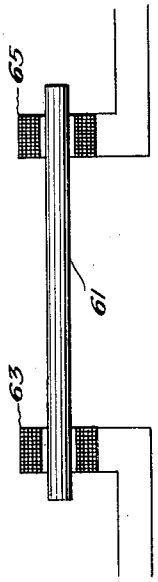


Fig. II.

Witnesses
A. Duska
George L. Jepson

Inventor
Maurice Artzt
by T. R. Goldsborough
Attorney

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OSCILLATOR

Maurice Artzt, Haddonfield, N. J., assignor to Radio Corporation of America, a corporation of Delaware

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8 Claims. (Cl. 250—36)

My invention relates to oscillators. More specifically my invention is an improved form of generator embodying a vibrating member.

One of the objects of my invention lies in the circuits for impressing a constant driving force on a tuning fork or similar vibrator.

Another object is to drive a tuning fork in such a manner as to hold the frequency substantially constant.

Another object is to automatically compensate for variations in the power source.

Further objects will appear in the following specifications and claims.

Figure I is a schematic diagram of one embodiment of my invention, and

Figure II is a schematic representation of a modified vibrating member which may be used in place of the tuning fork of Figure I.

In Figure I a thermally insulated member 1 houses a vibratory member 3. The interior of the housing 1 is kept at uniform temperature by the heating coil 5 which is serially connected through bi-metal thermostat 7 to the power source 9. The housing, vibratory member, and heat control are not, per se, part of my invention. These elements are well known to those skilled in the art, and, by way of examples, may be of the type described in United States Patent 1,937,583 which issued to Norrman on December 5th, 1933, and is entitled "Oscillation generator". The Norrman patent describes the system as a whole and illustrates compensating means tending to overcome relatively small variations in supply potential. However, I have found that such compensation means are insufficient to take care of wide fluctuations in supply and fail to provide any means for compensating for variations in the cathode heater currents. The present invention provides full control over the variable factors.

In Figure I the power source 9 has its positive terminal connected to the screen grid 11 of thermionic tube 13. The negative terminal of 9 connects to the cathode 15 through the self-biasing resistance 17, which may be by-passed by condenser 19. A suppressor grid 21 is connected to the cathode 15. The control grid 23 is connected to the primary 27 of transformer 25 and the remaining terminal of the primary is connected to the negative terminal of the source 9. The secondary 29 of transformer 25 is serially connected to a pair of pick-up coils 31 and 33 which are arranged in suitable relation to the vibrating member 3. The anode circuit of tube 13 commences with the positive terminal of source 9 which is connected to resistance 35. The resistance in turn joins inductance 37 which is connected to anode 39. The anode circuit is connected through capacity 41 to the primary 43 of transformer 45 which is connected to cathode 15. The secondary 47 of transformer 45 is serially connected to a pair of driving coils 49 and 51, and venier resistance 53. The coils 49 and 51 are suitably secured near the ends of the tuning fork or vibratory member 3.

The method of operation is as follows: The power is applied at source 9. The impulse caused in the anode circuit by the flow of electrons from the heated cathode to the anode is transmitted through the capacity 41 and primary 43. The primary in turn induces the impulse in the secondary 47 and the serially connected driving coils 49 and 51. The current flowing through the driving coils 49 and 51, which are phased properly, starts vibrations in the tuning fork. These vibrations induce currents in the pickup coils 31 and 33. The induced currents are properly phased to set up voltages in the secondary 27 of transformer 25. These voltages are impressed on the control grid electrode, which varies the anode current. The anode current again induces impulses which drive the fork. The whole process repeats at a frequency determined by the constants of the vibrating member. The various electrical constants are chosen to aid and reinforce the vibrations. Voltage impulses across 37 and 35 may be conveyed to the output terminals 55—57 by coupling capacity 59.

The frequency of oscillation of the system as a whole is not solely dependent upon the natural frequency of the vibrating member. The frequency may vary with temperature changes within the housing 1. The uniform temperature control within the housing minimizes this variable. I have also found that if the driving power is not constant but varies in amplitude, the rate of vibration or frequency of oscillation of the system, will vary.

The applied power impulses may be kept constant in amplitude by choosing a value of resistance 35 in the order of 16,000 ohms and an inductance 37 of the order of 30 henries with an RCA Type 89 tube. The magnetic core of inductor 37 is designed to operate at flux values which cause changes in saturation with changing anode current. An increase in anode current slightly lowers the value of the inductance 37 which shifts the phase angle of the current in the inductance with respect to the voltage across the inductance. The phase angle changes an amount and in such

direction that increases in voltage of the source 9 which tend to increase the voltage at the driving coils, are made ineffective, by being out of phase with the currents due to impedance changes in the inductor in the output circuit of the tube. That is, the total effective impedance of the anode load (inductance 37+resistance 35) is automatically varied to compensate for variations in the supply voltage which would otherwise impress varying power impulses on the driving coils. By properly chosen circuit constants, I have observed line variations from 95 to 135 volts which caused frequency changes of less than one part in a million.

In Figure II I have illustrated a magnetostrictive oscillator. The magnetic bar 61 extends through the driving coil 63 and the pickup coil 65. The terminals of 63 and 65 take the place of the terminals of 49—51 and 31—33, respectively. Oscillators of the magneto-strictive type depend upon the magnetic material expanding and contracting at a frequency equal to the driving frequency in coil 63. The expansion and contraction of the bar 61 induces currents of a corresponding frequency in pick-up coil 65. In other respects the circuit, and compensating means of Figure I apply equally to Figure II.

The constant frequency oscillatory currents generated by the circuits of my invention may apply to any number of cases when constant frequencies are required. For example, the oscillations may be used for synchronizing, television, or timing systems, oscillographs and the like. The constants and circuits I have set forth are given merely by way of example. I do not intend to thereby limit my invention. One modification within the scope of my invention would be to apply the phase change compensating means to the grid circuit of the amplifier instead of to the anode circuit. Various other modifications will occur to those skilled in the art, without departing from the spirit of my invention and scope of the claims.

I claim as my invention:

1. In a device of the character described, a source of power subject to variations, a vibratory member, an amplifier, means for driving said member, means including said vibratory member for generating voltages, means for impressing voltages generated by movement of said vibratory member on the input circuit of said amplifier, and means for automatically compensating by phase adjustment any variation of power in said driving means resulting from variations in said source, including a magnetic core inductor connected in the plate circuit of said amplifier, means for applying a feedback current corresponding to the current derived across said magnetic core inductor to the input of said amplifier, and means for adjusting the current flowing through said inductor to maintain a saturated condition in said magnetic core.

2. In a device of the character described, a vibratory member for generating voltages, a source of power subject to variations, an amplifier, means for driving said amplifier, means for impressing voltages generated by movement of said vibratory member on the input circuit of said amplifier, and means for automatically compensating by phase adjustment any variation of power caused by changes in said power source, including an inductor having a core subject to saturation connected to the plate circuit of said amplifier, means for applying feedback currents corresponding to the currents derived across said inductor to the input of said amplifier, and means for adjusting the current flowing through said inductor to a range of values insuring a saturated condition in said core.

3. In a device of the character described, a source of power subject to variations, a vibratory member for generating voltages, an amplifier, means for impressing voltages generated by vibrations of said member on the input of said amplifier, means in the output of said amplifier for driving said vibratory member, and means for compensating for variations in said amplifier output by adjusting the phase relations of voltage and current in said amplifier including a magnetic core inductor connected in series in the plate circuit of said amplifier, means for deriving potentials from said inductor and impressing feedback currents corresponding to said potentials upon the input of said amplifier, and means for establishing the current in said inductor at a value insuring saturation in said core, whereby the driving power applied to said vibratory member is maintained substantially constant.

4. In a device of the character described, a vibratory member including means for generating voltages, an amplifier, means for impressing voltages generated by movement of said vibratory member on the input circuit of said amplifier, means in the output circuit of said amplifier for driving said vibratory member, a source of power for said amplifier subject to variations, and means for compensating for such variations consisting of an impedance including a core of saturable material, connected in said amplifier output circuit and to said source whereby the current in said impedance will have a phase angle which changes with said variations to oppose any changes in power in said driving means, and means for adjusting the current flowing through said impedance to a range of values insuring saturation in said core.

5. A device of the character described in claim 4 including an output circuit coupled to said impedance.

6. A device of the character described in claim 4 in which said amplifier is of the thermionic tube type.

7. A device of the character described in claim 4 in which said amplifier is of the thermionic tube type having a cathode energized from said source of power.

8. In a device of the character described, a vibratory member including voltage generating means; a thermionic amplifier having cathode, control grid, and anode electrodes; means for impressing voltages generated by movement of said vibratory member on the grid and cathode electrodes; means connected to the anode electrode for driving said vibratory member; a source of power for said amplifier subject to variations; an inductor connected to said anode, said inductor having a saturable core; a variable resistance connected between said source of power and said inductor to adjust the currents flowing through said inductor to a value insuring saturation in said core, whereby changes in the current through said inductor cause phase angle variations which cause substantial compensation for variations of power in said source, and means for applying a feedback current corresponding to a current derived from said inductor to the cathode and control grid of said amplifier.

MAURICE ARTZT.