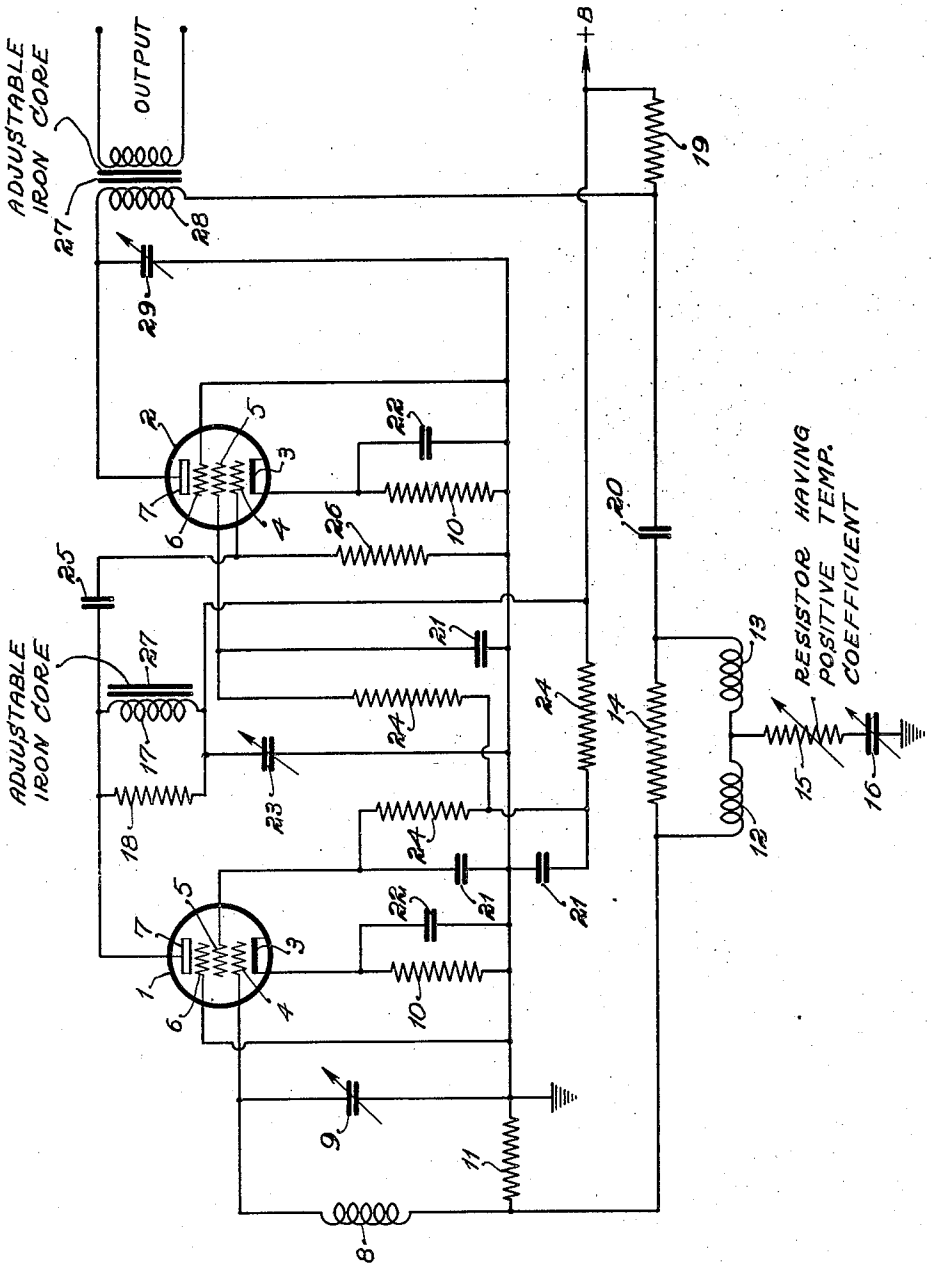
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BRIDGE STABILIZED OSCILLATOR

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BRIDGE STABILIZED OSCILLATOR

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1

This invention relates to bridge-stabilized oscillators and has for its principal object to provide frequency stability in such an oscillator when the same is also arranged to be tunable over a wide range of frequencies.

It is another object of my invention to provide an oscillator in which frequency stability is obtained by means of a thermally controlled resistance element which affects the balance of a bridged-T network in accordance with the amplitude of oscillation.

It is still another object of my invention to provide a two-stage oscillator of great stability wherein the feedback from the second stage to the first is obtained through a bridged-T network. Constant amplitude as well as constant frequency is obtained by the use of a thermally responsive resistance element operating to control the phase of the feedback potentials through the bridge network so as to maintain oscillations at the lowest possible amplitude consistent with the quantity of useful power which is to be derived from the oscillator.

In the achievement of the foregoing objects, I provide a circuit arrangement which is operable in the same manner as Class A amplifiers, so as to derive output energy which is quite free from harmonics and other unwanted frequencies. Hence, it is a further object of my invention to provide a system which will operate to produce a substantially pure sine wave, and which will, as far as possible, be independent of temperature changes and other adversely variable conditions such as variations in the driving D. C. voltage, humidity, jarring of the apparatus, and age of the electronic tubes.

My invention will now be described in more detail, reference being made to the accompanying drawing, the sole figure of which represents diagrammatically a preferred circuit arrangement.

Referring to the drawing, I show therein two electron discharge tubes 1 and 2, these being preferably of the pentode type. In each of these tubes is a cathode 3, a control grid 4, a screen grid 5, a suppressor grid 6, and an anode 7. The input circuit for tube 1 comprises an inductance 8 and an adjustable capacitor 9 which constitutes a tank circuit tunable to the desired frequency of operation. The capacitor 9 is directly connected to ground and to cathode resistor 10. Resistor 11 preferably has a very low impedance, say of the order of 10 ohms. It is connected between the lower end of the inductance 8 and ground. The

2

purpose of this resistor 11 is to prevent oscillation at unwanted frequencies.

The control grid 4 in tube 2 is coupled to the anode circuit of tube 1 by means of capacitor 25. Tube 2 has an input circuit which includes grid leak resistor 26. The output circuit for tube 2 is tuned by means of a parallel-arranged inductance 28 and capacitance 29. A core 27 of powdered iron or magnetite is made adjustable for tuning purposes.

The inductance coils 8 and 28 are interconnected by means of a T-bridge circuit which is used for feedback purposes. This circuit comprises two inductances 12 and 13 shunted by a resistor 14. The junction between inductances 12 and 13 is connected through a variable resistance element 15 and through a capacitor 16 to ground.

Anode potential is fed to the anode 7 of tube 1 from any suitable source (indicated as +B) through an inductive impedance 17, the latter being preferably shunted by a resistor 18. Inductance 17 together with a capacitor 23 provide series tuning of the output circuit for tube 1. Anode potential for the anode 7 in tube 2 is derived from the same D. C. source through a resistor 19 and through inductance 28. A capacitor 20 isolates the D. C. anode potential from the input circuit for tube 1. Bypass condensers 21 provide an A. C. path from each of the screen grids 5 to ground. Bypass condensers 22 serve the same purpose with respect to the A. C. potentials on the cathodes 3. The proper value of screen grid potentials is obtained by the use of three resistors 24, one being in a common lead and the other two being individual to the screen grids.

Any voltage variation which appears in the output circuit of tube 2 affects the temperature of the variable resistance element 15. This element is preferably so constructed that it provides the necessary compensation so as to maintain constant the phase angle of the feedback potentials from the output circuit of tube 2 across the bridged-T network to the input circuit of tube 1. Preferably, therefore, the resistance element 15 is composed of a very fine platinum wire. In an embodiment of the invention which was actually constructed, this wire had a diameter of 0.8 mil and its length was ¼ inch. The value of this resistance element when cold was approximately 2 ohms. The increase in the resistance of this element caused by the action of the radio frequency current was in a direction to produce a balance in the bridged-T network. The resistance 14 bridging the two coils 12 and 13 requires a value

of 4(R+R') for a balance, R and R' being the coil and variable resistance values respectively.

Thus when the resistance element is cold, there is less attenuation in the bridge, which causes an increase in the voltage applied to the amplifier input and the amplitude of oscillation increases. With this increase in amplifier output the bridge is brought more nearly into balance. Furthermore, the attenuation is increased, thereby decreasing the input voltage. Thus, it is evident that by such a means the amplitude of oscillations is automatically stabilized.

It will be understood by those skilled in the art that the degree of unbalance of the bridge circuit as caused by the amplifier output current results in a voltage variation of input potentials applied to the grid of tube 1. However, the gain of the system is so adjusted that substantially no grid current is permitted to flow.

It will be apparent that many advantages are to be derived from the construction of my oscillation generator in the manner heretofore set forth. The system operates with no tube overloading and produces a very pure sinusoidal output. Furthermore, the system can be made to operate substantially independent of anode voltage variations, which fact has been demonstrated by actual tests on apparatus constructed in accordance with the invention. For example, the following data was obtained during such tests:

Frequency deviation from 10^7 cycles with given change in supply voltages for various oscillator types

Per cent Decrease in Filament Voltage	Per cent Decrease in Plate Voltage	Frequency Change, Cycles
0	10	70
0	20	260
10	0	600
20	0	1,450
10	10	60
20	20	1,100

The effectiveness of the circuit in holding constant frequency is brought about by the use of the bridged-T network, operated near the balance point. The effectiveness is a function of the rate of change of phase with a change in frequency. This factor is highest when the bridged-T network is operated very close to the balance point. Operation is automatically maintained at a point as close to the balance point as is possible while maintaining sufficient feedback to sustain oscillation.

My invention is, of course, capable of modification in various ways, as will be clear to those skilled in the art.

I claim:

1. An oscillation generator comprising two cascaded stages of electron discharge tubes, each tube having an input circuit and an output circuit, tuning means in the input circuit of the first stage and in the output circuit of the second stage, a series resonant circuit in the output circuit of the first stage, a circuit for coupling said series resonant circuit to the input circuit of the second stage, a resistor of relatively low ohmic value interconnecting two points on the input circuit tuning means of the first stage, one of said points being grounded, means including a feedback circuit connected between the output circuit of the second stage and the input circuit of the first stage for causing oscillations of relatively low amplitude to be generated and for stabilizing the frequency of said oscillations, said feedback circuit being constituted as a T-bridge network composed of two series-inductive elements shunted by a single resistive impedance, a variable resistance element being connected at one end to the junction between said inductive elements and having its other end capacitively coupled to ground, said variable resistance element possessing a positive temperature coefficient of such value that phase compensation results from variations in the amplitude of the feedback energy.

2. An oscillation generator comprising a pair of electron discharge tubes, each tube having a pair of input electrodes and a pair of output electrodes, a tuned input circuit connected between the input electrodes of the first tube, a resonant output circuit connected between the output electrodes of the second tube, a series resonant circuit connected between the output electrodes of the first tube, a circuit for coupling the input electrodes of the second tube to said series resonant circuit, means for grounding said tuned input circuit and said resonant output circuit, and a feedback circuit coupling said resonant output circuit to said tuned input circuit, said feedback circuit being constituted as a T-bridge network composed of an inductive link shunted by a resistor and a variable resistance connected at one end to a point intermediate the ends of said inductive link and having its other end capacitively coupled to ground, said variable resistance possessing a positive temperature coefficient, said T-network being so adjusted as to maintain sufficient feedback to sustain oscillations.

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