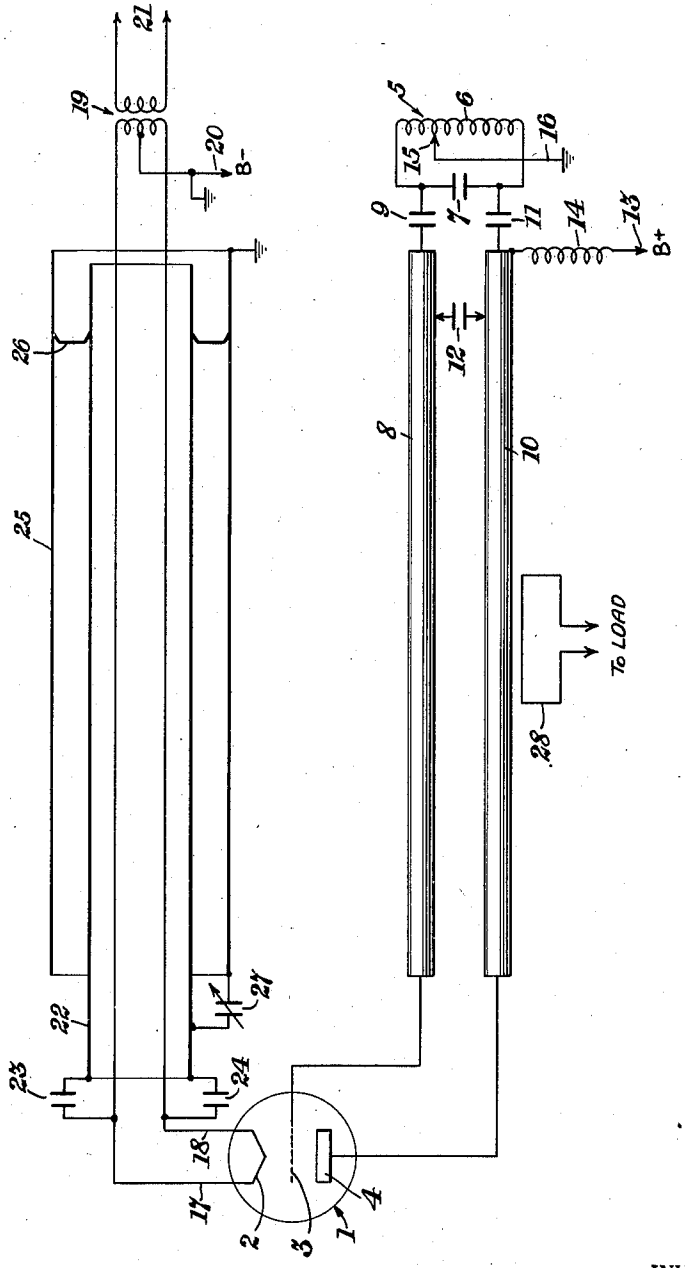
April 25, 1950 C. McK. WHEELER 2,505,022

TWO-CHANNEL OSCILLATOR

Filed July 20, 1945



INVENTOR.
CARSON McK. WHEELER

BY Percy P. Lantzy

ATTORNEY

Patented Apr. 25, 1950 2,505,022

UNITED STATES PATENT OFFICE

2,505,022

TWO-CHANNEL OSCILLATOR

Carson McKeag Wheeler, Montclair, N. J., assignor to Federal Telephone and Radio Corporation, New York, N. Y., a corporation of Delaware

Application July 20, 1945, Serial No. 606,213

3 Claims. (Cl. 250—36)

1

The present invention relates to electron discharge device circuits and particularly to electron discharge device oscillator systems.

In high power oscillator equipment, such as for example equipment having an input of the order of hundreds of kilowatts, which are operated at the lower frequencies, such as for example of the order of 50 kilocycles, long leads must be used because of the large dimensions required of the equipment. These long leads tend to be the most prolific cause of parasitic oscillations, which oscillations are usually undesirable.

An object of the present invention is the provision of an improved oscillator system including means for preventing parasitic oscillations, particularly those due to long leads.

It is often advantageous to operate the same oscillator at a selected one of two widely different frequencies such as for example, a low frequency in the order of 50 kilocycles and a high frequency in the order of 20 megacycles. Such dual range oscillators are valuable for numerous purposes. For example, they are not only advantageous in communication systems but are decidedly valuable for seasoning electron discharge devices and testing them. Before electron discharge devices of high power are used for high frequency operation of the order of megacycles, they are preferably aged or seasoned at lower frequencies, such as for example, at 50 to 100 kilocycles over a period of time until they operate smoothly. During this seasoning process, it is important that no parasitics occur because these higher frequency parasitics may cause arcing and other reactions deleterious to the electron discharge device. After the device has been suitably seasoned, it is then tested at the high frequency at which it is intended to operate. By using the same equipment for operation at both the lower and higher frequencies, a substantial saving is obtained. Furthermore, it is advantageous to accomplish this by a simple adjustment without requiring switching or rearrangement of the apparatus.

Another object of the present invention is the provision of an oscillator which is adapted to be operated at a selected one of two widely separated frequencies.

Still another object of the present invention is the provision of an oscillator adapted to operate at two widely separated frequencies in which, during the course of operation at the lower frequency, no parasitics of said higher frequency occur.

Other and further objects of the present invention will become apparent and the invention will be best understood from the following description of an embodiment thereof, reference being had to the drawing in which the figure is a schematic diagram of an oscillator system embodying my invention. Referring now to the drawing, an electron discharge device in the form of a triode, generally designated by the numeral 1, includes a filamentary cathode 2, a grid 3 and an anode 4. The tube 1 may be very large, for example having a rating of 200 kilowatts, and provided with water cooling (not shown).

2

In the system illustrated, the tube is designed to operate at two frequencies, at a lower frequency of the order of, for example, 50 kilocycles, and at a higher frequency of, for example, of the order of 20 megacycles. At the lower frequency, the circuit employed functions as a Hartley oscillator and includes lumped constants in the form of a tank circuit 5, including an inductance 6 and a shunt capacitor 7. The grid 3 is connected to one side of tank circuit 5 by a long lead 8 through a blocking condenser 9. The anode 4 is connected through a long lead 10 and blocking condenser 11 to the other side of the tank circuit 5. Leads 8 and 10 are parallel to each other and at the higher frequency, form a transmission line having an effective length of approximately one quarter wavelength. The transmission line consisting of leads 8 and 10 is tuned by a slidable condenser arrangement 12 which acts as an effective short at the higher frequency but not at the lower frequency. The positive side 13 of a source of anode voltage, is connected through a choke coil 14 to a point on lead 10 which is a voltage node for the higher frequency or as close to said node as practical. The inductance 6 is provided with a tap 15 and is connected to ground by a lead 16. The filamentary cathode 2 is also connected to ground in the following manner. The filamentary cathode 2 is connected by two leads 17 and 18 to a transformer arrangement 19, the midpoint of whose secondary is connected to the negative side 20 of the anode voltage supply, and whose primary is connected to a source of heating current 21. The two leads 17 and 18 are surrounded by a cylindrical conductor 22 which is intended to carry the alternating current voltages. In order to keep these alternating current voltages out of the power supply, condensers 23 and 24 connect leads 17 and 18 respectively at the end thereof nearest tube 1 to the cylindrical conductor 22. The cylindrical conductor 22 is in turn surrounded by another outer conductor 25 which may be coaxial or in any other shape and serves with

conductor 22 as a transmission line section. A slidable shorting device 26 is provided between the cylindrical conductor 22 and its outer conductor 25 to vary the effective length thereof, the outer conductor 25 being connected to ground. A small condenser 27 is also connected between the cylindrical conductor 22 and the outer conductor 25 at the end thereof nearest the tube, this small condenser 27 serving as a vernier adjustment in adjusting the effective length of the transmission line consisting of conductors 22 and 25 respectively. Energy may be extracted from the system hereindescribed by any suitable means, such as for example, a loop 28 coupled to any one of a number of selected points on one of the lines such as, for example, lead 10.

Cylindrical conductor 22 and outer conductor 25 form a transmission line circuit. If slide 26 is adjusted so that the length of this circuit is a quarter wavelength at the higher frequency, energy will be fed back from said circuit through the tube inter-electrode capacities to the transmission line circuit consisting of leads 8 and 10. Variations of the position of slider 26 from the exact quarter wavelength position, will vary the phase and amplitude of the energy fed back. In one series of positions of slide 26, energy will be fed back through said inter-electrode tube capacities with such phase and amplitude as to produce oscillations at the higher frequency in the transmission line circuit including leads 8 and 10. In another series of positions of the slide 26, energy will be fed back in such a direction as to prevent oscillation of the transmission line circuit consisting of leads 8 and 10. For the lower frequency operation, the slide 26 is moved to one of the points which prevents oscillation at the higher frequency. The oscillations at said lower frequency will then be governed primarily by the constants of the lumped constant tank circuit 5. The circuit then operates as a Hartley oscillator circuit. It will be noted that the tap 15 is arranged close to the grid side of the tank circuit. This position is usually found desirable as not very much feed-back is required in order to produce sustained oscillations. The tendency during the course of this low frequency operation for parasitics to occur will be a minimum since the most probable parasitic, that due to the length of leads 8 and 10, is prevented by the adjustment of the slide 26 which prevents oscillation at that frequency. When it is desired to operate the system at the higher frequencies, the slide 26 is adjusted to the optimum oscillation point, which as stated hereinbefore, is a little off a quarter wavelength. The energy then being fed back through the tube 1 tends to produce oscillation, the frequency of these oscillations being such that condenser 12 is substantially a short and everything to the right of said condenser 12 may be considered as completely out of the circuit. Fine adjustments both for the optimum oscillation point and for the non-oscillation point at the higher frequencies may be made by adjusting the vernier condenser 27.

While I have described above the principles of my invention in connection with specific apparatus, it is to be clearly understood that this description is made only by way of example and not as a limitation on the scope of my invention as defined in the accompanying claims.

I claim:

1. An oscillator system comprising an electron-discharge device having an anode, grid, and cathode, a lumped constant circuit tuned to substantially a given frequency, leads coupling said lumped constant circuit to said electron-discharge device to feed back energy from said anode to said grid through said lumped constant circuit, said leads forming a distributed constant circuit equal to approximately a quarter wavelength at a higher frequency than said given frequency, means controlling the frequency at which said system oscillates comprising a tunable distributed-constant feed-back circuit having an electrical length of approximately a quarter wavelength at said higher frequency, and at one setting preventing oscillations of said higher frequency, and at another setting causing oscillations at said higher frequency, said leads at said higher frequency being effectively short-circuited before the lumped constant circuit whereby no oscillations occur at said given frequency at said another setting.

2. An oscillator system comprising an electron-discharge device having an anode, cathode and grid, a lumped constant tank circuit tuned to substantially a given frequency, means coupling opposite points of said tank circuit to the grid and anode, said means including a pair of leads effectively forming a distributed constant circuit, slidable capacitive means coupling said leads together at any one of a number of selective points thereon, said capacitive means having a substantial reactance at said given frequency but operating as an effective short circuit at a relatively higher frequency, said capacitive means being adjusted to control the effective electrical length of said leads so that they are substantially a quarter wavelength at said higher frequency, a line coupling an intermediate point of said tank circuit to the cathode, said line forming a distributed constant circuit of approximately a quarter wavelength at said higher frequency, means for adjusting the effective length of said line to prevent oscillations at said higher frequency by feeding back energy through the inter-electrode capacities of said device with a given phase and amplitude thus enabling the system to oscillate solely at said given frequency, and for said line to another setting to cause feed-back through said inter-electrode capacities with another phase and amplitude to produce oscillations at said higher frequency, the capacitive means then acting as an effective short circiut of said tank circuit to prevent oscillation at said given frequency.

3. An oscillator system for operation at a plurality of frequencies comprising an electron-discharge device having grid, plate and cathode electrodes, a lumped circuit tuned to one of said frequencies, a parallel transmission line substantially a quarter wavelength long at another frequency for coupling said lumped circuit between the grid and plate electrodes, a coaxial transmission line having an adjustable electrical length at said other frequency coupled between said cathode electrode and said lumped circuit.

CARSON McKEAG WHEELER.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
2,272,851	Ramsay	Feb. 10, 1942

OTHER REFERENCES

Radio Engineers Handbook, by F. E. Terman; McGraw-Hill Co. Inc. (1943), pages 498–502. (Copy in Division 51.)