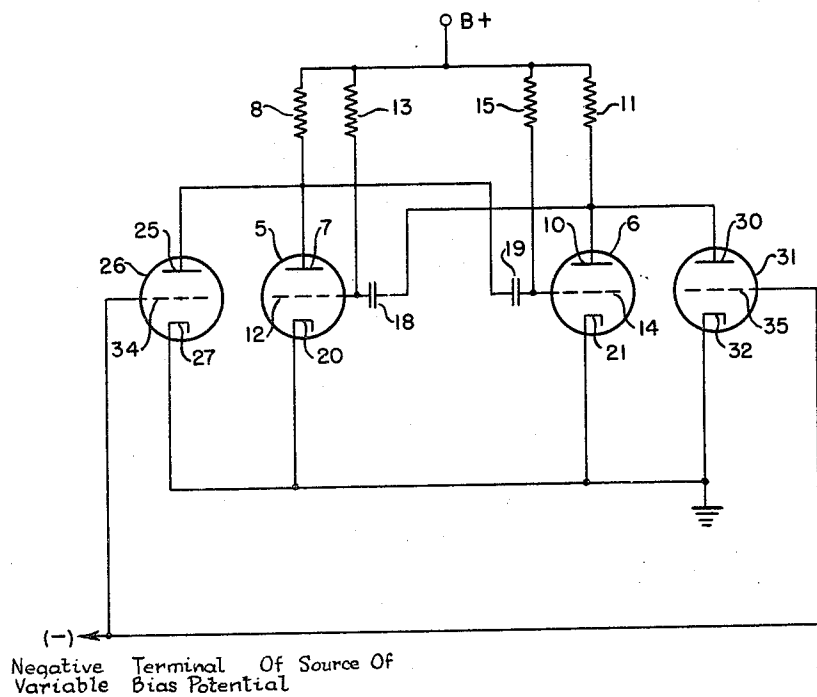


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VARIABLE FREQUENCY MULTIVIBRATOR

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VARIABLE FREQUENCY MULTIVIBRATOR

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This invention relates in general to electrical circuits and more particularly to multivibrator oscillators.

The principles and applications of the multivibrator type of oscillator are well known in the electronics art. The ability of these circuits to provide periodic waveforms of variable frequency and shape has made them standard devices in many types of radio and electronic apparatus.

In the past, variation of the fundamental operating frequency of such a circuit has been accomplished by alteration of the values of various resistors and capacitors in the circuit. It is often difficult by such means to provide wide frequency variation in the multivibrator without affecting the stability of the circuit. In addition, such mechanical tuning becomes highly awkward when the control knob or dial must be placed at any distance from the multivibrator itself.

Various forms of voltage controlled multivibrators have been devised but these suffer from the disadvantage of requiring an extra voltage supply.

Accordingly, it is one object of the present invention to provide a multivibrator, the frequency of which may be controlled.

Another object of the invention is to provide a multivibrator tunable in frequency over a wide range.

Still another object is to provide a multivibrator which is tuned by a variable voltage rather than by mechanical means.

Briefly, the present invention contemplates a multivibrator in which the vacuum tubes are bypassed by a second set of vacuum tubes, the latter operating in a manner similar to that of variable resistances in shunt with the multivibrator tubes. A variable negative bias applied to the control grids of the shunt tubes controls their effective resistance.

The principles and operation of the invention will be more apparent to those skilled in the art upon reference to the following specification and claims, and to the drawing in which the single figure represents a schematic diagram of one embodiment of the invention.

Referring now to this figure, vacuum tubes 5 and 6 form a part of a multivibrator circuit, plate 7 of tube 5 being connected through load resistor 8 to a positive voltage supply. Plate 10 of tube 6 is connected through load resistor 11 to the same voltage source. Grid 12 of tube 5 is connected to the positive voltage source through resistor 13 and grid 14 of tube 6 is similarly connected through resistor 15. Anode 10 of

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tube 6 is connected through coupling capacitor 18 to grid 12 of tube 5 and anode 7 of tube 5 is connected through capacitor 19 to grid 14 of tube 6. Cathode 20 of tube 5 and cathode 21 of tube 6 are grounded. This combination and connection of circuit elements constitutes a normal positive grid-return multivibrator circuit although the grids may be returned to ground without making the circuit inoperative. However, anode 25 of vacuum tube 26 is connected to anode 7 of tube 5 and cathode 27 of the former tube is connected to cathode 29 of tube 5. In like fashion, anode 30 of vacuum tube 31 and cathode 32 of the same tube are connected directly to anode 10 and cathode 21, respectively, of tube 6. Grid 34 of vacuum tube 26 and grid 35 of vacuum tube 31 are tied together, and connected to a source of variable negative bias voltage.

As is well known in the art, operation of a multivibrator includes alternate conduction of the tubes caused by the periodic charging and discharging of the coupling capacitors. During the time when one of the tubes, for example tube 5, is cut off, the coupling capacitor, in this case capacitor 19, attached to its plate, charges through load resistor 8. However, due to the fact that tube 26 is drawing its plate current through resistor 8, dropping the potential at anode 7, capacitor 19 will not charge to as high a value of voltage as it would if tube 26 were not connected into the circuit. Therefore, during the next portion of the operating cycle when tube 5 is conducting and tube 6 cut off, the depressing effect of capacitor 19 on grid 14, which decreases exponentially with discharge of the capacitor, will persist for a shorter time than would otherwise be the case, shortening this portion of the cycle. Since the other half of the cycle is similarly affected by the action of tube 31, the net result is an increase in the fundamental frequency of the multivibrator. When either one of the multivibrator tubes is conducting, the voltage drop in its plate load resistor so lowers the plate voltage of the associated shunt tube that the latter is rendered nonconductive. Simple shunt resistors would not be so satisfactory in the circuit since they would draw current continuously.

The circuit is highly adaptable in that the basic multivibrator may be either balanced or unbalanced, either one or both of the multivibrator tubes may be shunted, and the grids of the shunt tubes may be connected to separate varying bias sources, rather than the same bias source.

In an exemplary embodiment of the invention,

it has been found that the fundamental frequency of the multivibrator could be varied from 200 to 27,000 cycles per second by changing the bias voltage of the shunt tubes from cut-off potential to zero potential. If a less wide variation is desired, additional load resistors in the plate circuit of the shunt tubes may be added, reducing the amount of current drawn by the shunt tubes through the multivibrator plate load resistors.

While there has been described hereinabove what is at present considered to be a preferred embodiment of the present invention, it will be obvious to those skilled in the art that changes and modifications may be made therein without exercise of inventive ingenuity. Hence, all such modifications and adaptations are claimed as may fall fairly within the true spirit and scope of the invention.

What is claimed is:

1. A variable frequency multivibrator comprising a first multi-electrode vacuum tube having at least anode, cathode, and control electrodes, a first plate load resistor associated with said first vacuum tube, a first grid resistor associated with said first vacuum tube, a second multi-electrode vacuum tube having at least anode, cathode, and control electrodes, a second plate load resistor associated with said second vacuum tube, a second grid resistor associated with said second vacuum tube, said grid and plate resistors being connected to a source of positive potential, first capacitor means coupling the anode of said first vacuum tube to the control electrode of said second vacuum tube, second capacitor means coupling the anode of said second vacuum tube to the control electrode of said first vacuum tube, a third multi-electrode loading vacuum tube having at least anode, cathode, and control electrodes, means for electrically connecting the anode of said third vacuum tube to the anode of said first vacuum tube, means for electrically connecting the cathode of said third vacuum tube to the cathode of said first vacuum tube, a fourth multi-electrode loading vacuum tube having at

least anode, cathode, and control electrodes, means for electrically connecting the anode of said fourth vacuum tube to the anode of said second vacuum tube, means for electrically connecting the cathode of said fourth vacuum tube to the cathode of said second vacuum tube, and means for biasing the control electrodes of said third and said fourth vacuum tubes negatively.

2. Apparatus in accordance with claim 1 wherein in addition said negative bias means is variable in output magnitude.

3. In combination, a free-running, symmetrical multivibrator including a pair of triode vacuum tubes, the anodes of each of said tubes being respectively coupled to the control grids of the other of said tubes, first and second loading triode vacuum tubes respectively connected in shunt with the respective cathode-anode current paths of the first-named pair of triodes, and means for variably biasing the control grids of said loading triodes so as to vary the non-conducting periods of said first-named pair of triodes.

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