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MULTIVIBRATOR

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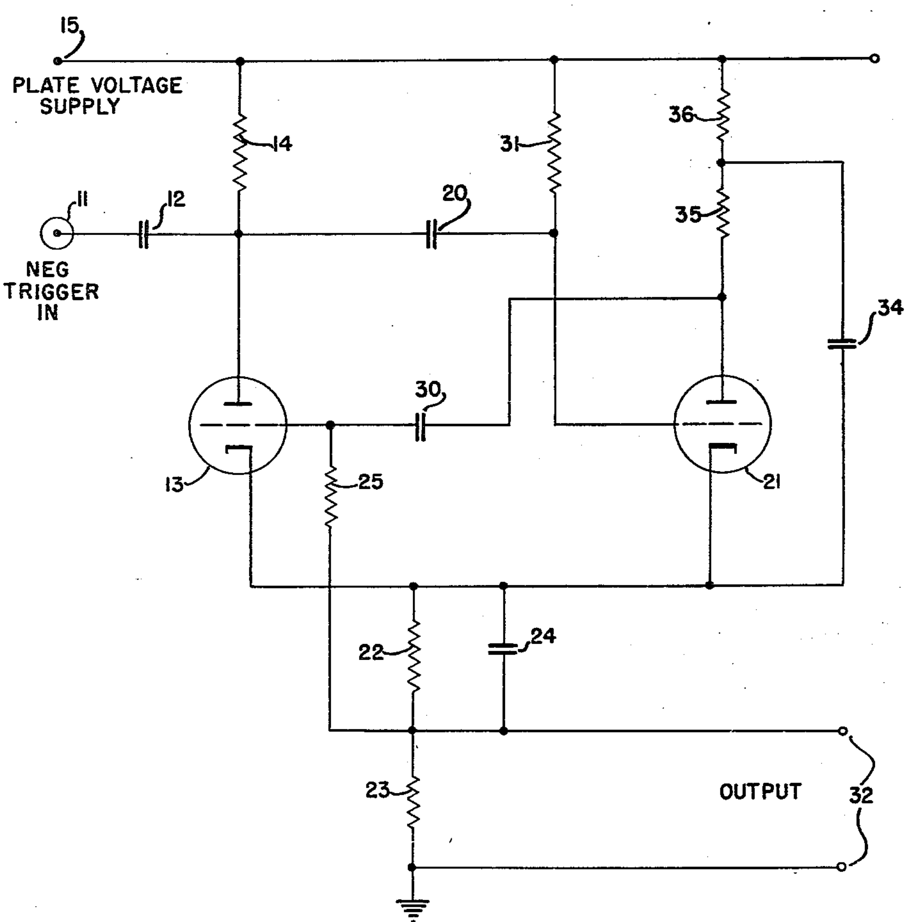

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MULTIVIBRATOR

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3 Claims. (Cl. 250—27)

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This invention relates to multivibrator circuits and more particularly to multivibrator circuits having a low average current drain.

In multivibrators as previously known in the art, the output voltage is normally taken directly from the plate of one of the electron tubes. The peak-to-peak magnitude of the square wave voltage output from a multivibrator so connected is equal to the product of the plate load resistance and the plate current of the tube from which the output is taken. This method of obtaining the output has been used with both free running multivibrators, and with biased multivibrators of the "one-shot" type. By the term "one-shot" as used in this specification is meant a multivibrator having one equilibrium state, and which will undergo a single complete cycle of operation each time that it is triggered from the equilibrium state. This type of multivibrator is often used to provide an output gate voltage synchronized in time with an input trigger voltage. When a biased multivibrator is used to produce a positive voltage pulse, the output is generally taken from the plate of the normally conducting tube; and the magnitude of the voltage pulse is equal to the product of the plate load resistance and the current flowing in the normally conducting tube. In order to obtain a large voltage pulse for the purpose of gating, or enabling, following circuits, it is necessary to have a large current flowing in the normally conducting tube. In many circuits using voltage gates produced in this manner, the gate duty cycle is very low; that is, the duration of the voltage gate is short when compared with the length of time between successive voltage gates. Under such circumstances, the average current drawn by the multivibrator is very nearly equal to the current drawn by the normally conducting tube. In the case where a large voltage gate is required with a low gate duty cycle, the average current of the multivibrator is, therefore, large.

In one embodiment of the present invention, the positive voltage gate output is taken from the cathode circuit of the normally non-conducting tube. With this type of connection, the magnitude of the voltage output pulse is substantially the product of the current through the normally non-conducting tube and the resistance of the cathode resistor. As the current through the normally conducting tube does not have much effect upon the magnitude of the voltage pulse, the circuit may be designed so that the current drawn by the normally conducting tube is relatively small. This will result in a small average

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current being drawn by a multivibrator of this design.

A further improvement introduced by this embodiment of the invention is the lowering of the internal impedance of the voltage gate source. In the proposed circuit the output gate voltage is generated across a cathode resistance which introduces a high degree of negative voltage feedback into the circuit. The result of this negative feedback is to reduce the internal impedance of voltage gate source.

A primary object of the present invention is to generally improve multivibrator circuits.

Another object of the present invention is to provide a multivibrator circuit suitable for producing positive voltage gates but which has a low average current drain.

A further object is to provide a multivibrator gate generator having a low internal impedance.

These and other objects of the invention will be apparent from the following description when taken with the accompanying drawings, which is a schematic diagram of one embodiment thereof.

Referring to the drawing, an input trigger voltage obtained at terminal 11 is connected through condenser 12 to the plate of triode electron tube 13. The plate of triode 13 is also connected through plate load resistor 14 to the plate voltage supply at terminal 15, and is coupled through condenser 20 to the grid of triode electron tube 21. The cathode of triode 13 is connected directly to the cathode of triode 21 and also to ground through resistor 22 and resistor 23. In parallel with resistor 22 is condenser 24. The grid of triode 13 is connected to the junction point of resistor 22 and resistor 23 through resistor 25, and is also coupled to the plate of triode 21 through condenser 30. In the absence of an external signal, triode 21 will be conducting since its grid is returned to the plate voltage supply at terminal 15 through resistor 31. The voltage drop established across common cathode resistor 22 by the current through triode 21 will keep triode 13 cut-off. This state of equilibrium is interrupted when a negative trigger is introduced at terminal 11. The negative trigger is capacitively coupled to the grid of triode 21 through condenser 12 and condenser 20 and results in multivibrator action cutting off triode 21 and turning on triode 13. Cathode resistor 22 is substantially by-passed by condenser 24 with respect to the heavy current pulses through triode 13, in order that the grid of triode 13 may be maintained at a high voltage during the gate. With the multivibrator in this stage of the cycle, the charge on condenser 20 increases exponentially until the voltage of the grid of triode 21, which is connected to one side of condenser 20, is raised above the cut-off voltage for triode 21; and the multivibrator action then causes triode 13 to be cut-off and triode 21 to conduct. The multivibrator then remains in this steady state condition until another negative trigger pulse is introduced at input terminal 11.

Under steady state conditions with triode 21 conducting and triode 13 non-conducting, the voltage available at output terminals 32 is equal to the product of the current through triode 21 and the resistance of resistor 23. When a negative trigger is applied to the circuit at terminal 11, triode 13 starts conducting and triode 21 is cut-off, the output voltage is increased from its steady state value to a voltage equal to the product of the resistance of resistor 23 and the combined current through triode 13 and the charging current of condenser 34, which is connected between the cathode of triode 21 and the junction of plate load resistors 35 and 36. The charging current of condenser 34 is approximately equal to the current that flows in triode 21, and, therefore, the magnitude of the voltage pulse is substantially equal to the product of the resistance of resistor 23 and the current through triode 13. In order to obtain a good output waveform it is necessary that the time constant of the charging circuit for condenser 34 be long compared with the time constant of the charging circuit for condenser 20 which determines the length of the voltage gate. For the same reason it is also required that the time constant of resistor 23 and condenser 24 be long in comparison to the length of the voltage gate.

The invention need not be limited to the details shown in the foregoing specification which are considered to be illustrative of one embodiment thereof. The scope of the invention is defined by the appended claims.

What is claimed is:

1. An unsymmetrical multivibrator having a low current drain comprising first and second electron tubes each having a cathode, an anode and a control grid, anode-cathode circuits for said electron tubes including a common source of space current, a resistance-capacity coupling between the anode of at least one of said electron tubes and the control grid of the other tube, said first and second electron tubes conducting alternately, the period of oscillation of said multivibrator being substantially determined by the time constant of said anode to control grid coupling circuit, the conducting period of said first electron tube being a very small part of the total period of said multivibrator oscillations, means for deriving an output voltage from said space current, and a condenser effectively in parallel with said second electron tube to draw during the off time of said second electron tube a charging current from said space current source substantially equal to the space current drawn by said second electron tube.

2. An unsymmetrical multivibrator having low current drain comprising first and second electron tubes each having a cathode, an anode and a control grid, the cathode circuits for said tubes including a common cathode resistor, anode-cathode circuits for said electron tubes including a common source of space current, a resistance capacitance coupling between the anode of each of said electron tubes and the control grid of the other tube, said first electron tube being normally non-conducting and said second electron tube being normally conducting, means to apply a control signal voltage to initiate a single cycle oscillation of said multivibrator, the period of said oscillation being substantially determined by the time constants of the capacities of said anode to control grid coupling circuits and the resistances effectively in series therewith including tube resistances, the conducting period of said first electron tube being a very small part of the total period of oscillation, an output circuit to obtain an output voltage established by the current flowing in said common cathode resistor, said output voltage being obtained at a low impedance level, and a condenser effectively in parallel with said second electron tube to draw from said source during the off time of said second electron tube a charging current substantially equal to the space current drawn by said second electron tube.

3. A low current unsymmetrical multivibrator comprising, first and second electron tubes each having a cathode, an anode and a control grid, the cathode circuits for said tubes including a common resistor, a source of space current for said tubes, a resistance-capacity coupling between the anode of one of said tubes and the grid of the other of said tubes, said first tube being normally nonconducting and said second tube being normally conducting, means to apply a control signal voltage to the control grid of said second tube to initiate a single cycle oscillation of said multivibrator, the period of said oscillation being substantially determined by the time constant of said coupling, an output circuit to obtain an output voltage at low impedance from the current flowing in said common cathode resistor, and a condenser effectively in parallel with said second tube to draw during the off time of said second tube a charging current substantially equal to the space current drawn by said second tube when normally conducting.

References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
2,405,237	Ruhlig	Aug. 6, 1946
2,416,201	Nagel et al.	Feb. 18, 1947

FOREIGN PATENTS

Number	Country	Date
456,450	Great Britain	Nov. 3, 1936