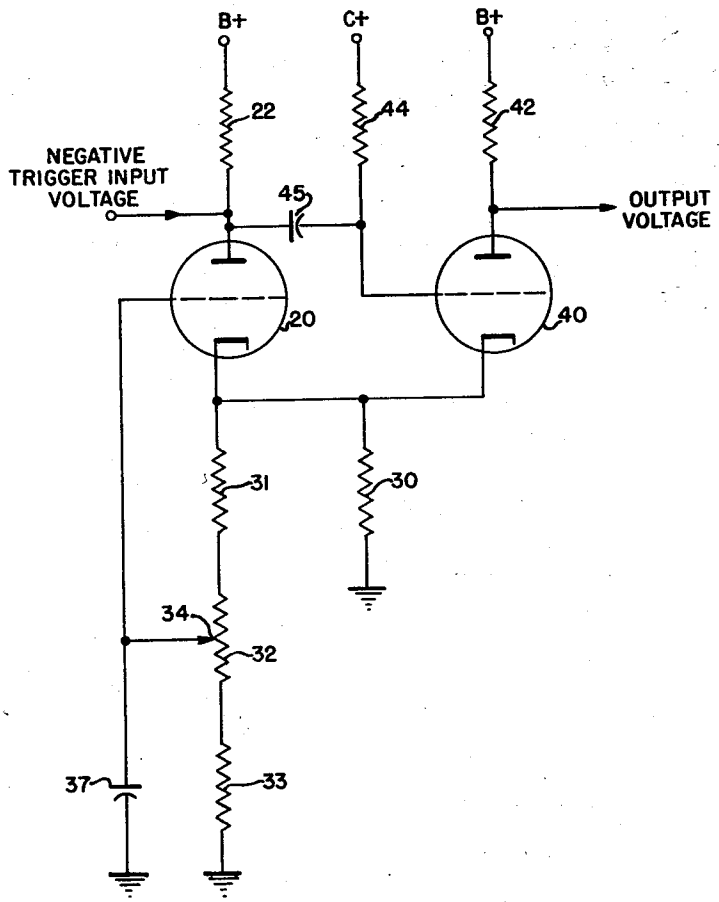
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STABILIZED MULTIVIBRATOR

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STABILIZED MULTIVIBRATOR

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This invention relates in general to the art of signal generation, and more particularly to a stabilized multivibrator circuit.

In the conventional cathode coupled multivibrator, as for example, that illustrated and described in detail in "Principles of Radar," second edition 1946, published by the McGraw-Hill Book Company, on page 2—53 thereof, the application of an input trigger signal of constant repetition rate provides an output alternating signal of substantially rectangular wave shape having the same repetition rate. The width of the output rectangular pulse is dependent primarily upon the biasing potential appearing at the grid of the input tube and upon the time constant of the resistance-capacitance charging circuit. However, the width also depends upon the values of all circuit parameters to some extent, whereby variations in these parameters for any reason will vary the output pulse width. Therefore, it may be seen that stabilization of the pulse output time duration is difficult when the conventional circuits are employed.

It is accordingly the primary object of this invention to provide a stabilized multivibrator.

Another object of this invention is to provide a multivibrator type signal generator having circuit means adapted to respond to a change in the output signal wave form.

A further object of this invention is to provide a stabilized multivibrator wherein variations in circuit parameters, tending to cause pulse width variations in output wave form, are compensated for by corresponding changes in the biasing potential at the grid of one of the tubes.

These and other objects of the present invention will be apparent from the following specification when taken in connection with the accompanying drawing wherein there is shown a schematic circuit diagram of a novel cathode coupled multivibrator.

With reference to the drawing, the multivibrator circuit comprises a pair of triode electron tubes, 20 and 40, having their cathodes connected to ground through a common resistor 30. The plates of the tubes 20 and 40 are each connected to a positive potential source, B+, through their respective plate load resistors 22 and 42. Tube 40 has its control grid returned to a source of positive biasing potential, C+, through a resistor 44 so that it is normally held conducting. Tube 20 is normally held non-conducting by virtue of the voltage drop across the cathode resistor 30 due to the flow of current therethrough from tube 40. The plate of tube 20 is joined to the grid of

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tube 40 through the coupling capacitor 45, so that a negative trigger pulse, when applied to the plate of tube 20, will be transferred through the capacitor 45 to the grid of tube 40.

Resistor 31, potentiometer 32 and resistor 33, all connected in series, provide a second conductive path for the joined cathodes to ground, which path is of much higher resistance than the path provided by resistor 30. A capacitor 37 is connected to ground at one of its terminals and is connected at its other terminal to both the potentiometer tap 34 of potentiometer 32 and to the grid of tube 20. The network comprising resistor 31, potentiometer 32, resistor 33, and capacitor 37 is responsive, as will be presently seen, to a periodically varying cathode potential so as to bias the grid of tube 20 with a substantially constant potential.

Broadly, as in a conventional multivibrator, when negative trigger pulses of constant repetition rate are applied to the plate of tube 20, tubes 20 and 40 will alternately conduct current through the common cathode resistor 30. The current through resistor 30 when tube 40 is conducting will be larger than when tube 20 is conducting. This will result in a cathode potential, with reference to ground potential, that will periodically vary between two values. Capacitor 37, in the aforementioned biasing network as a result, will have a substantially constant potential established thereacross dependent upon the position of the potentiometer tap 34, and also upon average magnitude of the cathode voltage. Resistor 31, potentiometer 32 and resistor 33 combine to provide a relatively high resistance to cathode current flow as compared to resistor 30, so that an adjustment of the potentiometer tap 34 to change the biasing potential at the grid of tube 20, does not alter the equivalent impedance to the flow of cathode current.

The operation of the circuit, now that the manner of biasing tube 20 has been discussed, will now be considered in more detail. Normally, tube 40 is conducting and tube 20 is held non-conducting by virtue of the voltage drop across the resistor 30 due to the conduction of tube 40. A negative trigger pulse voltage applied between the plate of tube 20 and ground is transferred through capacitor 45 to the grid of tube 40, thereby rendering it non-conducting. Tube 20 is then rendered conducting by virtue of the decreased voltage drop across the cathode resistor 30. At the same time capacitor 45 starts to discharge exponentially through resistor 44, and correspondingly raises the grid voltage on tube 40.

When discharged to a point where it approaches the cathode voltage developed across the resistor 30 due to the current flow therethrough from tube 20, it renders tube 40 conducting again. The cathode voltage across resistor 30 is thereby again increased to its original value due to the larger cathode current of tube 40, causing tube 20 to become non-conducting again; and the original condition of the circuit is restored. Recurring negative input trigger pulses cause this operation to be periodically repeated.

If circuit parameters were to remain constant, the cathode voltage during conduction of tube 20 would depend principally upon the biasing potential at the grid of tube 20. This in turn would determine the amount of charge upon capacitor 45 before overcoming the cut-off bias developed across the resistor 30 due to tube 20 current flow through resistor 30. In other words, the time of conduction and the time of non-conduction of tube 40, are dependent upon the biasing potential at the grid of tube 20. However, since the grid biasing potential of tube 20 is dependent upon the average cathode voltage across resistor 30, and since the average cathode voltage is dependent upon the time of conduction of tube 40, the grid biasing potential of tube 20 depends upon the conduction time of tube 40.

Therefore, if due to changes commonly experienced in the values of circuit parameters, tube 40 tends to conduct for a longer time than the predetermined time for stable operation, the average cathode voltage will tend to increase since the cathode current, when tube 40 conducts, is larger than when tube 20 conducts. The biasing potential of tube 20 will increase accordingly, thus tending to decrease the conduction time of tube 40. If for some reason the conduction time of tube 40 tends to decrease, the grid biasing potential of tube 20 will decrease, thus tending to increase the conduction time of tube 40. The net result in either case is that there will be no appreciable change in the pulse width of the output wave form.

The pulse width in the output wave form may be adjusted to have a different width by changing the position of potentiometer tap 34 so as to change the grid biasing potential of tube 20, or by changing the values of the resistor 44 and the capacitor 45 to change the time constant of the charging circuit, or by changing both the grid biasing potential and the value of the time constant of the charging circuit. In any event, stable operation will be assured by the novel circuit shown.

Resistors 31 and 33 in the cathode circuit prevent the multivibrator from becoming inoperative if the potentiometer tap 34 is adjusted to be at either extreme end of the potentiometer 32.

It will be apparent that numerous modifications and extensions of the principles disclosed herein will become evident to those skilled in the art. Accordingly, it is preferred that this invention be limited solely by the spirit and scope of the appended claims.

The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

What is claimed is:

1. In a unistable multivibrator comprising an electron tube having at least a grid, a cathode, and a plate, means for generating a periodically varying potential in response to a trigger potential applied to the plate of said tube and recurring at a constant repetition rate, means responsive to said periodically varying potential for generating a substantially constant potential, the magnitude of which is dependent upon the average magnitude of said varying potential, and means for applying said generated substantially constant potential to the grid of said electron tube for biasing the grid of said tube.

2. In a cathode coupled unistable multivibrator comprising an input electron tube having at least a grid, cathode and plate, means for generating a periodically varying potential at the cathode of said tube in response to an applied trigger potential recurring at a constant repetition rate, means responsive to said periodically varying cathode potential for generating a substantially constant potential, the value of which is dependent upon the average magnitude of said varying cathode potential, and means for applying said generated constant potential to the grid of said input electron tube for biasing said grid.

3. Apparatus as in claim 2 and means operatively associated with said means for generating a substantially constant potential for varying the magnitude of said substantially constant potential.

4. In a cathode coupled unistable multivibrator comprising an electron tube having at least a grid, cathode and a plate, means responsive to a negative input trigger voltage applied to the plate of said tube and recurring at a constant repetition rate for generating at the cathode of said tube a periodically varying potential having the same frequency as that of the applied input trigger voltage, means responsive to said periodically varying cathode potential for generating a substantially constant potential, the magnitude of which is dependent upon the average magnitude of said periodically varying cathode potential, and means operatively connected to said last-mentioned means for varying the magnitude of said substantially constant potential independently of the average magnitude of said periodically varying cathode potential, and means for applying said substantially constant potential to the grid of said tube for biasing its grid with said substantially constant potential.

5. A stabilized cathode coupled unistable multivibrator comprising first and second electron tubes, each of said tubes having a grid, a cathode and a plate, a cathode resistor, a cathode potentiometer, said cathode resistor being connected between a point of fixed potential and said cathodes, said cathode potentiometer being connected between said point of fixed potential and said cathodes, a capacitor connected to the tap of said potentiometer at one of its terminals and said point of fixed potential at its other terminal, the grid of said first tube being connected directly to said potentiometer tap, a second capacitor connected between the plate of said first tube and the grid of said second tube, a grid resistor, a positive biasing potential source, said grid of said second tube being returned to said positive biasing potential source through said grid resistor, a plate resistor for each of said tubes, and a positive potential supply source, each of said plates of said tubes being returned through its plate resistor to said positive potential supply source, whereby the application of a negative trigger input voltage of constant repetition rate between said plate of said first tube and said point of fixed potential provides an output voltage between the plate of said second tube and said

point of fixed potential of pulse width substantially independent of circuit parameter changes within said multivibrator.

6. In a unistable multivibrator comprising at least two electron tubes and an impedance common to said tubes and adapted to conduct the currents flowing in each of said tubes, said multivibrator being adapted to generate a periodically varying potential across said impedance in response to a trigger potential applied to one of said tubes and recurring at a constant repetition rate, means responsive to said periodically varying potential for generating a substantially constant potential having a magnitude dependent upon the average value of said periodically varying potential.

7. Apparatus as in claim 6 wherein each of said electron tubes comprises a plate, a grid, and a cathode and wherein said substantially constant potential is applied to the grid of one of said tubes.

8. An electron tube circuit comprising at least one electron tube, means operatively associated with said electron tube for generating a periodically varying potential in response to the application to said tube of periodic trigger pulses, means responsive to said periodically varying potential for generating a substantially constant potential, and means for coupling said substantially constant potential back to said electron tube to stabilize the operation thereof.

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