

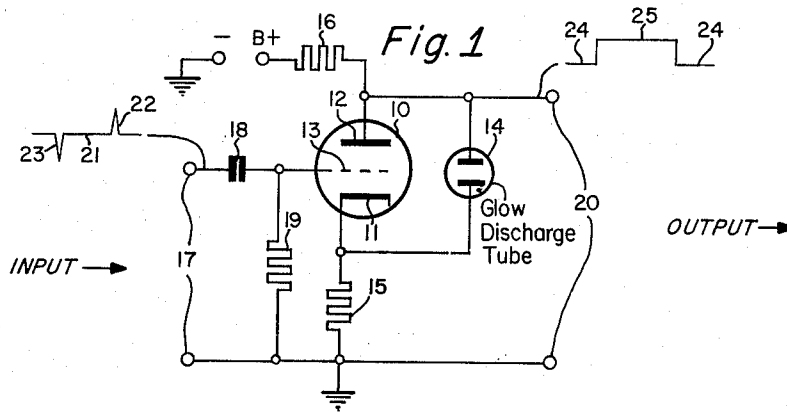
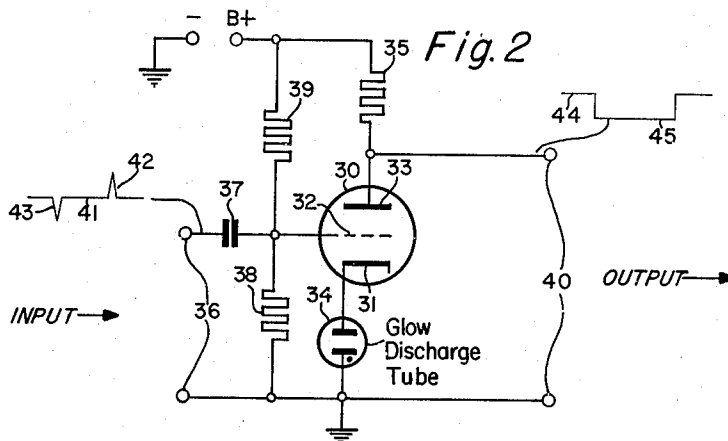
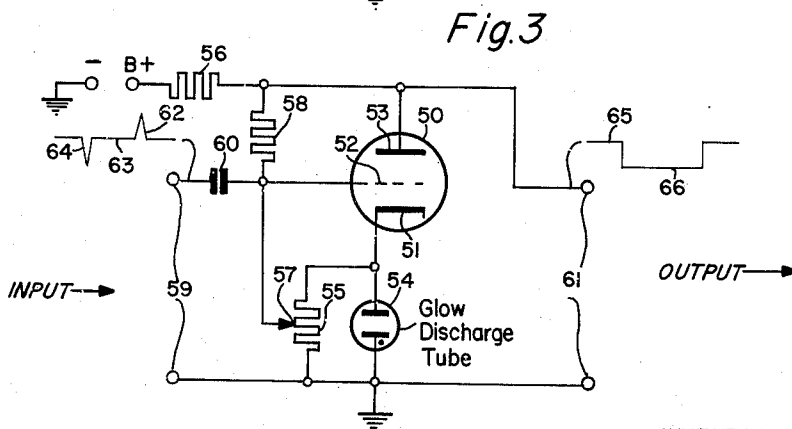
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PULSE-CONTROLLED BISTABLE MULTIVIBRATOR

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PULSE-CONTROLLED BISTABLE
MULTIVIBRATOR

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3 Claims. (Cl. 250—27)

1

This invention relates to multivibrator circuits and more particularly to multivibrators of the "single-shot" or "flip-flop" type, that is, multivibrator circuits of the type that have two stable operating conditions and are capable of being triggered from a first to a second condition by pulses of one polarity while being returned to the first condition by pulses of a second polarity.

The pulse-controlled bi-stable multivibrator circuit of the invention comprises an electron-discharge device having a cathode, an anode, and a control electrode; a glow-discharge tube; a source of unidirectional operating potential; and a load impedance. The source of unidirectional operating potential and the load impedance are coupled in series with the discharge paths of the electron-discharge device and the glow-discharge tube. The multivibrator further comprises a source of control pulses including pulse components of opposite polarities, and the control-pulse source is coupled to the control electrode and the cathode to alternate the electron-discharge device between two different conditions of space-current conductivity in accordance with the opposite-polarity pulse components and to render the glow-discharge tube conductive only during intervals when the electron-discharge device is maintained in one of these conditions. Finally, the multivibrator comprises an output circuit coupled to the anode and to the cathode and including the load impedance for developing an output signal which varies between two discrete potential levels in time synchronism with the opposite-polarity control pulses.

It is, accordingly, an object of the invention to provide an improved multivibrator circuit having two stable operating conditions, and which may be triggered from one to the other of these operating conditions by the application of successive pulses of opposite polarities.

A further object of the invention is to provide an improved multivibrator circuit that is simple and expedient to construct, and which utilizes a minimum of component elements and associated circuitry.

The features of this invention which are believed to be new are set forth with particularity in the appended claims. The invention itself, however, together with further objects and advantages thereof may best be understood by reference to the following description when taken in conjunction with the accompanying drawing, in which:

Figure 1 represents a multivibrator circuit constructed in accordance with one embodiment of the invention;

2

Figure 2 shows a multivibrator circuit constructed in accordance with a second embodiment of the invention; and,

Figure 3 shows a multivibrator constructed in accordance with a preferred embodiment of the invention.

The circuit of Figure 1 comprises an electron-discharge device 10 having a cathode 11, an anode 12 and a control electrode 13. A glow-discharge tube 14 is connected between the anode and cathode of device 10, and may be of the neon type or the like. Cathode 11 is connected to ground through a cathode impedance 15, and anode 12 is connected to the positive terminal B+ of a source of unidirectional potential through a load impedance 16, the negative terminal B- of the unidirectional source being connected to ground.

Electron-discharge device 10 has an input circuit comprising a pair of input terminals 17, one of which is connected to ground and the other to control electrode 13 through a capacitor 18, the control electrode being connected to ground through a grid-leak resistor 19. The discharge device has an output circuit comprising a pair of output terminals 20 connected to ground and to anode 12.

An input signal represented by curve 21 may be applied across terminals 17, this signal having positive pulse components 22 and negative pulse components 23. When the multivibrator is in its first operating condition, device 10 is correspondingly established in a first conductive condition and glow tube 14 is in its conductive state. In this first conductive condition, the space current of device 10 has a minimum value and may be zero. The conduction of glow tube 14 causes current to flow through load resistor 16 and through cathode resistor 15. The potential drop across resistor 16 establishes a predetermined potential level 24 in the output signal developed across terminals 20. The potential developed across cathode resistor 15 applies a predetermined bias to discharge device 10, maintaining this device in its first conductive condition.

The application of a positive pulse component, such as pulse 22 of signal 21, to control electrode 13 increases the space current through device 10, establishing the device in its second conductive condition. This increase in space current causes an additional potential drop across load resistor 16, and the circuit parameters are so chosen that this additional potential drop reduces the potential applied to glow tube 14 to such a value that the glow tube becomes extin-

3

guished. The extinguishment of the glow tube reduces the potential across cathode resistor 15 sufficiently to maintain device 10 in its second conductive condition until the application of a negative pulse, such as pulse 23. When device 10 is in its second conductive condition, a voltage drop occurs across load resistor 16 to establish the potential of the output signal at a level 25. Due to the fact that the internal impedance of device 10 is greater than the impedance of glow tube 14 (as compared in their fully conductive states) the potential drop across resistor 16 during the intervals when glow tube 14 is conductive exceeds that when the glow tube is extinguished. Therefore, the output signal may be considered to have positive pulse components corresponding to intervals when glow tube 14 is extinguished.

The circuit of Figure 1 is triggered, therefore, from one condition to another by a positive-polarity pulse and is returned to its first operating condition by a negative-polarity pulse. Pulses of like polarity that might occur in the input signal between the opposite polarity pulses have no material effect on the circuit, the circuit being maintained in any one operating condition until the occurrence of a pulse having a polarity opposite to that of the pulse which triggered the circuit into its particular condition. Moreover, the circuit remains in either of its operating conditions for an indefinite time and may be triggered from one to the other of these conditions solely by the application of opposite polarity pulses.

The multivibrator circuit of Figure 2 comprises an electron-discharge device 30 having a cathode 31, a control electrode 32 and an anode 33. Cathode 31 is connected to a point of reference potential or ground through a glow-discharge tube 34 which may be similar to tube 14 of Figure 1; and anode 33 is connected to the positive terminal B+ of a source of unidirectional potential through a load impedance 35, the negative terminal B- of this source being grounded.

Device 30 has an input circuit comprising a pair of input terminals 36 connected to ground and to control electrode 32 through a capacitor 37. Control electrode 32 is connected to ground through a resistor 38 and to the positive terminal of the unidirectional potential source through a resistor 39. Device 30 has an output circuit comprising output terminals 40 connected to ground and to anode 33.

Assume that when the multivibrator of Figure 2 is in its first operating condition, device 30 is established in a first conductive condition in which its space current may be zero, and glow tube 34 is extinguished. During this condition, the potential of cathode 31 approximates the potential of control electrode 32, the potential of the control electrode being positive with respect to ground and being derived from the potentiometer arrangement of resistors 38, 39. Moreover, the potential drop across load resistor 35 is reduced to a minimum value and the output signal has the potential value 44. At this time there is an insufficient potential applied across glow tube 34 to cause a discharge therein.

When a positive-polarity pulse, such as pulse 42 of an input signal designated by waveform 41, is applied to control electrode 32, the potential of the control electrode increases and the potential of cathode 31 similarly increases in cathode-follower fashion until the discharge potential of glow tube 34 is exceeded. The glow tube discharges and provides a relatively low impedance

4

path between cathode 31 and ground. During this latter condition, the cathode bias is such that device 30 is established in its second conductive condition wherein relatively high space current flows, causing a potential drop across load resistor 35 to establish the output signal at the potential level 45. The circuit is maintained in this second condition by glow tube 34 until a negative-polarity pulse is applied to control electrode 32. The application of such a negative pulse reduces the space current flowing through device 30 and the potential across glow tube 34 to such a point that the glow tube becomes extinguished and the circuit returns to its first operating condition.

The circuit of Figure 2 is, therefore, triggered between a first and second operating condition by opposite polarity pulses applied to control electrode 32 of device 30, and develops an output signal across terminals 40 having negative pulse components corresponding to one of the operating conditions.

The preferred embodiment of the invention illustrated in Figure 3 is generally similar to that of Figure 2 and includes an electron-discharge device 50 having a cathode 51, a control electrode 52 and an anode 53. Cathode 51 is connected to ground through a glow-discharge tube 54, the discharge tube being shunted by a compensating impedance 55. Anode 53 is connected to the positive terminal B+ of a source of unidirectional potential through a load impedance 56, the negative terminal B- of this source being connected to ground. Control electrode 52 is connected to a tap 57 on compensating impedance 55, and is also connected to anode 53 through a further compensating impedance 58.

Device 50 has an input circuit comprising a pair of input terminals 59 connected to ground and to control electrode 52 through a coupling capacitor 60; and the device has an output circuit comprising a pair of output terminals 61 connected to ground and to anode 53.

The operation of the circuit of Figure 3 is essentially similar to that of Figure 2, the positive pulse 62 of input signal 63 triggering the multivibrator from its first to its second operating condition, and negative pulse 64 of the input signal returning the multivibrator to its first operating condition. The succeeding opposite-polarity pulse components of the input signal cause the multivibrator to develop across output terminals 61 an output signal 65 having negative pulse components such as 66 corresponding to one of the operating conditions of the multivibrator.

It has been found that when glow-discharge tube 54 is in a conductive state there is some tendency for the current therethrough to decrease and the tube to return to its extinguished state. This tendency, if not compensated, may vary the bias on cathode 51 and cause some distortion in the wave form of the negative pulse components 66 of output signal 65. This characteristic of the glow-discharge tube is compensated by means of shunting impedance 55, tap 57 being adjusted so that any tendency for the current flow through the glow tube to decrease and alter the bias of cathode 51 results in a signal on control electrode 52 of such polarity and proper amplitude that it increases the current through the glow tube and opposes such tendency.

It has also been found that intermediate positive pulse components that might appear in the input signal succeeding component 62 yet pre-

5

ceding the negative pulse 64 may have an adverse effect on the wave form of the pulse 66 of output signal 65. It is desired that such intermediate pulses have no effect whatever on the multivibrator circuit. However, it is difficult to construct a circuit wherein device 50 is fully conductive when the multivibrator is in its second operating condition, and intermediate-positive pulse components applied to control electrode 52 when the multivibrator is in this condition may increase the conduction of device 50 and cause distortions in the wave form of the output signal.

The effect of these intermediate pulses is compensated in the circuit of Figure 3 by means of impedance 58 connected between anode 53 and control electrode 52. This last-mentioned impedance acts to reflect a compensating signal upon control electrode 52 to oppose any change in the conduction of device 50 when in its conductive state. However, the value of this impedance is made sufficiently great so that there is no interference with the triggering action of the circuit. Thus, should an intermediate positive pulse tend to increase the conduction of device 50 so as to decrease the potential of anode 53, impedance 58 reflects a potential decrease to control electrode 52 to oppose such increase in the conduction of the device. Impedances 55 and 58 have an additional function of providing a desired bias potential to control electrode 52 for the reason described in conjunction with Figure 2.

In one constructed embodiment of the circuit of Figure 3 the following parameters were used, and highly satisfactory results obtained. These parameters are listed herein merely by way of example and are not intended to limit the invention in any way:

Resistor 55..... 5 megohms.
Resistor 56..... 68,000 ohms.
Resistor 58..... 7.8 megohms.
Capacitor 60..... 47,000 micromicrofarads.

Discharge device 50... ½ section of a type 6SN7 tube.

Glow - discharge tube Type OB2.

54.

Potential source B+.... 250 volts.

The invention provides, therefore, a highly efficient multivibrator circuit of the single-shot or flip-flop type which may be constructed simply and conveniently and which utilizes a minimum of component parts.

While particular embodiments of the invention have been shown and described, modifications may be made, and it is intended in the appended claims to cover all such modifications as may fall within the true spirit and scope of the invention.

We claim:

1. A multivibrator circuit comprising: an electron-discharge device having an anode, a cathode and a control electrode; a glow-discharge tube connecting said cathode to a point of reference potential; a first compensating impedance shunting said glow-discharge tube and having a tap thereon connected to said control electrode; a second compensating impedance connecting said control electrode to said anode; a load impedance connecting said anode to a source of unidirectional potential; an input circuit coupled to said control electrode and to said point of reference potential for applying a signal having positive and negative pulse components to said device; and an output circuit coupled to said

6

anode and cathode for developing an output signal having pulse components determined by space current variations in said electron-discharge device.

2. A pulse-controlled bi-stable multivibrator circuit comprising: an electron discharge device including a cathode, an anode, and a control electrode; a glow-discharge tube connecting said cathode to a point of reference potential; a source of unidirectional operating potential; a load impedance; means coupling said source of unidirectional operating potential and said load impedance in series with the discharge paths of said electron-discharge device and of said glow-discharge tube; a source of control pulses including pulse components of opposite polarities; means coupling said control-pulse source to said control electrode and to said point of reference potential to alternate said electron-discharge device between two different conditions of space-current conductivity in accordance with said opposite-polarity pulse components and to render said glow-discharge tube conductive only during intervals when said electron-discharge device is maintained in one of said conditions; and an output circuit coupled to said anode and to said cathode and including said load impedance for developing an output signal which varies between two discrete potential levels in time synchronism with said opposite-polarity control pulses.

3. A pulse-controlled bi-stable multivibrator circuit comprising: an electron-discharge device including a cathode, an anode, and a control electrode; a glow-discharge tube connecting said cathode to a point of reference potential; a source of unidirectional operating potential; a load impedance; means coupling said source of unidirectional operating potential and said load impedance in series with the discharge paths of said electron-discharge device and of said glow-discharge tube; a potential divider extending between said source of unidirectional operating potential and said point of reference potential and having an intermediate point connected to said control electrode; a source of control pulses including pulse components of opposite polarities; means coupling said control-pulse source to said control electrode and to said point of reference potential to alternate said electron-discharge device between two different conditions of space-current conductivity in accordance with said opposite-polarity pulse components and to render said glow-discharge tube conductive only during intervals when said electron-discharge device is maintained in one of said conditions; and an output circuit coupled to said anode and to said cathode and including said load impedance for developing an output signal which varies between two discrete potential levels in time synchronism with said opposite-polarity control pulses.

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