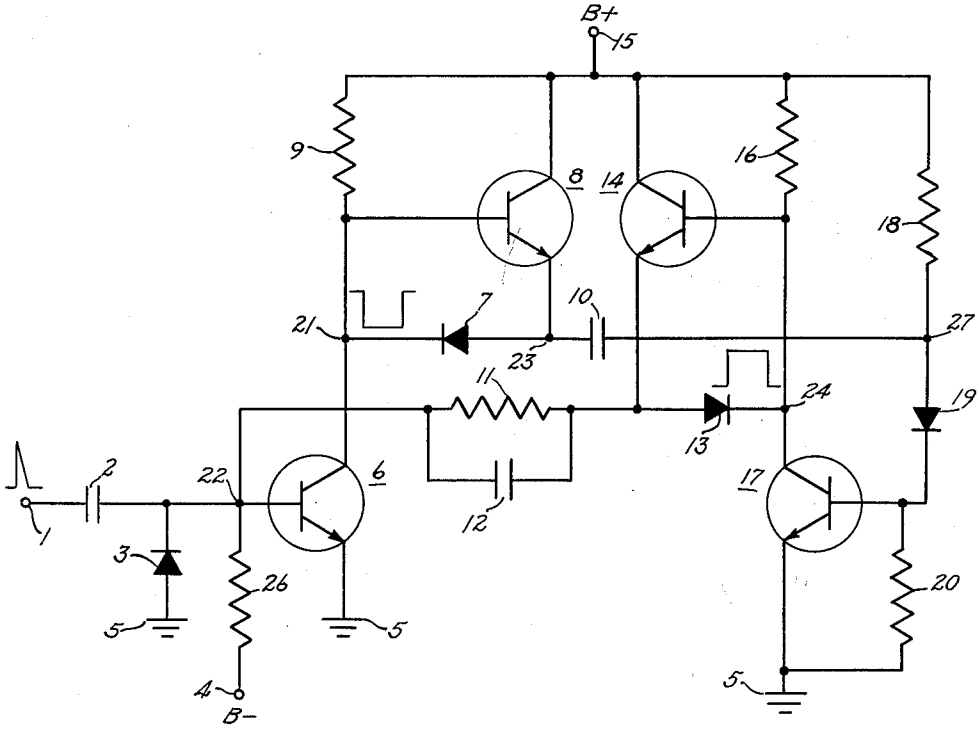
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STABLE-FAST RECOVERY TRANSISTORIZED MULTIVIBRATOR CIRCUIT

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STABLE-FAST RECOVERY TRANSISTORIZED MULTIVIBRATOR CIRCUIT

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This invention relates to multivibrators and more particularly to multivibrators incorporating transistors and having operating characteristics featuring stability and fast recovery.

On the basis of their operating characteristics, multivibrators may belong to three classes, bistable, monostable, and astable. The bistable multivibrator requires application of an external signal to trigger it from one stable state to another and another signal to return it to its original stable state. The monostable multivibrator requires an external signal to trigger it from one stable state to another but is capable of self triggering back to the original state. The astable multivibrator is capable of self triggering from either stable state.

Because of the advantages offered by transistors due to their small size, nominal power requirements, and low heat dissipation, it was natural that they be utilized in multivibrators. However, the use of transistors in multivibrators occasionally presents problems because of their low impedance, temperature effects, and the detrimental effects of transients on the circuit incorporating the transistors.

The present invention makes a multivibrator capable of highly unsymmetrical operation such as, for example, a duty cycle of 95%. To prevent the transients associated with the recovery time of the capacitors from affecting the performance especially at highly unsymmetrical operation, two more transistors are employed according to this invention than are normally employed in a transistor multivibrator. A diode is included with each of the additional transistors. The results are a significant reduction in circuit recovery time during switching from one operating state to another, improved stability, and independence of interchange of transistors, supply voltage, loading and duty cycle.

It is, accordingly, a general object of the present invention to obtain an improved multivibrator. It is a more specific object of this invention to produce a monostable multivibrator whose output characteristics are highly independent of temperature, transistor changes, supply voltage, loading, and duty cycle. It is a still more specific object of the invention to provide a multivibrator having an output pulse of uniform width regardless of the loading of the circuit, even when in the condition of highly unsymmetrical operation.

Other objects, uses, and advantages of the present invention will become apparent when the detailed description thereof is studied and reference is made to the single figure of drawing which shows a preferred embodiment of the invention.

Referring to the single figure of the drawing, there is illustrated a preferred embodiment of the invention utilizing four N-P-N type transistors; however, it is to be understood that by making the proper polarity changes, transistors of the P-N-P type may also be utilized. Transistor 6 has its emitter-collector path coupled between a source 15 of positive potential, and a source of zero potential (ground) 5, the collector of transistor 6 being

coupled through resistor 9 to the source 15. There is an input terminal 1 coupled through coupling capacitor 2 and junction 22 to the base of transistor 6. A clamping diode 3 is connected between ground and junction 22. Resistor 26 is connected between a source 4 of negative potential and junction 22. Transistor 17 has its emitter-collector path coupled between source 15 of positive potential and ground 5. Its collector which is connected to junction 24 is coupled through resistance 16 to the source of positive potential 15. There is a direct current conductive path coupled from the base of transistor 6 at junction 22 to junction 24 at the collector of transistor 17. There is a diode 13 connected in series with the parallel combination of resistance 11 and capacitor 12 in the direct current conductive path. Diode 13 is oriented such that it conducts readily in a direction from resistance 11 to junction 24. There is a voltage divider circuit coupling the base of transistor 17 through resistor 20 to ground 5 and through diode 19 and resistance 18 in series to the source of positive potential 15, diode 19 being oriented so that its high resistance direction is in the direction from the base of transistor 17 to the source of positive potential 15. There is a circuit branch between the collector of transistor 6 at a junction 21 and the junction 27 between resistance 18 and diode 19. In this circuit branch there is a storage capacitor 10 and diode 7, diode 7 being oriented to have its low resistance direction in the direction from capacitor 10 to junction 21. There is a transistor 8 having its emitter-collector path between the source 15 of positive potential and a junction 23 between capacitor 10 and diode 7. The collector of transistor 8 is coupled to the source 15 of positive potential and its base is connected to junction 21. There is a transistor 14 having its emitter-collector path connected between source 15 of positive potential and the junction between resistance 11 and diode 13. The collector of transistor 14 is connected to the source 15 of positive potential. The base of transistor 14 is connected to junction 24. Outputs for the multivibrator circuit shown in this figure are normally taken from junction 21 or junction 24.

In one example of the operation of the invention, trigger pulses are applied at terminal 1. The repetition rate of the incoming trigger pulses may be variable. Transistor 6, which is normally in a non-conducting operating state, is turned on by application of a positive trigger pulse through capacitor 2 to its base. The potential at junction 21 then drops rapidly toward ground. Because timing capacitor 10 is large, it acts somewhat like a battery whose voltage equals the initial voltage across capacitor 10 when transistor 6 is cut off. Accordingly, as the potential at junction 21 drops toward ground, the potential at junction 23 becomes positive with respect to junction 21. To provide the drive required to cut off transistor 17, diode 7 is employed between junctions 23 and 21 and provides a low impedance path from junction 23 to 21. Consequently, as soon as the voltage at junction 23 becomes very slightly more positive than that at junction 21, there is provided in effect a very low impedance source whose output impedance is effectively that of two series diodes conducting in the forward direction to turn off transistor 17 and to supply the energy required to reliably determine the time constant of the circuit. As conduction ceases in transistor 17, the potential at junction 24 rises slightly toward B+. This places a forward bias on transistor 14 to charge capacitor 12 and supply current to the base of transistor 6. Consequently, a sharp rise in potential at junction 24 is achieved. This sharp rise would not be possible in a conventional circuit where the rise would depend on the time constant of the capacitor 12 and resistances 11 and 16.

While transistor 6 is turned on, timing capacitor 10 begins to charge through resistance 18. When capacitor

10 has charged sufficiently to cause a forward bias to be re-established on transistor 17, the latter is turned on again. This causes a sharp drop in potential at junction 24. This results in removal of forward bias on transistor 6, turning it off. A sharp rise in potential at junction 21 is made possible by transistor 8 because as the rise begins, it turns on transistor 8 through which capacitor 10 is then discharged. Use of transistor 8 reduces the circuit recovery time constant to

$$\frac{R_1}{B}C_1$$

where R_1 is the resistance of resistor 9, C_1 is the capacitance of capacitor 10 and B is the gain of transistor 8. This avoids the delayed rise which would result if transistor 8 and diode 7 were not used and the charging current was supplied to capacitor 10 in conventional manner through resistance 9.

From this description of a preferred embodiment of my invention, it will be apparent that low impedance outputs for both positive and negative pulses are available. These are low impedance both for current flow out of and back into the multivibrator. It should also be apparent that if the recovery time from one of the stable states is relatively unimportant to a user of the multivibrator the appropriate transistor and diode can be omitted.

While the above description has dealt with a preferred embodiment of the invention, numerous modifications or alterations may be made therein without departing from the spirit and scope of the invention as set forth in the appended claims.

What is claimed is:

1. A monostable multivibrator-circuit comprising: a first and second transistor of the N-P-N type, each including a base, an emitter, and a collector electrode; a first feedback means coupled between the base of said second transistor and the collector of said first transistor said feedback means including a first storage means and a first and second diode in series connection; a second feedback means coupled from the base of said first transistor to the collector of said second transistor said second feedback means including a second storage means and first resistance in parallel combination, the parallel combination being in series with a second diode; input means coupled to the base of said first transistor for receiving trigger pulses in said multivibrator circuit for rendering said first transistor conductive to initiate a cycle, said input means including a coupling capacitor, a clamping diode connected between said base and a source of reference potential, and second resistance connecting said base to a source of negative potential; a third resistance in series between a source of positive potential and the collector of said first transistor to produce through said first feedback means the removal of a forward bias on said second transistor upon conduction in said first transistor to turn off said second transistor; a fourth resistance in series between said source of positive potential and the collector of said second transistor to provide a bias to said second feedback means, to turn off said first transistor upon resumption of conduction in said second transistor; a fifth resistance coupled to said source of positive potential and said first storage means to charge said first storage means; a third transistor having a base, an emitter, and a collector, said transistor being coupled between said source of positive potential and said first storage means to discharge said first storage means when said first transistor is turned off; and a fourth transistor having a base, an emitter, and a collector, said transistor being coupled between said source of positive potential and said second storage means to charge said second storage means and maintain a forward bias on said first transistor when said second transistor is turned off.

2. A monostable multivibrator circuit comprising: first and second alternately conducting transistor means, each having a base, an emitter, and a collector electrode, and each having its collector electrode resistively coupled to a source of direct current potential and its emitter electrode coupled to ground potential; input terminal means for receiving a trigger signal capacitively coupled to the base of said first transistor means, said base of said first transistor means being further coupled through a diode means to ground potential and through a resistance means to a source of direct current potential; a third and fourth transistor means, each having a base, an emitter, and a collector electrode, and each having its collector electrode coupled to a source of direct current potential, said third transistor means having its base electrode coupled directly, and its emitter electrode coupled through a diode means, to the collector electrode of said first transistor means, and said fourth transistor means having its base electrode coupled directly, and its emitter electrode coupled through a diode means, to the collector electrode of said second transistor means; an impedance, consisting of a resistance means placed in parallel with a storage means, coupled between the base electrode of said first transistor means and the emitter electrode of said fourth transistor means; a resistance means coupling the base electrode of said second transistor to ground potential; and a diode means having a first terminal coupled to the base electrode of said second transistor means and a second terminal coupled through a resistance means to a source of direct current potential, and through a storage means to the emitter electrode of said third transistor means whereby said multivibrator circuit provides a unit featuring stability and fast recovery.

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