

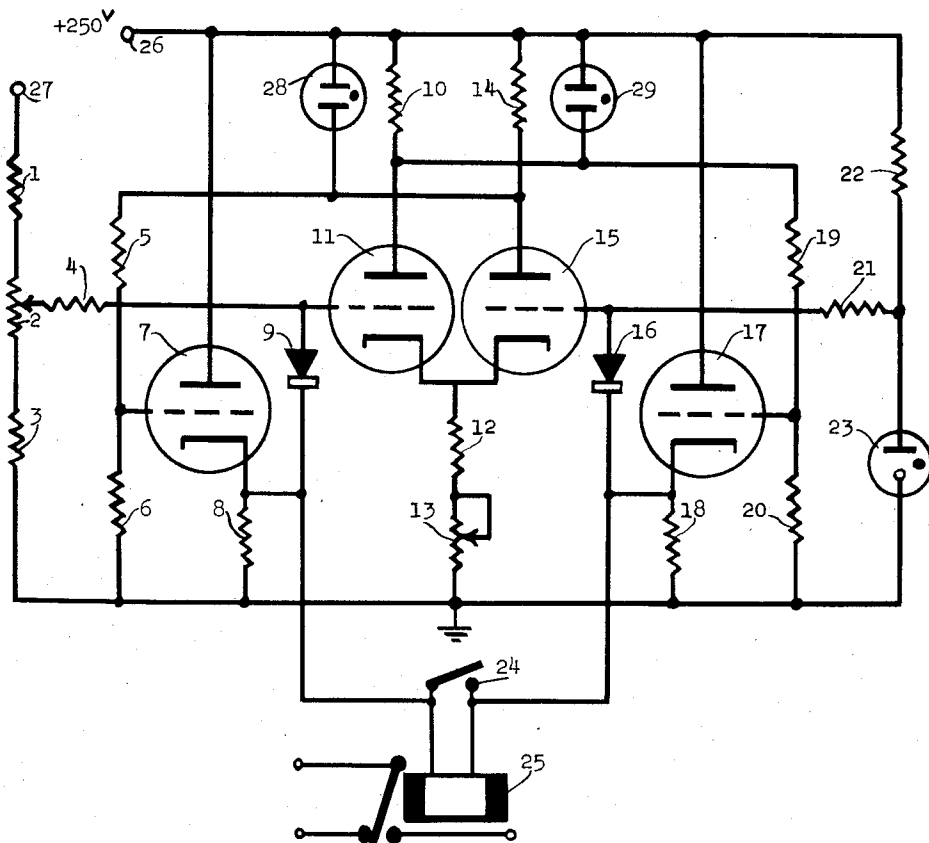
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VOLTAGE MONITOR CIRCUIT

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1

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VOLTAGE MONITOR CIRCUIT

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This invention relates to a voltage monitor circuit and more specifically to a triggered multivibrator with three stable states.

Existing multivibrators have two stable states, that is, one and only one of two tubes conducting. This characteristic is no handicap if purely binary operation is desired, but if distinctive response to three conditions is desired, two or more conventional multivibrators must be employed.

The object of this invention is to provide a triggered multivibrator having three stable states corresponding to three input conditions.

Another object is to provide a triggered multivibrator having three stable states and which, on being triggered from one stable state to a second stable state, remains in said second stable state until the circuit is reset.

A further object is to provide a triggered multivibrator having three stable states which is responsive to transients to indicate the polarity thereof subsequent to the occurrence of the transient.

These and other objects of the invention are achieved by a circuit similar to the conventional one-shot multivibrator circuit except that, in addition to conditions where either side of the circuit is conducting and the other side is cut off, there is an additional quiescent state where both sides are conducting at some intermediate value of current. When the circuit is operating in this quiescent state, if the input voltage is increased or decreased from a selected normal value by a certain threshold amount the circuit will switch to one or the other of its corresponding unbalanced states.

The accompanying drawing is a circuit diagram of one embodiment of the invention.

The operation of this invention may best be understood by reference to the drawing. The two triodes 11 and 15 are connected as a difference detector and amplifier with a common cathode circuit consisting of fixed resistor 12 and variable resistor 13. The grid of triode 15 is connected through resistor 21 to the plate of gas tube 23, which operates through resistor 22 connected to terminal 26 as a constant reference voltage. The plates of triodes 11 and 15 are connected to a positive D.-C. voltage at terminal 26 through plate load resistors 10 and 14 respectively. The grid of triode 11 is connected to the voltage being monitored through resistor 4 to the voltage divider network provided by resistors 1, 2, and 3, serially connected between ground and input terminal 27. The parameters are so chosen that when the fractional input voltage selected by the movable contact of resistor 2 is at the normal desired level the voltages on the grids of triodes 11 and 15 are identical, thus establishing the quiescent state with triodes 11 and 15 conducting equally. The voltages on the plates of triode sections 11 and 15 are fed back to the opposite grids through triodes 17 and 7 connected as cathode followers and diodes 16 and 9, which are polarized for conduction from grid to cathode. In the quiescent state a small back voltage appears across diodes 16 and 9. The amount of this voltage, and thus

2

the sensitivity of the circuit to changes in input voltage can be adjusted by means of variable resistor 13.

If the input voltage at terminal 27 is raised the voltage on the grid of triode 11 is raised, causing triode 11 to conduct more, lowering the voltage at its plate and raising the voltage at its cathode. If the lowering of the plate voltage, which is coupled through cathode follower 17 to diode 16, is less than the initial back voltage across this diode, the circuit reaches a new equilibrium, with triode 11 conducting a little more and triode 15 conducting a little less, since the voltage at its grid has remained constant while the cathode voltage has increased somewhat. If, however, the input voltage raises sufficiently so that the voltage change at the cathode of cathode follower 17 is equal to the original back voltage across diode 16, then further changes are applied to the grid of triode 15. When this occurs, the gain of the loop is sufficient so that rapid switching to the condition of triode 11 conducting and triode 15 cut off takes place.

If the input voltage at terminal 27 decreases, a similar, but reverse occurrence takes place. A decrease in input voltage causes a decrease in the voltage at the grid of triode 11 and thereby an increase in the plate voltage of triode 11 and a decrease in the common cathode voltage. The decrease in cathode voltage of triode 15, its grid voltage remaining at the constant value determined by gas tube 23, causes an increase in current through triode 15 with a resulting decrease in the voltage at its plate. This voltage decrease is fed back through cathode follower 7 to diode 9. The gain of the circuit ensures that this voltage change is greater than the input at triode 11. If the voltage fed back to diode 9 becomes sufficient to remove the back voltage across the diode, further changes are applied to the grid of triode 11 and the gain of the loop is sufficient to cause rapid switching to the condition of triode 15 conducting and triode 11 cut off.

If resistor 13 is adjusted to a lower value, the initial back voltage across diodes 9 and 16 is less, with a resultant increase in circuit sensitivity, that is, smaller input changes are required to produce switching. Conversely, an increase in the value of resistor 13 decreases circuit sensitivity.

Once the circuit has switched, it remains at its new state until reset, unless an extremely large abnormal variation in input voltage in the opposite direction occurs. The exact ratio of the change required to switch back to the change required for initial switching will depend on the circuit components chosen.

Relay 25, connected between cathode followers 7 and 17, is shown as one means of obtaining an output from the circuit. A polarized relay may be used to indicate the direction of input change. Or, if an ordinary relay is used, as illustrated in the drawing, indication of the direction of change can be obtained by the change in circuit voltages. Neon glow tubes 28 and 29 connected across plate resistors 14 and 10, respectively, for example, would be one means of providing this indication.

Resetting is accomplished manually in this embodiment of the circuit by closing reset switch 24, which connects together the cathodes of cathode followers 7 and 17, thus removing the unbalance in the voltages being fed to the grids of triodes 11 and 15 and restoring the circuit to its initial quiescent condition with both triodes conducting and a small back voltage across diodes 9 and 16.

The circuit will function similarly if diodes 9 and 16 are polarized for conduction from cathode to grid rather than from grid to cathode. The direction of diode polarization shown in the drawing is preferred because, as shown, severe aging of triodes 7 and 17 increases the circuit sensitivity and complete loss of conduction of

triodes 7 and 17 triggers the circuit and thus provides a fail-safe arrangement.

The circuit of the drawing will function as described even if the cathode followers 7 and 17 are removed, for example, by connecting diode 9 between the junction of resistors 5 and 6 and the grid of tube 11. However, the cathode followers serve to supply the power to operate relay 25 with minimum disturbance to the circuit and also serve to make the circuit more tolerant to variations in diode characteristics.

Since this invention will detect transient changes far too short to appear on conventional voltage recording devices, it is particularly useful for monitoring voltages fed to devices where such short transients may affect operations. In a computer, for example, such rapid changes may mean an undetected error, or, if the error is obvious, may mean time wasted searching for non-existent trouble within the computer.

If a capacitor input is used, the device may be used to indicate the existence and polarity of noise pulses in a signal. Other instances where it is desirable to detect a deviation and its direction will suggest themselves.

The particular circuit configuration and component types—triodes for example—have been used for illustration only and not to limit the invention. Users may well wish to make modification to fit specific applications.

Having thus described the invention, what is claimed is:

1. A circuit having three stable states of conduction including a quiescent state for monitoring the amplitude of an input signal comprising first and second triodes connected as a difference amplifier with a common cathode circuit, first and second diodes, means including said first diode for coupling the plate of said first triode to the grid of said second triode, means including said second diode for coupling the plate of said second triode to the grid of said first triode, means for applying a constant reference voltage to the grid of said second triode, means for applying a predetermined portion of said input signal to the grid of said first tube to establish said quiescent state, whereby deviation of said input signal drives one of said triodes to full conduction and the other of said triodes to cut-off, means to indicate the state of conduction of said triodes, and means to reset said circuit to said quiescent state.

2. A circuit as described in claim 1 wherein said diodes are polarized for conduction from grid to cathode and means for adjusting the common cathode circuit to control the back voltage across said diodes, thereby adjusting the amount of deviation of said input signal to shift the state of conduction of said triodes.

3. A circuit as described in claim 1 wherein each of

said coupling means between plate and grid circuits of said difference amplifier includes a cathode follower.

4. A circuit having three stable states of conduction including a quiescent state for monitoring the amplitude of an input signal comprising a pair of electron tubes each having at least an anode, a cathode and a control grid, said pair of tubes being connected as a difference amplifier, means each including a unidirectional device for coupling the plate of each of said pair of tubes to the grid of the other of said pair of tubes, means for biasing the grid of one of said pair of tubes with a constant reference voltage, means for applying a portion of said input signal to the grid of the other of said pair of tubes to establish said quiescent state, whereby deviation of said input signal drives one of said pair of tubes to increase conduction and the other of said pair of tubes to cut-off depending upon the direction of said deviation, and means to reset said circuit to said quiescent state.

5. A circuit as defined in claim 4 including means to indicate the state of conduction of said tubes.

6. A circuit having three stable states of conduction including a quiescent state for monitoring the amplitude of an input signal comprising first and second triodes connected as difference amplifier with a common cathode connection, third and fourth triodes connected as cathode followers, the plate of said first triode being connected to the grid of said fourth triode and the plate of said second triode being connected to the grid of said third triode, first and second diodes, the grid of said first triode being connected to the cathode of said third triode through said first diode, the grid of said second triode being connected to the cathode of said fourth triode through said second diode, said diodes being polarized for conduction from grid to cathode, means for applying a constant reference potential to the grid of said second triode, a voltage divider for applying a predetermined portion of said input signal to the grid of said first triode, means for adjusting the common cathode bias of said first and second triodes to control the back voltage across said diodes, means to indicate the state of conduction of said first and second triodes, and means for resetting said first and second triodes to said quiescent state.

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