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GATE USING VARIABLE CATHODE FOLLOWER IMPEDANCE FOR SHORTING OR PASSING CATHODE-FED IMPULSES

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The present invention relates to signal transfer circuits and more particularly to circuits for selectively passing electrical impulses to an output circuit.

In electronic systems such as digital computing apparatus, a binary counter for counting a selected number of electrical pulses is frequently employed. Where four bistable circuits are employed as a binary counter the total number of permutations in the conditions of conduction of the bistable circuits equals 16. For some applications, however, it is desirable to limit the maximum count to a lesser number, say 10 counts. This may be accomplished by inhibiting the passage of counting impulses to selected ones of the bistable circuits so that one or more of the possible permutations is omitted.

In accordance with our invention we have provided an improved and simplified circuit for controlling the passage of electrical impulses to an output circuit which may comprise a selected one of the bistable circuits in a binary counter.

In one embodiment, our invention includes an electron tube having a cathode, a primary anode, a control electrode, and two auxiliary electrodes adjacent to the cathode. By connecting a cathode resistor between the cathode and a reference potential, a back voltage is provided at the cathode by the passage of current between the cathode and the primary anode which tends to diminish current flow between the cathode and the auxiliary anodes. A source of negative pulses is coupled across the cathode resistor, an output circuit is connected to the auxiliary anodes, and a biasing means is coupled to the control electrode.

A better understanding of the operation and advantages of our invention may be had upon a reading of the following detailed description when taken in connection with the drawings, in which:

Fig. 1 is a combination block and schematic diagram of one embodiment of our invention; and

Fig. 2 is a graphical representation of certain of the electrical signals appearing in the embodiment of Fig. 1. A signal transfer circuit is shown which includes an electron tube 3 having a primary anode, a control electrode, a cathode, and two auxiliary anodes 5 and 7. Several commercial electron tubes, which are readily available, include all of these electrodes. Ordinarily the auxiliary anodes are employed as second detectors and automatic volume control indicators in superheterodyne radio receivers. The auxiliary anodes 5 and 7 share the cathode of the electron tube 3 with the primary anode.

A cathode impedance, such as a resistor 9, is connected between the cathode and a reference potential. The anode of the electron tube 3 may be energized by means of a terminal 11 which is adapted to be connected to a suitable source of positive potential (not shown). Biasing means 13, which is connected to the control electrode of the electron tube 3, provides a control potential for varying the flow of current between the cathode and the anode, and hence the voltage appearing across the cathode resistor 9. When a relatively large voltage appears across the cathode resistor 9, current flow between the anode and the auxiliary anodes 5 and 7 tends to be diminished or cut off.

A negative pulse source 15 is coupled across the cathode resistor 9 and produces negative pulses at the cathode. When the voltage across the cathode resistor 9 is relatively large, the negative pulses 15 do not cause substantial current flow between the cathode and the auxiliary anodes 5 and 7. On the other hand, if the voltage across the cathode resistor 9 is relatively small, the negative pulses 15 from the negative pulse source 15 drive the cathode negative with respect to the auxiliary anodes 5 and 7, thereby causing conduction and a negative pulse to pass to the output circuit connected to the auxiliary anodes.

The relationship of the electrical signals involved is shown in Fig. 2 wherein Fig. 2(a) illustrates the signal provided by the inhibiting means 13 in two conditions of operation. When the signal from the biasing means 13 is low, as indicated at 17, the negative pulses from the negative pulse source 15, as illustrated in Fig. 2(b), are passed to the output circuitary associated with the auxiliary anodes 5 and 7 as shown in Fig. 2(c).

On the other hand, when the signal provided by the biasing means 13 is high, as illustrated in Fig. 2(a) at 19, the negative pulses provided by the negative pulse source 15, as illustrated in Fig. 2(b), do not appear at the auxiliary anodes 5 and 7 as illustrated in Fig. 2(c).

The particular output circuitry associated with the auxiliary anodes 5 and 7 of the illustrative embodiment of Fig. 1 is a conventional bistable circuit including two cross-coupled electron tubes 21 and 23. The circuit is arranged so that a negative pulse applied to the control electrode of that electron tube of the bistable circuit which is conducting, will tend to decrease conduction therein, thereby resulting in an increase in potential at the anode, which in turn is coupled to the control electrode of the other of the cross-coupled electron tubes, so as to tend to increase conduction therein. This action is cumulative until the initially conducting electron tube becomes substantially cut off, while the initially nonconducting electron tube becomes conducting.

In a binary counter having a plurality of bistable circuits, the signal transfer circuit, including the electron tube 3, may be used to form what is sometimes termed a "permutated binary counter." In a permutated binary counter, the maximum number of stable conditions of a plurality of bistable circuits is decreased so that the counter may be adapted to count in a desired number system. For example, as noted above, four bistable circuits may be employed to count to 16, but where the decimal system of notation is adhered to, and the decimal digits are coded in binary form, it is frequently desirable to count from 0 to 9 only. By including the signal transfer circuit of our invention in such a binary counter, any selected one of the bistable circuits may be inhibited from responding to counting pulses by applying a signal from another of the bistable circuits to the control electrode of the signal transfer electron tube 3. By this means, the condition of conduction of one of the bistable circuits determines whether the selected bistable circuit will respond to incoming pulses.

Although the signal transfer circuit of our invention is shown in connection with a bistable circuit which may be used as a portion of a permutated binary counter, the signal transfer circuit is not limited thereto, since it may be employed to pass selectively, electrical pulses to an output circuit wherever such is required. In addition, the electron tube types, the resistance values, and the power supply voltages given in Fig. 1 are exemplary only, being indicative of one embodiment of the invention which has operated satisfactorily. In Fig. 1 the values of the re-
sistances are in ohms where \( K = 1000 \) and the potential values are in volts.

We claim:

1. A signal transfer circuit for selectively passing negative pulses to an output circuit including in combination, an electron tube including at least a cathode, a primary anode, a control electrode and one auxiliary anode located adjacent the cathode, a cathode resistor connected between the cathode and a reference potential, means energizing the primary anode of the electron tube to provide a current flow between the cathode and the primary anode, an output circuit coupled to the auxiliary anode, a source of negative pulses coupled across the cathode resistor, and means coupled to the control electrode for biasing the electron tube to provide a voltage across the cathode resistor of a polarity tending to diminish conduction between the cathode and the auxiliary anode, whereby negative pulses from the source of negative pulses are inhibited from passing to the output circuit.

2. A signal transfer circuit including in combination, an electron tube having at least a cathode, anode and control electrode, a diode sharing the cathode of the electron tube, an output circuit coupled serially with the diode, a cathode impedance coupled between the cathode and a reference potential, means energizing the electron tube to induce a current flow between the cathode and the anode, a source of negative pulses coupled across the cathode impedance, means biasing the control electrode of the electron tube to allow the negative pulses to pass through the diode to the output circuit during one condition of operation, and means biasing the control electrode of the electron tube to inhibit the passage of negative pulses through the diode to the output circuit in another condition of operation.

3. In apparatus including a binary counter having two stable conditions of operation, the combination of a pair of cross-coupled electron tubes connected so that one of the electron tubes is conducting while the other electron tube is substantially cut off, a signal transfer circuit including an electron tube having at least a cathode, a primary anode, a control electrode and a pair of auxiliary anodes positioned adjacent the cathode, means coupling the auxiliary anodes to the cross-coupled electron tubes, a cathode resistor connected between the cathode and a reference potential, means energizing the primary anode positively with respect to the cathode, a source of negative pulses connected across the cathode resistor, means biasing the control electrode of the electron tube to permit negative pulses from the negative pulse source to be applied to the cross-coupled electron tubes via the cathode and auxiliary anodes during one condition of operation, and said latter means biasing the control electrode of the electron tube to provide a voltage across the cathode resistor which tends to diminish current flow between the cathode and auxiliary anodes whereby negative pulses from the negative pulse source are inhibited from passing to the cross-coupled electron tubes via the cathode and auxiliary anodes in another condition of operation.

4. A signal transfer circuit including in combination, an electron tube having at least a cathode, anode, control electrode and auxiliary anode located adjacent the cathode, circuit means for supplying an operating potential to said anode, a cathode resistance connecting said cathode to a common reference potential, a source of negative pulses coupled across said cathode resistance, and a source of inhibiting signals coupled to said control electrode, said tube being responsive to said inhibiting signals to control the conduction between the cathode and auxiliary anode in response to said negative pulses.

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