

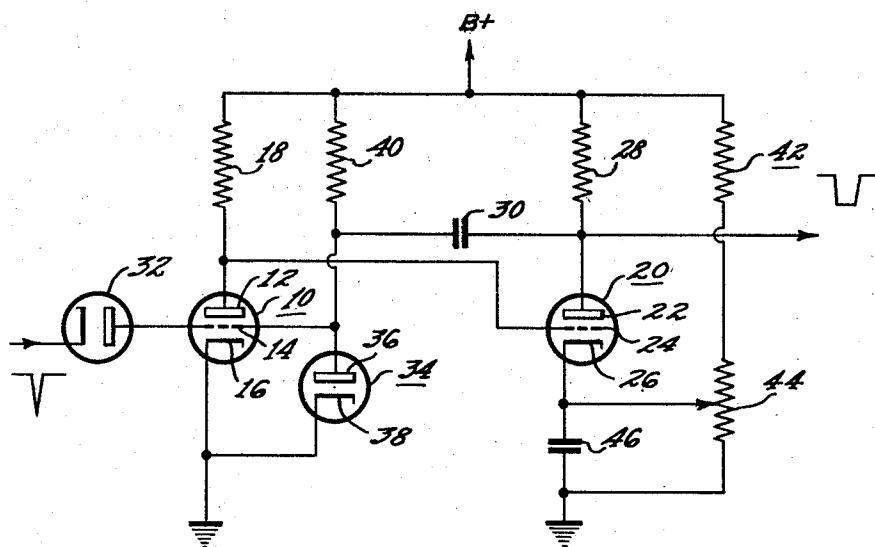
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MULTIVIBRATOR

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MULTIVIBRATOR

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The terminal fifteen years of the term of the patent to be granted has been disclaimed

4 Claims. (Cl. 250—27)

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This invention relates to multivibrators and more particularly to an improvement in multivibrators of the unstable or slideback type.

Slideback or unstable multivibrators are often used to generate uniform width and amplitude pulses in response to random pulses of non-uniform width and amplitude. These multivibrators or trigger circuits are of the well known type employing two electron discharge tubes in which the grids and anodes are cross-connected to each other. Bias is applied to the tubes so that in the standby or stable condition, one of them is conducting and the other is non-conducting. A pulse is usually applied to the conducting tube to render it non-conducting. This transfers conduction to the other tube. This unstable condition is maintained for a time determined by the time constant of the coupling between the tubes. Then the tubes return to their stable condition of conduction. An output is usually derived from the anode of the other tube, or the one which is non-conducting in the standby state.

In attempting to use a slideback trigger circuit of the general type described to drive directly a substantially low impedance load, difficulty was experienced. The trigger circuit behaved in typical overloaded fashion by providing a low output with an extremely poor waveshape. Reducing the plate load of the output resistor merely reduced the output, which was not a very efficient practice. Of course, a buffer stage could have been used as an impedance converter, but this is not as economical a practice as is desired.

It is, therefore, an object of this invention to provide a novel and improved slideback trigger circuit. It is a further object of this invention to provide a novel slideback trigger circuit which can drive a substantially low impedance load.

It is a further object of this invention to provide an improved slideback trigger circuit which permits circuit economies by providing a sufficiently high output, thus eliminating the need for an amplification stage.

These and other objects of the present invention are achieved by providing a slideback trigger circuit having two tubes wherein the anode of a first tube is directly connected to the grid of a second tube, a bias is applied to the grid of the first tube to maintain it conducting in the standby condition, and a bias is applied to the second tube cathode to maintain it at cutoff in the standby condition. The value of the anode load resistor of the first tube is chosen to permit the second tube grid to rise in potential substantially above its cathode potential even though

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this means drawing grid current when the first tube is rendered non-conducting and the second tube conducting. The second tube anode load resistor is chosen to have a value which is low because when driven to the unstable condition the second tube plate voltage will drop nearly to cathode potential whether the load resistor is large or small; thus the smaller resistor gives the same amplitude output across a lower impedance.

The novel features of the invention as well as the invention itself, both as to its organization and method of operation, will best be understood from the following description, when read in connection with the accompanying drawing of a circuit diagram of an embodiment of the invention.

Referring now to the drawing, there may be seen a circuit diagram of an embodiment of the invention. It comprises a first electron discharge tube 10 having an anode 12, grid 14, and cathode 16, and a second electron discharge tube 20 also having an anode 22, grid 24, and cathode 26. The anode 12 of the first tube 10 is directly coupled to the grid 24 of the second tube 20. The grid 14 of the first tube 10 is connected to the anode 22 of the second tube 20 by means of a coupling condenser 30. A source of operating potential of B+ is provided. An anode load resistor 18 is connected between the anode 12 of the first tube and the source of operating potential. The first tube cathode 16 is connected to ground.

Negative input pulses are applied to the grid of the first tube 10 through a diode 32. The first tube grid 14 is also connected to its cathode 16 through a diode 34 whose anode 36 is connected to the first tube grid 14 and cathode 38 is connected to the first tube cathode 16. This diode 34 is maintained conducting by means of a resistor 40 connected from the first tube grid 14 to the source of operating potential. Since a negative pulse is applied to the first tube grid to effectuate a transfer of the circuit from a stable to an unstable state, in order to permit the first tube grid to go positive again and thus permit return to the stable condition, electrons must be removed from the grid. This resistor 40 connected to the source of B+ serves that purpose and restores the diode 34 to conduction after the conduction has ceased by reason of the application of a negative pulse.

The anode 22 of the second tube 20 is connected to the source of B+ by an anode load resistor 28. A voltage divider 42 is connected across the source of operating potential and includes a variably tapped portion 44 which is connected to the cathode 26 of the second tube. A capacitor is con-

nected from the cathode of the second tube to ground. The capacitor 46 serves to maintain constant the bias applied to the cathode of the second tube. The voltage divider is tapped to provide cutoff bias for the second tube. This occurs when the cathode bias exceeds the voltage applied by the first tube anode to the second tube grid.

The diode 34 connected between the first tube grid and cathode in conjunction with the resistor connected to the B+ source serves to maintain the first tube in a conducting condition. It should be noted that the diode may be omitted with some tube types and satisfactory diode action is still obtainable from the grid-cathode path of the tube. The use of the diode insures this action. The application of a negative pulse to the input diode 32 causes the first tube 10 to be cut off. This applies a positive pulse from the first tube anode 12 to the second tube grid 24 causing the second tube to become conductive. The amplitude of the trigger pulse need only be big enough to initiate the action, since as soon as tube 20 starts to conduct, feedback will complete the switch. The first anode load resistor 18 has its value selected low enough so that even though the grid of the second tube draws some grid current, the grid is driven considerably positive, substantially above the tube cathode potential. The second anode load resistor 28 is also selected rather low. As a result of the large positive signal on the second tube grid, the second tube draws a large plate current and accordingly its output is of a large amplitude across a rather low impedance. After a time, depending on the RC time constant of the coupling from the second tube plate 22 to the first tube grid 14, the grid of the first tube, which has been negative in order to hold the tube non-conducting, becomes positive enough to cause the circuit to switch back to its normal operation.

By eliminating the coupling condenser between the first and second tubes not only is the tube grid permitted to be driven so positive that the tube is forced to draw an extremely large plate current, but also no coupling condenser is charged up by the grid current so as to introduce a dead time following each output pulse. This type of operation is not possible with the usual coupling condenser present, since a large grid current could not be drawn without causing blocking by the coupling condenser. The output of the second tube is increased two to three times. As is usual, such output is derived from the anode of the second tube. As an illustration of the circuit values used in a typical embodiment of the invention which was built and operated, but not to serve as any restriction thereon, the following values are provided:

Resistors	Condensers	Tubes	B+
18-12,000 ohms. 28-3,000 ohms. 40-220,000 ohms.	30, 20 μ f. or greater depending on pulse width desired. 46, 15 μ f.	10 and 20 6SN7. 32 and 34 6AL5.	250 volts.

Using the 6SN7 tube, an output pulse consisting of 150 volts, peak to peak, was obtained. It should further be noted that in view of the extremely large current drawn through the tube (50 milliamperes in the illustrated case), the duty cycle of the tube should be chosen as a rather low one in order to prevent the tube from suffering damage. In view of the low value of the sec-

ond anode load resistor, a substantially low impedance load could be readily driven.

In the above description, there has been described and shown a simple, novel, slideback type of trigger circuit which is capable of generating a large output and can supply this output to a low impedance load.

What is claimed is.

1. A slideback trigger circuit comprising first and second electron discharge tubes each having an anode, a cathode and a grid electrode, means coupling said first tube grid to said second tube anode, said second tube grid being directly connected to said first tube anode, a first anode load resistor connected to said first tube anode, a second anode load resistor connected to said second tube anode, means to bias said first tube grid to maintain said first tube conducting when said slideback trigger circuit is in standby condition, means to apply a bias to said second tube cathode to maintain said second tube non-conducting when said slideback trigger circuit is in a standby condition, means to apply a pulse to said first tube grid to transfer conduction from said first to said second tube, the last named condition of conduction being reversed after a time determined by the time constant of said means coupling said first tube grid with said second tube anode, and means to derive an output from said second tube anode, said means to bias said first tube grid including a rectifier having an anode and cathode, said rectifier anode being connected to said first tube grid, said rectifier cathode being connected to said first tube cathode, a resistor connected to said first tube grid, and means to apply a positive voltage to said rectifier anode through said resistor.

2. A slideback trigger circuit comprising first and second electron discharge tubes each having an anode, a cathode and a grid electrode, said second tube grid being directly connected to said first tube anode, means coupling said first tube grid to said second tube anode, a source of operating potential, a first anode load resistor connected between said source and said first tube anode, a second anode load resistor connected between said source and said second tube anode, a rectifier having an anode and a cathode, said rectifier anode being connected to said first tube grid and said rectifier cathode being connected to said first tube cathode, means in circuit with said source and said rectifier to render said rectifier conducting and to supply to said first tube grid a voltage to render said first tube conducting when said slideback trigger circuit is in a standby condition, said first anode load resistor having its resistance value selected sufficiently low to permit the potential of said second tube grid to rise substantially above the potential of said second tube cathode when said first tube is rendered non-conducting, said second anode load resistor is selected to have a low value of resistance when compared with said first anode load resistor, means to apply a voltage to said second tube cathode that is positive with respect to said second tube grid to maintain said second tube non-conducting when said slideback trigger circuit is in a standby condition, means to apply a negative pulse to said first tube grid to transfer conduction from said first to said second tube grid for a time dependent upon the time constant of said means coupling said first tube grid to said second tube anode, and means to derive an output from said second tube anode.

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3. A slideback trigger circuit comprising first and second electron discharge tubes each having an anode, a cathode and a grid electrode, a coupling capacitor connecting said first tube grid to said second tube anode, said second tube grid being connected directly to said first tube anode, a source of operating potential, a first anode load resistor connected between said source and said first tube anode, a second anode load resistor connected between said source and said second tube anode, a voltage dropping resistor connected between said source and said first tube grid, a rectifier having its anode connected to said first tube grid and its cathode connected to said first tube cathode, said first tube being in a state of conduction when said slideback trigger circuit is in a standby condition, a voltage divider connected across said source of potential, means coupling said second tube cathode to said voltage divider at a point to derive a bias voltage to maintain said second tube non-conducting when said slideback trigger circuit is in a standby condition, a capacitor connected between said second tube cathode and the low potential end of said voltage divider, means to apply a negative pulse to said first tube grid to transfer conduction from said first to said second tube for a time proportional to the value of said coupling capacitor, and

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means to derive an output from said second tube anode.

4. A slideback trigger circuit as recited in claim 2 wherein the resistance value of said second anode load resistor is selected to have a low value when compared with said first anode load resistor, and said first anode load resistor has its resistance value selected sufficiently low to permit the potential of said second tube grid to rise above the value of the potential of said second tube cathode when said first tube is rendered non-conducting.

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