Nov. 12, 1946. O. H. SCHADE 2,411,062

BLOCKING IMPULSE GENERATOR

Filed June 24, 1942

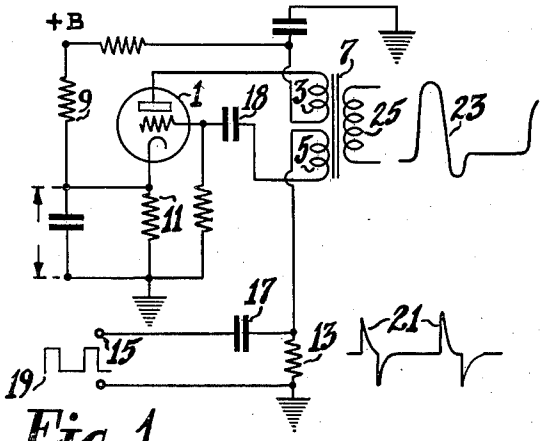


Fig. 1.

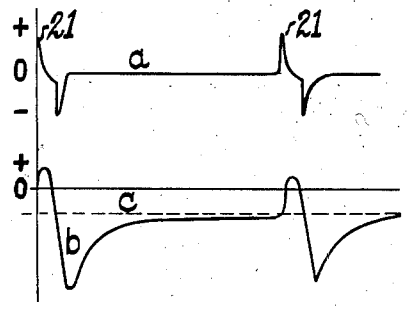


Fig. 4.

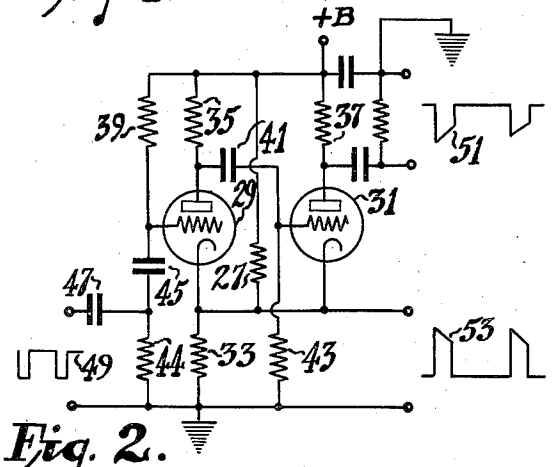


Fig. 2.

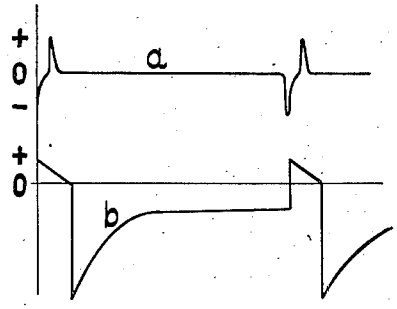


Fig. 5.

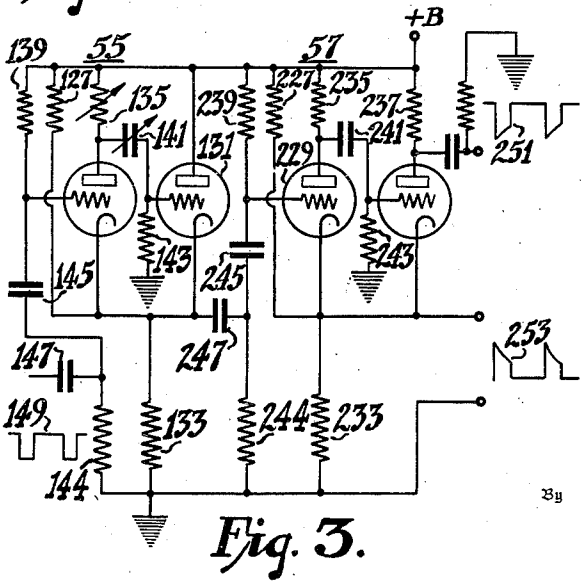


Fig. 3.

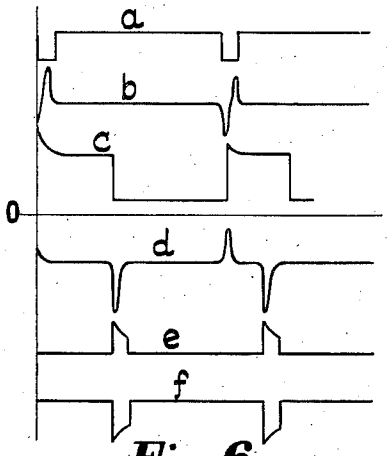


Fig. 6.

Inventor
OTTO H. SCHADE
By C. D. Puska
Attorney

Patented Nov. 12, 1946

2,411,062

UNITED STATES PATENT OFFICE

2,411,062

BLOCKING IMPULSE GENERATOR

Otto H. Schade, West Caldwell, N. J., assignor to Radio Corporation of America, a corporation of Delaware

Application June 24, 1942, Serial No. 448,210

4 Claims. (Cl. 250—36)

1

This invention relates to circuits for producing electrical impulses, and particularly to blocking impulse generators. A blocking impulse generator is a circuit which is normally quiescent, i. e., the voltages at various points in the circuit remain constant, until a trigger or control impulse is applied, whereupon the circuit voltages vary through an operating cycle and then resume their former values. Such circuits usually comprise an oscillator of some sort, biased to prevent oscillation. The blocking bias is momentarily overcome by the trigger impulse, the oscillator goes through one cycle, and is blocked again. The duration, wave shape and amplitude of the output pulse are determined by the constants of the oscillator circuit while the trigger pulse determines only the time at which an output pulse is initiated. Circuits of the described type find application, for example, in deflection circuits for cathode ray tubes.

It is an object of the invention to provide an improved method of and means for producing pulses of predetermined duration, amplitude, and wave shape at a repetition rate determined by the frequency of a controlling pulse.

A further object is to provide an improved method of and means for producing pulses having duration, amplitude and wave shape independent of their repetition time and independent of the wave shape of the pulse used to control their repetition time.

Another object of the invention is to provide an improved method of and means for maintaining constant pulse shape and duration without circuit adjustments over a wide range of pulse frequency.

Still another object is to provide a method of and means for producing pulses of predetermined duration and wave shape having a predetermined time delay with respect to their respective control impulses, independent of the repetition rate.

Other and incidental objects will become apparent to those skilled in the art upon consideration of the following description with reference to the accompanying drawing, of which Fig. 1 is a circuit diagram of a transformer coupled blocked oscillator type impulse generator, Fig. 2 is a circuit diagram of a blocked multivibrator type impulse generator and Fig. 3 is a schematic diagram of a pulse delay circuit. Figs. 4, 5 and 6 are graphical representations of the wave forms of voltages appearing at various points in the circuits during the operation of the devices shown in Figs. 1, 2 and 3 respectively.

Referring to Fig. 1, a vacuum tube 1 is connected to the coupled primary windings 3 and 5 of a transformer 7 so as to feed back energy from the plate circuit to the grid in such polarity as to tend to produce oscillation at a frequency determined by the circuit constants. A resistor 11 is connected in the cathode circuit of the tube 1, and a resistor 9 is connected from the positive plate voltage supply terminal to the resistor 11. Current flowing from the plate supply (not shown) through the resistors 9 and 11 produces a voltage drop in the resistor 11 sufficient to cut off the tube 1 and prevent oscillation.

2

A resistor 13 is connected in the grid A.-C. return circuit in series with the transformer winding 5, so that a positive voltage impulse 19 applied across resistor 13 will overcome the grid biasing effect of the voltage drop on the resistor 11. Control impulses 19 may be applied to the circuit at a terminal 15, which is connected through a capacitor 17 to the resistor 13. The value of the capacitor 17 is selected with reference to that of the resistor 13 so that a pulse 19 applied at the terminal 15 will be differentiated to provide a sharply defined pulse 21 at the beginning of each control pulse 19.

The circuit will oscillate for one-half cycle as each pulse 21 reaches the grid circuit, producing an output pulse 23 at the secondary 25 of the transformer 7. At the end of the half cycle, the voltage fed back from the plate circuit to the grid circuit cuts off the tube 1 because of the charge on capacitor 18 and the tube remains cut off by the voltage across the resistor 11 until another pulse 21 arrives at the grid circuit. Thus, the repetition frequency of the output pulse is determined solely by that of the control pulse 19, while the wave shape, duration, and amplitude of the output pulse depend on the oscillator circuit and are independent of frequency.

Referring to Fig. 4, the curve *a* represents the voltage across the resistor 13 as a function of time, the curve *b* represents the total voltage between the grid and the cathode of the tube 1, and the dotted line *c* represents the voltage across the resistor 11.

Referring to Fig. 2, a blocking impulse generator including a multivibrator circuit is illustrated. The multivibrator circuit is of the type described in U. S. Patent No. 2,157,434 to J. L. Potter, and comprises tubes 29 and 31 provided with a common cathode resistor 33 and plate load resistors 35 and 37. The plate of the first tube 29 is coupled through a capacitor 41 to the grid of the second tube 31, which is connected to ground through a grid leak 43. The various cir-

cuit constants are so proportioned that cyclically repeating voltage pulses would be produced across the resistors 33 and 37, if the circuit were allowed to operate as described in the said Potter patent.

This type of operation is prevented by a resistor 27 connected between the positive terminal of the plate voltage supply and the common cathode circuit. Current from the plate flows through the resistors 27 and 33, producing sufficient voltage drop on the resistor 33 to cut off the second tube 31. A resistor 44 is coupled to the grid of the first tube 29 through a capacitor 45 so that a negative voltage impulse 49 applied across the resistor 44 through a capacitor 47 will reach the grid of the tube 29 in the proper polarity to reduce the positive grid bias of tube 29 momentarily causing an amplified positive impulse on the grid of the tube 31, which in turn causes the circuit to produce, by current feedback in resistor 33, one pulse 51 in the plate circuit of the tube 31. The duration of the pulse 51 is controlled predominantly by the product of the resistor 35 and the capacitor 41, and is independent of the repetition time, which is controlled by the input pulse 49. The time constant represented by the product of the resistor 43 and the capacitor 41 must be less than one-third of the minimum pulse repetition time in order to assure discharge of the capacitor 41 before occurrence of the trigger pulse. A pulse 53 similar to the pulse 51 but of opposite polarity appears simultaneously across the resistor 33.

Referring to Fig. 5, the curve *a* represents the voltage across the resistor 43, and the curve *b* represents the resultant voltage at the grid of the tube 31, for a fairly high repetition rate. For lower repetition rates the pulse decay occupies a smaller percentage of the total time per cycle.

A circuit for producing a pulse of predetermined wave shape and amplitude a predetermined time after the occurrence of a controlling pulse is shown in Fig. 3. Two blocked multivibrators 55 and 57, each like the device shown in Fig. 2, are employed. The elements of the devices 55 and 57 are designated by the same reference numerals as the corresponding elements of the circuit of Fig. 2, with prefixes 1 and 2 respectively.

The output of the multivibrator 55 across a resistor 133 is coupled through a capacitor 247 to a resistor 243 in the control input circuit of the multivibrator 57.

The operation of the multivibrator 55 is exactly like that of the device of Fig. 2. A control pulse 149 applied to the resistor 143 through the capacitor 147 produces a voltage shown by the curve *b* of Fig. 6, which overcomes the blocking bias on the tube 131 and produces a voltage shown by the curve *c* of Fig. 6 across the resistor 133. The pulse duration of the voltage *c* is largely determined by the product of the resistor 135 and the capacitor 141. The voltage *c* is differentiated by the capacitor 247 and the resistor 243, resulting in a voltage at the grid of the tube 229 shown by the curve *d* of Fig. 6. The negative pulses of the voltage *d* lag the corresponding control pulse fronts by the pulse duration time of the voltage *c*, and produce output pulses 251 and 253, illustrated in Fig. 6 by the curves *e* and *f* respectively. The delay of the output pulses over the corresponding control pulses is controlled by the time constant represented by product of the resistor 135 and the capacitor 141, and is independent of the repetition frequency of the pulse 149.

I claim as my invention:

1. A pulse generator comprising two oscillator devices including elements so proportioned that said devices tend to oscillate and block at a frequency higher than the repetition frequency of the highest frequency pulse to be generated; means for applying a bias to each of said devices to prevent oscillation; means for applying a pulsating control voltage to one of said devices to momentarily overcome said bias on said first device in response to each pulse of said control voltage, whereby said first device produces, in response to each pulse of the control voltage, a pulse having a duration time determined by the circuit elements of said first oscillator device; means for deriving a voltage proportional to the rate of change of the output voltage of said first device, and applying said derived voltage to said second oscillator device to overcome momentarily said bias at the end of each pulse of the output voltage of said first oscillator device.

2. A pulse delay circuit comprising two normally blocked oscillator devices; means for applying a control signal to one of said oscillator devices, and high frequency pass filter means connected to the first of said oscillator devices for applying the output of the first of said oscillator devices to the second of said devices.

3. A system for producing a pulse in response to a control pulse at a predetermined time after the occurrence of said control pulse comprising two normally blocked oscillator devices; means for applying said control pulse to one of said oscillators to cause said oscillator to produce an output pulse of predetermined duration; means for deriving from said output pulse a voltage proportional to the time derivative of said output pulse and for applying said derived voltage to the other of said oscillator devices.

4. A system for producing pulses of predetermined magnitude and wave shape and a repetition frequency determined by that of a pulsating control voltage, comprising two electron discharge tubes each including a cathode, an anode and a control grid, a source of anode potential connected to the anodes of said tubes through load resistors and to the cathodes of said tubes through a common cathode resistor, means for coupling the anode of the first of said tubes to the control grid of the second of said tubes whereby said tubes tend to oscillate at a frequency higher than that of the highest frequency pulse to be generated, a resistor connected between the positive terminal of said source of anode potential and said cathodes to provide sufficient drop in said cathode resistor to bias said second tube to cutoff, a resistor connected between said positive terminal and the control grid of said first tube, and means for applying said pulsating control voltage to the control grid of said first tube.

OTTO H. SCHADE.