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[54] ADJUSTABLE INTERVALOMETER INCLUDING SELF-TESTING MEANS
7 Claims, 1 Drawing Fig.

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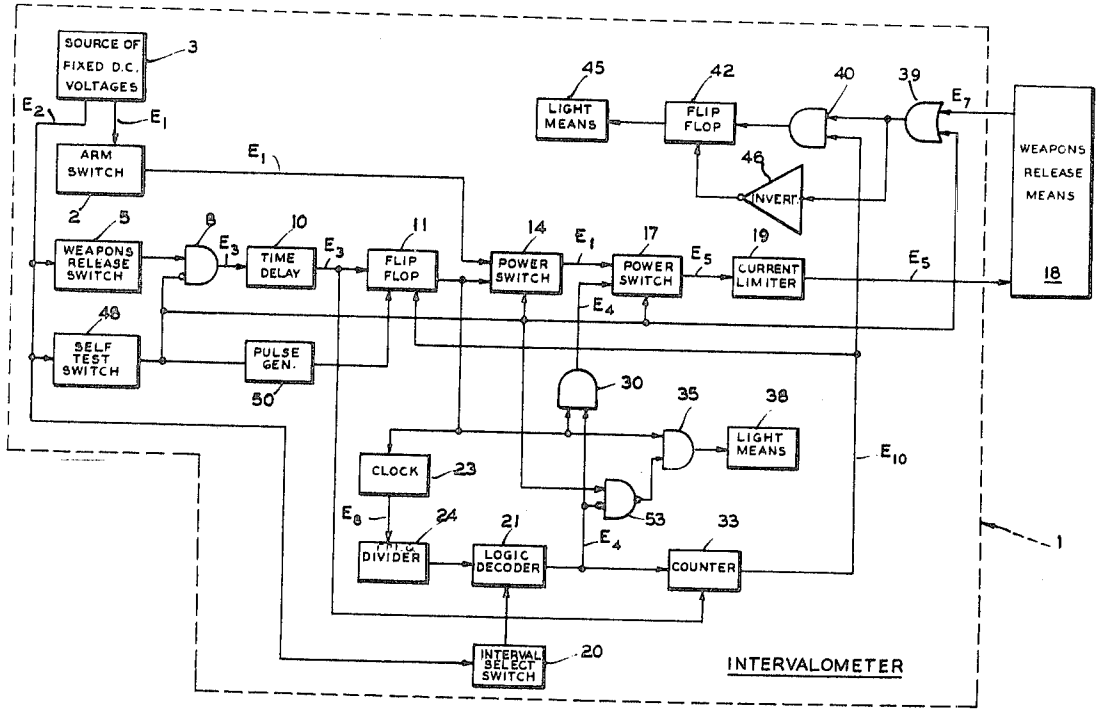
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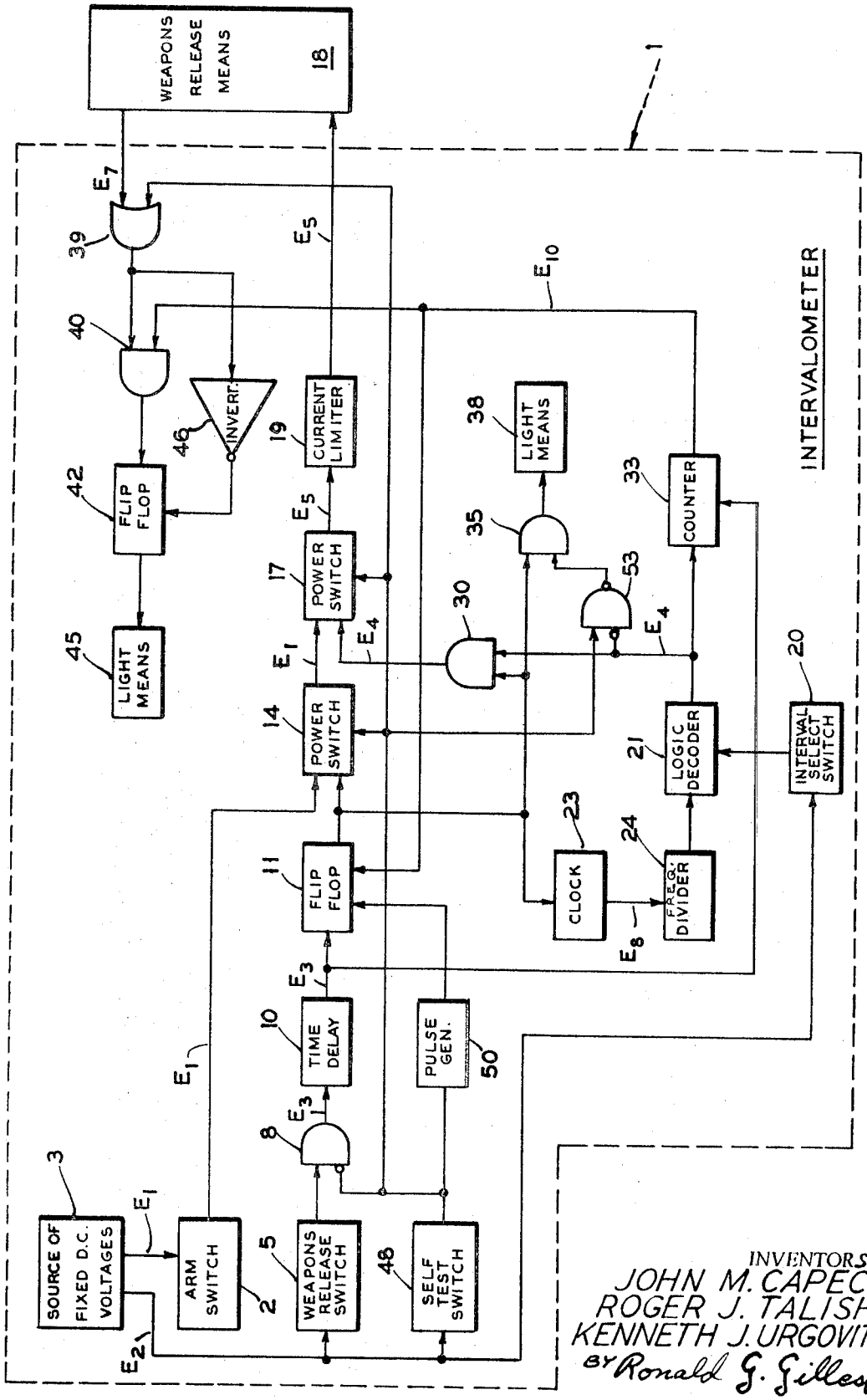
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ABSTRACT: An intervalometer in which a direct current voltage is modulated to provide a release pulse train to object release means, each pulse releasing an object, which may be a weapon such as a bomb, or a similar type of weapon. The intervalometer includes a time interval select circuit for controlling the time interval between object releases and providing a control pulse train output. A start release sequence circuit, when manually activated, modulates the direct current voltage in accordance with the control pulse train to provide the release pulse train.

The intervalometer also includes a circuit for self-testing the intervalometer and indicators for indicating that a release sequence is occurring and for indicating a failure to release an object.





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ADJUSTABLE INTERVALOMETER INCLUDING SELF-TESTING MEANS

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to an intervalometer for controlling the time interval between weapon releases by a weapon release system.

2. Description of the Prior Art

Heretofore, intervalometers use electromechanical devices to provide a release signal for releasing weapons and do not have a self-test capability. The present invention uses a solid state power switch to provide the release signal and has a built-in self-test capability and indicators for indicating that a weapon release sequence is occurring and for indicating a failure to release a weapon when the weapon release sequence is completed.

SUMMARY OF THE INVENTION

An intervalometer for controlling means for releasing objects comprising means connected to the releasing means for providing a pulse train to the releasing means. Each pulse in the pulse train causes an object to be released by the releasing means. Means connected to the pulse train means controls the time interval between object releases. Other means connected to the pulse train means and to the control means test the pulse train means and the control means.

One object of the present invention is to provide an intervalometer for controlling the releasing of objects in a sequence in which the time interval between releases may change.

Another object of the present invention is to provide an intervalometer having a self-test capability.

Another object of the present invention is to provide an intervalometer having indicators for indicating that the release sequence is being performed and for indicating failure to release an object.

Another object of the present invention is to provide an adjustable intervalometer having less size and greater accuracy than heretofore achieved.

The foregoing and other objects and advantages of the invention will appear more fully hereinafter from a consideration of the detailed description which follows, taken together with the accompanying drawing wherein one embodiment of the invention is illustrated by way of example. It is to be expressly understood, however, that the drawing is for illustration purposes only and is not to be construed as defining the limits of the invention.

DESCRIPTION OF THE DRAWING

The drawing shows a weapon release system having an adjustable intervalometer, constructed in accordance with the present invention, for controlling the release rate of weapons in the weapons release system.

DESCRIPTION OF THE INVENTION

Referring to the drawing, there is shown an intervalometer 1 for controlling the time interval between releasing of bombs, rockets, or similar weapons. Intervalometer 1 modulates a direct current voltage to provide a pulse train whose period corresponds to a selected time interval between weapon releases.

When used in a bomb release system in an aircraft, for example, a pilot of an aircraft activates an arm switch 2, which may be a conventional type on-off toggle switch, to pass a direct current voltage E_1 from a source 3 of fixed direct current voltages, as the aircraft approaches a target area, to arm the bomb release system.

A start release circuit in intervalometer 1 controls the start of the release sequence and includes serially connected weapons release switch 5, which may be a conventional type momentary "on" switch, and AND-gate 8, a time delay 10, a conventional-type flip-flop 11, and a solid state power switch 14. When bombing the target, the pilot activates the weapons release switch 5 to release the bombs at a preselected time interval. Switch 5 momentarily passes a direct current voltage E_2 from source 3 to provide a trigger pulse E_3 to flip-flop 11, through AND-gate 8 and time delay 10, causing flip-flop 11 to provide an output. AND-gate 8 blocks an erroneous output from switch 5 when intervalometer 1 is being self-tested as hereinafter explained. Time delay 10 provides noise immunization by delaying the trigger pulse from switch 5 so that flip-flop 11 is triggered only by a pulse from switch 5 and not by electrical noise.

Power switch 14 is enabled by the output from flip-flop 11 and passes the voltage E_1 from arm switch 2 to another solid state power switch 17 where it is modulated in accordance with a control pulse train E_4 to provide a pulse train E_5 to weapons release means 18 through a current limiter 19, which releases a bomb for each pulse in pulse train E_5 and provides a signal E_7 while there are unreleased bombs. Weapons release means 18 may be similar to the type shown in the U.S. Pat. No. 2,991,700 although it would require a modification that is obvious to one skilled in the art to provide signal E_7. Current limiter 19 limits the current flowing through switch 17 to protect switch 17 from damage due to excessive current.

A time interval release circuit determines the time interval between bomb releases and includes an interval select switch 20, which may be a conventional-type rotary-type switch, connected to source 3 and to a logic decoder 21, which is connected in series with flip-flop 11, a clock 23, and a divider 24. The pilot preselects the time interval by setting switch 20 to one of several positions corresponding to different time intervals, each position having a corresponding output. Each output of switch 20 is connected to logic decoder 21 and only one output of switch 20 provides voltage E_2 due to the setting of switch 20.

The output from flip-flop 11 causes clock 23 to provide timing pulses E_8 to frequency divider 24. Frequency divider 24, which may be a bank of flip-flops, divides timing pulses E_8 to provide a plurality of outputs to logic decoder 21, each output having a different pulse repetition rate. Logic decoder 21 includes a plurality of AND-gates (not shown), each AND gate receiving a different output from divider 24 and is connected to a different output of switch 20. Only one of the AND gates is enabled by the passed voltage E_2 from switch 20 to pass control pulse train E_4 having a repetition rate corresponding to the selected time interval.

Control pulse train E_4 from logic decoder 21 is applied to switch 17 through an AND-gate 30 which is enabled by the output from flip-flop 11. AND-gate 30 controls the application of the control pulse train E_4 in accordance with the state of flip-flop 11. When flip-flop 11 is not set by switch 5, AND-gate 30 blocks control pulse train E_4 to prevent any voltage accidentally applied to switch 17 from passing through switch 17 to cause the release of a bomb.

While the bombs are being released, the output from flip-flop 11 passes through an AND-gate 35 to light means 38 which lights to indicate that the bomb release sequence is being performed. AND-gate 35 controls the lighting of light means 38 and is continuously enabled during a bombing release sequence and is enabled, as hereinafter explained, when intervalometer 1 is being self-tested.

The bombs release sequence is terminated when a conventional-type counter 33, connected to logic decoder 21 and counting the pulses in the control pulse train E_4, reaches a predetermined count corresponding to the number of bombs to be released. Counter 33 provides an output E_{10} corresponding to the predetermined count to flip-flop 11 resetting it thereby disabling switch 14 and thus terminating the bomb release sequence. Counter 33 is reset at the start of each bomb release sequence by pulse E_3 from time delay 10.

Weapon release means 18 also provides signal E_7 through an OR-gate 39 to an AND-gate 40 and enables AND-gate 40. When there are bombs that have failed to release, output E_{10}

from counter 33 passes through enabled AND-gate 40 to trigger a conventional-type flip-flop 42 which provides an output to light means 45 causing light means 45 to light indicating that the bomb release sequence is over but there is still a bomb that has not been released. The pilot may then repeat the bomb release sequence by actuating switch 5.

Signal E_7, which is also applied to flip-flop 42 through OR-gate 39 and an inverter 46, is removed when all the bombs are released. The removal of signal E_7 clears flip-flop 42 thereby turning off light means 45.

The pilot may self-test intervalometer 1 to determine if the time interval between bomb releases correspond to the selected time interval and to determine if light means 45 will light if a bomb fails to release. The self-test circuit includes a self-test switch 48, a pulse generator 50 and a NAND-gate 53 having an inverting input. Switch 48 may be a conventional-type momentary "on" switch. The pilot holds switch 48 in the "on" position when performing self-test to pass voltage E_2 from source 3 to the inverting input of AND-gate 8, to switches 14 and 17, to pulse generator 50 and to AND-gate 40 through OR-gate 39. AND-gate 8 and switches 14, 17 are disabled by the passed voltage from switch 48 to prevent bombs being released during self-test. Pulse generator 50 provides a pulse in response to the passed voltage from switch 48 to flip-flop 11 causing flip-flop 11 to provide an enabling output to AND-gate 35 and to start clock 23 resulting in logic decoder 21 providing control pulse train E_4 as heretofore explained. Control pulse train E_4 is applied to an inverting input of NAND-gate 53 which is enabled by the voltage from switch 48, so that NAND-gate 53 effectively passes the control pulse train E_4 to light means 38 through enabled AND-gate 35. Light means 38 will blink on and off in response to control pulse train E_4. The pilot may then time the blinking of light means 38 to determine if the time interval between pulses corresponds to the selected time interval that switch 20 is set at.

At the end of control pulse train E_4, counter 33 provides output E_{10} to AND-gate 40, as heretofore explained. AND-gate 40 is enabled by the passed voltage from switch 48 and passes output E_{10} to flip-flop 42. Flip-flop 42 is set by output E_{10} causing light means 45 to light indicating its operability.

Output E_{10} from counter 33 resets flip-flop 11 ending the time interval self-test and when the pilot releases switch 48, the removal of the passed voltage from switch 48, which is applied through OR-gate 39 and inverter 46, clears flip-flop 42 turning off light means 45 to end the self-test of the unreleased bomb indicating circuit.

The present invention as heretofore described is not limited to airborne use but may be used with other systems; such as the firing of ground artillery, the releasing of torpedoes by a submarine, releasing of sonobuoys for detecting submarines; which use a release sequence.

The present invention as heretofore described provides a pulse train having a predetermined number of pulses and having a variable repetition rate. The present invention further provides an intervalometer for controlling the releasing of objects in a sequence, in which the time interval between releases may be changed, and having a self-test capability and indicators for indicating that the release sequence is being performed and for indicating failure to release an object.

Although but a single embodiment of the invention has been illustrated and described in detail, it is to be expressly understood that the invention is not limited thereto. Various changes may also be made in the design and arrangement of the parts without departing from the spirit and scope of the invention as the same will now be understood by those skilled in the art.

I claim:

1. An intervalometer for controlling release of weapons, comprising:

means for providing a pulse train including manually operable switching means for passing a constant level signal and other manually operable switching means connected to the first mentioned switching means for passing and blocking the constant level signal to respectively start and stop the pulse train;

weapons release means connected to the pulse train means and responsive to each of the pulses in the train provided thereby for releasing a weapon;

control means for controlling the interval between weapons releases and including means for providing control pulse trains, each pulse train having a different interval between pulses, and means connected to the control pulse train means for manually selecting a pulse train having a desired pulse interval;

means connected to the other switching means in the pulse train means, to the weapons release means and to the control means for modulating the constant level signal passed by said switching means to apply the pulse train from the pulse train means to the releasing means in accordance with the control pulse train; and

means connected to the pulse train means and to the control means for testing both of said means to determine if the actual pulse interval corresponds to the desired pulse interval.

2. An intervalometer as described by claim 1, including:

the release means providing a signal while there are weapons remaining to be released;

the pulse train means providing a signal at the end of a pulse train;

means for indicating the operative status of the pulse train means and the release means, said indicating means having switching means connected to the release means and to the pulse train means for providing a signal in response to the signals from both of said means, and display means connected to the switching means and responsive to the signal therefrom for providing a display indicating that the pulse train has terminated and there is still a weapon to be released; and

the switching means in the indicating means having a flip-flop, an AND gate connecting one input of the flip-flop to the release means and to the pulse train means and passing the signal from the pulse train means to the flip-flop when the signal from the release means is present to cause the flip-flop to provide a signal to the display means, and blocking the signal from the pulse train means when the signal from the release means is absent, and an inverter connecting another input of the flip-flop to the release means so that the termination of the signal from the release means causes the flip-flop to remove the signal applied to the display means.

3. An intervalometer of the kind described in claim 1 in which the other switching means includes a switch for momentarily passing a direct current signal in response to manual operation thereof, a counter connected to the control means for counting the number of pulses in the selected control pulse train and providing an output when the number of pulses equals the number of weapons to be released, another switch connected to the modulating means and controlled by a command signal to pass the direct current signal to the modulating means, and a flip-flop connected to the momentary switch and to the counter and responsive to the direct current signal from the momentary switch for providing the command signal to start the pulse train and responsive to the output from the counter for removing the command signal to stop the pulse train after the weapons have been released.

4. An intervalometer of the kind described in claim 3 further comprising time delay means for delaying the signal from the momentary switch to provide noise immunization.

5. An intervalometer of the kind described in claim 1 in which the control means includes a source connected to the pulse train means and controlled by the pulse train means to provide timing pulses, and means for dividing the timing pulses to provide the different control pulse trains.

6. An intervalometer of the kind described in claim 5 in which the test means includes manually operative switching means for passing a signal, means connected to the switching

means for disabling the pulse train means in response to a passed signal so as to prevent the application of a pulse train to the release means during test, and means connected to the switching means and to the control means and controlled by the passed signal from the switching means for indicating the occurrence of pulses in the control pulse train so that the time interval between pulses can be determined.

7. An intervalometer of the kind described in claim 6 in which the pulse indicating means includes second switching means connected to the first mentioned switching means and responsive to a passed signal from the first mentioned switching means for passing the control pulse train from the control means and blocking the control pulse train during an absence of a passed signal from the first mentioned switching means, and a light responsive to the passed control pulse train from the second switching means for indicating the pulses in the passed control pulse train.

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