United States Patent

Ziemba

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[54] CONTROLLED RANGE PROXIMITY FUZE

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[58] **Field of Search** ..... 102/70.2 R, 70.2 P

[56] **References Cited**

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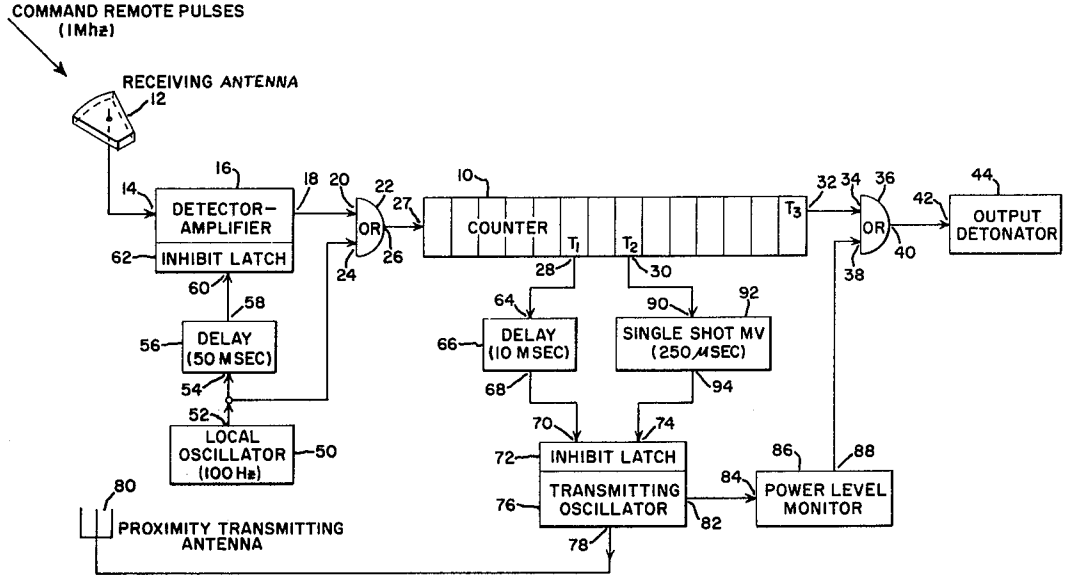
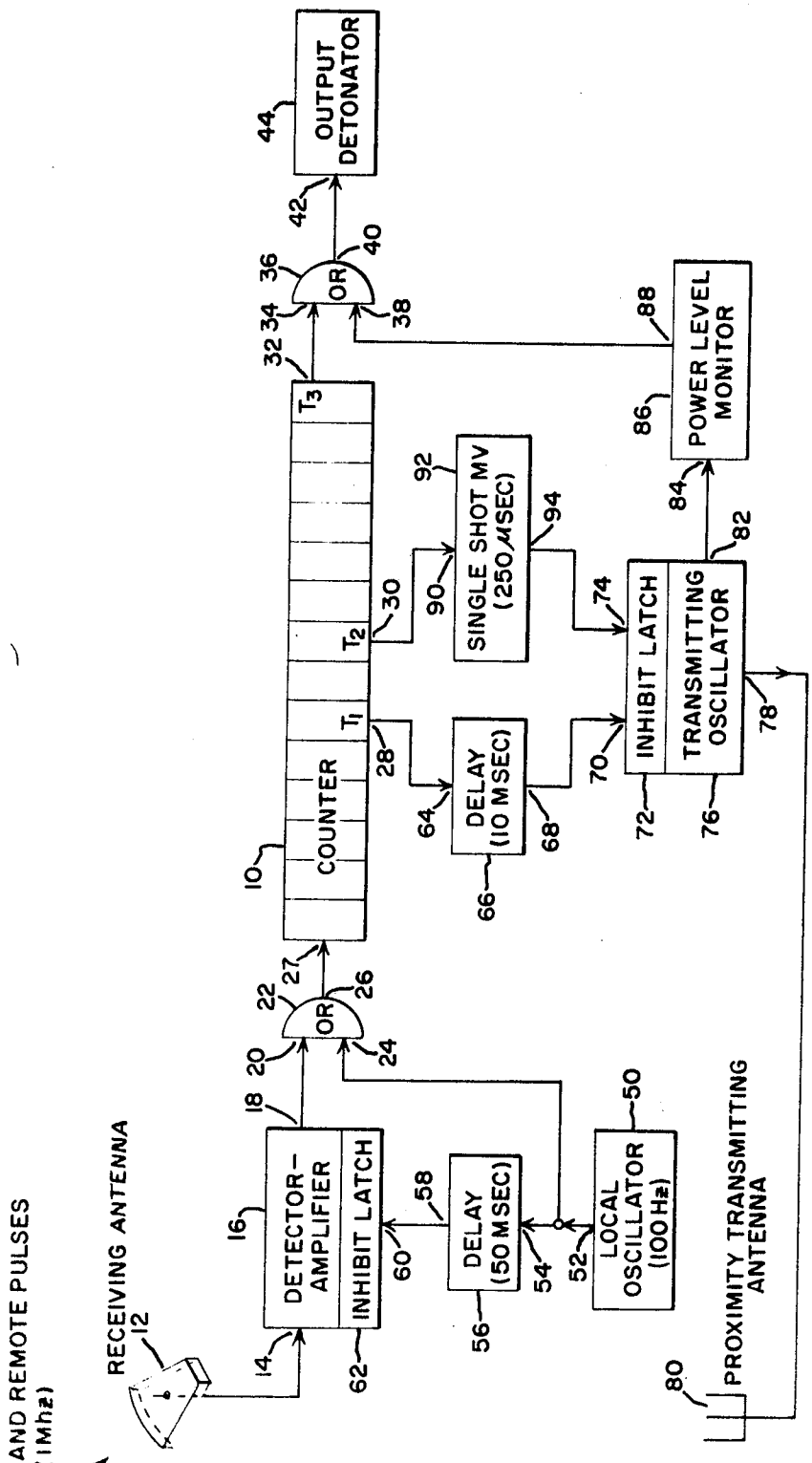
[57] **ABSTRACT**

An electronic, digital time fuze has a counter which also serves as a serial programmer and which may be remotely preset while in flight to enable a proximity detector circuit at a first predetermined range, and to self detonate the fuze, if not sooner detonated by the proximity detector circuit, at a second predetermined range.

5 Claims, 1 Drawing Figure





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CONTROLLED RANGE PROXIMITY FUZE

BACKGROUND OF THE INVENTION

1. Field of Art

This invention relates generally to fuze actuating systems, and especially to systems having an inflight variable range adjustment.

2. Prior Art

In my earlier application, Ser. No. 843,478, filed July 22, 1969, there is shown an electronic, digital time fuze, whose time base is introduced over a radar command link at a rate which is inversely proportional to the desired projectile flight time. A target following ranging device, such as a ranging laser, provides target range information to a pulsed radar transmitter. The range signal from the ranging device controls a variable pulse rate control unit which in turn adjusts the transmitter pulse rate to a value which is inversely proportional to the target range. The transmitter is fixed to the weapon system and radiates in the direction of the projectile flight path. Each projectile includes a fuze actuating circuit consisting of an antenna, an r.f. detector, a fixed-set counter and a firing circuit. At launch, the fuze actuating circuit within each projectile becomes activated a short distance after departure from the gun muzzle. As the projectile travels towards its target it receives a series of r.f. pulses at a rate which will just fill the counter when the projectile is at the proper range. The counter within the fuze counts the pulses received during its flight to target. When the final count has been accumulated, the firing circuit detonates the payload. Once the rate at which pulses are to be generated is set, as a function of range, each projectile must travel the same time, and the same range, before it accumulates the same final count. Thus, by adjusting the pulse rate frequency of the transmitter, the gunner adjusts the range at which the payload is detonated.

BRIEF SUMMARY OF THE INVENTION

It is an object of this invention to provide an improved system of the type shown in Ser. No. 843,468 which may not only be used as a controlled range detonating fuze, but alternatively, as a true proximity fuze which is enabled at a controlled range and which if not sooner detonated, is self destructed, at a greater controlled range.

A feature of this invention is an electronic, digital time fuze having a counter which also serves as a serial programmer and which may be remotely preset while in flight to enable a proximity detector circuit at a first predetermined range, and to self detonate the fuze, if not sooner detonated by the proximity detector circuit, at a second predetermined range.

BRIEF DESCRIPTION OF THE DRAWING

These and other objects, features and advantages of the invention will be apparent from the following specification thereof taken in conjunction with the accompanying drawing in which:

The FIGURE is a block diagram of the electronic circuitry of a controlled range enabled proximity fuze embodying this invention.

THE PREFERRED EMBODIMENT

A fuze embodying this invention is designed around a counter **10** having a plurality of outputs at respective predetermined counts, and thereby serving as a serial programmer. The counter may be mechanized as a series of bistable flip-flops with appropriate decoding gates. To permit the counter to be remotely pulsed by a radar command link after the round has been launched from the gun, the fuze is provided with antenna receiving slots **12** which are coupled to the signal input terminal **14** of a detector-amplifier circuit **16** having a signal output terminal **18**. The terminal **18** is coupled to a first signal input terminal **20** of an OR gate **22** having a second signal input terminal **24** and an output signal terminal **26**. The terminal **26** is coupled to the input terminal **27** of the counter **10** which has a first, intermediate count, output terminal **28**, a second, intermediate count, output terminal **30**, and a third, full count, output terminal **32**. The terminal **32** is coupled to a first signal input terminal **34** of an OR gate **36** which has a second signal input terminal **38** and a signal output terminal **40**. The terminal **40** is coupled to a signal input terminal **42** of a firing or output-detonator circuit **44**.

A local oscillator **50** has a pulse output terminal **52** coupled to the input terminal **54** of a first pulse delay network **56** having an output terminal **58**. The terminal **58** is coupled to the inhibit terminal **60** of a first inhibit latching circuit **62** which is coupled to the detector-amplifier **16**. The terminal **52** is also coupled to the second signal input terminal **24** of the OR gate **22**.

The first, intermediate count, output terminal **28** of the counter **10** is coupled to the input terminal **64** of a second pulse delay network **66** having an output terminal **68** which is coupled to the enable input terminal **70** of a second inhibit latching circuit **72** having an inhibit input terminal **74**. The circuit **72** is coupled to a transmitting oscillator **76** having a pulse output terminal **78** coupled to a transmitting antenna **80**, which may be of the helical type. The oscillator **76** also has a power level monitoring terminal **82** which is coupled to an input terminal **84** of a power level monitoring circuit **86** having an output terminal **88** providing an output signal in response to a low power level, e.g. a loaded transmitter. The terminal **88** is coupled to the second input terminal **38** of the OR gate **36**.

The second, intermediate count, output terminal **30** is coupled to the input terminal **90** of a single shot multivibrator **92** having an output terminal **94** coupled to the inhibit input terminal **74** of the inhibit latch circuit **72**.

A power source, not shown, is coupled to the various active circuits as required. This power source may be provided by a high rate of rise thermal battery; or by a piezoelectric source coupled to the detector-amplifier **16**, local oscillator **52** and counter **10** for instantaneously available low power, and by a thermal battery coupled to the transmitting oscillator **76** and firing circuit **44** for delayed high power. The counter may be of the type that assumes the reset state upon the application of power thereto. Alternatively, a reset circuit, such as shown by Robert A. Leightner in Ser. No. 843,625, filed July 22, 1969, and assigned to a common assignee, may be coupled to the counter to coerce the counter to its reset state on energization.

Immediately after the projectile is launched from the weapon, e.g. within 50 milliseconds, a burst of r.f. pulses is transmitted to the fuze in the traveling projectile from a low power, high frequency, e.g. 1 Mhz., transmitter adjacent the weapon. These pulses are re received by the fuze via a plurality of slot antennas **12** disposed in the ogive of the projectile fuze. These pulses are rectified in the detector/amplifier circuit **16** and fed via the OR gate **22** to the input of the binary counter **10**. The binary counter **10** has a second input from the local oscillator **50** within the fuze. This oscillator may operate at 100 H_z, and is enabled at the launching of the projectile, and continues to function throughout the flight of the projectile. The local oscillator is also coupled to the detector inhibit latching circuit **62**, via the **50** millisecond delay unit **56**. At approximately 100 milliseconds after projectile launch, the first pulse generated by the local oscillator arrives at the detector inhibit latching circuit to effect the disabling of the detector. The receiving circuit is thus disabled for the remainder of the flight of the projectile, precluding electronic counter-measures from effecting the fuze. The counter is a multi-stage, serial, binary logic device, with appropriate decoding gates, whose final output initiates the detonator circuit **44** to detonate the projectile warhead.

The fuze is designed to function in two alternative modes, i.e., either as an electronic time fuze, or as a proximity fuze. The mode may be selected remotely.

To function the fuze in the proximity mode, r.f. pulses are initially transmitted in a burst to the fuze immediately after

launch, as described previously. However, the quantity of pulses so transmitted is only sufficient to provide an output pulse T_1 at the first output terminal **28** at approximately 1 second before ground impact, when taken in conjunction with the pulses provided by the local oscillator **50** at a fixed rate, e.g. 100 pps, during the flight. The T_1 pulse is delayed a few milliseconds, e.g. 10 milliseconds, after which it enables the proximity transmitting oscillator **76** which feeds the transmitting antenna **50**. An output pulse T_2 at the second output terminal **30**, which may be programmed to occur approximately 1 second after T_1, will trigger the single shot multibrater **92** to latch the proximity oscillator into a permanently disabled condition. The presence of a target, ground or aircraft, in the near field of the antenna, will load the transmitting oscillator **76**, reducing its output power level, which will be detected by the monitor **86** which will trigger the fuze detonate circuit **44**. Meanwhile the local oscillator continues to advance the counter, and in the event the monitor has not already triggered the detonator, the provision of an output pulse T_3 at the final output terminal **32** will trigger the detonate circuit **44**.

To function the fuze in the time mode, r.f. pulses are initially transmitted in a burst to the fuze immediately after launch. Sufficient r.f. pulses at 1 Mhz. are provided to fill the counter beyond the output terminals **28** and **30**. Since the T_1 pulse which is one microsecond wide, is delayed 10 milliseconds en route to the proximity transmitting oscillator **76**, the T_2 pulse will arrive to trigger the single shot multiplier to generate a 250 microsecond wide pulse to latch the oscillator off before the T_1 pulse arrives to start it, and which wide pulse extends after the termination of the delayed T_1 pulse, thereby precluding the transmitting oscillator from generating any pulses. The local oscillator **50** starts up and pulses the counter until it is filled to provide a T_3 pulse at the final output terminal to trigger the detonate circuit **44**.

While there has been shown and described a preferred embodiment of this invention, it will be appreciated that the invention may be embodied otherwise than as herein specifically illustrated or described, and that certain changes in the form and arrangement of parts and in the specific manner of practicing the invention may be made without departing from the underlying idea or principles of this invention within the scope of the appended claims.

What is claimed is:

1. A fuze for a projectile, comprising:

a counter including

an input terminal,

first output terminal for providing a first output signal at a first count, and

a final output terminal for providing a final output signal at a final count greater than said first count;

a circuit for receiving pulses from an outside source, including

a receiving antenna,

an r.f. detector having an input terminal coupled to said receiving antenna and an output terminal coupled to said counter input terminal for providing pulses thereto;

a local oscillator circuit having an output terminal coupled to said receiving circuit for providing a pulse thereto precluding the subsequent provision of pulses from said receiving circuit to said counter input terminal and also coupled to said counter input terminal for providing pulses thereto;

a proximity circuit, including:

a transmitting antenna,

a transmitting oscillator having an output terminal coupled to said transmitting antenna for providing energy thereto, and an input terminal coupled to said counter first terminal for enabling the provision of energy by said transmitting oscillator to said transmitting antenna at and subsequent to said first count, and

means for detecting the presence of a target in the near field of said transmitting antenna when said antenna is energized by said transmitting oscillator and having an output terminal for providing a signal in response to such detection; and

an output function circuit, including

a first input terminal coupled to said counter final output terminal for providing an output function at the final count, and

a second input terminal coupled to said proximity detecting means output terminal for providing an output function in response to the detection of the presence of a target in the near field of said transmitting antenna.

2. A fuze according to claim **1**, wherein

said counter further includes

a second output terminal for providing a second output signal at a second count, which second count is greater than said first count and smaller than said final count; and

said proximity circuit further includes

latchable means, for inhibiting the functioning of said proximity circuit, having an input terminal coupled to said counter second output terminal, thereby precluding the provision of a signal in response to the presence of a target in the near field of said transmitting antenna at and subsequent to said second count.

3. A dual alternative function fuze, for proximity or controlled range detonation, comprising:

a counter including

an input terminal,

a first output terminal for providing a first output signal at a first count,

a second output terminal for providing a second output signal at a second count, which second count is greater than said first count, and

a final output terminal for providing a final output signal at a final count, which final count is greater than said second count;

a circuit for receiving pulses from an outside source, including

a receiving antenna

an r.f. detector having an input terminal coupled to said receiving antenna and an output terminal coupled to said counter input terminal for providing pulses thereto;

first latchable means, normally disabled, for inhibiting the functioning of said receiving circuit, having an input terminal,

a local oscillator circuit having an output terminal coupled to said first latchable means for providing a pulse thereto for precluding the subsequent provision of pulses from said receiving circuit to said counter input terminal, and also coupled to said counter input terminal for providing pulses thereto;

a proximity circuit, including

a transmitting antenna,

a delay means,

a transmitting oscillator having an output terminal coupled to said transmitting antenna for providing energy thereto, and an input terminal coupled via said delay means to said counter first terminal for enabling the provision of energy by said transmitting oscillator to said transmitting antenna at a fixed time subsequent to said first count,

means for detecting the presence of a target in the near field of said transmitting antenna when said antenna is energized by said transmitting oscillator, and having an output terminal for providing a signal in response to such detection, and

latchable means for inhibiting the functioning of said proximity circuit, having an input terminal coupled to said counter second output terminal for precluding the provision of a signal in response to the presence of a target in the near field of said transmitting antenna at and subsequent to said second count;

an output function circuit, including
a first input terminal coupled to said counter final output terminal for providing an output function at the final count, and
a second input terminal coupled to said proximity detecting means output terminal for providing an output function in response to the detection of the presence of a target in the near field of said transmitting antenna;
whereby if said pulses provided by said r.f. detector run the count in said counter up to or beyond said second count before said first count signal, as delayed said fixed time, enables said transmitting oscillator, said fuze will omit any proximity function, and output function will be provided by said final count signal; but, if said pulses provided by said r.f. detector run the count not up to said second count before said first count signal, as delayed said fixed time, enables said transmitting oscillator, then said fuze will provide a proximity function, and output function will be provided by the first to occur of target detection and signal and final count signal.

4. A weapons system comprising:
an r.f. pulse transmitter having a transmitting antenna; and
a projectile having a dual, alternative function fuze, for proximity or controlled range detonation, comprising:
a counter including
an input terminal,
a first output terminal for providing a first output signal at a first count,
a second output terminal for providing a second output signal at a second count, which second count is greater than said first count, and
a final output terminal for providing a final output signal at a final count, which final count is greater than said second count;
a circuit for receiving pulses from an outside source, including
a receiving antenna,
an r.f. detector having an output terminal coupled to said receiving antenna and an output terminal coupled to said counter input terminal for providing pulses thereto;
first latchable means, normally disabled for inhibiting the functioning of said receiving circuit, having an input terminal,
a local oscillator circuit having an output terminal coupled to said first latchable means for providing a pulse thereto for precluding the subsequent provision of pulses from said receiving circuit to said counter input terminal, and also coupled to said counter input terminal for providing pulses thereto;
a proximity circuit, including
a transmitting antenna,
a delay means,
a transmitting oscillator having an output terminal coupled to said transmitting antenna for providing energy thereto, and an input terminal coupled via said delay means to said counter first terminal for enabling the provision of energy by said transmitting oscillator to said transmitter antenna at a fixed time subsequent to said first count,
means for detecting the presence of a target in the near field of said transmitting antenna when said antenna is energized by said transmitting oscillator, and having an output terminal for providing a signal in response to such detection, and
latchable means for inhibiting the functioning of said proximity circuit, having an input terminal coupled to said counter second output terminal for precluding the provision of a signal in response to the presence of a target in the near field of said transmitting antenna at and subsequent to said second count;
an output function circuit, including
a first input terminal coupled to said counter final output terminal for providing an output function at the final count, and
a second input terminal coupled to said proximity detecting means output terminal for providing an output function in response to the detection of the presence of a target in the near field of said transmitting antenna;
whereby if said pulses provided by said r.f. detector run the count in said counter up to or beyond said second count before said first count signal, as delayed said fixed time, enables said transmitting oscillator, said fuze will omit any proximity function, and output function will be provided by said final count signal; but, if said pulses provided by said r.f. detector run the count not up to said second count before said first count signal, as delayed said fixed time, enables said transmitting oscillator, then said fuze will provide a proximity function, and output function will be provided by the first to occur of target detection and signal and final count signal.

5. A fuze for a projectile, comprising:
a counter including
an input terminal,
first output terminal for providing a first output signal at a first count, and
a final output terminal for providing a final output signal at a final count greater than said first count;
a circuit for receiving pulses from an outside source, including
a receiving antenna,
a r.f. detector having an input terminal coupled to said receiving antenna and an output terminal coupled to said counter input terminal for providing pulses thereto;
a local oscillator circuit having an output terminal coupled to said receiving circuit for providing a pulse thereto precluding the subsequent provision of pulses from said receiving circuit to said counter input terminal and also coupled to said counter input terminal for providing pulses thereto;
an output function circuit, including
a first input terminal coupled to said counter final output terminal for providing an output function at the final count.

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