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Stout et al.

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[54] **GUN LAUNCHED, DIGITAL, VARIABLE TIME FUZE**

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[73] Assignee: **The United States of America as represented by the Secretary of the Navy,** Washington, D.C.

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[52] **U.S. Cl.** ..... **102/70.2 R,** 174/68.5, 102/70.2 P

[51] **Int. Cl.** ... **F42c 13/00,** F42c 11/06, F42c 19/06

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

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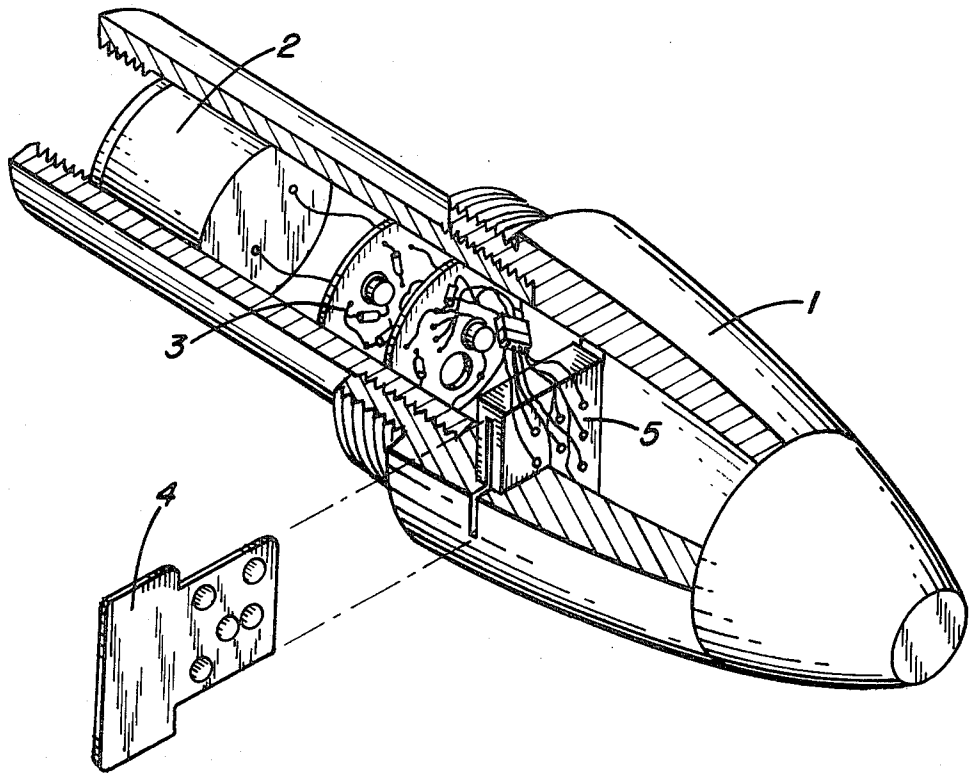
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[57] **ABSTRACT**

A variable time fuze for a gun launched projectile comprises a digital electronic counter which is preset by insertion of a coded key into a slot within which are spring loaded contacts. The number which is preset in the counter depends on the pattern of conductive and non-conductive areas inscribed on the key. A clock circuit provides pulses to the counter which initiates a squib-firing network when the preset number is reached. Time delay circuits are provided to prevent accidental firing of the squib, to strobe the preset number into the counter and to allow the counter to stabilize before application of the clock pulses.

5 Claims, 5 Drawing Figures



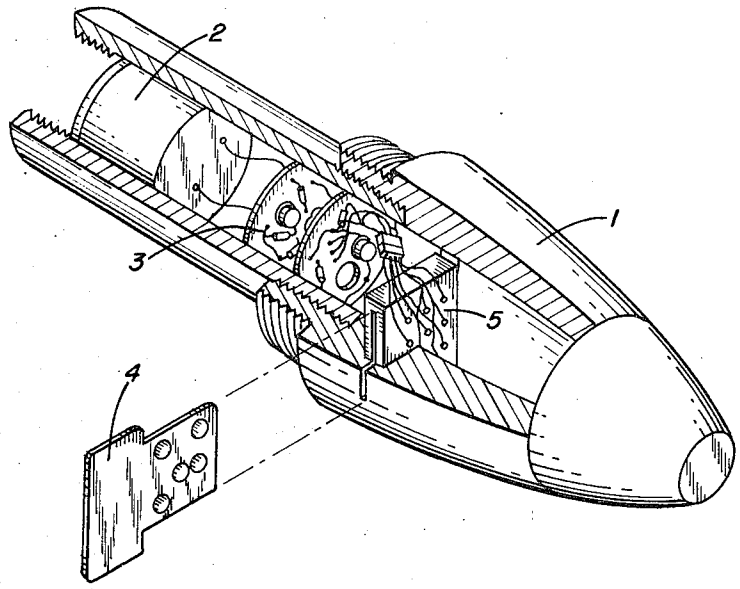

2
1
3
5
4

FIG. 1

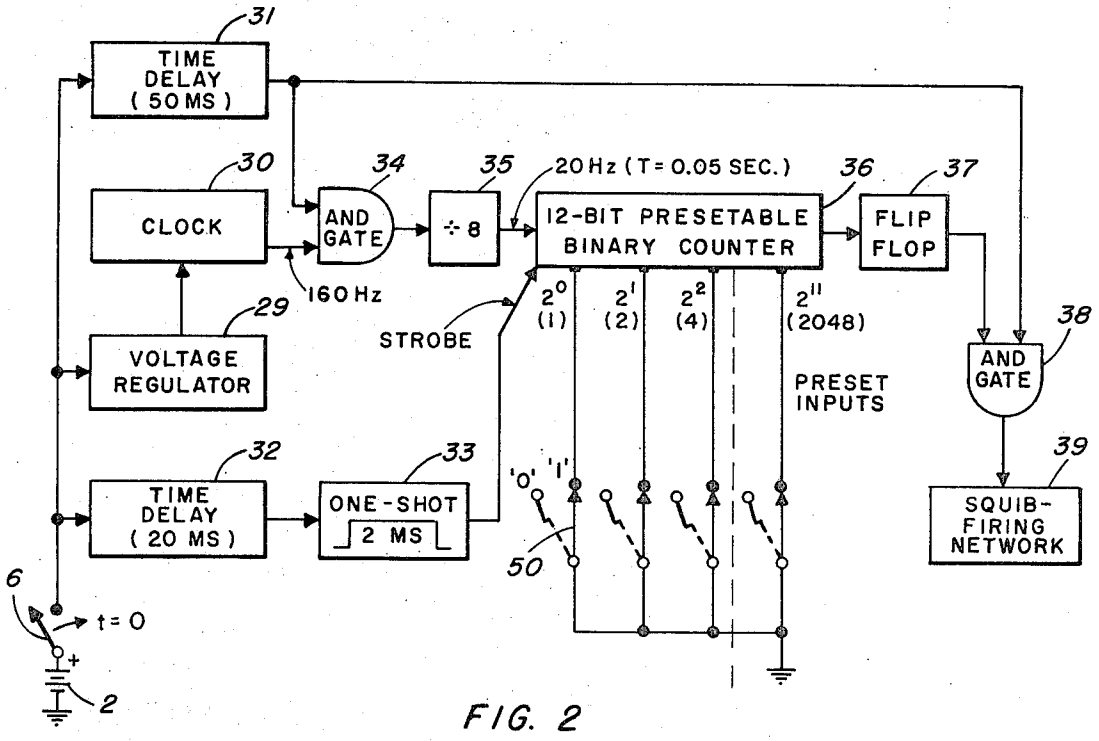

31
TIME DELAY (50 MS)
30
CLOCK
34
AND GATE
35
÷ 8
20 Hz (T = 0.05 SEC.)
36
12-BIT PRESETABLE BINARY COUNTER
37
FLIP FLOP
160 Hz
29
VOLTAGE REGULATOR
STROBE
2^0 (1)
2^1 (2)
2^2 (4)
2^{11} (2048)
PRESET INPUTS
38
AND GATE
39
SQUIB-FIRING NETWORK
32
TIME DELAY (20 MS)
33
ONE-SHOT 2 MS
'0' '1'
50
6
t = 0
2

FIG. 2

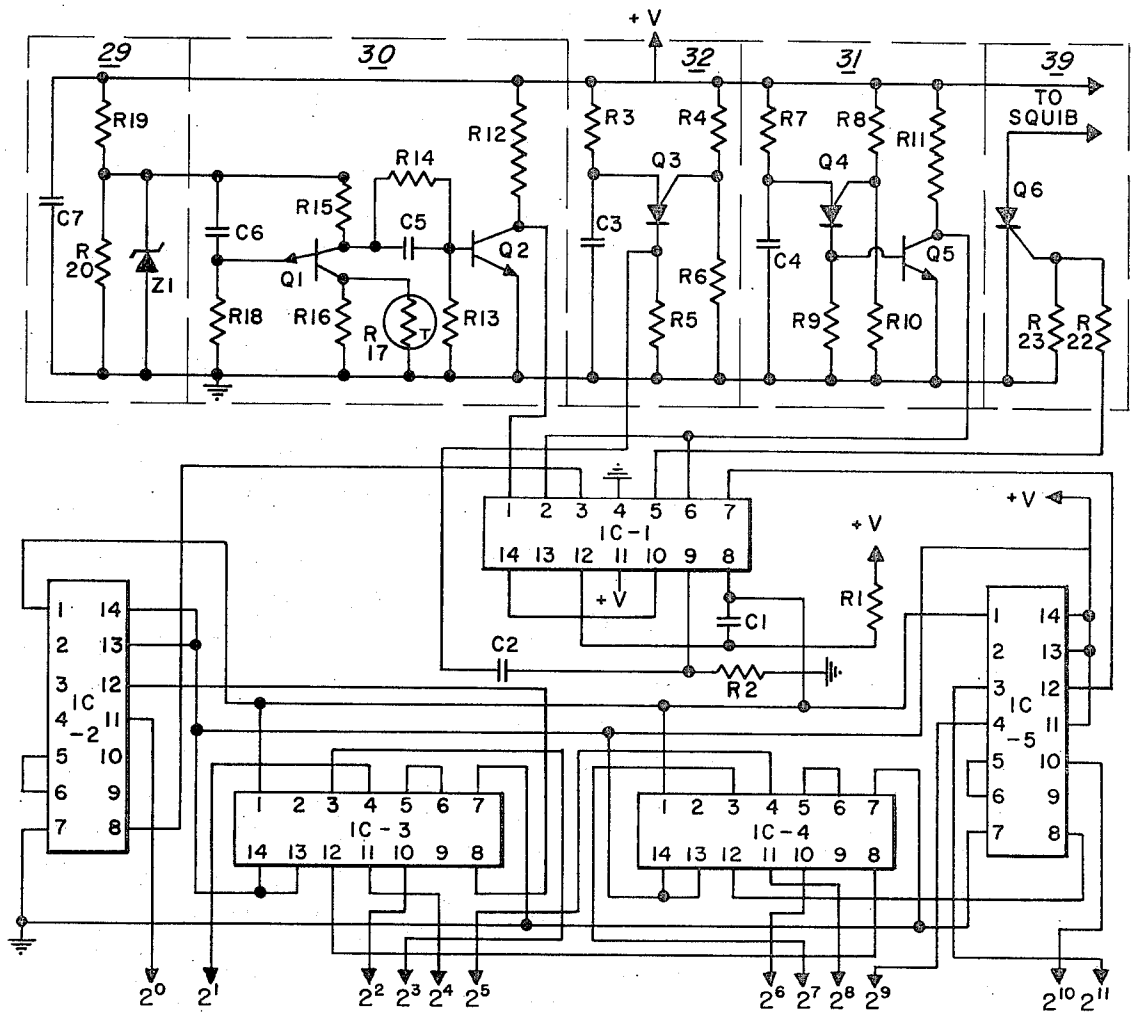


FIG. 3

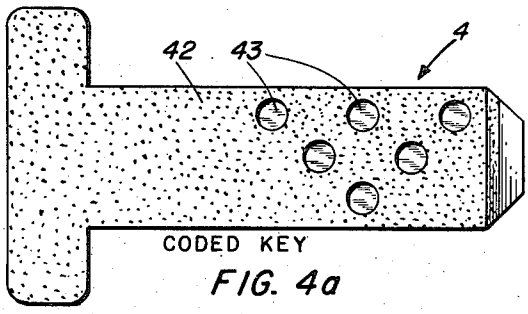


FIG. 4a

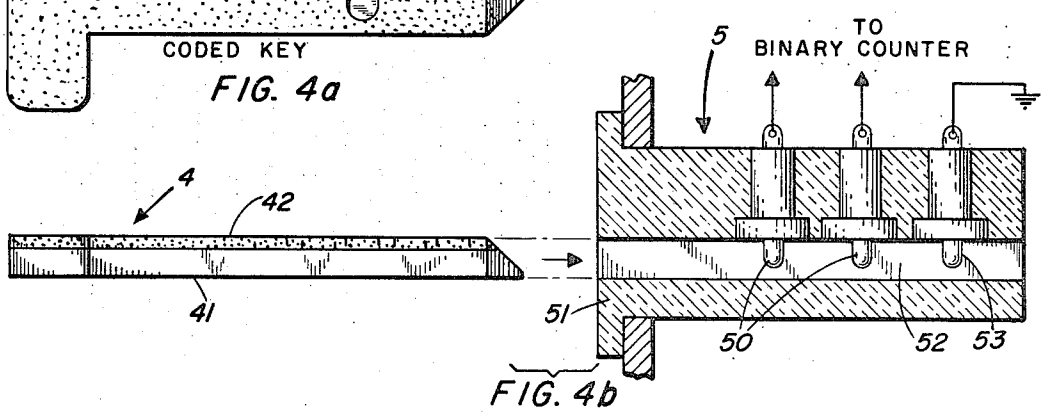


FIG. 4b

GUN LAUNCHED, DIGITAL, VARIABLE TIME FUZE

STATEMENT OF GOVERNMENT INTEREST

The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

BACKGROUND OF THE INVENTION

The invention relates generally to a time fuze for a projectile and more particularly to a variable time fuze that actuates a squib after elapse of a predetermined time from the launch of the projectile.

Variable time fuzes of the prior art rely upon mechanical and/or electrical analog timing mechanisms for fuze initiations. In order to set the time delay into the projectile it is necessary to adjust a dial on the round. In the case of an electrical analog device, the dial sets a potentiometer which is part of the electrical circuit. In the case of a mechanical device, the dial sets a spring or some other mechanical actuator. The setting resolution of such dials is poor. In addition, in an operational situation where, upon the receipt of information relating to target distance, an operator must hurriedly set the dial prior to firing the projectile, it is obviously difficult to attain a high degree of accuracy in the setting. Accuracy is also reduced due to the susceptibility of analog devices to temperature variations and, in mechanical devices, to vibrations. When used with automatic fuze setters, mechanical alignment, fuze shape and dimensional tolerances all affect setting accuracy. In the case of a different shaped round and fuze, a new fuze setter must be designed to set the new fuze.

When setting automatic fuzes, the danger of accidental firing exists. Safety devices of the prior art are either complex, unreliable or both.

SUMMARY OF THE INVENTION

The present invention is based on the use of a coded key to input the desired time information into a digital counter which then counts pulses received from a clock. Time delay circuits are provided to isolate the power supply from the counter and from the squib for a period after launch of the projectile. The use of a digital counter and a coded key provides extremely high resolution, accuracy, versatility and reliability. The setting resolution of the desired time is limited only by the clock rate and counter register size. Time range can be doubled for the same resolution by adding just one bit. Resolution can be halved for a fixed time range by adding just one bit. The system does not depend on the geometry of the shell or fuze to accept time information. Only axial and angular reference on the projectile need to be established for insertion of the key. Simple but effective time delay circuits isolate the power supply from the squib network for a short period after launch and increase accuracy of the counter by allowing it to stabilize before the clock pulses are applied.

From an overall operational standpoint, the instant invention provides a significant improvement over the prior art. The use of coded keys to input information to the projectile allows an operational system to be employed in which multiple keys are coded and stored in proximity to the projectile. Upon receipt of the time setting information, the operator can immediately select the proper key and insert it into the projectile. The increase in time resolution and accuracy resulting from this procedure is apparent. An alternative procedure would consist of connecting the digital fire control computer associated with the projectile mount (such as the MARK 45) directly to the key making device. Upon receipt of the time information the computer automatically causes the key making device to inscribe the proper code on the key which is then inserted into the projectile.

OBJECTS OF THE INVENTION

An object of the present invention is to provide a reliable, versatile and accurate time fuze for a projectile.

Another object of the invention is to provide a time fuze system for a projectile which permits the input of time information of high resolution into the projectile in a manner both fast and accurate.

A further object of the invention is to provide a time fuze for a projectile having simple and reliable safety features.

Other objects, advantages and novel features of the present invention will become apparent from the following detailed description of the invention when considered in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a diagram of the head of a projectile embodying the principles of the invention.

FIG. **2** is a block diagram of the electrical circuitry of the preferred embodiment.

FIG. **3** shows the circuit of FIG. **2** in schematic form.

FIGS. **4***a* and *b* show an embodiment of the coded key and slot arrangement.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

In FIG. **1**, the arrangement of components in the head portion **1** of a projectile is shown. The components comprise a setback initiated power source **2**, electronic timer circuit **3**, coded key **4** and key operated contact mechanism **5**.

In FIG. **2**, a block diagram of the electronic timer circuit **3** is shown. Upon launch of the projectile, a setback initiated switch **6**, such as a G-switch, is closed connecting power source **2** directly to time delay circuits **31** and **32** and to clock **30** via voltage regulator **29**. After 20 milliseconds, time delay **32** allows the power source to be applied to one-shot multivibrator **33** which produces a 2 millisecond pulse. The pulse is applied to binary counter **36** and thereby strobes the binary preset number into the counter. After 50 milliseconds, time delay **31** applies power to AND gates **34** and **38**. The time delay circuit **31** in conjunction with AND gate **38** prevents transients or other accidentally generated signals from triggering the squib network during the 50 milliseconds, thereby providing an effective and simple safety device. The 50 millisecond delay, in conjunction with AND gate **34**, allows the counter to stabilize, after the code is strobed in, before clock pulses are applied. This allows the clock to frequency stabilize before its output pulses are utilized. In this embodiment a clock frequency of 160 HZ is utilized.

When AND gate **34** is connected to the source through circuit **31**, the clock pulses are passed through the gate to frequency divider **35** which provides division by eight and outputs pulses at 20 HZ to the counter. The counter of the embodiment is a **12** bit binary counter. Therefore, the maximum number of pulses it can count is 4,096. The counter begins counting the pulses and upon reaching a count of 4,096 less the preset number, flip-flop **37** is toggled. The change in the output of the flip-flop closes the AND gate **38** thereby applying power to squib firing network **39.**

The number to be preset into the counter is determined by subtracting the number of pulses representing the desired time from the maximum count of the counter. For example, the disclosed embodiment uses a 12 bit counter which has a maximum count of 2^{12} or 4,096. If the the desired time is 100 seconds, then 2,000 pulses must be counted before triggering of the fuze. That is, 20 pulses per second multiplied by 100 seconds. The number be preset in the counter is then 4096 less 2,000, i.e., 2096. With the number 2096 preset into the counter, it will require 2000 pulses (100 seconds) for the counter to reach it full count of 4096. The preset number is determined by the positions of switches **50.**

The disclosed embodiment has a time range of 0.05 to 204.8 seconds, a resolution of 0.05 sec and variation due to temperature of $\pm$ 0.35 percent.

A partial schematic diagram of the timing circuit is shown in FIG. **3.** Voltage regulator **29** is comprised of a large value capacitor C_7 in parallel with voltage divider network R_{19} and R_{20} and a constant voltage diode Z_1, such as a IN4730A, in parallel with R_{20}. Clock 30 comprises unijunction transistor oscillator Q_1 and associated components connected across diode Z_1, and driver stage Q_2. R_{17} is a thermistor and provides temperature compensation for the oscillator. Time delay circuit **32** is comprised of programable UJT Q_3 and associated circuitry. Time delay circuit is comprised of programable UJT Q_4 and associated circuitry and driver stage Q_5. R_{22}, R_{23} and SCR Q_6 comprises squib firing network **39.** AND gates **34** and **38,** divider **35,** one-shot multivibrator **33** and counter **36** are formed by the IC's connected as shown. IC_1 is a MC724P. IC_2 through IC_5 are S8281A.

The coded key and contact mechanism is shown in FIG. **4.** The key **4** is made of electrically insulating material **41** covered by a metallic coating **42.** The contact mechanism **5** consists of block **51** of electrically insulating material having a slot **52** therein. The shape of the slot is such as to provide a snug fit for key **40** when the key is inserted in the slot. Embedded in the block **51** are a plurality of spring loaded contacts **50.** In the disclosed embodiment, **12** are provided. Each of the contacts is connected to one of the inputs of the binary counter. A separate contact, such as **53,** in addition to the **12,** can be provided to connect the metallic coating to ground. The key is coded by removing the metallic coating from certain areas **43** of the key which correspond to certain contacts. When the key is inserted into the slot, certain contacts are connected to ground and others are not. If all the stages in the counter are initially in the logic zero state, then those stages which are to be set to logic one will make contact with ground through the metallic coating on the key. Those stages which are to remain at logic zero do not make contact with ground through the metallic coating on the key. Those stages which are to remain at logic zero do not make contact with ground because the associated contacts do not touch the metallic coating on the key, the coating having been removed in the areas of the key which touch those contacts. After launch, the strobe pulse is provided to the counter by the one-shot multivibrator **33** as explained above. Those stages of the counter in contact with ground through the coded key will be set to logic one while those stages not in contact with ground will remain set at logic zero. Thus, the desired time is preset into the counter by means of the coded key and contact mechanism.

Obviously many modifications and variations of the present invention are possible in light of the above teachings. For example, a setback initiated thermal battery could be used as the power source. Various clock circuits and pulse frequencies could be used. It is therefore to be understood that, within the scope of the appended claims, the invention may be practiced otherwise than as specifically described.

What is claimed is:

1. A variable time fuze for a projectile comprising:
- a housing which is part of the projectile;
- a power supply disposed within said housing;
- an electronic timer circuit disposed within said housing including: a counter, a first time delay circuit for delaying application of power, a clock, a first AND gate having its input terminals connected to the first time delay circuit and to the clock and its output connected to the counter, means for strobing a preset number into the counter, a squib firing network, and a second AND gate having its input terminals connected to the first time delay circuit and to the counter and its output connected to the squib-firing network;
- electrical contact means for providing electrical continuity between said power supply and said counter to enable presetting various numbers in said counter; and
- variable coded key means for setting said contact means in accordance with a predetermined number, whereby the desired time interval may be preset prior to firing.

2. The variable time fuze of claim **1** wherein the strobing means comprises:
- a second time delay circuit connected to the power source; and,
- one-shot pulse generating means connected to the second time delay circuit and to the counter.

3. The variable time fuze of claim **2** wherein the first and the second time delay circuits include programmable unijunction transistors.

4. The variable time fuze of claim **3** wherein the counter and the first and second AND gates comprise integrated circuits.

5. A variable time fuze for a projectile comprising:
- a housing which is part of the projectile;
- a power supply disposed within said housing;
- an electronic timer circuit including a binary counter disposed within said housing;
- electrical contact means for providing electrical continuity between said power supply and said binary counter to enable presetting various numbers in said counter;
- said counter including a plurality of interconnected binary stages, each stage being connected to one of said electrical contacts, whereby the position of each contact sets its associated binary stage; and
- variable coded key means for setting said contact means in accordance with a predetermined number, whereby the desired time interval may be preset prior to firing.

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