United States Patent

Kern

[15] **3,688,701**

[45] **Sept. 5, 1972**

[54] **COMMAND FUZE**

[72] Inventor: **Neil C. Kern,** Scottsdale, Ariz.

[73] Assignee: **Motorola, Inc.,** Franklin Park, Ill.

[22] Filed: **Feb. 2, 1970**

[21] Appl. No.: **12,881**

[52] **U.S. Cl.** ....**102/70.2 P**

[51] **Int. Cl.** **F42c 13/04,** F42c 11/00, F42c 15/40

[58] **Field of Search** ....102/70.2 P; 343/7

[56] **References Cited**

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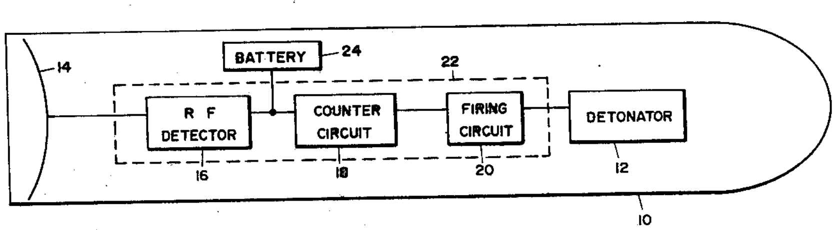
Primary Examiner—Benjamin A. Borchelt
Assistant Examiner—Thomas H. Webb
Attorney—Mueller & Aichele

[57] **ABSTRACT**

The shell includes RF detector circuitry, a pulse counter, and a firing circuit for a detonator which may be caused to explode during flight when it receives a predetermined number of radio pulses transmitted by ground command, or when, after receiving the predetermined number of pulses, the shell also receives a radio fire pulse by ground command. The fire pulse may be sent out by differential ranging system which continuously checks the distance to the shell and to the target and sends out the fire pulse when the distance is reduced to the predetermined one.

1 Claim, 6 Drawing Figures



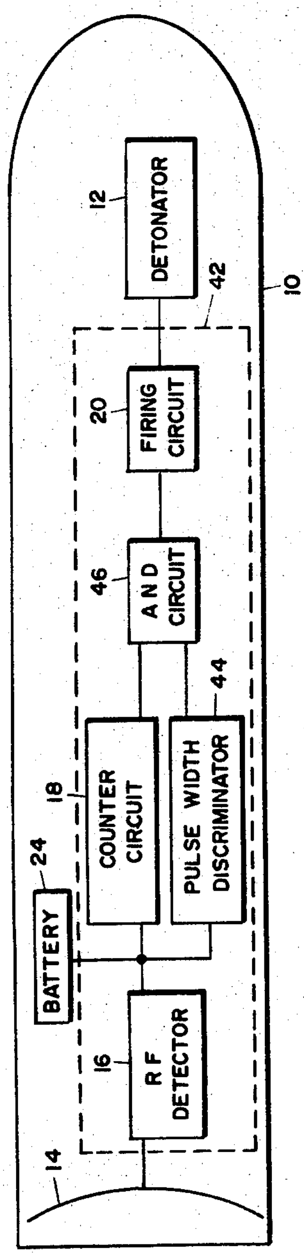


FIG 2

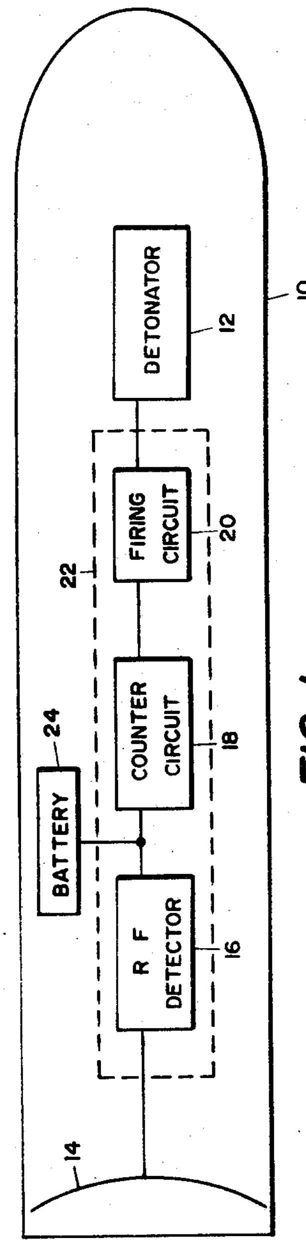


FIG 1

INVENTOR.
Neil C Kern
BY
Mueller, Aichele, & Rauner
Attys

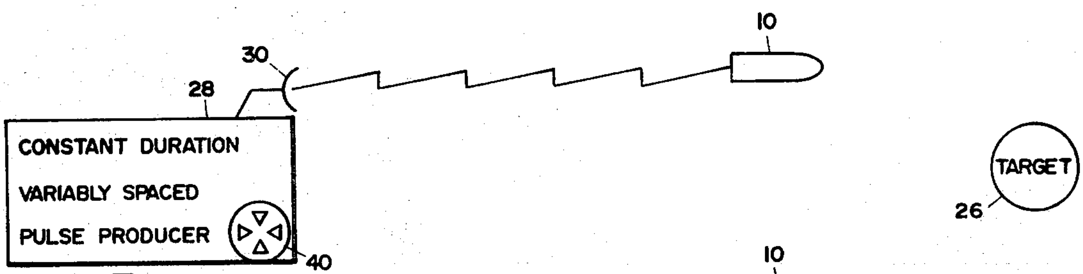


FIG 3

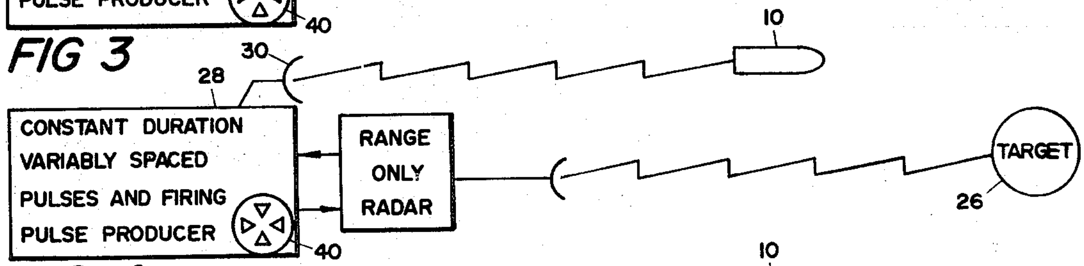


FIG 4

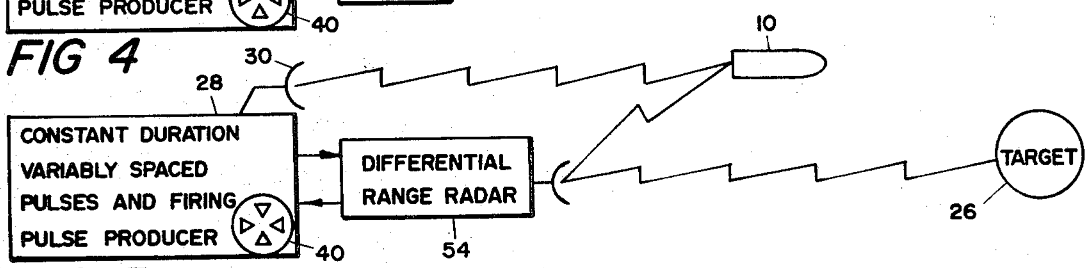


FIG 5

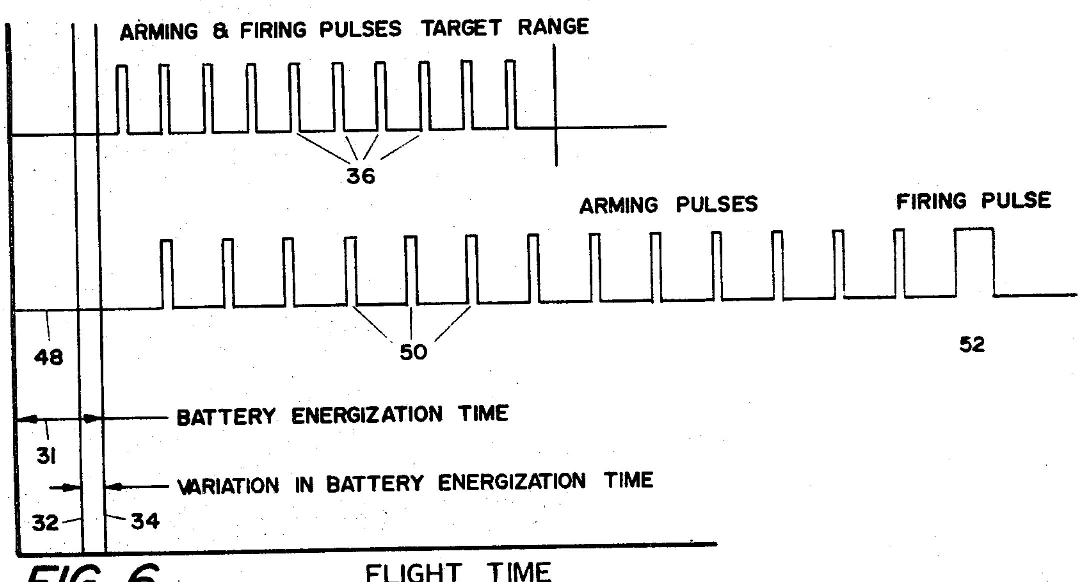


FIG 6

INVENTOR.
Neil C Kern

BY
Mueller, Aichele, & Rauner
Attys

COMMAND FUZE

BACKGROUND

This invention relates to a fuze for a shell which will cause the shell to explode under radio control.

In many cases, more damage will be done to a target if a shell explodes at a predetermined distance on the approach side of the target. For example, a shell may pass right over a target and do it no damage; however, if the shell explodes over the target or just before it reaches the target, the target may sustain severe damage. While proximity fuzes are known, a proximity fuze normally cannot distinguish between the background and the target. For example, if the target is behind a wall, the shell including a proximity fuze will be exploded by the proximity to the wall and not by the proximity to the target. Similarly, if the trajectory of the shell to the target is low, the proximity fuze on the shell may cause the shell to explode due to proximity to the ground and not due to proximity to the target. Time fuzes are known for shells, but when time fuzes are used the fuzes on each shell must be set individually and the timing of the fuzes of the successive shells must be corrected in accordance with information noted by observing previous shells. Also round to round ballistic changes cause timing errors.

It is an object of this invention to provide an improved radio controllable fuze for each shell.

It is an object of this invention to provide a fuze which will cause the shell of which it is a part to explode during its flight and after a predetermined time, or at a range which is determined after the shell has been fired out of the gun.

SUMMARY

In accordance with this invention, a pulse counter is mounted in the shell and fuze means are provided in the shell to cause the fuze to explode the bursting charge of the shell when the counter has counted a predetermined number of transmitted radio pulses. A radio pulse transmitter is so located as to send pulses to be counted to the shell, the pulses produced by the pulse producer being all equal in length but being spaced in time by a variable amount. By varying the spacing between the pulses, the instant of the time of flight at which the shell explodes may be determined. Since the spacing of the pulses produced by the transmitter is variable while the guns are firing the shells, the effect of the shell explosions may be observed and the pulse spacing may be varied to cause the shell to explode at the most effective point in its flight. As another embodiment of this invention, the first series of pulses may arm the fuze on the shell and then a second distinctive firing pulse may be sent out either by the same transmitter or by a supplemental one. This firing pulse will cause all shells that are in flight and which have been armed to explode but will not cause shells carrying unarmed fuzes to explode. The firing pulse may be transmitted under control of a radio ranging device which measures the distance of the target from the ranging device or which measures the distance between the shell and the target.

DESCRIPTION

The invention will be better understood upon reading the following description in connection with the accompanying drawing in which:

FIGS. 1 and 2 indicate in block form two embodiments of this invention, and

FIGS. 3 to 6 are diagrams which are useful in explaining the operation of the device of this invention.

EXPLANATION

Turning first to FIG. 1, a shell **10** is illustrated which carries, besides the usual detonator **12**, a control or command means for causing firing of the detonator **12**. This means includes an antenna **14** which may be built into the back end of the shell **10** and a radio frequency detector **16**, the output of which is coupled to a counting circuit **18**. The output of the counting circuit **18** is fed to a firing circuit **20** whose output is in turn fed to the detonator **12**. The elements **16**, **18** and **20** may be put on a chip such as the integrated circuit **22**. The elements **12**, **16**, **18**, and **20** are energized by a battery **24**.

When the shell **10** of FIG. 1 is fired from a gun in the direction of target **26**, as shown in FIG. 3, pulses from a constant duration variably spaced pulse producer **28** are radiated by an antenna **30** which is the output of the pulse producer **28** to the antenna **14** on the shell **10**. The concussion produced by the propelling charge for the shell **10** causes the battery **24**, which is in an inactive state until the occurrence of the concussion, to become energized. As indicated by line **31** of FIG. 6, a certain length of time must pass before the battery **24** is energized. Also, as indicated by the lines **32** and **34** of FIG. 6, all batteries do not become energized after exactly the same time interval after the concussion takes place. Therefore, the battery **24** becomes operative during a time after it has left the gun barrel indicated by the lines **32** or **34** or some time thereinbetween. When the battery **24** is energized, the described electronic elements **16** and **18** become operative to receive, to detect, and to count the pulses **36** (see FIG. 6) transmitted by the transmitter **28** of FIG. 3. When a predetermined number of pulses **36**, such as **256** thereof, for example, have been counted by the counter **18**, a pulse is applied to the firing circuit **20** by the counter **18** to cause the detonator **12** to explode. The observer can note when the shell **10** has burst and by manipulation of the adjusting wheel **40** of the transmitter **28**, for example, the burst can be brought closer to the gun if it is beyond the target **26** by making the time or spaces between the pulses **36** smaller, or further from the gun by making the time or spaces between the pulses **36** greater. Since the shell bursts occur only at the time the counter counts **256** pulses (for example), the time of flight of the shell **10** before it bursts is controllable by making the time between the pulses greater or less. A radio ranging system may be adapted to control the spaces between the pulses in accordance with the distance to the target.

It may be desirable to only arm the shell by means of spaced pulses of uniform width and explode the shell by means of another firing pulse whose time position is adjustable either manually or automatically. Such a shell is shown in FIG. 2. In FIGS. 1 and 2, the same reference characters are applied to similar elements.

In FIG. 2, the chip 42 has applied thereto, besides the RF detector 16, the counter circuit 18, and the firing circuit 20, a pulse width discriminator 44 and an AND circuit 46. The counter 18 and the width discriminator 44 are connected between the output of the RF detector 16 and respective input terminals of the AND circuit 46. The output of the AND circuit 46 is connected to the input of the firing circuit 20.

The operation of the shell of FIG. 2 is explained in conjunction with FIGS. 4 and 5 and line 48 of FIG. 6. Arming pulses 50, which are short and uniform in duration but variably spaced in time, are counted by the counter 18 of FIG. 2. When it has counted 256 pulses (for example), it applies an output to the AND circuit 46, but at that time the AND circuit 46 has only one input thereto, whereby it has no output. At a desired time, a firing pulse 52 is transmitted to the shell 10. This firing pulse 52 is wider than the arming pulses 36, whereby the firing pulse 52 gets through the pulse width discriminator circuit 44 which applies the second input pulse to the AND circuit 46. There now being a pulse applied to each of the inputs of the AND circuit 46, the AND circuit 46 applies an output to the firing circuit 20 which causes the detonator 12 to explode.

By use of a differential range radar apparatus 54, shown in FIG. 5, the firing pulse 52 (FIG. 6) may be sent out automatically when the shell and the target 26 are at the right distance apart for inflicting maximum damage on the target 26.

Since all the armed shells 10 that are in the air will be exploded by the firing pulse 52, even though only the front one is at the desired burst position, it may be desirable to adjust the spacing of the arming pulses 50 so that only the shells 10 that are near the target 26 are armed. In this manner, several shells 10 which bracket the target 26 may be exploded simultaneously, while the shells 10 that are still at too great a distance on the approach side of the target 26, will not be exploded.

The differential range radar 54 of FIG. 5 may be constructed in accordance with the application of Neil C. Kern, Ser. No. 790,327, filed Jan. 9, 1969, entitled "-Differential Ranging Systems," and assigned to Motorola, Inc.

What is claimed is:

1. A shell including:
a detonator,
an antenna,
a radio detector connected to said antenna,
a pulse counter connected to said radio detector and being responsive to an external command signal,
a pulse width discriminator,
an AND circuit having two input connections and an output connection, and
the output of said counter being connected to one input connection of said AND circuit, said pulse width discriminator being connected between the output of said detector and the other input of said AND circuit and the output of said AND circuit being connected to said detonator for causing said detonator to explode in response to said external command.

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