

[72] Inventor **Raymond W. Warren**
McLean, Va.
 [21] Appl. No. **770,185**
 [22] Filed **Oct. 24, 1968**
 [45] Patented **Mar. 9, 1971**
 [73] Assignee **The United States of America as represented**
by the Secretary of the Army

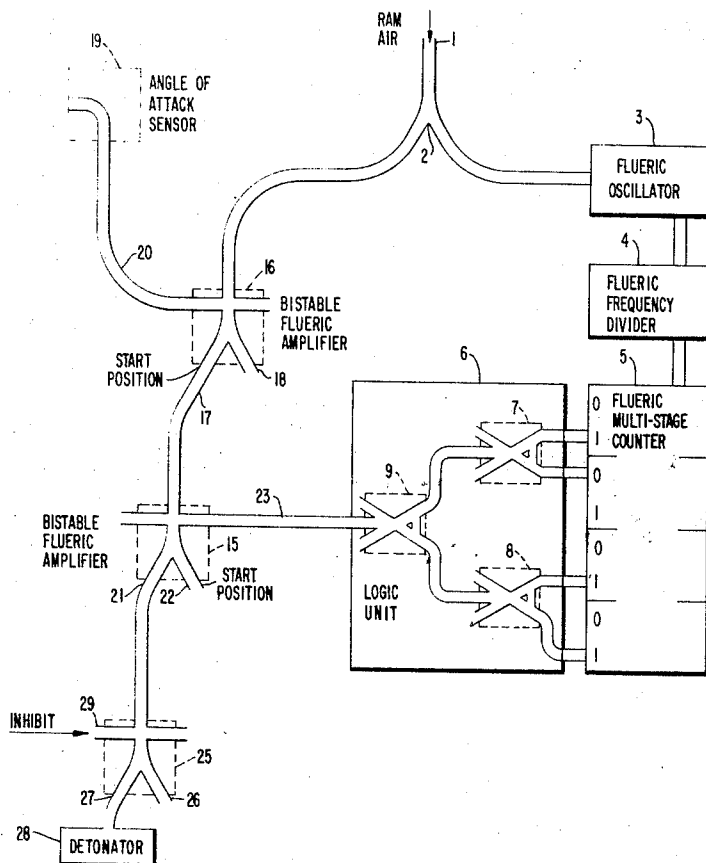
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UNITED STATES PATENTS
 3,093,306 6/1963 Warren 235/201
 3,229,638 1/1966 Woolston et al. 102/81X
 3,306,538 2/1967 McCracken, Jr. 235/201
 3,362,332 1/1968 Campagnuolo 102/81

Primary Examiner—Verlin R. Pendegrass
Attorneys—Harry M. Saragovitz, Edward J. Kelly, Herbert
 Berl and John D. Edgerton

[54] **FLUERIC ARMING DEVICE**
6 Claims, 3 Drawing Figs.

[52] U.S. Cl. **102/81**
 [51] Int. Cl. **F42c 15/28**
 [50] Field of Search **102/81,**
70.2; 235/201

ABSTRACT: A device for arming an explosive missile. Fluid pressure for operation of the device is provided by ram air, which drives a flueric oscillator. A count of the output cycles of the oscillator determines the distance through the air that the missile has travelled. When the count reaches a predetermined point, unless other conditions inhibit arming, a detonator is armed.



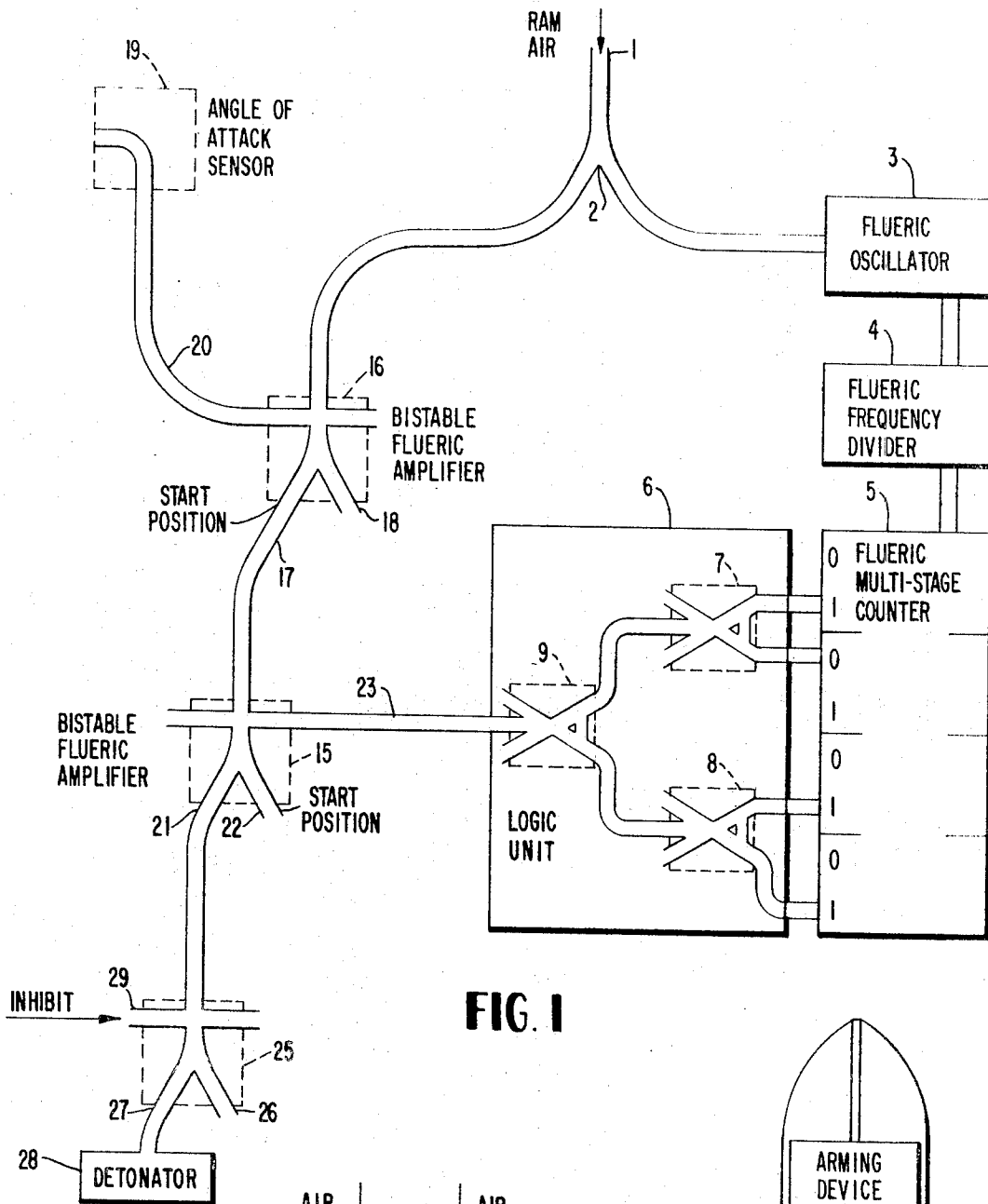


FIG. 1

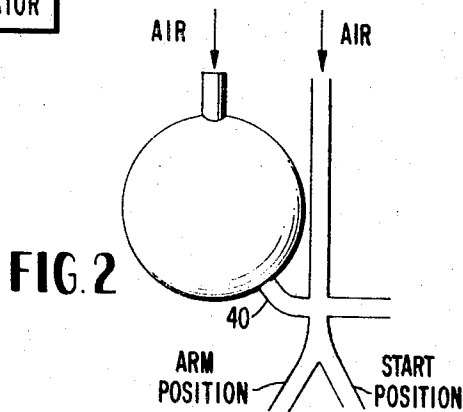


FIG. 2

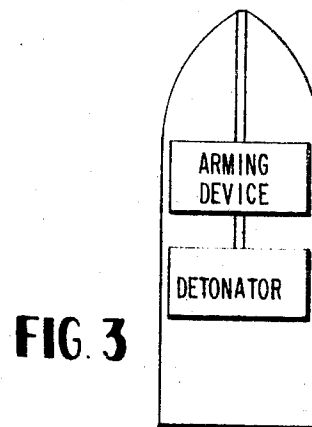


FIG. 3

INVENTOR
 RAYMOND W. WARREN
 BY *Harry M. Saragovitz, Edward J. Kelly, Herbert Seal and J. D. Colyer*
 ATTORNEY

FLUERIC ARMING DEVICE

BACKGROUND OF THE INVENTION

1. Field of the Invention

The invention is a flueric system for arming an explosive missile after a predetermined period of flight.

2. Description of the Prior Art

Arming devices are used on missiles to ensure that the missile cannot be detonated until it has travelled for some predetermined time from the point of launch. In a conventional artillery shell, the nearly simultaneous occurrence of two large dissimilar forces, setback and rotation, is used to mark to the beginning of a predetermined time interval. At the end of this time interval, arming takes place, thereby allowing detonation upon expiration of some longer predetermined time or upon impact.

It is more difficult to maintain safety by use of arming devices when only setback without rotation is present, as is the case with mortar shells.

However, the most difficult problem occurs with some missiles, for example, rockets, having little setback and no rotation available to provide start signals for timing the period before arming.

U.S. Pat. No. 3,229,638 (Woolston et al.) discloses a flueric arming device in which a ram air pressure is generated within a projectile when projectile reaches a predetermined velocity. Occurrence of this ram air pressure is used by a device of minimal complexity to arm the missile upon mere occurrence of the pressure.

Summary of the Invention

This invention is a flueric device responsive to the presence of ram air pressure for a predetermined interval beginning when the pressure reaches a significant value for arming a detonator aboard a missile. A flueric oscillator powered by the ram air operates a counter to count off the predetermined air distance interval and arm the detonator. Other conditions can be measured to inhibit arming.

This invention provides an arming device that is not dependent on setback or rotational forces for operation.

This invention also provides an arming device that can be preset to arm after any desired travel in flight.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic diagram of a flueric device according to the present invention.

FIG. 2 is a schematic illustration of a Helmholtz oscillator according to the present invention.

FIG. 3 is a schematic illustration of a device according to FIG. 1 mounted on a missile.

DESCRIPTION OF THE PREFERRED EMBODIMENT

FIG. 1 illustrates an arming device according to the present invention. A ram tube 1 located at the nose of the missile admits a ram air to the device when the missile is in flight. The air passes a stream divider 2 where it is divided into two parts.

One part of the air from stream divider 2 enters a flueric oscillator 3. This oscillator may be of the well-known resistance-capacitance-resistance in which the power jet is supplied with ram air. Thus, the oscillator only oscillates when the missile is moving with a velocity sufficiently large to generate the minimum required power jet pressure.

Within the lower region of the atmosphere where the density (D) is fairly constant the ram pressure is proportional to the square of the velocity of the missile through the air $P=1/2^2$. The frequency of a fluid resistance-capacitance-resistance oscillator can be made proportional to the square of the pressure over a selected range of supply pressure. In this case the selected range of pressure is the ram air pressure. So the frequency of the 1 fluid oscillator is proportional to the velocity of the missile through the air.

The sum of the number of oscillations is proportional to the distance the missile has traveled through the air. In effect, the sum of the number of oscillations is the integral of the velocity and is the air distance traveled.

The output oscillatory signal from oscillator 3 is applied to a flueric frequency divider 4 to a stepdown the oscillator frequency f by an integer factor of N . The frequency divider applies pulses at a repetition rate f/N to the input of a flueric multistage counter 5.

A flueric frequency divider and a flueric counter can both be built using conventional flueric flip-flops, for example, those shown in FIGS. 1, 2, and 3 of U.S. Pat. No. 3,001,698 (Warren). The sum of the oscillation frequency stepdown in the frequency divider and the repetition frequency stepdown in the counter is a function of the initial frequency f and the maximum distance allowed to pass before arming. The counter must have enough stages to allow measurement of distance intervals with the desired accuracy. The remainder of the stepdown is carried out in the frequency divider.

Counter 5 may be any arrangement of counting stages, and may be, for example, as shown in FIG. 4 of the Warren patent. When counter 5 reaches some predetermined count, the predetermined time interval before arming has passed, and arming can take place, in the absence of other inhibiting conditions.

A logic unit 6 determines when the counter 5 has reached the predetermined count. Although numerous configurations of logic units could determine this information, one preferred embodiment has been illustrated. Three flueric AND gates 7, 8, and 9 are connected to form logic unit 6.

AND gates 7 and 8 receive inputs from predetermined output terminals of the stages of counter 5. In the illustration the predetermined count is 1101 and the AND gates are so connected. Only when the count is 1101 will gates 7 and 8 pass fluid pressure to AND gate 9, causing an output from gate 9 and thereby an output from the logic unit 6.

It is obvious that valves or fluid switches can be placed between the counter and the logic unit to allow variation of the predetermined count before firing the missile. These fluid switches can be ganged to a dial arrangement to allow dialing to predetermine a count.

The output from a logic unit 6 is applied to a control terminal of bistable flueric amplifier 15. The purpose of this amplifier will be more fully explained below.

The second part of the air as divided by stream divider 2 furnishes the power jet for a bistable flueric amplifier 16 which serves as a power jet control means. Amplifier 16 has two output channels 17 and 18, and initially turns on to exhaust fluid through channel 17. This can readily be accomplished by a slight bias of the element.

An angle of attack sensor 19 is connected to amplifier 16 by control channel 20. The angle-of-attack sensor is used to inhibit arming of the system if the angle of attack of the missile exceeds a safe minimum. The outlet of sensor 19 is so placed that normally a small amount of ram air aspirates out through control channel 20. But if the angle of attack changes, air is forced into sensor 19 and in through channel 20 to cause amplifier 16 to switch and exhaust air to atmosphere through output channel 18.

Because amplifier 16 is bistable, the exhaust continues through channel 18, inhibiting the arming of the system.

When logic unit 6 provides an output signal to amplifier 15 through control channel 23, the output flow switches to output channel 21, indicating that the system is ready for arming unless further inhibited.

An additional bistable amplifier 25 is illustrated, indicative of any number of such amplifiers which can be used in series to sense various irregularities and inhibit arming. Two output channels 26 and 27 are provided from amplifier 25. In normal operation the fluid passes out through channel 27 to arm detonator 28. However, when an inhibit signal is applied to a amplifier 25 through control channel 29, the fluid exhausts to atmosphere through outlet channel 26, without arming the detonator.

Any number of sources of inhibit signal can be used, for example, indicating a violent maneuver or crosswind, failure of operation of a switch, turning of a valve, or failure of operation of a control or homing system, or boost pressure on. Boost pressure occurs when the second or subsequent stage of a rocket is fired. The inhibit device may be set up to require first the presence of boost pressure to indicate firing and then its absence to indicate shutoff of the second stage.

If the attainment of minimum velocity by the missile is sufficient indication of safety, a Helmholtz resonator may be used without a counter.

Most oscillators will oscillate at a substantially constant frequency after the ram air reaches a minimum pressure. However, a Helmholtz resonator, as illustrated in FIG. 2, can be designed to oscillate only over a narrow range or band of input air pressure. Thus, the velocity of the missile must be held within narrow limits or the Helmholtz resonator will not oscillate. If operation of the missile within a predetermined velocity range is critical for safety in the particular application, a Helmholtz oscillator may be used for oscillator 3. Air will freely flow through the Helmholtz resonator and out through output channel 40 until it oscillates; then the flow is blocked.

FIG. 3 is a simple diagram illustrating, in block form, the placement of the present system on a missile.

Of course the missile might also be an underwater torpedo, in which case the operating fluid would be water rather than air. The invention includes both air and water as environmental fluids for operation of the arming device.

While the invention has been particularly shown and described with reference to preferred embodiments thereof, it will be understood by those skilled in the art that various changes in form and details may be made therein without departing from the spirit and scope of the invention

I claim:

1. In a fluoric device carried by a missile and operated by environmental fluid pressure to arm the missile, the improvement comprising:

means responsive to the movement of said missile through the environmental fluid for admitting pressurized environmental fluid to said device;

splitter means for separating said pressurized environmental fluid into two streams;

oscillator means driven by one pressurized fluid stream for generating fluidic pulses;

a fluoric multistage counter for counting said fluid pulses constituting the output of said oscillator means;

a bistable fluoric amplifier driven by said other stream and

having an output passage thereof fluid cup coupled to a detonator for said missile;

means normally biasing the output of said bistable fluoric amplifier to another outlet passage thereof; and

means fluid coupling the output of said fluoric multistage counter to a control passage for supplying a control signal for said bistable fluoric amplifier to overcome said bias upon reaching of a predetermined count to effect arming of said missile.

2. The device according to claim 1 wherein said fluoric multistage counter incorporates frequency stepdown means responsive to said first stream for providing an output indication of the number of cycles of said varying intensity and logic means responsive to said said output indication for providing said control signal for overcoming the biasing signal applied to said bistable fluoric amplifier.

3. The device according to claim 2, wherein said stepdown means further comprises:

a frequency divider means responsive to said first stream for providing a divider output signal which varies at a frequency less than and proportional to said predetermined frequency; and

said counter means are responsive to said divider output signal for counting the number of cycles in said divider output signal when providing said control signal for overcoming the biasing signal applied to said bistable fluoric amplifier.

4. The device according to claim 1, further comprising:

a fluid switch driven by the output of said bistable fluoric amplifier to provide an arming signal to said detonator; and

control means for said switch responsive to an inhibit signal for preventing the arming signal from said bistable fluoric amplifier from reaching a point of utilization.

5. The device according to claim 4, further comprising: power control means responsive to a sensor signal for controlling the amount of power reaching said bistable fluoric amplifier.

6. The device according to claim 5 wherein said power control means comprises a second bistable fluoric amplifier positioned intermediate of said divider and said first bistable fluoric amplifier, with the output of said second bistable fluoric amplifier normally operating as the power stream for said first bistable fluoric amplifier, and control means for second bistable fluoric amplifier receptive to said sensor signal for causing said second flow stream to be diverted from said first bistable fluoric amplifier.

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