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[54] **FLUIDIC-ELECTRIC SWITCH AND SAFETY, ARMING AND DETONATING SYSTEM USING SAME**

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[58] **Field of Search**..... 102/70.2 P, 70.2 G, 81, 76, 102/70 R; 235/201 FS

[56] **References Cited**

UNITED STATES PATENTS

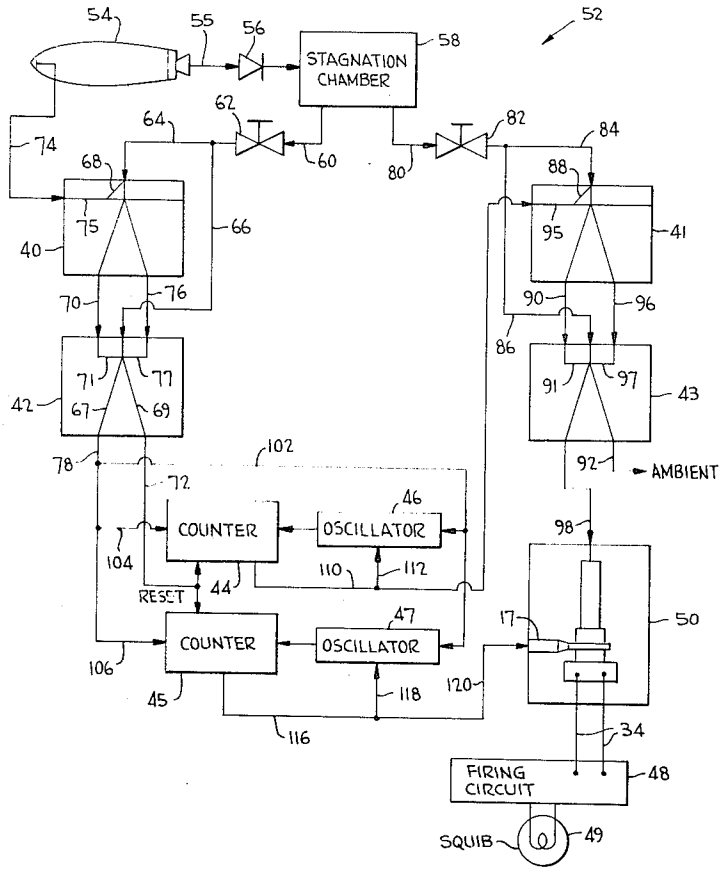
2,509,910	5/1950	Dike	102/70.2 P
3,306,538	2/1967	McCracken	102/81 UX
2,479,582	8/1949	McCaslin	102/81
3,170,403	2/1965	Heilprin	102/70.2 G

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[57] **ABSTRACT**

A fluidic safety, arming and detonating system for use in a weapon-carrying missile whose power output is controlled by a fluidic-electric switch. The system's operation is based on two external environmental signatures plus two internal fluidic signatures. The two external environmental signatures, which are prerequisite to subsequent operation of the system, are provided by combustion gases during ignition of the missile and by ram air after lift-off. The two internal fluidic signatures, which are required to arm and detonate the explosive carried by the missile, are provided by the fluidic-electric switch actuated and controlled by two preset fluidic timers, each of which comprises an oscillator coupled with a binary counter. The two timers turn the fluidic-electric switch first ON, which arms the firing circuit, then OFF, which triggers the firing circuit to detonate the explosive.

23 Claims, 2 Drawing Figures



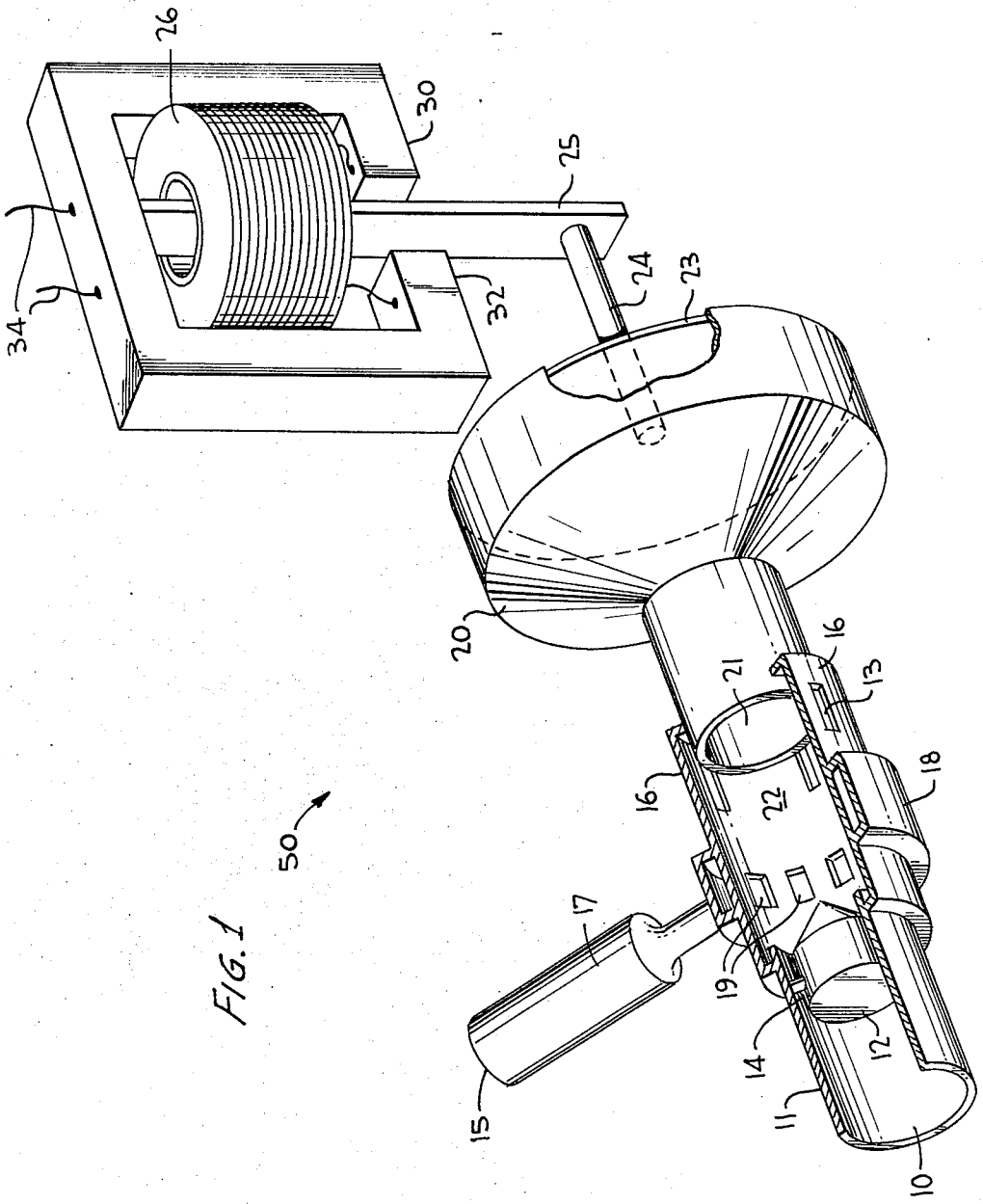
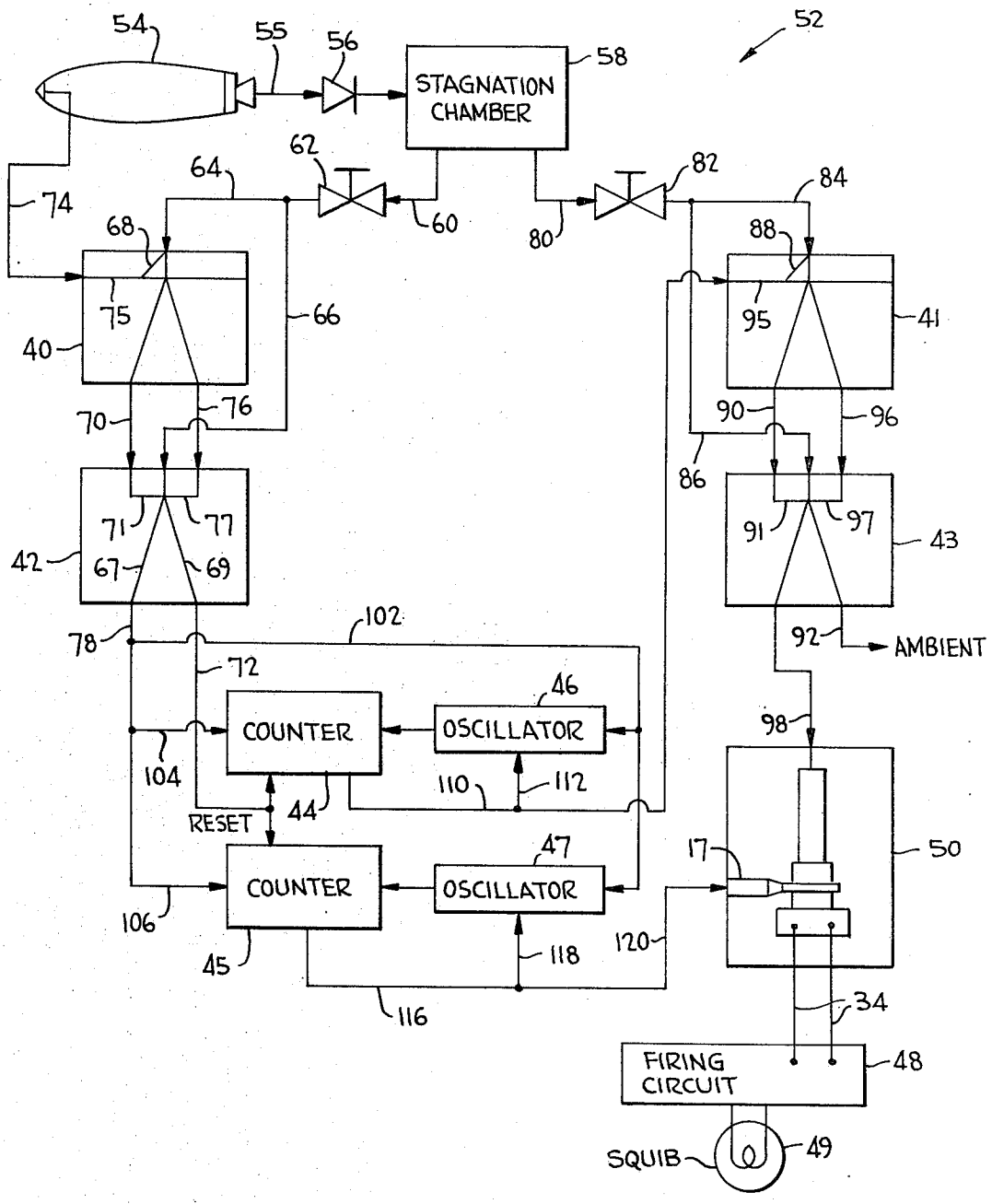


FIG. 1

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FIG. 2



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FLUIDIC-ELECTRIC SWITCH AND SAFETY, ARMING AND DETONATING SYSTEM USING SAME

RIGHTS OF GOVERNMENT

The invention described herein may be manufactured, used, and licensed by or for the United States Government for governmental purposes without the payment to me of any royalty thereon.

BACKGROUND OF THE INVENTION

This invention relates to an ordnance fuzing device and in particular to a fluidic safety and arming system utilizing a novel fluidic-electric switch. More particularly, the present invention utilizes pure fluid devices to arm a weapon-carrying missile at a predetermined time from the launching means, and at a later predetermined time to fire the explosive contained in the weapon.

It is essential in many ordnance applications to provide the missile with a safety mechanism to preclude detonation until a certain minimum distance from the launching site is attained. Control means must also be provided in the missile or projectile in order to later trigger the explosive charge carried in the missile. Prior safety and arming systems have relied primarily upon mechanical and electronic means for arming the missile and for detonating it at a certain time or height above the target. The mechanical and electronic systems commonly used for such purposes are subject to severe shock, vibration, pressure and temperature extremes encountered by the missile during launch and in flight. The fluidic system of the present invention is ideally suited to withstand such severe environmental conditions because it has no moving parts and indeed utilizes environmental signatures for its actuation and operation.

It is also apparent that the power supplies utilized in such missile systems must also be able to withstand severe shock and vibrations. In addition, such power supplies must be storable over long periods of time without deterioration, while being activated only when needed in flight. Known chemical and mechanical power supplies often do not satisfactorily meet the aforesaid requirements. The fluidic system of the present invention is made impervious to such disturbances by employing a fluidic-electric switch which is essentially a fluid-controllable power supply that converts pneumatic energy to electrical energy and is activated only after a preset time from launching is attained. At a later preset time, the fluidic arming circuits will switch off the electric power output which will in turn trigger the firing circuit, as more fully explained hereinafter.

It is therefore an object of the present invention to provide fluidic safety and arming means which activates a weapon-carrying missile only at a safe distance away from the launching area.

It is another object of the present invention to provide fluidic detonating means for a weapon-carrying missile to operate only at a preset time after launching.

It is a further object of the present invention to provide a fluidic-electric switch that transforms pneumatic energy to electrical energy and has a switching capability that controls the electric power output by means of an independent fluid source.

It is an additional object of the present invention to provide means to arm and detonate a weapon-carrying missile that is insensitive to high missile speed, shock, vibration, and environmental temperature and pressure extremes.

Still another object of the present invention is to provide means to arm and detonate a weapon-carrying missile that is responsive solely to two external environmental signatures plus two internal fluidic signatures which must occur sequentially in order for the system to be activated, thus contributing an extra safety measure to the system.

A further object of the present invention is to provide to a weapon-carrying missile safety and arming means plus electric power means that are not subject to deterioration or wear while in storage and that are activated only upon their use in flight.

SUMMARY OF THE INVENTION

Briefly, the present invention utilizes ram air of a weapon-carrying missile and exhaust gases of the missile to provide two fluid signals for a fluidic safety, arming and detonating system whose power actuation is controlled by a fluidic-electric switch. The two fluid signals actuate two fluidic timers, the first of which turns ON the fluidic-electric switch which energizes a firing circuit. The second of the two fluidic timers at a specified later time switches OFF the fluidic-electric switch which in turn acts to release the energy stored in the firing circuit to detonate a squib.

BRIEF DESCRIPTION OF THE DRAWINGS

The specific nature of the invention as well as other objects, aspects, uses, and advantages thereof will clearly appear from the following description and from the accompanying drawings, in which:

FIG. 1 shows the fluid-electric switch of the present invention,

FIG. 2 is a schematic illustration of a safety, arming and detonating system utilizing the fluidic-electric switch.

DESCRIPTION OF THE PREFERRED EMBODIMENT

FIG. 1 shows a fluidic-electric switch that transforms pneumatic energy into electrical energy and is controlled by an external fluid source in the following manner. The fluidic source of power enters the switch at end **10** of tube **11**. At the end of cylinder **11** opposite port **10** a cylindrical plug **12** is centrally located therein forming an annular orifice **14**. The column of fluid entering port **10** is converted into an annular column by annular orifice **14**. The annular column of air from orifice **14** is directed to an opening **21** through an interaction chamber **22** by means of a conduit **16** which has aperatures **19** therein for control purposes and openings **13** for exhaust purposes. Annular orifice **14** is of a slightly smaller diameter than opening **21** but the columns of air emanating from orifice **14** will tend to spread and impinge upon the edge of opening **21**. The impinging of the air on this edge, in the well-known manner, will produce a multiple frequency edgetone or ringtone. The oscillation of the annular column of air back and forth across the end of opening **21** will cause the column of air in a resonating cavity **20** to vibrate, the frequency of that vibration being determined by the depth of cavity **20**. The vibration in cavity **20** will

cause increases and decreases in pressure in the cavity which in turn will cause a diaphragm 23 to pulsate inwardly and outwardly. The vibrations of diaphragm 23 are transmitted to an armature 25 in the form of a vibrating reed by means of a rod 24 attached to the diaphragm at one end and to the armature 25 at its other end. The free end of metallic reed armature 25 is centrally located in a magnetic coil 26 between two permanent magnet pole pieces of opposite polarity 30 and 32.

The pulsations of diaphragm 23 causes the armature 25 to oscillate between magnetic pole pieces 30 and 32 which in turn will induce an electromotive force in coil 26; this emf can then be coupled to an external circuit through wires 34.

The electrical output from wires 34 can be independently switched ON and OFF in the following manner. Conduit 16 is encased near its midsection by a ring conduit 18 that receives control fluid from an independent source through a control nozzle 17 and exhausts this control fluid through apertures 19 that circumscribe interaction chamber 22. Upon receipt of a fluidic signal in a port 15, control nozzle 17 will direct through ring conduit 18 and apertures 19 said fluidic signal which will disturb the annular column emanating from annular orifice 14 in interaction chamber 22. This disturbance will prevent the annular column of air from impinging upon the edge of opening 21. This will in turn cause the oscillations in resonating cavity 20 to cease, thus terminating the generation of electrical energy at wires 34. This corresponds to an OFF condition of the switch. Upon the removal of the fluid signal from control nozzle 17, the annular column will proceed undisturbed through interaction chamber 22 as before, and thus the device will switch to an ON condition, provided there still exists the fluid power entering port 10. It is thus seen that control nozzle 17, ring conduit 18, and apertures 19 provide means for independent fluidic control of the electrical power output of the device.

One example of a system in which the fluidic-electric switch of FIG. 1 would find useful application is illustrated in schematic form in FIG. 2 which depicts a fluidic safety, arming and detonating system for use in a weapon-carrying missile or rocket. The circuitry indicated generally at 52 is shown as being positioned outside a weapon-carrying missile 54. It is to be understood that normally the circuitry 52 is positioned within the missile 54 but is as shown in FIG. 2 for illustrative purposes only.

The circuitry indicated at 52 is responsive solely to two environmental signatures which occur during the normal deployment of the missile 54. Until such time as the missile 54 is put in actual flight, the fluidic circuitry 52 remains totally inoperative and can in no way initiate an accidental firing. The first of the two environmental signatures occurs at ignition of the missile during which some of the gases from combustion are collected into a stagnation chamber 58 by means of a pneumatic diode 56 and a conduit 55 which is appropriately placed in missile 54 to receive the combustion gases. Pneumatic diode 56 permits one-way flow only of the gases into chamber 58, which is an enclosed volume designed to increase the static pressure of the fluid at the expense of the fluid velocity in a manner well known in the art. The gas from stagnation chamber 58 flows through conduits 60 and 80 into two pressure regulators 62 and 82 respectively, which maintain the level of flow necessary to operate the remaining fluidic devices.

The output from pressure regulator 62 provides supply fluid for the power nozzles (not shown) of a biased fluid amplifier 40 and a fluid buffer amplifier 42 by way of conduits 64 and 66 respectively. Amplifier 40 is biased to discharge from conduit 70 in the absence of a fluid signal from control conduit 75, this self-bias being schematically represented by channel 68. The fluid output from conduit 70 is then utilized as the left control jet 71 of buffer amplifier 42. Left control jet 71 in the well known manner causes the power nozzle supply fluid from conduit 66 to entrain along the right output channel 69 of buffer amplifier 42 and exhaust through conduit 72. This fluidic signal in conduit 72 is fed to fluidic binary counters 44 and 45 and acts to reset both counters to their ground states.

The output from pressure regulator 82 provides supply fluid to conduits 84 and 86 which feed the power nozzles (not shown) of a biased fluid amplifier 41 and a buffer fluid amplifier 43, whose actions are similar to and simultaneous with the actions of biased fluid amplifier 40 and buffer amplifier 42. In the absence of a fluid signal from control conduit 95, amplifier 41 is biased by channel 88 to exhaust through conduit 90 which is then connected to serve as the left control jet 91 of buffer amplifier 43. Left control jet 91 in turn causes the power nozzle supply fluid from conduit 86 to discharge through output conduit 92 to ambient. Thus, the action of the first environmental signature at ignition is to reset the fluidic binary counters 44 and 45 to their ground states and to prepare the remaining fluidic circuits for the second signature which occurs shortly after lift-off.

After lift-off, ram air enters the fluidic safety, arming and detonating system of FIG. 2 through conduit 74, appropriately placed in the missile to receive said ram air. This fluid signal provided by the ram air in conduit 74 is fed into control conduit 75 in biased amplifier 40, causing the power nozzle supply fluid fed by conduit 64 to be deflected and exhaust through conduit 76, which is then utilized as the right control jet 77 of buffer amplifier 42. The right control jet 77 in turn causes the power nozzle supply fluid from conduit 66 to entrain upon the left output channel 67 of buffer amplifier 42 and exhaust through conduit 78. The fluid signal from conduit 78, which is present only after the missile has lifted off the launching means, serves to arm the missile in the following manner.

A portion of the fluid from conduit 78 is fed by conduit 102 to activate fluid oscillators 46 and 47 which provide a time base for fluid binary counters 44 and 45 respectively. Simultaneously, conduit 78 supplies fluid signals to fluid binary counters 44 and 45 by way of conduits 104 and 106 respectively. Said counters are turned ON by said fluid signals and are preset to run for time periods t_1 and t_2, respectively, where t_2 is greater than t_1. The time periods of counters 44 and 45 are preset by adjusting the frequency of oscillation of the oscillators 46 and 47 and the number of stages in counters 44 and 45.

At the end of time period t_1, counter 44 emits a fluid signal through conduit 110 which turns OFF oscillator 46 by means of line 112 and also provides a control signal to biased amplifier 41 through conduit 114 that feeds a control conduit 95. In a similar manner as here-

tofore described with respect to amplifiers **40** and **42**, biased amplifier **41** upon receipt of fluid control signal in conduit **95** now exhausts through conduit **96** that becomes right control jet **97** in buffer amplifier **43**. Receipt of a fluid signal in right control jet **97** causes the supply fluid from conduit **86** to switch its output path from conduit **92** to conduit **98**. Conduit **98** in turn provides a supply fluid to the afore-described fluidic-electric switch **50** which transforms the pneumatic energy in the form of a fluidic stream in conduit **98** to an electrical energy output along wires **34**. Wires **34** are connected to an electronic firing circuit **48** and are arranged so as to charge up a firing capacitor (not shown). Thus, the ram air of the missile, at a safe time t_1 after the missile has been launched, has enabled the fluidic circuitry of FIG. **2** to arm the missile and prepare it for firing.

At the end of preset time period t_2, counter **45** releases a fluid signal by way of conduit **116** that turns OFF oscillator **47** by way of line **118** and also provides a fluid control signal to the fluidic-electric switch **50** by way of conduit **120**. Conduit **120** feeds directly into the control nozzle **17** of the fluidic-electric switch **50**. As heretofore explained, the receipt of this signal by control nozzle **17** causes the fluidic-electric switch **50** to cease generating electrical energy. This in turn triggers the firing capacitor in firing circuit **48** to release its stored energy in such a fashion as to detonate the firing element, shown as a squib **49**, which initiates the firing of the explosive carried by the missile.

The construction and use of many of the fluidic devices and concepts presented herein are well known to those persons skilled in the art. For example, a preferred embodiment of the firing circuit **48** which can be utilized in the prescribed manner can be found at 103 of FIG. 2 in U. S. application Ser. No. 684,602 filed Nov. 16, 1967 by Carl J. Campagnuolo et al., entitled "Fluidic Arming System." Additionally, it is desirable that the frequencies of fluid oscillators **46** and **47** be made insensitive to both pressure and temperature changes due to the inherent fluctuations of those parameters in the exhaust gases of the missile. An appropriate embodiment of such an oscillator is disclosed in U. S. application Ser. No. 595,538 filed Nov. 18, 1966 by Carl J. Campagnuolo et al. for a "Pressure and Temperature Insensitive System."

Oscillators **46** and **47** are switched OFF at the end of time periods t_1 and t_2, respectively, to insure that the fluid flow from counters **44** and **45** is continued at the level and rate necessary to maintain the output of buffer amplifier **43** at conduit **98** after time period t_1, and to insure that the fluidic-electric switch **50** remains inoperative after time period t_2.

Time period t_1 of counter **44** would be set to correspond to the desired time delay between missile lift-off and arming; time period t_2 would be selected to be the delay between lift-off and detonation; time interval $t_2 - t_1$ would yield the fluidic-electric switch ON time t_g, given mathematically by

$$T_g = 2^{N_2}/f_2 - 2^{N_1}/f_1 = t_2 - t_1$$

where N_2 represents the number of stages in counter **45**; N_1 represents the number of stages in counter **44**; f_2 is the frequency of oscillator **47** and f_1 is the frequency of oscillator **46**. Hence once the basic frequency for each oscillator has been chosen, any desired t_1 and t_2 can be obtained by adjusting the number of stages in the counters.

It can be readily seen that the system as heretofore described, when adapted to a missile or projectile, is fail-safe, because its actuation is dependent on a successful launch and take-off of the vehicle.

I wish it to be understood that I do not desire to be limited to the exact details of construction shown and described, for obvious modifications will occur to a person skilled in the art.

I claim as my invention:

1. In a weapon carrying missile, a fluidic safety, arming, and detonating system, comprising:

a. an electrical circuit including a normally de-energized electrically operated fuze firing element;

b. a pressure activated means for arming said electrical circuit and detonating said fuze firing element;

c. a means associated with said missile for receiving a plurality of fluid signals; and

d. a fluid circuit means for activating and deactivating said pressure-activated means at the end of first and second time intervals, respectively, in response to and at predetermined times after the coincidental receipt of said plurality of fluid signals, said fluid circuit means including a first and second delay means, each having no moving parts, for determining the lengths of the said first and second time intervals.

2. The invention according to claim **1** wherein said pressure activated means comprises a fluidic-electric switch responsive to a first fluid signal and to a second fluid signal wherefrom electrical energy is provided to said electrical circuit upon the sole application of said first fluid signal and wherefrom said electrical energy ceases upon the concurrent application of said second fluid signal.

3. The invention according to claim **1** in which said first and second delay means are comprised of first and second fluidic timing circuits, respectively.

4. The invention according to claim **3** in which said first fluidic timing circuit comprises a fluidic binary counter, means for resetting to ground state said counter upon the application of one of said plurality of fluid signals to said system, a fluidic oscillator providing a signal to be counted by said binary counter upon the application of another of said plurality of signals, and an output conduit through which is delivered an output signal upon the completion of said first time interval.

5. The invention according to claim **3** in which said second fluidic timing circuit comprises a fluidic binary counter, means for resetting to ground state said counter upon the application of one of said plurality of fluid signals to said system, a fluidic oscillator providing a signal to be counted by said binary counter upon the application of another of said plurality of signals, and an output conduit through which is delivered an output signal upon the completion of said second time interval.

6. The invention according to claim **1** wherein said plurality of fluid signals comprises a portion of the exhaust gases of said missile and ram air.

7. A safety, arming and detonating system for use in a weapon-carrying missile or the like, comprising:

a. means for receiving a portion of the exhaust gases of said missile;

b. means for transforming said portion of exhaust gases into first and second streams of supply fluid;

c. means for receiving ram air;

d. first fluid amplifier means supplied with a source of power fluid comprising control means in communication with said means for receiving ram air, first and second output conduits, and means to direct said power fluid out said first output conduit in the absence of ram air and out said second output conduit upon the application of ram air to the system;

e. first and second fluidic oscillators each of which has an input conduit connected to said second output conduit of said first fluid amplifier means so that said oscillators are rendered operative only when ram air is applied to said first fluid amplifier means;

f. a first fluidic binary counter comprising a first input conduit connected to an output of said first fluidic oscillator for detecting the oscillations of said oscillator, a second input conduit in communication with said second output conduit of said first fluid amplifier means such that said first counter begins counting said oscillations only upon receipt of a fluid signal from said second output conduit, and an output conduit that emits a fluid control signal after the detection of a predetermined number of said oscillations corresponding to a first time interval;

g. a second fluidic binary counter comprising a first input conduit connected to an output of said second fluidic oscillator for detecting the oscillations of said oscillator, a second input conduit in communication with said second output conduit of said first fluid amplifier means such that said second counter begins counting said oscillations only upon receipt of a fluid signal from said second output conduit, and an output conduit that emits a fluid control signal after the detection of a predetermined number of said oscillations corresponding to a second time interval;

h. second fluid amplifier means supplied with a source of power fluid comprising control means adapted to receive said fluid control signal of said first fluidic binary counter, first and second output conduits, and means to direct said power fluid through said second output conduit only after said first time interval has elapsed;

i. a fluidic-electric switch comprising transducer means to produce an electrical energy output in response to a fluid signal input from said second output conduit of said second fluid amplifier means, and switching means responsive to said fluid control signal from said second fluidic binary counter, whereupon the receipt of said fluid control signal will act to terminate the generation of electrical energy therefrom only after said second time interval has elapsed;

j. an electrical circuit comprising a normally deenergized electrically operated fuze firing element, means to arm said circuit in response to the activation of said fluidic-electric switch, means to energize said fuze firing element in response to the deactivation of said fluidic-electric switch.

8. The invention according to claim **7** wherein said exhaust gas receiving means comprises a stagnation chamber, a receiving conduit and a pneumatic diode located therebetween to allow unidirectional flow of said exhaust gases into said stagnation chamber.

9. The invention according to claim **7** wherein said means for transforming said portion of exhaust gases comprises a pair of pressure regulators each fed by output conduit of said receiving means whereby portions of said exhaust gases are transformed into said first and second streams of supply fluid at a predetermined pressure level and flow.

10. The invention according to claim **7** wherein said sources of power fluid for said first and second fluid amplifier means comprises said first and second streams of supply fluid, respectively.

11. The invention according to claim **7** wherein said first fluid amplifier means comprises:

a. a first self-biased amplifier adapted to receive said power fluid, comprising a control conduit in communication with said means for receiving ram air to serve as said control means, first and second output conduits, and self-biasing means to direct said power fluid out said first conduit in the absence of ram air and out said second output conduit upon the application of ram air to the system; and

b. a first buffer amplifier adapted to receive power fluid comprising first and second control conduits and first and second output conduits, said first control conduit in communication with said first output conduit of said first self-biased fluid amplifier and said second control conduit in communication with said second output conduit of said first self-biased fluid amplifier, whereby said control conduits act on said power fluid in such a manner as to direct said power fluid out said first output conduit of said first buffer amplifier in the presence of a fluid signal in said first control conduit and out said second output conduit of said first buffer amplifier in the presence of a fluid signal in said second control conduit.

12. The invention according to claim **11** wherein said power fluid of said first self-biased fluid amplifier and of said first buffer amplifier comprises portions of said first stream of supply fluid.

13. The invention according to claim **7** further comprising means for terminating the oscillations of said first fluidic oscillator at the end of said first time interval.

14. The invention according to claim **13** wherein said means for terminating oscillations comprises a conduit that communicates a portion of said fluid control signal from said first fluidic binary counter to said first fluidic oscillator.

15. The invention according to claim **7** further comprising means for terminating the oscillations of said second fluidic oscillator at the end of said second time interval.

16. The invention according to claim **15** wherein said means for terminating oscillations comprises a conduit that communicates a portion of said fluid control signal from said second fluidic binary counter to said second fluidic oscillator.

17. The invention according to claim **7** further comprising means for resetting said first and second fluidic binary counters to their ground states.

18. The invention according to claim **17** wherein said resetting means comprises a conduit connecting said first output conduit of said first fluid amplifier means

with an input to each of said first and second fluidic binary counters whereupon the application of the said exhaust gases to the system will cause said counters to reset.

19. The invention according to claim **7** wherein said second fluid amplifier means comprises:

a. a second self-biased fluid amplifier adapted to receive said power fluid, comprising a control conduit in communication with said output conduit of said first fluidic binary counter, first and second output conduits, and self-biasing means to direct said power fluid out said first output conduit in the absence of said control signal from said first (fluidic binary) counter and out said second output conduit upon the application of said control signal from said first (fluidic binary) counter;

b. a second buffer amplifier adapted to receive power fluid comprising first and second control conduits and first and second output conduits, said first control conduit in communication with said first output conduit of said second self-biased fluid amplifier and said second control conduit in communication with said second output of said second self-biased fluid amplifier, whereby said control conduits act on said power fluid in such a manner as to direct said power fluid out said first output conduit of said second buffer amplifier in the presence of a fluid signal in said first control conduit and out said second output conduit of said second buffer amplifier in the presence of a fluid signal in said second control conduit.

20. The invention according to claim **19** wherein said power fluid of said second self-biased fluid amplifier and of said second buffer amplifier comprises portions of said second stream of supply fluid.

21. The invention according to claim **19** wherein said first output conduit of said second buffer amplifier exhausts to ambient.

22. The invention according to claim **7** wherein said transducer means of said fluidic-electric switch comprises:

a. an input conduit that receives said fluid signal from said second output conduit of said second fluid amplifier means;

b. a cylindrical plug centrally located within said input conduit so as to form an annular orifice for transforming said fluid signal into an annular column of fluid;

c. an interaction chamber located to receive said annular column of fluid and transmit it so as to impinge upon the edge of the opening to a resonating cavity to produce a multiple frequency edgetone or ringtone which acts to set up oscillations of the fluid within said resonating cavity;

d. a diaphragm forming the closed end of said resonating cavity adapted to pulsate inwardly and outwardly in response to said fluid oscillations;

e. a metallic reed connected to said diaphragm and located between the pole pieces of a permanent magnet and adapted so as to vibrate therebetween in response to said pulsations of said diaphragm;

f. wires connected to said magnet adapted to receive and transmit the electromotive force generated in response to said vibrations of said reed.

23. The invention according to claim **22** wherein said switching means of said fluidic-electric switch comprises a control nozzle which connects said output conduit of said second fluidic binary counter with said interaction chamber of said transducer means whereupon the reception of said fluid control signal will cause a disturbance in said annular column of fluid in said interaction chamber so as to prevent said oscillations of said fluid from occurring and terminate the generation of electrical energy upon the conclusion of said second time interval.

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