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Grantham et al.

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[45] **June 6, 1972**

[54] ORDNANCE FUZE ENCODING AND DECODING SYSTEM

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[52] **U.S. Cl.** ..... **102/70.2 R**, 89/1.5 D

[51] **Int. Cl.** **F42c 13/00**, F42c 15/24, F42c 11/02

[58] **Field of Search** ..... 89/1.5 D; 102/70.2

[56] **References Cited**

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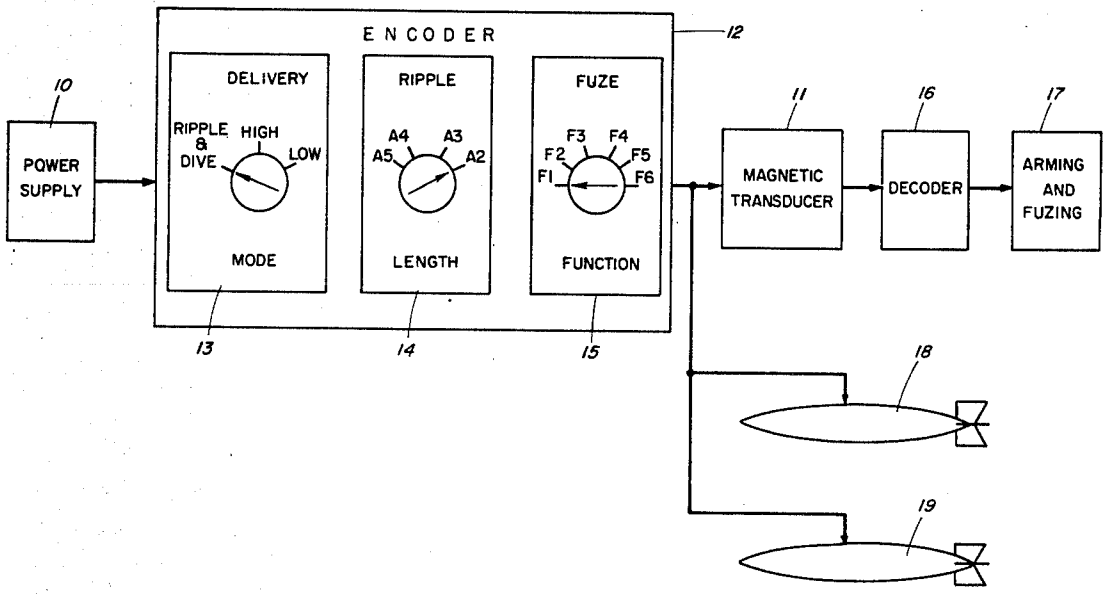
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[57] **ABSTRACT**

An ordnance fuze system includes a source of D.C. voltages and an encoder located on an ordnance delivery vehicle, such as an aircraft, and a magnetic transducer, decoder, and arming and fuzing circuit located on an ordnance device, such as a bomb. A ternary voltage code is encoded on the aircraft to select the delivery mode, arming time, and fuze options of the bomb. The coded signal is transferred to the bomb at aircraft-bomb separation via the transducer and decoded in the decoder, which includes a plurality of SCR's and switch actuators, to initiate the arming and fuzing circuit which includes a plurality of fuze sensors, energy storage devices, switches, and an arming motor. The encoder includes a mechanically initiated ripple option.

12 Claims, 4 Drawing Figures



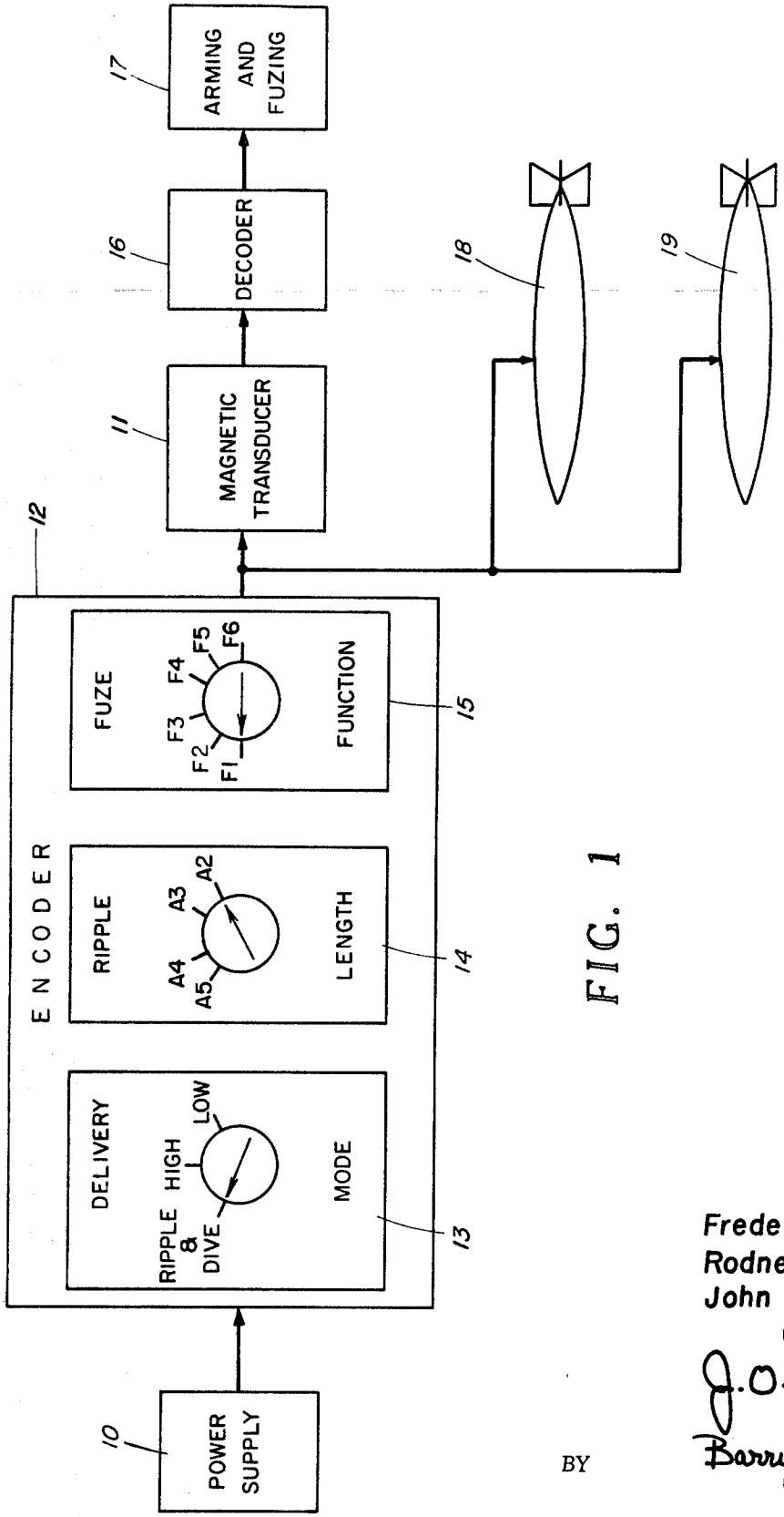


FIG. 1

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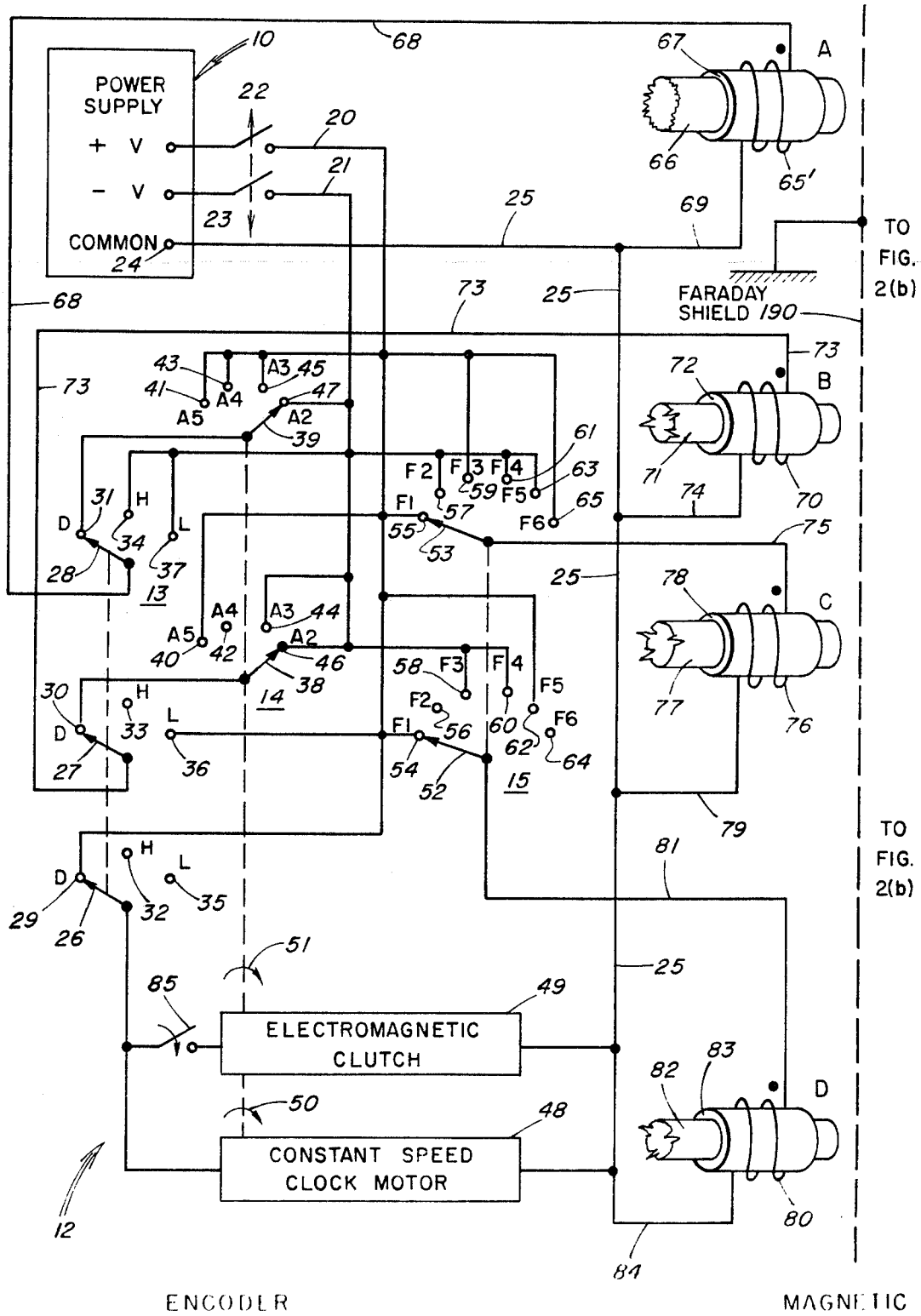

POWER SUPPLY
+ V
- V
COMMON
ELECTROMAGNETIC CLUTCH
CONSTANT SPEED CLOCK MOTOR
FARADAY SHIELD 190
TO FIG. 2(b)
TO FIG. 2(b)
ENCODER
MAGNETIC

Fig. 2(a)

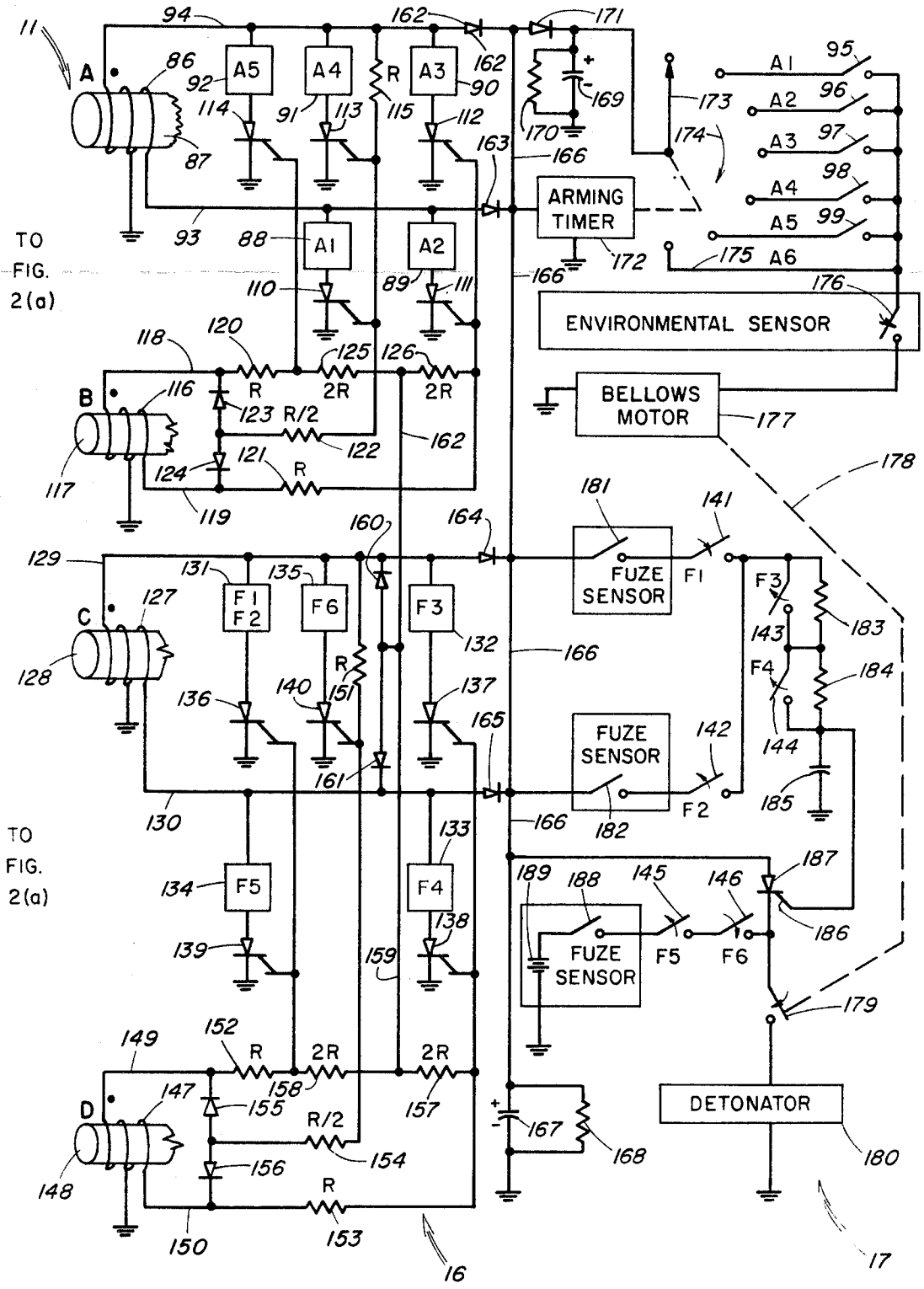

TO FIG. 2(a)
TO FIG. 2(a)
ARMING TIMER
ENVIRONMENTAL SENSOR
BELLOWS MOTOR
FUZE SENSOR
FUZE SENSOR
FUZE SENSOR
DETONATOR
A1
A2
A3
A4
A5
A6
F1
F2
F3
F4
F5
F6
R
2R
R/2
TRANSDUCER
DECODER
FUZING AND ARMING

Fig. 2(b)

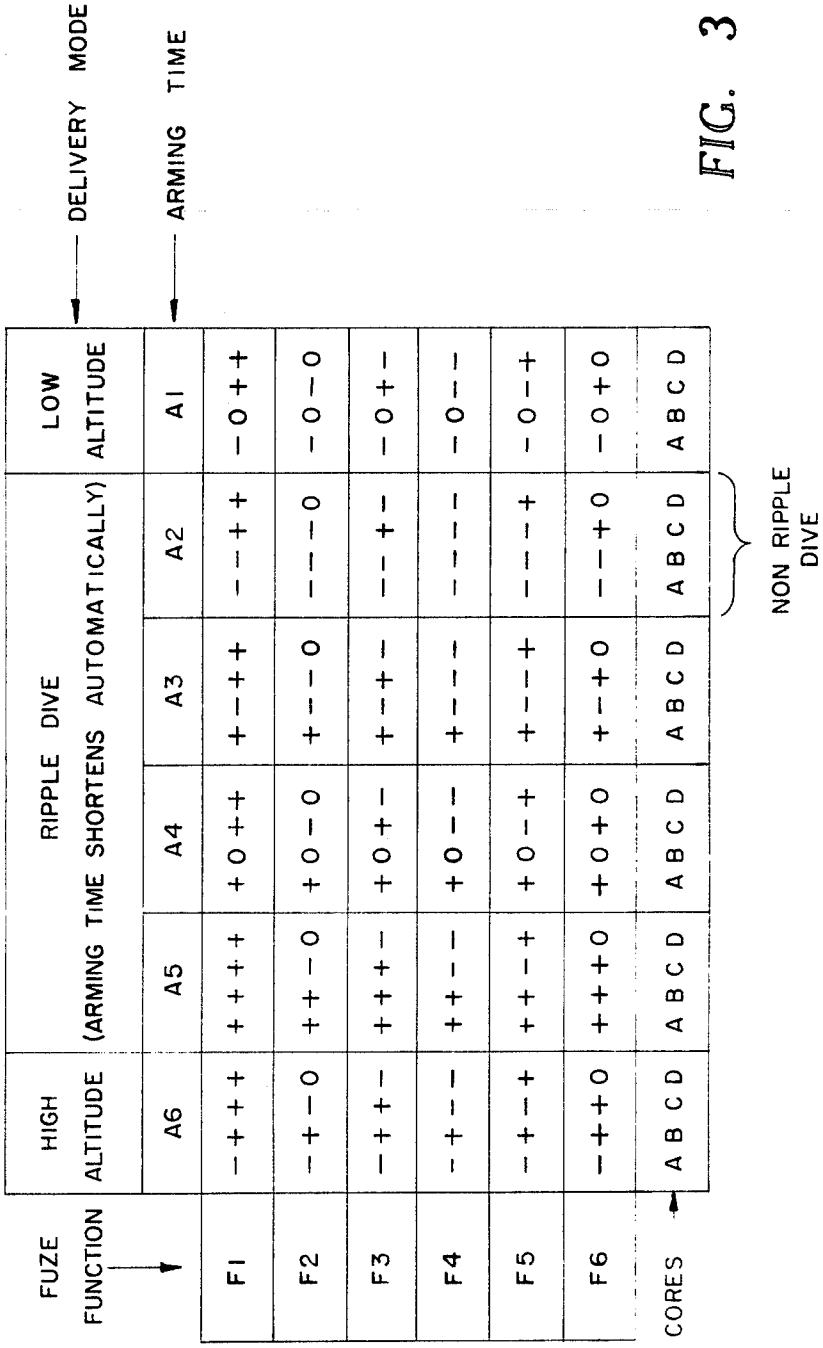

DELIVERY MODE
ARMING TIME
FUZE FUNCTION
HIGH ALTITUDE
RIPPLE DIVE (ARMING TIME SHORTENS AUTOMATICALLY)
LOW ALTITUDE
A6
A5
A4
A3
A2
A1
F1
F2
F3
F4
F5
F6
CORES
A B C D
NON RIPPLE DIVE

FIG. 3

ORDNANCE FUZE ENCODING AND DECODING SYSTEM

BACKGROUND OF THE INVENTION

This invention relates generally to ordnance fuzes and, more particularly, to an ordnance fuze encoding and decoding system for providing a plurality of arming and fuzing options.

Heretofore employed ordnance fuzes have been devised which provide a plurality of arming and fuzing options. These prior art ordnance fuzes have been somewhat unsatisfactory, however, since these ordnance devices make use of radio frequency (RF) signals to select the desired arming or detonation option and, therefore, are somewhat complex, expensive, voluminous or otherwise undesirable. Recently, ordnance fuzes have been devised which make use of D.C. voltages to select the desired arming or fuzing option. Unfortunately, however, these D.C. initiated fuzes have been somewhat undesirable in that they are subject to both A.C. and RF signal interference. Additionally, these D.C. signal initiated fuze systems have been somewhat unsatisfactory in that they do not provide an adequate number of arming and fuzing options. Still furthermore, D.C. initiated fuzes have required the use of high D.C. voltages available from the delivery vehicle to initiate the desired arming or fuzing option.

SUMMARY OF INVENTION

Accordingly, one object of the present invention is to provide an ordnance fuze having a plurality of arming and fuzing options.

Another object of the instant invention is to provide an ordnance fuze whose detonation options and fuzing options are selectable by utilizing D.C. voltages.

Another object of the present invention is to provide an ordnance fuze that is immune to A.C. or RF signals.

A still further object of the instant invention is to provide an ordnance fuze utilizing a low magnitude direct current voltage as the selecting signal.

Another object of the present invention is to provide an ordnance fuze that is not initiated until release of the ordnance device from the delivery vehicle.

Briefly, these and other objects of the present invention are attained by providing an ordnance fuze having a plurality of arming and fuzing options. D.C. voltages are selectively stored within an encoding unit, located in the delivery vehicle and, upon release of the ordnance device, are transmitted to a decoding unit, located within the ordnance fuze, to selectably choose the desired arming and fuzing option. The encoding and decoding units are connected by a magnetic link to insure that no output is transmitted to the fuzing and arming options prior to separation of the delivery vehicle and ordnance device.

BRIEF DESCRIPTION OF THE DRAWINGS

A more complete understanding of the invention and many of the attendant advantages thereof will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings wherein;

FIG. 1 is a block diagrammatic view of the ordnance fuze system according to one embodiment of the present invention;

FIG. 2(*a*) and 2(*b*) comprise a circuit schematic view of various components of the ordnance fuze system embodied in FIG. 1; and

FIG. 3 is a tabular view showing various applied D.C. voltages and the respective fuzing and arming options associated therewith.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawings, wherein like reference numerals designate corresponding parts throughout, and more particularly to FIG. 1 thereof, the ordnance fuze system is shown as including a source of direct current voltage, such as a power supply **10**, located on the ordnance delivery vehicle,

such as an aircraft or the like. As hereinafter explained, power supply **10** supplies D.C. voltages of predetermined polarity to a magnetic transducer **11** located within the ordnance device, such as a bomb or the like, according to a code selected by an encoder **12** connected therebetween. Thus, encoder **12** "-defines" the voltage of power supply **10**. By way of example, magnetic transducer **11** may be similar to that disclosed in U.S. Pat. application Ser. No. 26,479 filed Apr. 8, 1970 by F. E. Warnock and J. H. Malloy for a "Magnetic Aircraft Weapon Link Transducer," which matured into U.S. Pat. 3,667,342 on the same date as this application. The particular voltage selectably applied to magnetic transducer **11** is a function of the switch positions of delivery mode, ripple length and fuze function switches, **13**, **14** and **15**, respectively, located within encoder **12**.

As hereinafter explained, the selected D.C. voltage code is stored in the input of magnetic transducer **11**. Upon physical separation of the aircraft and the bomb, the magnetic transducer output transfers the stored voltage code to a decoder **16** located within the bomb which selects the particular arming and fuzing option for an arming and fuzing circuit **17** located in the bomb. It is to be noted that magnetic transducer **11** does not supply an output to decoder **16** unless there is concurrent physical separation of the aircraft and the bomb, and D.C. excitation from encoder **12**. More particularly, magnetic transducer **11** will not provide an output to decoder **16**, and subsequent arming and fuzing of circuit **17**, upon mere physical separation of the aircraft and the bomb. Similarly, mere D.C. excitation of magnetic transducer **11** from the encoder **12** will not provide an output to the decoder, and subsequent arming and fuzing selection, absent physical separation of the bomb and the aircraft. Other ordnance devices, such as bombs **18** and **19**, including their respective magnetic transducers, decoders, and arming and fuzing circuits, (not shown) may be connected to encoder **12** to provide plural arming and fuzing capabilities as selected by the voltage applied from the encoder.

Referring now to FIG. 2 of the drawing, power supply **10** is adaptable to supply D.C. voltages +V and −V at leads **20** and **21**, respectively, to supply encoder **12** with the desired coding voltage when a double pole switch **22**, **23** is closed. Power supply **10** also includes a point of reference or common potential **24** which is connected to the magnetic transducer and the encoder by a lead **25**. A plurality of ganged switches, **13**, **14**, and **15**, corresponding respectively to the delivery mode, ripple length, and fuze function switches shown in FIG. **1**, are located in the encoder.

More particularly, delivery mode switch **13** includes a plurality of switch armatures **26**, **27**, and **28**, ganged together for movement in unison, which make contact with dive mode position contacts **29**, **30**, and **31**, high mode position contacts **32**, **33**, and **34**, or low mode position contacts **35**, **36**, and **37**, respectively. Similarly, switch armatures **38** and **39**, located in ripple length switch **14**, are ganged together for movement in unison and make contact with contacts **40** and **41**, **42** and **43**, **44** and **45**, and **46** and **47**, corresponding, respectively, to various arming times A5–A2. Switch armatures **38** and **39** are adapted to be moved mechanically, via a constant speed clock motor **48** and an electromagnetic clutch **49** connected thereto, in a clock-wise direction as shown by arrowheads **50** and **51**. As hereinafter more fully explained, constant speed motor **48** and electromagnetic clutch **49** serve to step switch armatures **38** and **39** through the various arming times, thereby varying the arming times for the individual bombs during the dive and ripple modes of operation. As indicated in the drawing, fuze function switch **15** includes switch armatures **52** and **53** ganged together for movement in unison which make contact with contacts **54–65** corresponding, respectively, to various fuze options F1–F6.

The switch contacts and switch armatures of delivery mode, ripple length, and fuze function switches, **13**, **14**, and **15**, respectively, are arranged to selectively apply voltages of +V, −V, or 0 volts to the input windings of magnetic transducer

11. More particularly, an input winding 65' of magnetic transducer core A is wound around an iron core 66 and a shorting turn 67 and is connected to switch armature 28 via a lead 68. The other side of input winding 65' is connected, via a lead 69, to lead 25 and, therefore, to common potential 24. Similarly, an input winding 70 of magnetic transducer core B is wound around an iron core 71 and a shorting turn 72, one side of the input winding being connected via a lead 73 to switch armature 27 and the other side of the input winding being connected via a lead 74 to common lead 25.

Switch armature 53 of magnetic fuze function switch 15 is attached via a lead 75 to one side of an input winding 76 of magnetic transducer core C which is wound around an iron core 77 and a shorting turn 78. A lead 79 connects one side of input winding 76 to common lead 25 and, therefore, connects one side of the input winding to reference or common potential. Similarly, switch armature 52 is attached to input winding 80 or magnetic transducer core D by a lead 81. Input winding 80 is wound around an iron core 82 and a shorting turn 83 and is connected via a lead 84 to common lead 25.

Shorting turns 67, 72, 78, and 83 are wound around the respective iron cores of the magnetic transducer on the input winding side to insure that mere D.C. excitation of the input winding, absent physical separation between the aircraft and the bomb, will not be transferred as D.C. output to the output windings of the transducer.

As hereinbefore mentioned and as hereinafter more fully explained, the switch contacts of switches 13, 14 and 15, are so arranged that movement of the switch armatures selectively engage the various contacts and selectively apply a predetermined voltage to the various input windings of the magnetic transducer. Thus, contacts 29 and 36 of delivery mode switch 13 are connected to lead 20 which carries a voltage of +V while contacts 34 and 37 are connected to lead 21 which carries a voltage of −V for application to the various input windings. Contacts 30 and 31 of switch 13 are connected to switch armatures 38 and 39 of ripple length switch 14, respectively, while contacts 32, 33, and 35 of the delivery mode switch are not connected and, therefore, may be eliminated if desired. Similarly, contacts 40, 41, 43, and 45 of ripple length switch 14 are connected to lead 20 carrying a plus voltage while contacts 44, 46, and 47 are connected to the minus voltage lead 21. Contact 42 of the ripple length switch is not attached to any point and may be eliminated if desired. Fuze function contacts 54, 55, 59, 62, and 65 and contacts 57, 58, 60, 61, and 63 are connected to the positive voltage and the negative voltage of power supply 10, respectively, while contacts 56 and 64 are not attached and, therefore, may be eliminated.

As hereinbefore explained, the various switch armatures of the respective delivery mode, ripple length, and fuze function switches are ganged together for respective movement in unison. Thus, the three switch armatures of delivery switch 13 are ganged together for movement in unison while the two switch armatures of fuze function switch 15 are ganged together for their respective movement in unison. The switch armatures of delivery mode and fuze function switches 13 and 15 are moved manually while the switch armatures of ripple length switch 14 are moved mechanically by the constant speed motor 48 and the electromagnetic clutch 49. Electromagnetic clutch 49 is energized to move the switch armatures upon closure of a weapon release switch 85 connected thereto.

The inputs to the magnetic transducer are selectably energized with a predetermined voltage and, upon physical separation of the bomb and the aircraft, a voltage is induced at the respective magnetic transducer outputs. An output winding 86 of magnetic transducer core A is wound around an iron core 87 with polarity as shown and is grounded in the middle to resemble a center tapped transformer. A plurality of switch actuators 88 and 89, and 90, 91, and 92 are connected to output winding 86 via leads 93 and 94, respectively. Switch actuators 88–92 are adapted, when actuated, to close switch contacts 95, 96, 97, 98, and 99 corresponding, as hereinafter more fully explained, to the various arming times A1–A5, respectively. As hereinafter more fully explained, switch actuators 88–92 are selectably actuated to close their corresponding switches 95–99 and, thereby, select the desired arming time, when unidirectional semiconductive devices, connected to the switch actuators, are rendered conductive. More specifically, a triggerable semiconductive device, such as a SCR 110, the anode of which is connected to the switch actuator and the cathode of which is grounded, is rendered conductive to energize switch actuator 88 and, thereby, close switch contact 95 which arms the bomb after a predetermined arming time interval A1. Similarly, triggerable semiconductive devices, such as SCR's 111, 112, 113, and 114, are connected to switch actuators 89–92, respectively, and are selectively rendered conductive to energize the switch actuator connected thereto and, therefore, close the corresponding switch contact to select the arming time A2, A3, A4, or A5 of the bomb.

Various resistive impedances, such as a resistor 115 of resistance value R, are connected to the gate terminals of the SCRs to trigger the SCR's into conduction. An output winding 116, wound around an iron core 117 with polarity as shown, is grounded at the center to provide an electrical output at lead 118 and 119 at concurrent D.C. excitation and bomb separation. Resistors 120 and 121, of resistance R, are connected to leads 118 and 119 to provide a trigger signal to the gates of SCRs 114 and 111, respectively. One side of resistor 122 of resistance R/2 is connected to the gates of SCRs 110 and 113. The other side of resistor 122 is attached to the juncture of semiconductive devices, such as diodes 123 and 124, and back to the output winding 116 via leads 118 and 119. Resistors 125 and 126, of resistance value 2R, are connected between the gates of SCRs 111 and 114. It is to be noted, of course, that the values of the various resistors are given by way of example only.

Core C of magnetic transducer 11 includes, on its output side, an output winding 127 wound around an iron core 128 with polarity as shown and grounded in the center to provide electrical output at leads 129 and 139. A plurality of switch actuators, such as explosive switches 131, 132, 133, 134, and 135, are connected to output winding 127 via leads 129 or 130. The switch actuators are actuated by triggerable semiconductor devices, such as SCR's 136, 137, 138, 139, and 140 connected thereto, to effect closure or opening of switches 142, 143, 144, 145, and 146 as shown by their respective arrowheads. Thus, conduction of SCR 136 energizes switch actuator 131 to effect closure of switch 141 and opening of switch 142 and so on. As hereinafter more fully explained, the selective opening or closing of switches 141–146 selects the desired fuze function or detonation option which may be, for example, impact, or impact plus time delay or the like.

An output winding 147 is wound around an iron core 148 of magnetic transducer core D with polarity as shown and grounded at the center to provide electrical signals at leads 149 and 150. Resistive impedances are connected to the gates of the various SCRs to provide trigger signals thereto responsive to the electrical signals appearing at leads 129, 130, 149, and 150. Thus a resistor 151 of resistance R is connected between lead 129 and the gate of SCR 140 to provide a trigger signal to the SCR. Similarly, resistors 152 and 153 are connected to lead 149 and the gate of SCR 139, and to lead 150 and the gate of SCR 138, respectiv ely. One side of a resistor 154 is attached to the gate of SCR 140 while the other side is connected to the juncture of semiconductive unidirectional devices, such as diodes 155 and 156. The other side of the diodes are connected, respectively, to leads 149 and 150 and, therefore, to output winding 147. Two other resistors 157 and 158 of resistance value 2R are connected, respectively, to the gate of SCR's 138 and 139. The juncture of the resistors are attached, via a lead 159, to the juncture of two unidirectional semiconductive devices, such as diodes 160 and 161. The

other side of diodes **160** and **161** are connected to leads **129** and **130**, respectively, and therefore, to output winding **127**. The purpose of resistors **125**, **126**, **127**, and **128** is to provide reverse bias to the SCR gates when no trigger signal is present. A lead **162** couples the juncture of lead **129** and diodes **160** and **161** with the juncture of resistors **125** and **126**.

As hereinafter more fully explained, magnetic transducer **11** is utilized as both an option selection circuit and a power transfer circuit between the aircraft and the bomb. More particularly, cores A, B, C, and D are selectively energized to select SCRs **110–114** and **137–140** which actuate the various explosive actuators to close the corresponding switches and, therefore, determine the fuzing and arming option. Magnetic cores A and C also transfer power to the arming and fuzing circuits attached to the decoder **16** as well as transferring option information. To facilitate this power transfer, it may be desirable that the iron cores of core A and core C be larger than the iron cores of core B and D. Thus iron core **66** is larger than iron core **71**, iron core **87** is larger than iron core **117**, etc. Power for the arming and fuzing circuit **17** is selectively available from cores A and C via output leads **94** and **93**, and **129** and **130**, respectively. Unidirectional semiconductor devices, such as diodes **162**, **163**, **164**, and **165**, are inserted in output leads **194**, **193**, **129**, and **130**, respectively, to insure that only positive outputs from the output winding of the cores will be transferred to the arming and fuzing circuit **17**. A lead **166** connects the cathode of diodes **162–165** together. An energy storage device, such as a parallel connected capacitor **167**, and a resistor **168**, are attached to leads **166** and is supplied with energy from the output of cores A and C. As hereinafter more fully explained, capacitor **167** and resistor **168** form an energy storage circuit for supplying power to fuzing option circuitry to detonate the bomb. Similarly, an energy storage device, such as a parallel connected capacitor **169** and a resistor **170**, is connected to lead **166** through a unidirectional semiconductive device, such as a diode **171**. As hereinafter more fully explained, capacitor **169** is charged up with energy from output cores A or C and this energy is utilized to arm the bomb. Diode **171** may advantageously be inserted between lead **166** and the capacitor **169** to prevent discharge of the capacitor back to the decoder or magnetic transducer circuits.

A conventional arming timer **172**, attached to lead **166**, moves a switch armature **173** attached capacitor **169** in the direction of arrowhead **174**. As switch armature **173** rotates, it makes contact with switches **95–99** and a lead **175** corresponding, respectively, to arming times A1–A6. An environmental sensor **176** is attached to switches **95–99** and lead **175**, and is adapted to close upon the sensing of any desired condition. By way of example, environmental sensor **176** may be an accelerometer or the like adapted to close upon separation of the bomb and the aircraft. Such devices are well known in the ordnance fuze art.

As hereinafter more fully explained, rotation of switch armature **173** makes contact with switches **95–99**, which may be selectively closed, and lead **175**. If the environmental sensor **176** is closed, contact of switch armature **173** and concurrence of a closed switch, such as switch **95**, allows capacitor **169** to discharge through switch armature **173**, closed switch **95**, and environmental sensor **176** to actuate a conventional bellows motor **177** connected thereto. Actuation of bellows motor **177**, as indicated by linkage **178**, closes a switch **179** to a detonator **180** and, therefore, arms the bomb. It is to be noted that if none of the switches **95–99** are closed, then switch armature **173** will make contact with lead **175**, corresponding to arming time A6, and the bomb will be armed at that particular time assuming, of course, that the environmental sensor is closed.

The fuzing portion of fuzing and arming circuit **17** includes fuze sensors **181** and **182** connected to energy storage capacitor **167** via lead **166**. The other side of fuze sensors **181** and **182** are connected through switches **141** and **142**, respectively, to a time delay circuit, including serially connected resistors **183** and **184** shunted by switches **143** and **144**, respectively, and a capacitor **185**. It is readily apparent, therefore, that the selective opening and closing of shunt switches **143** and **144** may vary the time delay of the time delay circuit by changing the time constant of the circuit. Thus, for example, when both shunt switches **143** and **144** are opened, one predetermined time delay is provided. Similarly, when both shunt switches are closed, no time delay is provided, etc.

Fuze sensors **181** and **182** may be responsive to any desired detonation condition such as impact, or proximity, or the like and, when closed, connect energy storage capacitor **167** to the time delay circuit depending, of course, on the position of switches **141** and **142**. The output of the time delay circuit is connected to a gate **186** of a triggerable device, such as SCR **187**. Upon triggering of the SCR, at a time dependent on the time delay of the time delay circuit, and the closure of fuze sensor **181** or fuze sensor **182**, capacitor **167** discharges through the SCR and closed switch **179**, which has been closed at arming, to detonator **180** to explode the bomb. Similarly, an additional fuze sensor **188**, including its own power source **189**, may be included to be responsive to a desired detonation condition independent of the energy on capacitor **167**. Upon closure of fuze sensor **188**, energy source **189** will discharge, depending on the position of switches **145** and **146**, through closed switch **179** to detonator **180** to explode the bomb. Fuze sensors **181**, **182**, and **188** may be of any type well known in the ordnance fuze art.

To prevent incorrect operation of the coder circuit **16** and corresponding incorrect fuzing and arming selection in circuit **17**, shielding techniques such as a Faraday shield **190** may be included between the input and output of magnetic transducer **11** to protect the transducer from stray RF signals.

The system of the present invention utilizes ternary logic, such as +, −, 0, to choose the arming times and fuze options. Use of ternary logic allows greater weapon flexibility by providing a greater choice of arming and fuzing selection with fewer components than if conventional binary logic is employed. The ternary logic is impressed on cores A, B, C, and D of transducer **11** responsive to encoder **12** and the position of delivery mode, ripple length, and fuze function switches **13**, **14**, and **15**, respectively, therein.

Referring now to FIG. **3** of the drawing, the ternary logic code employed in the present invention is shown in tabular form. High altitude, ripple dive, and low altitude delivery modes are selectively available for the bomb depending on the position of delivery mode switch **13**. In conjunction therewith, fuze options F1–F6 are available and are selected depending on the position of fuze function switch **15**. If the high altitude mode of delivery is selected, the bomb will be armed at time A6 regardless of the fuze option selected. Similarly, if the low altitude delivery mode is selected, the bomb will be armed at a time A1 independent on the fuze option selection. During the ripple dive-delivery mode, the arming times A5–A2 are automatically varied as the aircraft approaches the target, depending on the position of ripple length switch **14**. Thus, if ripple length switch **14** is set at position A5, the arming times will be automatically shortened from A5, to A4, to A3, and, finally, to A2 by the rotation of switch armatures **38** and **39** moved by constant speed motor **48** via the electromagnetic clutch **49** as shown in FIG. **2**. Similarly, if the ripple length switch **14** is set at position A4, the arming times will automatically shorten from A4 to A2, and so on. It is to be noted that the ripple length delivery mode, as determined by ripple length switch **14**, occurs only when the delivery mode switch **13** is in its dive position. Thus, ripple delivery mode is advantageously utilized when the aircraft is in a dive delivery mode to shorten the arming time of the bomb as the aircraft approaches the target. Since information is transferred from the aircraft to the bomb only after D.C. excitation and subsequent physical separation, the arming time of a particular bomb, during ripple delivery, will be determined by the particular code available at the encoder during the particular moment of separation of that bomb from the aircraft. It is to be noted that when ripple

length switch 14 is in the A2 position, corresponding to switch armatures 38 and 39 in contact with contacts 46 and 47, respectively, as shown in FIG. 2, the switch armatures are in their end position and, therefore, the arming time will not be varied but will remain at A2 during the entire dive.

Reference to FIG. 3 of the drawing reveals that the ternary logic code employed in the embodiment of the present invention is a "non-hazard" code in that only one core A, B, C, or D of magnetic transducer 11 is progressively changed during the variation of the arming times for a particular fuze option. Thus, for fuze option F1, as the arming time is changed during ripple delivery from A5 to A2 only one core excitation is varied from one arming time to the next. More particularly, as the arming time varies A5 to A4 the excitation of core B is varied but the excitation of the remaining cores remain the same. This insures that no state is passed through which would give an arming time out of sequence or change the fuze function selected. Thus, there are no logic hazards when rippling from A5 to A2. In fact, this prevention of logical hazards is extended to include transition from the high altitude arm A6, through ripple dive, to the low altitude arm A1.

The operation of the bomb fuze system may best be understood with regard to a particular example corresponding to a desired fuze option and arming time, it being understood, of course, that a like analysis applies to the other fuze option and arming time combinations. Let it be assumed that a pilot or the like on the aircraft desires to deliver the bomb in a dive delivery mode with an arming time A2 for a fuze option F1. He selects the desired combination of delivery mode, ripple length, and fuze function positions on the encoder panels of FIG. 1. Referring to FIG. 3 of the drawing, it is seen that this combination corresponds to a logic code −, −, +, and + imposed on cores A, B, C, and D of the magnetic transducer, respectively.

FIG. 2 of the drawing shows the various encoder positions corresponding to the encoder positions of FIG. 1. More particularly, switch armatures 26, 27, and 28 make contact with contacts 29, 30, and 31, respectively, corresponding to the dive position of delivery mode switch 13. The armatures of ripple length switch 14 are in the A2 position since switch armatures 38 and 39 are in contact with contacts 46 and 47. Still furthermore, armatures 52 and 53 in fuze function selection switch 15 make contact with contacts 54 and 55 which are the F1 fuze function contacts.

Upon closure of double pole switch 22, 23, +V and −V voltages are available at lead 20 and 21, respectively. Upon closure of switch 23, −V volts are supplied to the input winding of core A through a path including lead 21 contact 47, switch armature 39, contact 31, switch armature 28 and lead 68. Thus, core A is excited with a − polarity at its dotted winding. Similarly, core B is supplied with a − polarity at its input winding via a path including lead 21, contact 46, switch armature 38, contact 30, switch armature 27 to lead 73. Similarly, a path of positive voltage may be traced from power supply 10 to core C and D when switch 22 of the double pole switch is closed and the armatures of fuze function switch 15 are in the position as shown. More particularly, a path is extended from the power supply, contacts 22, lead 20, contact 55, switch armature 53 to a lead 75 and the input of core C. Likewise, a path is extended from the positive power supply terminal through lead 20, contact 54, switch armature 52, and lead 81 to the input winding of core D. It is readily apparent that the excitation of the input windings of the magnetic cores with the aforementioned voltages and polarities correspond to the ternary code −, −, +, + shown in FIG. 3 of the drawing and, therefore correspond to the desired fuze option F1 and arming time A2. Similarly, other excitations of the magnetic transducer corresponding to the other fuze options and arming times may be imposed on the cores depending on the positions of the delivery mode, ripple length, and fuze function switches 13, 14, and 15. Still furthermore, as hereinbefore explained, when delivery mode switch 13 is in its dive position and when ripple length switch 14 is set at arming times A5, or A4, or A3, the constant speed clock motor 48 will translate the switch armatures 38 and 39 of the ripple length switch to progressively vary the arming times of the bomb during ripple-dive delivery.

As hereinbefore explained, mere D.C. excitation of the magnetic transducer cores 11 from encoder 12, absent physical separation of the aircraft and the bomb, will not effect the desired fuzing and arming initiation of the bomb. Thus, transducer 11 will not transfer the code until physical separation. Upon separation of the bomb and the aircraft, the D.C. excitation available at the input windings of the magnetic cores will be transferred to the corresponding output windings of the magnetic transducer cores. Thus, upon physical separation of output winding 86 from the negatively excited input winding 65' −V volts will be available at output winding 94 and +V volts will be available at output lead 93 of output winding 86 due to the magnetic coupling between the input and output coils of magnetic core A and the polarity of excitation of the input winding. Similarly, −V volts will be available at leads 118, 130, and 150 while +V volts will be available at leads 119, 129, and 149 of the output cores corresponding to the particular excitation of their corresponding input windings.

The availability of a negative voltage at output lead 94 insures that SCR's 112, 113, and 114 will not be triggered since a positive voltage is required to be impressed upon the anode of an SCR before it can be fired. This positive voltage is available at lead 93 and, therefore, either SCR 110 or SCR 111 will be triggered depending on the proper trigger signal available at their corresponding gates. A positive trigger signal is applied to the gate of SCR 111 via lead 119 and resistor 121 to affect conduction of the SCR and, therefore, actuate explosive switch 89 connected in the SCR anode circuit, to close switch contact 96. To insure that SCR 110 is not triggered by a spurious positive voltage which may be available at its gate, the gate is negatively biased with a negative voltage from a path including lead 118, diode 123 and resistor 122. A like analysis for the other arming and fuzing options likewise shows that only one SCR is triggered at a time and that if the voltage available at the anode of the other SCRs would allow triggering of more than the desired SCR, then the gates of the non-triggered SCR's are biased negatively to ensure that they will not conduct due to any spurious positive signals applied to their gates.

As hereinbefore explained, a positive voltage is available at leads 129 and 149 and a negative voltage is available at leads 130 and 150 corresponding to the selected voltages applied to the input windings of the magnetic transducer. A positive voltage at lead 129 enables SCR's 136, 137 and 140 to be triggered depending on which SCR is gated correctly, while the negative voltage available at lead 130 cannot trigger SCR's 138 or 139 since the anodes of the latter SCR's are negatively biased.

A positive voltage is applied to the gate of SCR 136 from lead 149 of magnetic core D and resistor 152 connected thereto to trigger the SCR 136 and, therefore, initiate operation of electroexplosive switch 131 to close switch contact 141 and open switch contact 142. While SCR's 137 and 140 have the proper anode voltage to be rendered conductive, SCR 137 is biased in its non-conductive state by the application of a negative voltage to its gate from output lead 150 and resistor 153. Similarly, a positive voltage is applied to the gate of SCR 140 through a path including lead 129 and resistor 151 of resistance value R. Normally, a positive voltage applied to the gate of SCR 140 in conjunction with a positive voltage applied to its anode would trigger the SCR to actuate electroexplosive switch 135. It is noted, however, that a negative voltage is applied to the gate of SCR 140 via lead 150, diode 156 and resistor 154 of resistance value R/2. Since the value of resistor 151 is greater than the value of resistor 154, the net current applied to the gate of SCR 140 is negative and, therefore, SCR 140 will not be triggered.

The closure of normally open switch 141 and the opening of normally closed switch 142 selectively inserts fuze sensor 181 into the fuzing and arming circuit 17. It is readily apparent, of

course, that the selection of other codes at encoder **12** will cause activation of other explosive switch actuators to open or close their switch contacts and, therefore, insert other fuze sensors, or other time delays, or the like, into the arming and fuzing circuit.

As hereinbefore explained, the magnetic transducer **11** also serves as a power link between the aircraft and the bomb as well as selecting the fuzing and arming options. More particularly, magnetic transducer cores A and C transfer energy from the power supply to the fuzing and arming circuit via leads **94**, **93**, **129**, and **130**. At separation, the positive voltage available at leads **93** and **129** will be passed via diodes **163** and **164** to charge up energy storage device **169**, actuate arming timer **172**, and charge up energy storage device **167**. Of course, the negative voltages available at the other leads **94** and **130** will be blocked by the action of diodes **162** and **165**. The actuation of arming timer **172** will sweep switch armature **173** in the direction of arrowhead **174** and capacitor **169**, which has been charged up with polarity as shown, will discharge through closed switch **96** and closed environmental sensor **176** to initiate operation of the bellows motor **177**. Thus, the actuation of the bellows motor closes a switch **179** to arm the bomb at the desired arming time A2. Likewise, if the other switch contacts **95**, or **97**, or **98**, or **99** had been selectively closed, or if the switch armature had made contact with lead **175**, the bomb would be armed at the other arming times.

It is readily apparent, therefore, the D.C. energization of the magnetic transducer at physical separation determines the arming time and fuzing options of the bomb, such as, in the hereinbefore example by closing switch **96**, and by closing switch **141** and opening switch **142**, respectively.

Responsive to a desired sensed condition by fuze sensor **181**, switch **181** therein will close and capacitor **167** will partially discharge through a path including lead **166**, fuze sensor **181**, switch **141**, and closed switches **143** and **144** to trigger SCR **187** and render it conductive. Capacitor **167** will then discharge through SCR **187**, closed switch **179**, and detonator **180** to explode the fuze. Obviously, the selection of the other fuzing option switches such as, for example, switch **143** and **144** will render a time delay between fuze sensing and detonation. Also, as hereinbefore explained, the other fuze sensors may be selectively inserted into the arming and fuzing circuits to provide other fuzing options depending, of course, on the particular code transferred from encoder **12** to decoder **16** via magnetic transducer **11**.

It is readily apparent, therefore, that the fuze system of the present invention provides selective arming and fuzing options. Similarly, the system is both RF and A.C. shielded and, also, requires both D.C. excitation and physical separation for bomb initiation.

Obviously, numerous modifications and variations of the present invention are possible in light of the above teachings. Thus, other ternary codes may be employed to choose the arming and fuzing options. It is therefore to be understood that within the scope of the appended claims the invention may be practiced otherwise than as specifically described herein.

What is claimed as new and desired to be secured by Letters Patent of the United States is:

1. An ordnance fuzing system comprising
- means connectable to a source of reference voltage,
- means for selectively defining said reference voltage in ternary logic,
- means for transferring said selectively defined reference voltage upon the occurrence of a predetermined condition,
- means responsive to said transferring means for ascertaining information from said defined voltage, and
- means responsive to said ascertained information of said defined voltage and to the power supplied by said defined voltage for selectively arming and detonating the fuze.

2. An ordnance fuzing system according to claim **1** wherein
- said means for selectively defining said reference voltage is an encoder means,
- said means for transferring said selectively defined reference voltage is a magnetic transducer means,
- said means for ascertaining information from said defined voltage is a decoder means, and
- said means for selectively arming and detonating said fuze is an arming and fuzing circuit means.

3. An ordnance fuzing system according to claim **2** wherein said encoder means includes
- means responsive to said fuze for selectively predetermining the arming time of said fuze, and
- means for selectively predetermining the fuzing option of said fuze.

4. An ordnance fuzing system according to claim **3** wherein said encoder means further includes
- means for automatically varying said predetermined arming time when said means for selectively predetermining said arming time is responsive to a predetermined voltage signal indicative of a predetermined delivery mode.

5. An ordnance fuzing system according to claim **2** wherein
- said magnetic transducer means includes at least one magnetic core having an input winding and an output winding, and
- said predetermined condition is concurrent excitation of said magnetic core and relative movement of said input and output windings.

6. An ordnance fuzing system according to claim **5** wherein
- said magnetic core of said magnetic transducer means is selectively excited by said encoder means.

7. An ordnance fuzing system according to claim **6** wherein
- said magnetic transducer means transfers information to said decoder means and transfers power to said arming and detonating means.

8. An ordnance fuzing system according to claim **2** wherein said decoder means includes
- switch means responsive to said defined reference voltage and selectively rendered conductive thereby,
- means responsive to conduction of said switch means for selectively determining an energy path in said arming and fuzing circuit means.

9. An ordnance fuzing system according to claim **8** wherein
- said switch means responsive to said defined reference voltage is a triggerable semiconductive device.

10. An ordnance fuzing system according to claim **9** wherein
- said triggerable semiconductive device is a SCR.

11. An ordnance fuzing system according to claim **2** wherein said arming and fuzing circuit means includes
- energy storage means responsive to said power supplied by said defined voltage, and
- switch means responsive to the signal intelligence of said defined voltage for selectively completing an energy path from said energy storage means to arm and detonate said fuze.

12. An ordnance fuze comprising
- means connectable to a source of reference voltage,
- encoder means for selectively defining said reference voltage said encoder means in ternary logic including means responsive to said fuze for selectively predetermining the arming time of said fuze, means for predetermining the detonation option of said fuze, and means for automatically varying said predetermined arming time,
- a magnetic transducer means for transferring said selectively defined reference voltage including at least one magnetic core having an input winding and an output winding, said transfer occurring at concurrent excitation of said magnetic core by said defined voltage and relative movement of said input and output windings,
- decoder means for ascertaining information from said defined voltage including triggerable semiconductive switch means responsive to said defined voltage and selectively rendered conductive thereby and means responsive to said triggerable semiconductive switch actuator means for selectively determining an energy path in said fuze and

an arming and fuzing circuit means including energy storage means for storing energy provided by said defined voltage, and switch means responsive to said switch actuator means for completing an energy path from said energy storage means to selectively arm and detonate said fuze.

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