Aug. 25, 1959 E. N. SHEELEY 2,900,913

FAIL-SAFE TIME DELAY FUZE

Filed Oct. 2, 1958 4 Sheets-Sheet 1

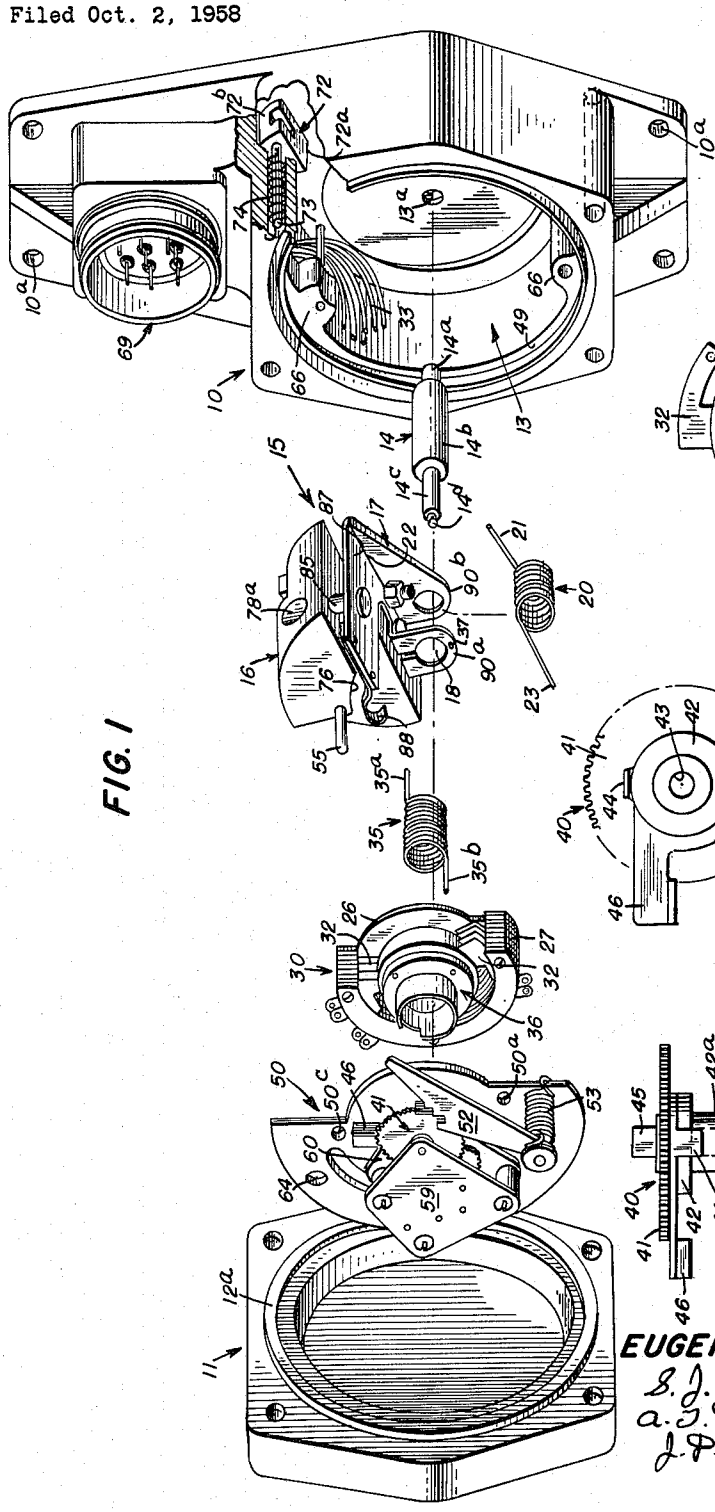


FIG. 1

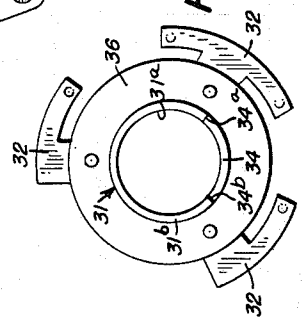


FIG. 8

FIG. 7

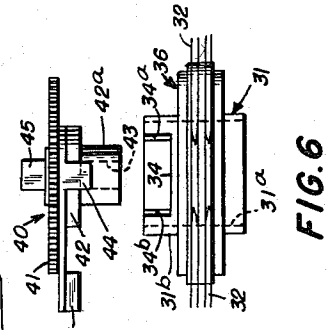


FIG. 6

INVENTOR

EUGENE N. SHEELEY

S. J. Rotondi,

a. J. Dupont 4th

J. P. Edgerton

ATTORNEYS

Aug. 25, 1959 E. N. SHEELEY 2,900,913

FAIL-SAFE TIME DELAY FUZE

Filed Oct. 2, 1958 4 Sheets-Sheet 2

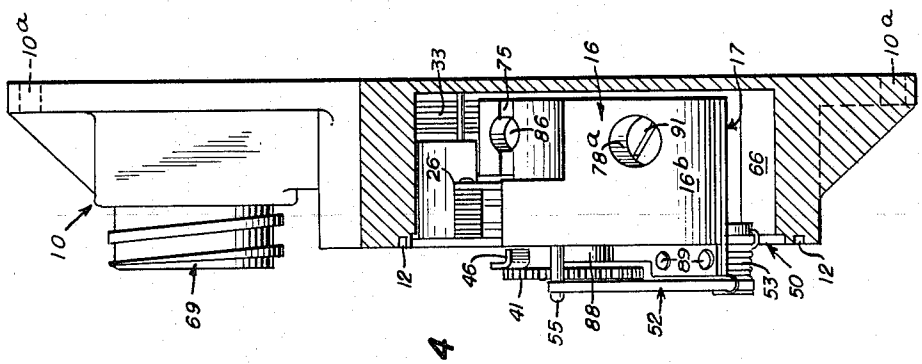


FIG. 4

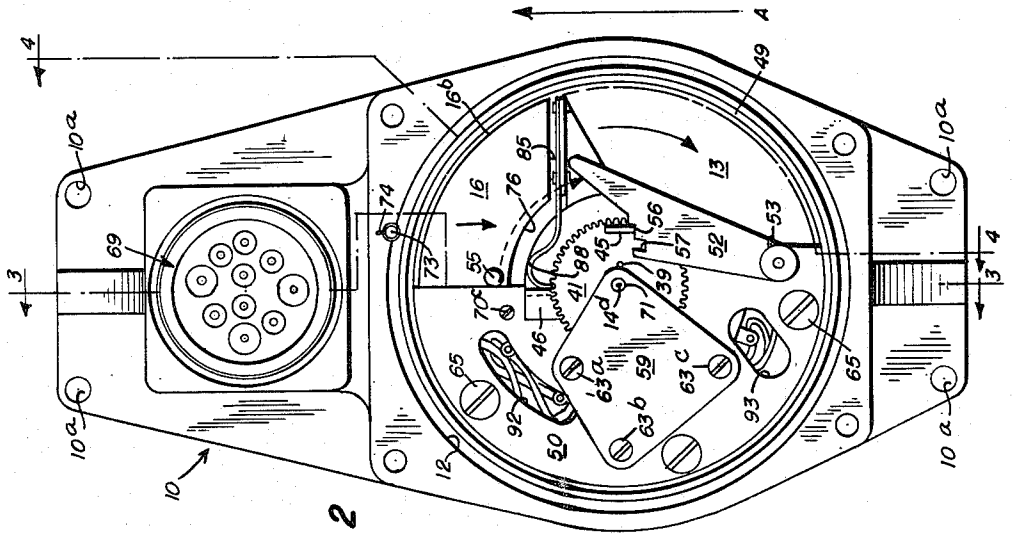


FIG. 2

INVENTOR
EUGENE N. SHEELEY

BY S. J. Rotondi, A. T. Dupont & J. P. Edgerton
ATTORNEYS

Aug. 25, 1959 E. N. SHEELEY 2,900,913

FAIL-SAFE TIME DELAY FUZE

Filed Oct. 2, 1958 4 Sheets-Sheet 3

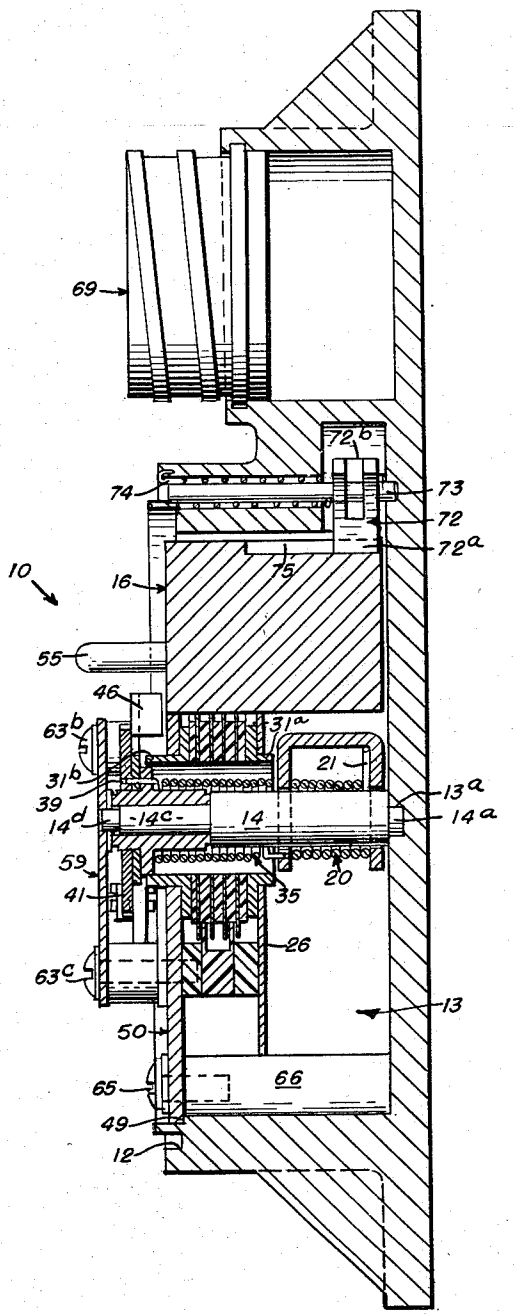


FIG. 3

INVENTOR

EUGENE N. SHEELEY

BY S. J. Rotondi, A. J. Dupont & J. D. Edgerton

ATTORNEYS

Aug. 25, 1959 E. N. SHEELEY 2,900,913

FAIL-SAFE TIME DELAY FUZE

Filed Oct. 2, 1958 4 Sheets-Sheet 4

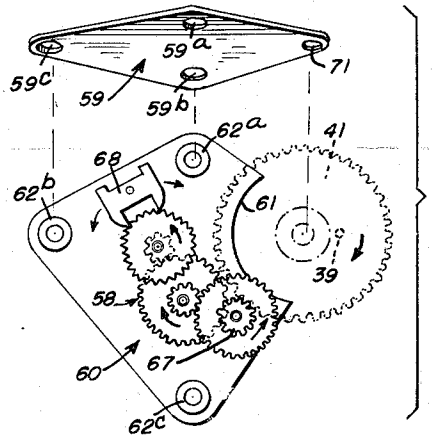


FIG. 9

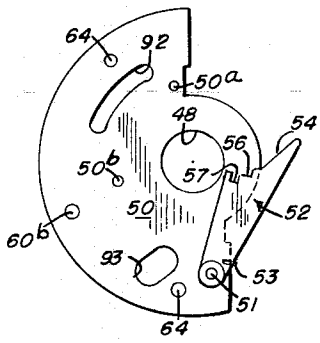


FIG. 10

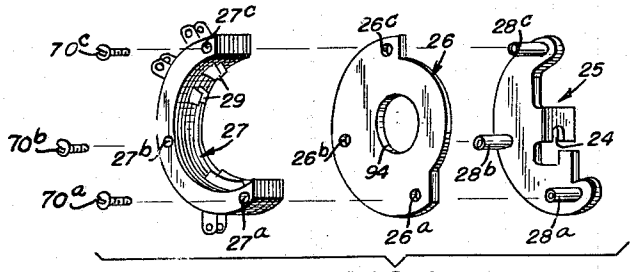


FIG. 5

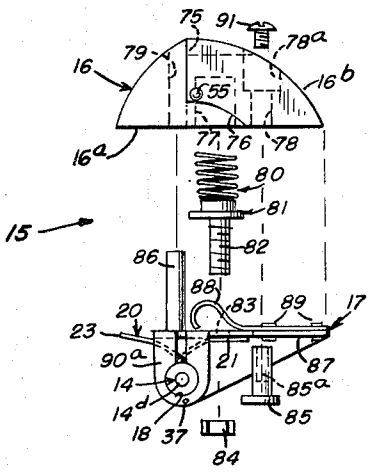


FIG. 11

INVENTOR

EUGENE N. SHEELEY

BY S. J. Rotondi, A. J. Dupont & J. D. Edgerton

ATTORNEYS

United States Patent Office 2,900,913
Patented Aug. 25, 1959

2,900,913

FAIL-SAFE TIME DELAY FUZE

Eugene N. Sheeley, Washington, D.C., assignor to the United States of America as represented by the Secretary of the Army

Application October 2, 1958, Serial No. 765,008

9 Claims. (Cl. 102—84)

(Granted under Title 35, U.S. Code (1952), sec. 266)

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

This invenution relates generally to an improved delay-type arming system for use in an ordnance fuze.

In nonrotative type missiles, forces of acceleration produced upon missile launching are generally used to arm the fuze. These forces are commonly referred to in the fuzing art as "setback." Arming systems which utilize setback to accomplish arming at launching are preferably additionally provided with some type of time-delay mechanism, so that arming is not completed until the missile has travelled a predetermined distance from the launcher.

The time-delay mechanism, which is initiated by the acceleration of the fired missile, must be capable of functioning properly during the acceleration. Prior art time delay mechanisms which have functioned satisfactorily include gear trains which are unwound by a coil spring, the unwinding of the gear train being delayed by some type of pivoted escapement mechanism. Such escapement and gear mechanisms have been found to be sturdy enough to function properly when subjected to missile acceleration forces.

One of the main drawbacks attendant in the use of escapement-gear type of time-delay trains, however, is that oftentimes there is a defect in the gearing of the train. This defect may be manifested by broken gears, gears with stripped teeth, gears which are misaligned and therefore not meshing properly, or by some defect in the escapement mechanism. Defects of this nature were sometimes disasterous because premature arming of the fuze often occurred immediately upon firing when the escapement-gear delay mechanism failed to function properly.

Known prior art fail-safe mechanisms which sought to prevent this premature arming of the fuze upon failure of the time delay train were complex or required considerable space in which to function. Because compactness is so important in fuzes, it is most desirable that the fail-safe mechanism be relatively small and simple so that it can be compactly placed within the fuze body.

Accordingly, it is a general object of this invention to provide a simple and compact arming system which is safe against failure of the time-delay train, and which can be used on almost any type of nonrotative missile.

More specifically, it is an object of this invention to provide an improved fail-safe arming system which in addition to being simple and compact is completely safe against premature arming should the time-delay train fail to function properly or should it be defective.

According to the present invention, the time-delay gear train which completes arming is designed in cooperation with the associated elements of the arming system so that rotation of the arming gear must be less than some predetermined angular velocity before arming of the fuze will occur. A faulty gear train, therefore, which would permit faster rotation of the arming gear (and resulted

in premature detonation in prior art devices) will not complete arming in the fuze of the present invention. In addition, this invention provides an inertia activated element which initiates arming only when the setback is in a predetermined direction and continues to act on the inertia element for some predetermined time with at least some predetermined magnitude. Also, the arming system of this invention is designed so that there is no stored energy when the system is in the unarmed state. Failure of any part of the system thus will not cause premature arming.

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

Figure 1 shows an exploded perspective view of the elements which comprise the fuze of this invention.

Figure 2 is a plan view of the assembled fuze.

Figure 3 is an end elevation of the fuze in the initial or unarmed position taken along line 3—3 in Figure 2.

Figure 4 is an end elevation of the fuze in the armed or final position, taken along 4—4 in Figure 2.

Figure 5 is an exploded view of members which partially form a rotary switch.

Figure 6 is a detailed view of a rotor and a geared arming element which drives the rotor.

Figure 7 is an enlarged plan view of the geared arming element.

Figure 8 is an enlarged plan view of the rotor.

Figure 9 is a plan view of the escapement time-delay gear train with the top plate removed.

Figure 10 is a view of a disc and an arm which is pivotly connected to the disc.

Figure 11 is detailed exploded view of the inertia element which is used to initiate arming of the fuze.

Referring now to Figures 1 and 2, there is shown a fuze in accordance with this invention, which consists of a body **10** and a cover **11**. Cover **11** is provided with an annular ring **12***a*, which can be tightly pressed into an annular groove **12** (Figure 2), so as to hermetically seal the assembled fuze againts moisture and air.

Screw holes **10***a* in body **10** receive suitable machine screws (not shown) so that the body **10** can be fastened to any type of nonrotative missile. Body **10** is positioned as shown in Figure 2, so that setback acting opposite in direction to that of arrow A will cause rotation of an eccentric inertia element **15**. As will be evident, inertia element **15** comprises a unique means for rotating only in response to those forces produced by acceleration which are parallel to arrow A shown in Figure 2.

Body **10** is provided with a substantially cylindrical cavity **13** in which the elements of the fail-safe arming system are enclosed. The bottom of cavity **13** is provided at its center with a small bore **13***a* into which end portion **14***a* of shaft **14** is inserted. Shaft **14** is composed of four cylindrical portions **14***a*, **14***b*, **14***c* and **14***d*. Inertia element **15** is eccentrically positioned on shaft portion **14***b* so as to rotate on shaft **14** in response to setback.

Figure 11, shows in detail a preferred embodiment of the inertia element **15**. As shown in this figure, element **15** comprises a weight **16**, a bracket **17** and a spring **80** positioned therebetween. Weight **16** is composed of a flat surface **16***a* and a circular surface **16***b*, and has three bores **77**, **78** and **79** therein. Bores **78** and **79** extend completely through weight **16** while bore **77** terminates inside weight **16** forming a suitable cavity for receiving coil spring **80**.

Coil spring **80** is compressible by plug **81** which is slidable in bore **77** and has a threaded end **82** which passes through opening **83** and which is held by nut **84** to bracket **17**.

Bores 78 and 79 receive pins 85 and 86, respectively, which are fixed at one end to bracket 17. Pins 85 and 86 are slidable within bores 78 and 79 thereby initially limiting movement of weight 16 relative to bracket 17 only in a direction parallel to that of the longitudinal axis of pins 85 and 86. The longitudinal axes of these pins are parallel to that of the arrow A shown in Figure 2. Bore 78 has a counterbore 78*a* (Figures 4 and 11) which is larger in diameter than bore 78. The head of machine screw 91 fits in counterbore 78*a* and abuts the shoulder between the counterbore 78*a* and bore 78. The end of screw 91 is threaded to connect with internally threaded end 85*a* of pin 85. Movement of weight 16 towards the circular walls of cavity 13 by expansion of spring 80 is limited by screw 91. Since screw 91 can be turned in threaded end 85*a*, the position of weight 16 relative to the circular walls of cavity 13 can be adjusted by merely turning screw 91.

Figures 1 and 11, show bracket 17 as consisting of a flat L-shaped member 87 having ears 90*a* and 90*b* extending perpendicularly from the plane of member 87. Hook 88 is affixed to member 87 by screws 89. The function of hook 88 will be disclosed hereafter.

Coaxial bores 18 in ears 90*a* and 90*b* are coaxial and rotatable on portion 14*b* of shaft 14. Spring 20 (Figure 1) is a coil spring of cylindrical shape and is positioned with its longitudinal axis coaxial of bores 18 and surrounds portion 14*b* of shaft 14. Spring 20 has a free end 21 which is restrained by corner 22 formed between member 87 and ear 90*b* (Figure 3). End 23 of spring 20 is restrained by slotted tab 24 (Figure 5) extending from semicircular plate 25 in a direction substantially parallel to the longitudinal axis of shaft 14. Spring 20 when so restrained by corner 22 and tab 24 is under no appreciable tension and tensions only when inertia element 15 rotates clockwise (as viewed in Figure 2).

Referring to Figure 4, circular portion 16*b* of weight 16 is indented to form a shoulder 75 against which latch end 72*a* can abut. Latch 72 is pivotly connected to body 10 by shaft 73, and is urged counterclockwise, as viewed in Figure 1, by spring 74 which is connected at one end to body 10 and at the other end to shaft 73. End 72*a* protrudes a small distance into cavity 13 to engage shoulder 75. End 72*a* is limited in its movement into cavity 13 by end 72*b* contacting body 10. When end 72*a* engages shoulder 75, weight 16 is prevented from rotating clockwise as viewed in Figure 2.

As should be evident, spring 80 presses weight 16 towards the circular portion of cavity 13 and thereby keeps shoulder 75 in engagement with latch end 72*a*. Rotation of inertia element 15 is thereby prevented, and the system is in the latched or initial position. Before clockwise rotation (as viewed in Figure 2) of element 15 can occur, the setback must be in a direction substantially parallel to that of pins 85 and 86 which is parallel to, and opposite in direction from that shown by arrow A. When the setback is parallel to, and opposite in direction to that of the arrow in Figure 2, weight 16 will be guided by pins 85 and 86 compressing spring 80 against plug 81 held in bracket 17.

Spring 80 must be compressed a distance sufficient for shoulder 75 to disengage from latch end 72*a* before rotation of inertial element 15, clockwise, as viewed in Figure 2, is possible.

As discussed above, screw 91 can be turned to vary the pressure exerted by the spring 80 against weight 16. For various types of missiles the setback produced by launching will also vary, and therefore the force exerted against spring 80 will vary. By merely adjusting screw 91, the arming system of this invention can be satisfactorily adapted for use in any type of missile.

After shoulder 75 clears latch end 72*a* rotation of inertia element 15 from the initial position by continued or sustained forces of acceleration will occur since the weight 16 is eccentrically positioned on shaft 14. Rotation of inertia element 15 tensions spring 20 which thereupon resiliently urges the element 15 back to its initial position against the force of setback. Weight 16 is provided with a pin 55 which extends from the face of the weight 16 substantially parallel to shaft 14. The function of pin 55 will be disclosed hereafter.

Figure 5 is an exploded view of plate 25 and associated members which form part of rotary switch 30. Plate 25, disc 26 and semicircular contact holder 27, when pressed against each other form a housing in which rotor 36 can rotate. Plate 25 is provided with three pins 28*a*, 28*b*, and 28*c* which are fixed at one end to plate 25. The free ends of pins 28*a*, 28*b*, and 28*c* are internally threaded. Disc 26 and contact holder 27 have coaxial bores 26*a*, 26*b*, 26*c*, and 27*a*, 27*b*, 27*c*, respectively, into which pins 28*a*, 28*b*, and 28*c*, respectively, can be inserted. Plate 50 (Figures 1 and 10) is provided with bores 50*a*, 50*b*, and 50*c* which are coaxial with pins 28*a*, 28*b*, and 28*c*, respectively, and receive machine screws 70*a*, 70*b*, and 70*c* (Figure 5), respectively, which fix pins 28*a*, 28*b*, and 28*c* to plate 50.

Figure 6 shows in detail the cylindrical rotor 36 which has a series of contacts 32 on its outer periphery. Contacts 32 are designed to contact contacts 29 (Figure 5) which are held in contact holder 27 when rotor 36 rotates. Cylindrical sleeve 31 is fixed inside rotor 36 and has two sleeve ends 31*a* and 31*b* which extend beyond the ends of rotor 36. End 31*a* is rotatably hold in bore 94 (Figure 5) in disk 26. End 31*b* is rotatable in bore 48 (Figure 10) in plate 50. When the fuze is assembled, rotary switch 30 is fixedly mounted on plate 50 by means of machine screws 70*a*, 70*b* and 70*c*.

Lead wires 33 (Figure 1) are connected by soldering to contacts 29 and terminate at their other ends in a socket 69. As should be apparent to those in the art, socket 69 is adapted to receive a plug which is connected to fuze circuitry.

Figures 1, 2 and 10 show the approximately hemispherically shaped plate 50 which is fitted into cavity 13. The periphery of plate 50 rests against the semicircular sleeve 49 (Figure 1) which has radially protruding ends 66 internally threaded to receive machine screws 65 (Figure 2) which pass through bores 64 spaced around the outer periphery of plate 50. Plate 50 is thereby held in cavity 13 against any type of movement. Weight 16 abuts against the diameter portion of plate 50 (Figure 2) and is prevented from rotating counterclockwise, as viewed in Figure 2, by the diameter portion of plate 50.

At one corner of plate 50, an arm designated by numeral 52, is pivotly fixed to plate 50 by pivot pin 51 (Figure 10). The pivoted end of arm 52 is provided with coil spring 53, one end of which is connected to arm 52 and the other end to plate 50. Spring 53 urges arm 52 counterclockwise as viewed in Figure 10. The free end of arm 52 has a flat edge 54 which terminates in a portion 56 which forms a step in edge 54, and a rectangular slotted portion 57. The function of these portions will be discussed in detail hereafter. Slots 92 and 93 in plate 50 are positioned opposite the soldered connections between contacts 29 and the lead wires 33, so that these connections can be observed without removing plate 50 from cavity 13.

As mentioned above, sleeve end 31*b* (Figure 6) of sleeve 31 is rotatable in bore 48 (Figure 10). Referring now to Figures 6 and 7, there is shown a geared arming element 40 which is composed of a hub 42 fixed to arming gear 41. Hub 42 is designed to fit inside sleeve 31 and is rotatable therein. Arming gear 41 and hub 42 have a common bore 42*a* therethrough which freely rotates upon portion 14*c* of shaft 14 (Figure 1), when hub 42 is assembled inside sleeve 31.

Hub 42 has three tabs 44, 45 and 46 which extend radially from the outer periphery of hub 42 and are affixed thereto. Tab 44 is designed to move within slot 34 provided in end 31*b* and abut the ends 34*a* and

34*b* of slot 34 when hub 42 is rotated. Tab 45 is bent at the end parallel to the longitudinal axis of shaft 14 and forms a rectangular end which extends beyond the outer face of arming gear 41 to engage arm 52. Tab 46 is also bent at its extremity to form a surface which abuts the end of hook 88 affixed to bracket 17 (Figure 2).

As shown in Figure 1, spring 35 has an end 35*a* which can be tightly inserted into hole 37 in ear 90*a*, and an end 35*b* which is tightly inserted into hole 39 through hub 42 and gear 41. Spring 35 is a cylindrical coil spring and is positioned between hub 42 and sleeve 31 when the hub and sleeve are assembled together. The longitudinal axis of spring 35 is coaxial to the coaxial longitudinal axes of sleeve 31, bore 42*a* and shaft 14. When so positioned, spring 35 is untensioned. The end 42*a* of hub 42 bears against the flat surface between portions 14*b* and 14*c* on shaft 14 (Figures 3 and 6).

Arming gear 41 mashes with gear 67 (Figure 9) the latter serving as one gear of the escapement-gear delay train 58, shown in this figure. The escapement-gear train 58 comprises gears which mesh with other gears and pinions in the usual manner, and includes the usual escapement mechanism 68 which oscillates and delays rotation movement of the last gear in the gear train 58. Delay train 58 is housed between plates 59 and 60 (Figure 9). These plates are provided with suitable recesses (not shown) for mounting the ends of the shafts upon which the gears in the gear train 58 rotate. Plate 60 is mounted on plate 50 by any suitable means such as machine screws (not shown), and plate 59 is held to plate 60 by means machine screws 63*a*, 63*b*, and 63*c* (Figure 2) which pass through holes 58*a*, 58*b* and 58*c*, respectively in plate 59 and are held by threaded engagement with pins 62*a*, 62*b* and 62*c* which are affixed at their ends to plate 60.

Plate 59 forms a cover for escapement-gear train 58 as shown in Figure 2, and has a bore 71 in one corner which tightly receives portion 14*d* of shaft 14 and prevents longitudinal movement of portion 14*a* from bore 13*a*. Shaft 14 is thereby held against longitudinal movement in cavity 13. Plate 60 has one corner cut to form an arcuate edge 61 which contacts the outer periphery of sleeve end 31*b* (Figure 9).

Tab 44 (Figure 6) is capable of rotating in slot 34 from end 34*a* to end 34*b* as mentioned above. When inertia element 15 is in the initial position shown in Figure 2, tab 44 contacts end 34*a*. Rotor 36 is designed so that a substantial frictional force exists between conductors 32 and contact holder 27 and, therefore, end 34*a* does not rotate counterclockwise (as viewed in Figure 2) when tab 44 contacts this end. Hook 88, which has been previously referred to, abuts tab 46 and thereby holds tab 44 against end 34*a*. An additional lock against clockwise rotation of tab 44 in slot 34 is provided by tab 45 engaging restraining portion 56 on arm 52. Since tabs 44, 45 and 46 are affixed to hub 42 and gear 41, these members are also prevented from rotating clockwise or counterclockwise when inertia member 15 is in the initial position.

When setback causes inertia element 15 to rotate clockwise (as viewed in Figure 2), hook 88 will no longer abut tab 46. Spring 35 which has hitherto been untensioned will be tensioned because end 35*a* is fixed to the inertia element 15 (Figure 1). While hook 88 no longer restrains tab 46 because it is connected to bracket 17 and accordingly rotates with inertia element 15, tab 45 is held against rotation by remaining in engagement with restraining portion 56 on arm 52. As a result, arming gear 41 is prevented from rotating under the influence of spring 35 which has become wound.

Rotation of inertia element 15 through a predetermined clockwise angle (as viewed in Figure 2) will result in pin 55 striking edge 54 which protrudes into the pin's rotational path. The position where pin 55 drives arm 52 against the bias of spring 53 (Figure 10) a clockwise distance sufficient to cause tab 45 to slide off restraining portion 56 will be hereafter referred to as the intermediate position because it is an angular position which inertia element 15 assumes when it is approximately halfway between its initial and final rotative positions.

An important feature of this invention is that the arming system hitherto disclosed is fail-safe against defects in the escapement-gear train 58. When the escapement-gear train 58 is defective, as for example, when one gear in the gear train is not meshing with another, or if one gear is broken, the following occurs.

Inertial element 15 having reached the intermediate position has caused arming gear 41 to become biased clockwise as viewed in Figure 2, because spring 35 has been wound by rotation of inertia element 15. Hence tab 45 is also biased clockwise so that it could be driven by spring 35 into slot portion 57 in arm 52. If tab 45 were driven into slot 57, clockwise rotation of arming gear 41 would be prevented and tab 46 would not move a sufficient distance through slot 34 to abut end 34*b* and drive rotor 36. As a result, the system remains unarmed, and after the missile impacts or after the acceleration decreases sufficiently, spring 20 which has also become wound by rotation of inertia element 15 would cause counterclockwise rotation of element 15. Hook 88 would also be rotated and push tab 46 counterclockwise. Counterclockwise rotation of tab 46 would cause tab 44 to rotate back to the position where it engages end 34*a*. As a result, the fuze would be restored to its initial or unarmed position.

The above described action would occur if there was a defect in the escapement-gear delay train 58 because a defective delay train would not rotate at some predetermined angular velocity to slow spring biased rotation of gear 41 and tab 45, and the gear 41, when released by tab 45 disengaging from portion 56, would rotate at a higher angular velocity than slot 57 rotating about pin 51. Hence pin 55 would not be able to drive edge 54 fast enough to prevent tab 45 from rotating into slot 57.

When the escapement-gear delay train 58 is functioning properly and retarding rotation of gear 41 and tab 45, when tab 45 is released by restraining portion 56, pin 55 can drive edge 54 and slot 57 at a higher angular velocity than tab 45 can rotate, and as a result slot 57 is driven beyond engagement with slower rotating tab 45. Tab 45 and gear 41 will then be free to continue rotation under the bias of spring 35 until tab 44 strikes end 34*b*. Tab 44 strikes end 34*b* with a considerable force which overcomes the frictional forces between conductors 32 and the contact holder 27. Consequent rotation of rotor 36 occurs which arms the fuze.

Those skilled in the art will understand that the cooperation between the inertia element 15, pin 55, arm 52, spring 53, step and slot portion 56 and 57 respectively, gear delay train 58 and gear 51 carrying tab 45, must be such that the gear delay train 58 rotates at some predetermined angular velocity which allows tab 45 to rotate at an angular velocity which is less than that of the angular velocity of slot 57 rotating about pin 51.

In view of the foregoing, it will be apparent to those skilled in the art that the above-described simple and compact arming system will not initiate arming unless it has been subjected to continued setback which has initially been directed substantially parallel to the longitudinal axes of pins 85 and 86 (or arrow A), and which continues with some predetermined magnitude for some predetermined period of time sufficient to cause unlatching and subsequent rotation of inertia element 15 beyond the intermediate position.

It will also be apparent that arming will not be completed unless the escapement-gear time-delay functions properly. Premature arming upon launching due to a defective escapement-gear is therefore eliminated by the use of this system.

In addition, it will be evident that while this system

employs two springs, 20 and 35, both are substantially untensioned when the fuze is in the initial positions and wind only upon rotation of inertia element 15. Thus the arming system of this invention has no "stored energy" which might cause premature rotation of rotor 36 should any part in the system fail.

It will be apparent that the embodiments shown are only exemplary and that various modifications can be made in construction and arrangement within the scope of the invention as defined in the appended claims.

I claim as my invention:

1. An improved arming system for use in a fuze comprising: a shaft; an inertia element eccentrically positioned on one end of said shaft and rotatable from an initial to a final position in response to forces of acceleration; an arming gear freely rotatable on the other end of said shaft; a coil spring connecting said gear to said inertia element, said coil spring winding upon rotation of said inertial element from said initial to said final position thereby spring-biasing said gear in one direction; an arm constructed and arranged so as to prevent rotation of said gear in said one direction while said inertia element rotates from said initial position to an intermediate position between said initial and final position of said inertia element; a pin on said inertia element adapted to drive said arm which releases said gear for spring-biased rotation in said one direction when said inertia element rotates through said intermediate position; and switch means driven by rotation of said gear in said one direction, said switch means when so driven, arming said fuze.

2. An improved arming system for use in a fuze comprising: a shaft; an inertia element eccentrically positioned on one end of said shaft and rotatable from an initial to a final position in response to forces of acceleration; an arming gear freely rotatable on the other end of said shaft; a coil spring on said shaft connecting said gear to said inertia member, said spring winding upon rotation of said inertia element from said initial to said final position so as to bias said gear in one direction; an arm adapted to prevent spring-biased rotation of said gear in said one direction while said inertia element rotates from said initial position to an intermediate position between said initial and final position; a pin on said inertia element for driving said arm and thereby releasing said gear for spring-biased rotation in said one direction when said inertia element rotates through said intermediate position towards said final position; an escapement-gear delay train engaging said gear and retarding rotation of said gear in said one direction; and switch means driven by said gear when said gear rotates in said one direction, said switch means when so driven, arming said fuze.

3. An improved arming system as defined in claim 2, wherein said arm provides a restraining portion and a locking portion, said restraining portion preventing spring-biased rotation of said arming gear in said one direction during rotation of said inertia member from said initial to said intermediate position, said locking portion being so constructed and arranged as to lock said gear against further spring-biased rotative movement upon failure of said gear delay train to properly delay spring-biased rotation of said arming gear.

4. A fuze for use in nonrotative missiles, said fuze comprising: a fuze body; a cylindrical cavity formed in said fuze body, the walls of said cavity encasing a shaft mounted in said cavity; an inertia element eccentrically positioned on one end of said shaft and rotatable in reponse to forces of acceleration from an initial position to a final position; an arming gear freely mounted for rotation on the other end of said shaft; rotary switch means fixed in said cavity to said housing and rotatable upon rotation of said gear in one direction; gear restraining means preventing rotation of said gear in said one direction while said inertia element is rotating from said initial position to an intermediate position between said initial and final positions; means connected to said inertia element to drive said gear restraining means from preventing rotation of said gear after said inertia member rotates through said intermediate position towards said final position; first and second coil springs coaxially positioned on said shaft, said first spring positioned on said one end of said shaft, said first spring being substantially untensioned when said inertia element is in said initial position, said second spring positioned on said other end of said shaft, one end of said second spring connected to said inertia element and the other end connected to said gear, said second coil spring being substantially untensioned when said inertia element is in said initial position and winding and tensioning upon rotation of said inertia element from said initial position to said intermediate position so as to spring-bias said gear in one direction, said means connected to said inertia element adapted to drive said restraining means from restraining spring-biased rotation of said gear when said inertia element rotates through said intermediate position, rotation of said gear in said one direction causing rotation of said switch in said one direction, rotation of said switch arming said fuze.

5. The fuze as defined in claim 4, wherein said inertia element comprises a weight member and a bracket; bores in said bracket which rotate on said second end portion of said shaft; a coil spring between said bracket and said weight member, said spring urging said weight member from said bracket towards the cavity walls.

6. The fuze as defined in claim 5, wherein said weight member is provided with a shoulder; a latch pivotally connected in said fuze body at one end, the other end protruding into said cavity so as to engage said shoulder when said inertia element is in said initial position; and means to resiliently urge said latch into engagement with said shoulder.

7. A fuze for use in nonrotative missiles, said fuze comprising: a shaft having first and second end portions; an inertia element eccentrically positioned on the first end portion, said inertia element adapted to rotate from an initial to a final position in response to forces of acceleration; a pin on said inertia element; an arming gear freely rotatable on the second end portion of said shaft; a tab fixed to, and extending from said gear and rotatable therewith; a coil spring on said second end portion of said shaft, one end of said spring connected to said gear and the other end to said inertia element, said spring being substantially untensioned when said inertia element is in said initial position, said spring winding and tensioning upon rotation of said inertial element from said initial position to an intermediate position between said initial and final position thereby biasing said gear for rotation in one direction; rotary switch means operatively connected to said gear and adapted to arm said fuze when said switch means is driven by said gear; and escapement-gear delay train engaging said gear so as to retard rotation thereof; a flat arm having one edge adjacent said tab, said edge being provided with restraining and locking portions, said edge positioned to contact said pin when said inertia element rotates from said initial position to said intermediate position, said restraining portion of said edge comprising a step in said edge, said step engaging said tab during rotation of said inertia member to said intermediate position, further rotation of said inertia element causing said pin to drive said restraining portion of said arm from contact with said tab thereby freeing said gear and tab for rotation in said one direction, said gear delay train being adapted to retard rotation of said arming gear until said locking portion of said arm is driven by said pin to a position which allows said tab to complete rotative movement in said one direction, said gear then being free to complete rotation thereby driving said switch in said one direction, rotation of said switch arming said fuze.

8. A fuze for use in nonrotative missiles, said fuze comprising: a shaft having first and second end portions;

an inertia element eccentically positioned on the first end portion, said inertia element adapted to rotate from an initial to a final position in response to forces of acceleration; a pin on said inertia element; an arming gear freely rotatable on the second end portion of said shaft; a tab fixed to, and extending from said gear and rotatable therewith; a coil spring on said second end portion of said shaft, one end of said spring connected to said gear and the other end to said inertia element, said spring being substantailly untensioned when said inertia element is in said initial position, said spring winding and tensioning upon rotation of said inertia element from said initial position to an intermediate position between said initial and final position thereby biasing said gear for rotation in one direction; rotary switch means operatively connected to said arming gear and adapted to arm said fuze when said switch means is driven by said gear in said one direction; and escapement-gear time delay train engaging said gear, said delay train adapted to retard spring-biased rotation of said gear to some predetermined angular velocity; an arm having one edge adjacent said tab, a step and a rectangular slot formed in said one edge, said tab engaging said step when said inertia element rotates from said initial to said intermediate position, said pin contacting said edge when said inertia element is in said intermediate position, continued rotation of said inertia element being adapted to cause said pin to drive said arm and said step portion at an angular velocity which is greater than said predetermined angular velocity of said gear so that the greater angular velocity of said arm causes said rectangular slot to rotate beyond engagement with said tab on said gear, freeing said tab and gear for further rotation, further rotation of said gear driving said rotary switch, rotation of said switch arming said fuze.

9. An arming system for use in a fuze comprising: an inertia element and an arming gear mounted for rotation in said fuze; said inertia element rotating in response to forces of acceleration; a spring connected to said inertia element and to said gear so that rotation of said element spring-biases said gear for rotation in one direction; tab means on said gear and rotatable therewith; a gear delay train meshing with said gear so as to retard rotation of said tab and gear to some predetermined angular velocity; a pivoted arm; means on one edge of said arm abutting said tab and adapted to prevent rotation of said gear in said one direction while said inertia member rotates through a given angle; means connected to said inertia element for pivoting said means on said arm when said inertia element rotates through an angle in addition to said given angle, said means on said arm pivoting at a greater angular velocity than said predetermined angular velocity of said tab in said one direction so that said tab freely rotates past said means, continued rotation of said gear in said one direction at said predetermined angular velocity causing said fuze to arm.

No references cited.