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Clark et al.

[11] **3,877,378**

[45] **Apr. 15, 1975**

[54] **SAFETY AND ARMING MECHANISM**

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[73] Assignee: **The United States of America as represented by the Secretary of the Army,** Washington, D.C.

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[21] Appl. No.: **458,999**

[52] **U.S. Cl.**..... **102/71;** 102/76 R; 102/78

[51] **Int. Cl.**..... **F42c 9/04;** F42c 15/04

[58] **Field of Search**..... 102/71, 70.2, 70 R, 76, 102/78

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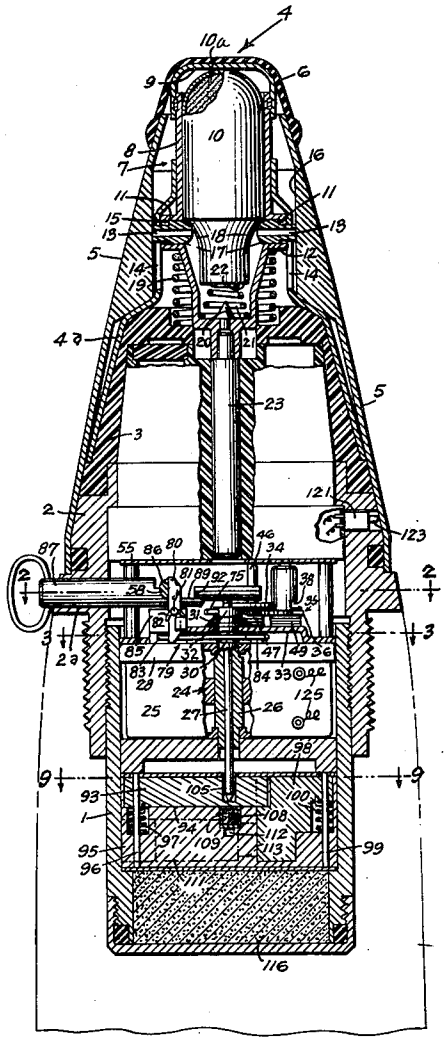
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Attorney, Agent, or Firm—Nathan Edelberg; Robert P. Gibson; Saul Elbaum

EXEMPLARY CLAIM

1. In a fuze for an explosive projectile having a base section, a body section, and a nose section, a safety and arming mechanism including a firing train having a booster charge and acceleration-sensitive means for initiating fuze arming when the projectile to which the fuze is affixed is fired from a gun, the improvement comprising: an impact assembly located in the nose portion of the fuze, said impact assembly comprising a cartridge containing a dust under pressure, means for releasing said dust from said cartridge after the projectile to which the fuze is affixed is airborne, the action of the dust passing over the projectile serving to deposit an electrostatic charge upon the projectile.

9 Claims, 11 Drawing Figures



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SHEET 1 OF 3

Fig. 1.

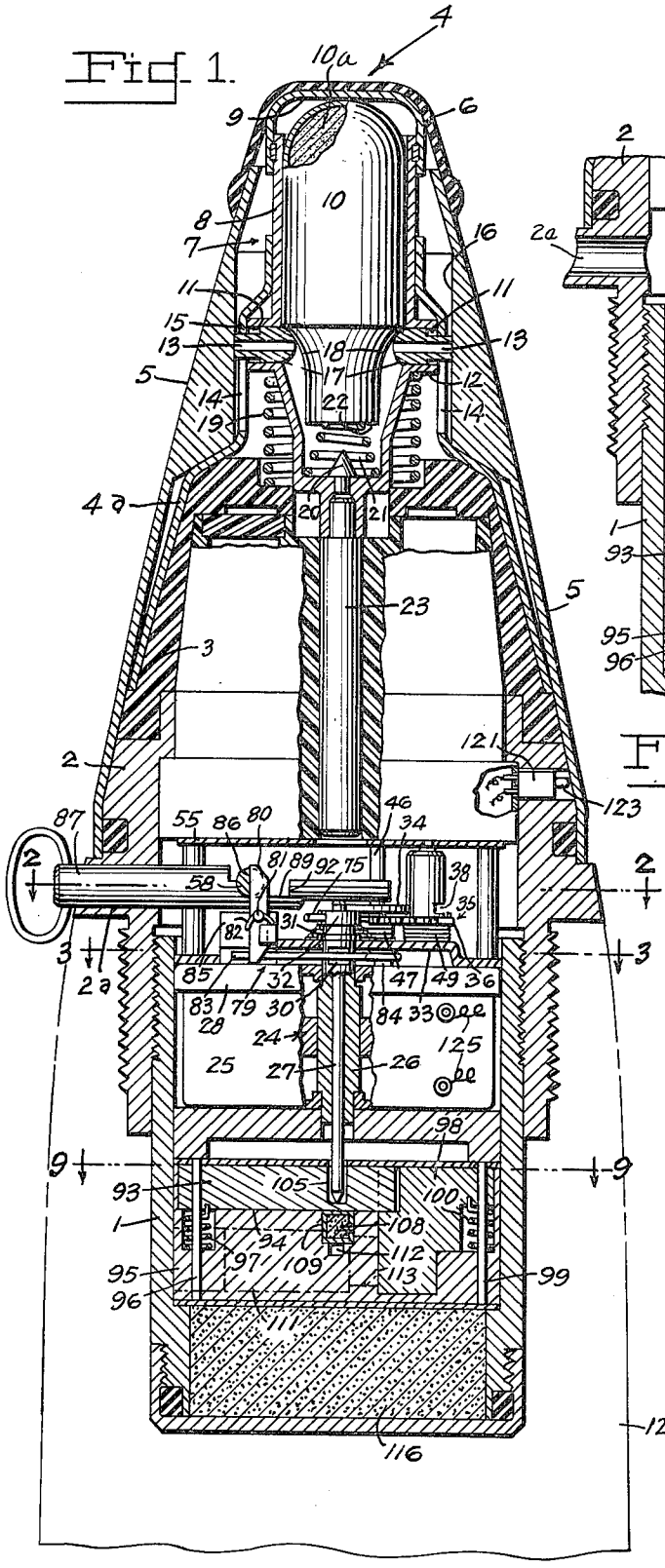


Fig. 4.

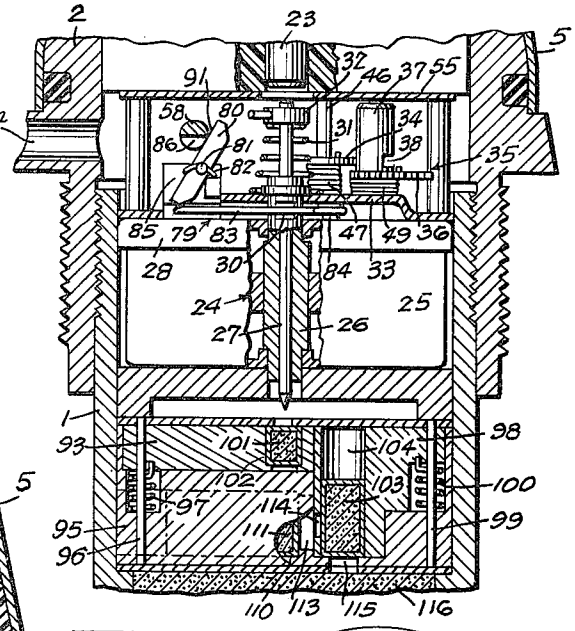


Fig. 10.

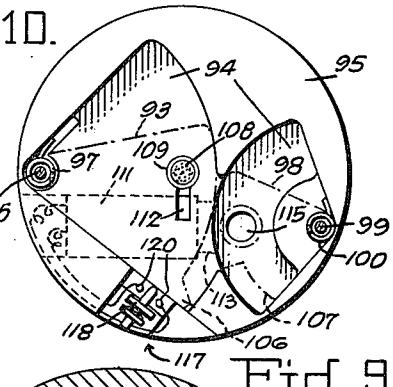
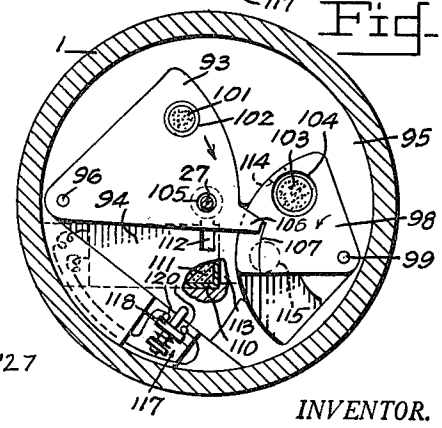


Fig. 9.



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Fig. 2.

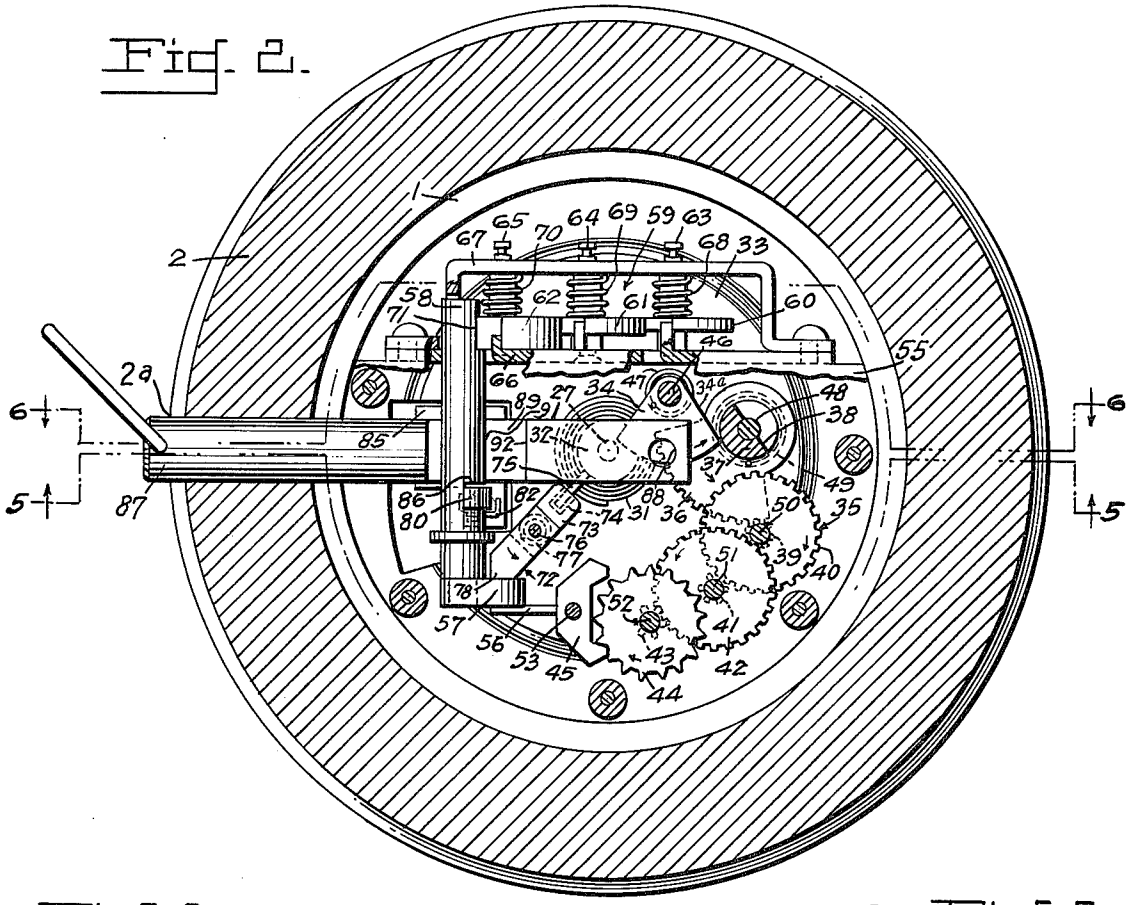


Fig. 3.

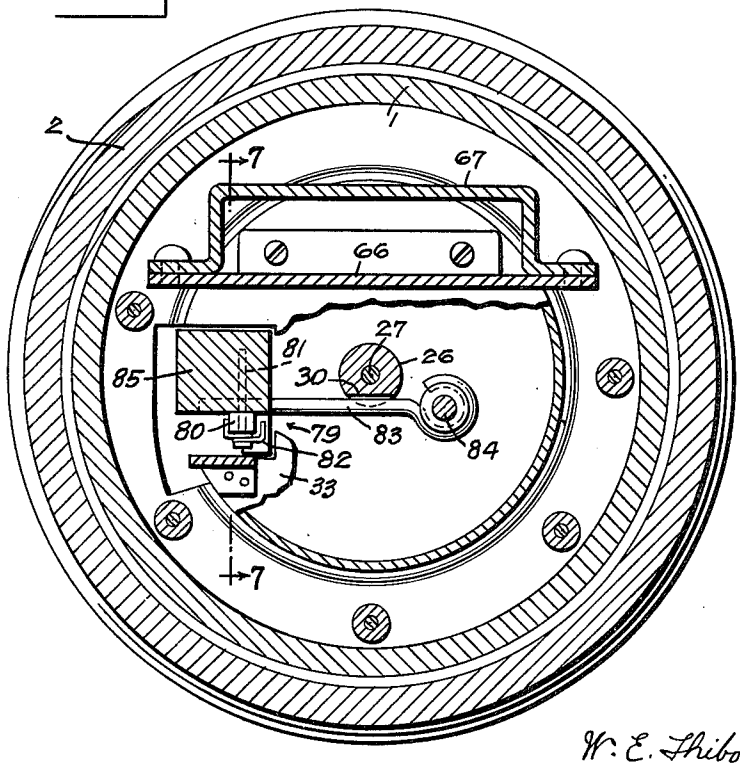
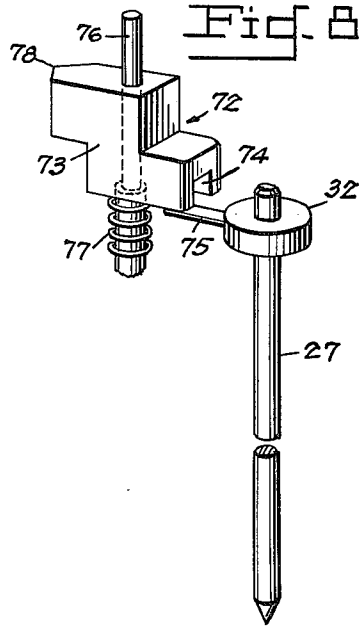


Fig. 8.



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Fig. 5.

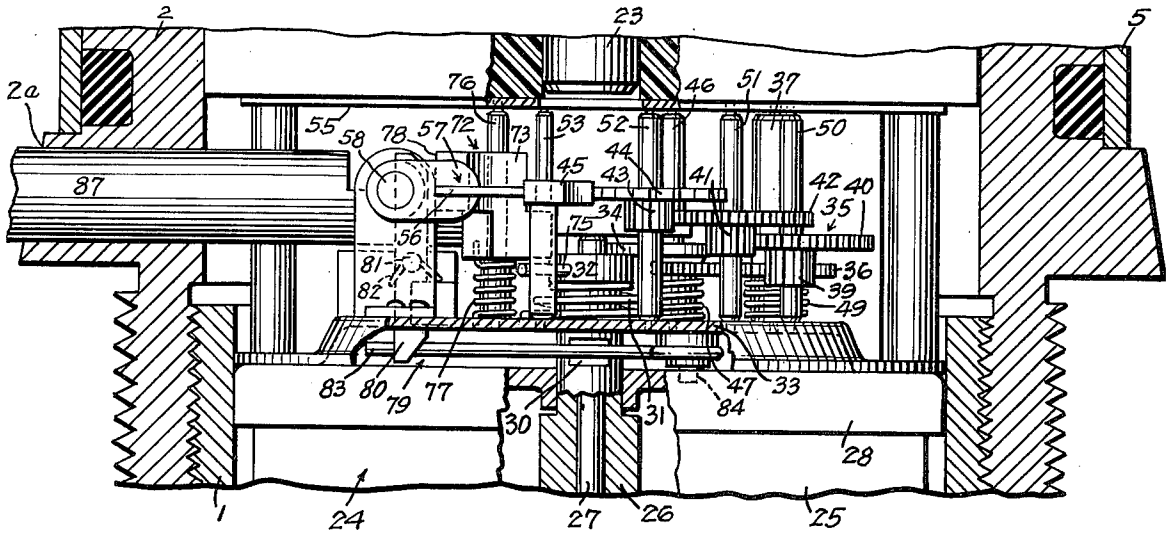


Fig. 6.

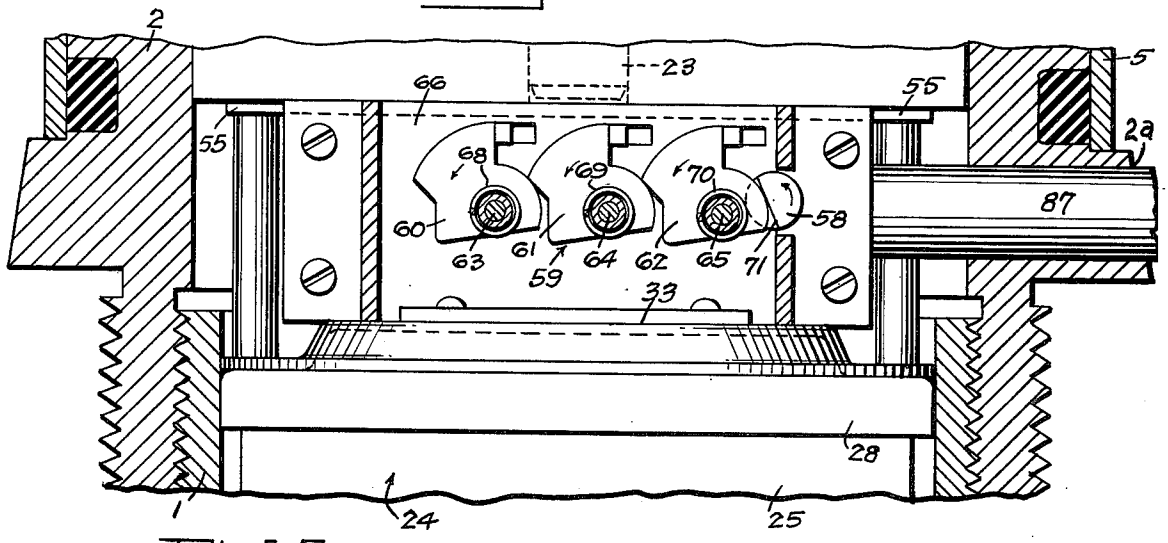


Fig. 7.

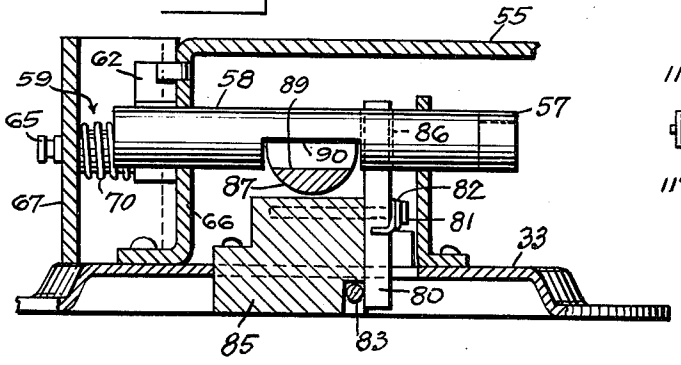
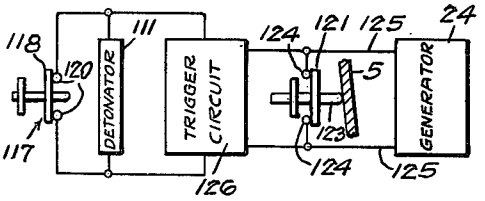


Fig. 11.



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SAFETY AND ARMING MECHANISM

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

This invention relates to fuzes for explosive projectiles, and more particularly to a safety and arming means for a combination proximity and point detonating fuze. It is to be understood that the term "arming" as used herein is very broad and is intended to include that part of the system which serves to deposit an electrostatic charge on the projectile to which the fuze is assembled.

The primary function of the fuze embodying this invention is proximity operation, whereas the impact operation is only secondary. For example, in the mortar application the fuze may be used for impact function when inclement weather such as rain, snow or heavy clouds prohibits the use of the proximity function.

The fuze described herein employs the electrostatic principle. A proximity fuze employing that principle is a "fair weather" fuze at the present stage of the art. An armed electrostatic proximity fuze, when fired in rain will, most frequently, be caused to function by the rain itself and will, as a result, cause premature detonation of the projectile's explosive charge. It is necessary in bad weather, therefore, to render the proximity element inoperative. The system can be so arranged that dust is dispensed, as hereinafter described, and the projectile charged, or that dust is not dispensed and the projectile not charged.

One object of this invention is to provide a fuze having means whereby selective functioning is obtained.

Another object of this invention is a fuze wherein means are provided for selecting arming for proximity or impact function.

A further object of this invention is to provide means for preventing a fuze from arming until after the shell has left the muzzle of the mortar and until the projectile is beyond the lethal range of the gun crew.

A still further object of this invention is to provide means for dispensing the electrostatic charging substance.

A still further object of this invention is to provide means for preventing the shell from becoming electrostatically charged and for shorting out the electric power supply when proximity action is not desired.

A still further object of the invention is to provide means for actuating an electric generator at the proper time to obtain electric energy for proximity operation.

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

FIG. 1 is a longitudinal sectional view of an unarmed fuze embodying the invention.

FIG. 2 is a cross sectional view of the fuze taken on line 2—2 of FIG. 1.

FIG. 3 is a cross sectional view of the fuze taken on line 3—3 of FIG. 1.

FIG. 4 is a longitudinal fragmentary section showing the fuze in the armed condition.

FIG. 5 is a longitudinal fragmentary section of the fuze taken on line 5—5 of FIG. 2.

FIG. 6 is a longitudinal fragmentary section of the fuze taken on line 6—6 of FIG. 2.

FIG. 7 is a detailed view of the release mechanism taken on line 7—7 of FIG. 3.

FIG. 8 is a detailed view of the firing pin and safety interlock.

FIG. 9 is a cross sectional view of the fuze taken on line 9—9 of FIG. 1 showing the firing train in the unarmed position.

FIG. 10 shows the elements of FIG. 9 in the armed position.

FIG. 11 is a schematic block diagram of the electrical system of the fuze.

A preferred embodiment of the invention is shown in FIG. 1 wherein 1 indicates the base member, 2 the body member affixed to the base member, 3 a plastic component holder molded to the body member, 4 the nose member and 4*a* the nose cap adapted to receive windshield 5 which fits over and around the nose cap and is attachable to and detachable from body 2 by means of a pin and bayonet slot, not shown. Flexible member 6 comprises the nose portion of windshield 5.

The nose member 4, which is of the impact functioning type, is also employed in a manner hereinafter described as a means for dispensing a charging dust whereby the fuse and projectile to which it is assembled are electrostatically charged. The body member 2 contains certain safety mechanisms including a mechanical clock to provide delayed arming for the fuze, in a manner described hereinafter. The base member 1 contains the firing train for the fuze.

The impact assembly, indicated generally by numeral 7, located in the nose portion of the fuze, is slidable within nose cap 4*a* and comprises a sleeve 8 and a cap 9, the cap forming a closure for the forward end of the sleeve 8 which houses a cartridge 10. Sleeve 8 is provided with a plurality of holes 11 in collar 12 thereof through which a plurality of hollow pins 13 radially protrude. The outer ends of the said pins are slidable within a plurality of elongated slots 14 in the larger tubular portion 15 of nose cap 4*a*.

With windshield 5 affixed to the fuze, cartridge 10 is maintained in the forward portion of impact assembly 7 inasmuch as the inner cylindrical wall 16 of the windshield restricts the outward radial movement of hollow pins 13. With the hollow pins so restricted the hemispherical heads 17 of the said pins engage the arcuate portion 18 of cartridge 10 to prevent the rearward travel of the said cartridge. Impact assembly 7 is normally biased forwardly by helical spring 19 which is compressible between the forward end of component holder 3 and collar 12 of impact assembly 7. Puncture pin 20 is rigidly attached to sleeve 8, the point of said puncture pin being disposed forwardly. Cartridge 10 is urged away from puncture pin 20 by helical spring 21 which is concentric with said puncture pin and which acts against the sealed end 22 of the cartridge and against the opposing flat surface of sleeve 8. Cartridge 10 contains a charging dust 10*a* under pressure.

Attached to the sleeve 8 of impact assembly 7 by means of screw threads, not shown, and extending axially rearwardly through the center of component holder 3 is impact transfer rod 23 which is slidable within the component holder 3.

The body member of the fuze has positioned therein an electric generator 24 mounted in housing 25. A hollow shaft 26 of generator 24 has slidably mounted therein a firing pin 27. The shaft 26 is journaled within generator cap 28 and generator housing 25. The forward end of hollow shaft 26 contains a flat 30, the function of which is described hereinafter. Firing pin 27 is

alignment with transfer rod 23 is urged forwardly by helical spring 31, FIG. 4, which is compressible between collar 32 of the firing pin and support plate 33.

In the unarmed position, as shown in FIG. 1, firing pin 27 is maintained in the retracted position, against the urging of helical spring 31, by snap release plate 34 which is in alignment with the firing pin collar 32 preventing the forward movement of the firing pin. Snap release plate 34 is spring loaded by means of spring 47, FIG. 5, which urges it to revolve out of alignment with the firing pin collar. Referring to FIG. 2, the snap release plate is restrained in its unarmed position by segment gear 36, the hub 37 of which acts against the leading edge 34*a* of the said snap release plate to prevent the said plate from turning. Segment gear 36 is a part of the gear train indicated generally by numeral 35. Hub 37 of segment gear 36 is formed with a cutaway portion 38, the function of which is explained hereinafter. Segment gear 36 engages pinion 39 which pinion turns with spur gear 40. Spur gear 40 engages pinion 41 which turns with spur gear 42. Spur gear 42 engages pinion 43 which turns with star wheel 44. Star wheel 44 engages and cooperates with pallet 45 to regulate the speed of progression of gear train 35.

Referring now to FIG. 5, snap release plate 34 is mounted upon shaft 46. Torsion spring 47 has one end thereof attached to the snap release plate 34 and the opposite end attached to support plate 33 to urge the said snap release plate in a counterclockwise direction. Segment gear 36 is mounted upon shaft 48. Main drive spring 49 has one end thereof attached to segment gear 36 and the opposite end attached to support plate 33 to urge the said segment gear in a counterclockwise direction. Pinion 39 and spur gear 40 are mounted upon shaft 50; pinion 41 and spur gear 42 are mounted upon shaft 51; pinion 43 and star wheel 44 are mounted upon shaft 52; and pallet 45 is mounted upon shaft 53. Each of shafts 46, 48, 50, 51, 52 and 53 has one end thereof journaled within support plate 33 and the opposite end journaled in support plate 55. When the fuze is in the unarmed condition, pallet 45 is prevented from oscillating by means of arm 57 of the setback release shaft 58 which is in releasable engagement with tongue 56 of the pallet.

As best seen in FIG. 6, the safety and arming system contains a multiple element setback device indicated generally by numeral 59. The setback device 59 comprises rotors or leaves 60, 61 and 62 which are mounted upon and adapted to turn with shafts 63, 64 and 65, respectively. The said shafts are journaled within frame members 66 and 67, FIG. 2. Frame member 66, which is the vertical portion of support plate 55, is affixed to support plate 33. Torsion springs 68, 69 and 70 on shafts 63, 64 and 65, respectively, bias the shafts and their associated leaves in the clockwise direction as seen in FIG. 6. Setback release shaft 58 is prevented from rotation by the leaves in a manner described hereinafter. Each leaf has its center of mass offset from its center of rotation so that the setback force applied to the projectile 127 will cause the individual leaves to revolve, in sequence. Setback release shaft 58 is formed with a flat 71 which engages leaf 62 in such a manner that the shaft is prevented from rotating until leaf 62 has revolved through a predetermined angle.

A safety interlock, generally indicated by numeral 72, FIGS. 2 and 8, comprises a stairstep shaped interlock member 73 mounted upon shaft 76 which is journaled within support plates 33 and 55 and is provided with a groove 74 at one end thereof. Groove 74 is adapted to receive pin 75 which extends from collar 32 of firing pin 27. Interlock member 73 is so oriented with respect to pin 75 that the pin will move into groove 74 should firing pin 27 be prematurely released from its unarmed position. Torsion spring 77 concentric with shaft 76, FIG. 5, has one end affixed to the interlock member 73 and its other end to support plate 33 urging the interlock member in a counterclockwise direction out of alignment with firing pin 27. Interlock member 73 is releasably maintained in alignment with pin 75 by means of arm 57 of setback release shaft 58 acting against the pointed end 78 of interlock member 73.

An electric generator 24 is provided with a driving spring, not shown, which is under tension when the fuze is in the unarmed condition. Generator 24 is releasably locked in the unarmed position by a generator release means indicated generally by numeral 79, as best seen in FIGS. 2 and 3. The release means cooperates with setback release shaft 58 and generator shaft 26 and comprises release bar 80 which is adapted to pivot about its center upon horizontal pivot shaft 81; torsion spring 82 which is positioned upon the said shaft to bias bar 80 in the counterclockwise direction; and release rod 83 which is adapted to turn about one end thereof upon vertical pivot shaft 84. Vertical pivot shaft 84 is journaled within generator cap 28, and horizontal pivot shaft 81 is journaled within block 85, which block is secured to generator cap 28. Release bar 80 rests within slot 86 of setback release shaft 58 when the fuze is in the unarmed condition. In this position the said bar is unable to pivot about horizontal pivot shaft 81. Release rod 83 rests against flat 30 of generator shaft 26 and is held in that position by release bar 80 when the bar is in the vertical position to prevent the generator from turning.

A safety pin 87 extends through an aperture 2*a* in the body member 2 to limit the forward movement of firing pin 27 and to limit the rotation of setback release shaft 58 should the fuze attempt to arm prematurely. Should firing pin 27 be prematurely released by snap release plate 34, interlock member 73 having rotated out of alignment with pin 75, the said firing pin would engage safety pin 87. Any attempt thereafter to extract the safety pin would cause the blunt end of firing pin 27 to "pop into" aperture 88 provided in safety pin 87, collar 32 of the firing pin limiting the forward travel of the firing pin to prevent the disengagement of the firing pin from percussion primer rotor 93. Should the setback release shaft 58 turn prematurely the edge 91, FIGS. 2 and 7, of the shaft would engage shoulder 92 of safety pin 87 to prevent the shaft from turning through its full arming angle. The restriction of setback release shaft 58 to less than its normal arming angle of rotation will prevent activation of generator release means 79 inasmuch as one function of the said shaft is to actuate the said generator release means.

The engagement of safety pin 87 by setback release shaft 58 or by firing pin 27 will prevent the extraction of the safety pin from the fuze.

The firing train is located in the base of the fuze below generator 24, as seen in FIGS. 1, 9, and 10. It comprises percussion primer rotor 93 which is located in recess 94 of firing train block 95 and is mounted upon shaft 96 which is journaled within the block. Tor-

sion spring 97 concentric with shaft 96, biases the percussion primer rotor in the clockwise direction. Lead charge rotor 98 is also located in recess 94 of block 95 and is mounted upon shaft 99 which is journaled within the block. Torsion spring 100, concentric with shaft 99, biases the lead charge rotor in a counterclockwise direction. Percussion primer rotor 93 houses percussion primer 101 in aperture 102 and lead charge rotor 98 houses lead charge 103 in aperture 104. Percussion primer rotor 93 is provided with a recess 105 which is adapted to receive the pointed end of firing pin 27 when the said firing pin is in the unarmed position, so as to maintain the percussion primer 101 "out-of-line" with the other explosive elements of the firing train. In the unarmed condition, lead charge 103 in lead charge rotor 98 is maintained "out-of-line" with the other explosive elements of the firing train inasmuch as finger 106 of percussion primer rotor 93 releasably engages slot 107 of lead charge rotor 98 to maintain the said rotor in the unarmed position.

Intermediate charge 108 is located in recess 109 of block 95, just rearward of percussion primer rotor 93, and in alignment with firing pin 27. Percussion primer 101 in percussion primer rotor 93 communicates with intermediate charge 108 when the said percussion primer is in the armed position. Located in aperture 110 in block 95 and rearward of percussion primer rotor 93 is electric detonator 111. Horizontal passage 112 communicates with intermediate charge 108 and with aperture 110. Passage 113 connects aperture 110 with lead charge 103 through aperture 114 in lead charge rotor 98 when the fuze is in the armed condition. Lead charge 103 communicates through aperture 115 with booster charge 116, located below block 95.

A switch 117, FIGS. 9 and 10, is affixed to firing train block 95 adjacent recess 94. Terminals 120 of the switch are connected to a pair of leads from detonator 111. The switch is normally maintained in the closed position by means of its spring biased armature 118, shortcircuiting the detonator 111. Percussion primer rotor 93 is adapted to engage armature 118 when the rotor moves into the armed position whereupon armature 118 moves away from terminals 120 to remove the short circuit from detonator 111.

A spring biased button switch 121, FIG. 1, positioned in the wall of body member 2 has its nipple 123 in contact with windshield 5 and is held thereby in closed circuit position as shown in FIG. 11. Leads 125 from the output terminals of generator 24 are connected to terminals 124 of button switch 121 and to trigger circuit 126 which is connected to detonator 111.

In using the invention safety pin 87 is manually extracted from the fuze. If the safety pin cannot be easily removed it is an indication that the fuze has armed prematurely.

To obtain a proximity function from the fuze, the fuze-projectile combination must be charged electrostatically. To charge the fuze electrostatically after the safety pin is extracted, the windshield 5 must first be removed by turning it slightly with respect to the fuze, disengaging the pin, not shown, in the body member 2, from the bayonet slot, not shown, in the windshield and withdrawing the windshield axially from the fuze whereupon the button switch 121 functions to remove the short circuit across the generator 24.

The mechanical arming process is initiated by the force of setback acting upon setback means 59. Under setback, leaves 60, 61 and 62 rotate sequentially in a counterclockwise direction, FIG. 6, against the force of their individual springs tending to turn the leaves in a clockwise direction. Leaf 60 must turn through a predetermined angle before leaf 61 can start to turn. Likewise, leaf 61 must turn through a predetermined angle before leaf 62 can start to turn. After leaf 62 has turned through an angle sufficiently great to permit setback release shaft 58 to turn, the said shaft will turn in a counterclockwise direction under the force of setback due to the fact that arm 57, attached thereto, causes the center of mass of the combination shaft and arm to be displaced from their center of rotation. A force of sufficient magnitude properly directed must persist for a minimum period of time to permit the three setback leaves to turn, in sequence, before the fuze will be permitted to arm. Should the force of setback abate before the last of the said leaves has completed its rotation, all three leaves will be returned to their previous positions by their respective springs.

When setback release shaft 58 turns and arm 57 is displaced from its previous horizontal position, three mechanisms begin to function:

As best seen in FIGS. 2 and 5, when arm 57 moves rearward tongue 56 of pallet 45 is no longer restrained and the pallet is free to oscillate and does so under the impetus of gear train 35. As it oscillates, the said pallet regulates the speed of rotation of star wheel 44. The star wheel is driven by the spring loaded segment gear 36 through cooperating spur gears and pinions. Gear train 35 is driven by main drive spring 49.

Snap release plate 34 is located just forward of collar 32 of firing pin 27 when the fuze is in the unarmed condition. The snap release plate is spring loaded urging it to revolve to a position out of alignment with the forward travel of the firing pin collar. Inasmuch as snap release plate 34 rests against hub 37 of segment gear 36, it is prevented from revolving clear of the firing pin collar until the segment gear has rotated through an angle such as wil allow the cut away portion 38 of hub 37 to move to a position no longer restraining the snap release plate. At that point the snap release plate will revolve clear of collar 32 of firing pin 27 and the firing pin will be driven forward by the force of helical spring 31 acting against collar 32 of the firing pin.

In the meantime, interlock member 73 of safety interlock 72 will have revolved to a position out of the path of the forward travel of pin 75 of firing pin 27. Upon setback, when arm 57 of setback release shaft 58 moves rearward, interlock member 73 is no longer prevented from revolving to a position out of alignment with pin 75 so that the said pin does not engage slot 74 of interlock bar 73 when firing pin 27 moves forward under the force of helical spring 31.

Rotation of setback release shaft 58 actuates generator release means 79 whereby generator 24 is permitted to rotate. Release bar 80 rests within square slot 86 of setback release shaft 58 when the fuze is in the unarmed condition. In the unarmed position the release bar is maintained vertically by spring 82. Rotation of setback release shaft 58 in a clockwise direction, as seen in FIG. 4, causes release bar 80 to rotate part of a revolution in a clockwise direction to permit release rod 83 to swing free and no longer press upon flat 30 of generator shaft 26. Shaft 26, no longer under restraint, commences to rotate so that generator 24 is

driven by its drive spring, not shown, in order to deliver electrical power to the fuze.

When firing pin **27** is released to move forward, as previously described, that movement results in the pointed end of the said firing pin moving out of engagement with hole **105** in percussion primer rotor **93.** As a consequence the rotor is free to rotate under the force of torsion spring **97,** to a position aligning primer **101** with firing pin **27,** FIG. **10.** As percussion primer rotor **93** had releasably maintained lead charge rotor **98** in the unarmed position, the release of the percussion primer rotor causes the release of lead charge rotor **98** inasmuch as finger **106** of percussion primer rotor **93** disengages slot **107** in lead charge rotor **98.** Lead charge rotor **98** rotates into a position under the force of torsion spring **100** aligning lead charge **103** with electric detonator **111.**

Premature release of firing pin **27,** before safety pin **87** is extracted, will not release percussion primer rotor **93.** The danger of the alignment of the several elements of the firing train is averted thereby. The forward travel of the firing pin is arrested by the engagement of pin **75** of firing pin **27** with groove **74** of interlock member **73.** Should interlock member **73** have revolved prematurely to a position out of alignment with pin **75,** the forward travel of the firing pin will be arrested by the engagement of the firing pin with the safety pin. Thereafter, any attempt to remove safety pin **87** will result in the forward end of firing pin **27** entering perforation **88** of the safety pin; thus, locking the said safety pin within the fuze and preventing complete withdrawal of the firing pin from recess **105** of percussion primer rotor **93.** Thus, the said rotor and the other element of the firing train are maintained in the unarmed position.

With the windshield **5** removed, the electrostatic arming process is initiated by the force of setback acting on the mass of cartridge **10.** This causes cartridge **10** to move rearwardly within sleeve **8** against spring **21,** camming hollow pins **13** outwardly. Sealed end **22** is impaled on puncturing pin **20.** When setback forces cease, spring **21** and the pressure within cartridge **10** push the punctured end **22** away from pin **20,** allowing the dust to escape from the cartridge **10** and impact assembly **7** through hollow pins **13.** The well known triboelectric effect of dust **10***a* rubbing past a dissimilar material places an electrostatic charge on the dust and nose cap **4***a*. The missile **127** is also charged by leakage through imperfect insulating material **3** and by the dust **10***a* being carried by the air relative to missile **127.**

With windshield **5** removed, the fuze approaching the target, the projectile charged electrostatically, and the fuze armed mechanically, the trigger circuit **126** is awaiting the return from the target of the firing signal. That signal should be received by the fuze when the projectile approaches within a predetermined distance from the target. Upon receipt of the firing signal the trigger circuit fires detonator **111** electrically. The resulting flash passes through opening **113** in block **95** and through aperture **114** in lead charge rotor **98** to set off lead charge **103.** Lead charge **103,** in turn, detonates booster charge **116.** The detonation of the booster charge functions the explosive charge of the projectile.

In the event the electrostatic means fails to function, the projectile will continue until it strikes the target. At that point an impact function results. When the nose of the fuze contacts the target, impact assembly **7** is driven rearwardly against the force of helical spring **19.** Inasmuch as impact transfer rod **23** is rigidly attached to impact assembly **7,** the said transfer rod moves rearwardly also. Firing pin **27,** being in alignment with the rod and located just rearward thereof in the armed position, FIG. **4,** is driven rearwardly, the point thereof penetrating percussion primer **101.** The percussison primer ignites intermediate charge **108** which is located just rearward of said percussion primer in recess **109.** Recess **109** communicates with aperture **102** which contains the percussion primer. The flash from intermediate charge **108** moves through horizontal passage **112** in block **95** to ignite detonator **111.** The ignition of detonator **111** causes the detonation of lead charge **103,** booster charge **116,** and the explosive charge of the projectile, not shown, in a manner previously described.

With windshield **5** affixed to the fuze, the fuze cannot function by proximity action. There can be no electrostatic charge deposited upon the projectile inasmuch as cartridge **10** upon setback attempts to move rearward relative to impact assembly **7** but is prevented from so moving by hollow pins **13,** the hemispherical heads **17** of which engage arcuate portion **18** of cartridge **10.** Hollow pins **13** are now prevented from moving outwardly and out of the path of cartridge **10** by the inner cylindrical wall **16** of windshield **5** which prevents the outward travel of the hollow pins.

Trigger circuit **126** is prevented from receiving the electric energy required for proximity function of the fuze by virtue of the fact that, with windshield **5** affixed to the fuze, button switch **121** is forced inwardly in closed circuit position to short-circuit generator **24.**

With the windshield affixed to the fuze, the fuze will arm mechanically in the manner previously described and will function on impact in the manner previously described, the flexible nose portion **6** of windshield **5** offering negligible resistance to the force of impact received by impact assembly **7.**

It will be apparent that the embodiment shown is 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.

We claim:

1. In a fuze for an explosive projectile having a base section, a body section, and a nose section, a safety and arming mechanism including a firing train having a booster charge and acceleration-sensitive means for initiating fuze arming when the projectile to which the fuze is affixed is fired from a gun, the improvement comprising: an impact assembly located in the nose portion of the fuze, said impact assembly comprising a cartridge containing a dust under pressure, means for releasing said dust from said cartridge after the projectile to which the fuze is affixed is airborne, the action of the dust passing over the projectile serving to deposit an electrostatic charge upon the projectile.

2. The invention in accordance with claim **1** wherein said dust releasing means comprises a puncture pin disposed along the axis of the fuze and pointed forwardly, a spring concentric with said puncture pin normally urging the cartridge forwardly and away from said puncture pin, and a plurality of hollow pins disposed radially in the periphery of the nose section of the fuze, the said puncture pin adapted to rupture the cartridge when the cartridge moves rearwardly under the force of setback to compress the spring and engage the punc-

ture pin, the said spring serving to separate the cartridge from the puncture pin when the force of setback abates, the rupture in the cartridge caused by penetration of the cartridge pin and the apertures in the hollow pins providing the escape path from the fuze for the charging dust.

3. The invention in accordance with claim **2** and means adapted to prevent the cartridge from engaging the puncture pin to release the charging dust from the cartridge, the result being that the fuze will not be charged electrostatically and will not function on proximity approach to the target, permitting the fuze to function on impact with the target.

4. The invention in accordance with claim **3** wherein the means adapted to prevent proximity function comprises a windshield attachable to and removable from the fuze, the said windshield when attached to the fuze adapted to prevent the hollow pins from moving outwardly when so urged by the cartridge on setback of the projectile, the said hollow pins, when so restrained, acting to prevent the engagement of the cartridge with the puncture pin, the electrostatic charging dust being thus prevented from escaping from the cartridge and from the fuze.

5. An electrostatic dust dispensing means for a proximity fuze comprising a cartridge, a sleeve and a cap forming a housing for said cartridge, a charging dust under pressure in said cartridge, a plurality of hollow pins extending radially from said sleeve, a puncture pin rigidly attached to the lower end of said sleeve with the point thereof disposed forwardly, and a helical spring contained within said sleeve and adapted to maintain the separation of the said cartridge and the said puncture pin, the said cartridge being adapted to move rearwardly relative to the said sleeve when the said means is subjected to the force of setback, the setback driving the cartridge rearwardly against the force of the helical spring to cause a penetration of the cartridge by the puncture pin, the hollow pins at the same time being driven outwardly by the cartridge as the cartridge moves rearwardly, the puncture of the cartridge permitting the charging dust to escape from the cartridge, and through the hollow pins.

6. The invention in accordance with claim **5** and a windshield disposed around said sleeve, the said windshield being attachable to and removable from the fuze and when so attached adapted to prevent the hollow pins from moving outwardly when so urged by the cartridge acting against the said pins under the force of setback, the said hollow pins, when so restrained, preventing the engagement of the cartridge with the puncture pin in order to prevent the electrostatic charging dust from escaping from the cartridge.

7. A firing train comprising a firing train block; a pair of spring loaded rotors oppositely disposed within a cavity formed in said block, each rotor having an explosive element positioned therein; means releasably engaging the first rotor and the first rotor releasably engaging the second rotor when the fuze is in the unarmed condition; an intermediate charge and an electric detonator housed in said block and in communication with one another, the intermediate charge being in alignment with the explosive element of the first rotor when the first rotor is in the armed position and out of alignment with said explosive element when the said first rotor is in the unarmed position, the electric detonator being in alignment with the explosive element of the second rotor when the said second rotor is in the armed position and out of alignment with the said explosive element when the said second rotor is in the unarmed position; a booster charge aligned with the explosive element of said second rotor when the said rotor is in the armed position and out of alignment with the said explosive element when the said rotor is in the unarmed position; means adapted to release the first rotor and the second rotor sequentially to bring the explosive elements into line with the intermediate charge, the electric detonator, and the booster charge; and means adapted to initiate the explosive element of the first rotor to detonate the booster charge through the explosive element of the second rotor, the electric detonator, and the intermediate charge.

8. In a safety and arming mechanism for a fuze having within a body member a percussion primer mounted in a rotor, a recess in the rotor, a firing pin with one end in the recess, a spring biasing the firing pin away from the recess, and means for aligning the percussion primer with the firing pin responsive to the removal of the firing pin from the recess, the improvement comprising: a release plate holding the firing pin in the recess; a release shaft mounted for rotation; means responsive to the angular position of the release shaft for removing the release plate whereby the firing pin is free to move away from the recess; a safety pin mounted for sliding movement through the body member and in line with the firing pin; means including the safety pin for locking the firing pin in said recess; the safety pin having an aperture mounted for alignment with the firing pin; means including the aperture for locking the safety pin in place responsive to a premature release of the firing pin by said release plate coupled with movement of said aperture of said safety pin in alignment with the firing pin; and further means including the release shaft for locking the safety pin in place responsive to the angular position of the release shaft.

9. in a safety and arming mechanism for a fuze having within a body member a booster charge; a lead charge mounted in a lead charge rotor adjacent the booster charge but out of line therewith; a percussion primer mounted in a percussion primer rotor adjacent the lead charge but out of line therewith; a recess in the percussion primer rotor; a firing pin with one end in the recess; a spring biasing the pin away from the recess; and means for aligning the percussion primer with the firing pin and lead charge and aligning the lead charge with the booster charge response to the removal of the firing pin from the recess; the improvement comprising: a release plate holding the firing pin in the recess; a safety pin extending through the body and in line with the firing pin; the safety pin having an aperture mounted for alignment with the firing pin so that should the release plate fail to hold the firing pin, the firing pin will enter the aperture so that the safety pin may not be removed; a release shaft mounted for rotation; setback leaf means responsive to acceleration for locking the release shaft against rotation; means on the release shaft and safety pin responsive to the angular position of the release shaft for locking said safety pin in place; a safety interlock mounted for rotation; a pin extending radially from the firing pin and in line with the safety interlock; means on the release shaft responsive to the angular position of the release shaft for permitting the safety interlock to rotate out of alignment with the pin on the firing pin; time delay means for moving said release plate away from the firing pin; and means responsive to the angular position of the release shaft for locking the time delay means.

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