United States Patent

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[73] Assignee **The United States of America as represented by the Secretary of the Army**

[54] **TAIL FUZE**
4 Claims, 9 Drawing Figs.

[52] **U.S. Cl.** **102/83,** 102/71, 102/81.2
[51] **Int. Cl.** **F42c 9/02,** F42c 15/34
[50] **Field of Search** 102/82, 81, 81.2, 83, 84, 71, 74, 75

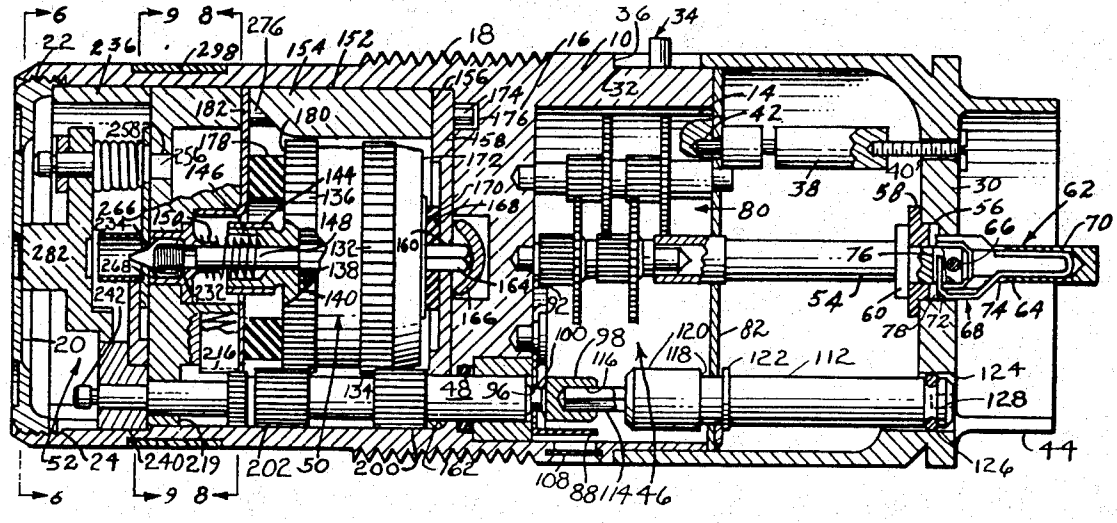
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Assistant Examiner—J. J. Devitt
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CLAIM: 1. A tail fuze comprising in combination: a body having a nose end and a tail end, said body being adapted to fit into a fuze well; a cover at said nose end; a cap on said tail end; an air arming reduction gear cluster disposed in said body adjacent said tail end for transmitting a predetermined rate of angular rotation; a main setting shaft disposed in said body substantially parallel to the axis of said body and along a major portion thereof; a primary safety cam rotatably disposed in said body adjacent said tail end and coupled to said gear cluster and rotatable therewith, said safety cam engaging the end of said shaft disposed nearest said tail end to maintain said shaft in a substantially fixed position, said safety cam adapted to longitudinally displace said shaft from said fixed position to a first position upon rotation of said gear cluster for a predetermined time interval, said shaft at said first position being free so as to be longitudinally displaced to a second position when said fuze body impacts on said nose end; a preset timer disposed axially of said fuze body and intermediate said nose and tail ends; gear means operably connecting said timer to said shaft, said gear means locking said timer against movement during said fixed and first positions and releasing said timer at said second position; a rotatable timing cam coupled with said timer and rotatable upon rotational movement of said timer, said timing cam having a slot in its periphery; a stop mounted on the nose end of said main setting shaft and disposed within said body; a spring-biased stab firing pin axially disposed adjacent said nose end; a spring-biased rotatable release lever having bifurcated first and second arms, the end of the first arm contacting the periphery of said timing cam; a spring-biased rotor mounted for rotation adjacent said nose end; a detonator in said rotor, the second arm of said lever blocking axial movement of said firing pin towards said rotor, said stop engaging said rotor during said fixed and first positions to lock said detonator out-of-line with said firing pin, said stop moving from engagement with said rotor at said second position so that said detonator is aligned with said firing pin, said stop also locking and unlocking said timing cam during said first and second positions, respectively, said timing cam after being unlocked rotating until the end of said first arm enters said slot, said second arm then being moved by the spring-bias acting on said lever so as to unblock said firing pin, said firing pin thereby being free to strike said detonator and initiate detonation of said fuze; a rotatable tamper release cam positioned in said nose end, said release cam being biased from locking contact with said stop, on end of said release cam being locked against rotative movement by said stop during said fixed and first positions and unlocked for rotation at said second position, the other end of said release cam being serrated so as to firmly grip the wall of said fuze well at said second position; and means on said release cam to contact the end of said second arm; said tamper release cam and said means thereon being so constructed and arranged that if subsequent to impact said body is rotated in a direction which would remove said fuze body from said fuze well, said second arm will be moved out of blocking position with said firing pin so that said firing pin can strike said detonator and initiate detonation of said fuze.



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SHEET 1 OF 2

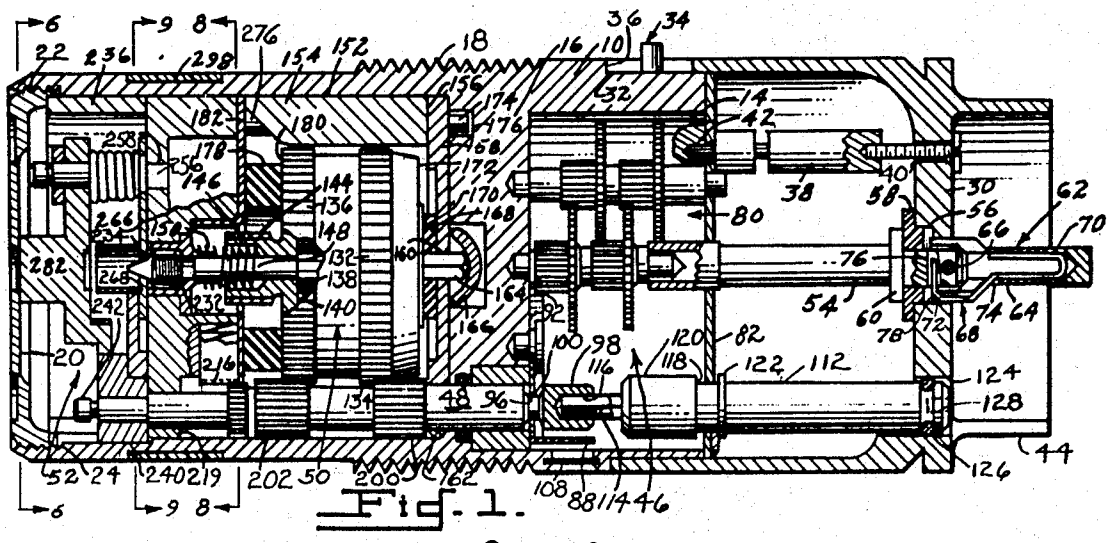


Fig. 1.

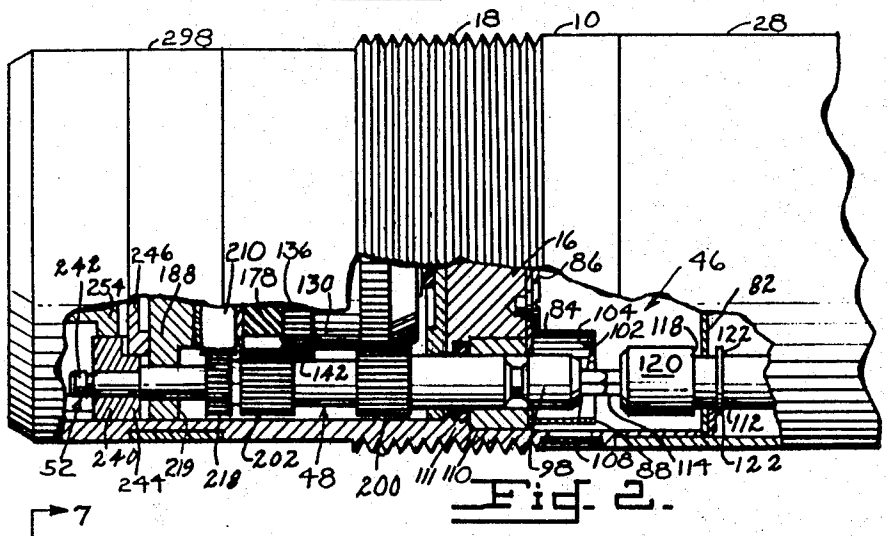


Fig. 2.

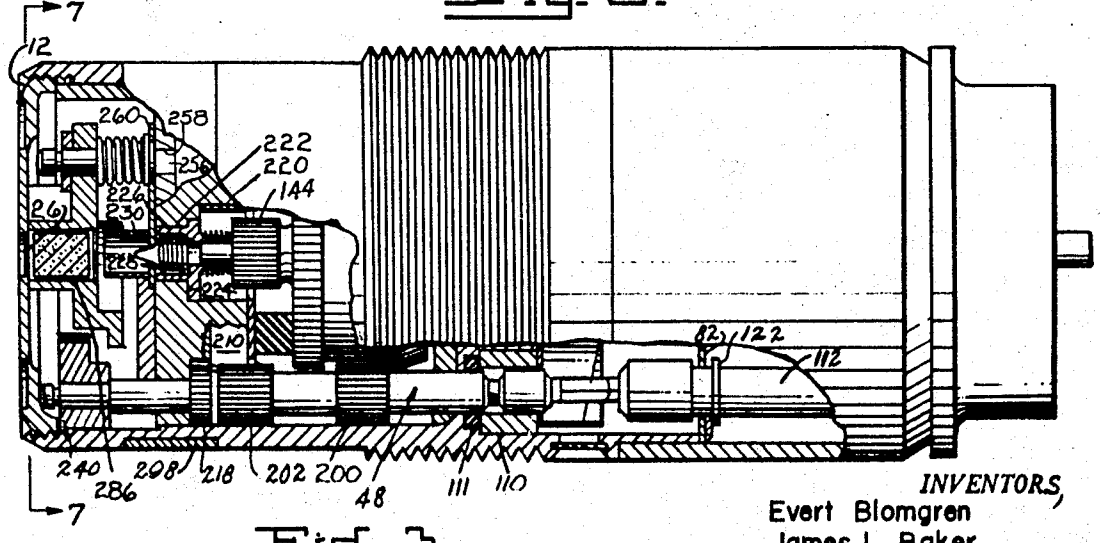


Fig. 3.

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Fig. 4.

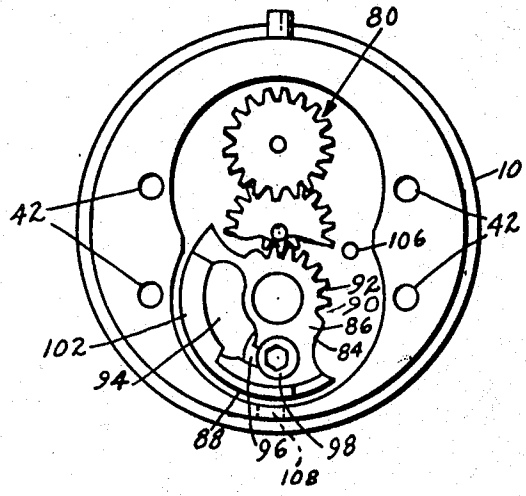


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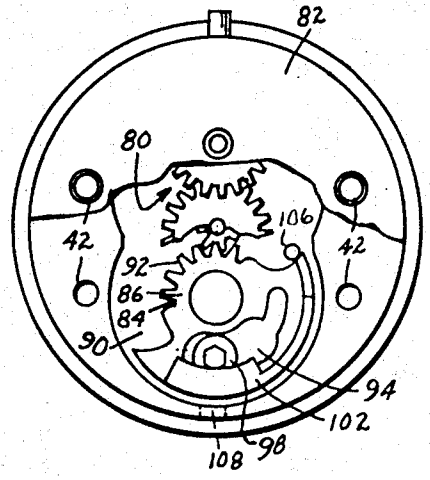


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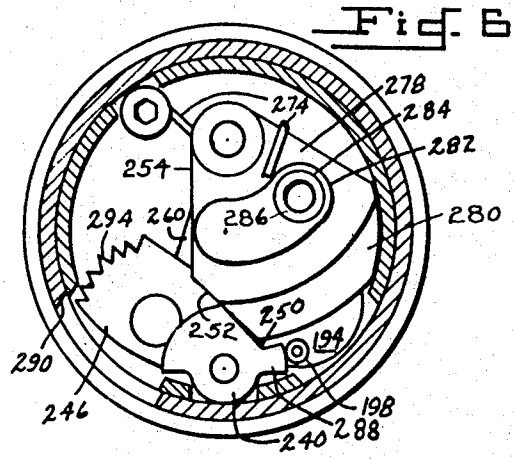


Fig. 7.

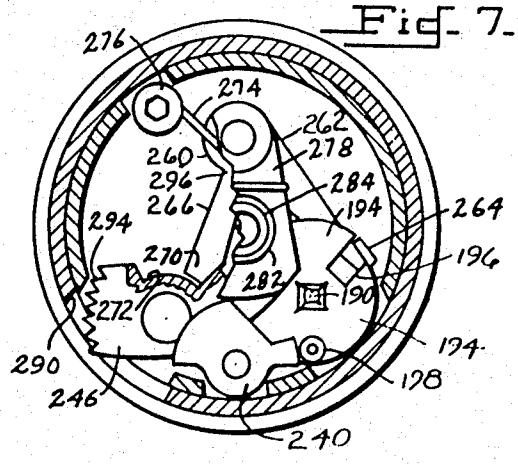


Fig. 8.

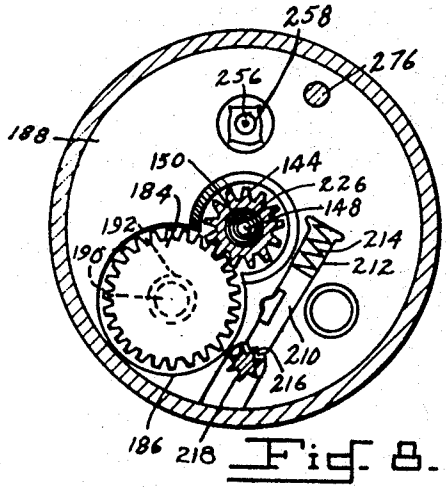
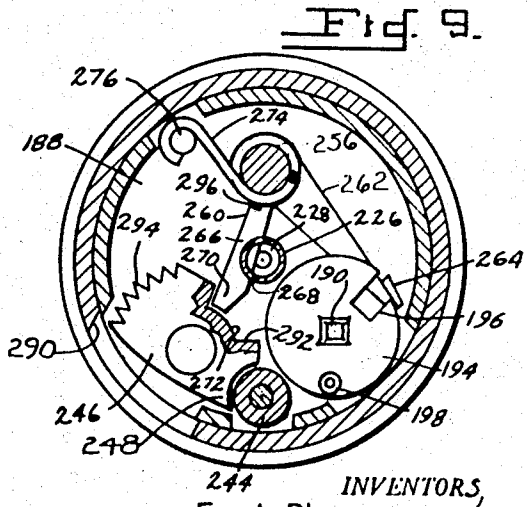


Fig. 9.



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TAIL FUZE

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, in general, to tail fuzes for ordnance missiles, and more particularly to tail fuzes adapted to accomplish delayed detonation of ordnance missiles after missile impact with a target.

For many strategic and tactical reasons it is extremely desirable to initiate missile detonation after suitable time delays subsequent to missile impact with a target. For example, bombs may be dropped on and near a beach hours before an amphibious landing, and detonation of these bombs set to take place immediately prior to landing. If harassing or commando tactics are employed, bomb detonation may be regulated to take place after the accomplishment of a prescribed mission. Most prior art devices of this type, however, are vulnerable to many disarming techniques, and thus susceptible to ultimate ineffectiveness.

Accordingly it is an object of this invention to provide against disarming of a tail fuze preset to detonate after missile impact.

Another object is the provision of a tail fuze adapted to insure arming at missile impact.

Still another object is the provision for two stages for tail fuze and three stages for the tail fuze detonation.

A further object is to provide a tail fuze adapted to detonate after a preset time interval after missile impact.

A still further object is to provide means for tail fuze detonation after missile impact and before a preset time interval upon a predetermined movement of the fuze.

Basically, the tail fuze of this invention may be segregated into four major functional components. Briefly, these components may best be described with reference to fuze actuation which experiences substantially three stages. In the first stage, a first fuze component functions upon missile launching or dropping, to linearly displace a second fuze component in a predetermined time interval during missile flight, to a position at which it is responsive to setback forces. This second component is held in this position by a frictional force. In the second stage a third component, potentially energized prior to launching or dropping, is set in motion when the missile contacts a target and the second component is no longer subjected to setback forces. At this second stage a fourth component is released to arm the fuze and a fuze antitampering means. Finally, in the third stage, the fourth component cooperates with the third component to cause fuze detonation after a preset time interval after arriving at the second stage. If the fuze is tampered with at any time after the second stage and prior to the expiration of the third stage, the fuze antitampering means cooperate with the fourth component to cause detonation.

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:

FIG. 1 is a partial longitudinal sectional view of the fuze when the main setting shaft is in the fixed position.

FIG. 2 is a longitudinal view of the fuze when the main setting shaft is in the first position with certain parts broken away.

FIG. 3 is a partial longitudinal sectional view of the fuze when the main setting shaft is in the second position.

FIG. 4 is an end view of the fuze, with the elongated cap and its associated parts removed and certain parts broken away, showing the initial position of the safety cam.

FIG. 5 is an end view substantially similar to FIG. 4 showing the final position of the safety cam.

FIG. 6 is a cross-sectional view taken substantially along line 6—6 of FIG. 1.

FIG. 7 is a cross-sectional view taken substantially along line 7—7 of FIG. 3.

FIG. 8 is a cross-sectional view taken substantially along line 8—8 of FIG. 1.

FIG. 9 is a cross-sectional view taken substantially along line 9—9 of FIG. 1 with certain parts broken away.

Referring to FIGS. 1–3, the tail fuze of this invention may comprise a hollow cylindrical body 10. Body 10 is preferably open at the forward end 12, and open at the tail end 14. A partition 16 may be integrally formed with body 10 and is disposed offcenter towards the tail end 14. Threaded portion 18 is formed in body 10 to facilitate securement of the fuze in a conventional fuze well (not shown) located at the tail of a missile. A cover 20 may be employed to seal the forward end 12 of body 10, and may be provided with an externally threaded portion 22 for mating with an internally threaded portion 24 formed in body 10. Cover 20 is preferably provided with the usual weakened portion 26 to insure the effectiveness of the fuze detonator on the missile's booster charge. An elongated cap 28 having a closed end 30 and an open end 32 is conveniently mounted on tail end 14. A guide pin and slot arrangement shown generally at 34 may be used to aid in aligning cap 28 on tail end 14 with open end 32 abutting against shoulder 36 on body 10. To secure cap 28 to body 10, a plurality of compound bolts 38 may extend through holes 40 in end 30 and threaded into threaded bores 42 in the walls of tail end 14. As shown more clearly in FIG. 4, provisions may be made to accommodate four such bolts. End 30 of cap 28 can be provided with an annular flange 44 to facilitate coupling with a conventional drive coupling of a conventional propeller assembly (not shown) that is usually disposed adjacent the fins of a missile. The propeller assembly usually comprises the standard propeller, governor, and flexible rotation transmission shaft.

The tail fuze may essentially be comprised of what may be called four functional components. These components can be termed an arming initiator assembly, a main setting shaft, a timer assembly and a final arming and detonation assembly illustrated generally at 46, 48, 50, and 52, respectively.

The arming initiator assembly 46 may comprise an input drive shaft 54 conveniently disposed in cap 28. Drive shaft 54 extends through an opening 56 in end 30, and is rotatably mounted therein preferably by a suitable Teflon bushing 58. An annular shoulder 60 may be provided on shaft 54 to abut against bushing 58 in order to prevent the shaft from becoming dislodged from cap 28. Drive shaft 54 has mounted thereon a shaft extension assembly 62 which may comprise a substantially hollow shaft extension 64 mounted on and secured for rotation with shaft 54 by means of pin 66 extending through a transversely bored opening in the end of shaft 54 and corresponding openings in the wall of shaft extension 64. A key spring 68 may be mounted in the bore 70 of extension 64. An end portion 72 of the key spring 68 preferably extends through a longitudinal slot 74 in the wall of extensions 64, and is reciprocable in a transverse bore 76 in shaft 54. When it is desired that the shaft 54 not rotate, spring 68 is biased to such an extent that it will lodge or fall into a recessed portion 78 in the sidewalls of opening 56. In operation, when it is desirable that shaft 54 be free to rotate, a coupling sleeve of the flexible rotational transmission shaft of the conventional propeller assembly (not shown) mentioned above is slid over the shaft extension 64 to depress spring end portion 72 back into recess 74 to render the extension 64 rotatable with the coupling sleeve. The desired rotation of input drive shaft 54 is transmitted to an air arming reduction gear cluster located in the open end 14 of body 10 and designated generally at 80. Gear cluster 80 is mounted for rotation by having the cluster's gear posts in suitable bores in partition 16 and is suitably coupled with drive shaft 54 to accept the desired rotation. The essential characteristics of gear cluster 80 should be that the rate of rotation of drive shaft 54 be transformed or changed into a rotational output of a predetermined magnitude. A workable gear reduction of 320/1 has been found to be desirable. A dirt shield 82 may be employed to protect the elements in open end 14 of body 10. Meshed with a pinion of gear cluster 80 and rotatably mounted on partition 16 is a primary safety cam 84. Cam 84 presents a substantially flat circular disc portion 86 from which transversely extends, at the periphery thereof,

a circular flange 88, traversing substantially an acute angle. Disc portion 86 further presents a reduced section 90 at its periphery distal flange 88 on which are formed a geared portion 92 for meshing with a correspondingly geared pinion of gear cluster 80. Adjacent flange 88 and radially opposite to portion 90 is an arcuate groove 94 communicating with an arcuate groove 96 of reduced width. Groove 94 is of sufficient radial width to permit the head portion 98 of main setting shaft 48 to pass therethrough. Main setting shaft 48 has adjacent head 98, a reduced section 100 of a diameter slightly smaller than the radial width of groove 96. Thus, when the reduced section 100 is in groove 96, as in FIGS. 1 and 4, the main setting shaft is not free to be longitudinally displaced, this being termed the main setting shaft fixed or safe position. Flange 88 has at the free end a ramp 102 presenting cam surface 104 (FIG. 2). It will be apparent that the rotation of gear cluster 80 will cause safety cam 84 to rotate from its initial position at which the main setting shaft 48 is in the fixed position (FIGS. 1 and 4) to a position at which the main setting shaft 48 is in its first position (FIGS. 2 and 5). This may be termed the first stage of fuze operation. The cam 84 will rotate in such a manner to free head 98 from restriction by groove 96 and present thereto groove 94. At this period of the first stage of operation the end of head 98 will act as a follower on cam surface 104. Surface 104 will now force head 98 and consequently shaft 48 longitudinally forward through groove 96. The rotation of cam 84 may be stopped by utilizing a suitable stop pin 106. The cam 84 places shaft 48 in its first or unlocked position as shown in FIG. 2, at which the shaft will be responsive to set back forces and at which further forward movement is now prevented by frictional forces created by certain portions of shaft 48 contacting certain portions of timer assembly 50, as will be evident shortly. The exterior surface of flange 88 may be suitably colored, as for example with a red section and a white section, so that by visual inspection through a transparent plastic window 108 it may be determined if the main setting shaft 84 is in its fixed position or its first position. A desirable time interval to accomplish the displacement of the main setting shaft from its fixed position to its first position may be in the order of two seconds. Cam 84 in combination with window 108 may be referred to as a visual arming indicator assembly.

A hard steel sleeve 110 is preferably permanently mounted in partition 16 but permitting reciprocation of shaft 48 therethrough. The principal purpose of sleeve 110 will become apparent shortly. Sleeve 110 further aids in retaining a suitable O-ring 111 around shaft 48 and in partition 16 to insure hermetically sealed conditions between the two open ends of body 10.

Main setting shaft 48 has a setting shaft extension 112 having a hexagonal-shaped boss 114 disposed in a correspondingly shaped bore 116, in shaft 48. Extension 112 passes through shield 82 and is conveniently held substantially longitudinally immovable by shoulder 118 of enlarged portion 120 and a retaining ring 122. Extension 112 preferably extends in an opening 124 and terminates adjacent the outer side of end 30 and may be sealed thereto by an O-ring 126 while still maintaining the extension 112 rotatable in the opening 124. Means 128, such as a hexagonal-shaped bore, may be provided in extension 112 to facilitate rotation of extension 112. This is desirable because rotation of the extension 112 will rotate main setting shaft 48 which in turn imparts rotation to the timer assembly 50. Consequently, a desired orientation of the timer assembly 50 with respect to the final arming and detonation assembly 52 will be achieved as will become evident when taken in conjunction with the description of the latter two assemblies.

Timer assembly 50 is conveniently adapted to snugly fit in the bore defined by body 10 in open forward end 12 separated from open tail end 14 by partition 16. Time assembly 50 comprises timer 130 which is comprised of conventional internal functioning parts. Timer 130 is well known in the art and features the movement assembly 132 which has circumferentially extending gear teeth 134 on the outer surface thereof. Similarly the mainspring barrel assembly 136 of timer 130, which includes the usual mainspring 138 and the longitudinally extending mainspring arbor 140, has circumferentially disposed gear teeth 142. A pinion 144 is preferably formed integral with mainspring barrel assembly 136, and is conveniently bored at 146 to house end 148 of mainspring arbor 140 and a shock absorbing spring 150. Substantially enclosing timer 130 is mainspring and movement barrel retainer assembly 152 which includes cylindrical sleeve 154 which is suitably recessed to allow free longitudinal movement of main setting shaft 48. Rigidly secured to end 156 of sleeve 154 is a hardened steel circular plate 158 suitably recessed at 160 and 162 to permit access for end 164 of mainspring arbor 140 and main setting shaft 48, respectively. Arbor end 164 is advantageously surrounded by a hardened steel dome 166 suitably secured to partition 16 in a bored portion of the latter. To aid in insuring functioning of the timer 130 after missile impact is a butyl rubber bumper pad 168 which bears against the internal surface of plate 158 and bearing disc 170 at the free end 172 of movement assembly 132. To prevent sleeve 154 and plate 158 from rotating and hindering operation of shaft 48, a pin 174 may be provided on plate 158 conveniently fitting into a bore 176 in partition 16. A butyl rubber shock absorber mount 178 to protect the timer 130 at missile impact preferably bears against mainspring barrel assembly 136, through the medium of a relatively thin circular bearing disc 180. A bearing plate 182 is provided to maintain mount 178 in sleeve 154. Pinion 144 (FIGS. 1 and 8) is in mesh with a gear wheel 184 mounted for rotation in a recess 186 in arming mechanism plate 188 by a shaft 190 extending longitudinally through plate 188 in bore 192. Shaft 190 is rigidly secured to a timing cam 194. Timing cam preferably has a recessed portion 196 at its periphery and a pin 198 extending normally therefrom. The positioning of pin 198 relative to recessed portion 196 will be described below. As will be noted in FIG. 1, main setting shaft 48 at the shaft fixed position has s circumferential geared portion 200 meshing with corresponding gear teeth 134 of movement assembly 132. Similarly geared portion 202 meshes with corresponding gear teeth 142 on mainspring barrel assembly 136. At the shaft fixed position mainspring barrel assembly 136 is not free to rotate relative to movement assembly 132 because of the meshing of the teeth on main setting shaft 48 with respect to these timer parts. Consequently timing cam 194 will not be fee to rotate. However, by rotation of main setting shaft 48 through the rotation of setting shaft extension 112, timer 130 as a unit will rotate. Accordingly, timing cam 194 will rotate, and this rotation of cam 194 may be termed orientation of the timer assembly 50 with respect to the final arming and detonation assembly 52. When the main setting shaft 48 assumes the first position, the disposition of the timer assembly 50 as well as assembly 52 has not been altered as will be evidenced by FIG. 2. At missile impact, which is the second stage of fuze operation, the momentum of main setting shaft 48 will carry shaft 48 through a forward displacement to the shaft second or armed position as more clearly shown in FIG. 3. Shaft 48 will be displaced to such an extent as still to have geared portion 200 in mesh with the teeth 134 of movement assembly 132. Further at the shaft second position geared portion 202 will no longer be meshed with mainspring barrel assembly 136. Thus, the latter assembly will now be free to rotate with respect to movement assembly 132 by the internal functioning parts of timer 130. Consequently, pinion 144 will force timing cam 194 to rotate through gear wheel 184 and shaft 190.

An extremely critical feature of the fuze of this invention is the provision of means for locking the main setting shaft 48 in the shaft second position. As illustrated in FIGS. 1–3 and 8, a setting rack 210 is placed in an elongated slot 212 in the arming mechanism plate 188. Rack 210 is suitably biased by a spring 214 at one end and presents gear teeth 216 of a relatively deep configuration at the other end. Main setting shaft 48 is further provided with a geared portion 218 having rela-

tively shallow teeth. In the shaft fixed and first position geared portion 218 meshes with teeth 216 of rack 210 and because of the configuration of the respective teeth shaft 48 is permitted to rotate. This rotation is accompanied by a clicking sound as the teeth become disengaged. This is taken advantage of by designing the pitch of the respective teeth to produce a clicking noise for each 15 minute angular movement. Thus each click can be utilized to properly orient timing assembly 50 with respect to the final arming and detonation assembly 52 to produce a desired predetermined time interval for timing cam 194 to pass through. When main setting shaft 48 assumes its second position on missile impact geared portion 218 will become disengaged from rack 210, and the toothed end of rack 210 will become engaged with geared portion 202. Since the teeth of portion 202 are substantially conventional and the teeth 216 of rack 210 deeply cut, main setting shaft 48 will become nonrotatable. Since the teeth of geared portion 218 are relatively shallow, it will be prevented from reengaging with rack 210, because the latter will be forced axially inward by spring 214 in order to full mesh with the teeth on geared portion 202. Further at the shaft second position geared portion 218 bears against shoulder 219 of arming plate 188. Thus it may be seen that main setting shaft 48 is also restrained from longitudinal movement towards the tail end 14 at the shaft second position.

An axial bore 220 is formed in arming plate 188 and is in communication with reduced bore 222. In bore 222 and abutting against shoulder 224 is a firing pin barrel retainer 226. The bias of shock-absorbing spring 150 maintains barrel retainer 226 relatively immovable. A conventional firing pin 228 is mounted in bore 230 of barrel retainer 226 and is spring biased by spring 232. Firing pin 228 is preferably provided with beveled surface 234, the purpose of which will be explained later.

The final arming and detonation assembly 52 is substantially mounted on arming mechanism plate 188. A spacer split ring 236 may be employed to secure the plate 188, and thus the timing assembly 50, in body 10, but must be suitably recessed at its periphery to allow functioning of the moving parts of the assemblies 52 and 50. Referring to FIGS. 1 and 6 and when the main setting shaft 48 is in the shaft fixed position a multipurpose stop 240 is fixedly mounted on end 242 of setting shaft 48. The stem 244 of stop 240 maintains a spring urged tamper release cam 246 in a cocked position by engaging projection 248. Stop 240 is provided with a beveled surface 250 which engages a correspondingly beveled surface 252 on spring urged detonator rotor 254 to maintain the latter in an unarmed position. On rotor post 256, which is securely mounted in bore 258 of arming plate 188, is a bifurcated release lever 260. Lever 260 has one lever arm 262 extending under timing cam 194 and adjacent arming plate 188. A transverse projection 264 is provided on the free end of arm 262 to engage the periphery of timing cam 194 as a cam follower. Release lever 260 is provided with another lever arm 266 which is adapted to fit in a transverse slot 268 in barrel retainer 226 to maintain firing pin 228 in a biased or loaded position. The free end 270 of lever arm 266 is adapted to conveniently fit in an arcuate recess 272 in the periphery of tamper release cam 246. Rotor 254 is rotatably mounted on post 256 and is biased by spring 274 which has one end secured to a threaded bolt 276. Bolt 276 may extend as far as sleeve 154 of the timer assembly 50 to a correspondingly threaded bore, and thus act as a further means for preventing rotational movement of the final arming and detonation assembly 52. Rotor 254 may be provided with stepped portions 278 and 280. Portion 278, being on rotor post 256, mounts a detonator housing 282 formed with bore 284 for suitably receiving a detonator charge 286 (FIG. 3). Portion 280 presents beveled surface 252 for the rotor 254. Stop 240 is further provided with projection 288 for engagement with timer cam pin 198. This engagement prevents the projection 264 from being able to accidentally slip into recess 196 during fuze setting or when the fuze is properly set. As will be evident from FIG. 2, the final arming and detonation assembly 52 is substantially unaffected when the main setting shaft 48 assumes its first position since the displacement of shaft 48 at this position is not sufficient to free any of the moving parts of assembly 52. However, at impact the main setting shaft 48 is displaced a sufficient amount to the shaft second position to permit rotor 254 to rotate to the armed position (FIGS. 3 and 7) with charge 286 in line with firing pin 228. Stop 240 will disengage with tamper cam 246 to permit rotation of the latter, which is under influence of a spring biasing means, to its armed position as shown in FIG. 7. It will be noted that at this position, cam 246 is adapted to project through an opening 290 in body 10 a predetermined amount. Further, lever arm 260 is in close proximity to end wall 292, adapted to limit further predetermined rotation of spring influenced cam 246. It will be observed that cam 246 presents serrations or teeth 294 which are adapted to bite into the fuze well wall. If an attempt is made to unscrew body 10 from the fuze well, a rotational force will be placed on tamper release cam 246 which will place lever arm 260 under stress. At a predetermined strain lever arm 260 will shear or fail at weakened portion 296, and thus release firing pin 229 to initiate detonation. This tamper release cam in conjunction with hardened steel member 158, 166 and 110 renders it virtually impossible to disarm the fuze by either removing it from the bomb or attacking the functional parts in body 10. Assuming that no attempt is made to disarm the fuze and the parts are substantially as shown in FIG. 7 with the main setting shaft 48 at its second position the fuze is experiencing its third stage of operation. Timing cam 194 will be rotating because of the movement of timer 130 with projection 264 on lever arm 262 acting as a cam follower. After a predetermined movement of cam 194 which will be equivalent to a preset time delay, projection 264 will be at opening 196. Since spring-urged firing pin 228 presents beveled surface 234, lever arm 260 will be forced from its restraining position and pin 228 will be free to initiate detonation. Cam 194 preferably has its periphery disposed at a decreasing radius from the cam axis, but the difference between maximum and minimum radius is not sufficient to prematurely release firing pin 228. This has proved to be desirable since the frictional force developed by projection 264 bearing against the periphery of cam 194 may be sufficient to prevent movement of cam 194 when mainspring 138 is in a relatively unwound state. Further, this configuration makes it difficult for projection 264 to back track on the cam periphery at missile impact. A sealing strip 298 may be employed to prevent foreign matter entering opening 290 in body 10.

The operation of the fuze is summarized as follows: Tail fuze 10 is secured to a bomb fuze well (not shown) by means of threaded portion 18. A propeller (not shown) is affixed to the end of shaft 54 so that the shaft is caused to rotate when the bomb is dropped. Rotation of shaft 54 causes rotation of gear cluster 80 shown in FIG. 1. Gear 92 in this cluster drives safety cam 84 so that arcuate groove 96 is rotated from the position shown in FIG. 4 to the position shown in FIG. 5 opposite head 98. Ramp surface 102 concurrently forces head 98 through groove 96 and thereby causes shaft 48 to move to the left as viewed in FIGS. 1–3. Gears 134 and 136 are urged in opposite directions by preset timer 130 but are held against rotative movement by gears 200 and 202 affixed to shaft 48. Shaft 48 cannot be rotated because toothed rack 210 (FIGS. 2 and 8) contacts gear 218. Ramp 102 will move shaft 48 longitudinally until the shaft 48 assumes the position shown in FIG. 2.

Upon impact of the bomb with the target, shaft 48 moves to the left under the forces of impact, as shown in FIG. 3, carrying stop 240 to the extreme left so that projection 288 no longer contacts pin 198. At the same time gear 202 releases gear 136 for rotation by spring 138 (FIG. 7). Gear 144 is connected to gear 136 (FIG. 1) and drives shaft 190 by means of pinion 144 and gear 184 (FIG. 8). Shaft 190 turns timing cam 194 which has been released for rotation by stop 240. Timing cam 194 is thus free to rotate clockwise, as shown in FIG. 9.

Stop 240 serves two additional functions on impact. It releases rotor 254 (FIG. 5) so that spring 274 can immediately rotate the detonator 284 from the out-of-line position to the in-line position with firing pin 288. The third function that stop 240 accomplishes is to release tamper release cam 246 for biased rotation so that serrations 294 bite into the wall of the fuze well in which body 10 is secured. Thereafter should the fuze body 10 be unscrewed from the well in an attempt to defuze the bomb, tamper release cam 246 will be rotated clockwise, as viewed in FIG. 9, pressing lever 260 from its blocking position and thereby permitting the firing pin 288 to strike detonator 284 immediately.

If the fuze is not tampered with, timing cam 194 will rotate through its cycle until projection 264 can drop into slot 196. Spring 274 will then rotate lever 260 clockwise (FIG. 9) and out of blocking position to spring-biased firing pin 288, thereby initiating detonation.

Thus, it will be evident from the above that a relatively efficient and inexpensive fuze is provided by this invention. The fuze is substantially waterproof and highly resistant to shock and vibrations. It is adapted to function through a wide temperature range and possesses extremely long shelf life. The positioning of timing cam 194 with respect to lever arm 262 may be so regulated to produce detonation after missile impact from 15 minutes to 33 hours. Additionally, at the shaft second position any attempt to alter the time delay by rotating or withdrawing shaft 48 at 98 will result in sharing and separation at reduced section 100 inside hardened steel collar 110. Hence, an added tamperproof feature is contemplated by this invention.

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.

We claim:

1. A tail fuze comprising in combination: a body having a nose end and a tail end, said body being adapted to fit into a fuze well; a cover at said nose end; a cap on said tail end; an air arming reduction gear cluster disposed in said body adjacent said tail end for transmitting a predetermined rate of angular rotation; a main setting shaft disposed in said body substantially parallel to the axis of said body and along a major portion thereof; a primary safety cam rotatably disposed in said body adjacent said tail end and coupled to said gear cluster and rotatable therewith, said safety cam engaging the end of said shaft disposed nearest said trail end to maintain sad shaft in a substantially fixed position, said safety cam adapted to longitudinally displace said shaft from said fixed position to a first position upon rotation of said gear cluster for a predetermined time interval, said shaft at said first position being free so as to be longitudinally displaced to a second position when said fuze body impacts on said nose end; a preset timer disposed axially of said fuze body and intermediate said nose and tail ends; gear means operably connecting said timer to said shaft, said gear means locking said timer against movement during said fixed and first positions and releasing said timer at said second position; a rotatable timing cam coupled with said timer and rotatable upon rotational movement of said timer, said timing cam having a slot in its periphery; a stop mounted on the nose end of said main setting shaft and disposed within said body; a spring-biased stab firing pin axially disposed adjacent said nose end; a spring biased rotatable release lever having bifurcated first and second arms, the end of the first arm contacting the periphery of said timing cam; a spring-biased rotor mounted for rotation adjacent said nose end; a detonator in said rotor, the second arm of said lever blocking axial movement of said firing pin towards said rotor, said stop engaging said rotor during said fixed and first positions to lock said detonator out-of-line with said firing pin, said stop moving from engagement with said rotor at said second position so that said detonator is aligned with said firing pin, said stop also locking and unlocking said timing cam during said first and second positions, respectively, said timing cam after being unlocked rotating until the end of said first arm enters said slot, said second arm then being moved by the spring-bias acting on said lever so as to unblock said firing pin, said firing pin thereby being free to strike said detonator and initiate detonation of said fuze; a rotatable tamper release cam positioned in said nose end, said release cam being biased from locking contact with said stop, one end of said release cam being locked against rotative movement by said stop during said fixed and first positions and unlocked for rotation at said second position, the other end of said release cam being serrated so as to firmly grip the wall of said fuze well at said second position; and means on said release cam to contact the end of said second arm; said tamper release cam and said means thereon being so constructed and arranged that if subsequent to impact said body is rotated in a direction which would remove said fuze body from said fuze well, said second arm will be moved out of blocking position with said firing pin so that said firing pin can strike said detonator and initiate detonation of said fuze.

2. A tail fuze comprising in combination: a body having a nose end and a tail end, said body adapted to fit into a fuze well; a cover at said nose end; a cap on said tail end; an air arming reduction gear cluster disposed in said body adjacent said tail end for transmitting a predetermined rate of angular rotation; a main setting shaft disposed in said body substantially parallel to the axis of said body and along a major portion thereof; a primary safety cam rotatably disposed in said body adjacent said tail end and coupled to said gear cluster and rotatable therewith, said safety cam engaging the end of said shaft disposed nearest said tail end to maintain said shaft in a substantially fixed position, said safety cam comprising an elongated arcuate opening of substantially uniform width concentric with the axis of rotation of said safety cam, said opening terminating in a portion of reduced width; said shaft having a reduced diameter portion disposed near the end of said shaft nearest said tail end, said reduced diameter portion of said shaft being in said portion of reduced width of said safety cam to maintain said shaft in said fixed position; upon rotation of said safety cam said end of said shaft nearest said tail end adapted to be disposed in said opening of substantially uniform width; a cam surface on said safety cam adapted to engage said end of said shaft nearest said tail end to displace said shaft to said first position through said opening of substantially uniform width, said shaft at said first position being free so as to be longitudinally displaced to a second position when said fuze body impacts on said nose end; a preset timer disposed axially of said fuze body and intermediate said nose and tail ends; gear means operably connecting said timer to said shaft, said gear means locking said timer against movement during said fixed and first positions and releasing said timer at said second position; a rotatable timing cam coupled with said timer and rotatable upon rotational movement of said timer, said timing cam having a slot in its periphery; a stop mounted on the nose end of said main setting shaft and disposed within said body; a spring-biased stab firing pin axially disposed adjacent said nose end; a spring-biased rotatable release lever having bifurcated first and second arms, the end of the first arm contacting the periphery of said timing cam; a spring-biased rotor mounted for rotation adjacent said nose end; a detonator in said rotor; the second arm of said lever blocking axial movement of said firing pin towards said rotor, said stop engaging said rotor during said fixed and first positions to lock said detonator out-of-line with said firing pin, said stop moving from engagement with said rotor at said second position so that said detonator is aligned with said firing pin, said stop also locking and unlocking said timing cam during said first and second positions, respectively, said timing cam after being unlocked rotating until the end of said first arm enters said slot, said second arm then being moved by the spring-bias acting on said lever so as to unblock said firing pin, said firing pin thereby being free to strike said detonator and initiate detonation of said fuze; a rotatable tamper release cam positioned in said nose end, said release cam being biased from locking contact with said stop, one end of said release

cam being locked against rotative movement by said stop during said fixed and first positions and unlocked for rotation at said second position, the other end of said release cam being serrated so as to firmly grip the wall of said fuze well at said second position; and means on said release cam to contact the end of said second arm; said tamper release cam and said means thereon being so constructed and arranged that if subsequent to impact said body is rotated in a direction which would remove said fuze body from said fuze well, said second arm will be moved out of blocking position with said firing pin so that said firing pin can strike said detonator and initiate detonation of said fuze.

3. A tail fuze comprising in combination: a body having a nose end and a tail end, said body being adapted to fit into a fuze well; a cover at said nose end; a cap on said tail end; an air arming reduction gear cluster disposed in said body adjacent said tail end for transmitting a predetermined rate of angular rotation; a main setting shaft disposed in said body substantially parallel to the axis of said body and along a major portion thereof; a primary safety cam rotatably disposed in said body adjacent said tail end and coupled to said gear cluster and rotatable therewith, said safety cam engaging the end of said shaft disposed nearest said tail end to maintain said shaft in a substantially fixed position, said safety cam adapted to longitudinally displace said shaft from said fixed position to a first position upon rotation of said gear cluster for a predetermined time interval, said shaft at said first position being free so as to be longitudinally displaced to a second position when said fuze body impacts on said nose end; a preset timer disposed axially of said fuze body and intermediate said nose and tail ends, said timer comprising a circumferentially geared fixed part and a circumferentially geared rotatably movable part; said shaft having a first circumferentially geared portion meshing with said geared fixed part, said shaft having a second circumferentially geared portion meshing with said geared rotatably movable part so that said movable part is immovable with respect to said fixed part when said shaft is in said fixed position and said first position; said shaft having a third circumferentially geared portion; a spring-pressed geared setting rack meshing with said third geared portion; said shaft when at said second position adapted to maintain said first geared portion meshed with said fixed part, adapted to unmesh said second geared portion with said movable part, and adapted to unmesh said third geared portion with said setting rack and mesh said second geared portion with said setting rack, said setting rack preventing rotation of said shaft when meshed therewith, and also preventing return of said shaft to said first position; a rotatable timing cam coupled with said timer and rotatable upon rotational movement of said timer, said timing cam having a slot in its periphery; a stop mounted on the nose end of said main setting shaft and disposed within said body; a spring-biased stab firing pin axially disposed adjacent said nose end; a spring-biased rotatable release lever having bifurcated first and second arms, the end of the first arm contacting the periphery of said timing cam; a spring-biased rotor mounted for rotation adjacent said nose end; a detonator in said rotor; the second arm of said lever blocking axial movement of said firing pin towards said rotor, said stop engaging said rotor during said fixed and first positions to lock said detonator out-of-line with said firing pin, said stop moving from engagement with said rotor at said second position, so that said detonator is aligned with said firing pin, said firing pin thereby being free to strike said detonator and initiate detonation of said fuze, said stop also locking and unlocking said timing cam during said first and second positions, respectively, said timing cam after being unlocked rotating until the end of said first arm enters said slot, said second arm then being moved by the spring-bias acting on said lever so as to unblock said firing pin; a rotatable release cam positioned in said nose end, said release cam being biased from locking contact with said stop; one end of said release cam being locked against rotative movement by said stop during said fixed and first positions and unblocked for rotation at said second position, the other end of said release cam being serrated so as to firmly grip the wall of said fuze well at said second position; and means on said release cam to contact the end of said second arm; said tamper release cam and said means thereon being so constructed and arranged that if subsequent to impact said body is rotated in a direction which would remove said fuze body from said fuze well, said second arm will be moved out of blocking position with said firing pin so that said firing pin can strike said detonator and initiate detonation of said fuze.

4. A tail fuze comprising in combination: a body having a nose end and a tail end, said body being adapted to fit into a fuze well; a cover at said nose end; a cap on said tail end; an air arming reduction gear cluster disposed in said body adjacent said tail end for transmitting a predetermined rate of angular rotation; a main setting shaft disposed in said body substantially parallel to the axis of said body and along a major portion thereof; a primary safety cam rotatably disposed in said body adjacent said tail end and coupled to said gear cluster and rotatable therewith, said safety cam engaging the end of said shaft disposed nearest said tail end to maintain said shaft in a substantially fixed position, said safety cam adapted to longitudinally displace said shaft from said fixed position to a first position upon rotation of said gear cluster for a predetermined time interval, said shaft at said first position being free so as to be longitudinally displaced to a second position when said fuze body impacts on said nose end; a preset timer disposed axially of said fuze body and intermediate said nose and tail ends, steel sections substantially enclosing said timer whereby said fuze is substantially tamperproof after said fuze is secured in said fuze well and said shaft assumes said second position; gear means operably connecting said timer to said shaft, said gear means locking said timer against movement during said fixed and first positions and releasing said timer at said second position; a rotatable timing cam coupled with said timer and rotatable upon rotational movement of said timer, said timing cam having a slot in its periphery; a stop mounted on the nose end of said main setting shaft and disposed within said body; a spring-biased stab firing pin axially disposed adjacent said nose end; a spring-biased rotatable release lever having bifurcated first and second arms, the end of the first arm contacting the periphery of said timing cam; a spring-biased rotor mounted for rotation adjacent said nose end; a detonator in said rotor; the second arm of said lever blocking axial movement of said firing pin towards said rotor, said stop engaging said rotor during said fixed and first positions to lock said detonator out-of-line with said firing pin, said stop moving from engagement with said motor at said second position so that said detonator is aligned with said firing pin, said firing pin thereby being free to strike said detonator and initiate detonation of said fuze, said stop also locking and unlocking said timing cam during said first and second positions, respectively, said timing cam after being unlocked rotating until the end of said first arm enters said slot, said second arm then being moved by spring-bias from blocking said firing pin; a rotatable release cam positioned in said nose end, said release cam being biased from locking contact with said stop; one end of said release cam being locked against rotative movement by said stop during said fixed and first positions and unblocked for rotation at said second position, the other end of said release cam being serrated so as to firmly grip the wall of said fuze well at said second position; and means on said release cam to contact the end of said second arm; said tamper release cam and said means thereon being so constructed and arranged so that if subsequent to impact said body is rotated in a direction which would remove said fuze body from said fuze well, said second arm will be moved out of blocking position with said firing pin so that said firing pin can strike said detonator and initiate detonation of said fuze.