Feb. 10, 1959 V. K. RASMUSSEN 2,872,869

ROCKET BASE FUZE

Filed May 24, 1948 4 Sheets-Sheet 1

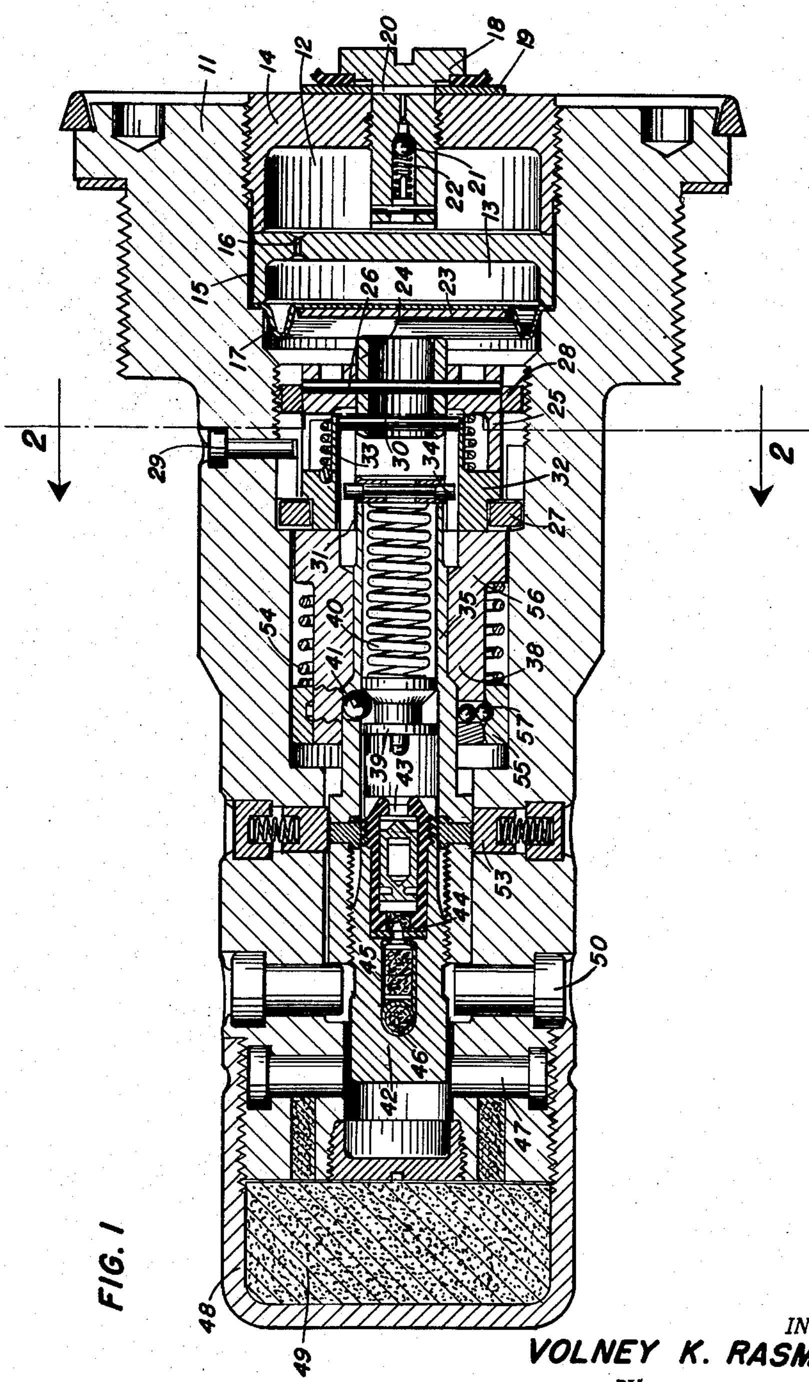

FIG. 1

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ROCKET BASE FUZE

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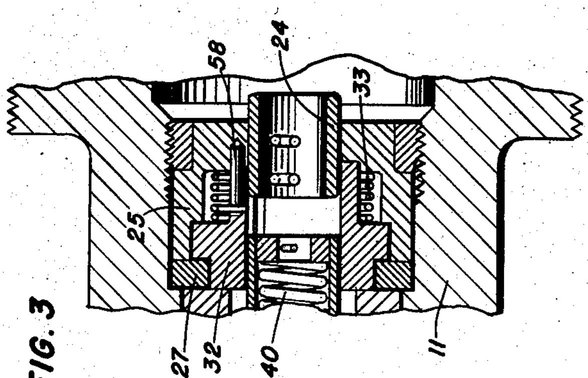

FIG. 3

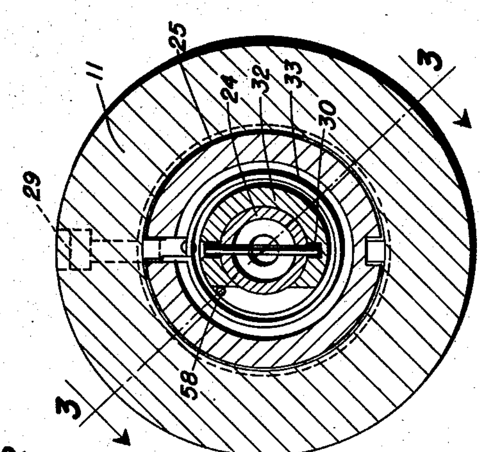

FIG. 2

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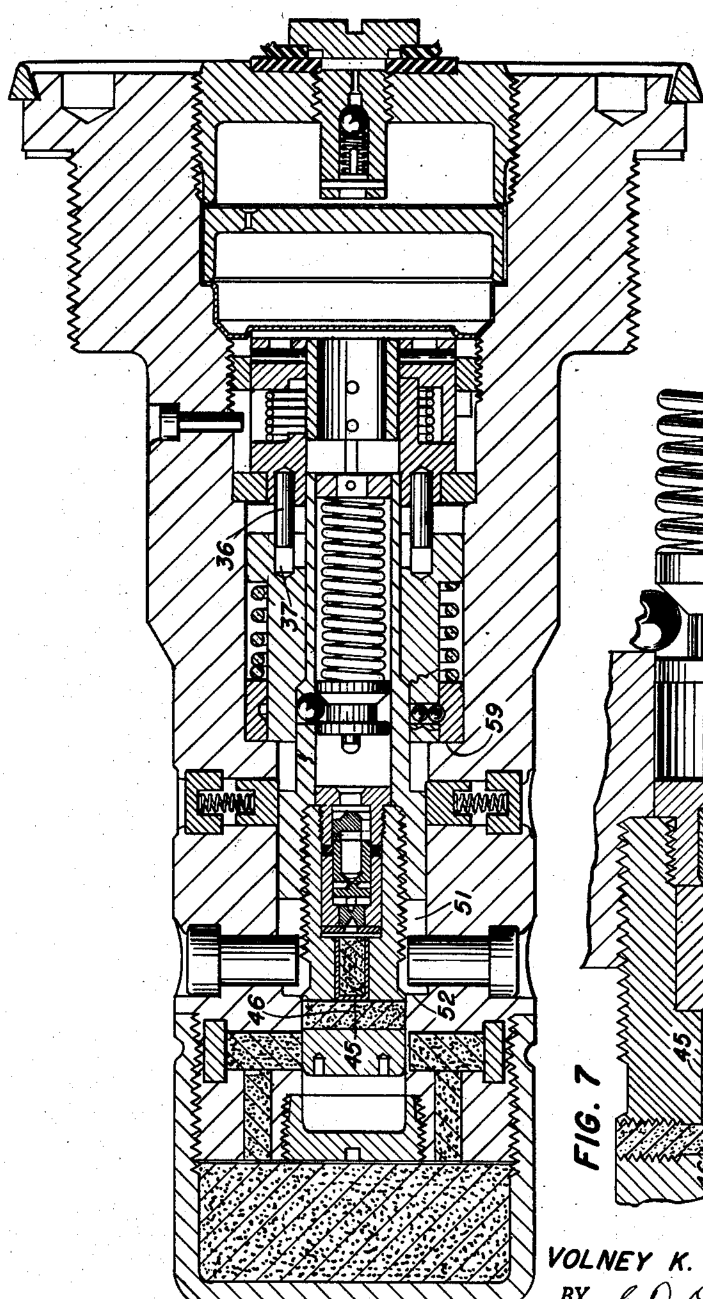

FIG. 4

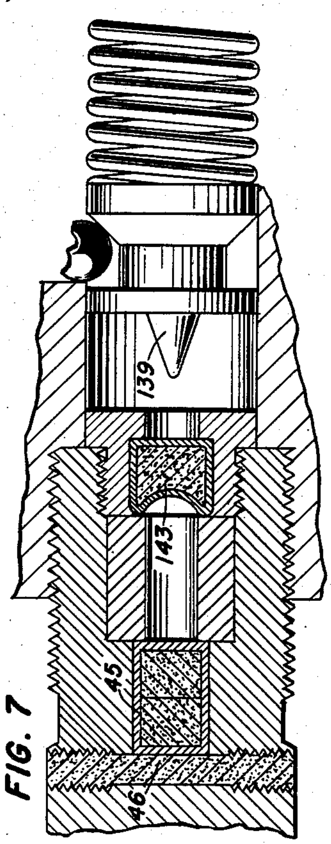

FIG. 7

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ROCKET BASE FUZE

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FIG. 6

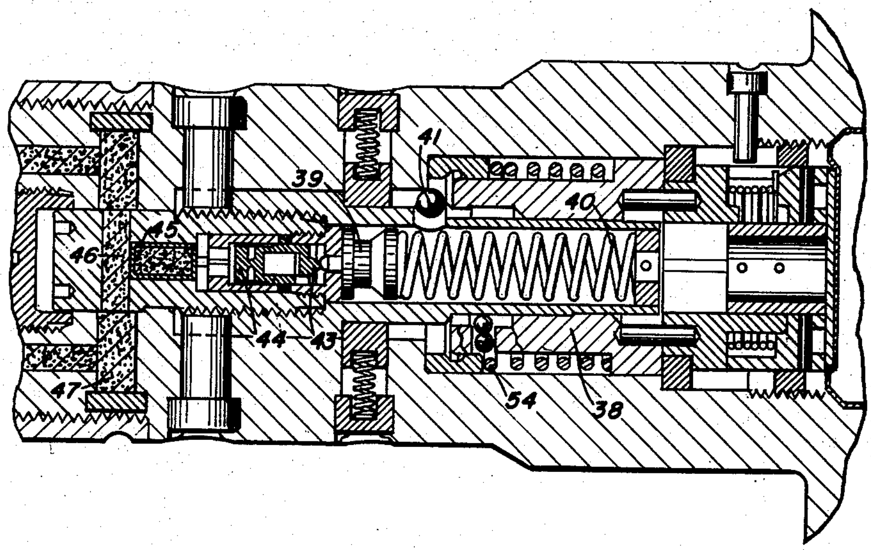
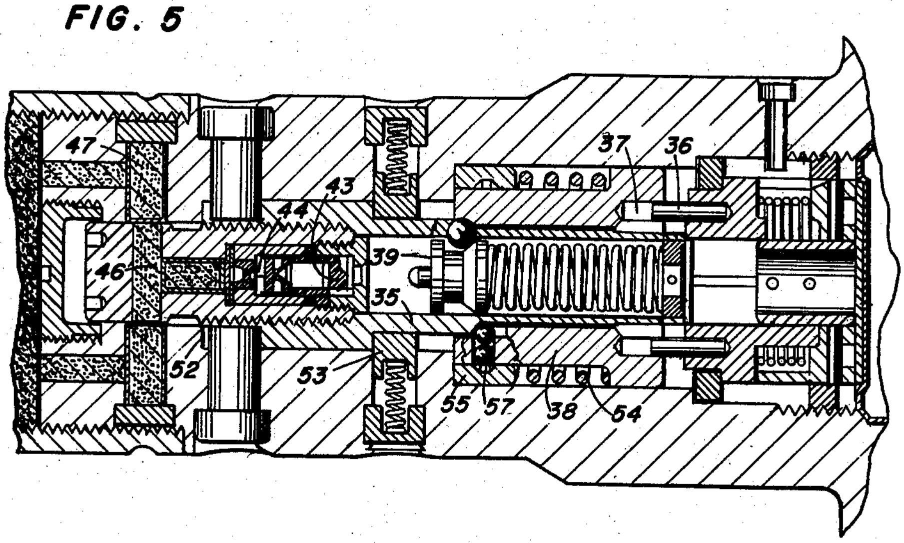


FIG. 5



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ROCKET BASE FUZE

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6 Claims. (Cl. 102—81)

This invention relates to deceleration discriminating fuzes for military missiles, more particularly, for rockets intended to be used against ships.

An object of the invention is to provide a projectile fuze that does not fire after impact until the deceleration or negative acceleration has fallen below a predetermined value.

Another object of the invention is to provide a projectile fuze which does not fire upon impact with a surface of water but fires either upon striking a solid object or upon losing the velocity required to penetrate such an object.

A further object of the invention is to provide a rocket fuze which is armed by the gas pressure generated in the rocket motor during flight.

An additional object of the invention is to provide a rocket fuze inherently safe and foolproof at all times prior to actually firing the rocket motor.

Another object of the invention is to provide a projectile fuze suitable for use against a wide variety of targets by reason of automatically delaying the detonation of the projectile until the optimum penetration of the target has occurred.

An additional object of the invention is to provide a rocket fuze which is especially effective underwater against submarines or the hulls of surface vessels by reason of arming in flight, cocking upon impact with the water surface, and firing when the deceleration drops below a selected value.

Other objects of the invention will become apparent upon study of the accompanying drawings and descriptions which set forth the preferred embodiment of the many modifications and adaptations of which the invention is capable.

In the drawings:

Fig. 1 is a longitudinal section of the fuze in the unarmed condition.

Fig. 2 is a transverse section of the fuze in the same condition, taken on line 2—2 of Fig. 1.

Fig. 3 is a longitudinal section view of the fuze in the same condition taken on the line 3—3 of Fig. 2.

Fig. 4 is a view similar to Fig. 1 showing the fuze of the invention in flight in the armed but uncocked condition.

Fig. 5 is a fragmentary sectional view taken on the same plane as Fig. 1 showing the fuze in the armed and cocked condition upon impact or rapid deceleration.

Fig. 6 is a view similar to Fig. 5 showing the fuze of the invention at the time of firing.

Fig. 7 is a fragmentary longitudinal section view showing a modification of the firing pin and detonator assembly.

Referring to Fig. 1 of the drawings, the fuze mechanism is contained in fuze body 11 which is installed in the base of a rocket head or projectile (not shown). The right or forward end of the body 11 is in contact with the bursting charge of the rocket head. The left or rear

end of the body 11 is exposed to the combustion chamber of the rocket motor (not shown).

The base of the fuze contains the two pressure chambers 12 and 13 formed by the plug 14, the baffle cup 15 which has a small orifice 16, and the diaphragm 17. Gases from the combustion of the propellant in the rocket motor, which are utilized in arming the fuze, enter these chambers through the inlet valve 18. The gases are admitted through inlet valve filter 19 of meshed "Inconel" wire which filters out any solid matter carried by the products of combustion. After passing through passage 20, the gases impinge on the inlet valve ball 21 forcing it forward off its seat and compressing the inlet valve spring 22, thus permitting the gas to slowly enter the first pressure chamber 12. From outer pressure chamber 12, the gas flows to inner pressure chamber 13 through orifice 16 which is of smaller diameter than inlet passage 20. The diaphragm 17 seals off the remainder of the fuze body cavity. This diaphragm is made from any suitable flexible and impermeable material, and it is backed with a reinforcing disc 23 to strengthen its central portion.

Immediately forward of diaphragm 17 an arming sleeve 24 is fixed to a stationary retaining cup 25 by a shear wire 26. The retaining cup is held in position against longitudinal movement by a bearing ring 27 abutting a shoulder in the fuze body cavity and the threaded retainer ring 28, and anchored against rotary movement by the locating pin 29 which fits into a slot in the retaining cup. A pin 29 extending diametrically through the arming sleeve 24 engages longitudinal interior slots 31 in the rotor 32 which is spring-loaded by a torsion spring 33. The rotor slots 31 also engage the detonator plunger pin 34 which passes through the detonator plunger 35. Located in a longitudinal plane, perpendicular to the plane of Fig. 1 are two pins 36 fixed in the rotor and slidably engaging the holes 37 in the trigger block 38. A firing pin 39 loaded by the compressed helical firing pin spring 40 is contained within the detonator plunger 35 and held cocked by several lock balls 41 which are retained in holes in the detonator plunger by trigger block 38. For a view of rotor pins 36, see Fig. 4.

Screwed into the forward end of the detonator plunger 35 is a detonator case 42 containing a percussion primer 43, a 0.010-second black powder delay element 44, a relay detonator 45 and tetryl lead-outs 46 (see Fig. 4). In the unarmed position (Fig. 1) these lead-outs are so oriented that the detonator plunger assembly must be rotated 90° to the armed position (Fig. 4) and also moved forward (Fig. 5) to line up the lead-outs with the lead-ins 47. These lead-ins are passages of circular cross section disposed radially and longitudinally in the forward end of fuze body 11. A magazine cover 48 of any suitable material is screwed onto the end of the fuze body and contains the tetryl booster pellet 49 which is in close proximity with the forward ends of the lead-ins 47.

In assembling the fuze, the locating pin 29 serves to orient the entire interior assembly. The forward end of the detonator plunger 35 is slotted in such manner that in the unarmed position, the detonator plunger is constrained from moving forward by the solid portions of the end of the detonator plunger bearing against the fixed stop pins 50 in the side of the fuze body as shown in Fig. 1. In arming the fuze, the detonator plunger 35 is rotated approximately 90° by torsion spring 33, bringing the slots 51 (Fig. 4) into engagement with the stop pins, thereby permitting the detonator plunger to move forward under the influence of inertia until the forward end of the detonator plunger reaches the shoulder 52 in the fuze body. As shown in Fig. 5, when the detonator plunger reaches this position, the radially disposed spring-mounted detents 53 move inwardly and engage a shoulder on the detent plunger 35 to prevent it from moving to the rear.

The trigger spring 54 is compressed between the trigger latch 55 and the shoulder 56 on the trigger block 38. Trigger latch balls 57 bearing against the detonator plunger 35 and a groove in the trigger latch 55 lock this latch with respect to the trigger block 38.

Referring to Figs. 2 and 3, it will be seen that a portion of the rotor 32 has been cut away in order to cooperate with rotor stop pin 58 mounted in retaining cup 25 to limit the motion of the rotor to approximately 90°. It will be obvious that the fit of the rotor must be adjusted to permit free rotation with respect to all other elements except rotor stop pin 58.

Another modification of the invention is illustrated in Fig. 7 which is a fragmentary view of the fuze in the same position as in Fig. 5. Here, an instantaneous firing train has been substituted for the delayed-action train of Fig. 5. This modification utilizes a firing pin 139 with a sharp point, a stab-type sensitive primer 143 and omits the delay element 44 (Fig. 5). All other members are identical with those disclosed in Figs. 1 to 6.

The operation of the fuzes of the invention involves the steps of arming, cocking and firing. The fuze is armed by gases from the rocket motor entering through inlet valve filter 19 and inlet passage 20, forcing the inlet valve ball 21 forward off its seat and compressing the inlet valve spring 22. This permits the gases to slowly enter the first pressure chamber 12. The gases then flow more slowly into the inner pressure chamber 13 through a smaller orifice 16 in the baffle cup 15. When the pressure in the inner chamber reaches a selected value, such as approximately 525 pounds per square inch, diaphragm 17 is pushed forward, forcing the arming sleeve 24 forward and shearing the shear wire 26. This frees the arming sleeve 24 as well as the rotor 32 which the arming sleeve engages by means of the arming sleeve pin 30, and permits the loaded torsion spring 33 to turn the rotor 32 approximately 90°. The rotor, which also engages the detonator plunger pin 34 and the trigger block 38 (by means of the rotor pins 36), thus turns the detonator plunger-trigger block assembly 90° until the rotor is stopped by the rotor stop 58 in the stationary retaining cup 25, lead-outs 46 in the detonator case are then lined up radially with the lead-ins 47 in the fuze body, but are still offset with respect to them along the fuze axis. Slots 51 in the end of the detonator plunger 35 and stop pins 50 are also aligned by the rotation so that the detonator plunger-trigger block assembly is free to move forward under the action of creep force (that is, the relatively small inertia force produced by air resistance slowing down or decelerating the exterior of the rocket projectile) until the forward end of the trigger block 38 rests against the shoulder 59 in the fuze body. Thus the arming operation involves the steps of rotation of the detonator plunger-trigger block assembly and movement of this assembly forward by creep force to the position shown in Fig. 4 where the slots 51 in the detonator plunger 35 engage the stop pins 50. When this operation is completed, the fuze is ready to either be cocked by light impact or be cocked and fired upon heavy impact. When cocked by a light impact, as for example on the surface of water, the fuze is then ready to fire when the deceleration or negative acceleration of the projectile drops below a preselected value regardless of whether the projectile is slowed down gradually by travel underwater or slowed rapidly by striking a solid object.

Friction of the four firing pin lock balls 41 on the trigger block 38 prevents the detonator plunger from moving farther forward than shown in Fig. 4 until impact. If necessary, the trigger block may be constructed with a shallow shoulder on its interior at the forward end in order to increase its frictional engagement with the firing pin lock balls. Upon impact the detonator plunger moves forward to the position shown in Fig. 5 where it is stopped by the shoulder 52 in the fuze body adjacent to the lead-outs 46, and is locked in this position by the detents 53; this cocks the fuze. In this position the lead-outs in the detonator case 42 are aligned with the lead-ins in the fuze body. Simultaneously, the trigger latch balls 57 fall in behind a sloping shoulder of the detonator plunger 35, releasing the trigger latch 55 which was formerly locked to the trigger block 38 thereby rendering the trigger spring 54 potentially active. The trigger spring is then effectively compressed between the shoulder 56 on the trigger block and the trigger latch resting against shoulder 59 in the fuze body cavity.

As long as the deceleration of the round is high, the inertia of the trigger block keeps the trigger spring compressed; but as soon as the deceleration drops below a predetermined value, the spring overcomes the inertia and frictional resistance and pushes the trigger block to the rear. This releases the firing pin lock balls 41 to move outward into the annular space now provided directly in front of the trigger block and release the spring-loaded firing pin 39. Firing pin spring 40 immediately drives the firing pin into the percussion primer 43. This primer is set off and in turn fires the delay element 44 which detonates the relay detonator 45 0.010 second later. The relay detonator fires the lead-outs 46 which in turn set off the lead-ins 47 which fire the booster pellet 49 to detonate the bursting charge in the projectile. The position of the various elements of the fuze at the instant of firing is shown in Fig. 6.

In the modification illustrated in Fig. 7, the action is the same except that no delay is introduced. Pointed firing pin 139 is driven into and sets off the primer 143 which in turn immediately fires the relay detonator 45. After that the sequence of actions in the firing train is identical with that described in conjunction with Fig. 6.

The value of deceleration or negative acceleration which will fire the fuze depends on several factors. One is the mass or weight of the trigger block which determines the inertia force acting against the trigger spring for any given deceleration. Another is the strength of the trigger spring. A third of these factors is the smoothness of the surfaces of the trigger block and associated parts, as the friction resistance to rearward motion depends on this. Various deceleration values may be selected according to the type of missile and the type of target. As an example, values ranging from approximately 45 to 75 times the acceleration of gravity are preferred for underwater-stable rocket projectiles for use against hostile ships.

The time required for the gas pressure in the inner pressure chamber 13 to reach the arming pressure value of 525 lbs. per sq. inch is dependent upon the pressure of the propellant gases in the rocket motor which in turn depends on the initial temperature of the solid propellant material. As soon as the burning of the propellant has ceased, the inlet valve spring and ball close the inlet passage 20, trapping the gases in the fuze pressure chambers. Since at this point the pressure is higher in the outer chamber 12 than in the inner chamber 13, the pressure in the inner chamber continues to rise until the pressures in both chambers are equalized. Thus, if the propellant is consumed before the arming pressure is attained in the inner chamber, closing of the inlet valve will permit arming to be accomplished after the end of the normal burning period of the propellant. The gas pressure required for arming depends on the strength of the shear wire, the effective area of the diaphragm, and to some extent in the fit of the arming sleeve with associated members; consequently the necessary pressure may be selected by proper selection of these factors.

It should be understood that the above description constitutes only the preferred embodiment of the invention, but that it is capable of a wide variety of modifications and adaptations and that the invention is limited only by the true and proper scope of the appended claims.

I claim:

1. In a fuze, pressure operable arming means releasably and rotatably supported within said fuze for movement from an initial safe position to an armed position when released, means for rotating said arming means to said armed position as the arming means is released, means including a pressure responsive device for releasing said arming means as the device is moved a predetermined amount in response to a predetermined pressure applied thereto, means for cocking the fuze upon rapid deceleration, pressure means, means including an inertia member operable to detonate the fuze at predetermined reduced deceleration as the inertia member is moved by said pressure means in response thereto.

2. In a fuze, a fixed explosive train, a movable detonation train initially remote from the fixed train, arming means releasably and rotatably supported within said fuze for aligning the detonation train and the fixed train in one plane as the arming means as rotated a predetermined amount, means for rotating said arming means said predetermined amount, means including a pressure responsive device for releasing said arming means as the device is moved a predetermined amount in response to a predetermined pressure applied thereto, a locked pressure member, cocking means operable upon rapid deceleration to free the pressure member and to align the detonation train and fixed train in a second plane, a locked firing pin, a primer at one end of the detonation train, means for propelling the firing pin into the primer, and an inertia member movable by the pressure member at a predetermined reduced deceleration to release the firing pin, whereby the firing pin strikes the primer to set off the detonation train which fires the fixed explosive train in turn.

3. In a deceleration discriminating fuze for military missiles, a fixed explosive train, a movable detonation train initially remote from the fixed train, arming means releasably and rotatably supported within said fuze for radially aligning the detonation train with the fixed train as the arming means is released and rotated a predetermined amount, means operatively connected to said arming means for rotating the arming means said predetermined amount as the arming means is released, means including a device slideably arranged within the fuze for releasing said arming means as the device is moved a predetermined amount, pressure controlled means movable into engagement with said device in response to a predetermined pressure applied thereto for moving said device said predetermined amount, a compressed and locked trigger spring, cocking means operable upon rapid deceleration to free the trigger spring and to longitudinally align the detonation train with the fixed train, a locked and spring loaded firing pin, a primer at the end of the detonation train adjacent the firing pin, and a trigger block movable by the trigger spring against the force of inertia at a predetermined reduced deceleration to release the firing pin, whereby the firing pin strikes the primer to set off the detonation train which fires the fixed explosive train in turn.

4. In a deceleration discriminating rocket fuze, a fuze body containing a fixed explosive train; a detonator plunger initially held against longitudinal movement and containing a firing pin, a compressed firing pin spring, locking means for the firing pin, and a detonation train initially remote from the fixed explosive train; a trigger block frictionally engaging the detonator plunger and maintaining the locking means in engagement with the firing pin; a trigger spring engaging the block; trigger latch means holding the trigger spring compressed; an arming sleeve; a shear wire fastening the sleeve to the body; a rotor rotatively engaging the sleeve, the plunger and the block; a torsion spring under tension engaging the rotor; a pressure chamber in the body; a flexible permeable diaphragm adjacent one end of the sleeve and forming one wall of the chamber; and an inlet valve in a wall of the chamber connected to a rocket motor; whereby the fuze is armed by propellant gases under pressure entering the chamber through the valve forcing the diaphragm against the sleeve to shear the shear wire thereby freeing the rotor to turn the plunger to radially align the detonation train with the fixed train and to free the plunger for longitudinal movement, the fuze is cocked by rapid deceleration moving the plunger to longitudinally align the detonation train with the fixed train and to release the trigger latch means, and the fuze is detonated at a predetermined reduced deceleration by the trigger spring overcoming the reduced inertia force of the trigger block to move the block to release the firing pin to set off the detonation train to fire the fixed explosive train.

5. The fuze of claim 4 in which the detonation train includes a delay element and the trigger block and trigger spring are so constructed and arranged as to detonate the fuze when the deceleration is reduced to between 45 to 75 times the acceleration of gravity.

6. The fuze of claim 4 in which the detonation train consists of substantially instantaneous elements and the trigger block and trigger are so constructed and arranged as to detonate the fuze when the deceleration is reduced to between 45 and 75 times the acceleration of gravity.

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