Dec. 24, 1957 H. B. WYLIE 2,817,295

FIRING PIN FOR ROCKET FUZE

Filed Aug. 14, 1953 3 Sheets-Sheet 1

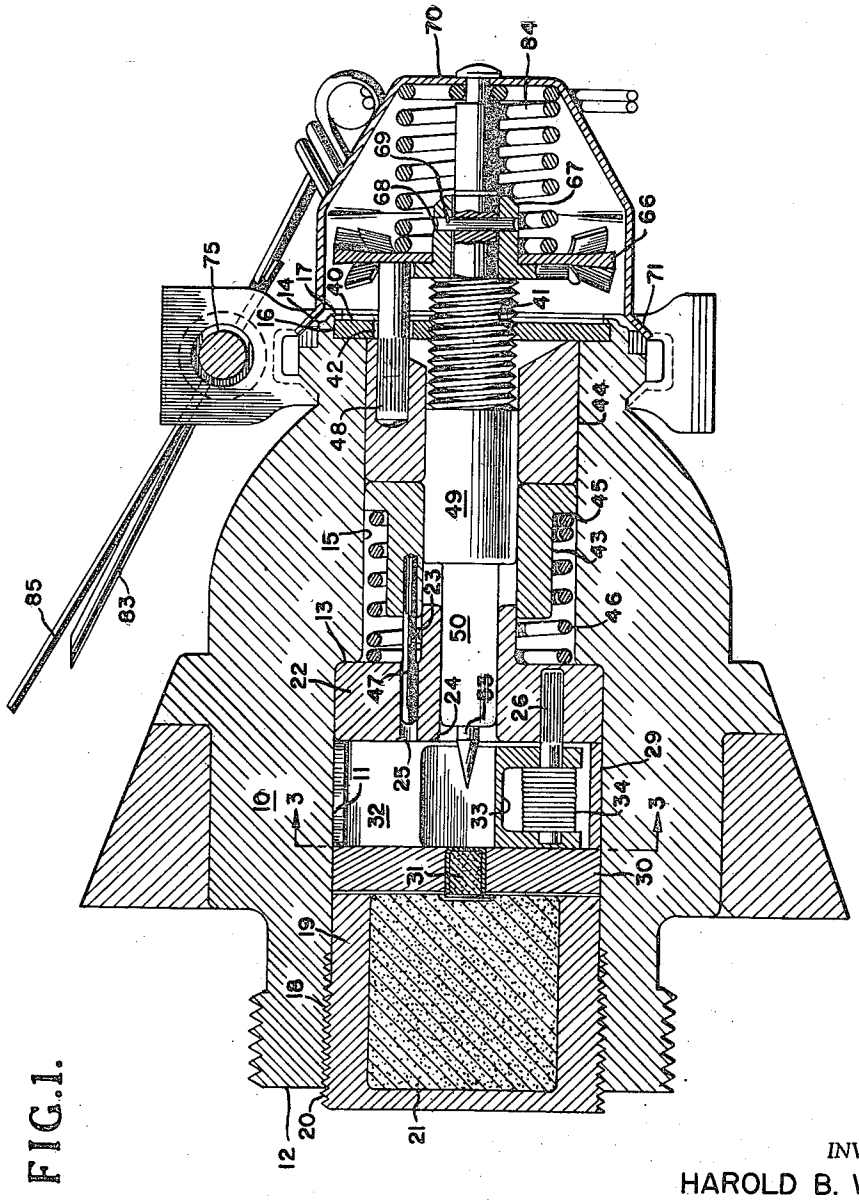


FIG. 1.

INVENTOR
HAROLD B. WYLIE

BY G. D. O'Brien
R. M. Hicks
ATTORNEYS

Dec. 24, 1957 H. B. WYLIE 2,817,295

FIRING PIN FOR ROCKET FUZE

Filed Aug. 14, 1953 3 Sheets-Sheet 2

FIG. 3.

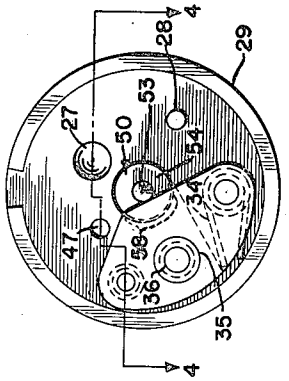


FIG. 4.

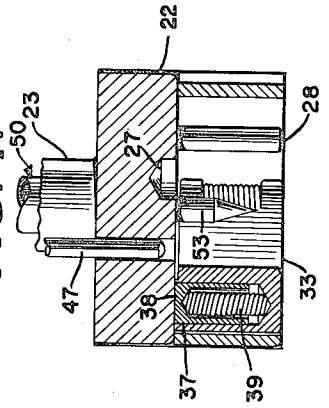
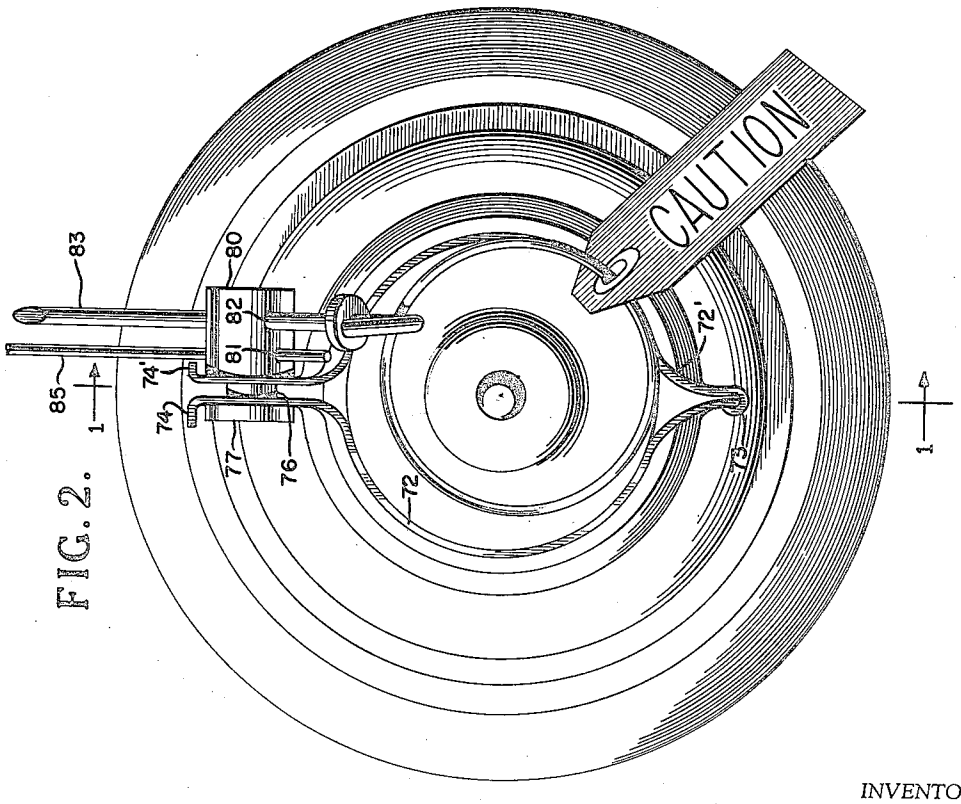


FIG. 2.



INVENTOR
HAROLD B. WYLIE

BY

G. D. O'Brien
R. M. Hicks
ATTORNEYS

Dec. 24, 1957 H. B. WYLIE 2,817,295

FIRING PIN FOR ROCKET FUZE

Filed Aug. 14, 1953 3 Sheets-Sheet 3

FIG. 5.

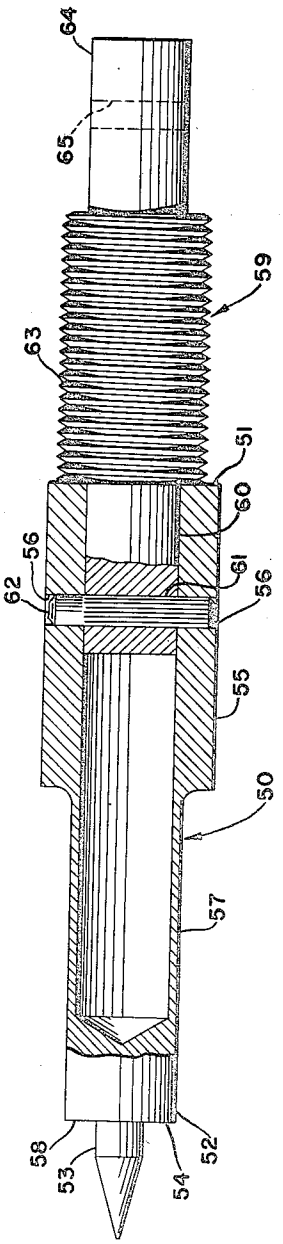
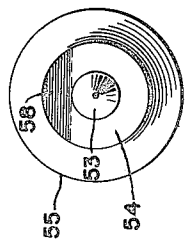


FIG. 6.



INVENTOR
HAROLD B. WYLIE

BY

R. M. Hicks

ATTORNEYS

United States Patent Office 2,817,295
Patented Dec. 24, 1957

2,817,295

FIRING PIN FOR ROCKET FUZE

Harold B. Wylie, Barrington, R. I., assignor, by mesne assignments, to the United States of America as represented by the Secretary of the Navy

Application August 14, 1953, Serial No. 374,455

1 Claim. (Cl. 102—81.2)

The present invention relates to fuzes for military missiles, more particularly to an improved firing pin for an impact fuze.

While primarily intended for fuzes used in rockets the firing pin described herein can readily be adapted for use in other types of projectiles which are detonated on impact.

In the past the practice has been to equip this type of fuze with a firing pin made in one piece and having a solid structure. The structure of the fuze was such that a portion of the firing pin protruded beyond the nose of the fuze body. While this particular construction was essential to the operation of the fuze this structure gave rise to a hazard which was ever present whenever the projectile was handled. Occasionally, as a result of a mishap in handling, the missile was accidentally dropped. If said missile was dropped and landed on its nose, the force resulting from the impact would crumple the fragile nose cap and drive the firing pin backward. If said force was of sufficient magnitude the firing pin would be driven back to a point which would enable the pointed striking portion of the firing pin to penetrate into the lead explosive. The lead explosive used in the past was comparatively inert so that mere penetration by the firing pin did not detonate it. However, the possibility always existed that eventually such a penetration of the lead explosive as described above might result in detonation. Needless to say, the subsequent explosion of the missile would in all probability cause unnecessary damage and injuries. If the fuze did not cause the explosion of the missile because of said accidental dropping, the fuze was in an unpredictable state because of the firing pin being embedded in the lead explosive. Consequently the safest remaining procedure was to remove and dispose of the entire fuze assembly.

This invention eliminates the danger of the firing pin penetrating into the lead explosive. To effectively accomplish this a portion of the firing pin is a tubular structure having a comparatively thin wall. This wall is only of such a thickness as to enable the firing pin to perform its function. The normal function of the firing pin is to be driven backward when the portion of the firing pin projecting beyond the nose of the fuze comes in contact with any object when the fuze is in the armed condition. This backward movement will permit the striking portion of the firing pin to come in contact with a sensitive explosive known as an ignitor. This initial contact will eventually result in the explosion of the missile. The exact operation of this fuze will be more fully described below.

The structure disclosed by the subject invention will cause the fuze to act in a somewhat different manner should the missile containing said fuze be accidentally dropped. Should such a missile be dropped so that the impact on its nose will cause the firing pin to be driven backward, a portion of a shoulder on the firing pin will engage a face of a shutter. Should the force be of sufficient magnitude so as to cause the firing pin to continue its backward movement, the thin wall of the tubular portion will collapse. Thus the striking portion of the firing pin is prevented from penetrating the lead explosive. In addition, the same fuze may be made reusable by replacing a few of the several elements.

It is an object of this invention to permit greater safety in the handling of an ordance missile.

Another object is to eliminate a dangerous condition induced by the firing pin penetrating the lead explosive in the event that the missile is accidentally dropped.

A further object is to achieve an added economy in regard to the consumption of fuzes.

Still another object is to eliminate the necessity of replacing the entire fuze assembly when the missile has been accidentally dropped.

An additional object is to provide a fuze in which only a few easily replaceable elements are damaged should the missile be accidentally dropped.

Other objects and many of the attendant advantages of this invention will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings wherein:

Fig. 1 is a longitudinal sectional view of the fuze assembly with the parts in their initial unarmed position taken substantially along the lines 1—1 of Fig. 2;

Fig. 2 is an elevational view of the fuze assembly shown in Fig. 1 looking at the nose thereof;

Fig. 3 is a transverse sectional view of the fuze assembly taken through section 3—3 of Fig. 1 looking in the direction of the arrows;

Fig. 4 is a sectional view taken through section 4—4 of Fig. 3 and looking in the direction of the arrows;

Fig. 5 is a longitudinal sectional view of the firing pin assembly; and

Fig. 6 is an elevational view of the firing assembly shown in Fig. 5, looking at the striking portion end of said firing pin assembly.

It is pointed out that the particular fuze assembly illustrated in Figures 1 through 6 is designed for use in rocket missiles. Therefore, some of the aspects of the operation of this fuze which must be explained in order to more clearly bring out the invention may be found to be peculiar to rocket-like missiles. However, this invention may be applied to any missile which is detonated on impact and is not in any way limited to that type of missile designated as a rocket.

Referring now to the drawings wherein like reference characters indicate corresponding parts throughout the several views, the numeral 10 indicates a tubular fuze body or housing member of the fuze having a compartment 11 which extends from the rearward end 12 of the fuze body to a point which is approximately one-half of the distance from the rearward end 12 to the nose 14. Communicating with the compartment 11 at said point is an axial cavity 15 which is of reduced diameter and extends to the nose 14 of the fuze body. Since the compartment 11 and the axial cavity 15 are of different diameters a shoulder 13 is formed at the point where said compartment and cavity meet. On the nose 14 of the fuze body 10 is an annular shoulder 16 surrounding the open end of the axial cavity 15. The shoulder 16 has inserted therein a cover plate 40 which is retained in place by crimping portions of the circumference of said shoulder as indicated at 17, or by any other suitable means such as screws which are not illustrated. The rear end 12 of the fuze body is internally threaded as indicated at 18 to receive a booster case 19 which is provided with an external thread 20. The booster case 19 contains a booster pellet 21 which serves as the lead explosive.

Within the compartment 11 and abutting the shoulder

13 is a partition piece 22. Said partition piece has a centrally located cylindrical boss 23 which projects into the axial cavity 15. A center passage-way 24 passes through said partition piece and said boss. The partition piece 22 has an off-center opening 25 passing therethrough which is smaller in diameter than the passageway 24. A shutter pin 26 is rigidly fastened into the partition piece 22 so as to project into the compartment 11. Said partition piece has a detent recess 27 therein (Fig. 4) opening to the rear of the fuze body. A pin 28 has one end secured in said partition piece and the free end projecting toward the rear of said fuze body. A slotted tubular sleeve 29 has one end in abutting relation with the partition piece 22. The external diameter of the sleeve 29 is substantially equal to the internal diameter of the compartment 11. In abutting relationship with the other end of the sleeve 29 is a partition disc 30 whose diameter is also substantially equal to the internal diameter of the compartment 11. Said partition disc contains an ignitor 31 which is axially aligned with the passageway 24 in the partition piece 22. When the fuze is finally assembled the inner end of the booster case 19 is just barely in contact with the rearward surface of the partition disc 30.

The partition piece 22 and the partition disc 30 each form an end wall, and the sleeve 29 serves as the cylindrical wall of a space which is designated as a shutter compartment 32.

Located within the shutter compartment 32 is a shutter 33 which is journaled eccentrically on the shutter pin 26. A helical shutter spring 34 is also mounted on the shutter pin 26 so as to tend to rotate the shutter from an unarmed to an armed position. The shutter spring 34 tends to rotate the shutter 33 in a clockwise direction about the pin 26 as viewed in Figure 3. As may be seen in Figure 3 the shutter 33 has an opening 35 therethrough which receives a detonator assembly 36. Said opening 35 is so positioned in the shutter that the detonator assembly 36 swings into axial alignment with the ignitor 31 and the passageway 24 when the shutter is rotated to the armed position in a manner to be later described. On the face of the shutter adjacent to the partition piece 22 there is a hole 37 which extends partially through said shutter. The hole 37 receives a suitable detent pin 38 which is biased by a helical detent spring 39 to engage the recess 27 in the partition piece 22 in order to lock the shutter 33 in the armed or firing position. The pin 28, which extends from the partition 22, is positioned so as to limit the clockwise motion of the shutter when said shutter under the urging of the pivot spring 34 reaches the armed position.

On the nose end 14 of the tubular fuze body the thin cover plate 40 is inserted into the shoulder 16. Said cover plate is retained in place by the crimping 17 and serves to close the nose end of the axial cavity 15. The cover plate has a threaded center opening 41 therethrough. A second opening 42 is located off-center in the cover plate 40. The opening 42 is somewhat smaller in diameter than the threaded opening 41.

In the axial cavity 15 a rear setback block 43 and a forward setback block 44 are reciprocally mounted. The rear setback block 43 is tubular in form with its internal diameter being of such a dimension as to enable the rearward block to fit upon the boss 23 of the partition piece 22 and to reciprocally slide thereon. On the cylindrical surface of the rearward block there is a shoulder 45 which receives one end of a cylindrical helical spring 46. The other end of said spring 46 is in contact with the forward face of the partition piece 22 so that the action of the spring is to bias the rearward block 43 in a forward direction. A pin 47 is rigidly mounted in the rearward block 43 so as to be slidably received within the opening 25 in the partition piece 22. The forward setback block 44 is also tubular in form and has a propeller locking pin 48 rigidly fastened in the front end thereof so that said pin is slidably received within the opening 42 in the cover

plate 40. The force of the helical spring 46 normally maintains both setback blocks in a forward position with the forward end of the setback block 44 in contact with the cover plate 40.

Slidably mounted within the setback blocks 43 and 44 is a firing pin assembly indicated generally as 49. (See Fig. 5.) The firing pin assembly includes a tubular portion indicated generally as 50 having an open end 51 and a closed end 52. A pointed solid striking portion or firing pin 53 of reduced cross-sectional area extends from the closed end 52 of the tubular portion 50. A shoulder 54 is thus formed at the junction of the striking portion 53 and the tubular portion 50. For satisfactory application of this invention the length of the striking portion 53 should be somewhat less than the thickness of the shutter 33. In this particular embodiment of the invention the tubular portion 50 is illustrated as having an increased external diameter 55 adjacent to the open end 51 thereof. Diametrically opposed apertures 56 pass through the wall of the increased portion 55 of the tubular portion. This structural relationship illustrated in Fig. 5 whereby the tubular portion has an increased external diameter is a preferable, although not essential, construction of the firing pin assembly. However, in regard to the thickness of the wall 57 of the tubular portion 50, tests have disclosed that when the cross-sectional area of the wall 57 is of the order of 1/10 of the area 58 on the shoulder 54 (see Fig. 6) or when said thickness is from 4% to 10% of the external diameter of the tubular portion 50, the invention functions satisfactorily. The shaded area 58 is substantially the area of the shoulder which will engage the shutter 33 when the shutter is in the unarmed position and the fuze is dropped so as to cause the firing pin assembly 49 to move back from the nose of the fuze.

A second unit of the firing pin assembly 49 is a solid arming shaft designated generally as 59. Said arming shaft has an unthreaded end 60 which is adapted to be received within the open end 51 of the tubular portion 50. Passing through the unthreaded end 60 on a diameter thereof is a hole 61 which is so located as to be aligned with the apertures 56 in the tubular portion 50 when the arming shaft 59 is positioned in the tubular portion. A snug fitting pin 62 is inserted in the openings 56 and 61 to rigidly fasten the arming shaft 59 to the tubular portion 50. The center portion of the arming shaft 59 is provided with a thread 63 and the free end 64 of said arming shaft is unthreaded and has a diametrically extending hole 65 passing therethrough. A propeller 66 having a hub 67 with an aperture 68 therethrough is fitted over the free end 64 of the arming shaft and is secured in place by a retaining pin 69 tightly received within the hole 65 in the free end 64 of the arming shaft. Said propeller is preferably constructed so that there is insufficient space between edges of adjacent blades to allow passage of the propeller locking pin 48 therebetween.

Initially a cap 70 fits on the nose end of the fuze body so as to completely cover the propeller 66. The open end of the nose cap is swaged as indicated at 71 so as to fit on the nose end 14 of the fuze body 10. A pair of clamps 72 and 72^1, joined at one end thereof by a spring hinge 73, hold the swaged portion 71 of the nose cap against the nose end of the fuze body. The free ends of said clamps, 74 and 74^1 respectively, are contiguous to each other when the clamps are in place on the nose of the fuze as illustrated in Fig. 2. Through each of said free ends is an aperture 75 and 75^1 respectively which are axially aligned with each other. In order to hold said clamps in place, a solid pin 76 having a head 77 and apertures 78 and 79 diametrically through the solid portion of said pin is inserted through the apertures 75 and 75^1. A tubular cylinder 80 which fits over the pin 76 has diametrically opposed apertures 81 (only one of which is shown in Fig. 2) for an arming wire 85 and diametrically opposed apertures 82 (only one of which is shown in Fig. 2) for

a safety wire 83. The apertures 81 and 82 will be aligned respectively with the apertures 78 and 79 when the tubular cylinder 80 is placed over the pin 76 in operating position. The safety wire 83 is then passed through the aligned apertures 79 and 82 to secure the tubular cylinder 80 to the solid pin 76 so as to retain the removable clamps 72 and 72¹ in place.

A helical spring 84, which may have one end attached to the inside of the nose cap 70, is interposed between the cap and the propeller 66 so that the free end of the spring 84 is in contact with the propeller.

A description of the operation of the fuze is pertinent at this point in order that the function of the invention will be more understandable. In order to more clearly bring out the operation of the fuze and the function of the invention, said operation will be described as if the fuze is to be mounted in the head of a rocket which is to be launched from an aircraft in flight. The operation of the fuze is identical regardless of whether the old solid firing pin or the firing pin described herein is used.

Referring back to Fig. 1, when the fuze is in the unarmed position the threaded portion 63 of the arming shaft partially protrudes through the threaded opening 41 in the cover plate 40 beyond the nose end 14 of the fuze body. The firing pin assembly 49 is restrained from any rearward movement at this time by the interaction of the propeller locking pin 48 with the propeller 66, the free end of said pin abutting the rear face of a propeller blade and the leading edge of the adjacent blade engaging the lateral surface of said pin. The striking portion 53 partially projects into the shutter compartment 32 and contacts an edge of the shutter 33 so as to prevent rotation of the shutter to the armed position.

When the rocket containing said fuze is inserted in the launching device, usually located beneath the wing of an aircraft, the free end of an arming wire 85 is inserted through the apertures 78 and 81 located in the solid pin 76 and tubular cylinder 80 respectively. The safety wire 83 may then be removed. When the rocket is launched from the aircraft the arming wire 85 is withdrawn from said apertures. This enables the pin 76 to withdraw from the tubular cylinder 80 which in turn causes the free ends 74 and 74¹ of the removable clamps 72 and 72¹ to separate under the force of the spring joint 73 of said clamps. When the clamps 72 and 72¹ are removed, the nose cap 70 is in turn forced off by the action of the spring 84. The rocket propellant burns for a fraction of a second after the rocket is launched to cause said rocket to accelerate at a high rate. Said acceleration forces cause the setback blocks 43 and 44 to move rearwardly until the rear end of the rearward setback block 43 contacts the forward face of the partition piece 22. As the forward setback block 44 moves away from the cover plate 40, the propeller locking pin 48 is disengaged from the propeller 60. The propeller, now free of any restraint, is rotated as the missile passes through the air. Said rotation causes the firing pin assembly 49 to move forward by the action of the threaded portion 63 on the internally threaded opening 41 of the cover plate 40 until the increased portion 55 of the firing pin assembly comes in contact with the cover plate 40. When said setback blocks 43 and 44 have moved rearwardly to their extreme position, the pin 47 in the rear setback block 43 projects into the shutter compartment 32 so as to engage an edge of the shutter 33. The setback blocks 43 and 44 are maintained in the rearward position by the action of the acceleration forces thereon as these forces are sufficient to overcome the action of the spring 46. The shutter is now blocked from movement to the armed position until the acceleration of the rocket is terminated and said blocks are returned to their forward position by the action of the spring 46. This delay in arming is desirable because the arming of the rocket will then take place at a safe distance from the launching site. It should be mentioned that this delay in the arming of the fuze was the only safety feature present in said fuze prior to the present invention. Even so, without the present invention and using the conventional solid firing pin, detonation of the rocket was possible during this delay in arming if said rocket encountered an unexpected object immediately after launching. This latter possibility is eliminated by this invention.

When the setback blocks 43 and 44 return to their forward position, there is nothing in the shutter compartment 32 to block the movement of the shutter 33 to the armed position. The shutter, under the action of the spring 34, will then rotate into the armed position. The pin 28 will stop the rotational movement of the shutter and the detent pin 38 in said shutter will engage the recess 27 to lock the shutter in the armed position. When the shutter is in the armed position, the striking portion 53 of the firing pin assembly 49, the detonator assembly 36 in the shutter, and the ignitor 31 in the partition disc 30, are all in axial alignment. Consequently, when the nose of the rocket comes in contact with a solid object, the engagement of the free end 64 of the arming shaft with said object will cause the firing pin to be driven backward and to strip the threading from the threaded center opening 41 of the cover plate 40. This stripping of the threads from the center opening 41 will occur only if the rocket strikes an object while traveling at a high velocity. Should the rocket strike an object while traveling at a low velocity, the cover plate 40, being made of a soft metal such as brass or copper, will bend backward at its center to cause the opening 41 to open wide enough which in turn enables the threaded portion 63 of the firing pin assembly 49 to move backward. As the rearward motion of the firing pin continues, the striking portion 53 will penetrate the sensitive detonator assembly 36 which will cause said assembly to detonate. This in turn will detonate the ignitor 31 which in turn will detonate the lead explosive 21 located in the booster case 19. The detonation of the main explosive located in the body of the rocket will then immediately follow.

As emphasized above, the invention relates to a safety feature operable when the fuze is in the unarmed position, both when the missile containing said fuze is being handled or immediately after the missile has been launched. The components of the fuze as illustrated in Fig. 1 are disclosed in the unarmed position. Hence, at this time, should a missile containing such a fuze be accidentally dropped and land on its nose, the resulting impact will crumple the fragile nose cap 70 and cause the firing pin assembly 49 to be driven backward. However, the firing pin assembly will continue back only until a portion of the shoulder 54 engages a face of the shutter 33. Should the force of the firing pin assembly caused by the impact be of sufficient magnitude, the firing pin assembly will continue to be driven back. However, at this point the thin wall 57 of the hollow portion 50 will collapse. Since any continued application of force on the firing pin assembly will merely further crumple the thin wall 57 of the tubular portion 50, it can be seen that the pointed striking portion 53 of the firing pin assembly will not penetrate the ignitor 31. As this explosive is not penetrated, the damaged missile may be removed in safety. Also, it is not necessary to dispose of the entire fuze assembly after it is accidentally dropped. The collapsed firing pin is removed and replaced together with a new nose cap, plate 40, propeller, and the fuze assembly is ready for operation.

The second situation in which the subject invention will provide an added safety feature is immediately after the rocket or missile containing such a fuze is launched. During the fraction of a second when the rocket is accelerated immediately after launching, the shutter 33 is blocked from moving into the armed position by the restraining pin 47 protruding from the rear setback block

43. During this period of time should the missile come in contact with any object the missile will not explode because the firing pin assembly, which will be driven backward upon contact with any object, will collapse as described above. This is a desirable feature because if an explosion of the rocket occurs before the rocket is armed, the aircraft launching the rocket may be within effective range of said explosion. Thus it may be seen that it is virtually impossible for a rocket equipped with the subject invention to be detonated where it may injure either personnel handling it or personnel who have launched it.

Obviously, many modifications and variations of the present invention are possible in the light of the above teachings. It is therefore to be understood that within the scope of the appended claim the invention may be practiced otherwise than as specifically described.

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

A fuze for an ordnance vehicle comprising a casing having an axial compartment therein, a spring loaded shutter arranged in a rearward portion of said compartment; an explosive element axially disposed in said shutter; a rotatable arming shaft assembly having a forward threaded section, an intermediate thin walled section, and a rearward firing pin section, said firing pin section initially lockingly engaging said shutter in an unarmed position and upon forwardly rotation of said assembly within said casing being disengageable therefrom thereby releasing said shutter for movement to an armed position, said thin walled section being crushable upon the application of a sudden axial force to said assembly while said shutter is in said unarmed position; an impeller affixed to said assembly, an inertia responsive member having a

forward concave surface slideably encircling said assembly; a forwardly extending rod secured to said inertia member for normally lockingly engaging said impeller, said rod being disengageable therefrom upon the application of a predetermined axial inertial force to said inertia member thereby releasing said impeller for effecting rotation of said assembly; a spring biased inertia responsive member slideably encircling said assembly and having a rearwardly extending rod secured thereto for preventing movement of said released shutter to an armed position until said applied inertial force has subsided to a predetermined level; and a soft metallic member having a threaded aperture therethrough in threaded engagement with said threaded portion of said assembly, said threaded aperture being shearable in response to a substantially axially applied impact force of a predetermined magnitude thereby to effect driving engagement of said firing pin with said explosive element, said metallic member also being rearwardly deformable within said concave surface in response to a substantially axially applied impact force less than said predetermined magnitude thereby to effect engagement of said firing pin with said explosive element.

References Cited in the file of this patent

UNITED STATES PATENTS

2,073,250	Morpeth et al.	Mar. 9, 1937
2,131,037	Brayton	Sept. 27, 1938
2,524,060	Liljegren	Oct. 3, 1950
2,544,860	Rasmussen	Mar. 13, 1951

FOREIGN PATENTS

835,304	France	Sept. 19, 1938