Sept. 20, 1955 C. F. BOWERSETT ET AL 2,718,192

TIME DELAY NOSE FUZE FOR A ROCKET

Filed Oct. 17, 1947 5 Sheets-Sheet 1

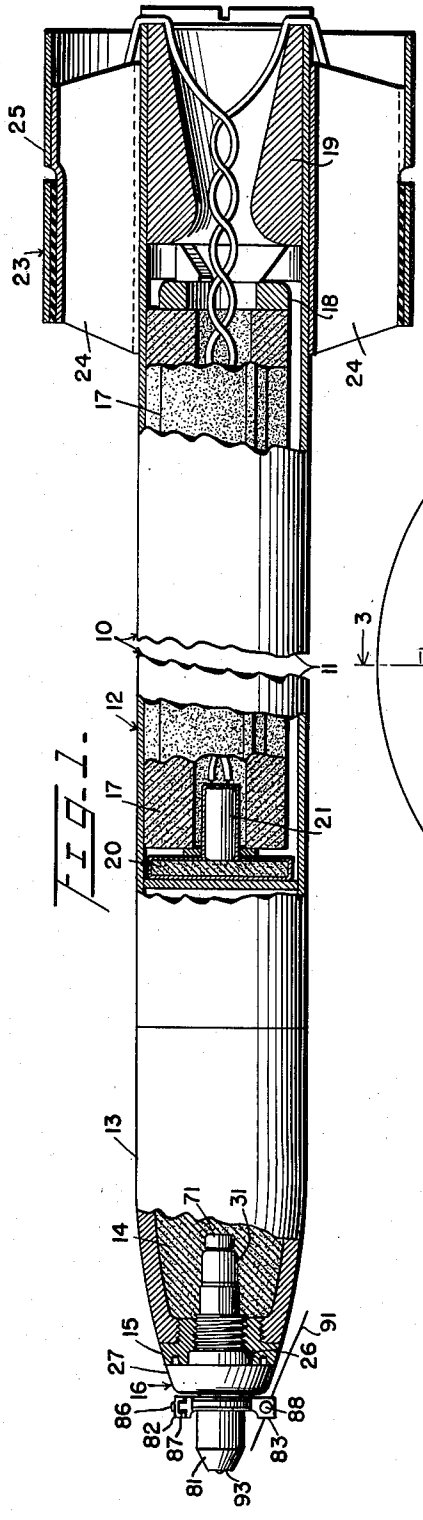


FIG. 1.

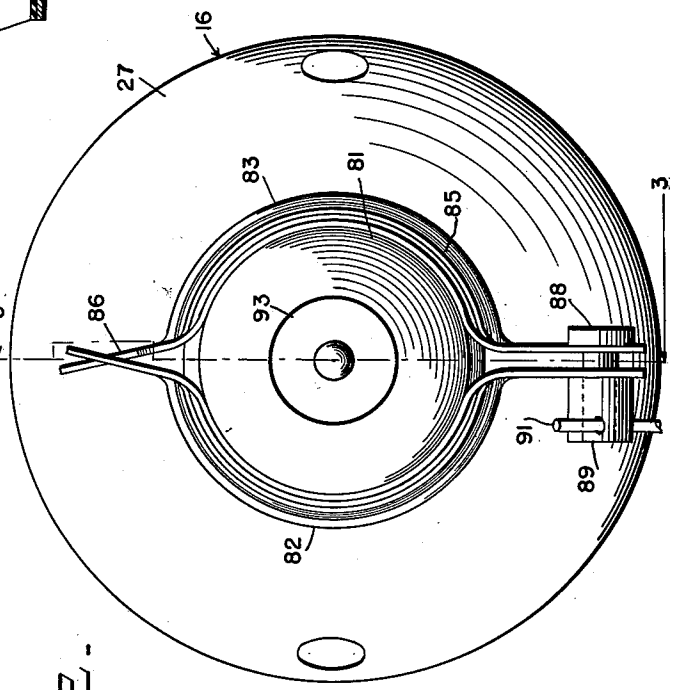


FIG. 2.

Inventors
C. F BOWERSETT
W. J. DONAHUE JR
K. L. BAKER

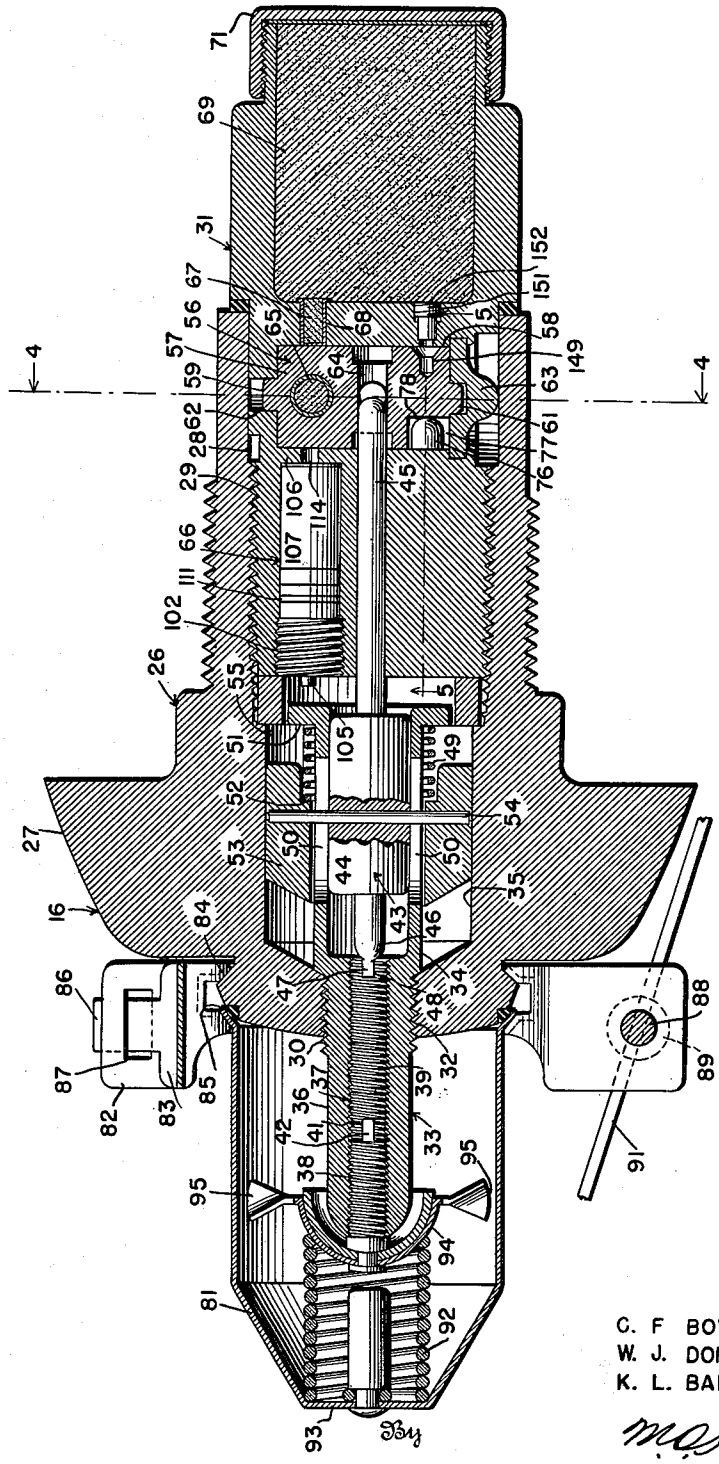
By M. O. Hayes
Attorney

Sept. 20, 1955 C. F. BOWERSETT ET AL 2,718,192

TIME DELAY NOSE FUZE FOR A ROCKET

Filed Oct. 17, 1947 5 Sheets-Sheet 2

FIG. 3.



Inventors

C. F BOWERSETT

W. J. DONAHUE, JR.

K. L. BAKER

By M. O. Hayes

Attorney

Sept. 20, 1955 C. F. BOWERSETT ET AL 2,718,192

TIME DELAY NOSE FUZE FOR A ROCKET

Filed Oct. 17, 1947 5 Sheets-Sheet 3

Fig. 4.

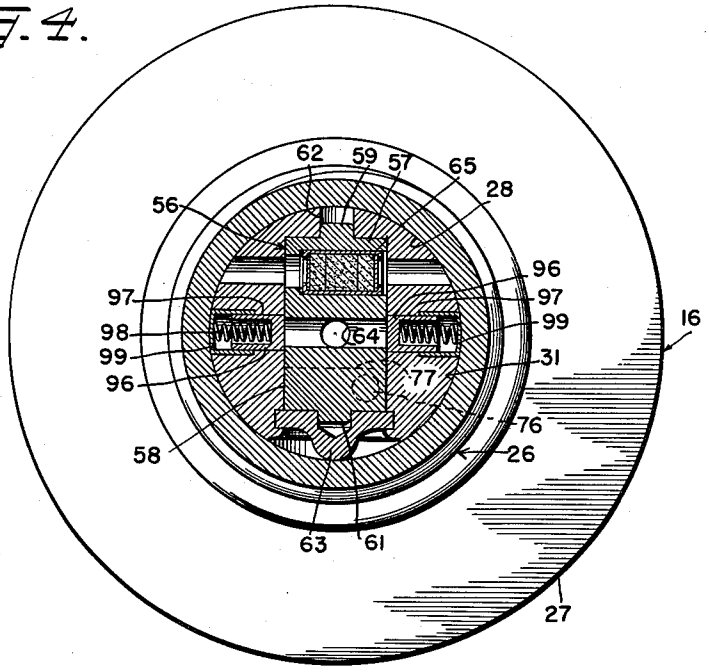
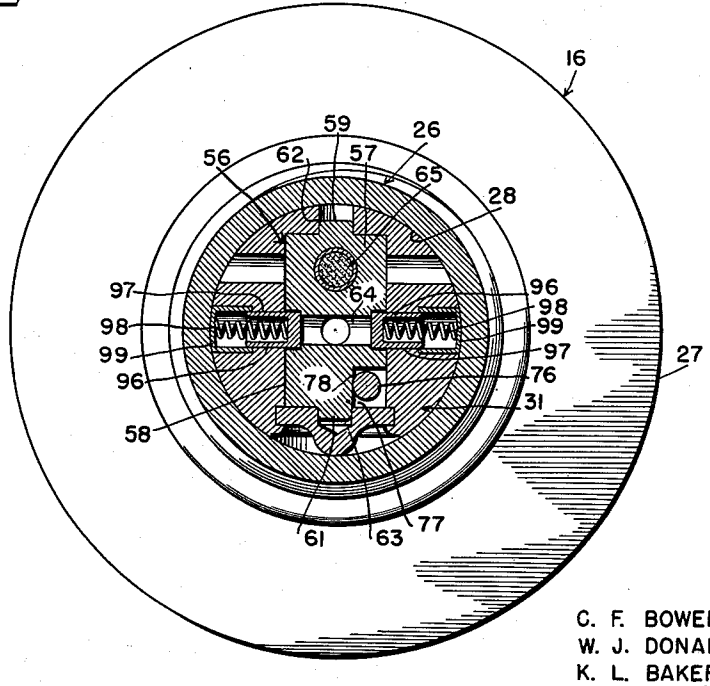


Fig. 7.



Inventors
C. F. BOWERSETT
W. J. DONAHUE, JR.
K. L. BAKER

By M. A. Hayes

Attorney

Sept. 20, 1955 C. F. BOWERSETT ET AL 2,718,192

TIME DELAY NOSE FUZE FOR A ROCKET

Filed Oct. 17, 1947 5 Sheets-Sheet 4

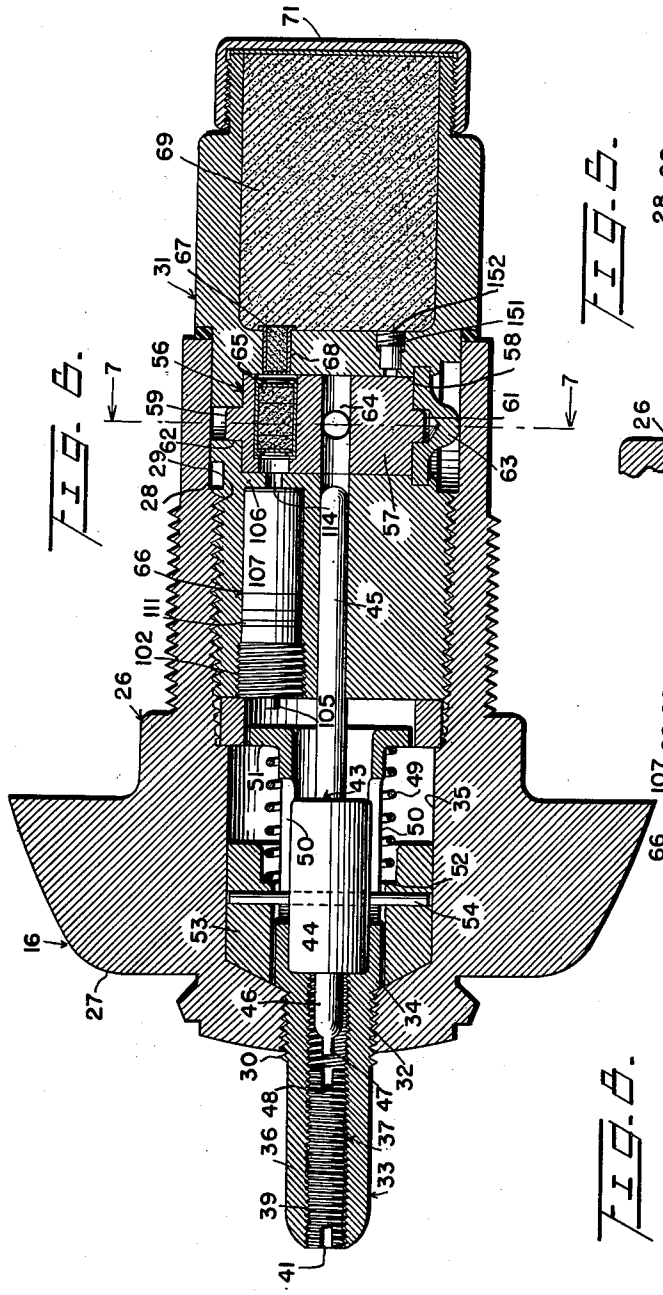


FIG. 8.

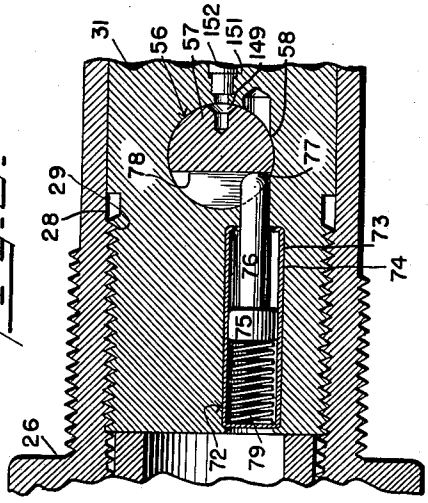


FIG. 5.

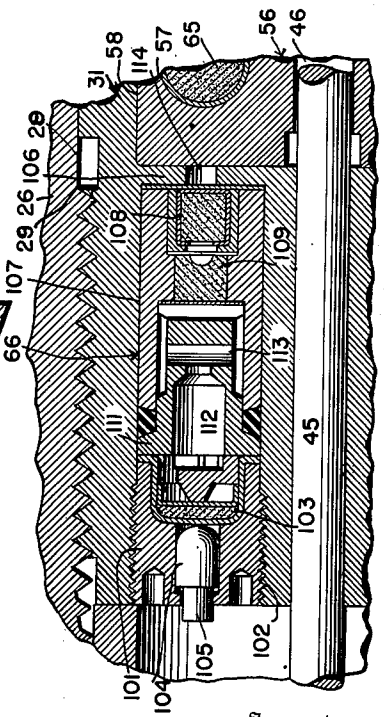


FIG. 6.

Inventors
C. F. BOWERSETT
W. J. DONAHUE, JR.
K. L. BAKER

By M. O. Hayes

Attorney

Sept. 20, 1955 C. F. BOWERSETT ET AL 2,718,192

TIME DELAY NOSE FUZE FOR A ROCKET

Filed Oct. 17, 1947 5 Sheets-Sheet 5

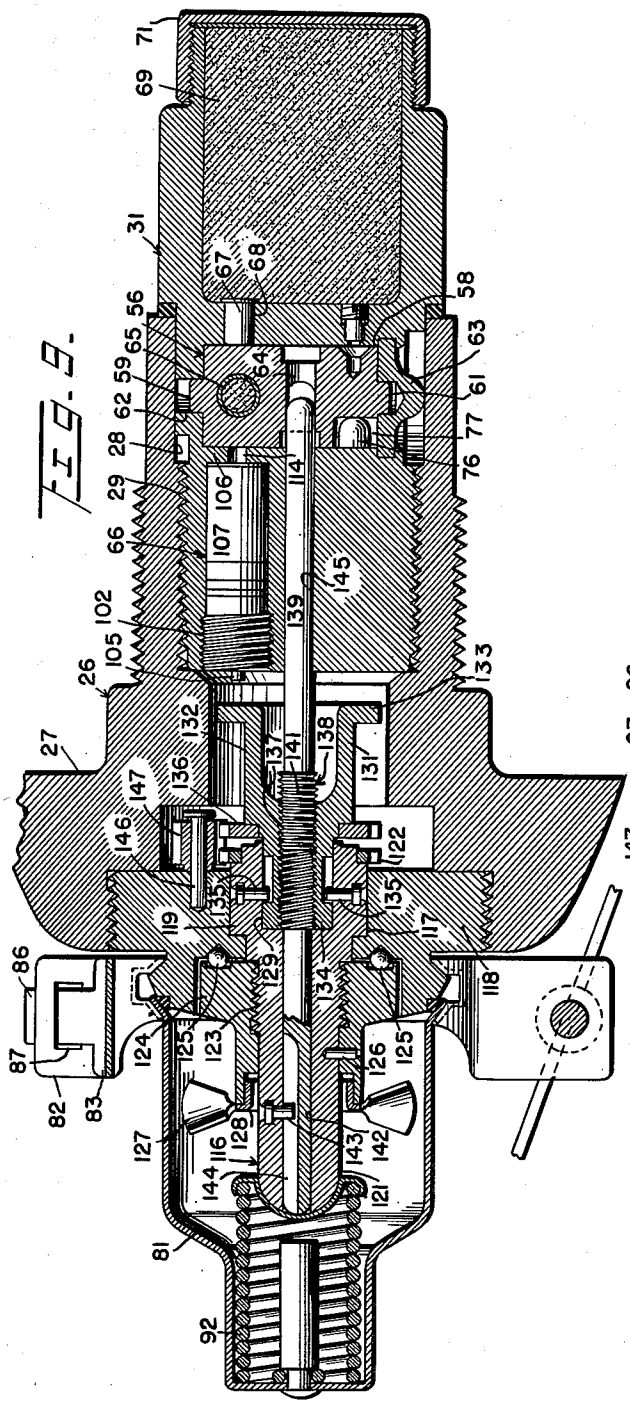


FIG. 9.

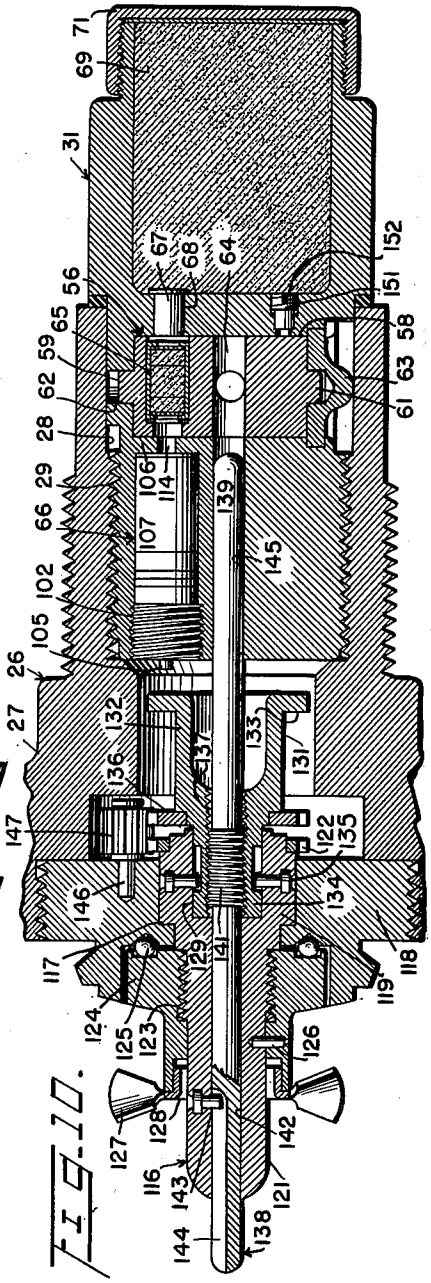


FIG. 10.

Inventors
C. F. BOWERSETT
W. J. DONAHUE, JR.
K. L. BAKER

By

M. O. Hay & Co

Attorney

United States Patent Office

2,718,192

Patented Sept. 20, 1955

2,718,192

TIME DELAY NOSE FUZE FOR A ROCKET

Charles F. Bowersett, Arlington, Va., and William J. Donahue, Jr., and Kenneth L. Baker, Washington, D. C.

Application October 17, 1947, Serial No. 780,560

11 Claims. (Cl. 102—81.2)

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

This invention relates to a fuze for a rocket and more particularly to a time delay nose fuze for a rocket in which means controlled by a propeller are provided for maintaining the fuze in an unarmed condition until the rocket has traveled a predetermined distance from the launching device.

More specifically, the invention in accordance with a preferred embodiment thereof relates to a time delay nose fuze for a rocket having a slideable inertia responsive locking device arranged therein adapted to be released from the arming screw by the setback force applied thereto as the rocket is launched. The inertial force on the inertia device caused by the acceleration of the rocket as the rocket is propelled by the rocket motor toward the target maintains the inertia device in locking engagement with a rotatable arming member during the burning time required to consume the major portion of the rocket propellent charge, thus the arming member is prevented from being rotated from an initial safe position to an armed position by the actuating means until the acceleration of the rocket has decreased sufficiently to permit the inertia device to be urged out of locking engagement with the arming means, whereupon the arming member is rotated to an armed position and locked therein. Furthermore, the inertia device of the present invention is maintained in an initial locked engagement with the arming member while the fuze is at rest by an arming screw comprising a pair of sections detachably secured together and rotatably arranged within one end of the fuze casing and adapted to be rotated and moved outwardly by a propeller secured to one section of the arming screw as the rocket is propelled toward the target whereupon the outer arming screw section is unscrewed sufficiently to become detached from the fuze casing and the remaining section of the arming screw, thus permitting the inertia device to be slideably urged out of locking engagement with the arming member. The fuze is arranged and constructed as not to function on impact with the surface of a body of water but to function only upon impact with a hard surface, such for example as the ground, bed of a body of water, hull of a ship, submarine, or any underwater target, at which time the bursting charge within the rocket shell is detonated in predetermined time delayed relation with respect to the aforesaid impact, such time delayed period being controlled by a delay element arranged within the fuze casing.

One of the objects of the present invention is the provision of a new and improved time delay nose fuze for a rocket in which the arming means thereof is locked in an unarmed condition by the inertia controlled device and maintained in the unarmed condition thereby until the acceleration of the rocket has been decreased sufficiently to permit the inertia controlled device to be urged out of locking engagement with the arming means.

Another object of the present invention is the provision of a new and improved time delay nose fuze for a rocket in which the inertia controlled device is forced out of engagement with the threaded locking screw by the inertial force applied thereto as the rocket is propelled from the launching rack, and in which means are provided for rotating the locking screw a predetermined amount as the rocket is propelled toward the target.

Another object is the provision of a nose fuse for a rocket having new and improved means for preventing firing of the fuze upon impact thereof with the surface of a body of water.

Another object of the present invention is the provision of a new and improved time delay nose fuze for a rocket in which the inertia member is maintained in locking engagement with the arming member by inertial force caused by the acceleration of the rocket as the rocket travels toward the target, and in which the inertia member is adapted to be maintained in locking engagement with the arming member until the acceleration of the rocket has decreased sufficiently to permit the inertia member to be urged to a release position.

A further object of the invention is the provision of a new and improved time delay nose fuze for a rocket in which the rotatable arming member arranged therein is maintained in an unarmed position by an inertia responsive device until the acceleration of the rocket has decreased to a predetermined value, and in which means are provided for rotating the arming member from an unarmed position to an armed position when released.

A still further object is the provision of nose fuze having new and improved means controlled by a propeller for unlocking a normally locked arming member during the flight of the rocket.

Still other objects, advantages and improvements will be apparent from the following description, taken in connection with the accompanying drawings, of which:

Fig. 1 is an elevational view of a rocket partially broken away and partially in section showing the time delay nose fuze of the present invention secured thereto;

Fig. 2 is an enlarged end view of the fuze of Fig. 1;

Fig. 3 is a longitudinal sectional view taken substantially on the line 3—3 of Fig. 2 and showing the fuze according to a preferred embodiment thereof in a safe or unarmed condition;

Fig. 4 is a cross-sectional view taken on the line 4—4 of Fig. 3;

Fig. 5 is a fragmentary longitudinal sectional view taken on the line 5—5 of Fig. 3;

Fig. 6 is a view similar to Fig. 3 and showing the fuze in an armed condition with the arming member unlocked and rotated to an armed position;

Fig. 7 is a cross-sectional view taken on the line 7—7 of Fig. 6;

Fig. 8 is an enlarged detailed sectional view of the firing and delay assembly employed with the fuze of the present invention;

Fig. 9 is a longitudinal sectional view of an alternative form of the fuze in which the inertia element is not employed and showing the fuze in a safe or unarmed condition; and

Fig. 10 is a view similar to Fig. 9 and showing the fuze in an armed condition.

Referring now to the drawings for a more complete understanding of the invention wherein like reference characters designate like parts throughout the several views, and more particularly to Fig. 1 thereof, there is shown thereon a rocket generally indicated by the reference character 10, comprising a motor tube 11 having the usual rocket motor generally indicated by the numeral 12 arranged therein. Secured to one end of the motor tube 11 in any suitable manner, preferably by threading the parts together, is a rocket shell 13 having arranged therein a bursting charge 14. Attached to the nose of the rocket preferably by threaded engage-

ment with an adapter 15 secured to the shell 13 in any suitable manner is the fuze of a preferred embodiment of the present invention generally indicated by the reference character 16.

The rocket, Fig. 1, is a conventional type rocket and the motor thereof comprises the usual component parts such, for example, as a propellant 17, grid 18 for supporting the propellant within the motor tube 11, nozzle 19, adapted to direct the gas jet as the propellant 17 burns and to provide for expansion of the gases in the exit cone of the nozzle, igniter 20, squib 21, arranged in operative relation with respect to the igniter, and a pair of conductors 22 connected to the squib and adapted to supply an electrical impulse thereto from an external source (not shown) thereby to fire the squib and ignite the igniter which, in turn, ignites the propellant which propels the rocket from the launching rack and maintains the rocket on a trajectory towards the target.

The motor tube 11 has secured to the trailing end thereof the usual stabilizing assembly generally indicated by the reference character 23 comprising a plurality of fins 24, the fins being attached to the tube in any suitable manner and extending radially therefrom and having a shroud 25 secured to the outer end portions thereof. As the operation and structure of the aforesaid rocket is well known to those skilled in the art, further detailed description thereof is deemed unnecessary.

Having described briefly the operation and structural arrangement of a conventional rocket, the fuze 16 of the present invention employed therewith and secured thereto, comprises a casing 26 composed of any material suitable for the purpose such, for example, as steel or the like and having an enlarged annular head 27 formed thereon, the inner surface of the head being in abutting engagement with the outer surface of the adapter and extending outwardly therefrom, the casing 26 having threaded engagement with the adapter and extending a predetermined distance into the bursting charge 14, Figs. 2 and 6, and thus the fuze is operatively secured to the nose of the rocket.

The casing 26 is provided with a centrally disposed well or bore 28 in one end thereof, a portion of which is threaded as at 29 for threaded engagement with a container generally indicated by the reference character 31 and extending a predetermined distance into the well 28.

Secured to the other end of the casing and having a shearable threaded portion 30 in engagement with a bore 32 formed in the head 27 thereof is an impact member and support generally indicated by the numeral 33 and comprising an enlarged tubular portion 34 arranged within a reduced portion 35 of bore 28 and having a tubular member 36 of reduced diameter formed thereon and extending a predetermined distance beyond the head 27. Arranged within the member 33 and having threaded engagement therewith is a locking screw 37 comprising threaded sections 38 and 39 detachably secured together as by a slot 41 arranged within the section 39 and a lug 42 formed on the section 38 thereby to provide a driving connection between the sections 38 and 39 whereby the sections are adapted to be rotated as a unit until the sections are detached.

Detachably secured to the section 39 is an inertia locking device generally indicated by the reference character 43 and comprising an enlarged cylindrical portion 44 having formed on one end thereof an elongated shaft 45, the other end thereof having a relatively short shaft 46 formed thereon, the inertia locking device 43 and the section 39 of the locking screw 37 being detachably secured together as by a lug 47 formed on the shaft 46 and a slot 48 formed in the end of the section 39.

A spring 49 encircles the portion 34 of the impact member 33, one end thereof having abutting engagement with an annular flange 51 formed thereon, the other end thereof having abutting engagement with a shoulder 52 formed on collar 53 arranged within the bore 35. The collar is secured to the inertia device 43 and slideable therewith by a pin 54 extending through a pair of openings respectively disposed therein and a complementary opening formed in the portion 44 of the inertia device 43, the pin 54 also extending through a pair of diametrically disposed slots 50 arranged in the portion 34 of the impact member 33 thus permitting free unitary sliding movement of the collar 53 and inertia pin 43 in either direction. By this arrangement the lug 47 on the shaft 46 is urged into engagement with the slot 48 in the section 39 and maintained therein by the spring 49 and thus the fuze is maintained in a safe condition and arming thereof will not occur until the lug 47 is urged out of engagement with the slot 48 in response to the set-back force applied to the inertia portion 44 of the inertia locking pin 43 as the rocket is launched and when the acceleration of the rocket has decreased sufficiently to permit the spring 49 to urge the shaft 46 on the inertia locking pin out of engagement with the arming rotor generally indicated by the reference character 56.

The arming rotor comprises a cylindrical body 57 disposed in a transverse bore 58 formed in the container 31 and having a pair of trunnions 59 and 61 respectively formed on the ends thereof adapted to rotatably support the rotor within the bore 58. The trunnion 59 is supported in a bearing 62 formed in the container 31, and the trunnion 61 is supported in a bearing member 63 secured to the container in any suitable manner such, for example, as pinning the bearing thereto. The arming member 56 is provided with a centrally disposed opening 64 for receiving the end portion or locking end of the shaft 45 on the inertia device 43 and preventing rotation of the arming member until the inertia device is urged away from the arming member by spring 49, and the locking end of shaft 45 is withdrawn from the opening 64 within the arming member whereupon the arming member is rotated from an unarmed position to an armed position, Figs. 6 and 7.

A detonator 65 is arranged within the rotor 56 and spaced substantially 90° from the firing assembly therefor and generally indicated by the numeral 66 when the rotor is in the unarmed position, the detonator being adapted to be brought in alignment with the firing assembly when the rotor has been released and rotated to the armed position. When this occurs, the detonator is brought in alignment with a lead-in charge 67 arranged in a bore 68 in the container 31 and operatively connected to a booster charge 69 disposed in one end of the container and maintained therein by an end cap 71 having threaded engagement with the container.

As shown on Fig. 5 the rotor is actuated to an armed position when released by an actuating member 72 arranged in a casing 73 disposed in a well 74 formed in one end of the container 31. The actuating member is slideably arranged within the casing 73 and comprises an enlarged head 75 having a pin 76 of reduced diameter integrally formed thereon, constructed and arranged to pass freely through an opening formed in one end of the casing 73 and extend into a recess 77 disposed in one end of the rotor 56, the end portion of the pin 76 being maintained in abutting engagement with the bottom parallel wall 78 defining the recess by a spring 79, one end thereof being tensioned in abutting engagement with the head 75 on the actuating member and the other end being in abutting engagement with other end wall of the casing 73. As clearly shown on Fig. 5, the end portion 76 of the actuating member is in engagement with the wall 78 on the rotor at one side of the axis thereof. By this construction and arrangement it will be apparent that when the rotor has been released by the inertia device 43 the actuating member will be moved toward the rotor in response to the pressure exerted thereon by spring 79 thus rotating the rotor to an armed position, Figs. 6 and 7.

As shown in Figs. 1, 2, and 3 a protecting cap 81 is

detachably secured ot the fuze by a pair of arcuate shaped retaining members 82 having a pair of substantially channel shaped members 83 respectively formed thereon, constructed and arranged to have releasable clamping engagement with the fuze as at 84 and with the cap as at 85. The arcuate members are detachably secured together by a tongue 86 and slot 87 respectively formed on one end of each of the arcuate members and a separable pin 88 and sleeve 89 respectively connecting the other end of each arcuate member together. It will be understood however, that the pin and sleeve are locked together by the usual safety pin (not shown) when the fuze is in a safe condition and adapted to extend through complementary openings formed in the pin and sleeve until the rocket has been placed in the launcher. The arming wire 91 is inserted into complementary openings formed in the pin and sleeve, Fig. 1 and the safety pin is withdrawn from the aforesaid pin and sleeve.

When the rocket is fired, the forward motion thereof as the rocket moves along the launcher withdraws the arming wire 91 from the pin and sleeve thus releasing the arcuate member from clamping engagement with the head of the fuze and cap, whereupon the cap is forced away from the fuze head and falls free therefrom in response to the pressure exerted on the cap 81 by a spring 92. The spring has one end thereof in abutting engagement with the end wall 93 of cap 81 and the other end thereof in abutting engagement with a semispherical portion 94 of a propeller 95, the propeller being secured to the outer section 38 of the locking screw in any suitable manner, and constructed and arranged to be rotated thereby when the cap 81 has been detached from the fuze head and during the free flight of the rocket toward the target.

It will be apparent from the foregoing description that upon rotation of the propeller 95 rotative movement is imparted thereby to the locking screw, it being understood, however, that the locking screw is locked in a safe condition by the inertia pin 43, Fig. 3, release thereof occurring when the rocket is launched in response to the set-back force exerted on the set-black block 44 on the inertia pin. The set-back force on the block 44 will move the lug 46 on the inertia device out of engagement with the slot 48 on the inner section of the arming screw thus releasing the arming screw for rotation and when the propeller has made a predetermined number of revolutions, the arming screw 37 is moved outwardly sufficiently to permit the outer section 38 thereof to become detached from the inner section 39, Fig. 6, whereupon the outer section 38 and propeller secured thereto will fall away from the fuze. The inertial force on the inertia pellet 44 caused by the acceleration of the rocket as the rocket moves toward the target will maintain the shaft 45 in locking engagement with the arming rotor and prevent rotation of the rotor 56 into an armed position until the major portion of the propellant has burned away and the acceleration of the rocket has decreased sufficiently to permit the inertia pin 43 to be urged out of engagement with the rotor 56 by the aforesaid spring 49, Figs. 6 and 7.

When this occurs, the rotor is locked in an armed position by a pair of locking detents 96, Fig. 7, respectively arranged in bores 97 formed on the container 31 and urged into locking engagement therewith by a pair of springs 98, one end of each of the springs being in abutting engagement with the detents and the other end thereof being in abutting engagement with the end walls of a pair of caps 99 respectively disposed within the aforesaid bore 97. As shown on Fig. 7 the pin 76 on the actuating member 72 is also adapted to lock the rotor 56 in armed position after the arming member has been rotated to the armed position thereby.

As shown on Fig. 8 the firing and delay assembly 66 comprises an adapter 101 threaded into one end of a bore 102 formed in the container 31 and having a sensitive primer 103 disposed therein. Slideably arranged within the adapter 101 and in firing engagement with the primer is a firing pin 104, the reduced end 105 thereof extending a predetermined distance beyond one end of the adapter such that upon impact of the rocket with the target the flange 51 on the impact member 33 will be driven into engagement with the end 105 of the firing pin with sufficient force to drive the firing pin into firing engagement with the primer thus exploding the primer.

Arranged in the other end of the bore 102 and abutting engagement with the bottom wall 106 defining the aforesaid bore is a casing 107 having disposed in one end thereof a relay detonator 108, and a delay charge 109 in substantial abutting engagement with respect to the relay detonator and adapted to fire the detonator 108. The primer 103 and the charge 109 are maintained in spaced relation with respect to each other by a member 111 having a centrally disposed bore 112 formed therein in communication with a radially arranged port 113 whereby the flash from the primer, when the primer is fired, is directed by way of bore 112 and port 113 against the delay charge 109 thus causing ignition of the charge.

When the fuze is in an armed condition, Fig. 6, a continuous firing train is provided from the primer 103 to the booster charge 69, one end of the detonator is in alignment with the lead-in charge 67, the other end thereof being in alignment with a port 114 in wall 106 and thus the detonator is fired by the detonator 108 by way of port 114 when a predetermined period of time has elapsed after impact of the rocket with the target. Upon impact of the rocket with the target the impact member is driven inwardly, the impact force being sufficient to shear the threads 30 thereon whereupon the flange 51 on impact member is moved in firing engagement with the end 105 of the firing pin.

On Figs. 9 and 10 is shown an alternative form of a rocket fuze in which means are provided for arming the fuze after the rocket has been launched and during the free flight of the rocket toward the target regardless of inertia effects. In this form of the invention an impact member or sleeve 116 similar to the member 33 is rotatably supported within an axial bore 117 arranged within a bearing support 118 secured to the head 27 as by threaded engagement therewith. The sleeve comprises an enlarged cylindrical portion 119 arranged within the bore 117 and a reduced cylindrical portion 121 formed thereon and extending a predetermined amount beyond the bearing member 118. Supported on the one end portion of the member 119 and secured thereto in any suitable manner is a stationary gear 122, the reduced portion 121 of the sleeve being threaded as at 123 for threaded engagement with a thrust bearing 124, the thrust bearing including a plurality of ball bearings 125 disposed within a pair of complementary races arranged in the thrust bearing and in the outer end of the bearing support 118 respectively. The thrust bearing 124 and sleeve 116 are secured together by a pin 126, Figs. 9 and 10, and are adapted to be rotated as a unit during the forward propulsion of the rocket toward the target.

A propeller 127 comprising a hub 128, Figs. 9 and 10, is secured to the thrust bearing 124 in any suitable manner and adapted to impart rotative movement to the bearing during the free flight of the bomb toward the target.

Rotatably supported in a well 129 formed in the portion 119 of the impact member is a hub generally indicated by the reference numeral 131. The hub comprises a body portion 132 having a striker flange 133 formed on one end and a reduced bearing 134 formed on the other end thereof, the bearing being maintained within the well 129 by a pair of diametrically disposed pins 135 arranged in the portion 119, the free ends of the pins extending into an annular groove formed in the bearing 134 and adapted respectively to engage one of the shoulders defining the groove. Arranged on the body

132 of the hub 131 is a gear 136, the gear being in abutting engagement with respect to a shoulder formed thereon and staked to the body in a well known manner.

The hub 131 is provided with a centrally disposed bore 137 adapted to have threaded engagement with a threaded portion of a locking pin generally indicated by the reference character 138. The locking pin comprises an elongated shaft 139 having the intermediate portion threaded as at 141 for threaded engagement with the aforesaid bore 137. One end of the shaft extends through a bore 142 formed in the portion 121 of the sleeve 116 and is secured thereto for rotative and sliding movement by a pin 143 secured to the portion 121, the end thereof extending into a splined portion 144 formed in one end of the shaft 139. The other end of the shaft extends through a bore 145 formed in the container 31 and into the bore 64 provided in the arming rotor 56. Thus the locking pin 138 maintains the rotor in a safe position and prevents rotation thereof to an armed position until the propeller 127 has made a predetermined number of revolutions during the free flight of the rocket toward the target.

Rotatably supported on a stud 146 and in continuous mesh with the gears 122 and 136 is an idle or driving gear 147, the movable gear 136 having one tooth more than the stationary gear 122. By this arrangement there is relative rotative motion between the gears 122 and 136, such rotation being transferred to the hub 131 through gear 136. When this occurs, the locking pin is moved outwardly due to the threaded connection between the hub and the locking pin. From the foregoing description, it will be apparent that a structure has been disclosed in which the hub 131 is adapted to be rotated at a greatly reduced rate of speed with respect to the rotation of the propeller and the component parts thereof operatively connected thereto, by reason of the planetary gear construction disclosed.

When the propeller 128 has made a predetermined number of revolutions during the free flight of the rocket toward the target, the locking pin 138 is moved outwardly and withdrawn from the opening 64 in the rotor, Fig. 10, by reason of the aforesaid threaded connection between the locking pin 138 and the hub 131 and the aforesaid means for imparting rotative movement thereto. When this occurs the rotor is released and moved to an armed position by the actuating member 72 in the same manner as heretofore described.

As shown on Fig. 10 the fuze is in an armed condition, the locking pin having been moved out of engagement with the arming rotor, the end thereof extending a predetermined amount beyond the end of the sleeve.

Upon impact of the rocket with the target, the force of the impact is sufficient to cause the pin to bend or become mashed due to the frangibility of the metals from which the pin 138 is constructed, whereupon the impact member 116 is driven inwardly with sufficient force to cause shearing of the threads 123 thereon, thus the striker flange 133 on the member 131 and movable with the impact member is driven into firing engagement with the firing means 66 in the same manner as the striker flange 51 on member 33 is operated upon impact to explode the rocket.

As shown on Fig. 9 the protector cap is detachably secured to the fuze in the same manner as heretofore described and upon release of the cap by the detachable means, the cap is forced free from the fuze by the spring 92 and falls away therefrom, one end of the spring being in engagement with the end wall of the cap and the other end thereof in engagement with a member 148 detachably arranged on the end of the impact member 116.

It will be understood, however, from the foregoing descripton that the threaded portions 30 on the impact member 33 and the threaded portion 123 on the impact member 116 may be so constructed as to shear or break in response to a predetermined amount of force applied thereto, such shearing or breaking action resulting from the impact force applied to the shearable threaded portions 30 and 123, as the rocket strikes a hard object such, for example, as asubmarine, hull of ship or the like, the delay element within the fuze being adapted to fire the main charge disposed within the rocket shell in predetermined time delayed relation with respect to impact of the rocket with a target. The aforesaid shear threads may be composed of any material suitable for the purpose which possesses the characteristics of shearing in response to sudden force applied thereto.

It will be obvious that when the rocket is placed in a launching rack or tube, as the case may be, and fired therefrom toward a target, the arming wire 91 is attached to the detachable means as heretofore shown and described. When the rocket is fired from the launching rack the forward motion thereof withdraws the arming wire 91 from the locking pin 88 and sleeve 89 thus releasing the arcuate members 87 from engagement with the fuze and cap whereupon the cap is forced from the fuze by the aforesaid spring 92 and falls away therefrom.

When this occurs the propeller 95 will be rotated during the free flight of the rocket toward the target and the arming member 56 will be released and rotated to an armed position when the propeller has made a predetermined number of revolutions to permit the device to be urged to a release position by spring 49. Upon impact of the rocket with the target the impact force applied to the shear threads is sufficient to cause shearing thereof thus permitting the striker flange secured thereto to be driven into firing engagement with the aforesaid firing means and explode the rocket in predetermined time delayed relation with respect to the impact thereof with the target and controlled by the time delay element 108.

As shown most clearly on Figs. 3 and 9, the arming rotor 56 is provided with a well 149 constructed and arranged to receive a suitable tool or the like (not shown) for maintaining the rotor in proper position within the container 31 during assembly of the fuze, the tool being adapted to be inserted through an opening 151 formed in the container 31 and into the well 149 thus preventing movement of the rotor during assembly. The opening 151 is closed by a plug 152 after the aforesaid assembly operations have been completed.

In the event that the arming wire 91 is withdrawn prior to launching, the detachment of cap 81 from the nose of the fuse enables the instant position of the locking pin 138 to be observed whereby a prematurely armed fuze may be detected before the fuze is launched.

Briefly stated in summary, the present invention contemplates the provision of a new and improved time delay nose fuze for a rocket constructed and arranged to fire upon impact with a hard surface and in which means are employed for maintaining the fuze in a safe condition while the fuze is at rest, and in which means are provided for maintaining the arming rotor thereof in an unarmed condition until the acceleration of the rocket has decreased sufficiently to permit the inertia device to be urged out of locking engagement with the arming means, and in which means are also provided for arming the fuze when the propeller has made a predetermined number of revolutions.

While the invention has been described with reference to two embodiments thereof which give satisfactory results, it will be obvious to those skilled in the art to which the invention pertains, after understanding the invention, that various changes and modifications may be made without departing from the spirit and scope of the invention, and it is intended, therefore, in the appended claims to cover all such changes and modifications.

The invention herein described and claimed may be manufactured and used by or for the Government of the United States of America for governmental purposes without payment of any royalties thereon or therefor.

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

1. A time delay nose fuze for a rocket comprising a casing, an arming member releasably locked in an initial safe position within said casing and adapted to be released and rotated to an armed position, an inertia responsive device slidably arranged within the casing for locking the arming member in said safe initial position and adapted to be moved slidably to a release position when the acceleration of the rocket has been decreased to a predetermined value during the free flight of the rocket toward a target, means including a spring operatively connected to said inertia device for moving the inertia device to said release position, means including an actuating member for rotating the arming member to said armed position when the inertia device has been moved to said release position, a propeller having a shaft rotatably and detachably threaded within said casing and adapted to be rotated by the propeller during said flight and concurrently therewith to be moved outwardly sufficiently to become detached from the casing, locking means threaded within the casing and detachably secured to said shaft for preventing sliding movement of the inertia device to said released position until said acceleration has decreased to said predetermined value and said shaft has been detached from the casing, and a detachable locking connection between said locking means and the inertia device constructed and arranged to prevent rotation of the propeller until the inertia device has been detached from the locking means in response to the set-back force applied thereto as the rocket is fired from a launcher.

2. A time delay nose fuze for a rocket comprising a casing, a booster charge arranged within said casing, an arming member releasably supported in an initial safe position within the casing and adapted to be released and rotated to an armed position, means arranged within the casing for rotating said arming member to said armed position when the arming member has been released, means including a releasable inertia responsive device for maintaining the arming member in said safe position when the fuze is at rest, a mass on said inertia responsive device and controlled by inertial force caused by the acceleration of the rocket during the free flight of the rocket toward the target for preventing said release of the arming member to said armed position until the inertial force has decreased to a predetermined value, spring means in engagement with said casing and operatively connected to said inertia device for urging the inertia device to a release position when said inertial force on said mass has decreased to said predetermined value, propeller means including a shaft threaded within the casing in engagement with said propeller means and said inertia device for preventing movement of said inertia device to said release position until the shaft has been rotated a predetermined number of revolutions in response to rotation of said propeller means, explosive means including a time delay element arranged within the casing for firing said booster charge when a predetermined period of time has elapsed after impact of the rocket with the target, and impact responsive firing means releasably secured to said casing arranged and constructed to fire said explosive means, said firing means being adapted to be severed from the casing and moved into firing engagement with said explosive means upon said impact.

3. A time delay nose fuze for a rocket comprising a casing, a booster charge arranged within said casing, an arming member releasably locked in an initial safe position within the casing, an inertia responsive device slideably arranged within the casing for maintaining the arming member locked in said safe position and adapted to be urged slideably to a release position when the inertial force thereof caused by the acceleration of the rocket as the rocket is propelled toward a target has been decreased to a predetermined value, spring means in engagement with said casing and operatively connected to said inertia device for slideably urging the inertia device to said release position, actuating means for rotating the arming member to said armed position when the inertia responsive device has been urged to said release position, means including a propeller rotatably supported on the casing, threaded means rotatably supported within said casing in engagement with said inertia device and having a driving connection with said propeller for preventing said sliding movement of the inertia responsive device to said release position until the propeller has made a predetermined number of revolutions and said threaded means has been rotated a predetermined amount thereby during the free flight of the rocket toward the target, explosive means including a time delay element arranged within the casing for firing said booster charge in predetermined time delayed relation with respect to the impact of the rocket with the target, and severable impact means secured to the casing and adapted to be severed therefrom upon said impact, said impact means being constructed and arranged to prevent the impact member from being forced into firing engagement with said explosive means until the impact means is severed.

4. A time delay nose fuze for a rocket comprising a casing, a booster charge arranged within said casing, an arming member releasably locked in an initial safe position within the casing, an inertia responsive device for maintaining the arming member locked in safe position and adapted to be moved slideably to a release position when the inertial force thereof caused by acceleration of the rocket has been decreased to a predetermined value, spring means for moving the inertia device slideably to said release position, means for rotating the arming member to said armed position when the inertia responsive device has been moved to said release position, means including a shaft rotatably and threadedly supported on the casing in engagement with said inertia device for preventing said sliding movement of the inertia responsive device to said release position until the rocket has been launched and said last named means has been rotated a predetermined amount as the rocket is propelled toward the target, explosive means including a time delay element for firing said booster charge in predetermined time delayed relation with respect to impact of the rocket with the target, and severable impact means secured to the casing and adapted to be severed and thereby permit the impact means to be forced into firing engagement with said explosive means in response to said impact.

5. A time delay nose fuze for a rocket comprising a casing, a booster charge arranged within said casing, an arming member releasably locked within the casing in an initial safe position and adapted to be rotated to an armed position, an inertia responsive device for maintaining the arming member locked in said initial safe position and adapted to be moved slideably to a release position when the inertial force thereon has been decreased to a predetermined value, means for moving the inertia responsive device to said release position, means for rotating the arming member to said armed position when the inertia responsive device has been moved to said release position, means including a pair of detents for locking the arming member in said armed position, means rotatably supported on the casing for preventing said sliding movement of the inertia responsive device to said release position until the rocket has been launched and the rotatable means has rotated a predetermined amount as the rocket is propelled toward the target, explosive means arranged within the casing and adapted to be fired in response to impact of the rocket with the target, a time delay element disposed within the casing and fired by said explosive means, means for firing said booster charge when the arming member is locked in said armed position and a predetermined period of time

has elapsed after said impact, and severable impact means secured to said casing and adapted to be severed therefrom and thereby permit the impact means to be forced into firing engagement with said explosive means.

6. A time delay nose fuze for a rocket comprising a casing, a booster charge arranged within said casing, an arming member releasably locked in an initial safe position within the casing and adapted to be released and rotated to an armed position, an inertia responsive device slideably arranged within the casing for maintaining the arming member in said initial safe position and adapted to be moved slideably to a release position when the acceleration of the rocket has been decreased to a predetermined value during the free flight of the rocket toward a target, means for rotating the arming member to said armed position as the inertia member is moved to said release position, an impact member normally secured to the casing, a propeller having a shaft rotatably and detachably threaded within said impact member and adapted to be rotated and moved outwardly by the propeller as the propeller rotates in response to the air pressure directed against said propeller during said flight sufficiently to become detached from said impact member, rotatable locking means threaded within the impact member and detachably secured to said shaft and rotated thereby for preventing said movement of the inertia device to said release position until the locking means has rotated a predetermined amount and the shaft has become detached from the impact member, a detachable connection between the locking means and the inertia device for preventing rotative movement of the propeller until the inertia device has been detached from the locking means in response to the set-back force applied thereto as the rocket is fired from a launcher, means for moving the inertia device to said released position when the locking means has been moved said predetermined amount, explosive means within said casing and adapted to be fired by the impact member as the rocket strikes a target, a time delay element arranged within the casing for firing said booster charge in predetermined time delayed relation with respect to said impact, and severable means for securing the impact member to the casing until the means is severed in response to said impact.

7. A time delay nose fuze for a rocket comprising a casing, an arming member releasably locked in an initial safe position within said casing, and adapted to be released and rotated to an armed position, and inertia responsive device slideably arranged within the casing for locking the arming member in said initial safe position and adapted to be moved slideably to a release position when the acceleration of the rocket has been decreased to a predetermined value during the free flight of the rocket toward the target, means including a spring operatively connected to said inertia device for slideably moving the inertia device to said released position when said acceleration has decreased to said predetermined value, means including a spring actuated device for rotating the arming member to said armed position when the inertia device has been moved to said release position, an impact member normally secured to said casing, a propeller adapted to be rotated in response to the air pressure thereagainst during said flight, a shaft secured to said propeller and threaded within the impact member for supporting said propeller and adapted to be rotated and moved outwardly thereby sufficiently to become detached from the impact member as the propeller is rotated, locking means threaded within said impact member and detachably secured to said shaft for preventing said sliding movement of the inertia device to said release position until the shaft has become detached from said impact member and the locking means has been rotated a predetermined amount by the shaft, a detachable connection between said locking means and the inertia device for preventing movement of the propeller until the inertia device has been detached from the locking means in response to the set-back force applied thereto as the rocket is fired from said launcher, explosive means adapted to be fired by the impact member as the rocket strikes a target, a booster charge arranged within the casing and adapted to be fired in predetermined time delayed relation with respect to said impact, a time delay element for firing said booster charge when said predetermined time has elapsed, and severable means for securing the impact member to the casing until the means is severed in response to said impact.

8. A time delay nose fuze for a rocket comprising a casing, an arming member releasably locked in an initial safe position within said casing and adapted to be released and rotated to an armed position, means including an inertia responsive device slideably arranged within the casing for locking the arming member in said initial safe position and adapted to be moved slideably to a release position when the acceleration of the rocket has been decreased to a predetermined value during the free flight of the rocket toward the target, means including a spring operatively connected to said inertia device for moving the inertia device to said released position when said acceleration has decreased to said predetermined value, means including a spring actuated device for rotating the arming member to said armed position when the inertia device has been moved to said release position, a pair of detents on said casing for locking the arming member in said armed position, an impact member normally secured to said casing, a propeller rotatably supported for rotation during said flight, a shaft secured to said propeller and threaded within the impact member for supporting the propeller rotatably on the impact member, said shaft being adapted to be rotated by the propeller and moved outwardly sufficiently to become detached from said impact member when the propeller has made a predetermined number of revolutions, a rotatable locking device threaded within the impact member and detachably connected to said shaft for preventing movement of the inertia device to said release position until the propeller has made said predetermined number of revolutions and the shaft has become detached from said impact member, said locking device being rotated and moved outwardly by said shaft as the propeller is rotated, means on the locking device and adapted to coact with complementary means on the inertia device for preventing rotation of the propeller until the inertia device has been detached from the locking device in response to the set-back force applied thereto as the rocket is fired from a launcher, explosive means adapted to be fired by the impact member as the rocket strikes a target, a booster charge arranged within the casing, a time delay charge for firing said booster charge in predetermined time delayed relation with respect to said impact, and severable means for securing the impact member to the casing, said severable means being constructed and arranged to prevent firing of the explosive means by the impact member until the last-named means is severed in response to said impact.

9. A device according to claim 8 in which the last named severable means include a pair of mutually threaded devices having the threaded portions thereof of sufficient strength to withstand the force of impact of the rocket against the surface of a body of water without shearing and of insufficient strength to prevent shearing of the threads as the rocket strikes a hard target area.

10. A time delay nose fuze for a rocket comprising a casing, a rotatable arming member releasably locked in an initial safe position within said casing and rotatable to an armed position when released, means including a mass slideably arranged within the casing and responsive to the inertial force applied thereto during the free flight of the rocket toward a target for locking the arming member in said safe position until said inertial force on said mass has decreased to a predetermined value, a sleeve secured to said mass and movable therewith, a spring in engagement with said sleeve and casing respectively for

moving said last named means to a release position, spring actuated means disposed within the casing in engagement with the arming member for rotating the arming member to said armed position when said inertial responsive means has been moved to said release position, means including a propeller rotatably and detachably secured to the casing for preventing said sliding movement of said inertial responsive means to said release position until the propeller has made a predetermined number of revolutions and said inertial force has decreased to said predetermined value, and means including a detachable locking connection between said propeller and inertial responsive means for preventing rotation of the propeller until the inertial responsive means has been detached therefrom in response to the set-back force applied thereto as the rocket is fired from a launcher.

11. A time delay nose fuze for a rocket comprising an arming member releasably locked in an initial safe position and rotatable to an armed position when released, an inertia responsive device having a mass thereon for maintaining the arming member in said initial safe position and for movement slideably to a release position when acceleration of the rocket has decreased to a predetermined value, means including a spring actuated plunger in engagement with said arming member for rotating the arming member to said armed position as the inertia member is moved to said release position, an impact member normally secured to said fuze, propeller means

detachably threaded within said impact member for rotation in response to the air pressure directed thereagainst during the free flight of the rocket toward a target sufficiently to become detached from said impact member, rotatable locking means threaded within the impact member and detachably secured to said propeller means and rotated thereby for preventing said movement of the inertia device to said release position until the locking means has been rotated a predetermined amount and said propeller means has become detached from the impact member, a detachable connection between the locking means and the inertia device for preventing rotation of said propeller means until the inertia device has been detached from the locking means in response to the set-back force applied to said mass as the rocket is fired from a launcher, and means including a spring actuated member secured to said inertia device for moving the inertia device to said release position when the locking means has been moved said predetermined amount.

References Cited in the file of this patent

UNITED STATES PATENTS

1,774,043	Summerbell	Aug. 26, 1930
2,131,037	Brayton	Sept. 27, 1938
2,409,205	Graumann	Oct. 15, 1946

FOREIGN PATENTS

16,186	Great Britain	of 1906