Sept. 23, 1958 A. S. WILL ET AL 2,853,011

FUZE

Filed March 27. 1953 4 Sheets-Sheet 1

FIG.1.

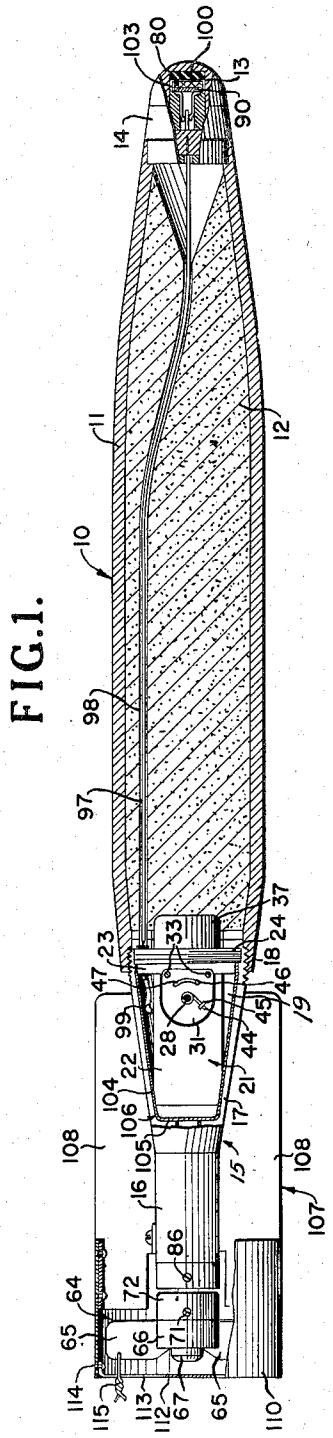


FIG.6.

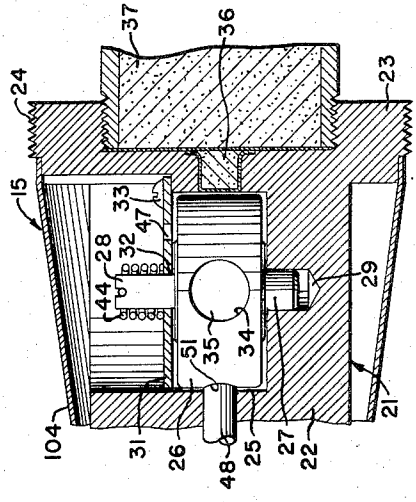
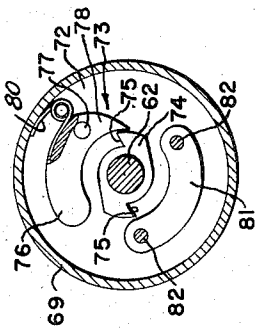


FIG.7.



INVENTORS
ALBERT S. WILL
WOOLFORD L. EDMONSTON

BY

R. M. Hicks

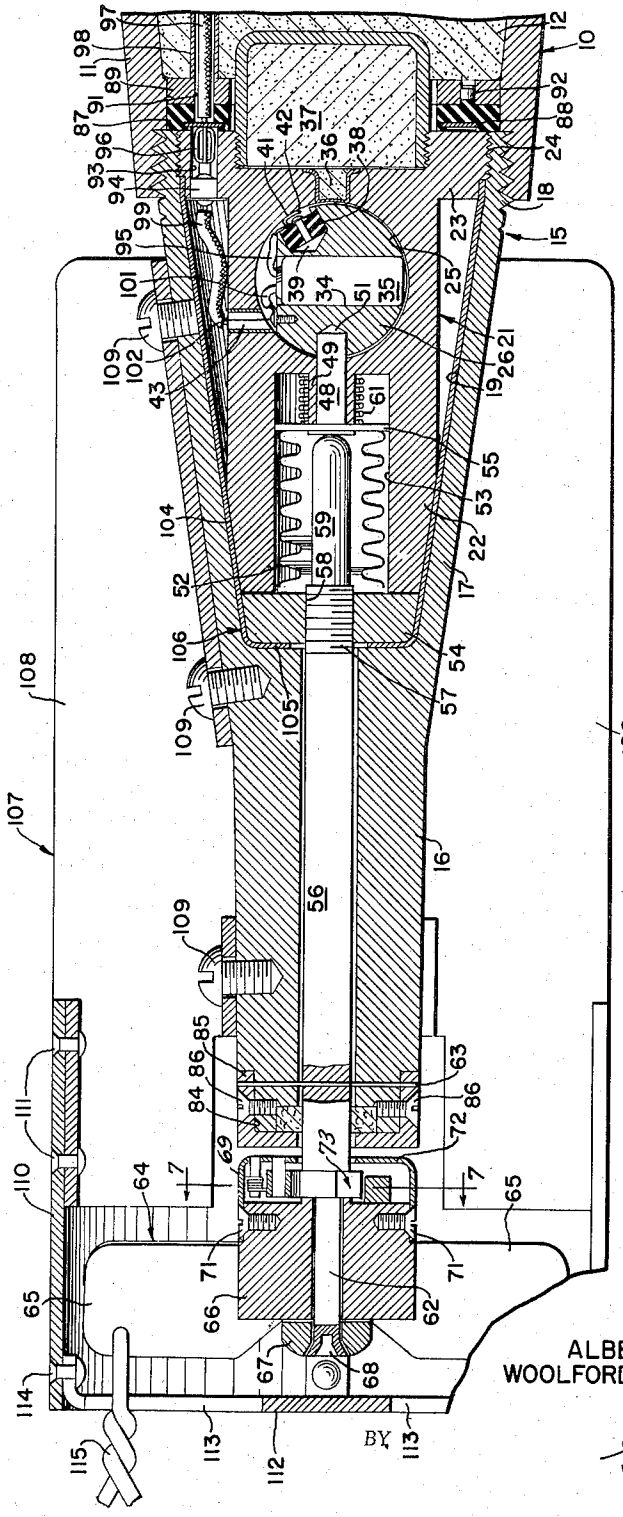
ATTORNEYS

Sept. 23, 1958 A. S. WILL ET AL 2,853,011

FUZE

Filed March 27, 1953 4 Sheets-Sheet 2

FIG. 2.



INVENTORS
ALBERT S. WILL
WOOLFORD L. EDMONSTON

BY

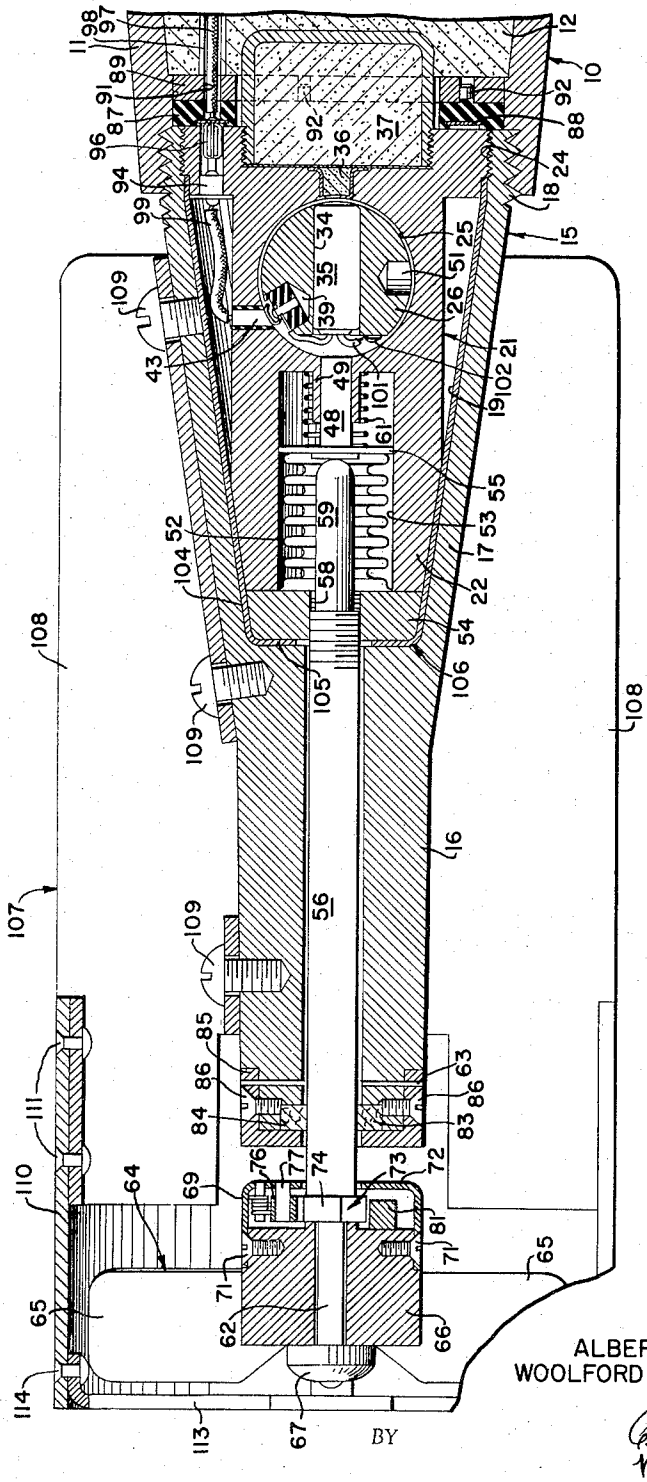
R. M. Hicks
ATTORNEYS

Sept. 23, 1958 A. S. WILL ET AL 2,853,011

FUZE

Filed March 27, 1953 4 Sheets-Sheet 3

FIG. 3.



INVENTORS

ALBERT S. WILL

WOOLFORD L. EDMONSTON

BY

R. M. Hicks

ATTORNEYS

Sept. 23, 1958 A. S. WILL ET AL 2,853,011

FUZE

Filed March 27. 1953 4 Sheets-Sheet 4

FIG 4.

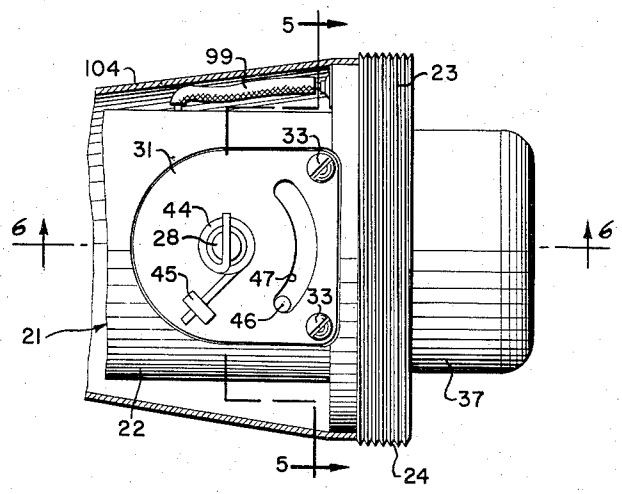
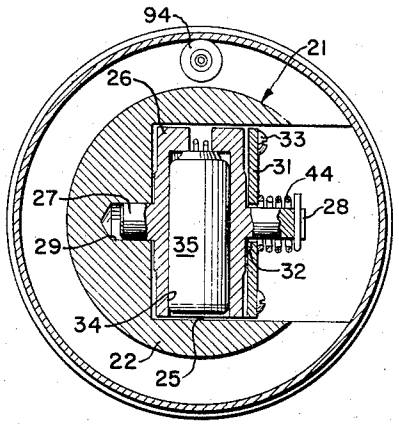


FIG.5.



INVENTORS
ALBERT S. WILL
WOOLFORD L. EDMONSTON

BY

ATTORNEYS

United States Patent Office 2,853,011 Patented Sept. 23, 1958

2,853,011

FUZE

Albert S. Will, West Hyattsville, and Woolford L. Edmonston, Laurel, Md., assignors to the United States of America as represented by the Secretary of the Navy

Application March 27, 1953, Serial No. 345,270

8 Claims. (Cl. 102—70.2)

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

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

The present invention relates to a bomb and more particularly to a tail fuze for use in a shaped charge bomb such, for example, as the type employed with a cluster missile.

Heretofore, fuzes of this type have not proven entirely satisfactory for the reason that due to the lack of safety features premature firing of the bombs occurred rather frequently upon release of the bombs from the cluster casing.

Furthermore, since such fuzes employed mechanical impact responsive means for firing the shaped charge upon impact a time lag occurred between impact and firing of the charge wherefore the destructive power of the bomb was greatly reduced.

The present invention provides a new and improved electric controlled tail fuze for a shaped charge bomb wherein means are provided for preventing premature arming and firing of the bomb as the bomb is released from a cluster casing, and in which an electroresponsive detonator is adapted to fire the shaped charge instantaneously upon impact of the bomb with a target. Furthermore, the invention provides means for hermetically sealing a bomb casing thereby to prevent deterioration of the explosive materials arranged therein.

An object of the present invention is to provide a new and improved electric controlled tail fuze for a shaped charge bomb.

Another object of the invention is the provision of a tail fuze for an aerial bomb wherein means responsive to an electrical impulse fires the shaped charge instantaneously upon impact of the bomb with a target.

Another object of the invention is the provision of a tail fuze wherein means are provided for preventing premature arming and firing of the bomb as the bomb is released from a cluster casing.

Still another object of the invention is the provision of a tail fuze for a shaped charge aerial bomb having normally locked arming means for maintaining the fuze in an initial safe position and adapted to be released and arm the fuze during the free flight of the bomb toward the target.

A still further object of the invention is the provision of a hermetically sealed tail fuze adapted for use in an aerial bomb.

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 an elevational view of a shaped charge bomb with the fuze of the present invention attached thereto, the casings of the bomb and fuze being partially broken away;

Fig. 2 is a central longitudinal sectional view of the fuze of Fig. 1 with the fuze in an unarmed condition;

Fig. 3 is a view similar to Fig. 2 with the fuze in an armed condition;

Fig. 4 is a fragmentary view of the fuze casing illustrating the rotor mounting plate;

Fig. 5 is a sectional view taken on the line 5—5 of Fig. 4;

Fig. 6 is a sectional view taken on the line 6—6 of Fig. 4; and,

Fig. 7 is a sectional view taken on the line 7—7 of Fig. 2 illustrating the centrifugal actuated clutch arrangement.

Referring now to the drawings and more particularly to Fig. 1 thereof, the numeral 10 generally indicates a shaped charge bomb comprising a casing 11 having a shaped charge 12 arranged therein. An impact responsive device 13 is disposed within the nose 14 of the casing 11 and may be of any suitable type such, for example, as the type disclosed and claimed in the copending application of Calvin F. Brown, Serial No. 260,295, entitled Crystal Point Detonation Fuze, filed December 6, 1951.

The fuze of the present invention is generally indicated by the reference character 15 and comprises a tubular casing or support 16 flared at one end thereof as at 17 and having a threaded portion 18 in threaded engagement with the bomb casing 11. By this arrangement the fuze is supported on the bomb casing at the trailing end thereof. The flared portion 17 of the casing 16 is provided with recess 19 having disposed therein a rotor housing 21 comprising a tubular support 22 and an enlarged flange 23, the flange being integrally formed with the support 22. As more clearly shown on Figs. 2 and 3 the flange 23 is provided with a threaded portion 24 in threaded engagement with the flared portion 17 and thus the housing 21 is supported within the recess 19.

The support 22 has formed therein a recess 25 in which is arranged an arming rotor 26, the rotor being rotatably supported within the recess by a pair of trunnions 27 and 28, trunnion 27 being journaled in a bearing 29 formed in the member 22, trunnion 28 being journaled in a closure 31 as at 32, Figs. 5 and 6. The plate 31 is disposed in abutting engagement with the rotor and secured to the member 22 by screws or the like 33 and thus by this arrangement the rotor is maintained within the recess 25 by the plate 31. The rotor 26 is provided with a centrally disposed bore 34, Figs. 2 and 3, having arranged therein an electroresponsive detonator 35 the detonator being normally out of alignment with the explosive train, the train comprising a lead-in charge 36 and a booster charge 37. As more clearly shown on Figs. 2 and 3 a plug 38 composed of suitable insulating material is arranged within a recess 39 formed in the rotor 26. Secured to the plug is a wiper 41, the free end 42 thereof being in engagement with a wall defining the recess 25 and movable into engagement with a contact 43 when the rotor is rotated from an initial safe position, Fig. 2, to an armed position, Fig. 3. The rotor is adapted to be rotated from an initial safe position to an armed position by a spring 44, one end of the spring being secured to the trunnion 28 and the other end thereof being secured to the plate 31 as at 45, Fig. 4. The rotor 26 is provided with a stop pin 46 disposed within a slot 47 formed in the plate 31 for limiting the rotative movement of the rotor.

The rotor is locked in the initial safe position by a pin 48 slidably arranged in a sleeve 49 and having one end thereof disposed within a recess 51 formed in the rotor 26, the pin being secured to a bellows 52 arranged in a centrally disposed recess or well 53 formed in the support 22. One end of the bellows is secured to a sealing disc 54 and disposed in abutting engagement with

one end of the support 22, the other end thereof being secured to a sealing disc 55 disposed within the recess 53.

As shown more clearly on Figs. 2 and 3 an arming shaft generally indicated by the reference character 56 is rotatably arranged within the fuze casing 16 and comprises a threaded portion 57 disposed within and threaded into a bore 58 formed in the disc 54. The shaft 56 has formed thereon a reduced extension 59 having an end thereof in engagement with the disc 55. By this arrangement the locking pin 48 is releasably maintained within the recess 51 of the arming rotor 26 and thus rotation of the rotor is prevented until the arming shaft has been rotated a predetermined amount. When this occurs the spring 61 moves the bellows sufficiently to cause the locking pin to be moved out of engagement with the recess 51 thereby releasing the rotor for rotative movement. The arming shaft 56 is provided at the trailing end thereof with a reduced portion 62 and is normally locked against rotation by a shear pin 63.

An impeller generally indicated by the reference character 64 and comprising a plurality of blades 65 mounted on a hub 66 is rotatably supported by the shaft portion 62, the hub 66 being free to rotate about the shaft portion 62 and is maintained thereon in any suitable manner such, for example, as by a washer 67 disposed in abutting engagement with the hub and secured to the shaft 62 as at 68. A hood 69 is secured to the hub 66 by screws 71 and has formed thereon an end wall 72.

A centrifugal actuated clutch generally indicated by the numeral 73 is disposed within the hood 69 and comprises a member 74 secured to the portion 62 of the arming shaft and having a pair of oppositely disposed notches 75 formed therein. A centrifugally actuated detent 76 is pivotally mounted on the end wall 72 of the hood by a pin 77, the detent comprising a tooth 78 maintained out of engagement with the notches 75 by a spring 80 and adapted to be moved into engagement with one of the notches as the detent 76 is actuated in response to a predetermined centrifugal force produced by the impeller rotational speed. When this occurs sufficient torsional stress is applied to the shear pin 63 to cause shearing thereof and release of the arming shaft 56 whereupon rotative movement is imparted to the arming shaft through the clutch 73 in response to rotation of the impeller 64. As more clearly shown on Fig. 7 a suitable counter balance element 81 is secured to the hub 66 by screws or pins 82.

The fuze casing 16 is sealed by a washer 83 disposed within a recess 84 formed in the casing and arranged in sealing engagement with the arming shaft 56 and casing, the washer 83 being maintained in the aforesaid sealing position by a cap or closure element 85 secured to the casing 16 by screws 86.

An annular member 87 composed of suitable insulating material is arranged within the casing 11 in abutting engagement with flared portion 17 of the fuze casing and the tubular support 22 and having a contact ring 88 molded therein. Disposed in abutting engagement with the member 87 and the shaped charge 12 is a retaining ring 89 having a plurality of openings 91 extending therethrough. The member 89 has formed thereon a plurality of pins 92 disposed within the openings 91 respectively. By this arrangement the plate 89 is fixed within the casing 11 and movement thereof is prevented.

As shown on Figs. 2 and 3 the flange 23 is provided with a bore 93 extending therethrough and in alignment with the contact ring 88. A suitable seal 94 such, for example, as a "Kovar" type seal is arranged within the bore 93 in sealing engagement with the wall defining the bore. The seal is electrically connected to the contact 43 by a conductor 95 and to the contact ring 88 by a spring contact element 96, the contact ring being electrically connected to one terminal or electrode 90 of the impact responsive device 13 by a conductor 97 enclosed within a conduit 98. A conductor 95 is connected to the wiper element 41 and to one terminal of the electroresponsive detonator 35, the other terminal of the detonator being connected to a conductor 101 which is grounded to the arming rotor Fig. 2 as at 102. The other terminal or electrode 100 of the impact responsive device is grounded to the casing 11 as at 103. A suitable crystal 80 such, for example, as abarium titanate crystal is arranged between the aforesaid electrodes 90 and 100. It will be understood that by the aforesaid circuit arrangement a firing circuit is established from the impact responsive device 13 through the detonator when the fuze is in an armed position, Fig. 3, and thus upon impact of the missile with a target the detonator will be fired instantaneously by a voltage developed in the impact responsive device as the crystal 80 thereof is compressed by the force of the impact which potential in turn fires the booster 37 and the shaped charge 12.

A sealing element 104 is arranged within the recess 19, one end of the element being in sealing engagement with the flange 23 and flared wall 17 of the fuze casing 16, the other end thereof being closed as at 105 and disposed between the washer 54 and a shoulder 106 formed on the casing 16. It will be understood, however, that by reason of the element 104, bellows and "Kovar" seal arrangement the fuze casing 16 is hermetically sealed and thus deterioration of the explosive materials arranged within the fuze is prevented.

The fuze is provided with a stabilizer assembly generally indicated by the numeral 107 comprising a plurality of radially disposed fins 108 secured to the fuze casing as at 109 and to the annular shroud 110 as at 111. Disposed within the shroud at the trailing end thereof is a brace 112 having a plurality of arms 113 secured to the shroud as at 114. A safety wire 115 is attached to one of the impeller blades 65 and to one of the arms 113 for preventing rotating of the impeller during handling and transportation, it being understood, however, that the safety wire is detached when the bomb is arranged in the bomb rack.

From the foregoing description it will be noted that a new and improved electric controlled tail fuze for a shaped charge bomb has been devised wherein means are provided for maintaining the fuze in a safe condition whereupon premature firing thereof will not occur as the bomb is released from a cluster casing and in which an electroresponsive detonator is adapted to fire the shaped charge instantaneously in response to an electrical impulse received thereby upon impact of the bomb with a target.

Obviously many modifications and varitions 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 claims the invention may be practiced otherwise than as specifically described.

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

1. In a fuze for a shaped charge bomb, a casing, an arming rotor releasably locked within said casing in an initial safe position, means including a spring actuated detent for locking the arming rotor in said initial safe position, means including a shaft rotatably supported within said casing for maintaining said detent in locking engagement with the arming rotor until the shaft has been rotated a predetermined number of revolutions, means including an impeller and a centrifugally actuated element rotatably supported on said shaft for rotating the shaft said predetermined number of revolutions when the speed of rotation of the impeller has reached a predetermined value during the free flight of the bomb toward a target, and means including a device responsive to an electrical impulse for firing said charge instantaneously upon impact of the bomb with the target.

2. A fuze for a bomb comprising a normally locked arm-

ing rotor, means for locking said arming rotor in an initial safe position, means rotatably supported on said fuse for maintaining said locking means in locking engagement with said rotor, means on the locking means for moving the locking means to a release position when the rotatable means has been rotated a predetermined number of revolutions, an impeller supported for rotation by said rotatable means, clutch means on said impeller for rotating the rotatable means said predetermined number of revolutions, and means on the arming rotor for rotating the arming rotor from said initial safe position to an armed position as the locking means is released.

3. A fuze for a bomb comprising a normally locked arming rotor, a detent for locking said arming rotor in an initial safe position, a shaft rotatably supported on said fuze for maintaining said locking detent in locking engagement with said rotor, spring means on the locking detent for moving the detent to a release position when the shaft has been rotated a predetermined number of revolutions, an impeller rotatably supported on said shaft, means including a detent on said impeller and controlled by the speed of rotation thereof for rotating the shaft said predetermined number of revolutions, and a torsional spring on the arming rotor for rotating the arming rotor from said initial safe position to an armed position as the arming rotor is released.

4. A fuze for a bomb comprising a normally locked arming rotor, a detent for locking said arming rotor in an initial safe position, a shaft rotatably supported on said fuze for maintaining said detent in locking engagement with said rotor, spring means on the locking detent for moving the detent to a release position when the shaft has been rotated a predetermined number of revolutions, an impeller rotatably supported on said shaft, driving means on said shaft, a centrifugally actuated detent on said impeller for imparting rotative movement to the shaft as the detent is moved into engagement with said driving means by centrifugal force, a torsional spring on the arming rotor for rotating the rotor from said initial safe position to an armed position as the rotor is released, an electroresponsive detonator arranged within the arming rotor, and means including a pair of electrical contact elements for establishing an electrical connection to said detonator when the arming rotor is in said armed position whereby the detonator may be fired in response to an electrical impulse received thereby.

5. In a fuze for a shaped charge bomb adapted to be dropped from an aircraft in flight upon a target, the combination of a casing for said fuze and secured to the tail of said bomb, an arming rotor releasably locked in an initial safe position within said casing, a detent slidably arranged within the casing for locking the arming rotor in said initial safe position, a shaft rotatably supported within said casing in abutting engagement with said detent for maintaining the detent in locking engagement with said arming rotor, threaded means on said shaft in engagement with said casing for causing the shaft to move out of engagement with said detent as the shaft is rotated a predetermined amount, spring means secured to the rotor and casing for rotating the rotor from said initial safe position to an armed position as the shaft is moved out of engagement with said detent, an impeller rotatably supported on said shaft and adapted to be rotated during the free flight of the bomb toward said target, a centrifugally actuated element pivotally mounted on said impeller and rotated therewith, means on said shaft and engaged by said element when the speed of the impeller has reached a predetermined value for rotating the shaft said predetermined amount, an electroresponsive detonator arranged within the arming rotor, a contact on said casing, a contact element on said rotor for establishing an electrical connection to said detonator as the rotor is moved to said armed position and the contact element is moved into engagement with said contact,

and an impact responsive voltage generator on the nose of said bomb for generating a voltage sufficient to fire the detonator upon impact of the bomb with the target thereby to fire said shaped charge.

6. In a fuze for a shaped charge bomb adapted to be dropped from an aircraft in flight upon a target, the combination of a fuze casing secured to said bomb, an arming rotor releasably locked within said casing in an initial safe position, means including a spring actuated detent for locking the rotor in said initial safe position, means including a shaft rotatably supported within said casing for maintaining said detent in locking engagement with the arming rotor until the shaft has been rotated a predetermined number of revolutions, means including an impeller and a centrifugally actuated device rotatably supported on said shaft for rotating the shaft said predetermined number of revolutions, means including an electroresponsive detonator for firing said charge instantaneously in response to an electrical impulse received thereby, and means responsive to impact of the bomb with a target for generating an impulse sufficient to fire said detonator.

7. In a fuze for a shaped charge bomb adapted to be dropped from an aircraft in flight upon a target, the combination of a fuze casing secured to said bomb, an arming rotor releasably locked within said casing in an initial safe position, a spring actuated detent disposed within said casing for locking the rotor in said initial safe position, an arming shaft normally locked to said casing for maintaining said detent in locking engagement with the arming rotor, means shearable in response to a torsional force applied thereto for releasing said arming shaft for rotative movement, means including an air actuated impeller and a centrifugally actuated clutch rotatably supported on said arming shaft for applying said force to the shearable means as the impeller is actuated and for imparting rotative movement to the shaft as the shearable means is severed thereby releasing said rotor from said initial safe position, means on said arming rotor for rotating the arming rotor from said initial safe position to an armed position as the arming rotor is released, means including an electroresponsive detonator disposed within the arming rotor for firing said charge in response to an electrical impulse received thereby, and means disposed within the nose of said bomb and responsive to impact of the bomb with the target for generating said impulse.

8. In a fuze for a shaped charge bomb adapted to be dropped from an aircraft in flight upon a target, the combination of a casing for said fuze and secured to the tail of said bomb, an arming rotor releasably locked in an initial safe position within the casing, a detent slidably disposed within the casing for locking the arming rotor in said initial safe position, a shaft rotatably supported within said casing in abutting engagement with said detent for maintaining the detent in locking engagement with the arming rotor, a threaded portion on said shaft in engagement with the casing for causing the shaft to move out of engagement with said detent as the shaft is rotated a predetermined amount, spring means secured to the rotor and casing for rotating the rotor from said initial safe position to an armed position as the shaft is moved out of engagement with said detent, an impeller rotatably supported on said shaft for rotative movement during the free flight of the bomb toward said target, a centrifugally actuated element pivotally mounted on said impeller and rotated thereby, means on said shaft and engaged by said element when the speed of the impeller has reached a predetermined value for rotating the shaft said predetermined amount, an electroresponsive detonator arranged within the arming rotor, a contact on said casing and insulated therefrom, a contact element on said rotor and operatively connected to said detonator and insulated from the rotor, a contact ring disposed within said casing and operatively connected to said detonator for establish-

ing an electrical connection to said detonator as the arming rotor is moved to said armed position and the contact element is moved into engagement with said contact, and a metallic titanate piezoelectric element arranged in the nose of said bomb and operatively connected to said contact ring for generating a voltage sufficient to fire the detonator upon impact of the bomb with the target.

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