

March 13, 1951

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2,545,204

JET-ACCELERATED ARMOR PIERCING BOMB

Filed Feb. 9, 1945

4 Sheets-Sheet 1

FIG. 1.

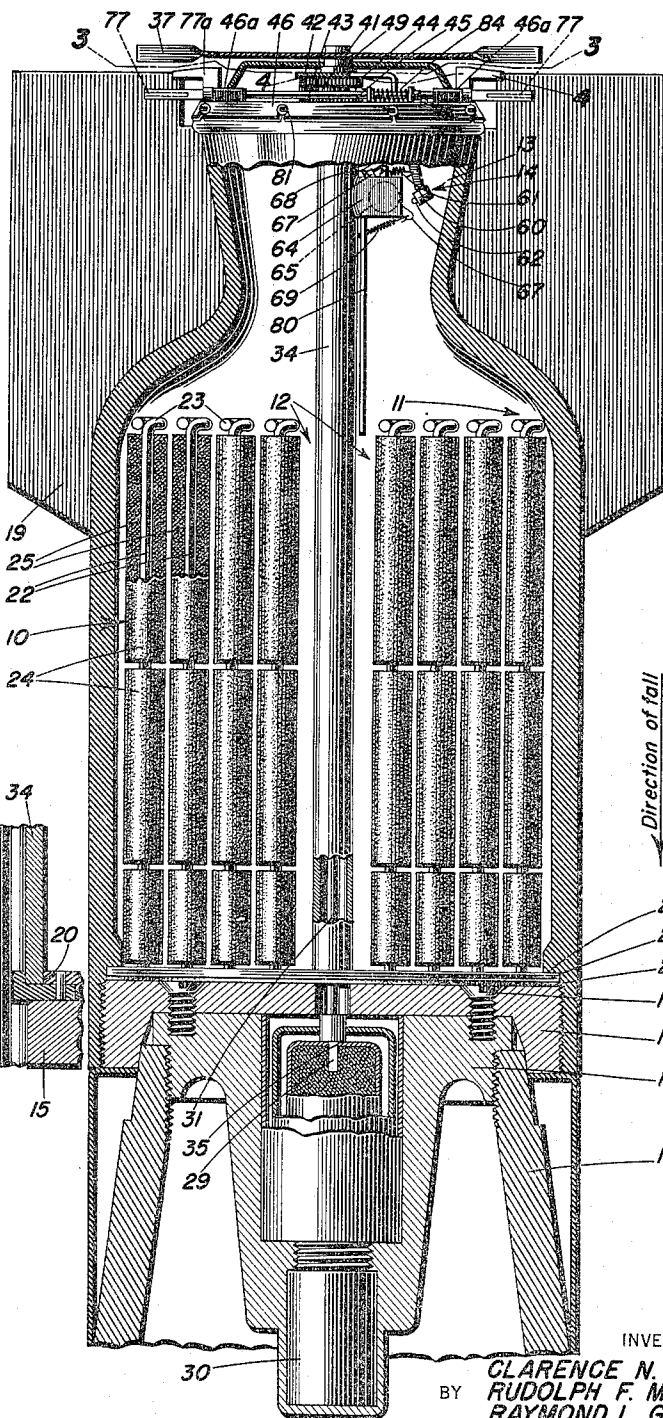
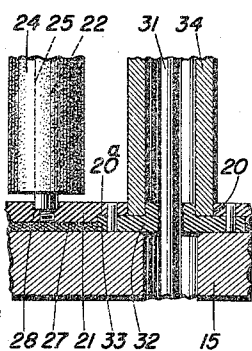


FIG. 2.



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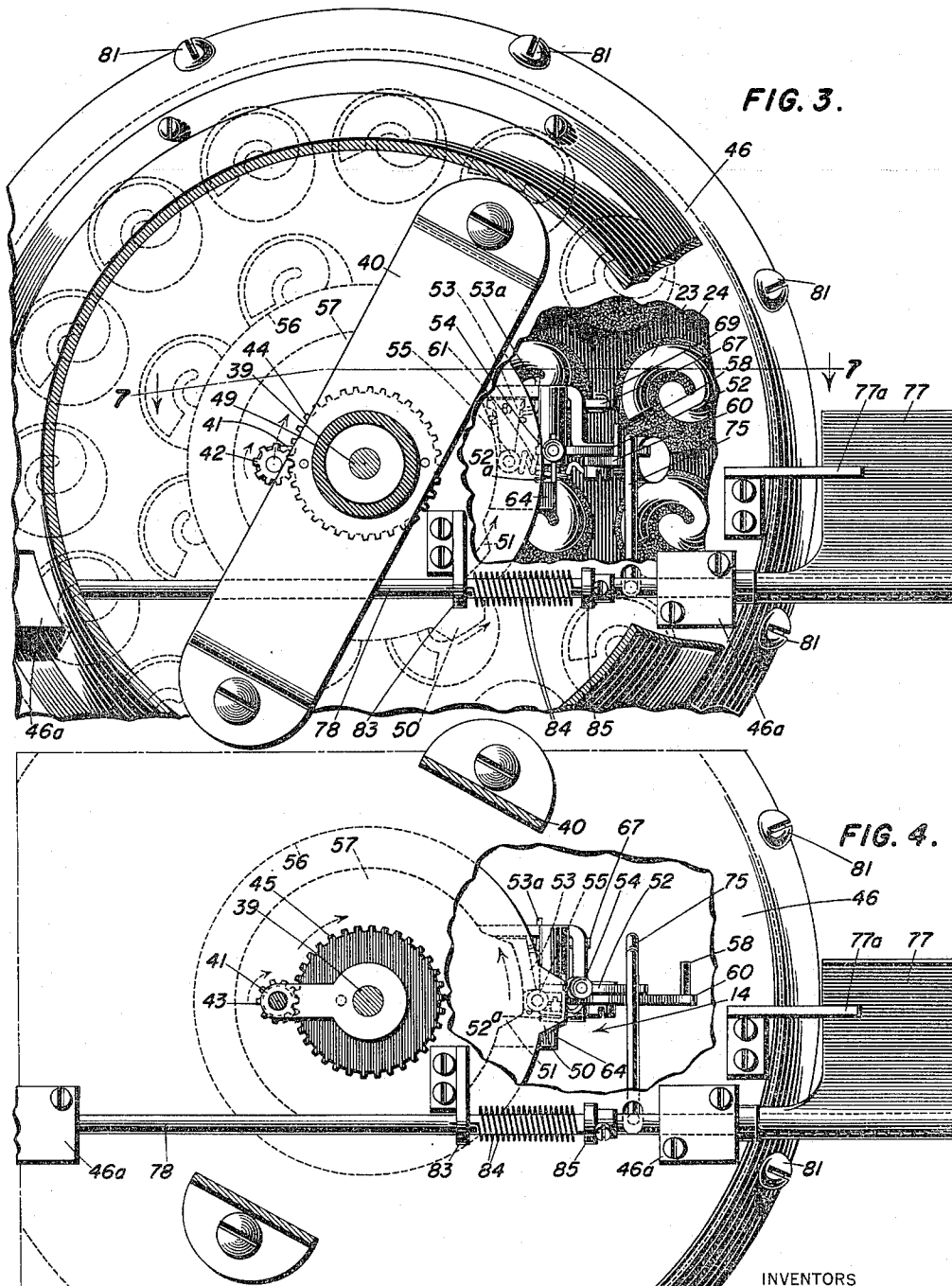
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4 Sheets-Sheet 2



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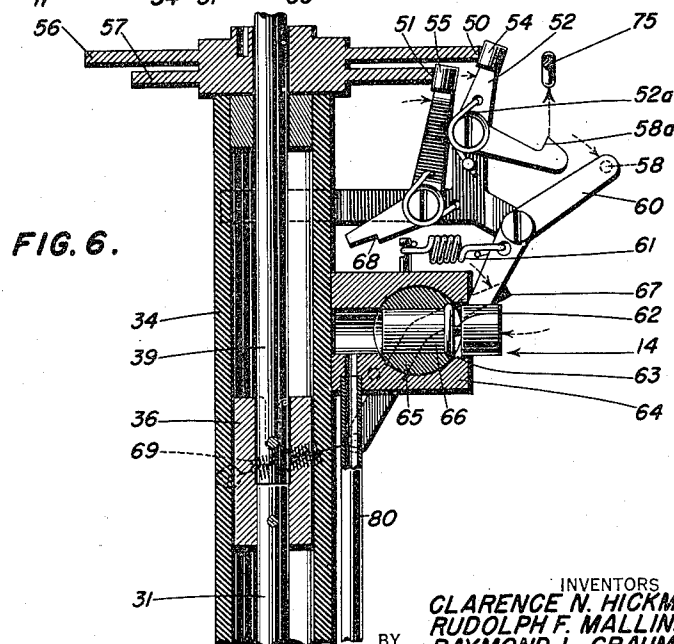
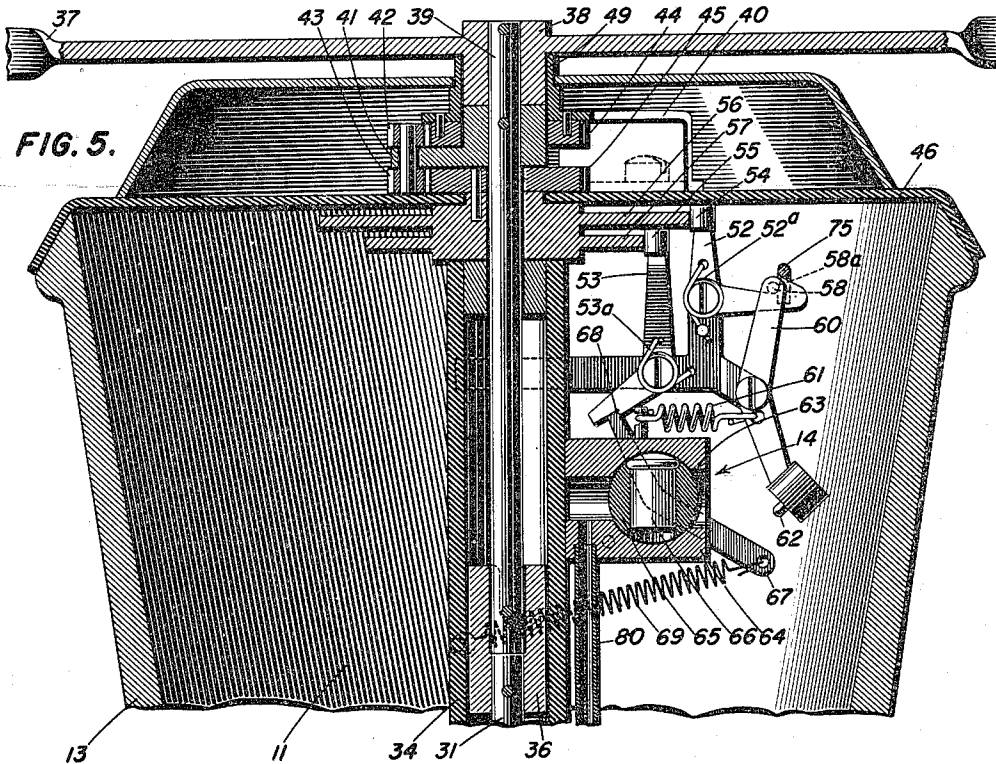
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JET-ACCELERATED ARMOR PIERCING BOMB

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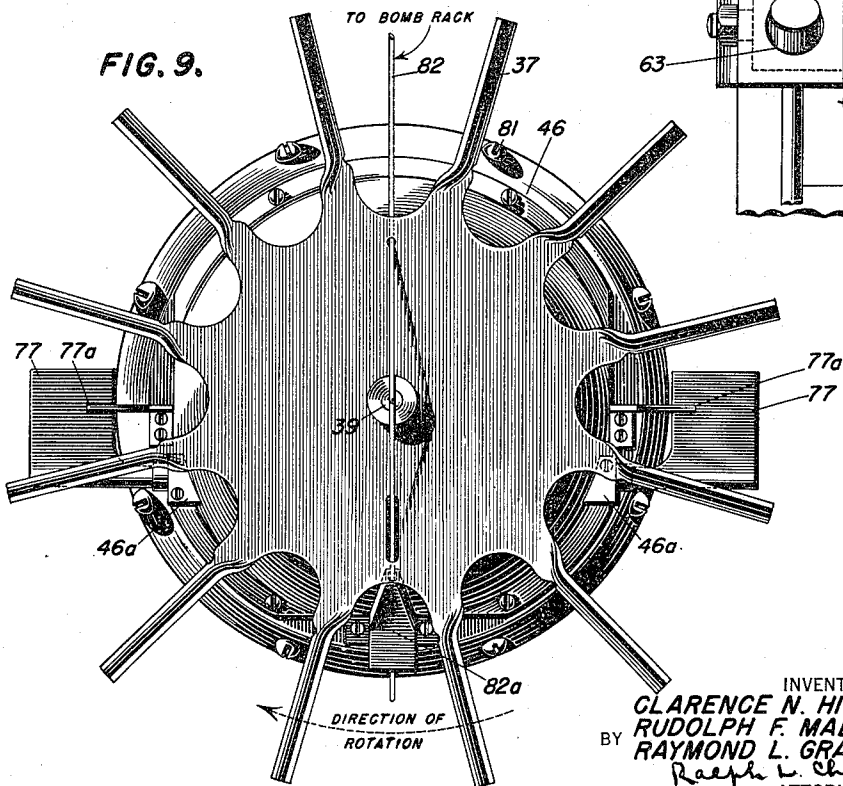
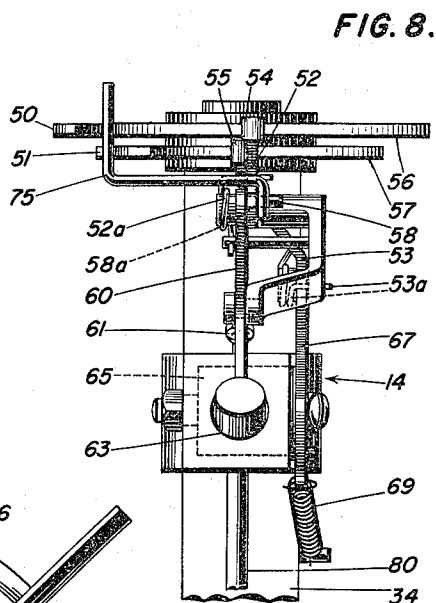
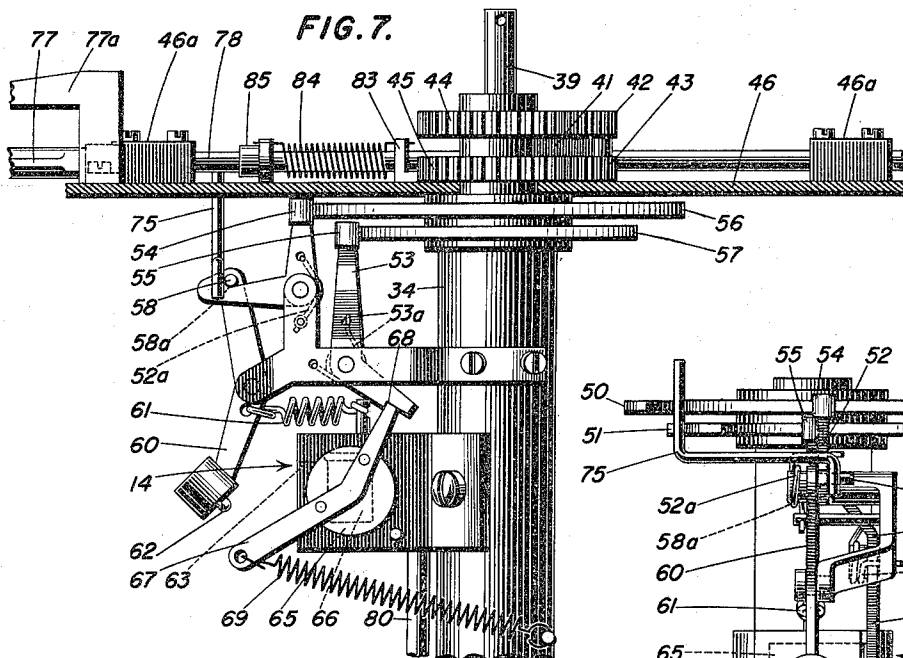
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JET-ACCELERATED ARMOR-PIERCING
BOMB

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16 Claims. (Cl. 102-49)

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This invention relates to an improved jet-accelerated armor piercing projectile, such as a bomb, and more particularly to a projectile of this type having novel means for arming the jet propellant of the projectile and for igniting the propellant after a time delay following launching of the projectile.

Modern armor piercing bombs must ordinarily be dropped from a very high altitude in order to attain a striking velocity sufficiently large to cause the bomb to penetrate the thick armor of battleships or other armored targets. It is well known that bombing accuracy decreases with altitude and that clouds and darkness frequently make it impossible to see the target from an altitude at which these bombs must be dropped if their armor-piercing qualities are to be effective. A jet impulse provides a suitable means for increasing the velocity of bombs dropped at relatively low altitudes. This jet impulse is produced by the rapid ejection of gases from a fast-burning propellant powder through a suitable nozzle attached to the body of the bomb.

In a bomb provided with a jet impulse accelerating device, it is necessary to control accurately the point of jet initiation in the trajectory in order not to decrease the accuracy of the bomb. By initiating the jet at a point in the normal trajectory of the bomb at which the lateral component of the thrust produced by the jet is at a minimum, it is possible to increase the velocity of the bomb with a minimum change in its normal trajectory.

One object of this invention, therefore, is to provide an improved jet-accelerated bomb or other projectile having novel means for arming the jet propellant and for igniting it at a predetermined point in the normal trajectory of the projectile, so that its normal trajectory is substantially preserved.

Another object of this invention is to provide an improved jet-accelerated armor-piercing bomb having a combustion chamber secured to the tail of the bomb and having a device for arming the bomb and the jet propellant igniting device, and for firing the jet propellant. In a preferred form of the bomb, the device is mounted in the nozzle of the combustion chamber and is ejected to clear the jet by pressure of the combustion gases developed in the chamber on ignition of the propellant powder.

Another object of the invention is to provide an arming device of the character referred to above in which the fuze for detonating the high explosive of the bomb is armed after the pro-

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jectile is launched even though the jet-accelerating device fails to become ignited.

Another object of the invention is to provide a device of the character referred to above which has safety means for preventing arming of the jet propellant igniting device even though the fuze for the high explosive of the projectile becomes accidentally armed.

A further object of this invention is to provide jet acceleration of a projectile with a minimum change in the normal trajectory of the projectile. In a projectile made according to the invention, the combustion chamber is secured to the tail of the projectile so as to conform substantially to the configuration thereof, and the space within the nozzle communicating with the combustion chamber is preferably used for retaining the arming and firing mechanism of the jet, this mechanism being ejected to clear the jet by the pressure developed within the combustion chamber of the accelerator. The mechanism is constructed to delay ignition of the jet propellant powder as desired, so as substantially to preserve the normal trajectory of the projectile.

Another object of the invention is to provide a means for sealing the fuze for the high explosive of the bomb from the hot propellant gases in the combustion chamber, and still permitting this fuze to be armed by a mechanism extending through the combustion chamber.

It has been found that the arming wire which normally extends through propeller vanes of bomb fuzes to prevent rotation thereof is not completely reliable as the sole safety element for the jet-propelling charge in the bomb. This will be apparent once it is considered that prior to loading these bombs on airplanes, the bombs frequently lie exposed upon the decks of aircraft carriers in a position where shell fragments or the like may easily dislodge the arming wire from its position of securing engagement with the propeller vanes. These propeller vanes are rotated by a slight wind so that if an arming wire were to be dislodged, the headwinds set up by motion of the ship or other winds, would be sufficient to cause the propeller to rotate and initiate the jet, with the result that the bomb would be propelled across the deck of the carrier by the jet, endangering personnel and equipment.

In order to prevent such occurrences, the projectile of our invention preferably includes a safety device for preventing ignition of the jet propellant until operated by a wind velocity of, for example, 100 knots. This device in its safe

position prevents the ignition of the jet, but does not in any way interfere with the arming of the high explosive fuze. Consequently, even though this safety device should fail to function in a live drop, the high explosive fuze would arm and the bomb would not drop as a dud.

A further object of the invention is to provide a device for igniting a jet propellant explosive, in which a charge for igniting the explosive is normally maintained in an unarmed position and is adapted to be fired by a striker which is normally retained in a clocked position separated from the charge. A mechanism operated by a propeller, which is rotated by the surrounding medium after the projectile is launched, preferably operates a cam or other means for successively moving the charge to an armed position and causing the striker to fire the charge.

The above-mentioned and other objects of the invention will be apparent from the following specification and the accompanying drawings, in which:

Fig. 1 is a vertical sectional view of a portion of a bomb made in accordance with our invention, showing some of the parts in elevation;

Fig. 2 is a fragmentary detailed sectional view showing the mounting of the trap rod for the propellant and the bearing for the arming shaft;

Fig. 3 is the horizontal sectional view taken on line 3—3 of Fig. 1, showing the parts in their safe or unarmed positions with some of the parts broken away for clarity;

Fig. 4 is a horizontal sectional view taken on line 4—4 of Fig. 1, showing the parts in their fired positions with some of the parts broken away for clarity;

Fig. 5 is a vertical sectional view of a portion of the mechanism, showing the parts in their safe positions;

Fig. 6 is a detailed vertical sectional view of some of the parts in their fired positions;

Fig. 7 is a detailed sectional view taken on line 7—7 of Fig. 3 and viewed reversely to Fig. 5;

Fig. 8 is a detailed elevation view of the igniting mechanism of the device, and

Fig. 9 is a plan view of the device showing the arming wire in position.

As shown in Fig. 1, the jet propulsion device 10 comprises essentially a chamber 11 in which the propellant charge 12 is burned, a nozzle 13 through which the gases from the burning charge issue, and a fuze mechanism 14 for initiating the jet action. As illustrated, the chamber 11 and the nozzle 13 are formed of a single piece of metal which is threaded on a supporting plate 15 secured to the base plate 16 of the bomb 17 by means of screws 18. Fins 19 are secured to the outer surface of the nozzle 13 for stabilizing the bomb in flight.

The chamber 11 contains a trap for holding the propellant charge 12. This trap comprises a plurality of rods 22 screwed to a trap disc 21 at one end and having a twisted wormhead 23 formed at the other end for holding the propellant within the combustion chamber. The propellant charge 12 comprises a plurality of grains 24 of ballistite or other suitable propellant in the form of cylinders, each having an axial perforation 25 through which the wormhead trap rod 22 is inserted to hold the grains to the disc 21. Cylindrical grains of propellant with a single axial perforation are used in order to provide a burning surface which remains substantially constant throughout the burning time. That is, as the outer surface of each cylindrical grain decreases

in burning, the inner surface of the grain defining the perforation 25 increases due to burning, so that the total burning surface remains substantially constant. The most important feature of the wormhead trap rod support for the propellant is that a sufficient surface is provided across the ends of the powder grains to support these grains against setback without impeding the flow of gas liberated by the combustion of the exposed inner circumferential surfaces of the grains. The trap wires 22 are secured to the disc 21 which is in turn held in place between a shoulder 26, formed in the combustion chamber 11, and the rear surface of the supporting plate 15.

It is desirable to prevent the gases formed by the burning propellant from leaking around the front of the disc 21 and causing the disc to bulge and break free from its securing engagement between the shoulder 26 and the supporting plate 15, and to this end a gasket 27 formed of an asbestos and metallic composition is placed between the trap disc 21 and the front plate 15 of the propulsion chamber. Bulging or loosening of the disc 21 might result in freeing the powder traps to move rearwardly where they would clog the nozzle and prevent the flow of gas there-through. Any such clogging of the nozzle by the trap wires or propellant material would cause the pressure within the combustion chamber to be built up rapidly resulting in "blow-ups" of the combustion chamber. Specifically, the gasket which is preferred is formed of asbestos sheets laminated to a pierced steel reinforcement plate by means of clinched over-projecting tangs. The surfaces of this gasket are smoothed out and then coated with finely divided graphite.

In order to prevent breaking off of the trap rods 22 at the points where they screw into the disc 21, holes 28 of a diameter equal to the diameter of the trap rods 22, are bored into the disc 21 a distance less than the thickness of the disc, and for the remaining portion of the thickness of the plate, the holes are tapped to fit the threaded end of the trap rod 22. This is an important improvement in trapping and prevents blow-ups and high pressures resulting from the trap rods breaking off and choking the nozzle.

As illustrated in Fig. 1, the base plate 16 of the bomb 17 is adapted to accommodate a standard impact detonating fuze 30. This fuze may be any suitable type of base detonating fuze which can be armed by rotation of a shaft 31, and its details are not illustrated since they are not involved in this invention. It is to be noted, however, that the base of the fuze fits flush with the rear surface of the base plate 16 except for the arming shaft 31 which protrudes therefrom. The fuze is provided with the usual percussion primer, booster charge, and firing pin inertia member (not shown). The firing pin inertia member is retained in a position spaced from the primer by suitable release mechanism which prevents the inertia member from being dislodged on impact for engagement with the primer until after the arming shaft 31 has completed a prescribed number of revolutions. After the arming shaft 31 has completed the necessary revolutions, the firing pin inertia member will be free to move to engage the percussion primer on impact to set off the fuze booster for detonating the bomb.

The arming shaft 31 is rotatable in a bearing 32 in the trap disc 21. This bearing has a flanged portion 33 which is fitted into a recess 20a cut away from the edge of the shaft opening 20 formed in the trap disc 21 (Fig. 2). The shaft

is thus rotatably secured within the propulsion device 10. The shaft, as shown, is provided with a flattened portion 29 at its front end adapted to engage in a recess 35 formed in the rotatable part of base fuze 30, so that on impact the combustion chamber 11 and the shaft 31 may break free of the body of the bomb so as not to interfere with its penetration of the target armor.

It is essential that the hot gases under pressure within the combustion chamber be prevented from gaining access into the fuze 30 and the high explosives within the bomb. Sealing of the shaft 31 within the bearing 32 by means of obturating cups and the like is very difficult because the hot propellant gases quickly erode the sealing material. In the present invention, this sealing is successfully accomplished by utilizing the high velocity discharge of the propellant fluid to obtain a low pressure about the shaft. As illustrated in Figs. 1, 5 and 6 of the drawings, shaft 31 is enclosed in a tube 34 which extends rearwardly of the combustion chamber past the throat of the nozzle so that its rear end lies within the nozzle flare 13 facing the direction of fluid discharge. When the plate 46 and the igniting mechanism are blown out on ignition of the jet, as will be explained presently, the rear end of tube 34 is opened to the atmosphere. The flow of the propellant fluid along the tube causes a low pressure area to be built up in front of its open rear end. Thus, even though the hot propellant fluid were to gain access into the tube by eroding the tube at its junction with the plate 21, this fluid would be caused to flow toward the low pressure area for discharge through the jet and would not gain access into the high explosive or its fuze.

As shown in Figs. 5 and 6, shaft 31, which is supported for rotation within the tube 34, terminates at a rotatable chuck 36. This chuck provides a releasable connection with the propeller shaft 39 which is secured to the arming propeller 37. Thus, when plate 46 and the rear mechanism is ejected on ignition of the propellant, shaft 39 separates from shaft 31 leaving the latter in place. The propeller hub 38 is rotatable in a bearing 49 formed integrally with a housing 40. The housing 40 also has a stationary sun gear 44 secured to its under surface and provides a bearing surface for the hub of a rotatable arm 41. The arm 41 is pinned or keyed to the shaft 39 for rotation therewith and provides a support for planet gears 42 and 43 which are rotatable about a longitudinal axis. The gear 42 meshes with the sun gear 44 and is rotated about its axis to rotate the pinion gear 43, as the arm 41 moves the gear 42 in its orbit about the sun gear 44 in response to rotation of the propeller 37.

A ring gear 45 is rotatably supported within a nozzle cover plate 46 and meshes with the planetary pinion gear 43 so as to be rotated thereby. Gear 45 has one more tooth than the sun gear 44 so that when the propeller 37 is rotated by air during the free fall of the bomb, the arm 41 rotates the two equivalent pinion gears 42 and 43 as a planet about the sun gear 44 and advances the ring gear 45 relative to sun gear 44. Assuming that sun gear 44 is provided with thirty-nine teeth and that the ring gear 45 has forty teeth, then since the sun gear 44 is held against rotation, the planet gears will be rotated about their axis as they revolve about gear 44. The number of teeth on the planet gears are equal, consequently the ring gear 45 will advance a distance equal to one tooth for each complete rotation of the propeller. The propeller vane must therefore revolve

thirty-nine times to turn the ring gear 45 and the members which rotate with it through a single revolution.

Two bell crank levers 52 and 53 are each pivoted to a support secured to the tube 34 and are spring biased by springs 52a and 53a, respectively, to a position so that followers 54 and 55, rotatably mounted on the ends of each lever, are forced into abutting engagement with cam surfaces 50 and 51 on the peripheries of rotatable disc-like members 56 and 57, respectively, which rotate with gear 45. The end of the bell crank lever 52 opposite the follower 54 has a notch 53a for engaging a pin 58 carried by the end of a pivoted impact striker 60. A spring 61 biases the impact striker 60 and its firing pin 62 toward a recess 63 formed in a percussion primer cartridge housing 64. A percussion primer cartridge 66 is retained in a holder 65 which has two open sides and two closed sides and is rotatably supported within a housing 64. Holder 65 has an arm 67 extending transversely from an end thereof for rotating the holder. Arm 67 is engaged by a notch 68 formed in the end of the bell crank lever 53 to retain the holder 65 and arm 67 in a displaced position against the action of a spring 69. In this displaced position, the percussion primer is disposed substantially 90° from its armed position, and the closed sides of the holder 65 separate the primer from the firing pin and also isolate the primer from the propellant explosive. The spring 69 provides the torque for rotating the holder to bring the percussion primer into impact receiving alignment with the firing pin 62 immediately upon release of the arm 67 by the bell crank lever 53. By retaining the percussion primer out of alignment with the firing pin, the igniter for the jet propellant is safe from operation by impacts which might dislodge the impact striker from its position of holding engagement with the bell crank 52.

The cams 50 and 51 are designed so that upon rotation in the direction which would result from the action of the air on the propeller in a free fall, the bell crank 53 will be lifted to release the arm 67 to permit the holder to bring the percussion primer into alignment with the firing pin prior to release of the striker from its displaced position as restrained by the bell crank lever 52. Further rotation of the discs 56 and 57 causes the cam 50 to move the bell crank lever 52 out of engagement with the striker. The striker is now free to be driven by the spring 61 into firing engagement with the percussion primer except for the fact that an arm 75 engages the pin 58 carried by lever 60 to hold the impact member away from the primer.

Arm 75 projects from a shaft 78 rotatably mounted on plate 46 by means of bearings 46a and a bracket 83 to which is attached one end of a coiled spring 84. The other end of the spring is attached to a collar 85 mounted on the shaft 78, the spring tending to rotate the shaft 78 toward its unarmed position in which the arm 75 engages pin 58. Shaft 78 is shown in its unarmed position in Figs. 3 and 7. When the bomb is launched, the air pressure on vanes 77 on the ends of shaft 78 rotates the shaft from the unarmed position to the armed position shown in Fig. 4, against the action of spring 84. Vanes 77 rotate into contact with the vane stops 77a, mounted on plate 46, and the resulting rotation of shaft 78 moves arm 75 out of engagement with pin 58 to the position shown in Figs. 4 and 6.

When the primer 66 is fired, upon release of

striker 62, the resulting blast is communicated to the propellant charges 12 through primer housing 64 and a tube 80 extending forwardly from the interior of the primer housing to a point adjacent the propellant charges. Accordingly, the propellant charges 12 are ignited by the primer blast so that the jet action is initiated.

Arm 75 provides additional safety means and prevents the jet propellant from being ignited by rotation of the propeller by normal head winds should the arming wire 82 be accidentally dislodged. By virtue of the air pressure actuated arm 75, not only must the propeller complete a certain number of revolutions, but the bomb must also be in an air stream of a predetermined velocity in order for the jet to become ignited. With this construction, the hazards previously attached to the jet-accelerated bomb are eliminated, since the new device requires a predetermined minimum air velocity for operation. For example, the tension of spring 84 may be set so as to require a slip stream of at least 100 knots acting on vanes 77 before arm 75 is moved to its armed position. Even though the vanes should fail to lift the arm 75, the base detonating fuze 30 will become armed by rotation of arming propeller 37 and the bomb will not be a dud.

Propeller 37 is normally restrained from rotating by an arming wire 82 which is inserted through apertures in the vanes of the propeller. A spring clamp 82a mounted on plate 46 holds the wire against accidental withdrawal. This arming wire is withdrawn in any conventional manner when the bomb is launched.

Bombs are seldom if ever launched from an aircraft at velocities less than 100 knots, and consequently the impact striker 60 is conditioned for release by the propeller-actuated bell crank immediately upon being launched. When the bomb is launched, the air pressure acts upon the vanes 77 to rotate the arm 75 out of its position of holding engagement with the striker, and acts also upon the propeller to rotate the pinion gears 42 and 43 about the sun gear 44 to drive the gear 45 and discs 56 and 57. The cam surfaces formed on the discs 57 and 56 successively actuate the bell crank levers 53 and 52 which successively release the arm 67 for rotating the cartridge holder 66 to bring the cartridge into its armed position in alignment with the firing pin 62 and release the striker member 69 to permit it to be driven by the spring 61 into percussion engagement with the primer 66. A tube 80 is provided for transmitting the flash from the percussion primer into the combustion chamber to ignite the primer for the propellant charge.

As soon as the propellant charge is set off, a fluid pressure is quickly built up within the combustion chamber by the gases of combustion. This fluid pressure acts upon the nozzle cover plate to shear the cover plate from its connection with the nozzle flare at the bolts 81 and thus eject the operating mechanism for the igniter and fuze to clear the jet for the high velocity discharge of the propellant fluid required to accelerate the bomb. The necessity for clearing the nozzle of the operating mechanism in order to assure efficiency of the jet propellant makes it necessary for the base detonating fuze 30 to be armed before the propellant charge is ignited, as explained above.

It will be understood that as the high pressure fluid in the combustion chamber 11 discharges through nozzle 13, the resulting reaction impulse increases the velocity of fall of the bomb and

thereby increases its armor penetrating ability. The propeller 37, operating through the planetary gearing 42, 43 and 44 and the cam 50 and lever 52, provides a time delay in ignition of the jet propellant charge 12, following the release of the bomb, and this delay is preferably timed so that the propellant charge is ignited when the bomb reaches a point in its normal trajectory at which the lateral component of the thrust produced by the jet is at a minimum. Thus, the design of the time delay means will depend upon the ballistics of the bomb for which the jet propelling device is intended. By properly designing the timing means so that the jet action is initiated at the trajectory point referred to, the bomb velocity may be increased with a minimum change in its normal trajectory.

Although one specific embodiment of the invention has been described and shown in the drawings, the invention is not to be construed as limited to that embodiment. The various features of the device such as the cartridge holder, the striker, and the safety means thereof may assume various other forms without departing from the scope of the invention. Also, the linkages between the propeller and the various members actuated thereby may be varied over a wide range of forms.

We claim:

1. A projectile having a combustion chamber, a propellant charge in said chamber, a rearwardly opening nozzle extending from said chamber, and a time delay mechanism normally positioned in said nozzle for igniting said propellant charge, detent means normally securing against initiation of the action of said time delay mechanism and movable by an air stream of a predetermined velocity to an inoperative position, said mechanism being adapted to be expelled from said nozzle by the gases of combustion to provide an unobstructed nozzle exit for said gases.

2. A high explosive projectile having a nose portion and a base portion, a normally unarmed fuze in said base portion for detonating the high explosive, a normally inactive jet propulsion device comprising a propellant charge, a vented chamber containing said charge conforming in configuration with said projectile when secured to the base thereof to form a tail therefor, and means carried by said tail and extending through said chamber for successively arming said fuze and initiating action of said jet propulsion device.

3. A high explosive projectile having a nose portion and a base portion, a normally unarmed fuze in said base portion for detonating the projectile, normally inactive jet propulsion means comprising a propellant charge, a vented chamber containing said charge and conforming in configuration with said projectile when secured to the base thereof to form a tail therefor, and means extending through said chamber and operable after said projectile is launched for successively arming said fuze and initiating action of said jet propulsion means.

4. A high explosive projectile having a nose portion and a base portion, a normally unarmed fuze in said base portion for detonating the projectile, normally inactive jet propulsion means including a propellant, a vented chamber containing said propellant and conforming in configuration with said projectile and secured to the base thereof to form a tail therefor, and aerodynamically operated means carried by said tail, means

connected to said aerodynamically operated means extending through said chamber for successively arming said fuze and initiating action of said jet propulsion means after said projectile is launched.

5. In a high explosive projectile, a normally unarmed fuze for detonating the projectile, normally inactive jet propulsion means, aerodynamically operated means for successively arming said fuze and initiating action of said jet propulsion means, and means for securing against actuation of said jet propulsion means by an air stream of less than a predetermined velocity.

6. In a high explosive projectile having a normally unarmed fuze for detonating the projectile, and normally inactive jet propulsion means, the combination of an aerodynamically operated mechanism for successively arming said fuze and initiating action of said jet propulsion means, and detent means normally securing against initiation of the action of said jet propulsion means and movable by an air stream of a predetermined velocity to an inoperative position.

7. In a high explosive projectile having a normally unarmed fuze for detonating the projectile and normally inactive jet propulsion means, a propeller rotatable by the flow of air when the projectile is launched, means operable by the propeller to arm said fuze, and means operable by rotation of said propeller subsequent to the arming of said fuze for initiating action of said jet propulsion means.

8. In a high explosive projectile having a normally unarmed fuze for detonating the projectile and having normally inactive jet propulsion means, an aerodynamically operated control mechanism carried by said jet propulsion means and having an operative connection extending through said jet propulsion means for successively arming said fuze and initiating action of said jet propulsion means, and means for securing against actuation of said jet propulsion means by an air stream of less than a predetermined velocity.

9. In a projectile having a normally inactive jet propulsion device, mechanism for igniting said device, including an air operated propeller, a percussion primer cartridge, a rotatably mounted holder for said cartridge, said holder being normally in an unarmed position, a striker for firing said cartridge, a cam operatively connected to said propeller, and follower means for said cam for successively rotating said holder to an armed position and causing said striker to fire said cartridge.

10. In a projectile having a normally inactive jet propulsion device, an air stream operated propeller, means under the control of said propeller for igniting said device after said propeller has completed a predetermined number of revolutions, and detent means normally securing against initiation of the action of said jet propulsion device and movable by an air stream of a predetermined velocity to an inoperative position.

11. In a high explosive projectile having a combustion chamber containing a jet propellant explosive, a fuze adjacent said chamber for detonating said projectile, and a partition between said chamber and said fuze, the combination of an air operated propeller, a propeller shaft extending through said chamber and said partition for arming said fuze on rotation of the propeller, and means for preventing flow of the high pressure combustion gases from said propellant through said partition along said shaft.

12. In a high explosive projectile having a combustion chamber containing a jet propellant explosive for generating a propellant fluid, a nozzle at the rear end of the chamber, and a fuze adjacent to said chamber for detonating said projectile, the combination of an air operated propeller, a shaft extending through said chamber for connecting said propeller and said fuze for arming said fuze, and means responsive to the high velocity discharge of said propellant fluid through the nozzle for maintaining about said shaft a fluid pressure lower than the fluid pressure within said chamber, whereby said fuze is maintained isolated from the hot propellant fluid.

13. In a high explosive projectile having a combustion chamber containing a jet propellant explosive for generating a propellant fluid, a nozzle at the rear end of said chamber, and a fuze adjacent said chamber for detonating said projectile, the combination of an air operated propeller, a shaft extending through said chamber for connecting said propeller and said fuze for arming said fuze, and a tube surrounding said shaft in spaced relation thereto and opening into said nozzle, whereby the high velocity discharge of propellant fluid through said nozzle produces a low pressure within said tube to draw the hot propellant fluid which enters said tube rearwardly away from said fuze.

14. A high explosive projectile having a combustion chamber containing a jet propellant explosive for generating a propellant fluid, a nozzle at the rear end of said chamber, a fuze adjacent to said chamber for detonating said projectile, and a partition between said fuze and said chamber, a propeller shaft extending from said fuze through said chamber, and a tube surrounding said shaft in spaced relation thereto and extending from said partition into said nozzle, said tube opening rearwardly into said nozzle, whereby the high velocity discharge of propellant fluid through said nozzle produces low pressure within said tube to draw the hot propellant fluid which may enter said tube rearwardly away from said fuze.

15. In a projectile having normally inactive jet propulsion means, mechanism for initiating action of said means comprising an air rotatable propeller, a holder for a propellant igniting charge, said holder being normally retained in an unarmed position and being biased toward its armed position, a striker for firing said igniting charge, said striker being normally retained in a cocked position and being biased toward firing engagement with said igniting charge, a cam movable by said propeller to release said holder for movement to its armed position, and a second cam movable by said propeller for releasing said striker for movement into firing engagement with said igniting charge subsequent to movement of said holder to its armed position.

16. In a high explosive projectile having a fuze, a combustion chamber containing a jet propellant explosive and a nozzle at one end of said chamber, the combination of a plate detachably mounted on the nozzle so as to substantially close said nozzle, a propeller rotatably mounted on said plate, mechanism carried by said plate and operable by rotation of said propeller for igniting said propellant explosive at a predetermined time interval after launching of the projectile, and a propeller shaft for detachable connection to the fuze for arming the fuze of the projectile by action of the propeller, whereby said plate, propeller, mechanism and shaft are adapted to be

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expelled by the gases of combustion on ignition of said propellant explosive.

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REFERENCES CITED

The following references are of record in the file of this patent:

5

Number

1,959,401

257,335

831,496

543,739

10

12**UNITED STATES PATENTS**

Number	Name	Date
1,959,401	Woodberry	May 22, 1934

FOREIGN PATENTS

Number	Country	Date
257,335	Great Britain	Aug. 27, 1926
831,496	France	June 7, 1938
543,739	Great Britain	Mar. 11, 1942