

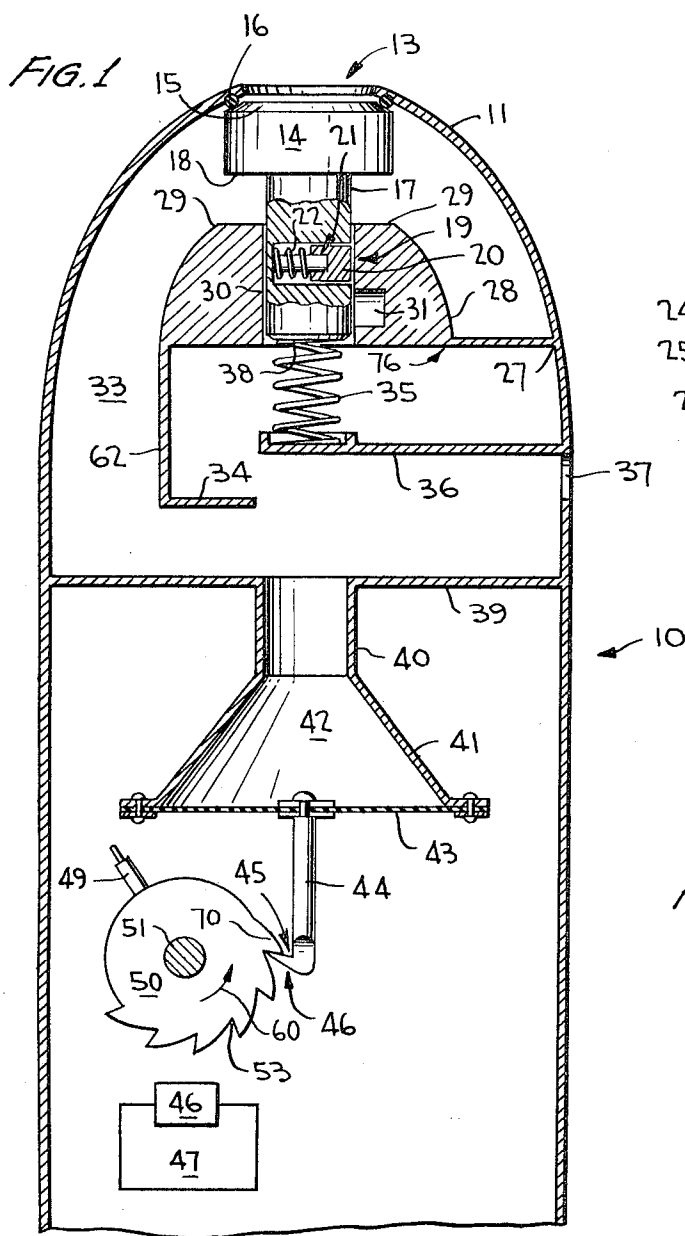
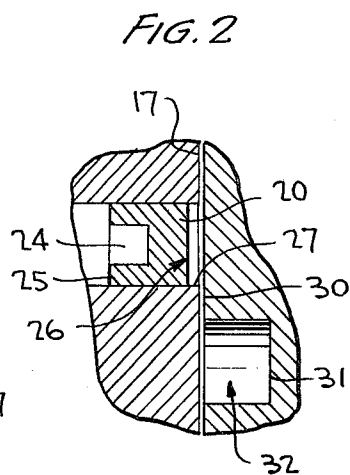
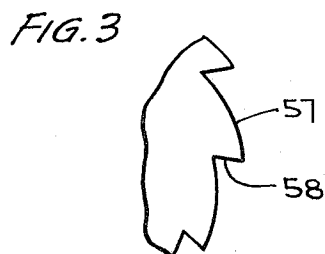
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RESONATOR SYSTEM AS A SAFETY AND ARMING DEVICE

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RESONATOR SYSTEM AS A SAFETY AND ARMING DEVICE

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ABSTRACT OF THE DISCLOSURE

A mechanical projectile arming mechanism which uses ram air as an activating force. The projectile to be armed has an opening in its nose and a pressure sensitive valve is set within. When the projectile reaches a certain velocity and hence the pressure on the valve reaches a certain level, the valve will open and the ram air is transferred to a Helmholtz resonator within the projectile which has a mechanical output. The mechanical output is used to rotate a gear which aligns a firing pin with a detonator to arm the projectile.

This device relates to the arming of ordnance fuzes and in particular to a device which utilizes ram air to arm itself.

Explosive projectiles are intended to damage a designated target in response to a firing influence received by the projectile near or at the designated target. The firing influence may be produced by impact, as in the present invention, by a timing device or by a proximity fuze. Maximum safety for the personnel who launch the projectile require the utilization of a highly effective safety-and-arming device. When the projectile fuze is in the safe, or unarmed, state it can be handled safely and is immune to firing influences. When the fuze is in the armed state it is ready to exploded in response to a firing influence. The safety and arming device must dependably keep the projectile unarmed until it has travelled a safe distance after being launched and must dependably arm the projectile by the time the projectile reaches the region of an intended target.

It is therefore an object of the present invention to provide a projectile with an arming device which will arm the projectile away from the launching means but before the projectile reaches its target.

A further object of the invention is to arm a projectile using the ram air of the projectile as the power supply.

Another object of the invention is to provide means to arm a projectile after it has reached a particular velocity.

Still another object of the invention is to utilize the ram air of a projectile to create mechanical movement in the projectile which will arm the projectile, without the need for an external power source.

Briefly, the present invention utilizes a pressure sensitive valve in the nose of the projectile to be armed. Ram air at a certain velocity (and hence pressure) opens the valve and is transferred to a Helmholtz resonator which has a mechanical output. The mechanical output is used to rotate a gear which aligns a firing pin with a detonator to arm the projectile.

The specific nature of the invention as well as other objects and aspects thereof will clearly appear from the following description and the accompanying drawing in which:

FIG. 1 is a schematic representation of the arming mechanism in accordance with the present invention.

FIG. 2 illustrates a latch mechanism employed in the present invention.

FIG. 3 illustrates a gearing element employed in the present invention.

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In FIG. 1, a projectile 10 has a nose portion 11 in which a circular opening 13 is formed. A valve 14 having a circular cross-section is adapted to seat in circular opening 13 to form an air tight seal between the ambient and the interior of the projectile. An O-ring 16 on the circumference of opening 13 and a taper 15 on the top of valve 14 are one of the conventional ways to seal the interior of the projectile from ambient. However, any efficient sealing means could be used and I do not wish to limit myself to the use of an O-ring. Valve 14 has a stem 17 of circular cross-section which is joined to the center of a valve base 18 by any conventional joining means available to the skilled mechanic. If desired stem 17 can be made integral with valve 14. Stem 17 houses a latch-mechanism 19 which houses a post member 21, which is attached to the walls of stem 17 by any conventional attaching means. A slide 20 has a groove 24 in it (FIG. 2) which receives the end of post 21 not attached to stem 17. A spring 22 surrounds the end of post 21 attached to stem 17 and applies a biasing force against a shoulder 25 of slide 20. Stem 17 has a hole 27 in it through which an end 26 of slide 20 can extend. A guide 76 is attached to projectile 10 at a junction 27 and has a curved section 28, which leads to a flat section 29. A sleeve section 30 is perpendicular to and integral with flat section 29 and surrounds stem 17. The sleeve section 30 has a latch catcher 31, which has an opening 32 (FIG. 2), which receives slide 20 when hole 27 and opening 32 are aligned. A left side 62 of guide 76 forms an air passage 33 between opening 13 and the lower section of projectile 10. Part of left side 62 is a section 34, which is perpendicular to the left side 62 and further serves to define air passage 33. Attached to a base 38 of stem 17 is a spring 35, which is attached to projectile 10 by a platform 36. A bleed 37 is in the sidewall of projectile 10 below the juncture of platform 36 and the sidewall of the projectile and constantly communicates with atmosphere. A support means 39 is attached to the sidewall of projectile 10 and by a funnel 40 and a conical section 41 defines a resonator chamber 42. Attached by conventional means to the bottom of resonator chamber 42 is a diaphragm 43. Resonator chamber 42 acts as a vibrating device in accordance with the principles of a Helmholtz resonator. Briefly, a Helmholtz resonator consists of a defined volume into which gas enters and leaves by a port leading to the defined volume. The pressure of gas in the defined volume changes as it is alternately compressed and expanded by the influx and efflux of gas through the port causing resonance within the chamber. A further detailed discussion of the Helmholtz resonator can be found in chapter 8 of the second edition of "Fundamentals of Acoustics" by Kinsler and Frey (published by John Wiley and Sons, 1962). A drive element 46 is attached by conventional means to diaphragm 43 by a rod 44. A tongue 45 is integral with rod 44 while being perpendicular to the rod. The tongue is of triangular cross-section and has a slight taper 46 on its bottom portion for reasons which will become readily apparent. A gear 50 rotates about a center 51 and over a portion of its circumference has teeth 53. The teeth (FIG. 3) have a curved top portion 57 and a straight bottom portion 58. A firing pin 49 is on the circumference of gear 50, and is approximately opposite to the toothed portion of the gear. A primer 46 is lodged in a detonator 47 below gear 50.

The initial orientation of firing pin 49 and detonator 46 must be considered in determining the number of teeth on gear 50. There must be a predetermined number of teeth to insure that if every tooth contributes to the counter-clockwise movement of the gear the firing pin will be properly aligned with the detonator. If there is an excess number of teeth, the firing pin will rotate past the detona-

tor while if there is an insufficient number of teeth the firing pin will stop short of the detonator.

Spring 35 can be selected to a particular strength so that valve 14 will not open under ram pressure till the projectile reaches a designated velocity.

Before the projectile is launched, gear 50 is positioned so tongue 45 is on top of tooth 70. When the projectile is launched, spring 35 will initially hold valve 14 in a seated position with respect to opening 13. As the velocity of the projectile increases, the ram air pressure against the top of valve 14 will increase tending to unseat valve 14 against the biasing force of spring 35. When the force from the ram air on the top of valve 14 is greater than the biasing force of spring 35, the valve will unseat by stem 17 sliding down sleeve 30. After valve 14 has moved, along with stem 17, in a downward direction a sufficient distance hole 27 in the stem will align with hole 32 of the latchet catcher. Slide 20 will no longer be constrained by the walls of sleeve 30 and under the urging of spring 22, will enter the latchet catcher, locking valve 14 in an unseated position. Ram air will enter the interior of projectile 10 and pass through air passage 33 where part will enter resonator chamber 42. The pressure in the resonator chamber will build up until it reaches a resonant pressure at which time resonance will result causing diaphragm 43 to vibrate vigorously in an up and down direction. As the diaphragm moves down, tongue 45 will also move down. The tongue will slide over the top rounded portion 57 of gear tooth 70. The tooth is not rotated because the rounded portion of the tooth and taper 46 of the tongue do not provide for positive displacement as the rounded portion of the tooth causes the tongue to slide over it. The sliding of the tongue over the gear tooth results in a slight rightward motion of the tongue. After tongue passes the rounded portion of the gear tooth, it will move to the left to about surface 58 since the tongue will no longer be guided to the right by rounded element 57. The diaphragm will now move in an upward direction with the top of tongue 46, catching the flat portion of the gear tooth. This will result in a counterclockwise motion of the gear as indicated by the arrow 60. In designing the pitch of the gear teeth, the amplitude of the diaphragm movement must be taken into account to insure proper displacement of the gear. Gear 50 will continue to be rotated in a counterclockwise direction until the firing pin and the detonator are aligned. At this point, there will be no further rotation of the gear since the gear will have only enough teeth to rotate the gear to align the firing pin and detonator. The projectile will be armed and ready to be detonated upon impact.

It will be apparent that the embodiments shown are only exemplary and that various modifications can be made in construction and arrangement within the scope of the invention as defined in the appended claims.

I claim as my invention:

1. A projectile arming mechanism comprising:

- (a) a projectile having walls defining an interior and a nose portion with an opening therein through which ram air is admitted to said interior,
- (b) valve means moved by the ram air of said projectile to admit said ram air to said interior of said projectile, said valve means biased to seat in said opening and including;

(i) a head and stem portion,

(ii) said head portion seating in said opening, and

(iii) said stem portion being surrounded by a sleeve and housing a latchet device, said sleeve having latchet means to co-operate with stem latchet device to lock said valve means when said valve means is moved by said ram air a certain distance,

(c) fluid resonator means in the interior of said projectile operated by said ram air, said resonator having a resonator chamber including a fluid port and a diaphragm for a base,

(d) means actuated by said resonator means to arm said projectile.

2. A device according to claim 1 wherein the means activated by said resonator means include:

(a) a rotating device,

(b) a firing pin carried by said rotating device, and

(c) a primer located below said rotating device.

3. A device according to claim 2 wherein:

(a) a rod is attached to said diaphragm,

(b) a tongue is extended from said rod,

(c) said rotating device carries a plurality of gear teeth,

(d) said tongue is positioned to move said gear teeth.

4. A device according to claim 3 wherein:

(a) said gear teeth each have a rounded and flat portion, and

(b) said tongue has tapered and flat portion to co-operate with said rounded and flat portion of each of said gear teeth to rotate said gear.

5. A projectile arming mechanism comprising:

(a) a projectile having walls defining an interior,

(b) valve means moved by the ram air of said projectile to admit said ram air to said interior of said projectile,

(c) fluid resonator means in the interior of said projectile operated by said ram air, said resonator having a resonator chamber, and

(d) means actuated by said resonator means to arm said projectile, said means including;

(i) a rotating device,

(ii) a firing pin carried by said rotating device, and

(iii) a primer located below said rotating device.

6. A device according to claim 5 wherein:

(a) a rod is attached to said diaphragm,

(b) a tongue extends from said rod,

(c) said rotating device carries a plurality of gear teeth,

(d) said tongue is positioned to move said gear teeth.

7. A device according to claim 6 wherein:

(a) said gear teeth each have a rounded and flat portion, and

(b) said tongue has tapered and flat portion to co-operate with said rounded and flat portion of each of said gear teeth to rotate said gear.

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