

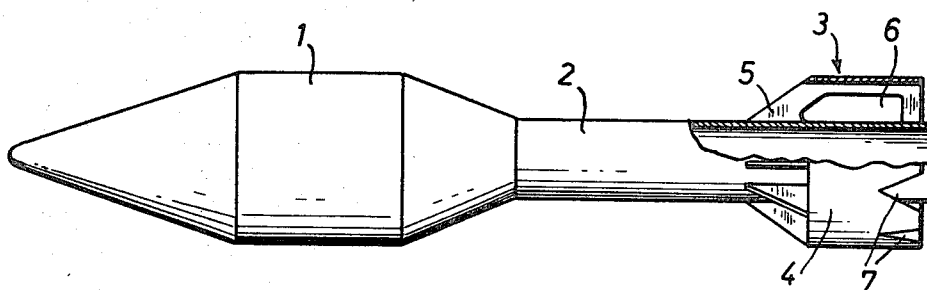
Oct. 6, 1970

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3,532,300

FIN-STABILIZED PROJECTILE HAVING AN IMPROVED ANNULAR FIN ASSEMBLY

Filed March 13, 1968



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3,532,300

FIN-STABILIZED PROJECTILE HAVING AN IMPROVED ANNULAR FIN ASSEMBLY

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Filed Mar. 13, 1968, Ser. No. 712,696

Claims priority, application Germany, Mar. 17, 1967, D 52,546

Int. Cl. F42b 13/24, 15/16

U.S. Cl. 244—3.24

6 Claims

ABSTRACT OF THE DISCLOSURE

This projectile is to be fired from a gun barrel. The projectile includes an annular fin assembly having a guide ring and connecting struts between the guide ring and the projectile body. The outside diameter of the annular fin assembly may lie at any point from inside to outside the caliber of the projectile on which the assembly is constructed.

BACKGROUND OF THE INVENTION

The annular fin assemblies of the type of projectile as described in this application generate great restoring torque thereby damping deflections of the projectile. This restoring torque is generated at even very small angles of incidence. The angle of incidence is that angle between the stationary line of reference in the shape of the annular fin assembly and the direction of flow or movement in the projectile. The restoring torque is the torque occurring on the projectile which restores the projectile to a position of equilibrium when it is turned out of this position through an angle.

On the other hand, however, annular fin assemblies may cause intensified deflections of vibration. These assemblies are affected by the issuing powder gases of the propellant charge in the region of the muzzle on the firing of the weapon. The forces generated by the powder gases act vertically on the annular surface of the assemblies. Disturbances to the flow symmetry of these gases cause a resultant force to arise vertically to the projectile's axis. This vertical resultant force institutes a pendulum motion to the projectile after it leaves the barrel of the weapon in which it has been guided in the initial moments immediately after firing. The extent of the disturbances in the flow symmetry depends mainly on the pressure and temperature of the powder gas. The temperature determines the velocity of the powder gas. Modern smokeless propellants provide a powder gas velocity in the range of about 1200 to 1500 meters per second. This velocity is therefore always greater than the speed of the projectile so that gases flow by and pass beyond the projectile. However, the projectile subsequently overtakes the gases as they quickly lose their velocity. The powder gases thereby come into contact with the annular fin assembly twice in opposed directions. The first contact is of particular importance for projectiles which have a muzzle velocity in the subsonic range to the region of the speed of sound. In such cases, relative speeds between the projectile and the gases reach about 1000 meters per second. At these relative speeds dynamic forces are created along with the prevailing pressure at the muzzle of the weapon to cause heavy stresses. At these high flow velocities it is important to enable the gases to move past the projectile without disturbance and without creating turbulence. The weight of the fin assembly is critical in such a situation. It cannot be made too heavy because of the permissible limitation in the moment of inertia. On the other hand a fin that is too light would be easily damaged at the time of firing.

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SUMMARY OF THE INVENTION

An object of this invention is to produce a projectile having a relatively light annular fin assembly which withstands the forces exerted by the gases upon the firing of the weapon.

Another object of this invention is to provide a projectile having an annular fin assembly comprising a guide ring and connecting struts between the guide ring and projectile body. The outer diameter of the annular fin assembly may lie in a range from inside to outside the caliber of the projectile on which it is mounted.

Another object of this invention is to provide an annular fin assembly having openings provided at points of the guide ring which is subject to particular stresses upon firing.

A still further object of this invention is to provide a projectile having an annular fin assembly with openings provided both in the guide ring and the connecting struts at points which are subject to particular stresses upon firing of the weapon.

Experiments have shown that where an extra-caliber fin assembly lies so far behind the head of an extra-caliber projectile that it is out of the lee of the projectile head, the rear edge of the guide ring is particularly endangered. The expanding powder gases flow over this rear edge at a large angle of incidence. To avoid particularly heavy stress arising on the rear edge of the guide rings, openings are extended from the rear edge of the guide ring to about half the length of the guide ring toward the front of the assembly. Such an opening is sufficient to prevent fin assembly damage which would arise if the guide ring were solid. Such openings may be either wedge shaped or semi-circular in the simplest cases. However any other geometric shape would be within the scope of this invention depending upon the static determination of the fin assembly construction.

Openings may be extended over the entire length of the guide ring in another embodiment of the invention to prevent particularly heavy stress from occurring on the rear edge of the guide ring. In this instance, the openings divide the guide ring along its entire length. The remaining parts of the ring are mounted symmetrically on radial struts which are necessarily a part of extra-caliber projectiles.

The stability of the fin assembly is maintained due to the resistance caused by the oblique flow of gases. This resistance is exerted on the projectile at the sectional areas of the openings. The stability of the fin assembly is thereby maintained despite the reduction in the size of the annular guide ring surface. This effect is supplemented if the opening edges which lie obliquely to the direction of flight are pointed in shape.

Another embodiment in such an extra-caliber projectile provides openings in the radial connecting struts which join the guide ring with the projectile body. Such openings in the radial struts afford the powder gases opportunity to equalize the pressure differences within the flow and thereby decrease vertical jump error.

A uniform caliber annular fin assembly in a uniform caliber projectile is particularly endangered by the static pressure of the propellant gases. Openings in the fin assembly extending from the transition between the assembly and the projectile body and extending substantially one-half the length of the guide ring will efficiently overcome the effects of this pressure on the fin assembly. The struts remaining between the openings connect the guide ring with the projectile body. In this type of projectile, the rear edge of the guide ring is not exposed to danger because the propellant gases come into contact with the ring at an angle of incidence approaching zero.

The openings in the fin assembly allow the pressure of the propellant gases to be released. In flight, the openings allow the air flow to be directed into the suction space behind the projectile.

The suction behind the projectile causes partial resistance to the flow of the projectile. Another feature of the invention, this partial resistance may be reduced to a minimum if the end of the projectile is streamlined. In addition, a streamlined fairing over the struts formed by the openings in the guide ring eliminates the last remaining suction behind the projectile.

A further feature of the invention includes two specific types of strut fairing. The first type of construction may be formed symmetrically to the projectile axis. The second type is a propeller shape and mounted at an angle of incidence to the projectile axis. The latter construction is particularly advantageous in rifled projectiles because it offers no resistance to the rifling movement. That is, its windmill effect generates and maintains a rifled motion.

A final feature of the invention involves the shape of the guide ring itself. An air foil shaped cross section avoids extensions of the channel width in the annular throughflow of the passing gases.

BRIEF DESCRIPTION OF DRAWING

An embodiment of the present invention will now be described by way of example with reference to the sole drawing which is a side view of an extra-caliber projectile showing an annular fin assembly partially in section.

DESCRIPTION OF SPECIFIC EMBODIMENT

The extra-caliber projectile shown in the drawing includes a projectile body 1 having a strut 2 mounted on the rear end of the said body 1. The annular fin assembly generally designated 3 is mounted at the rear end of the strut 2. The diameter of the assembly 3 is greater than the projectile caliber. The annular fin assembly 3 comprises a plurality of radial struts 5 connected to the strut 2 and a guide ring 4 mounted on the struts 5. The guide ring 4 includes wedge shaped openings 7 which extend from the rear edge of the guide ring 4 to a position where their points are substantially half way along the guide ring 4. These openings 7 are located at the points at which there is the greatest stress on firing of projectile. The openings 7 may be of a geometric shape such as semi-circular. The particular geometric shape is a function of the particular static characteristics surrounding the firing of the projectile and for the simplification of the static determination of the construction of the fin assembly. Openings 6 are provided in the struts 5 to enable the pressure differences in the gases to be equalized in the guide ring 4.

Having thus set forth and disclosed the nature of this invention, what is claimed is:

1. A fin-stabilized projectile comprising:

(a) a fin assembly mounted at the rear end of a projectile body,

(b) said fin assembly including strut members fixedly mounted on the projectile body and radially connecting an annular guide ring thereto,

(c) said annular guide ring includes a continuous, closed forward portion and a discontinuous rear portion having openings extending from a rear edge thereof in a direction forwardly to said closed forward portion.

2. A projectile as defined in claim 1 wherein said strut members include openings intermediate the front and rear ends of the fin assembly to provide means for equalizing pressure differences of gases in the annular guide ring.

3. A projectile as defined in claim 1 of the extra-caliber type wherein said guide ring openings extend from the rear edge thereof to a position substantially half way along the guide ring to said forward closed portion.

4. A projectile as defined in claim 1 wherein said guide ring openings lie transversely to the flight path and have a pointed shape converging in the direction of the flight path.

5. A projectile as defined in claim 4 wherein said strut members include openings intermediate the front and rear ends of the fin assembly to provide means for equalizing pressure differences of gases in the annular guide ring.

6. A projectile as defined in claim 5 of the extra-caliber type wherein said guide ring openings have a triangular shape and extend from the rear edge thereof to a position substantially half way along the guide ring to said forward closed portion.

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U.S. Cl. X.R.

102—49.1