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FIN STABILIZED PROJECTILE

Filed March 4, 1968

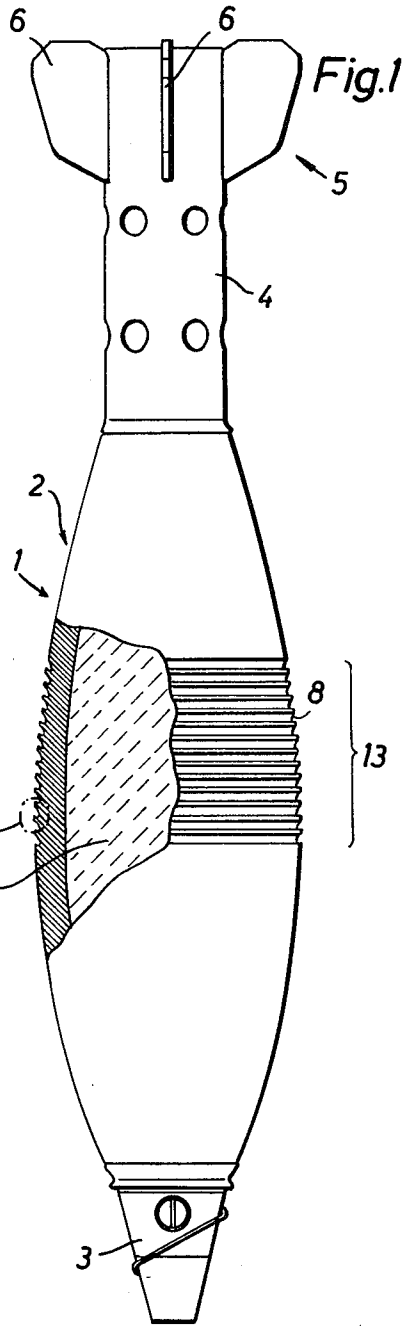

Fig.1

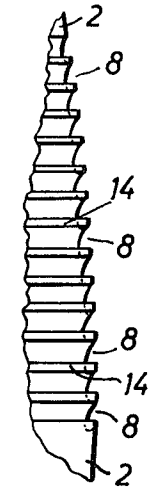

Fig.2

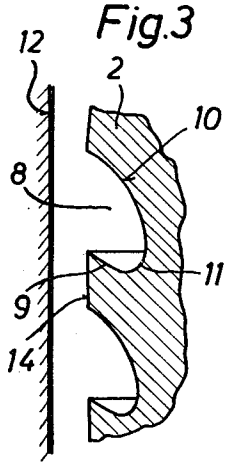

Fig.3

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FIN STABILIZED PROJECTILE

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U.S. Cl. 102—49.1 9 Claims

ABSTRACT OF THE DISCLOSURE

This non-gyrating fin stabilized projectile has an elliptical shaped body and a tail unit rim. The projectile includes circumferential grooves located in the region of the largest diameter of the body.

BACKGROUND OF THE INVENTION

Fin stabilized projectiles of the type of this invention generally have an elliptical shaped body in longitudinal cross section and a tail unit rim comprising radial fins. Shallow circumferential grooves are generally provided in the region of the largest diameter of the projectile body. The number of grooves is usually limited to a small number. The maximum diameter of such a projectile is usually slightly less than the inner diameter of the barrel from which the projectile is to be fired.

More specifically, when a projectile of this type is adapted for firing from a mortar barrel, the barrel is more or less inclined. When such a projectile is loaded into a mortar barrel for firing, the inclined nature of the barrel causes an uneven air gap to result between the surface of the projectile and the barrel at the location of the maximum diameter of the projectile. That is, the projectile rests on the lower part of the inner wall of the barrel thereby resulting in a slight increase in the air gap at the upper part of the inner wall. As the projectile moves out of the barrel upon firing, gases stream into this air gap and reduce the pressure at this point. The gases at the lower part of the inner wall are partly trapped below the projectile. When the reduction of pressure takes place in the air gap above the projectile the trapped gases below the projectile are subjected to an increase of pressure.

The tail unit guides the projectile through the smooth inner barrel upon firing. The uneven distribution of gas pressure within the barrel as described above causes the projectile to be knocked to and fro as a function of the position of the center of gravity of the projectile with respect to its maximum diameter. When the tail unit is a short one, it will be the first part to knock against the upper part of the inner wall. When the tail unit is very long, the region of the maximum diameter of the projectile will be the first part to knock against the upper part of the inner wall. In both cases the projectile generally knocks three times against the inner wall when passing through the smooth inner barrel. This knocking movement takes place both in a vertical direction and in a cross sectional direction. Such a knocking movement of the projectile as it passes through the barrel will clearly adversely affect the trajectory of the projectile. The banking of the projectile as it leaves the barrel results in a slight deviation from the theoretical trajectory. This banking caused by the knocking movement will clearly affect the trajectory in either a vertical or lateral direction or as a result of a combination in both directions. In light weapons, the problem of such a knocking movement can clearly result in a movement of the gun. Therefore in such a case, a flying projectile is subject to both interior and exterior ballistic influences. Such an adverse

knocking movement also affects the type material used in the construction of the tail unit. This material must be relatively strong so that it can withstand the knocking action without being undesirably deformed.

SUMMARY OF THE INVENTION

It is the object of this invention to provide a fin stabilized projectile which substantially eliminates the knocking action affecting such a projectile as it passes through a barrel after firing. Another object of the invention is to provide a projectile having grooves which are specially constructed to trap gases present in the gap between the projectile and the barrel from which the projectile is being fired.

It is still a further object of this invention to provide a projectile including grooves which have an undercut pocket. Such an undercut pocket produces an eddy motion of the gases thereby substantially preventing an initial rapid passage of the following gases to the front of the barrel along the upper surface of the projectile. Such an eddy motion reduces the local velocity of the gases along the upper surface of the projectile in the gap between the projectile and the barrel. The reduced velocity results in an increased pressure of the gas surrounding the projectile. Therefore, the gases surrounding the lower half of the projectile have a higher pressure than those in the space or gap of the upper half of the projectile and barrel combination. The balancing of the pressure within the barrel in this manner causes the projectile to be held suspended near the theoretical axis position of the barrel from which it is being fired. Such a positioning of the projectile substantially eliminates the knocking action as it passes through the barrel. Another object is to provide the projectile having grooves which are undercut in the direction of the nose located at the maximum diameter of the projectile body. This achieves a more settled passage of the projectile through the smooth barrel and thereby improves both ballistic properties and range of the projectile.

The undercut annular groove includes a front surface sloping inward at a pointed angle, a reversing arc surface which is located substantially inside the undercut and adjoining concave arc portion. The undercut is in the direction toward the nose of the body of the projectile. This undercut construction effectively traps the gases streaming through the gap between the projectile and the barrel. In this manner, the flow velocity around the projectile is substantially stabilized and a smooth passage of the projectile through the barrel results.

It is advantageous to have a larger number of annular grooves located at regular intervals on the projectile than were used heretofore. The annular grooves should extend from the region of the maximum diameter towards the tail of the projectile. With this arrangement, the gases within the barrrel are affected before reaching the region of the maximum diameter of the projectile. The annular grooves may extend to approximately the last half of the rear part of the projectile.

The annular grooves may also have different depths along the length of the projectile. The annular grooves in front of the region of the maximum diameter are constructed to be flatter than those located in the region behind the maximum diameter of the projectile.

BRIEF DESCRIPTION OF DRAWINGS

The invention is explained in the following with reference to the embodiment shown by way of example in the accompanying drawings which include:

FIG. 1 is a longitudinal view of a fin stabilized projectile constructed in accordance with the invention shown partly in section.

FIG. 2 is an enlarged sectional view of annular grooves as they are arranged on the projectile in accordance with this invention.

FIG. 3 is an enlarged view of the section I indicated on FIG. 1 of the drawings. This section I is shown in relation to the inner wall of the barrel from which the projectile is to be fired.

DESCRIPTION OF SPECIFIC EMBODIMENT

The fin stabilized projectile generally designated **1** comprises a body **2** which carries an igniting device **3** on its front end. A tail unit **5** includes fins **6** and a tail unit tube **4** which is screwed on the body **2** at the rear end. An explosive charge **7** is shown inside the body **2** of the projectile **1**. A ground cartridge and an ignition cartridge, neither of which are shown, are located inside the tail unit tube **4**. A number of annular grooves **8** are located on the body **2** of the projectile **1** in the region of the largest body diameter.

As shown more clearly in FIGS. 2 and 3, the annular grooves **8** are undercut in a direction toward the nose of the projectile. Each annular groove **8** comprises a front surface **9** sloping inwardly at a pointed angle with the outer surface of the body **2**, a concave arc portion **10** and a reversing arc portion **11** which connects the front surface **9** to the concave arc portion **10**. This reversing arc portion **11** is located substantially inside the space of the annular groove **8** formed by the undercut front surface **9**. The distance between the barrel wall **12** and the projectile **2** at its maximum diameter may be relatively large. The special construction of the annular grooves **8** substantially prevents the knocking action of the projectile **2** inside the barrel wall **12**. Therefore, it is unnecessary to decrease the knocking action of the projectile **2** in the barrel wall **12** by reducing the amount of play between the projectile **2** and the wall **12**. The distance between the barrel wall **12** and the projectile **2** of the instant invention is therefore effectively slightly larger than encountered in the use of conventional types of fin stabilized projectiles. Gases inside the barrel are essentially trapped and converted into local eddying currents by the undercut annular grooves **8**. These eddying currents extend as far as the barrel wall **12** and substantially prevent the passage of following gases between the barrel wall **12** and the projectile **2** so that a higher pressure than heretofore obtained is built up behind the projectile **1**. The gases are substantially prevented from passing more easily along the upper surface of the projectile **2** even though a larger gap exists between the projectile and the barrel wall **12** at that point than on the lower surface of the projectile **1** as it is inclined against the barrel wall **12** before firing. An effective number of undercut annular grooves **8** is provided at regular intervals to obtain the desired results. The region **13** including the annular grooves **8** may extend from the maximum diameter of the body **2** of the projectile **1** to a point located relatively far towards the tail unit **5**. The specific embodiment has fourteen (14) annular grooves provided relatively close to each other at regular intervals along the surface of the body **2**. The groove region **13** extends to approximately one-half of the rear portion of the projectile body **2**. This achieves a massive effect on the gases which are inclined to pass through the gap between the projectile **1** and the barrel wall **12**. A larger portion of the annular grooves **8** should be situated on the projectile body **2** towards the tail unit **5** behind the location of the maximum diameter of the body **2**.

The annular grooves **8** are cut deeper than those grooves provided heretofore on similar projectiles. The depth of the annular grooves **8** may be three to four times the size of the gap between the body **2** and the barrel wall **12**. The annular grooves **8** may have different depths. The width of the groove opening may be one point eight to two times the depth. The non-recessed distance **14** located between the annular grooves **8** may be approximately equal to the depth of the grooves.

While the fin stabilized projectile has been shown and described in detail, it is obvious that this invention is not to be considered as being limited to the exact form disclosed, and that changes in detail and construction may be made therein within the scope and without departing from the spirit of this invention.

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

1. A non-gyrating fin stabilized projectile comprising
(a) an elliptical shaped body having a maximum diameter, a nose and a rear portion,
(b) a tail unit rim including radial fins, and
(c) means for trapping firing gases and converting the gases into local eddying currents to substantially prevent knocking action of the projectile within a barrel of a firearm, said trapping and converting means includes annular grooves located on said body in the region of and including the maximum diameter,
(d) said grooves being undercut and having a front surface sloping inwardly at a pointed angle with respect to the surface of said body and in a direction toward the nose of the body,
(e) said grooves forming an entirely free space adjacent the surface thereof.

2. A projectile as defined in claim **1** wherein the said annular grooves are located at regular intervals along the surface of the body, and
the said region of the annular grooves extends from the maximum diameter of the projectile body in a direction toward the rear portion.

3. A projectile as defined in claim **2** wherein the said region of the annular grooves extends to approximately ½ of the rear portion of said projectile body.

4. A projectile as defined in claim **1** wherein the annular grooves have different depths.

5. A projectile as defined in claim **1** wherein
said grooves include a concave arcuate surface portion.

6. A projectile as defined in claim **5** wherein
said grooves include a reversing arc surface portion adjacent said sloping front surface.

7. A projectile as defined in claim **6** wherein the reversing arc surface portion is located substantially inside the undercut.

8. A projectile as defined in claim **6** wherein the said annular grooves are located at regular intervals along the surface of the body, and
the said region of the annular grooves extends from the maximum diameter of the projectile body in a direction toward the rear portion.

9. A projectile as defined in claim **8** wherein the said region of the annular grooves extends to approximately ½ of the rear portion of said projectile body.

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