

SMALL CALIBER PROJECTILE AND METHOD FOR MANUFACTURING THE PROJECTILE

Field of the Invention

5

The present invent relates to small caliber projectiles. In particular, this invention relates to small caliber projectiles having core materials to enable penetration of light armor and method for manufacturing such projectiles.

10

Background of the Invention

Projectiles launched from weapons such as rifles or guns are known. In the art, a projectile with a diameter of less than half an inch (12.7 millimeters) is classified as small caliber. Effectiveness of a projectile depends on material qualities such as core or jacket hardness. Other than material qualities, the structure of a projectile also contributes to the projectile's effectiveness.

20

US Patent 4,619,203 Habbe, assigned to the Olin Corporation, describes a case hardened steel nosed lead projectile that is utilized to help reduce projectile fragmentation at impact. In this projectile, a steel nose is positioned adjacent to a lead body. Subsequent improvements made to the projectile include US Patent 5,009,166 Bilsbury et al and US Patent 6,085,661 Halverson et al. These two latter US patents describe different projectiles that are structurally designed and formed with materials having specific hardness ranges to achieve desired penetrative and impact characteristics.

25

However, performance of the projectiles described in the above US patents in terms of an effective projectile range can be further improved. The effective projectile range depends on stability of a projectile when launched from a weapon such as, for example, a rifle. For stability, such a rifle typically has a barrel with one or more internal grooves to form what is known as riflings. A rifling spirals along the longitudinal axis of a barrel from one end of the barrel to the other. The riflings

30

engage a projectile that is travelling along the barrel to thereby rotate the projectile. Thus rotated, the projectile spins axially while travelling in a trajectory towards a target.

5 A rifling twist is the parameter that is often used to characterize a rifle barrel. The rifling twist indicates the number of turns of a rifling for a given length of the rifle barrel. Hence, a projectile rotates more with more turns for a given length of the rifle barrel with a higher rifling twist. However, too many turns or too few turns can adversely affect the stability of the projectile. This is because the stability of a
10 projectile also depends on other factors such as, for example, the structure and mass of the projectile. Therefore, the rifling twist has to be optimized depending on such other factors.

Experiments carried out by the applicant have shown that the effective
15 projectile ranges and armor piercing capabilities of existing projectiles can be further improved. For example, the projectile of US Patent 4,619,203 Habbe and other similarly structured projectiles is optimized for a rifling twist of one turn in 229mm (9 inches). However, this projectile is not stable when used in rifles having rifle barrels with a rifling twist of one turn in 305mm (12 inches). Consequently, the rifles
20 barrels of such rifles have to be modified to attain a desired stability that is comparable to a rifling twist of one turn in 178mm or one turn in 229mm. Alternatively, users of such rifles have to accept a lower effective projectile range.

Modifying rifle barrels is expensive. Furthermore, accepting a lower effective
25 projectile range is not desirable for obvious reasons. Therefore, what is clearly needed is a small caliber projectile for use with existing rifles that have varying rifling twists without having to modify such rifles. The small caliber projectile should at least have the same armor piercing capabilities as that of existing
projectiles.

Brief Summary of the Invention

The present invention seeks to provide a small caliber projectile and a method for manufacturing such a small caliber penetrator projectile.

5 Accordingly, in one aspect, the present invention provides a small caliber projectile comprising:

 at least one core section, the at least one core section being symmetrical about a longitudinal axis of the projectile;

 and

10 an outer section, the outer section being substantially concentric relative to the at least one core section over at least one length of the projectile along the longitudinal axis.

 In another aspect, the present invention provides a method for manufacturing
15 a small caliber projectile, the method comprising the steps of:

 providing a preformed jacket having a jacket cavity;

 placing a preformed lead-based slug into the jacket cavity;

 inserting at least one preformed steel pin into the preformed lead-based slug, the at least one preformed steel pin having a predetermined pin length
20 and a predetermined pin diameter;

 and

 forming a base of the jacket to thereby retain the preformed lead-based slug and the at least one preformed steel pin within the preformed jacket.

25 **Brief Description of the Drawings**

 A preferred embodiment of the present invention is more fully described, by way of example, with reference to the drawings of which:

 FIG. 1 is an axial cross section of a projectile in accordance with a preferred
30 embodiment of the present invention;

FIG. 2 is a lateral cross section of the projectile of FIG. 1 along line 2-2';

FIG. 3 is a lateral cross section of the projectile of FIG. 1 along line 3-3';

5 and

FIG. 4 is a flowchart of a method for manufacturing the projectile of FIG. 1.

Detailed Description of the Drawings

10 A small caliber projectile and a method for manufacturing the small caliber projectile in accordance with a preferred embodiment of the invention are described. In the following description, details are provided to describe the preferred embodiments. It shall be apparent to one skilled in the art, however, that the invention may be practiced without such details. Some of these details may not be
15 described at length so as not to obscure the invention.

There are many advantages of the preferred embodiment of the invention. One advantage of the preferred embodiment is that penetration of light armor is improved with the small caliber projectile compared with existing small caliber
20 projectiles.

Another advantage of the preferred embodiment of the invention is that the structure of the small caliber projectile enables better stability compared with existing small caliber projectiles. Thus, the effective projectile range of the small
25 caliber projectile is increased from the effective projectile ranges of existing small caliber projectiles.

A further advantage of the preferred embodiment of the invention is that the small caliber projectile can be used for existing rifles that have barrels with varying
30 rifling parameters. These rifling parameters may vary from one turn in 178 millimeters (7 inches) to 305 millimeters (12 inches). Hence, modifications are not

needed to adapt the barrels of such existing rifles to accommodate the small caliber projectile to achieve desired effective projectile ranges.

Referring now to FIG. 1, an axial cross section of a projectile 10 in accordance with a preferred embodiment of the present invention is illustrated. The projectile 10 comprises a core section 12, an outer section 14 and a jacket 16. A longitudinal axis 18 of the projectile 10 is indicated for reference purposes.

The disposition of the core section 12 relative to the outer section 14 and the jacket is illustrated in FIG. 2 and FIG. 3 with, respectively, lateral cross sections along line 2-2' and line 3-3' of the projectile 10. As illustrated in these lateral cross-sections, the core section 12 is symmetrical about the longitudinal axis 18.

The core section 12 comprises an ogival front portion 20 and a body 22. The body 22 is substantially cylindrical. In this preferred embodiment of the projectile 10, the core section 12 is made of steel that is preferably hardened to provide good penetrative characteristics. One example of such hardened steel is medium carbon steel that has an optimum hardness range between HV 550 to 635. The core section 12 is positioned within the outer section 14 to achieve a balanced center of mass for stability.

The outer section 14 is substantially concentric relative to the core section 12 over a length 24 of the projectile 10 along the longitudinal axis 18. The outer section is also symmetrical about the longitudinal axis 18. In this preferred embodiment of the projectile 10, the outer section 14 is made of a lead-based alloy. The lead-based alloy has about 1.5% of antimony.

The jacket 16 retains the core section 12 and the outer section 14. As seen in the FIGs. 1 to 3, the outer section 14 is disposed between the jacket 16 and the core section 12. A base portion 26 of the outer section 14 is interposed between a base 28 of the jacket 16 and the body 22. The jacket 16 is made with a gilded metal and

provides the projectile 10 with an ogival front portion 30 and a boattail rear portion 32.

5 It is to be noted that the core section 12 can be moved along the longitudinal axis 18 closer to or further from the ogival front portion 30 to optimize the center of mass of the projectile 10. When attached at a crimping section 34 to a primed cartridge case (not shown) that has a propellant charge (not shown), the weight of the projectile 10 is optimized to be carried to an effective range of 1 kilometer by the propellant charge.

10

Test results of the projectile 10 has shown a stable trajectory within acceptable limits when used with rifles having rifle barrels of 1 turn in 305mm (12 inches) rifling twist, 1 turn in 229mm (9 inches) and 1 turn in 178mm (7 inches) rifling twists. In addition, these test results have shown that the core section 12 can
15 penetrate 3.5mm NATO steel plate having an approximate Brinell hardness (HRB) of 55 to 70 placed at a minimum distance of 549 meters (600 yards).

A method 40 for making the projectile 10 is illustrated with the flowchart of FIG. 4. The method starts at step 41 and proceeds to step 42 at which a preformed
20 jacket having a jacket cavity is provided. The preformed jacket corresponds to the jacket 16. Thereafter, the method 40 proceeds to step 43 at which a preformed lead-based slug, corresponding to the outer section 14, is placed into the jacket cavity.

The method continues to step 44 at which at least one preformed steel pin is
25 inserted into the lead-based slug. The at least one preformed steel pin has a predetermined pin length and a predetermined pin diameter and corresponds to the core section 12. This inserting step 44 comprises indenting the lead-based slug to form a core cavity for inserting the at least one preformed steel pin. The core cavity is indented to set a predetermined cavity depth and a predetermined cavity diameter.

30

The projectile 10 is completed with a forming step 45 that turnovers the base 28 of the jacket 16 to thereby retain the core section 12 and the outer section 14 within the jacket 16. The forming step 45 forms the boattail rear portion 32 of the projectile 10.

5

It is to be noted that the indenting of the core cavity includes aligning a longitudinal axis of the core cavity with the longitudinal axis 18 of the projectile 10. In addition, the predetermined cavity depth is slightly less than the predetermined pin length, and the predetermined cavity diameter is slightly larger than the
10 predetermined pin diameter. For example, using the preferred embodiment for a 5.56mm projectile, the predetermined cavity depth is 10mm and the predetermined pin length is 15mm. In such a 5.56mm projectile, the predetermined cavity diameter is $3.04\text{mm} \pm 0.01\text{mm}$ and the predetermined pin diameter is $3.00\text{mm} \pm 0.02\text{mm}$. These dimensions enable a clearance fit between the core section 12 and the outer
15 section 14.

The present invention therefore provides a small caliber projectile 10 and a method 40 for manufacturing the projectile 10 in accordance with the preferred embodiment of the invention. The projectile 10 can be used with existing rifles that
20 have varying rifling twists without having to modify such rifles. Furthermore, the projectile 10 has substantially the same armor piercing capabilities as that of existing projectiles.

Claims

- 1) A small caliber projectile comprising:
 - at least one core section, said at least one core section being symmetrical about a longitudinal axis of said projectile;
 - an outer section, said outer section being substantially concentric relative to said at least one core section over at least one length of said projectile along said longitudinal axis;
 - and
 - a jacket for retaining said core section and said outer section.
- 2) The small caliber projectile as claimed in Claim 1, wherein said at least one core section comprises an ogival front portion.
- 3) The small caliber projectile as claimed in Claim 1, wherein said at least one core section comprises a substantially cylindrical body.
- 4) The small caliber projectile as claimed in Claim 1, wherein said at least one core section comprises steel.
- 5) The small caliber projectile as claimed in Claim 1, wherein said outer section is symmetrical about said longitudinal axis.
- 6) The small caliber projectile as claimed in Claim 1, wherein said outer section comprises a lead-based alloy.
- 7) The small caliber projectile as claimed in Claim 6, wherein said lead-based alloy comprises antimony.
- 8) The small caliber projectile as claimed in Claim 1, wherein said outer section is disposed between said jacket and said core section.

- 9) The small caliber projectile as claimed in Claim 8, wherein said outer section comprises a base portion between said core section and a base of said jacket.
- 10) The small caliber projectile as claimed in Claim 8, wherein said jacket comprises an ogival front portion and a boattail rear portion.
- 11) A method for manufacturing a small caliber projectile, said method comprising the steps of:
 - providing a preformed jacket having a jacket cavity;
 - placing a preformed lead-based slug into said jacket cavity;
 - inserting at least one preformed steel pin into said preformed lead-based slug, said at least one preformed steel pin having a predetermined pin length and a predetermined pin diameter;
 - and
 - forming a base of said jacket to thereby retain said preformed lead-based slug and said at least one preformed steel pin within said preformed jacket.
- 12) The method as claimed in Claim 11, wherein said inserting step comprises the step of indenting said preformed lead-based slug to form a core cavity for said at least one preformed steel pin.
- 13) The method as claimed in Claim 12, wherein said indenting step comprises the step of aligning a longitudinal axis of said core cavity with a longitudinal axis of said small caliber projectile.
- 14) The method as claimed in Claim 12, wherein said indenting step further comprises the step of setting a predetermined cavity depth and a predetermined cavity diameter for said core cavity.