

(39)

The invention relates to a projectile to be fired from a firearm having a rifled barrel and comprising on the one hand a rear body made from a material suitable for cooperating with the rifling of the barrel and on the other hand a central core made from a harder material than that from which the rear body is formed, means being provided for joining the rear body and central core to one another.

A projectile of this type for firing from a firearm with a rifled barrel is known from patent GB-A-6785, which describes a projectile which, as stated in the preamble of claim 1, comprises a rear body formed from a material able to cooperate with the rifling of the barrel and a central core made from a material different from that of the rear body. Means are provided for joining said rear body to the central core. To this end, the rear body envelops the central core and is connected to a front envelope.

The problem which occurs in projectiles of this composite type is the construction of the joining means between rear body and central core, said joining means having to be such that, from the mechanical standpoint, the projectile can behave in the manner of a monoblock or one-piece projectile when fired by a firearm having a rifled barrel.

The joining means proposed in patent GB-A-6785 of A.D. 1911 are not satisfactory, because during the rotation of the rear body by the barrel rifling, sliding takes place between the rear body enveloping the central core and the latter. Thus, the rear body tends to become disengaged from the central core due to centrifugal

forces and the central core is consequently imperfectly rotated. The projectile according to GB-A-6 785 cannot behave like a one-piece projectile.

Another problem which occurs in projectiles of the composite type is the arrangement of the rear body, which has to cooperate with the rifled barrel of the firearm.

In this connection, a one-piece projectile is known of the type described in patent FR-A-393 079, which is formed from a soft material and whereof the cylindrical part, which cooperates with the firearm barrel, has cords, separated by grooves, said cords being pressed into the barrel rifling. However, a one-piece projectile of this type is necessarily made from a soft material and consequently has no perforating property.

The invention relates to a perforating projectile having to satisfy the two following requirements:
must have a high rotary speed, which requires good rifling in the barrel, i.e. the use of a material for its part which cooperates with the barrel which must be soft or maleable; have a front part, i.e. that which reaches the target, which is necessarily made from a hard material, as opposed to the material from which its rear part is formed and which cooperates with the barrel.

Thus, a projectile with a high rotary speed, but which is made from a soft material (projectile according to patent FR-A-393 079 for example) cannot have a perforating property and a projectile

37

having a central core only having a low rotary speed (projectile according to patent GB-A-6 785 for example) can also not have a perforating property.

The objective of the invention has been achieved by means of a perforating projectile for a firearm with a rifled barrel having a rear body made from a material able to cooperate with the rifling of the barrel, a central core made from a harder material than that from which the rear body is made and joining means between said rear body and said central core, characterized in that the joining means have a conical coupling arranged, particularly with regards to its conicity, so as to ensure a self-locking effect between the rear body and the central core, and an abutment surface between the rear body and the central core, and in that said rear body has at least one bulge cooperating with the grooves of the firearm barrel and at least one indentation, said bulge and said indentation interconnecting progressively so as to define a profiled shape.

As a result of the self-locking effect of the conical coupling and the bearing effect of the abutment surface, during firing, the projectile behaves like a one-piece projectile. This is particularly advantageous for a projectile fired by a firearm with a rifled barrel because, at the incident of the rotation when the rear body engages in the rifling, the angular acceleration is transmitted, without any loss by sliding, between the rear body and the central core.

It is therefore possible to form said projectile from two parts,



which permits a choice of the material from which the central core is made (soft, semi-hard or hard material) and a choice of the material from which the rear body is made (material adapted to cooperate with the firearm barrel under the best possible conditions), whilst still retaining the advantages of a one-piece projectile from the ballistic standpoint.

In particular, it is possible to produce a projectile having a high penetration force, as a result of its ballistic characteristics, and high expansion effects, due to the material choice and shape possibilities offered by its two-part construction.

Moreover, the external construction of the rear body of the projectile makes it possible, as a result of the shape of its bulge, to obtain on the one hand an increase in the pressure following combustion of the powder charge due to a higher effectiveness of the crimping of the case to the projectile and also a better sealing between the projectile and the inner wall of the firearm chamber and on the other hand a progressive rifling engagement when the projectile reaches the rifled wall of the firearm barrel, because said rifling engagement takes place with a limited axial deceleration.

With regards to the crimping of the case to the projectile, this can take place on the rear body either level with the bulge, or level with the indentation, efficiency being improved in both cases.

The aerodynamic characteristics of the projectile are improved

39

compared with a conventional projectile due to the fact that the marking of the rear body by the barrel affects solely the bulge of said body and produces a significantly lower parasitic drag than that found on a conventional projectile.

Thus, the projectile according to the invention has precision and power characteristics significantly better than those in the case of a conventional projectile and particularly with respect to the initial velocity and the impact velocity.

Moreover, the life of the firearm barrel firing projectiles according to the invention is increased, particularly when it has a rifled barrel as a result of the progressivity of the rifling engagement phenomenon, which is due to the external construction of the projectile rear body.

According to an advantageous development of the invention, the conical finger is made on the central core and the conical recess in the rear body.

From the constructional standpoint, the conical coupling advantageously has an axial extension at least equal to its mean diameter and which is preferably more than twice its mean diameter. The angle of said conical coupling is preferably between 3 and 25°. It is also possible to use a conical coupling having two different conicities.

According to an advantageous variant of the invention, the bulge and the indentation made on the rear body of the projectile also

define a profiled shape with its central core.

According to another advantageous variant of the invention, the bulge and indentation made on the rear body of the projectile define a profiled shape with the front body coupled to a front conical portion of the central core.

Advantageously the rear body has a succession of bulges separated by indentations. The radii of curvature of the bulges and indentations can be equal to one another.

The conical recess made in the rear body can issue into the rear face thereof, the conical finger of the central body then extending up to said rear face. The conical finger then has a conical bore for fixing a shoulder having a conical pin, whose shape is complimentary to that of the conical bore.

The central core can be conical and is terminated by a rounded point or a profiled shape terminated by a sharp point.

Advantageously, the central core can have a conical front portion with a shape symmetrical to the conical finger, said conical front portion then being covered by a front body in which is provided a conical recess which can be coupled to said conical front portion, said front body having a shape substantially symmetrical to that of the rear body.

The invention will be better understood from the following

(4)

description relative to the drawings relating to non-limitative embodiments of the invention.

Fig. 1 shows an axial section of a projectile according to a first embodiment of the invention.

Figs. 1_a and 1_b respectively show in section the two constituent parts of the projectile of fig. 1.

Fig. 2 shows an axial section of a projectile according to a second embodiment of the invention.

Figs. 2_a, 2_b, 2_c respectively show in section the three constituent parts of the projectile of fig. 2.

Fig. 3 shows an axial section of a projectile according to a third embodiment of the invention.

Figs. 3_a, 3_b, 3_c respectively show in section the three constituent parts of the projectile of fig. 3.

Fig. 4 shows an axial section of a projectile according to a fourth embodiment of the invention.

Figs. 4_a and 4_b respectively show in section the two constituent parts of the projectile of fig. 4.

As shown in the drawings, the projectile has a central core 1, a rear body 2, whose diameter determines the calibre of the projectile and joining means between said central core 1 and said rear body 2. These joining means comprise on the one hand a conical coupling 6, 5 constituted by a conical recess 6 and a conical finger 5 having complimentary shapes and on the other hand an axial abutment surface 15.

(12)

The rear body 2 has at least one bulge $A_2, A_4, A_6, D_3, B_2, B_4$ cooperating with the firearm barrel and at least one indentation A_3, A_5, B_{14}, B_3 , said bulge and said indentation being interconnected progressively so as to define a profiled shape.

According to the embodiments respectively illustrated in figs. 1, $1_a, 1_b$, figs. 2, $2_a, 2_b, 2_c$, figs. 3, $3_a, 3_b, 3_c$ and figs. 4, $4_a, 4_b$, the conical finger 5 is provided on the central core 1 and the conical recess 6 is made in the rear body 2.

According to the embodiments illustrated in figs. 1, $1_a, 1_b$, figs. 2, $2_a, 2_b$, figs. 4, $4_a, 4_b$, bulge A_2, A_4, A_6, B_2, B_4 and indentations A_3, A_5, B_3 made on the rear body 2 also define a profiled shape with central core 1.

According to the embodiment illustrated in figs. 3, $3_a, 3_b, 3_c$, bulge D_3 and indentation B_{14} made on the rear body 2 also define a profiled shape with the front body 4 coupled to a conical front portion 14 of central core 1.

According to the embodiments shown respectively in figs. 1, $1_a, 1_b$ and figs. 2, $2_a, 2_b, 2_c$, the rear body 2 has a succession of bulges A_2, A_4, A_6 separated by indentations A_3, A_5 . The radii of curvature R_2, R_4, R_6 of bulges A_2, A_4, A_6 are equal to one another and equal to the radii of curvature R_3, R_5 of indentations A_3, A_5 .

According to the embodiment of figs. 1, $1_a, 1_b$, the first bulge A_2 of rear body 2 is connected to the central core 1 by a connecting portion A_1 having a radius of curvature R_1 equal to the

(43)

radius of curvature R_2 of bulge A_2 .

According to the embodiments illustrated in figs. 1, 1_a , 1_b and figs. 2, 2_a , 2_b , 2_c , the last bulge A_6 of rear body 2 is connected to the rear face 8 of said rear body 2 by a conical connecting portion 7 tangential to said bulge A_6 .

According to these two embodiments, the diameter 9 of the rear face 8 of rear body 2 is equal to twice the radius of curvature R_6 of the last bulge A_6 of rear body 2.

As can be clearly seen in figs. 1 and 2, the projectile can be crimped to a case E. Under these conditions, the crimping of case E takes place on the rear body 2 on an intermediate bulge A_4 between the first bulge A_2 and the last bulge A_6 .

As is shown in the embodiment of figs. 2, 2_a , 2_b , 2_c , the conical recess 6 made in the rear body 2 issues into the rear face 8 of said rear body 2 and the conical finger 5 of the central body 1 extends up to said rear face 8. The conical finger 4 then has a conical bore 23 for fixing a shoulder 25 provided with a conical pin 31 having a complimentary shape to the conical bore 23. The conical coupling 6, 5 can then have two different conicities, as is clearly shown in figs. 2, 2_a , 2_b and 4, 4_a , 4_b .

The conical finger 5 on central core 1 then has a conicity α_3 , then a conicity α_4 less than α_3 and the conical recess 6 in rear body 2 firstly has a conicity α_1 equal to α_3 and then a conicity α_2 equal to α_4 (figs. 2, 2_a , 2_b and 4, 4_a , 4_b).

44

As shown in figs. 1 and 1_b, the central core 1 has a conical shape 3 terminated by a rounded point 3a. As shown in figs. 2 and 2_b, the central core 1 has a profiled shape 13 terminated by a sharp point 13_a.

According to the embodiment illustrated in figs. 3, 3_a, 3_b, 3_c, the central core 1 has a conical front portion 14, whose shape is symmetrical to the conical finger 5. Said conical front portion 14 is then covered by the front body 4 in which is provided a conical recess 17 which can be coupled to said conical front portion 14. This front body 4 has a shape which is substantially symmetrical to that of rear body 2.

According to this embodiment, front body 4 has a bulge D₁ having a diameter equal to or slightly smaller than the diameter of bulge D₃ of rear body 2.

As shown in figs. 3, 3_a and 3_c, the rear face 8 of rear body 2 has a profiled shape with a radius of curvature R₁₃ connected to bulge D₃ and the front face 18 of front body 4 has a profiled shape of radius of curvature R₁₁ connected to bulge D₁, said radii of curvature R₁₃ and R₁₁ being equal.

As can be seen in the aforementioned drawings, towards the front, rear body 2 has a tapered profiled shape constituted by an indentation B₁₄ of radius of curvature R₁₄ connected to the rear of front body 4 and the latter has, towards the rear, a tapered profiled shape constituted by an indentation B₁₂ of radius of curvature R₁₂ connected to the front of rear body 2, said radii

of curvature R_{14} and R_{12} being equal.

As is clearly shown in fig. 3, the projectile can be crimped to a case E. Under these conditions, the crimping of case E is effected on the rear body 2 in indentation B_{14} in front of bulge D_3 .

A limited depth groove G can then be made at this point in said rear body. The front portion 14 of central core 1 cooperates with the front body 4 by an axial abutment surface 33.

As shown in the embodiment illustrated in figs. 4, 4_a, 4_b, the rear body 2 has a rear bulge B_4 towards the rear, a front bulge B_2 towards the front and a diameter equal to or slightly smaller than the diameter of rear bulge B_4 and a tapered zone constituted by indentation B_3 connected to the two said bulges B_2 , B_4 .

As shown in the drawings, the radius of curvature S_4 of the rear bulge B_4 exceeds or is equal to the radius of curvature S_2 of the front bulge B_2 and the radius of curvature S_3 of the tapered zone B_3 is equal to or exceeds the radius of curvature S_2 of the front bulge B_2 .

As shown in fig. 4, the projectile can be crimped to a case E. Under these conditions, the crimping of case E to rear body 2 takes place in the indentation B_3 positioned between the front bulge B_2 and the rear bulge B_4 .

No matter what the embodiment, the invention makes it possible to obtain a projectile, whose advantages are clearly indicated in

the introduction to the description.

Moreover, it must be stressed that the facilitated manufacture makes it possible to obtain a less expensive projectile than those of the prior art.

It is possible to produce projectiles of any calibre according to the invention and projectiles of any type according to the invention, particularly ordinary projectiles, perforating projectiles, perforating-incendiary projectiles, perforating-incendiary-tracer projectiles, incendiary projectiles, tracer projectiles and explosive projectiles.



47

CLAIMS

1. Projectile for firing from a firearm with a rifled barrel comprising a rear body (2) made from a material suitable for cooperating with the rifling of the barrel, a central core (1) made from a harder material than that from which the rear body (2) is made and means for joining said rear body (2) to the central core (1), characterized in that the joining means comprise a conical coupling (6, 5) arranged, particularly with respect to its conicity, in such a way that it ensures a self-locking between the rear body (2) and the central core (1), as well as an abutment surface (15) between rear body (2) and central core (1), the rear body (2) having at least one bulge ($A_2, A_4, A_6, D_3, B_2, B_4$ cooperating with the grooves of the firearm barrel and at least one indentation (A_3, A_5, B_{14}, B_3), said bulge and said indentation interconnecting progressively so as to define a profiled shape.

2. Projectile according to claim 1, characterized in that the angle of the conical coupling (5, 6), which is twice the apex angle, is between 3 and 5° to obtain a high self-locking effect.

3. Projectile according to claims 1 or 2, characterized in that the front portion of the central core (1) forms the front of the projectile.

4. Projectile according to claims 1 or 2, characterized in that the front portion (14) of the central core (1) receives a front body (14) coupled onto said front portion (14), the front body (14) constituting the front of the projectile.

5. Projectile according to any one of the claims 1 to 4, characterized in that the conical coupling (5, 6) is constituted by a conical finger (5) on central core (1) and by a conical recess (6) made in the rear body (2).

6. Projectile according to claim 5, characterized in that



48

-2-

the conical recess (6) in the rear body (2) issues into the rear place (8) of said rear body (2) and that the conical finger (5) of central body (1) extends up to said rear base (8), said conical finger (5) having a conical bore (23) for the fixing of a flange (25) provided with a conical pin (31) having a shape complementary to that of the conical bore (23).

7. Projectile according to any one of the claims 1 to 6, characterized in that the conical coupling (5, 6) has two different conicities.

8. Projectile according to claim 3, characterized in that the central core (1) has a conical shape (33) terminated by a rounded point (3_a).

9. Projectile according to claim 3, characterized in that the central core (1) has a profiled shape (13) terminating by a sharp point (13_a).

10. Projectile according to claim 4, characterized in that the front body (4) has a bulge (p_1) having a diameter equal to or slightly smaller than the diameter of the bulge (D_3) of the rear body (2).

11. Projectile according to claim 3, characterized in that the rear body (2) has a rear bulge (B_4) located towards the rear, a front bulge (B_2) located towards the front and having a diameter equal to or slightly smaller than the diameter of the rear bulge (B_4) and a thinned zone constituted by the indentation (B_3) interconnecting said two bulges (B_2, B_4).

12. Projectile according to claim (4), characterized in that the central core (1) has a conical front portion (14) with a shape symmetrical to conical finger (5), in that said conical front portion (14) is covered by the front body (4) in which is provided a conical recess (17) suitable for coupling onto



49

-3-

said conical front portion (14) and in that said front body (4) has a shape substantially symmetrical to that of the rear body (2).

13. Projectile according to claim 1, which is to be crimped onto a case (E), characterized in that the crimping of case (E) onto rear body (2) takes place on one of the bulges of said rear body (2).

14. Projectile according to claim 1 for crimping onto a case (E), characterized in that the crimping of case (E) onto rear body (2) takes place in one of the indentations of said rear body (2).