

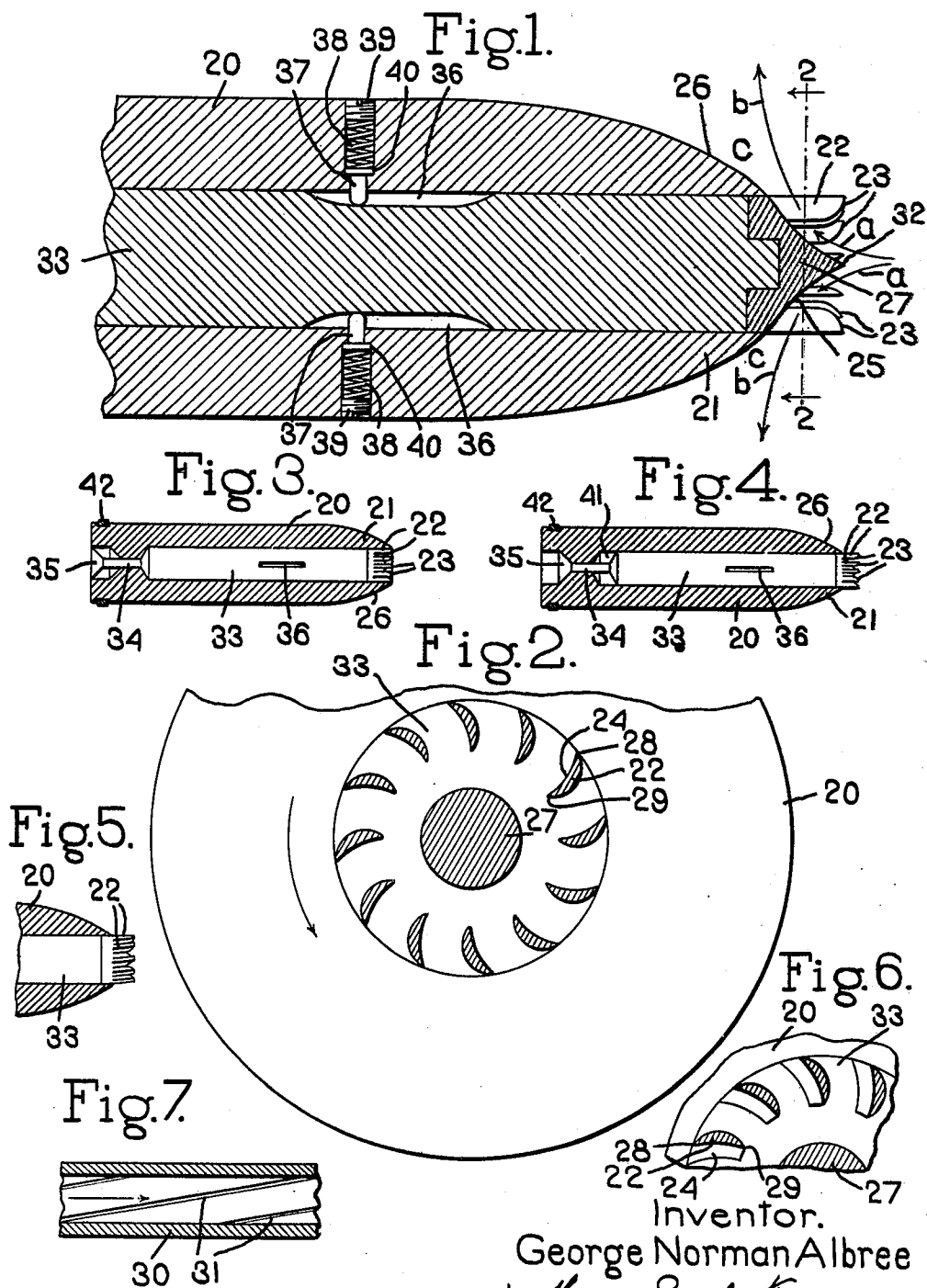
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PROJECTILE

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PROJECTILE

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This invention relates to a projectile designed to be launched from a rifled firearm and which, therefore, has its maximum spinning motion and kinetic energy of rotation as it leaves the muzzle of the firearm.

One of the objects of the invention is to provide a novel projectile which is so constructed that the reservoir of kinetic energy of rotation which it acquires in traveling through the rifled barrel of the firearm is utilized to supplement the kinetic energy of translation which it has as it is discharged from the firearm, whereby the projectile will have a flatter trajectory and a greater range.

This object is accomplished by providing the projectile with means rendered operative by the spinning motion thereof during its flight to reduce the density of the air in the compression zone adjacent the tip of the nose of the projectile thereby reducing the resistance of the air to the translational movement of the projectile. By this means the air in the path of the projectile is thrust aside to make way for it largely through expenditure of otherwise unused kinetic energy of rotation instead of solely by the kinetic energy of translation as is the case with an ordinary projectile, and such kinetic energy of translation is thereby conserved for maintaining the velocity of the projectile and increasing its range.

The projectile herein illustrated is provided adjacent its tip with a multiplicity of blades or wings or teeth that present air-impelling surfaces, the shape of which has such relation to the speed of spinning motion of the projectile given to it by the rifling in the barrel that said surfaces attack and act on the air immediately surrounding and adjacent to the tip of the projectile nose and force the air outwardly from the path of the projectile, thereby producing a zone of much reduced air pressure surrounding the nose of the projectile immediately in the rear of the extreme point or tip. Hence the projectile will be traveling through rarefied air and therefore less of the kinetic energy of translation is absorbed in pushing aside the air to make a path for the projectile. This results in an improved sustained velocity and greater range. The energy for the work which is done by the air-impelling surfaces in thus forcing outwardly the air in the path of the projectile is drawn from the kinetic energy of rotation of the projectile as distinguished from the kinetic energy of translation.

It has been established that during the flight

of a projectile that has been shot from a rifled barrel, the kinetic energy of translation falls off more rapidly than the kinetic energy of rotation, due largely to the fact that the kinetic energy of translation is being continually absorbed in overcoming the resistance which the air offers to the translational movement of the projectile, while the skin friction of the air on the exterior surface of the projectile is the only force retarding the spinning or rotative movement of the projectile. Moreover the gravitational pull during the upward movement of a projectile toward the apex of its trajectory will also absorb some of the kinetic energy of translation.

With my improved projectile a considerable portion of the work normally done by the kinetic energy of translation in pushing the air aside out of the path of the projectile, or in other words in overcoming the air resistance, is transferred to and is performed by the kinetic energy of rotation. The performance of such work by the kinetic energy of rotation has the effect of retarding the spin of the projectile, thus keeping the rotary motion of the projectile more nearly in proper relation to the translational motion or velocity thereof, thereby facilitating the nosing over of the projectile as it reaches the apex of its trajectory.

In the drawing, wherein I have illustrated a selected embodiment of my invention,

Fig. 1 is a fragmentary longitudinal sectional view through a projectile embodying my invention;

Fig. 2 is an enlarged sectional view with part broken out on the line 2—2 Fig. 1;

Fig. 3 is a longitudinal sectional view on a reduced scale showing the projectile embodying the invention with the blades or teeth in retracted position;

Fig. 4 is a view similar to Fig. 3 but illustrating the position of the blades during the flight of the projectile;

Fig. 5 is a fragmentary view of the nose portion of the projectile showing a different embodiment of the invention;

Fig. 6 is a fragmentary sectional view similar to Fig. 2, but showing the form of the invention illustrated in Fig. 5;

Fig. 7 is a fragmentary sectional view of a rifled barrel from which the projectile can be fired.

In the drawing 20 indicates the body portion of a projectile embodying my invention and 21 the nose portion thereof. The projectile nose is

provided at or near its tip with a multiplicity of air-impelling surfaces so constructed that the spinning motion of the projectile during its flight causes said surfaces to act on the air at the tip of the nose and force said air outwardly from the circumferential surface of the projectile, thereby producing a zone of reduced air pressure surrounding the projectile in the rear of such air-impelling surfaces and thus eliminating a considerable portion of the air resistance which a projectile normally encounters during its flight.

Such air-impelling surfaces may be provided for in various ways and by means of a variety of constructions. In the embodiment of the invention herein illustrated these air-impelling surfaces are formed by a plurality of blades or teeth 22 which project forwardly from the surface of the projectile adjacent the tip of the nose. Each blade 22 is formed with a free end 23 and extends in a general fore and aft direction, each blade presenting an air-impelling surface 24.

The projectile herein shown has a low calibre nose portion formed with an ogee curvature which presents the concavely curved portion 25 at the tip end of the nose and the convexly curved portion 26 at the base of the nose. The blades or teeth 23 are preferably located on the concavely curved portion 25 of the ogee curvature and said blades are arranged in a circular zone surrounding the extreme tip 27 of the nose which is shown as situated within the circular row of blades 22.

In the construction illustrated the air-impelling surfaces 24 have a slight concave curvature in a transverse direction and they also have a slight angular relation to a radial direction so that the outer edge 28 of each blade is slightly in advance of the inner edge 29.

It is intended that this projectile shall be shot from a rifled barrel 30, as shown in Fig. 7, wherein 31 indicates the rifling by which the projectile is given its spinning motion. If the projectile is discharged from the barrel in the direction of the arrow in Fig. 7 it will be given a spinning motion counterclockwise in Fig. 2 as indicated by the arrow in said figure. The speed of the rotational movement of the projectile depends, of course, upon the size of the projectile, its muzzle velocity, and on the character of the rifling 31 in the barrel. During the traveling movement of the projectile after it leaves the barrel of the firearm the air is parted by the pointed tip 27 of the projectile and flows over the concave surface 25 of the tip as shown by the arrows *a*. As this air reaches the rapidly rotating blades or teeth 22 it is acted upon positively by the air-impelling surfaces 24 thereof and is thrown outwardly with considerable force in the general direction of the arrows *b*. The force with which the air-impelling surfaces 24 act on the air due to the rapid rotation of the projectile about its axis is sufficient to throw it outwardly such an extent that the air in the zone *c* immediately surrounding the base of the nose of the projectile will have reduced pressure, and the effect therefore is that of the projectile traveling through rarefied air.

This outward motion of the air indicated by the arrows *b* is partly due to the centrifugal force developed in the air as it is rotated around by the blades 22 and partly by the shape of the surfaces 24 which throw or deflect it outwardly. The rapid high-velocity outward movement

which blades 22 impart to the air as indicated by the arrows *b* results in reducing the air pressure in the compression zone directly in front of the projectile and the effect therefore is that of a projectile traveling through a body of rarefied air or air of reduced pressure.

The action of the blades or teeth is thus to dissipate the air surrounding the projectile immediately in the rear of the pointed end 32 and to thereby reduce the pressure of the air against the projectile.

These blades 22 may extend parallel to the projectile axis, as shown in Figs. 1-4, or the blades may have a slight spiral shape, as illustrated in Figs. 5 and 6. In either case, however, it is the kinetic energy of rotation of the projectile which supplies the force necessary to throw the air outwardly, as indicated by the arrows *b* and to create the zone *c* of reduced air pressure. The creation of such zone of reduced air pressure reduces the amount of air resistance which the projectile encounters during flight and thereby correspondingly reduces the amount of work which it is necessary for the kinetic energy of translation to perform in continuing the flight of the projectile.

In other words, with this improvement part of the work normally performed by the kinetic energy of translation of the projectile in maintaining the translational movement of the projectile is performed by the kinetic energy of rotation and the result is that the projectile will have a flatter trajectory and a greater range.

Moreover, since part of the kinetic energy of rotation is being absorbed in creating the zone *c* of reduced air pressure, the rotational speed of the projectile will be slowed down somewhat and will thus be kept more nearly in a proper relation with the speed of translational movement.

Ballistically a projectile with a high calibre head will have a greater sustained velocity than one with a low calibre head, but at practical rotational speeds the projectile with the very high calibre head is not as accurate as one with a relatively low calibre head such as shown in the drawing.

The present improvements, however, make a projectile with a low calibre head just as efficient ballistically as one with a high calibre head and this is accomplished without sacrificing anything in the way of accuracy.

While the present improvements may be applied to any type of projectile, yet they are herein shown as applied to a projectile having a movable core portion 33, the forward end of which constitutes the tip portion of the projectile nose. The blades or teeth 22 are shown as mounted on the core which is adapted to be retracted within the body so that the pointed tip portion 27 and the air-impelling blades 22 may be withdrawn within the body of the projectile, as shown in Fig. 3. The rear end 34 of the core is shown as being reduced in diameter and as carrying at its end a head or seal 35. When the projectile is being stored and while it is being handled or loaded into the firearm the core is in its retracted position shown in Fig. 3, in which position the tip 27 and the air-impelling blades 22 are protected.

When the projectile is fired the pressure generated by the explosive charge will force the core forwardly into its operative position shown in Figs. 1 and 4, thereby projecting the tip 27 and the blades or surfaces 22 outwardly beyond the body of the projectile.

Where this construction is employed the concave portion 25 of the ogee curvature of the projectile will preferably be formed on the end of the core 33 and the convex portion 26 of said ogee curvature will be formed on the body portion of the projectile.

The friction between the core 33 and the wall of the chamber 41 in which the core is received may be sufficient to cause the core 33 to be rotated by and at the same speed as the body of the projectile, especially in projectiles of small size.

In the case of a large projectile, however, it may be desirable to have the core keyed to the projectile body and such a construction is shown in Fig. 1 wherein the core member 33 is provided with two oppositely disposed keyways 36 and the projectile body is provided with two keys 37 operating in said keyways 36. This construction permits the core 33 to have a movement in an axial direction but locks the core and the projectile body together for rotative movement.

The keys 37 are shown in Fig. 1 as being in the form of spring pressed pins each of which is backed by a spring 38 that yieldingly holds it in its forward operative position. Each spring is confined between its pin 37 and a plug 39 that is screw threaded into the projectile body. The pins 37 are provided with heads 40 which limit the forward spring pressed movement thereof.

The tip portion 27 of the nose on which the blades or teeth 22 are mounted may either be integral with the core 33 or may be a separate piece mounted on the end of the core. In the latter case such separate tip portion may be made of plastic material, or other similar material that will be disintegrated upon impact with the target. When the projectile strikes its target the inertia of the core 33 tends to continue its forward movement after the movement of the body of the projectile has been retarded, and the core then becomes an auxiliary projectile of high sectional density which will have much greater penetrating power than a solid projectile of the shape herein illustrated. The connection between the head or seal 35 and the stem 34 should be such that said head will be readily stripped from the stem as the core tends to move forwardly beyond the projectile body.

The keyways 36 are made with inclined end portions and the employment of the springs 38 permit the keys to be retracted automatically as the core moves forwardly beyond the projectile body so that said keys do not interfere at all with the movement of the core beyond the projectile body as an independent or auxiliary projectile.

The keys 37 accomplish their primary mission during the time that the projectile is traveling through the rifled barrel 30 and while a spinning or rotary motion is being imparted to the projectile body, said keys serving to impart to the core the same rotary motion that the rifling 31 imparts to the projectile body.

After the projectile has been discharged from the barrel 30 and there is no further demand on the keys 37 for imparting rotary motion to the core, the centrifugal force developed in the keys by the spinning motion of the projectile will throw the keys outwardly against the action of the springs 38, thereby partially or entirely withdrawing the keys from the keyways 36.

The spiral curvature of the blades or teeth 22 and the shape of the air-impelling surfaces 24 may be varied within wide limits and according

to the size and type of projectile without departing from the invention.

42 indicates the usual driving bands with which projectiles are commonly provided.

These blades or teeth 22 are intended to attack the air in the compression zone immediately surrounding and at the tip of the projectile nose and to direct such air outwardly from the path of the projectile and thereby reduce the density of the air in the space surrounding and immediately in front of the projectile nose, thus correspondingly reducing the resistance of the air to the translational movement of the projectile. Said blades or teeth are not intended to exert forward pulling effect on the projectile and may therefore be defined as non-thrust-producing blades. Nor are they intended to develop or increase the rotary motion of the projectile during its flight. On the contrary their purpose is to act positively on the air as it is parted by the tip of the projectile and throw the air outwardly from the path of the projectile body, and it is the kinetic energy of rotation of the projectile that provides the power or energy for accomplishing this end.

I claim:

1. A projectile designed to be shot from a rifled barrel, said projectile having a nose portion presenting an ogee curvature and provided in its peripheral surface of concave curvature with a plurality of longitudinally extending air-impelling faces having such relation to the direction of spinning motion of the projectile that they operate to force the air immediately surrounding the projectile nose outwardly at an angle to the normal line of air flow over the surface of the traveling projectile.

2. A projectile designed to be shot from a rifled barrel, said projectile having a body portion and an axial core portion free to move axially in the body portion from a retracted position to a forward operative position in which the front end of the core portion constitutes the tip of the projectile nose, and air-impelling teeth carried by said core portion and extending forwardly beyond the surface of the body portion, said teeth having air-impelling surfaces which, due to the rotation of the projectile during its flight act on the air immediately surrounding the projectile nose and force said air outwardly away from the path of the projectile, thereby creating a zone of reduced pressure around the projectile immediately in the rear of the tip thereof.

3. A projectile for use in a rifled arm and which when fired has acquired its maximum spinning motion and reservoir of kinetic energy of rotation at the instant it leaves the muzzle, said projectile having adjacent its nose and extending generally axially and forwardly therefrom a plurality of air impelling teeth which are so shaped and positioned that during the continued spinning motion of the projectile after it has been discharged which is maintained by its kinetic energy of rotation, they attack the air in the path of the projectile and force said air outwardly away from said path, whereby said kinetic energy of rotation is utilized to reduce the density of the air circumjacent the projectile immediately in the rear of the tip thereof.

4. A projectile for use in a rifled arm and which has its maximum spinning motion at the time it leaves the muzzle, said projectile having adjacent its nose and extending generally axially and forwardly therefrom a plurality of air-impelling teeth, the shape of which has such relation to

the speed and direction of the spinning motion of said projectile during its flight that said teeth attack the air in the path of the projectile nose and force such air outwardly away from the path.

5. A projectile for use in a rifled arm and which, therefore, has its maximum spinning motion at the time it leaves the muzzle, which spinning motion is maintained during the flight of the projectile by its kinetic energy of rotation, said projectile having adjacent its nose and extending generally axially and forwardly therefrom a plurality of air-impelling but non-thrust-producing teeth which are so shaped and positioned that during the continued spinning motion of the projectile which is maintained by its kinetic energy of rotation, they attack and act on the air in the path of the projectile and force said air outwardly away from said path but without producing any appreciable axial thrust on the projectile, whereby said kinetic energy of rotation is utilized to reduce the density of the air circumjacent the projectile immediately in the rear of the tip thereof.

6. A projectile for use in a rifled arm and which, therefore, has its maximum spinning motion at the time it leaves the muzzle, said projectile having adjacent its nose and extending generally axially and forwardly therefrom, a plurality of air-impelling but non-thrust-producing teeth, the shape of which has such relation to the speed and direction of the spinning motion of the projectile during its flight that said teeth attack the air in the path of the projectile nose and force such air outwardly away from the path without producing any appreciable thrust on the projectile in the direction of its flight.

7. A projectile for use in a rifled arm and which therefore has its maximum spinning motion at the time it leaves the muzzle, said projectile having a body portion and an axial core member free to move axially in the body portion from a retracted position to a forward operative position in which the front end of the core member is exposed, said exposed portion of the member having a plurality of air-impelling teeth extending generally axially and forwardly therefrom, the shape of which has such relation to the speed and direction of rotation of the projectile during its flight that said teeth attack the air in the path of the projectile and force such air outwardly away from said path.

8. A projectile for use in a rifled arm and which when fired has acquired its maximum spinning motion and reservoir of kinetic energy of rotation at the instant it leaves the muzzle, said projectile having adjacent its nose and extending forwardly in the general direction of its lengthwise dimension a plurality of air-impelling teeth which are so shaped and positioned that during the continued spinning motion of the projectile after it has been discharged and which is maintained by its kinetic energy of rotation they attack the air in the path of the projectile and force said air outwardly, whereby said kinetic energy of rotation is utilized to reduce the density of the air circumjacent the projectile immediately in the rear of the tip thereof and the resistance which the air offers to said teeth slows down the spinning motion of the projectile.

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