June 25, 1946. G. N. ALBREE 2,402,718

PROJECTILE

Filed Feb. 19, 1942

Fig.1.

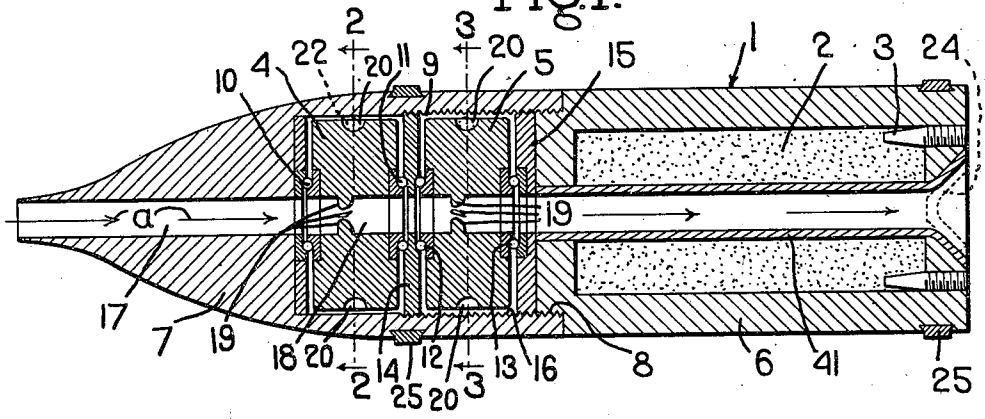


Fig.2.

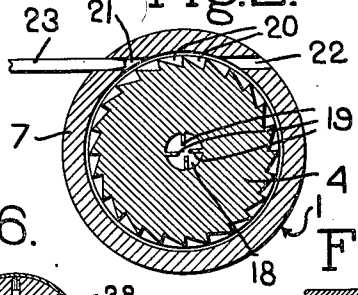


Fig.3.

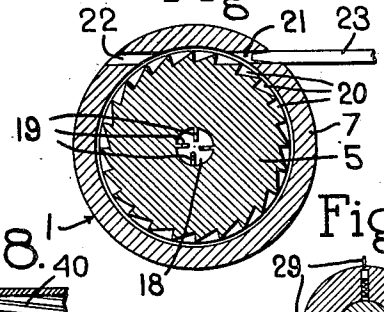


Fig.6.

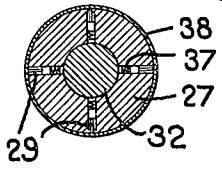


Fig.8.



Fig.7.

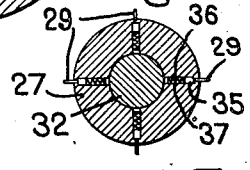
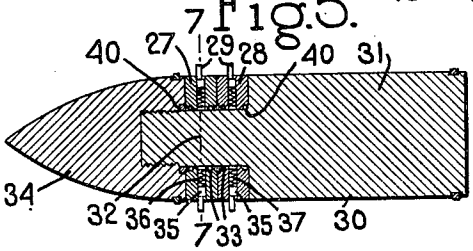


Fig.4.

Fig.5.



Inventor.
George Norman Albree
by Heard Smith & Tennant.
Attys.

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2,402,718

PROJECTILE

George Norman Albree, Winchester, Mass.

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7 Claims. (Cl. 102—50)

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This invention relates to projectiles for firearms and particularly to that type of projectile that has a stabilizing element rotatably mounted thereon for the purpose of giving the projectile stability during its flight.

One of the objects of the invention is to provide a projectile of this type in which the rotary stabilizing element is provided with wings that project therefrom and are situated to be acted on by the air during the flight of the projectile, thereby to impart rotary movement to said stabilizing element.

A further object of the invention is to provide a projectile of this type with an axial passage through which air flows at high velocity during the flight of the projectile and to provide the stabilizing element with wings or blades that project into the passage so that rotary motion is imparted to the stabilizing element by the stream of air flowing through said axial passage.

Another object of the invention is to provide pneumatic means operative independently of the projectile propelling force to give the stabilizing element an initial rotary movement before the element is loaded into the gun.

Other objects of the invention are to improve projectiles of this type in various ways as will be more fully hereinafter set forth.

In order to give an understanding of the invention, I have illustrated in the drawing some embodiments thereof which will now be described after which the novel features will be pointed out in the appended claims.

In the drawing:

Fig. 1 is a longitudinal, sectional view through the projectile embodying my invention.

Figs. 2 and 3 are sections on the lines 2—2 and 3—3, Fig. 1, showing one means for imparting an initial rotary movement to the stabilizing element before the projectile is loaded into the gun.

Fig. 4 is a longitudinal section through a projectile showing a different embodiment of the invention.

Fig. 5 is a longitudinal section through a projectile showing another embodiment of the invention.

Figs. 6 and 7 are sections on the line 7—7, Fig. 5, Fig. 6 illustrating the projectile as having a sleeve thereon for retaining the wings in their retracted position.

Fig. 8 is a longitudinal section through a portion of a rifled gun barrel.

The present improvements may be embodied in projectiles of either the ball type or the shell type. In Fig. 1, the invention is illustrated as embodied

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in a projectile of shell type and in said figure, 1 indicates generally the projectile which is shown as formed with a chamber 2 containing an explosive charge and as provided with fuse elements 3 for exploding or detonating the explosive charge.

The projectile has mounted thereon, one or more rotary stabilizing elements, two such elements being illustrated in Fig. 1 which are indicated at 4 and 5 respectively. The stabilizing element or elements may be placed in any position lengthwise of the projectile but it is preferable to place them in the front portion of the projectile.

The projectile body may conveniently be made in two sections, the rear section 6 which contains the chamber 2 for receiving the explosive charge, and the front or nose section 7, said two sections being screw-threaded together as shown at 8. The stabilizing element or elements will preferably be mounted in the nose section 7 of the projectile, said section being provided with a chamber 9 to receive said elements.

These stabilizing elements are rotatably mounted in ball bearings so as to provide for free rotation thereof. In the construction herein shown, each stabilizing element is mounted in two ball-bearing assemblies, one on each side thereof, those for the stabilizing element 4 being indicated generally at 10 and 11 and those for the stabilizing element 5 being indicated generally at 12 and 13. The two ball-bearings 11 and 12 are mounted in a disk or plate 14 which is located between the two stabilizing elements 4 and 5. The ball-bearing 13 is partially supported in a similar disk 15 at the outer end of the chamber 9, and the two disks 14 and 15 are shown as being provided on their periphery with screw threads adapted to have screw-threaded engagement with screw threads 16 formed on the interior of the chamber 9. In this way, the disks 14 and 15 can be properly positioned and adjusted so as to load the ball-bearings to the proper extent.

As stated above, the present invention involves novel means by which rotary motion is imparted to the stabilizing element or elements by the forward traveling movement of the projectile through the air.

One way of accomplishing this is to make the projectile 1 with an axial passage 17 extending therethrough, which passage also extends axially through the stabilizing elements, and to provide said elements with wings or blades that project into this passage so that the air which flows

through the passage at high velocity during the traveling movement of the projectile will act on these wings or blades and will thus impart rotary motion to the stabilizing element or elements.

In Fig. 1, the axial passage through the projectile is indicated at 17, this passage extending axially through the stabilizing elements 4 and 5 as shown at 18, and the wings or blades with which the stabilizing elements are provided are indicated at 19, said wings or blades projecting into the portions 18 of the passage 17. These wings or blades 19 may have any desired shape or configuration but preferably will be in the form of miniature aerofoils which have a high aspect ratio and an efficient lift-drift ratio, and are so disposed that the current of air flowing through the passage 17 and indicated by the arrows *a* will, by its action on the wings or blades, impart the desired rotary movement to the stabilizing element.

Where two stabilizing elements are used, they may be arranged in closely adjacent tandem relation as shown in Fig. 1, and it is desirable to so construct the wings or blades on each stabilizing element that the flow of air through the passage 17 will cause the stabilizing elements to rotate in opposite directions. This is shown in Fig. 1 wherein the blades 19 carried by the stabilizing element 4 are designed to give said element a counterclockwise rotary motion looking from the left, while the blades 19 carried by the stabilizing element 5 are designed to give said element a clockwise rotary motion also looking from the left, Fig. 1. Because of the opposite directions of rotation of the two tandem arranged stabilizing elements, the tendency of the projectile to drift laterally during flight due to the rotation of one stabilizing element is counterbalanced by the tendency of said projectile to drift laterally in the opposite direction due to the rotation of the other stabilizing element. This will give a high degree of inherent stability to the projectile, thus making it possible to fire the projectile from a smooth bore gun as accurately as a projectile can be fired from a rifled gun. It is well understood that for the same powder charge a smooth bore gun will develop a higher muzzle velocity of the projectile than a gun having a rifled barrel because in the case of a rifled gun, some of the force of the exploding charge is converted into the spinning motion of the projectile.

The speed at which each stabilizing element is rotated will depend somewhat upon the characteristics, such as the aspect ratio, lift-drift ratio, angle of incidence, etc., of the wings carried thereby and by employing wings on the two stabilizing elements having certain predetermined characteristics, the said elements may be given a rotary motion of substantially the same speed or may be so driven that the speed of one element will have any desired relation to that of the other element.

While the action on the wings 19 of the stream of air indicated by the arrows *a*, Fig. 4, will impart rotary movement to the stabilizing element, yet in the case of a large projectile, it may be desirable to impart to the stabilizing elements an initial rotative movement before loading the projectile into the gun, so that when the projectile is discharged from the gun the stabilizing elements will be already in rotation thus giving stability to the projectile the instant it leaves the muzzle of the gun. After the projectile has been discharged, the rotative movement of the stabilizing elements will be maintained during flight and may even be increased by the action of the stream of air flowing through the passage 17 and acting on the wings 19.

Various ways of imparting an initial rotative movement to the stabilizing elements before the projectile is loaded into the gun may be employed without in any way departing from the invention, but I prefer to accomplish this by delivering jets of gas under pressure against the peripheral portion of each stabilizing element. One simple construction by which this may be done is shown in Figs. 2 and 3. Each stabilizing element is formed on its periphery with a series of pockets 20 and the projectile is provided with two opposed transverse openings 21 and 22 that communicate with the chamber 9 at one side thereof. 23 indicates a nozzle connected to a source of compressed air and by which air under high pressure may be discharged into the inlet opening 21. The impact of this jet of air under high pressure against the rear walls of the pockets 20 will give the stabilizing element a rapid rotary movement, the air after having done its work being discharged from the outlet passages 22.

In the case of large projectiles that are brought to the breech end of the ordnance on a carriage, the air jet nozzles 23 may be used to impart rotary motion to the stabilizing elements while the projectile is on the loading carriage and just before it is entered into the gun. Where two stabilizing elements are employed, as shown in Fig. 1, which rotate in opposite directions, the pockets 20 in the two elements will be oppositely disposed, as shown in Figs. 2 and 3. For giving initial rotation to the stabilizing element 5, the nozzle 23 will be entered into the opening on the opposite side of the projectile from that just used in giving initial rotative movement to the stabilizing element 4.

The above-described means for giving initial rotary motion to the stabilizing elements is in the nature of pneumatic means operative independently of the projectile propelling force. While I have referred to air as the compressed gas to be used, yet the invention contemplates the use of any suitable gas for this purpose.

Since the projectile shown in Fig. 1 has an axial passage therethrough, it is necessary to provide means for closing this passage at the base of the projectile until the latter has been discharged from the barrel of the gun. For this purpose, a sealing member 24, shown in dotted lines in Fig. 1 is employed, which seals the rear end of the passage 17. This sealing member 24 may be temporarily retained in place by any appropriate means, as by means of some suitable cement or adhesive. As soon as the projectile has been discharged from the gun, the suction condition which tends to form in the vortex immediately in the rear of the projectile together with the pressure of the air in the passage 17 will dislodge the sealing member 24 thus leaving the passage 17 entirely open for the free flow of air therethrough. The stream of air flowing through this passage 17 not only serves to impart rotary motion to the stabilizing elements, but it also reduces very materially the vortex drag on the projectile and relieves the compressibility effect at the nose of the projectile, thus giving the latter an increased sustained velocity.

The projectile shown in Fig. 1 which has two stabilizing elements and is intended to be shot from a smooth bore gun is illustrated as having

bands 25 on which it rides as it moves through the barrel, said bands also serving as gas checks.

In Fig. 4, I have shown a different embodiment of the invention wherein the projectile has a single stabilizing element. This embodiment of the invention is well suited for use with projectiles that are to be shot from a gun having a rifled barrel such as that illustrated in Fig. 8. The body of the projectile, shown in Fig. 4 is made with the rear section 6*a* and the nose section 7*a* which are screw-threaded together as shown at 8*a*. The nose portion of the projectile is provided with a chamber 9*a* in which is received a single stabilizing element 4*a* similar to the stabilizing element 4, said element being rotatively mounted in ball bearings 10*a* and 11*a*. The projectile shown in Fig. 4 is provided with the axial passage 17*a* which extends through the stabilizing element 4*a* and said element 4*a* is provided with the wings or blades 19*a* that project into the passage 17*a* so that the air flowing through the passage 17*a* will be its action on the wings 19*a*, impart a rotary movement to the stabilizing element. The projectile 1*a* is shown as having a driving band 26 thereon adjacent to its base, said driving band cooperating with the rifling 40 in the barrel 41 of the gun to give the projectile a spinning or rotating motion about its axis. The wings 19*a* of the stabilizing element 4*a* may be so shaped and disposed and have such characteristics as to give said element a rotation in a direction either opposite to or the same as that imparted to the projectile itself by the rifling in the gun. In Figs. 4 and 8 the wings 19 and the rifling 40 in the gun barrel have such a relation that the stabilizing element 4*a* will be rotated in a direction opposite to that in which the projectile will be spun as it travels through the barrel 41. The spinning projectile, itself constitutes a stabilizing member during its flight, and by embodying in the projectile a stabilizing element such as shown at 4*a* in Fig. 4 and by providing for rotating said element in a direction opposite to that in which the projectile is spinning, the effect will be that of a projectile having two stabilizing elements rotating in opposite directions. This will have a counteracting effect on the torque of the projectile, that is, the tendency of the projectile to drift laterally during flight, a tendency which is inherent in all projectiles which are shot from a gun having a rifled barrel.

In the devices shown in Figs. 1 and 4, a rotary motion is imparted to the stabilizing element by means of an air current which passes through the projectile. In Fig. 5, there is shown another embodiment of the invention wherein the flow of air around the projectile is utilized to impart a rotary motion to the stabilizing element. In said Fig. 5, the projectile 30 is provided with two stabilizing elements 27 and 28, so mounted that their peripheral surfaces are flush with the peripheral surface of the projectile body, and each stabilizing element has one or more wings or blades 29 extending outwardly from its peripheral surface and adapted to be acted upon by the air flowing over the surface of the projectile body, thereby to impart rotary movement to the stabilizer. The projectile 30 is formed with a body 31 having a reduced portion 32 on which the two stabilizing elements 27 and 28 are mounted, ball bearings 33 being provided to permit free rotation of said elements. The nose portion 34 of the projectile is separate from the body portion 31 and is screw-threaded onto the end of the reduced portion 32, the latter having exterior screw threads for this purpose. The two stabilizing elements 27 and 28 are thus mounted on the reduced portion 32 and are confined between the nose 34 and the body 31 of the projectile. Each stabilizing element is provided with a plurality of wings or blades 29 adapted to extend outwardly beyond its periphery. Each wing or blade is shown as carried by a block 35 having flat sides that is mounted in a radial recess 36 with which the stabilizing element is provided and which receives a spring 37 tending to force the wings 29 outwardly into their operative position. The wings 29 on the two stabilizing elements are so disposed that the air flow over the surface of the projectile during flight will cause one stabilizing element to rotate in one direction and the other to rotate in the opposite direction. The flat sides of the blocks 35 prevent the blocks from turning in the recesses and ensures that the wings 29 will be held at the proper angles.

In order to protect the wings 29 while the projectile is being handled preparatory to loading it into the gun, a band 38 may be placed around the stabilizing elements as shown in Fig. 6, this band serving to hold the wings 29 in their retracted positions. The yielding movement of the springs 37 permit the wings to be thus retracted. When the projectile is loaded into the gun, the band 38 will be removed and the wings will then be retained in their retracted position by engagement by the interior wall of the gun barrel.

As soon as the projectile has been discharged from the gun, the springs 37 will move the wings 29 outwardly into their operative position, in which they are acted upon by the air flow around the projectile, thereby imparting the desired rotary motion to the stabilizing elements.

In the above discussion in which reference is made to rotary motion being imparted to the stabilizing element, it has been assumed that the relation between the translational speed of the projectile and the rotational speed of the stabilizing element was such that the action of the air on the wings was effective to give rotary motion to the stabilizing element. It will be evident, however, that if the translational speed of the projectile is sufficiently reduced relative to the rotational speed of the stabilizing element, or the initial rotational speed of the stabilizing element is sufficiently increased relative to the translational speed of the projectile as it is discharged from the gun, then the relation between such rotational and translational speeds may be such that the action of the air on the wings of the stabilizing element will have a retarding effect on the rotational speed thereof. In other words, the action of the air on the wings of such stabilizing element may serve either to augment or to retard the rotational motion thereof depending on the relation existing at any moment between the rotational speed of the stabilizing element and the translational speed of the projectile.

Hence in the case of a projectile which is discharged with a relatively high trajectory the translational speed of the projectile may be reduced to such an extent during its flight toward the vertex of its trajectory that the action of the air on the wings will retard the rotation of the stabilizing element, thereby reducing the stabilizing effect thereof, while the projectile is approaching and traveling through the vertex portion of its trajectory, thereby preserving the proper balance in the relation between the air

resistance on the projectile and the stabilizing effect to insure that the projectile will maintain its axis in line with its trajectory and will thus "nose over" properly as it reaches its vertex and begins its descent. During the descending movement of the projectile it will naturally gather speed and such increased translational speed will then result in giving increased rotational movement to the stabilizing element.

The construction herein illustrated therefore provides means for varying the rotational speed of the stabilizing element as the translational speed of the projectile varies.

I claim:

1. A projectile for firearms comprising a projectile body provided with an axial passage open at both ends for the flow of air therethrough during the flight of the projectile, and a stabilizing element rotatably carried by said body and situated co-axially thereof, said stabilizing element having an axial opening which registers with the axial passage of the projectile body and also having an impelling blade projecting into said opening whereby the air flowing through said passage and opening during such flight acts on the blade and imparts rotary motion to the stabilizing element.

2. A projectile comprising a projectile body provided with an open-ended axial passage through which air flows during the flight of the projectile after it has been launched, two stabilizing elements rotatably carried by said body in tandem relation, each stabilizing element having an axial opening which registers with the axial passage of the projectile body, and means actuated by the flow of air through said passage and opening during such flight to impart rotary motion in one direction to one stabilizing element and in the other direction to the other stabilizing element.

3. A projectile comprising a projectile body provided with a through axial passage open at both ends and through which air flows during the flight of the projectile, and two stabilizing elements rotatably carried by said body in tandem relation, each stabilizing element having an axial opening therethrough which registers with the axial passage of the projectile body, and also having rigid therewith a blade that extends into said opening, whereby the air flowing through said passage and opening during the flight of the projectile acts on the blades of the two stabilizing elements successively and imparts rotary motion to both stabilizing elements, the blade on one stabilizing element being shaped to cause it to rotate in one direction and the blade on the other stabilizing element being shaped to cause it to rotate in the opposite direction.

4. A projectile for firearms having a stabilizing element rotatively carried thereby, pneumatic means operative independently of the projectile-propelling force for giving the stabilizing element the initial rotary motion, and means actuated by the air through which the projectile travels during its flight to impart additional rotary motion to the stabilizing element.

5. A projectile comprising a projectile body provided with a through axial passage, a stabilizing element rotatively carried by said body, pneumatic means operative independently of the projectile-propelling force to give the stabilizing element an initial rotary motion, and means actuated by the flow of air through said passage during the flight of the projectile to impart additional rotary movement to said stabilizing element.

6. A projectile for firearms comprising a body portion, a stabilizing element rotatively mounted therein, means independent of the projectile-propelling force for giving said stabilizing element an initial rotary movement about its axis, and wings mounted directly on the stabilizing element which are exposed to the air flow past the projectile during its flight and which thereby vary the rotative movement of the stabilizing element as given to it by said means.

7. A projectile comprising a projectile body provided with a through axial passage open at its ends for the flow of air therethrough during the flight of the projectile, a stabilizing element rotatively carried by said body and having an axial opening which registers with the axial passage of the projectile body, means independent of the projectile-propelling force to give the stabilizing element an initial rotative movement about its axis, and wings carried by the stabilizing element and projecting into said opening whereby during the flight of the projectile the air flowing through said passage acts on the wings and thus exercises an influence over the rotative movement of the stabilizing element.

GEORGE NORMAN ALBREE.