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Infantino

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[54] **SELF-PROPELLING BALLISTIC PROJECTILES**

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[30] **Foreign Application Priority Data**

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[52] **U.S. Cl.** **102/49.3,** 102/92.1

[51] **Int. Cl.** **F42b 15/10**

[58] **Field of Search** ..... 102/49.3, 49.7, DIG. 1, 102/92.1, 93; 89/7

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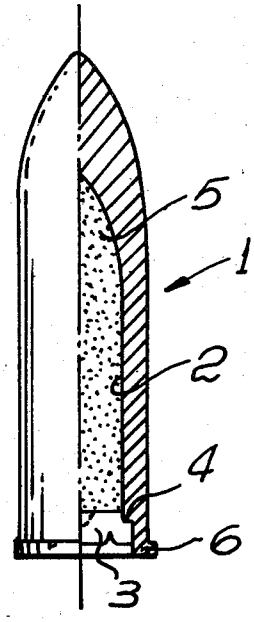
[57] **ABSTRACT**

Ballistic projectiles for firearms and more particularly to a self-propelling ballistic projectile which, upon firing, is totally expelled from the firearm without leaving a residual case therein.

4 Claims, 6 Drawing Figures



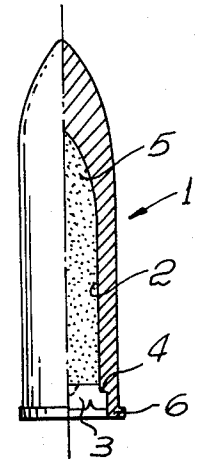


FIG.1

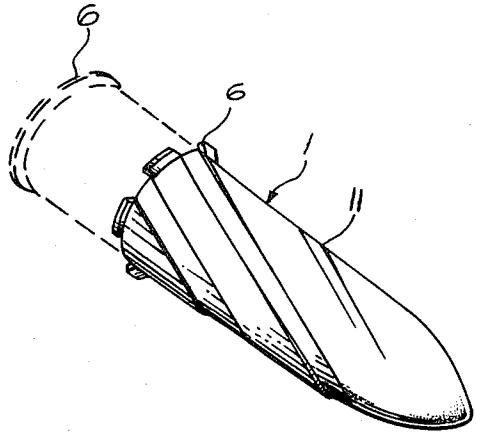


FIG.6

FIG.2

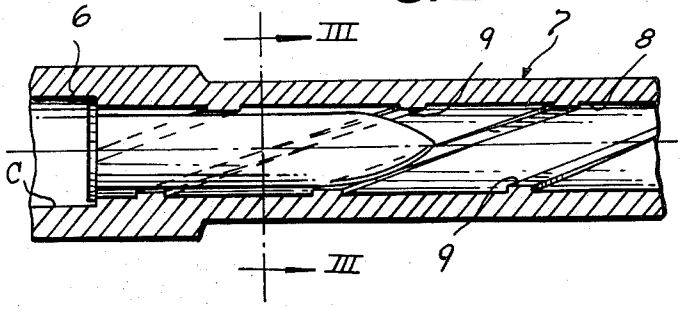


FIG.3

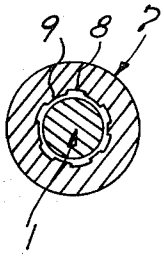


FIG.4

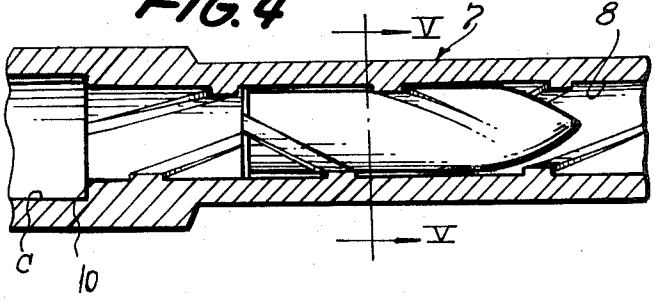
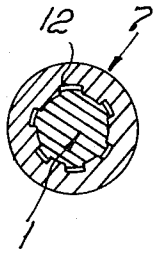


FIG.5



SELF-PROPELLING BALLISTIC PROJECTILES

Conventional firearm cartridges comprise a case, a projectile or bullet fitted at the mouth end of the case, a propellant charge inside the case, and priming means at the rear end of the case. These cartridges are loaded into the chamber of a firearm and, upon being fired, the propellant charge impells the projectile or bullet through the barrel of the firearm. The case is retained in the chamber and elaborate means have been devised to eject it either manually or automatically.

These ejecting means are prone to malfunction and are a major cause of jamming. Besides, the necessity of ejecting the residual case reduces the frequency of firing and severely limits the effectiveness of the firearm.

In addition, conventional cartridges comprise several independent parts requiring an elaborated manufacturing process which makes them rather expensive.

It is also evident that the bullet proper is only a fraction of the total weight of the cartridge and therefore, storage volume and transportation costs are disproportioned to the effectiveness of the ammunition.

Efforts to improve firearm ammunition in the recent past were directed towards reducing barrel erosion and attaining improved ballistic performance.

Modern firearms have barrel bores with a series of equidistant parallel groves (called "rifling") which spiral from one end of the barrel to the other. These groves or "rifling" define land portions which bite into the surface of the bullet while it travels through the bore and causes it to spin. The gyroscopic effect thus created helps to stabilize the path of the bullet and increases the accuracy of fire.

The outer diameter of the bullet is, of necessity, slightly larger than the inner diameter across the lands of the bore and, as a consequence, the bore is subjected to sever erosion.

In view of the above-mentioned problems, several attempts have been made to produce a self-propelling ballistic projectile which is totally expelled through the barrel of the firearm from which it is fired. These attempts have not been successful mainly because the self-propelling projectiles were designed on the same criteria used for conventional ammunition, namely, the body of the projectiles had a diameter larger than the inner diameter across the lands of the barrel bore so that the lands of the bore bit into the surface of the projectile and imparted to it the above-referred to spinning motion.

This oversizing of the projectile body and the expansion it experienced under the pressure of firing, subjected the bore to severe erosion, decreased appreciably the kinetic energy of the projectile, and caused excessive gas leakage through the firearm chamber.

Other attempts to solve the above problem were centered about the design of a self-destroying case, but this created other problems which rendered this solution totally ineffective.

With a view to solving the problems normally associated with conventional ammunition and known self-propelling projectiles, the present invention provides a ballistic, self-propelling projectile adapted to be fired from a firearm having a helically grooved bore and capable of being totally expelled through said bore without leaving any residue in the firearm, said projectile comprising a body of substantially cylindro-ogival shape, having a propellant cavity therein, priming means in said propellant cavity, and an outer, peripheral flange at the rear, terminal end of said body and integral therewith; the maximum outer diameter of said body being equal to, or slightly less than the diameter of said bore across the lands defined between said grooves; and the outer diameter of said rear peripheral flange being larger than the diameter of the bore across said lands; whereby, upon the projectile being fired and impelled through the bore, said rear peripheral flange is bit and deformed by the lands in the bore, and the projectile body expands under the pressure of firing and engages the lands in the bore thus causing the projectile to spin while it travels through the bore.

The basic principle of the invention resides in making the maximum outer diameter of the projectile body, equal or slightly less than the diameter of the bore of the firearm from which the projectile is to be fired. The desired spinning motion is produced, on the one hand, by a rear peripheral flange which, upon firing of the projectile, engages and is deformed by the rifling in the bore, and on the other hand, by engagement of the surface of the projectile with the rifling in the bore due to the expansion caused by the ignition of the propellant charge.

This principle may be applied to ammunition of a wide range of calibres and intended for diverse types of firearms, such as portable, automatic, semi-automatic, or artillery weapons.

The main advantages of the invention are the elimination of the residual case and the reduction of barrel erosion. Other advantages are:

1. Supersonic muzzle velocity with the consequent increase in impact energy.
2. Higher offensive power since the full projectile structure strikes the target.
3. Less firearm recoil.
4. Lower manufacturing costs.
5. Possibility of simplifying the firearms using ammunition in accordance with the invention by eliminating the case ejecting mechanism and this eliminates a major source of mechanical trouble.
6. Possibility of increasing the frequency of firing by decreasing the firing cycle.
7. Lower weight, storage volume and transportation costs.
8. Better resistance to water and humidity.

The invention will now be described with reference to the accompanying drawings which illustrate, by way of example, a preferred embodiment of the invention.

In the drawings:

FIG. 1 is an elevation view, partially in section, of a ballistic projectile according to the invention.

FIG. 2 shows schematically the projectile of the invention in the chamber of a firearm, prior to firing.

FIG. 3 is a cross section along line III—III of FIG. 2.

FIG. 4 is a view similar to that of FIG. 2 but immediately after the projectile has been fired.

FIG. 5 is a cross section along line V—V of FIG. 4.

FIG. 6 is a perspective view of the projectile immediately after being fired showing the deformation of the rear peripheral flange.

With reference now to the drawings, the self-propelling ballistic projectile shown in FIG. 1 comprises a single-piece body 1, preferably of cylindro-

ogival shape, having an internal ogival or cylindro-ogival propellant cavity **2**. The propellant cavity is closed at the rear end of the body by priming means **3** which could be of the central fire or ring fire type.

The priming means **3** rest on an internal shoulder **4** provided in the wall of the projectile body.

The propellant cavity contains a propellant charge **5** which may consist of common gun powder.

The projectile body **1** has, at its rear terminal end, an outer peripheral flange **6** formed integrally with the projectile body and extending substantially at right angles with respect to the longitudinal axis of the projectile. The outer diameter of the flange **6** is larger than the outer diameter of the cylindrical portion of the projectile body. The diameter and thickness of the flange **6** depend on the calibre of the projectile.

In FIG. **2** the projectile is shown in the chamber C of a firearm prior to firing. The firearm barrel **7** has a series of parallel grooves **8** which spiral from the chamber end to the muzzle end of the barrel and define land portions **9** therebetween.

In the position shown in FIG. **2** the rear flange of the projectile abutts against shoulder means **10** provided in the chamber which hold it in place. As it may be best seen in FIG. **3**, the outer diameter of the projectile body is equal or, preferably, slightly less than the inner diameter, across the lands, of the bore.

As an example, a desirable clearance between a calibre **9** projectile and the bore of the corresponding firearm is in the order of 0.006 mm.

FIG. **4** shows the projectile immediately after it has been fired by percussion of the priming means **3** with the percussion pin (not shown) of the firearm. As it can best be seen in FIG. **6**, the rear flange **6** of the projectile is deformed by the rifling and "screws" into the helical grooves of the bore. This produces the spinning of the projectile. Almost simultaneously, the projectile body expands slightly under the pressure of firing and engages the lands in the bore, which maintain and guide the spinning motion of the projectile until it abandons the barrel through the muzzle. In FIG. **6** it has been indicated the indentations **11** formed by the rifling on the surface of the projectile body.

It should be noted that the rear flange **6** acts as a stop for the projectile in the chamber before the projectile is fired, and also as a guiding ring while the projectile travels through the bore. It furthermore assists in stabilizing the projectile after it is expelled from the barrel.

FIG. **5** is a cross section through line V—V of FIG. **4** showing schematically the deformation or extrusion suffered by the projectile while traversing the bore. The reference numeral **12** indicates the clearance between the bore and the projectile.

The remnants of the primer **3** are expelled, together with the projectile through the barrel. To accomplish this, several primer designs are possible and it is not considered necessary to discuss them in detail. It will be apparent to those expert in the art, that the priming means may be located at either end of the propellant cavity.

The projectile body is preferably made of a brass alloy although other suitable metals could also be employed.

The performance of the self-propelling projectile of the invention was compared with conventional ammunition of the same and different calibre.

The self-propelling projectile tested had the following characteristics:

Calibre	9 mm
Total length	27 mm
Weigh (loaded)	6010 mg
Propellant charge	330 mg

The results of the tests are indicated in the attached table.

The tests showed that the muzzle velocity of the projectile of the invention was frankly supersonic and substantially higher than that of all the ammunition compared. The recoil energy of the projectile of the invention was also substantially less than that of ammunition of the same calibre.

Ballistic tests conducted in a subsonic tunnel showed that the projectile of the invention had excellent ballistic stability, i.e., its centre of gravity followed a fixed path after the projectile left the barrel and the propellant charge became inert.

TABLE

Test No.	279	280	281	282	283
Ammunition type and Calibre	C.22 long	C.32 long	C.32 long	C.9 PAM	C.9 according to invention
Initial Velocity (m/sec.)	* DGFM 348	DGFM 270	ORBEA (TM) 311	DGFM 327	455
Initial Energy (Kg.m)	15	23	31	44	59
Recoil Energy (Kg.m)	—	0.260	0.308	0.500	0.430
Dynamometer travel (m)	—	0.241	0.284	0.460	0.372
Projectile Weight (mg)	2600	6300	6300	8100	6010
Propellant Charge	Standard	Standard	Standard	Standard	Common hunting gun powder FANAZUL (T.M.)
Remarks	Winchester barrel 0.53 m	Specially made barrel 0.18 m	Same as before	PAM barrel 9-standard	Same as before

* DGFM: Direccion General de Fabricaciones Militares

The stability conditions of the projectile of the invention were verified also with the Kranz equations.

An additional feature of the invention resides in the design of the propellant cavity **2**. The ogival or cylindro-ogival shape of the cavity permits a better utilization of of the explosive energy developed in the projectile, and the use of a smaller propellant charge than would be required in conventional ammunition of equivalent calibre.

While the invention has been described in connection with a specific embodiment thereof, it is to be understood that this is by way of illustration and not by way of limitation, and the scope of the appended claims should be construed as broadly as the prior art will permit.

What is claimed is:

1. A ballistic, self-propelling projectile adapted to be fired from a firearm having a helically grooved bore and capable of being totally expelled through said bore without leaving any residue in the firearm, said projectile comprising an expandable body of substantially cylindro-ogival shape, the maximum outer diameter of said body being equal to or slightly less than the diameter of said bore across the lands defined between said grooves, which body expands under pressure of firing and engages the lands of said bore, said body having a propellant cavity therein, said propellant cavity being substantially ogival; priming means in said propellant cavity; and an outer, peripheral flange at the rear, terminal end of said body and integral therewith, the outer diameter of said rear peripheral flange being larger than the diameter of the bore across said lands, and serving as a stop for the projectile in the firearm chamber before firing, whereby, upon the projectile being fired and impelled through the bore, said rear peripheral flange is bit and deformed by the lands in the bore which in conjunction with expansion and engagement of the projectile body with the lands in the bore causes the projectile to spin while it travels through the bore.

2. The ballistic, self-propelling projectile in accordance with claim **1** wherein said outer peripheral flange has a rectangular cross section.

3. The ballistic self-propelling projectile in accordance with claim **1** wherein said expandable body is made of a brass alloy.

4. The ballistic, self-propelling projectile in accordance with claim **1** wherein said propellant cavity is of cylindro-ogival shape.

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