Jan. 2, 1968 B. B. GOULD ET AL 3,361,385

MINIATURE BALLISTIC ROCKET

Original Filed April 2, 1965 2 Sheets-Sheet 1

FIG. 1.

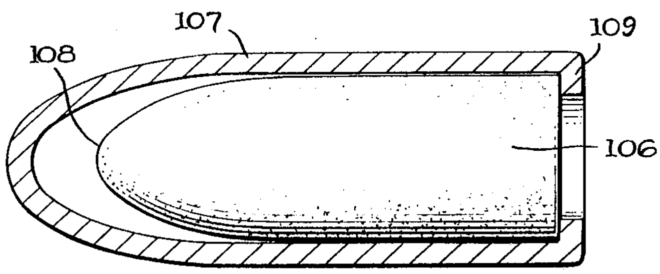

FIG. 2.

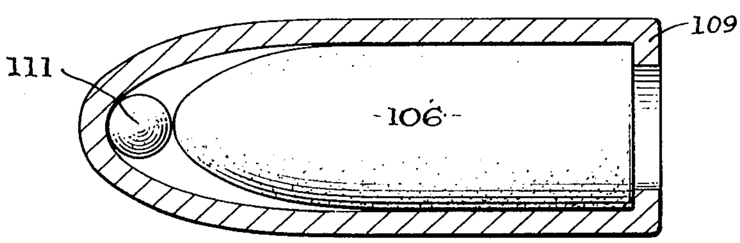

FIG. 3.

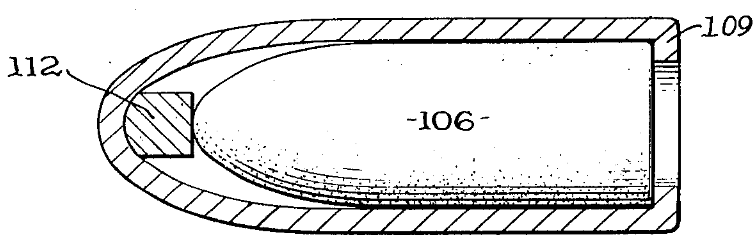

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FIG. 4.

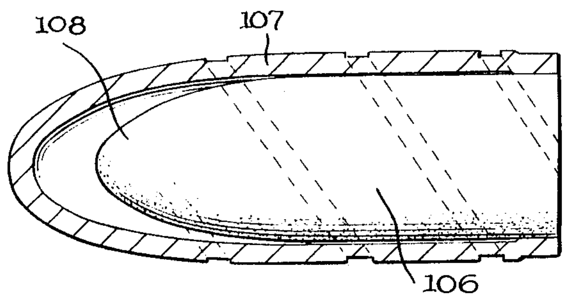


FIG. 5

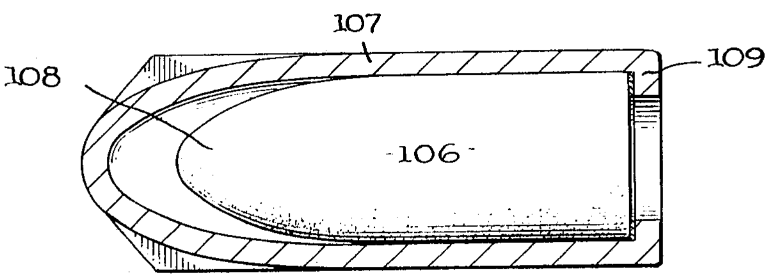
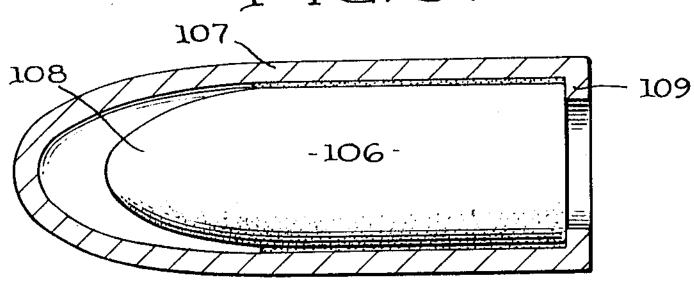


FIG. 6.



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MINIATURE BALLISTIC ROCKET

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10 Claims. (Cl. 244—3.1)

This application is a divisional application of my copending application Ser. No. 445,276, filed Apr. 2, 1965, entitled, "Miniature Ballistic Rocket," which is a continuation-in-part of application Ser. No. 189,222, filed Apr. 16, 1962, entitled, "Miniature Ballistic Rocket," the latter application having been abandoned.

The present invention relates, in general, to the field of ballistic missiles and, more particularly, to a rocket construction embodying novel construction features whereby size may be reduced to miniature proportions for use in small arms type weapons.

The development of the present invention creates a new concept in small arms type weapons. It eliminates the traditional parameters that designers have labored under throughout the history of small arms type weapons. By replacing the familiar bullet and cartridge with a miniature rocket, a great number of advantages are realized. There can be a complete elimination of recoil; there is no muzzle blast; the weapons will not overheat; a large number of moving parts can be eliminated as no spent cartridges must be ejected from the chamber; precision manufacture is no longer necessary for manufacturing the barrel and related components; the barrel can be made of relatively thin wall tubing as it does not need to contain the pressure rise of the propellant; rifling is unnecessary; a higher rate of fire can be achieved as two or more projectiles can be traveling in the launching tube simultaneously; and most important, the higher projectile velocity is in the target impact area rather than just after the projectile leaves the barrel.

When a rocket is fired it accelerates without recoil if means are provided in the launching tube for allowing the gases of combustion from the burning propellant grain to escape. Alternatively a short portion of the launching tube, e.g., an inch or two, can be left unported to provide some pressure blowback to actuate the reloading mechanism. By using a ported launching tube, there is no pressure buildup to cause muzzle blast. The rockets of the present invention do not use a tight fit in the launcher as they are self-stabilizing and do not need to seal the gases of combustion in the barrel. The launcher does not overheat from repeated firing because there is no friction between the projectile and the launching tube, and only some 10% of the propellant charge is expended in the barrel. When a rocket is fired, all components leave the weapon through the launching tube. There is no spent cartridge case to be ejected. Thus the weapon can be designed with fewer operational movements and therefore fewer moving parts, thereby saving cost, weight, and mechanism motion. Since the rockets are self-stabilizing, the barrel does not need to be precision machined to provide rifling and a tapering longitudinal barrel wall cross-section thickness. In addition, since the barrel does not need to contain the pressure rise of the propellant, simple thin wall tubing having a smooth bore and constant inside diameter will suffice as a launching tube. By using rockets in a firearm, a much higher rate of fire can be achieved since it is not limited by the rate of insertion and ejection of cartridges. In automatic weapons of contemporary design, the bullet must be almost out of the barrel before blowback pressure is siphoned off to actuate the ejection and reloading mechanism. This is to allow the bullet to absorb the largest amount of energy possible, from the pressure rise of the propellant, before it is ejected from the barell. Rockets, on the other hand, do not need to absorb energy in the launching tube, as they are self-propelled and therefore do not need to wait for the preceding rocket to clear the muzzle. Two or more projectiles can be in the launching tube simultaneously, thereby permitting a much higher rate of fire and eliminating unnecessary mechanisms. The most valuable characteristic of a rocket that has not been used advantageously, prior to the present invention, is the fact that the highest velocity of a rocket is achieved at some point after launch, and not at the end of the launching tube. Bullets, on the other hand, have their maximum velocity upon emergence from the barrel and they continually decelerate until they strike the target. Rockets, therefore, are a more ideal weapon for antipersonnel use as a kinetic energy kill mechanism since they can be designed to have their highest energy in the probable impact area. Rockets have traditionally been used to deliver a payload, such as incendiaries or high explosive, on an objective, but never as an antipersonnel kinetic energy kill weapon until the inventors produced the rockets of the present invention and of associated patent applications. One unique advantage that rockets obtain, which is not true of other small arms type weapons, is that they are less dangerous at very close range than they are at a distance from the end of the launching tube. When fired from launching tubes the length of conventional pistols they have not gained sufficient velocity at the end of the barrel to penetrate the human body. Thus accidents at very close range are much less severe; an inverse of the effect caused by standard small arms weapons. Additionally, the use of rockets provides a tracer to the point of highest projectile velocity. Additional tracer material could be provided to effect a tracer for the complete trajectory. These new parameters, advantages, and characteristics provide the designer of weapons for firing the rockets of the present invention with virtually unlimited freedom to create a whole concept in small arms type weapons.

Heretofore the lower limit in size for which rockets useful for ordnance purpose could be constructed has generally been considered to be on the order of a few inches in diameter and no less than about one foot in length. These rockets are generally launched by means of apparatus especially constructed for the purpose, since the heretofore large size and launching characteristics of rockets have precluded the use of rifle or sidearm weapons as a launcher. Producing a rocket or other self-propelled projectile having a size corresponding to the ammunition usually employed in sidearms and rifles has not been attempted before due to the numerous problems involved. If attempts have been made in the past to achieve effective operation with fueled rockets of smaller size than those of the prior art, they do not appear to have been sufficiently successful to warrant practical application.

The size range which is appropriate for the indicated purposes is comparable to the size range of conventional sidearm, rifle, and shotgun calibers. These would be in a range of below about one inch in diameter down to about one to two tenths of an inch in diameter, i.e., 10 gauge to .22 caliber, with a maximum length of a few inches, with the minimum length being about one inch as represented by a generally cylindrical body. For present purposes a rocket projectile in the indicated size range will be termed a "miniature" rocket to distinguish from previous devices.

Certain serious technical difficulties, apparent from previous experience with smaller rockets, were believed to be insurmountable obstacles for constructing rocket sizes substantially below those previously employed. It was known that propellant efficiency is highly dependent upon chamber volume, and chamber volume decreases at such a rapid rate with a decrease in size that it was concluded by workers in the art that conventional propellants become inoperative or impractical in miniature size projectiles. Another factor pointing toward the technical unfeasibility of creating a miniature rocket projectile was the heretofore thought impossible task of maintaining stable burning conditions in the combustion chamber. It was noted that certain propellant crystal component dimensions would be of an order of magnitude comparable with the propellant perforation and web thickness on the order of 0.10 inch. Whereupon it was concluded that when the flame front reached a large propellant crystal there would result a pressure pulse which in a miniature size would cause burning to become uncontrolled and rupture the case. It was further felt that a nozzle and grain perforation combination could not be provided in accord with known practice to successfully damp out such pressure pulses. Investigations had shown that the burning of rocket propellants produces particles of macroscopic size and it was believed that these particles would plug the nozzle orifices of miniature rockets. Other investigations had shown that the time for the elements of combustion to come into contact was on the order of microseconds and that with miniature rockets a large percentage of the combustion process would occur outside the combustion chamber behind the rocket, providing lower specific impulse. Other theories dictated that the case and nozzles of the miniature rockets would absorb large amounts of heat from the combustion of the propellant, thus lowering the rocket motor efficiency. Moreover, the case bonding agents, in accordance with conventional techniques, would unproductively utilize an undesirable amount of the small combustion chamber volume available. It was also contemplated that inhibiting or case bonding compounds usually considered necessary, and which function by diffusing into the outer surface of the fuel charge, would likewise produce a prohibitive reduction in propellant effectiveness. While the latter effects can usually be ignored in larger projectiles, the disproportionate decrease in chamber volume, with a decrease in size, causes these factors to become critical, as do others, when a miniature size projectile is to be provided.

Several discoveries were made whereby the obstacles were overcome. It was found advantageous to employ a light case in combination with propellant of high energy content to achieve as high a velocity as possible at a distance from the launcher, and in the vicinity of the target, since impact effectiveness increases at a remarkable rate with increase in terminal velocity. A relatively homogeneous propellant of low porosity is employed extending substantially the length thereof. The propellant grain, unlike those of conventional rockets, is supported without any internal structure or hardware, thereby affording maximum utilization of all the available combustion chamber volume. It was found necessary to employ a nozzle configuration which provides gyroscopic stabilization of this miniature size projectile without the use of fins and also thereby providing accuracy to the projectile. This nozzle means also provides for the control of internal pressure. The elimination of fragile fins as a means of stabilization also allows the use of heretofore lost volume in the launching tube for a larger casing containing a larger combustion chamber and more propellant.

Briefly, the invention is a miniature ballistic rocket for use in conventional small arms type weapons comprising a generally elongated cylindrical casing of exterior dimensions comparable to those of small arms weapons ammunition and having an aerodynamically streamlined closed forward end and a rear end, the casing defining a combustion chamber; a self-supporting propellant grain of high energy content capable of burning at a continuous deflagration rate having at least one longitudinal perforation extending substantially the length thereof, disposed and

secured in spaced relation to the rear end of the casing, nozzle means disposed in the rearward end of the casing in spaced relation to the propellant grain and formed for imparting spin to the rocket about its longitudinal axis from the gases of combustion passing therethrough, and ignition means including a primer cap integral to the nozzle means providing substantially uniform longitudinal ignition of the propellant grain perforation. This invention can actually be fired from conventional rifles and pistols of the correct caliber.

An object of this invention is to provide a structural configuration for a miniature rocket suitable for launching from small arms weapons and having a high impact velocity at a substantial distance from the launcher.

A still further object of this invention is to provide a means for spin stabilization in this miniature size which allows this projectile to be compatible with small arms type weapons.

Other objects and advantages of the invention will be set forth in the following description of the invention and illustrated in the accompanying drawings of which:

FIG. 1 is a side view, in section, of a miniature rocket embodying the present invention.

FIG. 2 is a further embodiment of the invention showing a ball between the projectile and the casing;

FIG. 3 is a still further embodiment of the invention showing a Teflon wad between the projectile and the casing;

FIG. 4 is a further embodiment of the invention showing a spirally grooved casing construction;

FIG. 5 is a still further embodiment of the invention showing another casing construction including vanes; and

FIG. 6 is still another embodiment of the invention showing a silicon lubricant disposed between the rocket and the casing.

Firing the rockets of the present invention from fast moving vehicles, such as jet aircraft, imposes additional problems due to the extreme cross winds encountered which causes the rocket to fly an unpredictable spiral trajectory. One effective solution to the problem is to provide an external casing or shield to the projectile. This creates a neutral interface to the cross wind, preventing air pressure imbalances on the casing which cause the spiral trajectories. The spinning rocket in the casing provides gyroscopic stability.

Turning now to the preferred embodiment of the invention of FIGURE 1, a projectile **106** generally similar to those shown in the other figures is first placed in an external shield **107** having a relatively close tolerance and an internal configuration which conforms to the shape **108** of the rocket. The rear end **109** of the shield is flanged over the rear end of the rocket. The rocket is then secured to the flanges by a light cement as illustrated in FIG. 5 to maintain alignment. Alternatively, instead of flanging over the rear end the shield can be given a light rolling on the rear end to grip the rocket. In this connection note the view of FIG. 4. When the rocket is ignited it thrusts forward in the shield on the air cushion in the nose of the shield. This forms an air bearing and permits the contained air to seep around the sides. In order to prevent the rocket from causing the shield to rotate, the shield can be given a slight counter rotation (FIG. 4) by rifling in the launching tube so that it emerges with little or no rotation or by placing vanes (FIG. 5) on the nose of the shield to provide a counter moment. By the time all of the air has escaped, the projectile will have reached the target or the cross wind effect will be negligible. Alternatively, a solid bearing instead of the air bearing can be provided in the nose of the shield. This could be a ball bearing **111** as shown in FIG. 2 or a Teflon wad **112** as illustrated in FIG. 3. The initial thrust of the rocket would unseat the rocket from the flange formed in the rear of the shield and permit it to freely rotate. A silicone lubricant as shown in FIG. 6 could be used between the shield and the rocket casing.

Other configurations of bearings and means of counter-rotating the shield can be devised but would simply be skill in the art of implementing the inventive concept here described. These and many other advantages to using rockets in conventional small arms type weapons have been carefully pointed out herein. Many problems have been overcome by the present invention to implement the novel idea of firing rockets from standard small arms weapons.

While changes can be made in the details of construction and methods of fabrication of the miniature rockets of the present invention, without departing from the spirit and scope of the invention, it is not to be limited except as defined in the following claims:

We claim:

1. An improved rocket construction comprising a rocket including a forward ogive nose portion and an aft portion, a shield surrounding said rocket having a leading portion and a trailing open end portion and including an inner configuration substantially complemental to said rocket and further having a portion slightly greater than said rocket, the trailing end portion of said shield being adapted to snugly embrace the perimeter of the aft portion of said rocket.

2. An improved rocket construction as claimed in claim **1**, wherein a frangible means is interposed between the trailing end portion of the shield and the aft portion of the rocket.

3. An improved rocket construction comprising a rocket including a forward ogive nose portion and an aft portion, a shield surrounding said rocket having a leading portion and a trailing open end portion and including an inner configuration substantially complemental to said rocket and further having a length slightly greater than said rocket, said shield having flanged means over the aft end of the rocket to contain the rocket within said shield.

4. An improved rocket construction as claimed in claim **3**, wherein a frangible means is interposed between the flanged means of said shield and the aft end of the rocket.

5. An improved rocket construction as claimed in claim **3**, wherein an air cushion is provided between the forward portion of said rocket and the shield.

6. An improved rocket construction as claimed in claim **3**, wherein a ball bearing is positioned between the forward portion of the rocket and the shield.

7. An improved rocket construction as claimed in claim **3**, wherein a Teflon wad is positioned between the forward portion of the rocket and the shield.

8. An improved rocket construction as claimed in claim **3**, wherein the perimetrical area of said shield is provided with rifling means to prevent rotation thereof relative to the rocket during flight.

9. An improved rocket construction as claimed in claim **3**, wherein the perimetrical area of said shield is provided wtih vanes to prevent rotation thereof relative to the rocket during flight.

10. An improved rocket construction as claimed in claim **3**, wherein a silicone lubricant is interposed in the area between the perimetrical area of said rocket and the shield to thereby provide for relatively free rotation of the rocket within the shield.

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