Sept. 26, 1967 A. T. BIEHL ET AL 3,343,766

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Original Filed April 2, 1965

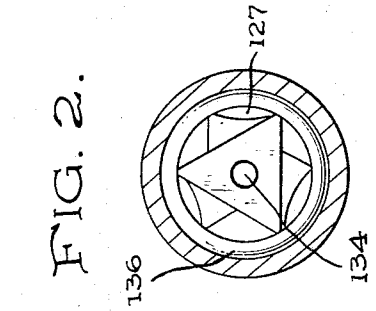

FIG. 2.

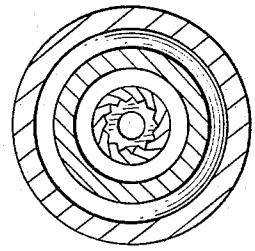

FIG. 4.

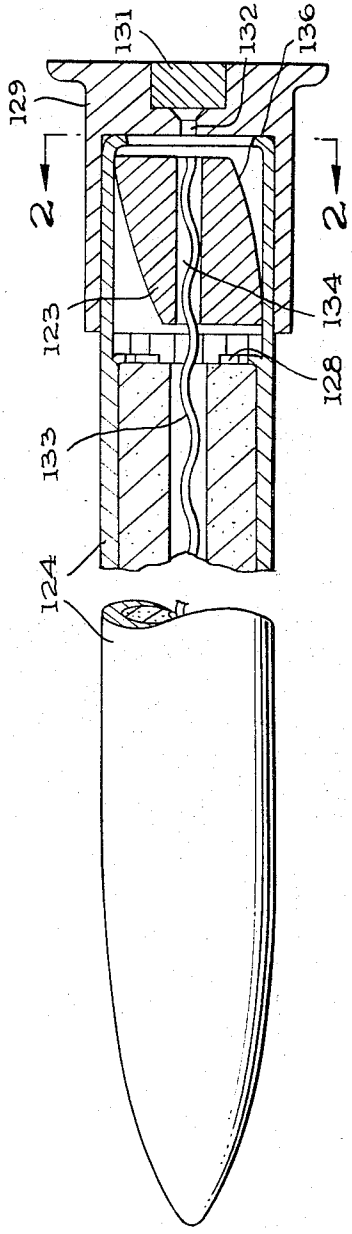

FIG. 1.

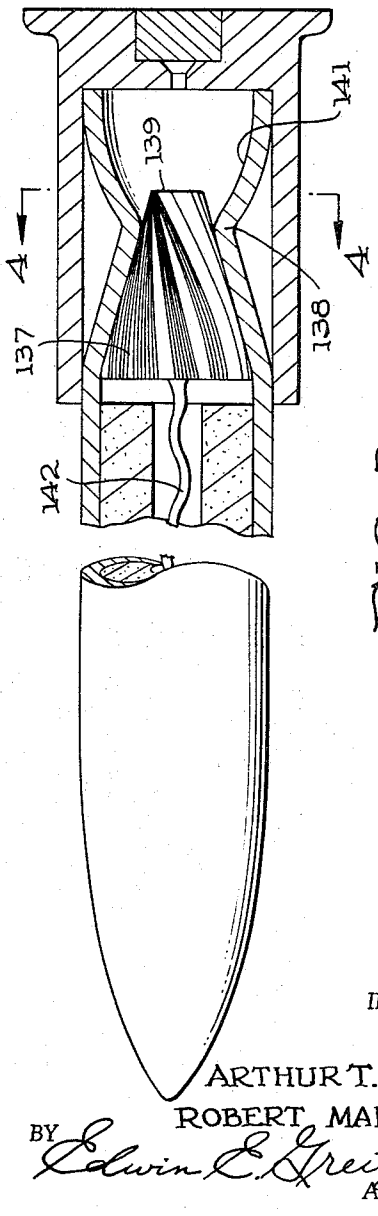

FIG. 3.

INVENTORS

ARTHUR T. BIEHL

ROBERT MAINHARDT

BY Edwin C. Greigg

ATTORNEY

United States Patent Office 3,343,766
Patented Sept. 26, 1967

3,343,766

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Arthur T. Biehl and Robert Mainhardt, Diablo, Calif., assignors to MB Associates, a corporation of California

Original application Apr. 2, 1965, Ser. No. 445,277, now Patent No. 3,313,207, dated Apr. 11, 1967. Divided and this application Oct. 22, 1965, Ser. No. 514,425
6 Claims. (Cl. 244—3.23)

This application is a divisional application of my co-pending application Ser. No. 445,277, filed April 2, 1965, now Patent No. 3,313,207, entitled "Underwater Weapon," which is a continuation-in-part of application Ser. No. 225,672, filed Sept. 24, 1962, entitled "Underwater Weapon," the latter application now abandoned.

The present invention relates in general to the field of underwater weapons and more particularly to a hand held underwater weapon wherein small rockets embodying novel construction features are employed to obtain unusual underwater ordnance effects.

Heretofore, hand held underwater weapons for fishing as well as for military applications have consisted of arbalete, spring driven, compressed gas, and explosive driven guns, all of which have certain disadvantages. Not the least of these disadvantages are that these weapons have relatively short range and very low penetrating power. Moreover, they are complicated to fire and hard to reload. Some of the advantages which could be obtained by using the underwater weapon comprising a rocket projectile are apparent from experience with larger rockets. Among these would be the elimination of recoil and muzzle blast, both of which are very undesireable underwater. Simplification of the design can be accomplished through the reduction of the need for precision manufacturing of launching apparatus, and reduction of the overall size and weight of the weapon. The cost is comparable, and in most cases less, than previously existing weapons.

In accordance with the present invention the launcher housing, launch tubes, and rockets may be made entirely of a strong plastic or non-magnetic material so as not to interfere with the operators compass, i.e., his navigation. A rocket propelled projectile also has a decided advantage over spring or arbalete projectiles in that it attains its maximum velocity at some distance from the launcher whereby the projectiles have the greatest energy in the target area. Although some compressed gas projectiles may exhibit this feature, they have a much lower energy potential wherefore the target range and effectiveness is considerably less. Compressed gas weapons also require undesirably heavy bulky containers for transporting the gas. The use of a rocket projectile in underwater applications also affords utilization of the combustion chamber flame to ignite a tracer as a pyrotechnic delay train which may be used to set off high explosives in a warhead. Impact initiated warheads are also contemplated and described herein.

In accordance with the present invention some embodiments of the rocket projectile are reusable, as propellant charges may be replaced therein, allowing the use of the entire casing and nozzle many times. Furthermore, stabilization of these rockets is achieved by a drag or roll induced through the configuration of the rocket nozzle or projectile exterior design. Normal finned stabilizing techniques could be used. The former two techniques obviate the need for fins, which reduces the complexity and size of the launchers required for these rockets. Novel ignition techniques are also contemplated which provide control of the launching sequence, as well as reliable ignition of the rocket underwater, and are disclosed herein.

An object of this invention is to provide an underwater weapon which is light weight, small, easily reloadable, inexpensive, and yet attains high energy with deep penetrating power at long range.

Another object of this invention is to provide an underwater weapon which has very little recoil or muzle blast, and does not produce an unpleasant or unbearable underwater sound effect.

A further object of this invention is to provide a miniature rocket of novel construction features which is suitable for underwater operation and has a variety of lethal warheads.

A still further object of this invention is to provide a means for maintaining miniature underwater rockets in dynamic stability.

Still another object of this invention is to provide an underwater weapon comprising reusable rocket projectiles.

Yet another object of this invention is to provide novel ignition techniques for underwater operation of small rockets.

Other objects and advantages of this invention will be set forth in the following description of the invention and illustrated in the accompanying drawings, in which similar reference characters relate to similar components and of which drawings:

FIG. 1 is a side view partially in cross-section of one type of roll stabilization means for a miniature rocket;

FIG. 2 is a view on line 2—2 of FIG. 1;

FIG. 3 is a side view partially in cross-section of an alternative form of roll stabilization means for a miniature rocket; and

FIG. 4 is a view on line 4—4 of FIG. 3.

Referring now to the drawings by reference characters and referring particularly to FIG. 1, there is shown a rocket casing **124** and an improved nozzle means for roll stabilization of the rocket. This nozzle is produced by taking a solid rod body, having a polygonal cross section, preferably triangular, and twisting it about its longitudinal axis to the desired helical degree. A piece of the twisted rod **123** is then inserted and secured into the rocket casing **124** rearwardly of the propellant grain **126** and in spaced relation thereto. This causes a constrictive cross section in the exit portion **127** (FIG. 2) of the casing through which the gases of combustion exhaust. The constricting effect results in providing a nozzle for the rocket. As the gases of combustion egress through this portion of the casing, the helical configuration of the twisted rod causes the gases to flow in such a manner that the linear momentum thereof is partially converted to include an angular moment which causes the rocket to rotate around its longitudinal axis.

The propellant is restrained in the forward end of the combustion chamber by metal tabs **128** extending from the interior wall of the casing and formed by a breaching tool. As with the devices of the previous embodiments, primer cap ignition is also provided which consists of an empty cartridge cap **129** coaxially pressure fitted to the rear end of the casing and including a primer cap **131** which is disposed in a seat at the rear of the cap and provided with a communication port **132** to the interior of the rocket. An igniter fuse **133** extends the length of the perforation and through a longitudinal perforation **134** in the twisted rod. Alternatively, the igniter could be run around the sides of the twisted rod, between the rod and the casing wall, thereby eliminating a hole through the center of the rod. Alternatively, a flash mix material could be disposed on the surfaces of the rod before it is inserted into the casing, which transmits the heat of ignition from the primer cap to the igniter fuse.

FIG. 2 is an end view taken on line 2—2 of FIG. 1 showing how the piece of twisted rod is restrained in the casing by means of the flange **136** which is rolled into the rear end of the rocket casing securing the rod therein.

A sophisticated version of this embodiment would permit the use of the 4 or 5 or 6 sided rod whereby very small clearances are then provided between the wall of the casing and the rod. In this embodiment, a nozzle would then be formed down the center of the rod with a diverging exit cone or a converging-diverging orifice. This could simply be done by drilling and counterboring. With this arrangement a basic portion of the exhaust gases would be properly constricted for egress through the portion of the rod while only the small portion of the issuing gases would be diverted to escape around the outside of the rod between the casing wall and the rod surfaces. This would permit the basic or the largest portion of the exhaust gases to be used for propelling the rocket and the siphoning off of only a smaller percentage of the exhausting gases for providing the angular rotation.

FIG. 3 is a further alternate nozzle means for providing roll stabilization to the rocket. In this embodiment the skewed vanes **137** are positioned in the rocket nozzle forward of the constricted orifice **138**. This is achieved by providing an insert **139** for the rocket casing which has a configuration comparable to a spiral miter gear. The insert tapers to conform to the converging portion of the nozzle cone. The spiral teeth on the insert provide the skewed vanes which divert the gases of combustion exhausting through the nozzle to create the angular moment. The nozzle throat is created by metal forming the nozzle casing over the insert and then metal forming a comparable diverging portion **141** to the casing whereby a converging-diverging nozzle cross section is formed in the rocket casing. Similarly, as with the embodiment of FIGURE 11 a central perforation could be provided in the insert to permit exhaustion of a basic portion of the gases of combustion whereby only a smaller portion is siphoned off to provide the angular turning moment. The skewedness of the vanes can range from one to approximately 35 degrees depending upon the degree of roll stabilization desired and how much of the gases of combustion will be routed through the skewed vanes. Ignition of the propellant grain through this insert can be effected down the center bore by means of an igniter fuse, if one is provided, or by means of an ignitor fuse routed between the vanes or by flash mix inserted on the surface of the insert between the vanes.

The use of the high powered underwater rockets of the present invention by underwater demolition teams of the Navy has the additional advantage of providing a lethal weapon which can be used for self-defense out of the water. The rocket provides such thrusts that the rocket powered projectile will carry for considerable distances in air with excellent accuracy. Thus, the UDT man does not have to carry two types of weapons.

While changes can be made in the details of construction and methods of fabrication of the underwater 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.

I claim:

1. A rocket nozzle and an insert in said nozzle, said insert consisting of a rod-like body, said rod-like body having polygonal end surfaces and contoured side surfaces, said contoured side surfaces having a configuration such that the intersecting line between any two adjacent side surfaces follows a helical path.

2. A rocket nozzle and an insert in said nozzle as claimed in claim **1**, wherein the contoured side surfaces of said rod-like body are formed to follow the helical path by twisting the rod-like body about a longitudinal axis.

3. A nozzle as claimed in claim **1**, wherein the rod-like body is provided with a constricted axial perforation.

4. A nozzle as claimed in claim **1**, wherein the rod-like body has a tripartite configuration.

5. A nozzle as claimed in claim **1**, wherein the rod-like body consists of a frustum, said body having helically contoured edges equally spaced over the entire surface area thereof.

6. A nozzle as claimed in claim **5**, wherein said casing is provided with a constricted area including a converging portion arranged to merge with a diverging portion, said frustum being positioned in the converging portion.

References Cited

UNITED STATES PATENTS

2,412,173	12/1946	Pope	102—49 X
2,545,496	3/1951	Short	102—51
3,017,748	1/1962	Burnside	60—35.6

BENJAMIN A. BORCHELT, *Primary Examiner.*

V. R. PENDEGRASS, *Examiner.*