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Inventor Matthew Sanford
Thomas A. DelGuidice

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OFFICE OF NAVAL RESEARCH
DEPARTMENT OF THE NAVY
CODE 00CC
ARLINGTON VA 22217-5660

ENERGY ABSORBING COUNTERMASS FOR SHOULDER-LAUNCHED ROCKET WEAPON

Origin of the Invention

The invention described herein was made in the performance of official duties by an employee of the Department of the Navy and may be manufactured, used, licensed by or for the Government for any governmental purpose without payment of any royalties thereon.

Field of the Invention

The invention described herein relates to shoulder-launched anti-armor, weapons and in particular to rocket propelled systems having reduced back blast.

Background of the Invention

To fire a shoulder-launched weapon with no recoil, the traditional method is to use either a rocket propulsion system or a powder charge with a countermass. Rocket propulsion operates by firing within the launcher tube, with the rocket exhaust exiting the open back of the tube. The disadvantages of rocket propulsion include a lethal zone behind the launcher caused by shock waves, hot, rapidly moving gas, and sound levels approaching allowable double ear protection levels in an open environment. Large smoke and flash discharge also give away the position of the gunner. All of the above characteristics prevent the use of rocket systems within a confined space, such as an enclosed fortification or bunker.

A variant of the rocket propulsion method is to fire the round out of the tube with a small charge, and then ignite the rocket when it is a safe distance from the gunner. The disadvantage of this method is that additional components (with potential failure mechanisms) are required. Additionally, guidance mechanisms must be incorporated into the round, thereby increasing the cost and complexity of the system.

The powder/countermass method operates by firing a powder charge within the launcher tube, with the charge sandwiched between the round and a countermass. The rocket is fired out the front of the launcher tube while a countermass is discharged out the rear of the launcher tube. The disadvantage of the powder/countermass method is that the countermass becomes a lethal projectile traveling rearward at high velocity, endangering anything in its path. This characteristic also prevents use within a confined space.

A variant of the powder/countermass method is the use of a frangible countermass which upon exiting the launch tube breaks up into small, light-weight pieces. These pieces slow down rapidly due to the high drag per unit mass. The discharge from the rear of the launcher tube remains dangerous at close range and the smoke and flash continue to give away the position of the gunner.

What is needed is a weapon having a mechanism to alternate the back blast of a rocket round without producing a high velocity countermass projectile. Current counter-mass systems, designed for gun firing, cannot properly alternate the comparatively slower burning but extended firing time of rocket-propelled weapons.

Summary of the Invention

It is an object of the invention to provide a countermass adapted to alternate the exhaust blast of a shoulder-launched, rocket propelled weapon.

It is another object of the invention to provide a countermass for a shoulder-launched rocket which has a low exit velocity.

It is a further object of the invention to provide a countermass for a shoulder-launched, rocket-propelled weapon which absorbs energy by crushing.

Accordingly, the invention is a crushable countermass assembly forming a plug for inserting in the aft end of the rocket tube of a shoulder-launched weapon. The plug is a cylindrical device having three components, a piston located at the forward end of the cylinder, a compressible material formed using aluminum honeycomb in the center section, and a countermass located at the rearward end of the plug. The mass is a frangible material which disperses after tube exit and after complete compression of the crushable material.

Brief Description of the Drawings

The foregoing objects and other advantages of the present invention will be more fully understood from the following detailed description and reference to the appended drawings wherein:

FIG. 1 is a cross-sectional side view of a shoulder-launched rocket weapon showing a rocket round and the energy-absorbing countermass assembly in firing position.

FIG. 2 is a cutaway side view of the energy-absorbing countermass assembly.

FIG. 3 is a partial side view of the rearward end of the countermass assembly.

FIG. 4 is a partial side view of the rearward end of the countermass assembly during release of the frangible countermass.

FIG. 5 is a cross-sectional side view of a shoulder-launched weapon showing a rocket round and the energy-absorbing countermass immediately after firing.

FIG. 6 is a cross-sectional side view of a shoulder-launched weapon showing a rocket round and the energy-absorbing countermass just prior to muzzle exit by the rocket.

FIG. 7 is a cross-sectional side view of a shoulder-launched weapon showing a rocket round and the energy-absorbing countermass immediately after muzzle exit by the rocket.

Detailed Description of the Invention

Referring now to FIG. 1, the energy-absorbing countermass assembly is described generally by reference numeral 10, which is shown inserted in the rocket tube of a shoulder-launched rocket weapon 9 immediately behind a rocket round 8. The energy-absorbing countermass assembly 10 comprises three major components, the lightweight piston 12, located on the forward end of the energy-absorbing countermass assembly, a crushable cylindrical center section 14, and a frangible countermass 16.

This energy-absorbing countermass assembly is a variant of the powder/countermass adapted for use in rocket weapons. The energy-absorbing countermass assembly uses a compressible energy absorbing material with a moveable countermass. When the weapon is fired, a powder charge produces high pressure gas. This gas expands between two pistons, one of which is the rocket round 8 and the other piston 12, is attached to the forward end of the compressible material 14. The countermass 16 is attached to the rearward end of the compressible material 14. As the round and lightweight aluminum piston 12 move apart, work is done (work = force x distance) on each assembly. For the round, this work takes the form of an increase in velocity (kinetic energy = $\frac{1}{2}mv^2$). For the energy-absorbing countermass assembly, part of the work is expended in accelerating the lightweight piston 12. Another part of the work is absorbed by the energy absorbing material 14 as it is compressed between the piston 12 and the inertial countermass. During the crush phase, the force transmitted to the countermass 16 is limited to the crush strength of the compressible material 14. For these reasons, the countermass experiences a much lower accelerating force than the rocket round, and leaves the barrel with much less velocity.

FIG. 2 shows the construction of the energy-absorbing countermass assembly 10. The lightweight piston 12 and compressible center section 14 are shown for reference. The countermass 16 is formed with a plurality of leaves 22 forming a cylindrical enclosure around the countermass 16. The leaves 22 are opened during the final crushing stages of the center section 14, thereby releasing the frangible material used to provide mass.

Referring to FIG. 3, the interior details are illustrated in a partial side section. The center section 14 is filled with crushable material 32. In the preferred embodiment, honeycombed aluminum structure was used as a crushable material. The rearward end of the crushable material 32 includes an aluminum actuator ring 34, which, when driven by the crushing of material 32 against the leaves 22 of the countermass 16, cause the leaves 22 to open.

Contained within the countermass 16 is a rippable envelope 36 containing the frangible mass 38.

FIG. 4 depicts the opening of leaves 22 at the end of the compression stroke. The crushable material 32 is fully compressed. At this point, the actuator ring 34 is forced rearward against the feet 42 of the leaves 22 causing the leaves to open. As the leaves 22 open, disengaging hooks on the aft ends of the leaves, the rippable polypropolene envelope 36 separates allowing the frangible mass 38 to be dispersed. A portion of the rippable envelope 36 remains attached to a plastic endcap 44. The frangible countermass may be any material having high density but formed of small particles. Powdered iron, lead or other material may be used. In the preferred embodiment, the frangible material is water.

OPERATION OF THE INVENTION

Referring now to FIG. 5, immediately after firing of round 8 within the shoulder-launched rocket weapon 9, the lightweight piston 12 begins to move rearward beginning the compression of the crushable center section 14. The crush resistance of the crushable section 14 is gradually increased from front to rear, thereby allowing a progressive crushing from the front of the energy-absorbing countermass assembly as shown by crushed section 52. The mass of the mass mechanism 16 is sufficiently large so that very little rearward movement occurs during the initial firing.

FIG. 6 shows the weapon with the round 8 just prior to muzzle exit from the shoulder-launched rocket weapon 9. The energy-absorbing countermass assembly 10 has partially exited the exhaust end of weapon 9. The lightweight piston 12 has compressed the crushable center section so that the crushed section 52 has absorbed a part of the rocket blast energy, the remaining energy transferred to the lightweight piston 12 and to the velocity imported to the mass mechanism 16.

Referring to FIG. 7, immediately after the rocket 8 exits the weapon 9, the energy-absorbing countermass assembly 10 also exits the exhaust end of the weapon 9. The lightweight piston 12 has fully compressed the crushable material leaving a crushed section 52 extending between the lightweight piston 12 and the mass mechanism 16. When the compression ends, the last movement of the compressible material causes an opening of the mass mechanism 16 and a release of the frangible mass 38.

The features and advantages of the present invention are numerous. While the warhead leaves the barrel at its design velocity, the compressible material compresses during launch, and it and the inertial mass leave the rear of the gun at a much reduced velocity. Initial analysis shows a countermass exit speed reduced by a factor of ten compared to the warhead muzzle velocity. Since the kinetic energy is a function of velocity squared, the countermass has 1/100th the kinetic energy. As such, the countermass greatly reduces the threat to the rear of the gunner.

Additionally, the flash and smoke exiting the exhaust of the rocket weapon are greatly reduced. This reduction avoids easy detection by energy forces and allows firing the weapon in partially enclosed fortifications, such as bunkers and the like.

Although the invention has been described relative to a specific embodiment thereof, there are numerous variations and modifications that will be readily apparent to those skilled in the art in the light of the above teachings. It is therefore to be understood that the invention may be practiced other than as specifically described.

ABSTRACT

An energy-absorbing countermass for a shoulder-launched rocket weapon is provided. The energy-absorbing countermass is to be placed behind a rocket round in the launch tube. The device has a center cylindrical section formed using a crushable aluminum honeycomb material. A lightweight piston is attached to the forward end of the center section and a mass mechanism is attached to the rearward end. The mass mechanism is a cylindrical enclosure having opening leaves. An envelope containing frangible mass is located inside the enclosure. When a rocket round is fired, the piston compresses the crushable material and at the end of the compression stroke actuates the release of the frangible mass material. The result is that the exhaust blast of the rocket round is sufficiently alternate to allow firing of a rocket weapon inside a bunker or other structure.

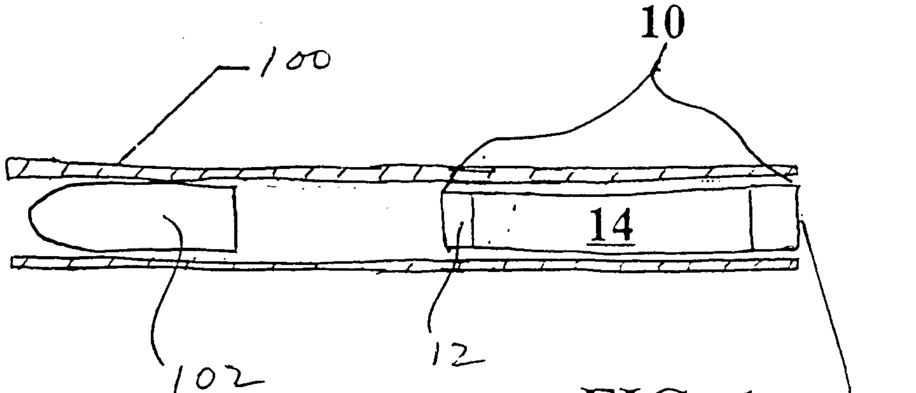

FIG. 1

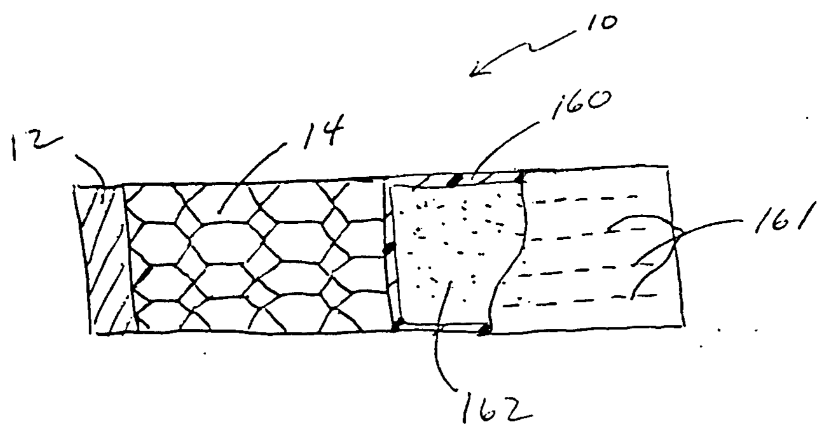

FIG. 2

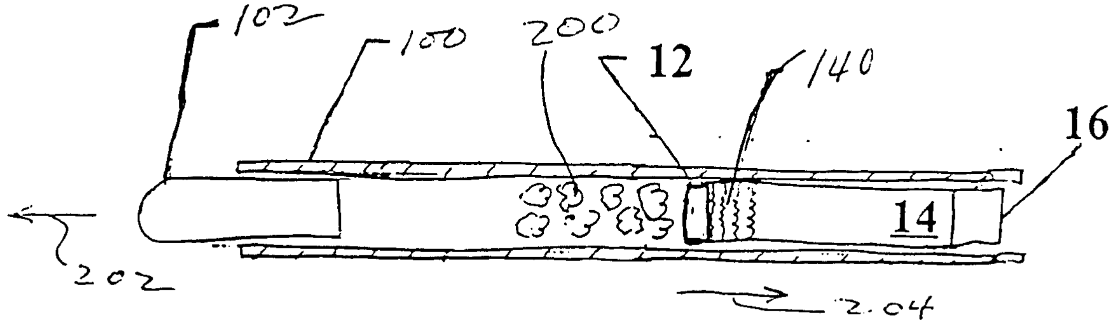

FIG. 3

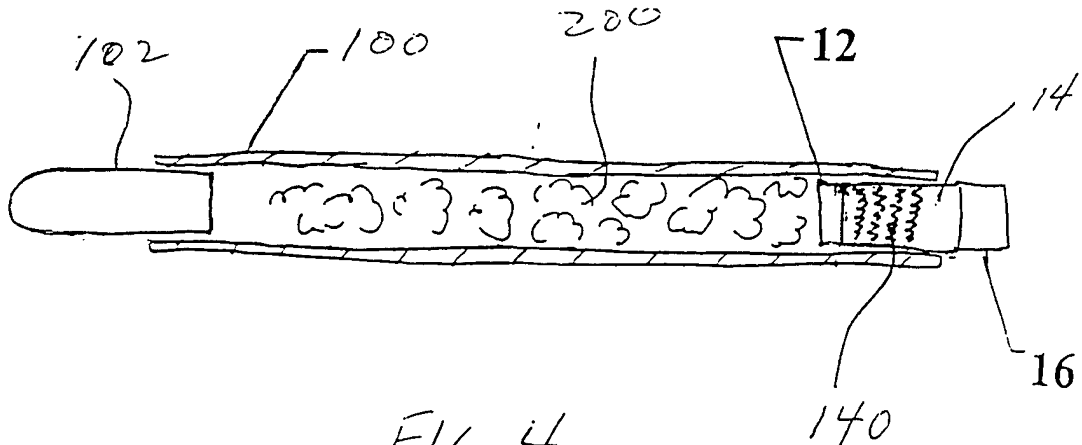

FIG. 4

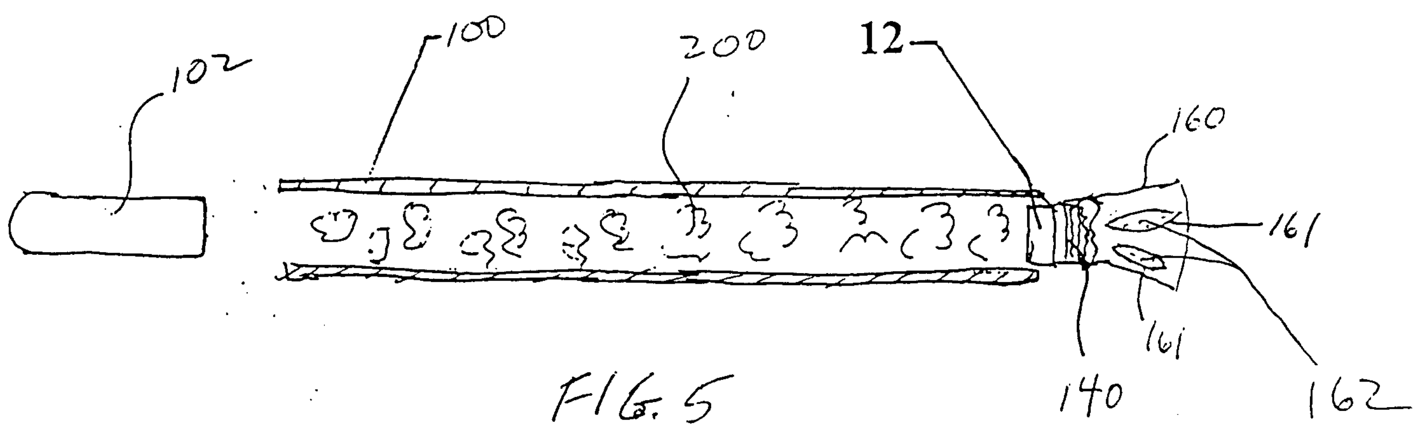

FIG. 5