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AUGMENTOR AND SABOT STRIPPER FOR HYPERVELOCITY LIGHT GAS GUN

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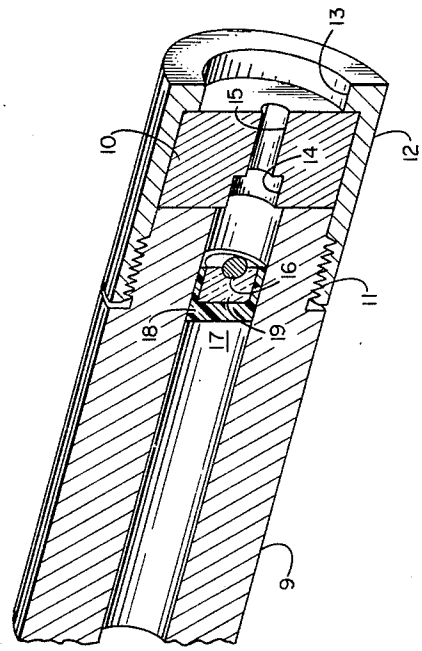

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AUGMENTOR AND SABOT STRIPPER FOR HYPERVELOCITY LIGHT GAS GUN

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The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

The present invention is directed to a hypervelocity gun facility and more particularly directed to a device for separating a projectile from the carrier or sabot to provide velocity augmentation for saboted projectiles at ultra-high velocities.

Heretofore, different types of hypervelocity light-gas guns have been used for propelling projectiles at high velocities. One such gun is described in Patent 2,882,796 in which a gas-driven piston forces a shear disc and projectile from a holder out through the gun barrel. Other types of light-gas guns use sabots which are driven down the gun barrel and when the sabot and projectile combination emerges from the gun barrel the sabot falls away and the projectile continues toward the target. Velocity augmentation techniques include heating of a light gas during a compression process by addition of electrical energy, adiabatic precompression, or application of direct heat through conductive and radiative processes. Other techniques include the application of heat to a light gas during the launch phase of the cycle. During this phase of the launch the gun barrel is subjected to excessively high pressures and the projectile is traveling at hypervelocities. Any modification to the gun barrel or adaptors, etc., will seriously effect the condition of both the barrel and the projectile, which may cause a projectile to break up or the gun barrel to burst. Other limitations to these techniques include timing of the energy insertion, wherein the energy must be inserted at times in the compression cycle which will cause increase in projectile velocity. Additional equipment requiring high degrees of sensitivity and calibration are necessary in order to achieve the time of energy insertion. None of the above described methods have achieved projectile velocities greater than the maximum velocity of the light-gas gun capabilities without augmentation. Velocity augmentation is brought about by techniques in which the sabot material is separated from the projectile wherein the sabot material is used to provide additional energy derived from the breakup of the sabot.

The present invention overcomes shortcomings of the prior art devices to provide an effective inexpensvie high-velocity gun which can be fired successively without damage to the gun barrel.

It is therefore, an object of the present invention to provide a hypervelocity gun which can be fired without damage to the barrel of the gun.

Another object is to provide velocity augmentation for saboted projectiles of ultra-high velocities.

Still another object is to provide a device for separating a projectile from the carrier or sabot.

Still another object is to insure accuracy of terminal ballistic data by eliminating or diverting the high velocity sabot particles from incidence with the target.

While still another object is to utilize kinetic energy produced by the projectile carrier or sabot, thereby increasing efficiency as well as performance of a hypervelocity light-gas gun.

Other objects and advantages thereof will be readily apparent from consideration of the following specification relating to the annexed drawing, in which:

The drawing is a sectional view of a gun barrel with an augmentor and sabot stripper attached to the gun barrel shown in perspective.

The hypervelocity augmentor and sabot stripper is a two-stage device designed to eliminate the sabot and to provide velocity augmentation to a projectile fired from a light-gas gun by utilizing the kinetic energy in the carrier or sabot. The hypervelocity augmentor and sabot stripper is secured to the end of a gun muzzle by use of screw threads or a suitable bolt and nut or screw arrangement. A projectile carried by a low density material such as a plastic sabot with fiber-glass insert is fired down the gun muzzle by a light-gas or other suitable means. The sabot on impact with the end surface of the sabot's stripper is explosively destroyed by the stripper. The sabot particles travel in the same direction as the projectile toward the target with a higher velocity than the sabot which produces additional forces on the projectile thereby producing a higher projectile velocity.

Referring now to the drawing, there is shown a cross sectional view of the hypervelocity augmentor and sabot stripper made in accordance with the present invention. The hypervelocity augmentor and sabot stripper **10** is formed by a high density material such as a copper insert. As shown, the gun muzzle end is cut down on the outer end and provided with screw threads **11** thereon. A holder **12** is threaded thereto for securing between the gun muzzle and the holder, the augmentor-sabot stripper **10**. The holder is provided with an axially aligned aperture **13** to permit passage of a projectile from the gun barrel. The augmentor and sabot stripper is made with two stages **14** and **15** and may be made of copper or any other dense materials as well as of a composite in which the first stage is of a less dense material than the material for the second stage. The inside diameter of the first stage of the insert is slightly smaller than the muzzle of the gun and the outside diameter of the sabot **17**. The second stage of the sabot stripper has an inner diameter which is less than the first stage but of a diameter which is slightly larger than the projectile to be fired by the gun. The distance between the first and second stage as well as the inside diameter of both stages must be carefully controlled in order to produce projectile acceleration without projectile breakup. This distance must be approximately equal to ½ the diameter of the bore of the gun barrel, with the inner diameter of the first stage slightly less than the bore and the diameter of the second stage just slightly larger than the projectile.

In assembly and in operation of the device, the augmentor-sabot stripper insert is placed in the holder which is then secured to the gun muzzle by the screw threads as shown or by a bolt or screw arrangement. A projectile **16** is secured to or assembled in a suitable sabot **17** made of a less dense material than the sabot stripper such as a plastic sabot **18** with fiber glass insert **19** and placed in the gun and fired down the gun muzzle in a normal manner of operation of a light gas gun. The plastic sabot strikes the first stage of the sabot stripper insert and on impact with the surface of the first stage material, a high pressure pulse is transmitted into the sabot but is quickly attenuated resulting in deceleration of the sabot and separation of the projectile.

The first stage separates the projectile from the sabot before the sabot reaches the second stage where more surface area of the sabot stripper is contacted and the sabot is explosively destroyed by the longer duration pressure pulse. The velocity of the particles of the sabot traveling in the same direction as the projectile toward the

target have a higher velocity which is equal to the velocity of the projectile plus the velocity imparted to the particles by the explosive forces generated upon impact of the sabot with the sabot's stripper. Some jetting of sabot material may occur as a result of the shape of the impacting surfaces. If jetting of sabot material does occur then the increase in velocity will be greater than the velocity produced by the explosive force alone. The high velocities of the sabot particles is maintained by the gas pressure which originally drove the sabot and projectile down the gun barrel toward the sabot stripper.

At the maximum velocities of light-gas guns the sabot material is gasified because of the high pressures generated in the sabot upon impact with the dense material, and a high velocity gas jet is formed by the vaporized sabot material behind the projectile.

Since the sabot stripper is secured to the end of the gun barrel and the force of the sabot is on the stripper, there is no damage to the gun barrel. The stripper is usually damaged and is replaced after each firing in order to obtain the best results and highest velocity of the projectile.

Obviously many modifications and variations of the present invention are possible in the light of the above teachings. It is therefore to be understood that within the scope of the appended claims the invention may be practiced otherwise than as specifically described.

What is claimed and desired to be secured by Letters Patent of the United States is:

1. A hypervelocity augmentor and sabot stripper which comprises:
- a cylindrical block of highly dense material,
- an aperture through said cylindrical block along the longitudinal axis thereof,
- said aperture forming first and second stages with different inner diameters of constant radii over the entire length of each stage along the axis of said cylindrical block,
- said first stage having an inner diameter greater than the inner diameter of said second stage with the wall thickness of said first stage of said sabot stripper less than the wall thickness of said second stage,
- said first stage having an inner diameter which is less than the outer diameter of a sabot to be stripped from a projectile,
- said first stage having an axial length which has a value of one-half the diameter of the bore of a muzzle of a gun barrel to which the augmentor-sabot stripper is secured in use,
- said second stage having an inner diameter which is slightly greater than the diameter of a projectile carried by the sabot
- whereby on assembly said first stage of said sabot stripper is secured juxtaposed the outer end of the muzzle of a gun barrel to which the sabot stripper is secured.

2. A hypervelocity augmentor and sabot stripper which comprises:
- a block of dense material of cylindrical configuration,
- said dense material having a greater density than the material of a sabot to be stripped by said sabot stripper,
- an axial passage through said block of dense material along the longitudinal axis thereof,
- said axial passage forming first and second stages in said block each with different wall thickness of uniform thickness along the length of each respective stage,
- said first stage having a wall thickness less than the thickness of the wall of said second stage,
- said passage through said first stage having a cross-sectional dimension perpendicular to the axes thereof which is less than a bore of the gun barrel to which said augmentor, sabot stripper may be secured and less than the outer dimension of the sabot to be stripped from a projectile by said sabot stripper,
- said second stage having a cross-sectional dimension perpendicular to the axis thereof which is less than the cross-sectional dimension of said first stage and larger than the projectile to be carried by a sabot to be stripped by the sabot stripper,
- whereby on assembly said first stage of said sabot stripper is secured juxtaposed the outer end of a muzzle of a gun barrel to which the sabot stripper is secured.

3. In combination,
- a gun barrel of a light gas gun,
- an augmentor-sabot stripper element,
- a holder associated with said augmentor-sabot stripper for securing said augmentor-sabot stripper in axial alignment with the muzzle end of said gun barrel and adjacent thereto,
- said stripper element having an axial passage therethrough in axial alignment with the gun barrel,
- first and second sections of different length and inside diameter of constant radii over the length of each section formed by said passage through said stripper with said first section secured adjacent the muzzle of said gun barrel,
- said first section having a cross-sectional diameter less than the bore of said gun barrel with a greater diameter and shorter length than said second section,
- said first section of said stripper having a cross sectional diameter less than the diameter of a sabot to be stripped from a projectile; and
- said second section has a cross-sectional diameter slightly greater than the diameter of a projectile to be fired through said stripper element.

4. In the combination, as claimed in claim 3, which includes:
- a projectile,
- a sabot adapted to cary said projectile through said gun barrel,
- said sabot comprising two separate and different types of low density material and having an outer diameter slightly less than the diameter of the bore of said gun barrel,
- said projectile being secured to said sabot on an axis through the sabot and said gun barrel and facing in the direction of the muzzle end of the gun barrel, whereby
- said projectile separates from said sabot on impact of said sabot with said first section of said sabot stripper secured adjacent to the muzzle end of said gun barrel and said projectile is forced out through said second section of said sabot stripper.

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