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HYPERVELOCITY PELLET PROJECTOR

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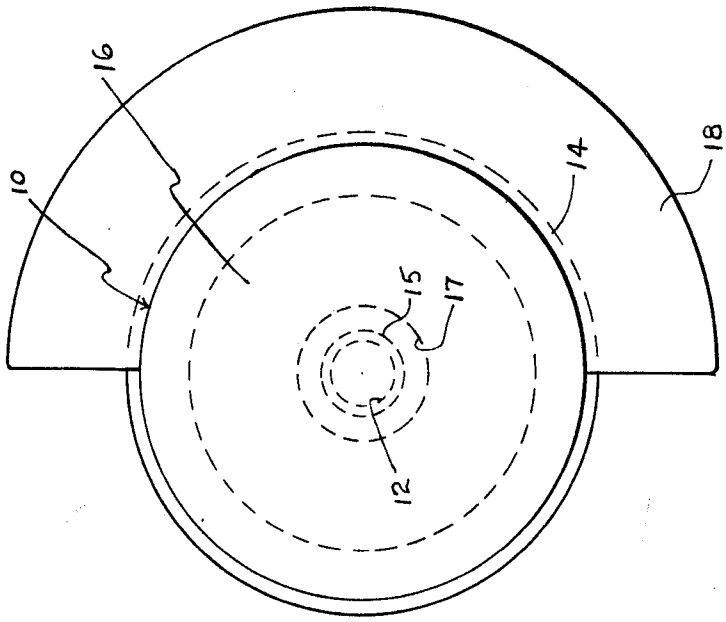


Fig. 2

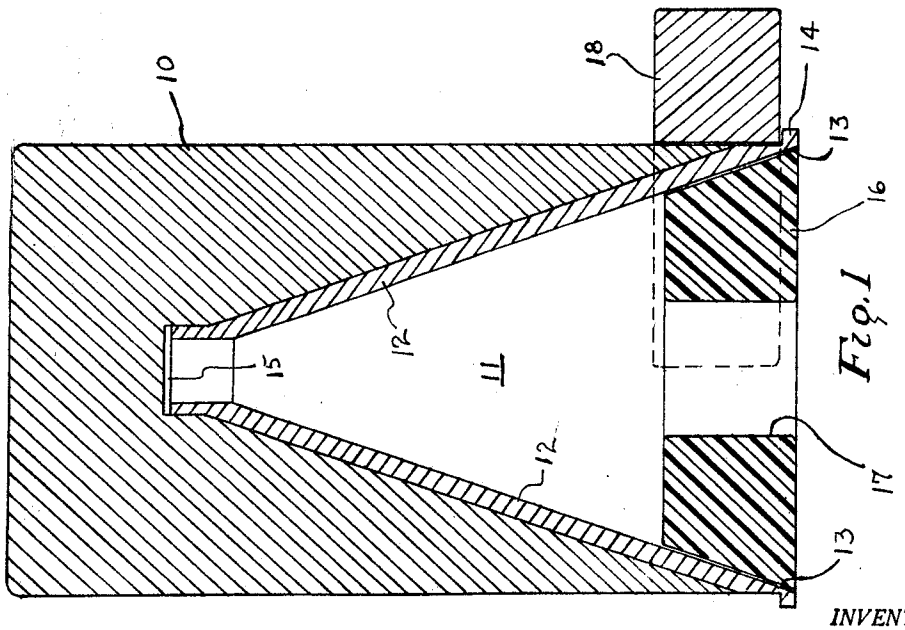


Fig. 1

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HYPERVELOCITY PELLET PROJECTOR

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5 Claims. (Cl. 102—24)

The invention described herein may be manufactured and used by or for the Government for governmental purposes, without the payment to us of any royalty thereon.

This invention relates to a device designed to produce pellets of varying size, velocity and materials to simulate meteoritic impact on ballistic missiles and/or orbiting satellites so that the effects may be observed and measured in the laboratory.

These pellets are produced by utilizing a hollow shaped charge and so modifying the construction that the net product will be a single pellet rather than the customary elongated jet.

A shaped charge is an explosive device having usually a cone-shaped cavity within the explosive charge and the base of the cavity being open and facing the intended direction of the charge. The cavity of the charge is usually provided with a thin liner of metal or other non-explosive material which is designed to more effectively concentrate the explosive energy in a jet and thereby increase the penetrating effect. When the explosive is detonated at the end opposite the cavity, the lining collapses to form a high speed jet with the forward portions moving at extremely high velocities. Depending on the geometrical shape of the liner and the material of the liner as well as the explosive employed, velocities exceeding 40,000 feet per second may be achieved. Heretofore, the high velocity jet of such shaped charges have been utilized to obtain greater penetration of steel armor and in perforating oil, gas and water wells.

In the discharge of a shaped charge, it is noted that the initial jet or the tip is formed by the region near the apex of the cavity liner and the subsequent parts of the jet are made up of the remainder of the collapsed liner. This action suggests that if the remainder of the liner can be separated or diverted either when forming a jet or interrupted after the jet has formed, the tip will be isolated as a discreet pellet.

It is therefore the object of this invention to so modify a shaped charge that its output will be a single pellet rather than an elongated jet.

This modification is accomplished by placing within the cavity at the base a Lucite inhibitor which substantially closes the cavity with the exception of an opening provided in the center of the inhibitor. This inhibitor, so constructed and properly positioned, is operative in isolating the tip from all but a small portion of the low velocity trailing material. This trailing material consists of slug from the collapsed liner, partially collapsed liner and uncollapsed liner and is deflected laterally with a semicircular peripheral charge placed on the outside around the shaped charge at the base of the conical cavity.

It is a further object of this invention to utilize this pellet projector as a means of simulating the movement of meteoritic bodies at high velocities and to study the impact of such bodies.

Other objects and advantages will become more apparent from the following description of the drawing which illustrates the principle of this invention.

In the drawing:

FIGURE 1 is a diagrammatical vertical section of the shaped charge of this invention, and

FIGURE 2 is a top plan view of the device shown in FIGURE 1.

Referring to the drawing, **10** represents a cylindrical shaped charge having a cone-shaped cavity **11** therein. The walls of the conical cavity **11** are lined with a liner **12** of a ductile metal such as aluminum and the base or mouth **13** of the liner **12** has a peripheral flange **14** which is integral with and of the same material as the liner **12**. A small brass cylindrical cap **15** is used to seal the top of the liner **12** if the explosive **10** is formed by casting. At the base of the cavity a Lucite inhibitor **16** is fitted securely by any convenient means within the mouth **13** of the liner **12**, flush with the flange **14** and substantially closing the mouth **13**. The inhibitor **16** is provided with an opening **17** for the purpose of limiting the discharge to that portion of the collapsed liner that is free to escape through said opening. It has also been ascertained that the height of the opening **17** or the inhibitor **16** has a definite relation with the length of the pellet ejected, i.e. an increased height produces a shorter pellet. To insure that only a single pellet will be ejected, it is necessary to deflect any trailing material and this is accomplished by a semicircular deflector charge **18** placed around the charge on the outside and resting on the flange **14**. The deflector charge **18** is made semicircular so that when discharged, trailing material will be directed in a direction other than the pellet.

In operation, the hollow shaped charge **10** is ignited and on discharge the conical liner **12** tends to follow the customary collapse until it reaches the inhibitor **16** which prevents anything from passing except that portion of the liner that passes through the opening **17** and which emerges as a single pellet. The isolation of the single pellet is made a certainty by the semicircular deflector charge **18** detonating when ignited by the shaped charge adjacent the base of the conical cavity **11** and discharging in a direction other than the directed shaped charge as previously explained in detail.

This pellet projector provides a valuable research tool to study the phenomenon of ultra high velocity (meteoritic) impact. With the advent of ballistic missiles and orbiting satellites, the need of understanding the physics of the impact at these velocities has become paramount. Satellites can be expected to encounter meteorites ranging in size from microscopic particles to pieces weighing in the order of hundreds of grams. Obviously, to study the impact of such particle sizes, these high velocities must be achieved on earth where sophisticated instruments can measure energy and momentum, and the materials or bodies subjected to these simulated impacts are available for examination.

If the shape charge has a cavity with an angle of 37° as shown in the drawing, a base of 3.4 inches, with an opening in the Lucite inhibitor of 1.0 inch, a semicircular deflector charge 1.0 inch square in cross sections, the pellet ejected will weigh approximately 5.0 grams and the velocity will be 9.6 kilometers per second or 31,000 feet per second.

Two principles of a shaped charge are emphasized as fundamental. First, as the size of the charge is scaled the mass of the jet produced increases as the cube of the scale factor. That is to say, if the charge above described were doubled in diameter the mass of the pellet would be increased by a factor of 8 and the pellet will weigh about 40 grams. It therefore may easily be calculated that a projector 12 to 14 inches in diameter will produce a pellet weighing approximately 300 grams. Such scaling does not change the velocity and the 300 gram pellet will also have a velocity of 31,000 feet per second. The second principle, the velocity of the jet tip or pellet increases as the included angle of the liner is reduced until a limit is reached in which the jet tip is travelling at twice the rate of detonation of the explosive used. For example, the charge employed with a rate of detonation of 7800 meters

per second will move the pellet more than 40,000 feet per second if the angle is nominally 20°. The operative range of angle at the apex of the cavity is from 20° to 60°.

This device employing the inhibited jet charge design is an extremely useful and economical device for studying the effects of hypervelocity impacts on various targets by its capability of simulating meteoritic velocities.

While this invention has been illustrated as one specific embodiment, it may be used advantageously in other endeavors and should only be limited by the appended claims.

What is claimed is:

1. An apparatus for converting a collapsed shaped charge liner to a single pellet comprising a conical hollow shaped charge with the base open, a metal liner for said shaped charge, an inhibitor secured within said open base and substantially closing same, said inhibitor provided with a small opening in the center and means attached at the base for limiting the output of said inhibitor to a single pellet.

2. An apparatus for producing a single pellet from a shaped charge liner comprising, a conical hollow shaped charge with the base open, a metal liner for said shaped charge, an inhibitor secured within said open base and substantially closing same, a semicircular deflector charge on the outside of the shaped charge at the base to force any scattered material following the collapsed liner in a direction other than that of the pellet, said inhibitor provided with a small opening in the center which upon discharge of the shaped charge limits the collapsed liner to the passage of a single pellet therethrough.

3. An apparatus for producing a single pellet from a shaped charge liner comprising a conical hollow shaped charge having a cylindrical tip at the apex and the base open, the angle at the apex varying from 20° to 60° with the smaller angle producing the highest velocity on discharge, a metal liner for said shaped charge and cylindrical tip, a frusto-conical inhibitor securely fitted within the open base of the shaped charge and substantially closing same, a semicircular deflector charge on the outside of the shaped charge at the base to prevent any scattered material following the collapsed liner from being discharged in the direction of the shaped charge, said inhibitor, provided with a small opening in the center, which upon discharge of the shaped charge limits the collapsed liner to the passage of a single pellet and increases the length of the pellet by decreasing the depth of said opening.

4. A shaped charge designed to fire a single pellet comprising a conical hollow shaped charge with the base open, a metal liner for the hollow charge adapted to collapse in the form of a jet on discharge, a frusto-conical inhibitor to confine said jet secured within the open base and substantially closing same, a semicircular deflector charge fitting the outside of the base of the shaped charge to direct any following material in a direction other than that of the charge, said inhibitor having an opening in the center for the passage of a portion of the collapsed liner, said portion emerging from the opening as a single pellet, the length of the pellet increasing with the decreasing depth of the opening and the velocity increasing by decreasing the angle at the apex of the hollow cone.

5. A shaped charge designed to fire a single pellet comprising a conical hollow shaped charge with the base open, a metal liner for the hollow charge adapted to collapse in the form of a jet on discharge, a frusto-conical inhibitor to confine said jet secured within the open base and substantially closing same, a semicircular deflector charge fitting the outside of the base of the shaped charge to direct any following material in a direction other than that of the charge, said inhibitor having an opening in the center for the passage of a portion of the collapsed liner, said portion emerging from the opening as a single pellet, the mass of the pellet increasing as the size of the charge is increased with the velocity remaining the same regardless of the change in mass.

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