



NATIONAL AERONAUTICS AND SPACE ADMINISTRATION  
WASHINGTON, D.C. 20546



APR 24 1979

REPLY TO  
ATTN: GP

NST-44  
TO: ~~KSE~~ Scientific & Technical Information Division  
Attn: Miss Winnie M. Morgan  
  
FROM: GP/Office of Assistant General  
Counsel for Patent Matters  
  
SUBJECT: Announcement of NASA-Owned U.S. Patents in STAR

In accordance with the procedures agreed upon by Code GP and Code KSI, the attached NASA-owned U.S. Patent is being forwarded for abstracting and announcement in NASA STAR.

The following information is provided:

U.S. Patent No. : 3,224,337  
Government or : MB ASSOCIATES  
Corporate Employee : San Ramon, CA  
  
Supplementary Corporate :  
Source (if applicable) :  
  
NASA Patent Case No. : XLE-3186

NOTE - If this patent covers an invention made by a corporate employee of a NASA Contractor, the following is applicable:

YES  NO

Pursuant to Section 305(a) of the National Aeronautics and Space Act, the name of the Administrator of NASA appears on the first page of the patent; however, the name of the actual inventor (author) appears at the heading of column No. 1 of the Specification, following the words "...with respect to an invention of ..."

*Bonnie L. Henderson*  
Bonnie L. Henderson

Enclosure  
(NASA-Case-XLE-03186-1) HYPERVELOCITY GUN N79-21084  
Patent (NASA) 3 p CSSL 14B  
Unclas  
00/09 20369

W-294  
XLE-3186

Dec. 21, 1965

F. C. FORD ETAL  
HYPERVELOCITY GUN  
Filed June 7, 1962

3,224,337

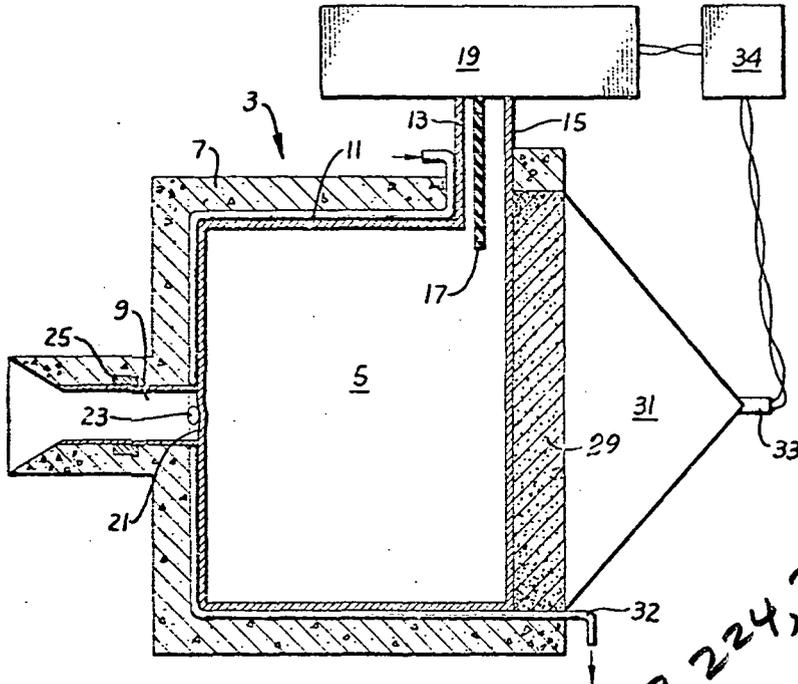


FIG. 1.

3,224,337  
40%

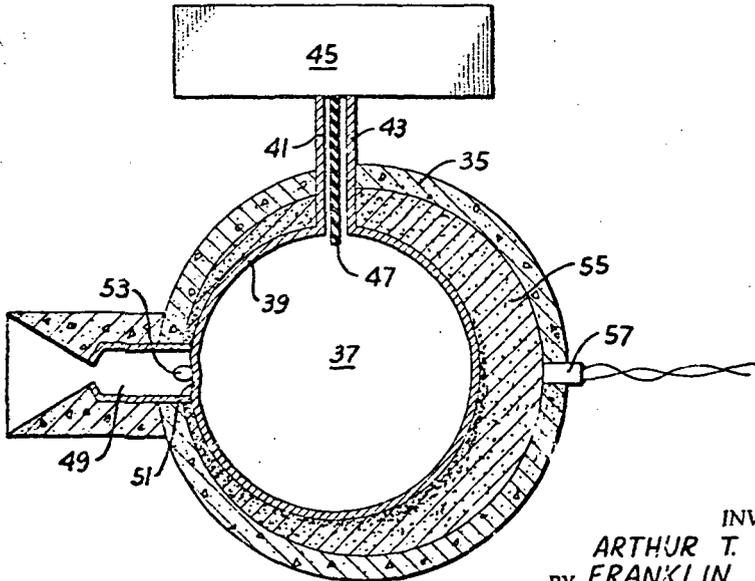


FIG. 2.

INVENTORS  
ARTHUR T. BIEHL  
BY FRANKLIN C. FORD

Eckhoff & Slick  
ATTORNEYS

1

3,224,337

**HYPERVELOCITY GUN**

Franklin C. Ford and Arthur T. Biehl, Walnut Creek, Calif., assignors to MB Associates, a corporation of California

Filed June 7, 1962, Ser. No. 200,770  
3 Claims. (Cl. 89-8)

The invention described herein was made in the performance of work under a NASA contract and is subject to the provisions of Section 305 of the National Aeronautics and Space Act of 1958, Public Law 85-568 (72 Stat. 435; 42 U.S.C. 2457).

This invention relates to a hypervelocity gun and more particularly relates to a hypervelocity gun wherein a velocity amplifier system is provided which utilizes both electric and chemical energy for the propulsion of a projectile.

In accordance with the present invention, velocities as high as 150,000 feet per second can be achieved wherein the projectile is not subjected to peak acceleration sufficiently great to cause fracture of the projectile, so that it remains intact until impact. Among other things, the gun of the present invention provides a valuable tool for impact studies involving small bodies traveling at extremely high speeds, such as might be encountered in space when micrometeorites strike a vehicle, and can be effective as a hypervelocity weapon, particularly in space where aerodynamic drag is essentially zero.

One object of the present invention is to provide a hypervelocity gun which is very compact and which can be utilized in a normal laboratory.

Another object of this invention is to provide a hypervelocity gun wherein a relatively small expenditure is involved for each shot.

Another object of this invention is to provide hypervelocity gun utilizing a combination of electric and chemical energy.

Still another object of this invention is to provide a hypervelocity gun wherein the projectile itself can be made in any shape or size and of any desired solid material and wherein the projectile will not be subjected to any physical deforming effects sufficiently great to cause fracture of the projectile or to elevated temperature.

A further object of this invention is to provide a hypervelocity gun wherein relatively small distances can be used to achieve hypervelocities and wherein acceleration in a partial vacuum can be achieved.

Other objects will be apparent from the specification which follows.

In the drawings forming a part of this application:

FIGURE 1 is a sectional view of a hypervelocity gun embodying the present invention.

FIGURE 2 is a sectional view of another embodiment of the invention.

Referring now to FIGURE 1 by reference characters, there is shown a hypervelocity gun generally designated 3 comprising an open chamber 5 which is surrounded by a relatively heavy layer of a tamping material, such as concrete, 7. At the front of the gun, an opening 9 is provided in the tamping material. A loop of conducting material 11 extends around the open chamber 5 and terminates in two leads 13 and 15 separated by an insulator 17 leading to the capacitor bank 19. The leads 13 and 15 are separated by insulator 17 to provide an explosively actuated switch.

At the forward part of the gun the material of loop 11 is necked down as at 21 to form a sabot which supports a projectile 23. A magnet 25 surrounds the path of the projectile to serve as a sabot catcher. That portion of the chamber 5 opposite the sabot is provided with a layer

2

of high explosive 29 to which is attached a line igniter 31 leading to a detonator 33. Detonator 33 and capacitor bank 19 are wired to control box 34. In use, the capacitor bank 19 is charged while the projectile and sabot are held in place. The detonator 33 is then ignited and substantially at the same time the control box 34 causes the capacitor bank 19 to discharge into loop 11. As the current in the loop 11 reaches maximum, the explosive 29 causes the back portion of the loop 11 to move forward, breaking down the insulator 17. This shorts leads 13 and 15, trapping the current in the loop 11, thus trapping the magnetic field and compressing the trapped flux in the coil, causing the magnetic pressure on the sabot to rise rapidly to its maximum value. This propels the sabot and the attached projectile forward at a high rate of speed. The sabot is trapped by the magnet 25, while the projectile is free to travel forward.

In one practical embodiment of the invention, the loop 11 was a copper strap 1 cm. wide having a height of 20 cm. and a width of 10 cm. That portion of the strap overlying the explosive 29 had a weight of 100 grams and a mass of 300 grams of high explosive was employed. The capacitor bank supplied 10,000 joules (50 microfarads at 20,000 volts). Maximum current in the loop was 440,000 amperes, with a rise time of about six microseconds. Utilizing a projectile weighing 0.75 gram, a velocity of 30,000 feet per second could be obtained.

In order to secure maximum velocity, it is necessary that the loop 11 be cooled. This may be accomplished by providing a cooling line 32 surrounding the loop 11. A suitable coolant such as liquid nitrogen is passed through the cooling line.

In FIGURE 2, another embodiment of the gun is shown, wherein the chamber is cylindrical. Here, the tamping material 35 forms a circular shell surrounding the chamber 37. The loop 39 within the chamber has terminals 41 and 43 leading to the capacitor bank 45. The leads 41 and 43 have an insulator 47 between them, forming an explosively actuated switch as above. The loop 39 is necked down at 51, forming a sabot to which a projectile 53 is attached. An explosive charge 55 occupies the space between the loop 39 and the tamping material 35. A detonator 57 is employed for detonating the explosive. In this particular embodiment, the charge 55 is thickest at the point opposite the sabot, and tapers to a very thin wall section opposite the sabot, so that as the loop 39 collapses, its center moves toward the sabot, keeping the maximum field behind the sabot. The operation of this embodiment is otherwise exactly as described above in connection with FIGURE 1.

We claim:

1. A hypervelocity gun utilizing a combination of electrical and chemical energy comprising in combination:
  - (a) a loop of an electrically conductive material;
  - (b) a tamping material substantially enclosing said loop;
  - (c) an explosive charge at least partially surrounding the loop, said explosive charge being adapted to collapse the loop upon detonation of the charge;
  - (d) a source of electricity electrically charging the loop through leads thereto;
  - (e) an electric switch adapted to disconnect the leads from the source of electricity and to short circuit the leads;
  - (f) said electric switch being actuated by the explosive charge;
  - (g) an opening in one portion of the tamping material, said opening extending to the loop and forming a barrel;
  - (h) the loop being necked down in the vicinity of the opening thus forming a sabot from a portion of the loop;

3

- (i) a projectile located on the sabot;
  - (j) whereby when the loop is electrically charged and the explosive detonated the loop is short circuited and collapsed building up a large magnetic field behind the sabot, detaching the sabot from the loop and accelerating the sabot and the projectile to a hyper-velocity.
2. The gun of claim 1 wherein a sabot catcher is provided in the form of a magnetic field in the barrel formed by the opening in the tamping material.
  3. The gun of claim 1 wherein a cooling coil is pro-

4

vided in contact with the loop, said coil having a cooling fluid circulating therethrough.

References Cited by the Examiner

UNITED STATES PATENTS

2,376,321	5/1945	Albertson	-----	89-14.1
2,382,152	8/1945	Jakobsson	-----	102-93
2,870,675	1/1959	Salisbury	-----	89-8 X

10 BENJAMIN A. BORCHELT, *Primary Examiner.*

SAMUEL BOYD, *Examiner.*