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SELF-OBTURATING, GAS-OPERATED LAUNCHER

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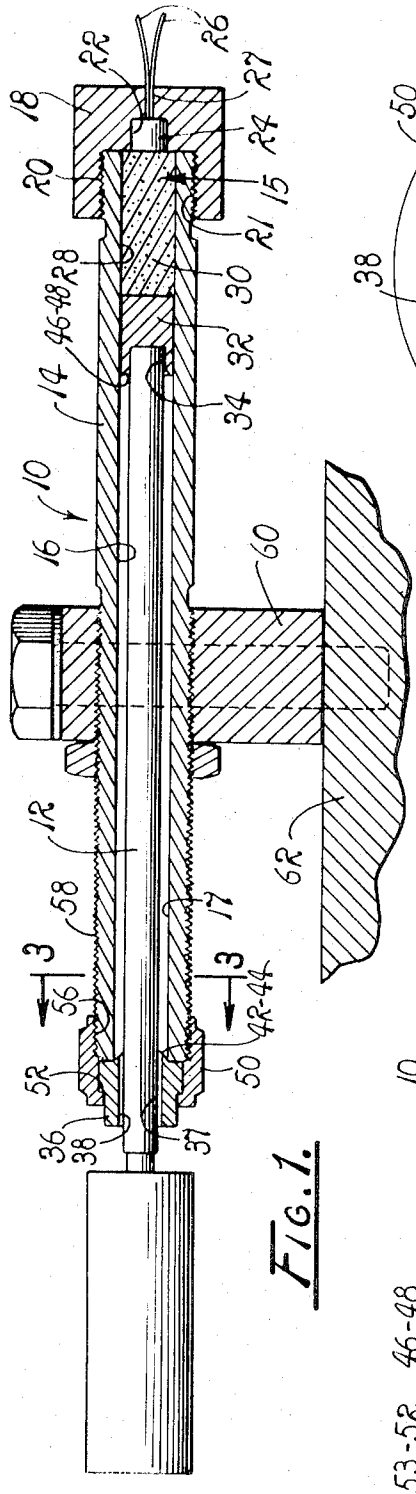


FIG. 1.

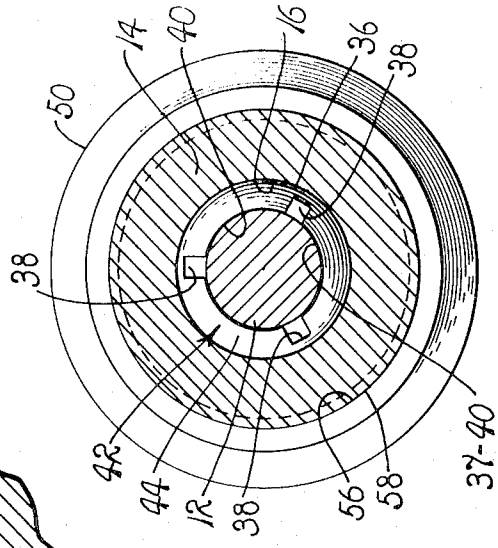


FIG. 3.

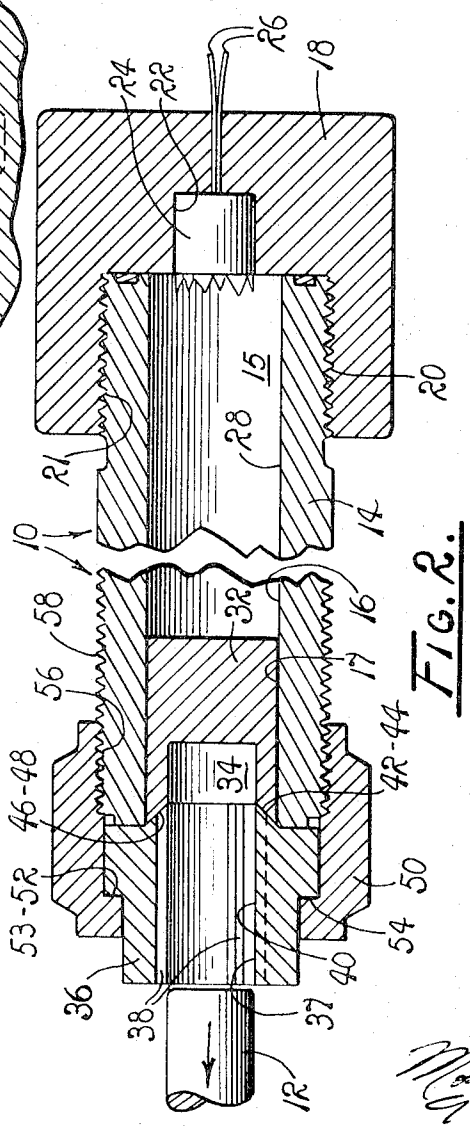


FIG. 2.

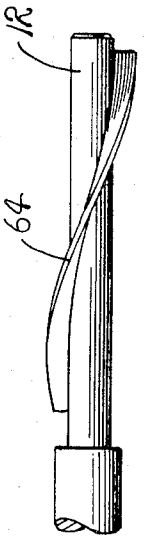


FIG. 4.

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SELF-OBTURATING, GAS-OPERATED LAUNCHER

T. O. Paine, Administrator of the National Aeronautics and Space Administration, with respect to an invention of Otto K. Heiney, Temple City, Calif.

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Int. Cl. F41c 11/00; F41f 17/00; F42b 11/42
U.S. Cl. 42—1 F 1 Claim

ABSTRACT OF THE DISCLOSURE

A self-obturating, gas-operated launcher particularly suited for use in launching projectiles in a decontaminated medium, characterized by the utilization of an elongated barrel including a rigid, barrel-sealing breech block, a muzzle block having a bore through which a projectile is ejected and a malleable slug disposed within the barrel adjacent to the breech block defining an expandable firing chamber within the barrel and adapted to be driven toward the muzzle block for launching a projectile as a pyrotechnic material is ignited within the chamber, a feature of the launcher being a plurality of openings formed within the muzzle block for relieving back-pressure, and an annular anvil circumscribing the bore of the muzzle block for receiving the malleable slug in impacted engagement for thus achieving an hermetic sealing of the bore thereby to retain within the barrel the residue of the ignited pyrotechnic material.

ORIGIN OF INVENTION

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 USC 2457).

BACKGROUND OF THE INVENTION

(1) Field of the invention

The invention relates to gas-operated launchers and more particularly to a self-obturating, gas-operated launcher adapted to employ ignited pyrotechnic materials for launching projectiles into an ambient medium while precluding a discharge of products of expended pyrotechnic materials.

(2) Description of the prior art

The prior art is replete with projectile launching devices which employ pyrotechnic materials of the types commonly referred to as explosives and propellants. Normally such materials, upon being fired within a firing chamber, generate rapidly expanding gases which act against projectiles for imparting acceleration thereto. Among such devices are rifles, mortars, and guns of the general variety, including spear guns and launchers for similar elongated projectiles.

Among the heretofore unsolved problems inherent in launching projectiles, through a use of expanded gases derived from ignited or detonated pyrotechnic materials, is the introduction of the resultant residue into the ambient medium which, for purposes of explanation, includes gas, water and vacuum.

Normally, the expanded gases and consumed pyrotechnic material are discharged from a launcher as the projectile exits its muzzle. In so doing, the heated gases introduce numerous side effects, some of which frequently are found to be particularly undesirable. For example, where a projectile is launched in the vicinity of a celestial body, gases and other products of the ignited pyrotechnic material tend to contaminate the ambient medium. Also,

in instances where a projectile is being delivered from a point of concealment, the resulting gases and shock waves tend to act as an alarm and reveal the point from which the launch occured, through effects which are both visually and audibly observable.

OBJECTS AND SUMMARY OF THE INVENTION

This invention overcomes many of the aforementioned difficulties through the use of a simplified obturating muzzle block and a displaceable, malleable slug adapted to launch projectiles from an elongated barrel and to establish an hermetically sealed muzzle, which is effective in obviating a discharge of products of expended pyrotechnic materials.

Accordingly, an object of the instant invention is to provide a self-obturating, gas-operated launcher.

Another object is to provide a self-obturating launcher particularly adapted for use in launching projectiles through the use of ignited pyrotechnic materials.

Another object is to provide a self-obturating launcher for use in launching projectiles, through an ignition of pyrotechnic materials, into an ambient medium while retaining all residue of the ignited pyrotechnic materials within the launcher.

Another object is to provide a self-obturating launcher adapted to employ expanded gases of ignited pyrotechnic materials for ejecting a spin-stabilized projectile from the launcher and delivering it along a preselected path without subjecting the ambient medium to effects of ignited pyrotechnic materials.

These together with other objects and advantages will become more readily apparent by reference to the following description and claim in light of the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a sectioned elevation of a self-obturating gas-operated launcher employing the principles of the present invention, illustrating a projectile arranged in a pre-launch configuration within the barrel of the launcher.

FIG. 2 is a sectioned, fragmented view of the launcher, on somewhat of an enlarged scale, illustrating the launcher in an actuated configuration.

FIG. 3 is a cross section view taken generally along line 3—3 of FIG. 1.

FIG. 4 is a side elevation of a projectile having a spin-stabilizing fin for imparting to the projectile spin-stabilization characteristics.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Turning now to FIG. 1, a self-obturating launcher **10** embodying the principles of the present invention is illustrated in a pre-launch configuration having seated therein a projectile **12**. The launcher includes an elongated tubular body **14** having a breech **15** and including therein an internal bore **16** of a cylindrical configuration extending from the breech **15** to a muzzle **17**. The breech **15** is closed through a removable breech block **18**. As presently employed, the breech block is a closure cap sealingly secured to one end of the barrel through mated opposed screw-threads **20** and **21** suitably provided at the contiguous surfaces of the body and cap, respectively.

The breech block **18** includes therein an initiator cavity **22** into which is seated an initiator **24**. The initiator is formed as a charge of a suitable pyrotechnic material which is ignited for purposes of igniting a larger charge of pyrotechnic materials. As currently employed, the initiator **24** is a squib having embedded therein a suitable resistant bridge wire, not shown, operatively connected with a pair of electrical leads **26**. The leads **26** are ex-

tended through a suitably sealed opening **27** formed in the breech block and are electrically connected with a suitable source of electrical potential, also not shown. Of course, it should readily be apparent that, where preferred, the initiator **24** may be replaced by a percussion cap of any suitable design. In such instances versatility is imparted to the launcher, since the launcher thus equipped can be employed in the absence of a source of electrical potential.

Adjacent to the initiator **24**, within the bore **16** of the body **14**, there is provided a firing chamber **28**. The firing chamber **28** serves to receive a pyrotechnic material **30** of a suitable composition selected on a basis of compatibility with the purpose of the launch. While, in practice, the pyrotechnic material is formed of a readily available propellant an explosive material may be employed, depending upon the nature and function of the projectile **12** and the environment into which the projectile is to be launched. In any event, the pyrotechnic material **30** is of the type which will respond to actuation of the initiator **24** for generating rapidly expanding gases within the firing chamber.

Defining the forwardmost end of the firing chamber **28**, there is a displaceable slug **32**. The slug **32** is of a cylindrical configuration having an outside diameter approximating the inside diameter of the bore **16** in order that the slug be received within the bore and an hermetic seal be established between the surfaces thereof. As a practical matter, the slug **32** is formed of a malleable material, such as lead, for example, and is adapted to be forwardly displaced in response to an expansion of gases generated within the firing chamber **28** as a pyrotechnic material is actuated therein.

The leading end portion of the slug **32** is provided with a concentrically arranged recess which defines a socket **34** into which the rearmost end of the elongated projectile **12** is inserted and mated preparatory to its launching. While various means, including lock rings. springs, spring-loaded detents and the like, may be employed for retaining an end of an associated projectile within the socket **34**, as a practical matter, forces of friction have served quite satisfactorily for this purpose.

At the muzzle **17** of the tubular body **14** there is provided a muzzle block **36** disposed in a coaxial relationship with the slug **32**. The muzzle block includes an axial bore **37** having a diameter less than the external diameter of the projectile **12**. However, along the internal surfaces of the bore **37** there is provided a plurality of slotted openings or grooves **38** arranged in a parallel disposition and establishing therebetween a multiplicity of projectile supporting surfaces or lands **40**. The purpose of the lands is to engage the external surfaces of the projectile **12** so long as it is received within the bore **37**, while the grooves accommodate a discharge of fluids from the bore **16** through the muzzle block.

Due to the presence of the grooves **38**, entrapment of pressure within the bore **16**, as the slug **32** is advanced, is inhibited since the grooves **38** permit the bore **16** to communicate with the ambient medium into which the projectile **12** is being launched. Hence, as the slug is advanced, the pressure which otherwise would develop along the slug's leading surfaces remains negligible as the medium within the bore is discharged through the grooves. While lands and grooves have proven quite satisfactory for use in avoiding pressure build-up, it should be appreciated that tubular openings extending through the muzzle block can also be employed.

The muzzle block **36** further is provided with an annular shoulder **42** of a truncated, frusto-conical configuration. The shoulder **42** includes an inclined face **44** which extends inwardly toward the slug **32** and terminates at the bore **37**. The face **44** serves as an imparting surface for the slug **32** as its advancement is arrested, subsequent to its being propelled forwardly.

As best shown in FIG. 2, the slug **32** also is provided with an annular shoulder **46** conforming to a frusto-conical configuration. This shoulder includes a face **48** extending from the external surface of the slug and terminating at the socket **34** in a manner such that it forms a mirror image of the face **44** upon which it is adapted to seat.

It is particularly important to note that the grooves **38** are of insufficient depth to extend to the surface of the bore **16**. Consequently, the peripheral portion of the face **48** of the shoulder **46** is mated with a peripheral portion of the face **44** between the grooves and the surface of the bore **16**. Therefore, it should be appreciated that as the slug **32** is impacted against the muzzle block **36**, the face **48** of the annular shoulder **46** of the slug **32** is mated with the face **44** of the shoulder **42** formed on the muzzle block **36**. Since the slug **32** is formed of a malleable material, the shoulders **42** and **46** become tightly mated whereby an hermetic seal is established at the interfaces to preclude a discharge of the residue of the consumed pyrotechnic material.

The muzzle block **36** may be coupled with an end portion of the body **14** of the launcher **10** through various suitable devices, including an annular coupling collar **50**. The collar **50** is provided with a radially extended annulus **52** having a radial locking face **53** directed inwardly from the periphery of the collar. The face of the annulus is mated with an outwardly extended shoulder **54** formed about the periphery of the muzzle block **36**. In order to couple the collar **50** with the body **14** of the launcher **10**, the collar is provided with an internally screw-threaded surface **56** while the adjacent end portion of the body **14** is provided with an externally screw-threaded surface **58**. Therefore, simply by advancing the threaded surface of the collar along the threaded surface of the body **14** of the launcher **10**, the muzzle block **36** is brought into a sealed relationship with the muzzle of the launcher.

As illustrated in FIG. 1, the launcher **10** is disposed in a mount **60** supported by suitable base structure **62**. The base serves to position the launcher **10** in a desired attitude relative to a selected target. However, the manner in which the launcher is mounted is a matter of convenience only and therefore the mount **60** may be varied as desired, depending upon its use in a given operative environment.

Frequently, the target selected requires an accurate delivery of the projectile **12**. In such instances it may be desirable to provide the projectile with spin-stabilization characteristics. To achieve such characteristics, the projectile **12** is provided with a helical fin **64** adapted to seat within one of the grooves **38** as the projectile is prepared for launch. Consequently, as the projectile is ejected from the bore **16**, the surfaces of the associated groove acting on the helical fin serve to impart a rate of rotation to the projectile whereupon spin-stabilization of the projectile is realized.

OPERATION

It is believed that in view of the foregoing description, the operation of the device will be readily understood, however, it will be briefly reviewed at this point. With the launcher **10** disassembled, that is, with the breech block **18** removed from the body **14** of the launcher **10**, a slug **32** is inserted into the bore **16** and advanced a selected distance along the bore **16** for defining a firing chamber **28**. Into this chamber there is inserted a charge of pyrotechnic material **30** of a selected composition, normally, a propellant. However, the material may be an explosive charge, if such is preferred. In any event, an initiator **24** is inserted into a cavity **22** with its leads **26** being extended through the opening **27**, which is then sealed in any convenient manner, including the use of a selected epoxy cement. The breech block **18** is mounted and coupled with the body **14**, through a mating of the screw-threads **20** and

21, for thereby closing the breech 15. As a practical matter, preparatory to each launching of a projectile 12, a new muzzle block 36 is coupled with the muzzle of the launcher 10.

With the device thus assembled, a stem of an elongated projectile 12 is inserted through the bore 37 of the muzzle block 36 and seated within the socket 34 of the slug 32. The leads 26 now are electrically coupled with a source of electrical potential preparatory to a launching of the projectile 12. Should it be preferred to do so, a precussion cap may be seated in the cavity 22 with an appropriate portion thereof being in communication with the opening 27 in order that the device may be fired mechanical without dependence upon a source of electrical potential.

At an appropriate instant, an electrical signal is delivered through the leads 26 for firing the initiator 24, whereupon heated gases are delivered to the pyrotechnic material 30 for igniting this material. As the material 30 is burned, additional hot gases are generated and caused rapidly to expand within the chamber 28 of the bore 16. As the gases are expanded, the slug 32 is advanced toward the muzzle 17 at an accelerating rate. The projectile 12 also is accelerated in response to the slug's displacement and ultimately is launched from the bore 16. As the slug 32 approaches the muzzle block 36, the faces 48 and 44 are brought into an impacting engagement, whereupon the shoulder 46, at the interface, is deformed to assure formation of an hermetic seal at the interface of the slug and muzzle block for thereby sealing the bore 37 and grooves 38. As the resulting seal serves to confine the residue of combustion of the pyrotechnic material, including gases, ashes and the like within the bore 16, the ambient medium remains free from contamination. Of course, it should readily be appreciated that since the bore is sealed, shock waves established at the firing of the pyrotechnic material are retained within the bore 16 of the launcher 10 so that only a minor report or no explosive report issues from the launcher as the projectile is driven toward its target.

It is also quite important to note that due to the presence of the grooves 38 back-pressure is maintained at a negligible level within the bore 16 as the slug 32 is advanced, since the grooves 38 of the muzzle portion of the bore 16 are in direct communication with the ambient medium so that as the slug is advanced any medium present at the leading portion of the slug is ejected through the grooves, prior to their being sealed by the shoulder 46.

In view of the foregoing it should readily be apparent that the instant invention is embodied in a launcher wherein a pyrotechnic material is ignited for effecting a launching of a projectile, while all by-products of the ignition, including heated gases, burned material, and resulting shock waves are retained within its bore.

Although the invention has been herein shown and described in what is conceived to be the most practical and preferred embodiment, it is recognized that departures may be made therefrom within the scope of the invention.

What is claimed is:

1. A self-obturating, gas-operated launcher for launching a projectile having an elongated body of a cylindrical configuration comprising:

(A) an elongated body having in coaxial relationship a breech, a muzzle, and a tubular bore axially extending therebetween;

(B) a breech block closing said breech and having a squib-receiving cavity formed therein;

(C) means defining an opening extending from said cavity through said breech block providing an electrical conduit between the cavity and the external surface of the breech block;

(D) a cylindrical slug formed of a malleable material seated within said tubular bore in spaced relationship with said breech block defining a firing chamber adjacent to said breech block and including a projectile-receiving socket concentrically related to said bore for receiving an end of the projectile preparatory to firing a pyrotechnic material within the chamber;

(E) a muzzle block coaxially related to said breech block coupled with said muzzle including means defining therein a cylindrical bore having a diameter substantially equal to the diameter of the body of the projectile and coaxially related to said socket and means defining about said bore a plurality of pressure-relief openings communicating with said tubular bore;

(F) means defining a slug-impacting shoulder of a frusto-conical configuration extending axially from the internal surfaces of said muzzle block in a manner such as to intercept and arrest advancement of the displaceable slug as it is advanced by a firing of a pyrotechnic material within said firing chamber; and

(G) means defining in said slug a shoulder surface of an outwardly flared, frusto-conical configuration of a dimension substantially equal to the dimension of the slug-impacting shoulder circumscribing said projectile-receiving socket for hermetically sealing said pressure-relief openings as advancement of the slug is arrested, whereby an hermetic seal is established at the muzzle block for obviating a discharge of by-products of combustion as a projectile is ejected from the launcher.

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