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1 Navy Case No. 77381

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3 REGULATED GAS SOURCE FOR UNDERWATER GUN OPERATION

4
5 STATEMENT OF GOVERNMENT INTEREST

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

10
11 CROSS-REFERENCE TO RELATED APPLICATION(S)

12 This application is related to U.S. Patent No. 5,648,631,
13 filed on 3 October 1995 for a SPOOLED METAL TAPE SEAL FOR
14 UNDERWATER GUN OPERATION.

15
16 BACKGROUND OF THE INVENTION

17 (1) Field of the Invention

18 The present invention relates to an apparatus and a method
19 for preventing the ingress of water into an underwater gun
20 before, during, and after the firing of a projectile.

21 (2) Description of the Prior Art

22 Underwater weapons are known in the art. U.S. Patent Nos.
23 3,323,457 to Biehl et al., 3,453,763 to Barr et al., 3,580,172 to
24 Hendricks and 3,158,062 to Feiler illustrate some of these
25 underwater weapons. Keeping the barrel of the weapon clear of
26 water is important to underwater gun operation because it reduces

1 the energy required to eject the projectile or bullet, it
2 increases the muzzle velocities that can be achieved, and it
3 reduces the strength requirements and thus the weight of the
4 barrel.

5 In the Biehl et al. patent, the underwater weapon comprises
6 a device for launching a projectile. One end of the projectile
7 is covered by a frangible diaphragm. The diaphragm is used to
8 maintain the watertightness of the launcher. In operation, the
9 projectile within the launcher is ejected through the frangible
10 diaphragm. The Barr et al. patent relates to an underwater
11 pistol having a rotatable cylindrical magazine. During operation
12 of this pistol, a projectile is driven through a frangible, and
13 fully removable, sealed front barrel cover. The Hendricks patent
14 also illustrates an underwater weapon in which a projectile
15 resides within a launch tube or barrel having a removable plug
16 affixed at one end to prevent the ingress of water.

17 The Feiler patent relates to an underwater missile container
18 and launcher which includes a device for maintaining an internal
19 pressure within the launcher which is substantially equal to the
20 pressure of the surrounding environment. The launcher further
21 includes a cap over the launch tube which prevents the ingress of
22 water prior to the launch.

23 Other devices are known in the art to render firearms
24 waterproof. U.S. Patent No. 3,677,132 to Plenge illustrates a
25 muzzle attachment for the barrel of a firearm. The muzzle
26 attachment includes a device for sealing it behind a bullet

1 passing therethrough to prevent the escape of expanding gases.
2 This device takes the form of a plurality of polyurethane discs
3 sandwiched between flat metallic washers and spaced apart by ring
4 members. The plugs are X-slotted on both faces thereof for
5 permitting a bullet to pass therethrough without fragmenting or
6 rupturing the element. The disc or plug automatically closes and
7 reseals itself after a bullet has been fired. When the muzzle
8 attachment is threadably engaged with the gun barrel, the weapon
9 is waterproof from the barrel end thereof. U.S. Patent No.
10 5,105,571 to Kinchin et al. also relates to a method and
11 apparatus for preventing moisture from entering a firearm. In
12 this patent, lightweight plastic covers are disclosed for use as
13 seals for the openings of a firearm such as the muzzle opening or
14 the magazine well opening. The plastic covers are removable
15 through manual operation. It is also possible to remove the
16 covers by actually firing the weapon.

17 U.S. Patent No. 4,848,209 to Almeras discloses sealing a
18 driving apparatus for an underwater device. The apparatus
19 includes a barrel holder, a barrel for guiding a fastener
20 intended to be driven by the gases of a propulsive charge and a
21 percussion system for setting of the charge. The barrel of the
22 device is closed by a closure device made by a material which may
23 be perforated by the projectile disposed inside the tubular
24 element or gun barrel.

25 U.S. Patent No. 4,742,775 to Harris illustrates still
26 another approach for sealing an end of an underwater device. In

1 the Harris patent, a sealing compound is used to prevent water
2 from penetrating the casing.

3 Despite the existence of these devices for sealing and
4 pressurizing underwater weapons and the like, there is still a
5 need for a more efficient approach for preventing the ingress of
6 water into a gun barrel and, in particular, to an approach
7 wherein a series of shots can be fired without water entering the
8 weapon.

9
10 SUMMARY OF THE INVENTION

11 Accordingly, it is an object of the present invention to
12 provide an improved apparatus for keeping water out of a gun
13 barrel.

14 It is a further object of the present invention to provide
15 an apparatus as described above which maintains a dry state in
16 the gun barrel and which purges the barrel of the products of
17 combustion.

18 Still further, it is an object of the present invention to
19 provide an improved apparatus as described above which helps
20 prevent gun barrel corrosion caused by exhaust gases.

21 The foregoing objects are attained by the apparatus of the
22 present invention.

23 In accordance with the present invention, an underwater
24 weapon has a tube, such as a gun barrel, having an opening, such
25 as a muzzle opening, through which a projectile, such as a
26 bullet, is to be discharged. The underwater weapon further has a

1 means for pressurizing the interior of the gun barrel to a
2 pressure greater than ambient pressure so as to keep water from
3 entering the gun barrel. The pressurizing means includes a
4 pressure regulator to maintain the pressure within the gun barrel
5 at a desired level and a check valve to insure that propellant
6 gases discharged in the gun barrel do not overpressurize the
7 barrel or source of the pressurizing gas.

8 The method of the present invention broadly comprises
9 providing a underwater weapon having an opening such as a muzzle
10 opening and pressurizing the interior of said underwater weapon
11 so as to prevent water from entering the underwater weapon
12 through the opening.

13 Other details, objects and advantages of the present
14 invention are set forth in the following detailed description and
15 the accompanying drawings wherein like reference numerals depict
16 like elements.

17
18 BRIEF DESCRIPTION OF THE DRAWINGS

19 FIG. 1 is a sectional view of a gun barrel in the ready
20 condition incorporating the water ingress prevention apparatus of
21 the present invention;

22 FIG. 2 is a sectional view of the gun barrel of FIG. 1 at
23 peak pressure;

24 FIG. 3 is a sectional view of the gun barrel of FIG. 1
25 between rounds;

1 FIG. 4 illustrates a spooled tape sealing system mounted to
2 the gun barrel of FIGS. 1-3; and

3 FIG. 5 illustrates a rotating disk seal which can be mounted
4 to the gun barrel of FIGS. 1-3.

5
6 DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT(S)

7 Referring now to the drawings, FIGS. 1 - 3 illustrate the
8 gun pressurization system 100 of the present invention at various
9 points of operation. FIG. 1 illustrates the gun pressurization
10 system in a ready firing position. FIG. 2 illustrates the gun
11 pressurization system at peak pressure during operation. FIG. 3
12 illustrates the gun pressurization system between rounds.

13 As shown in these figures, the gun pressurization system 100
14 is mounted to a gun barrel 12. The gun barrel 12 has an opening
15 14 through which a projectile 102 positioned within the gun
16 barrel is discharged. The projectile 102 may be a bullet or some
17 other form of projectile.

18 The gun pressurization system 100 comprises a system for
19 pressurizing the gun barrel 12 with a gas, such as an inert gas,
20 so that the pressure within the gun barrel is above ambient
21 pressure. By doing this, the interior of the gun barrel 12 can
22 be maintained in a dry state. Further, the products of
23 combustion caused by the firing of the projectile 102 can be
24 purged from the barrel.

25 Referring to FIG. 1, the gun pressurization system includes
26 a source 104 of gas such as a supply of inert gas and a pressure

1 regulator 106. The purpose of the pressure regulator 106 is to
2 adjust the flow of the gas from the source 104 into the gun
3 barrel. The pressure regulator 106 may comprise any suitable
4 regulator known in the art; however, preferably, the regulator
5 which is used should be capable of sensing the presence of
6 exhaust gases in the barrel, which are expelled after each
7 firing, and adjust the gas flow rate into the barrel accordingly.
8 The gas pressurization system 100 also includes conduits such as
9 108 and 110 for supplying gas from the source 104 to the interior
10 112 of the gun barrel preferably near each end of the gun barrel
11 and check valves 114 and 116.

12 A muzzle port 118 is provided in communication with muzzle
13 check valve 116. Breech check valve 114 is in communication with
14 a breech port 120. In operation, gas is fed from the source 104
15 to the interior of the gun barrel via conduits 108 and 110. The
16 gas is maintained at a pressure greater than the ambient
17 pressure, preferably slightly over the ambient pressure, by
18 pressure regulator 106. This ensures that gas flowing from
19 muzzle port 118 moves out of the opening 14 so as to keep the
20 interior 112 free of water. This also insures that presence of a
21 gas flow around the circumference of the muzzle opening 14 which
22 prevents entry of water into the gun barrel 12 at any point
23 around the circumference of the opening 14. Multiple ports 118
24 and 120 can be provided to ensure a uniform gas distribution.

25 As shown in FIGS. 1-3, gas is also fed to the interior 112
26 of the gun barrel at breech port 120 remote from the opening 14

1 via conduit 108. This is done to ensure that the gun barrel 12
2 remains free of water along substantially its entire length.

3 During and after firing a projectile, propellant gases will
4 remain in the interior 112 of the gun barrel. Check valves 114
5 and 116 are provided in the pressurization system 100 to
6 establish a one-way flow so that these propellant gases are
7 prevented from over pressurizing the gas source 104. Any
8 suitable check valve arrangement known in the art may be used for
9 check valves 114 and 116. Eventually, the propellant gases
10 within the interior 112 of the gun barrel are purged by the gas
11 which is introduced into the interior 112 of the gun barrel.

12 Keeping the barrel dry is important in underwater gun
13 operations because (1) bullets achieve higher muzzle velocities
14 with a dry barrel and (2) firing bullets through a dry barrel, as
15 opposed to a barrel filled with water, reduces the strength
16 requirements of the barrel, permitting a reduction in weight.
17 Further, purging of the products of combustion from the barrel
18 after a firing is important for safety considerations and to
19 prevent barrel corrosion caused by exhaust gases.

20 Accordingly, it is also desirable to keep the barrel free
21 from fluid. In order to accomplish this, a device such as a
22 spooled tape seal or a rotating disk seal can be used. The
23 spooled tape seal is taught by U.S. Patent No. 5,648,631 to
24 Kirschner et al. As shown in FIG. 4, the spooled tape seal
25 incorporates a tape spool 20 on one side of barrel 12 and a take
26 up spool 22 on the other side of barrel 12. The tape 18 extends

1 between spools 20 and 22 and across barrel muzzle 14. A drive
2 means 30 is used to advance tape 18 after a projectile discharges
3 and punctures tape 18.

4 Another means for keeping the barrel free from fluid is the
5 rotating disk seal taught by U.S. Patent Application Serial No.
6 08/613,814. As shown in FIG. 5, the rotating disk seal
7 incorporates a rotating plate 32 affixed to gun barrel 12 by a
8 drive shaft 34. Rotating plate 32 has a plurality of apertures
9 36 therein. A face seal 38 is joined to muzzle 14 of gun barrel
10 12 to seal gun barrel 12 against plate 32. Face seal 38 is
11 biased against plate 32 by a spring 40. Muzzle port 118 can be
12 joined to gun barrel 12 near muzzle 14. As in FIGS. 1-3, muzzle
13 port 118 is joined to check valve 116 and regulated gas line 110.
14 A drive system 42 rotates plate 32 so that aperture 36 is in
15 communication with muzzle 14 during firing. After firing, drive
16 system 42 rotates plate 32 such that muzzle 14 is blocked by
17 plate 32 to seal gun barrel 12. Plate 32 is balanced by a
18 support 44 also affixed to barrel 12.

19 It is apparent that there has been provided in accordance
20 with this invention a regulated gas source for underwater gun
21 operation which fully satisfies the objects, means and advantages
22 set forth hereinbefore. While the invention has been described
23 in combination with specific embodiments thereof, it is evident
24 that many alternatives, modifications and variations will be
25 apparent to those skilled in the art in light of the foregoing
26 description. Accordingly, it is intended to embrace all such

1 alternatives, modifications, and variations.

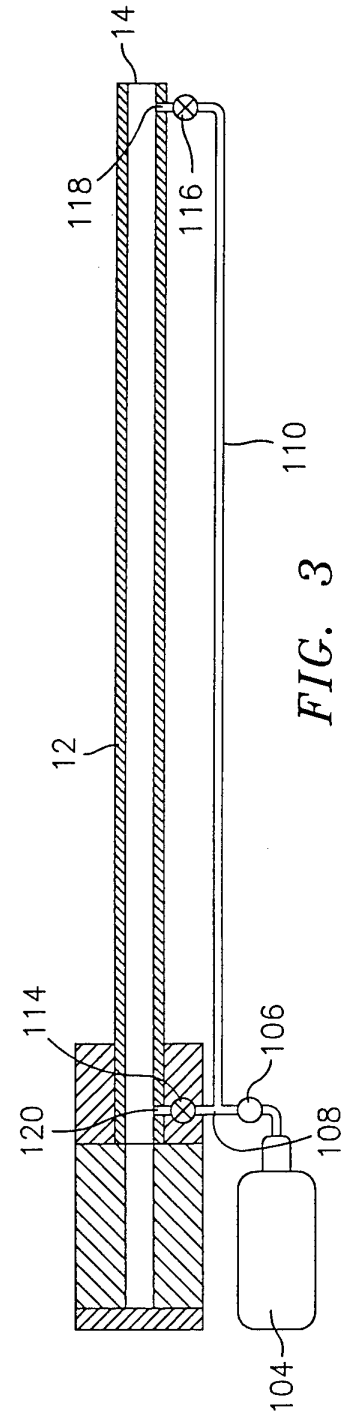
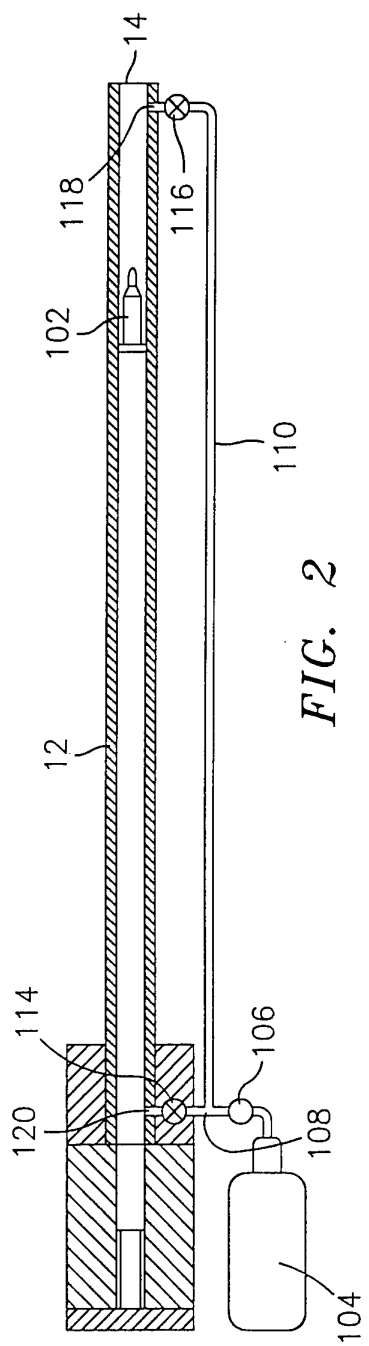
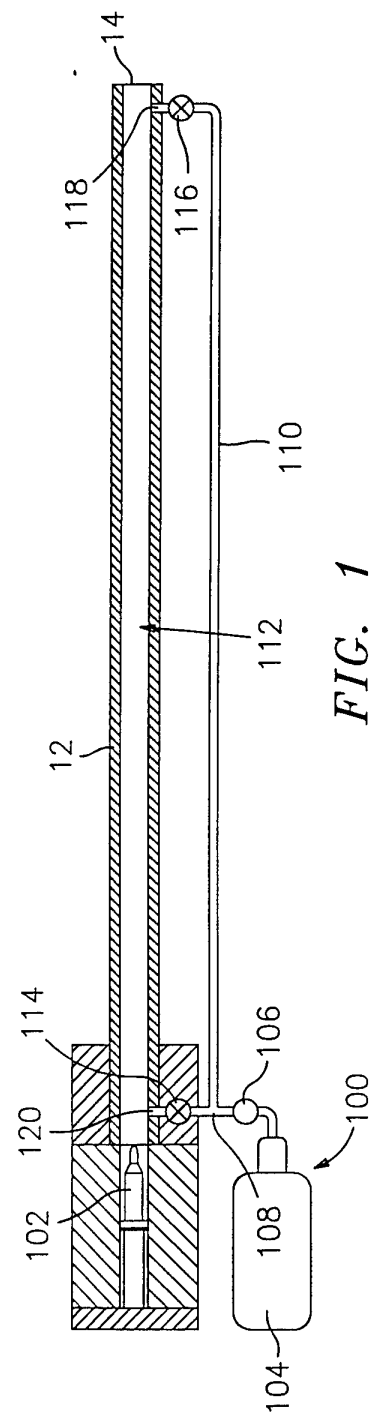
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1 Navy Case No. 77381

2 REGULATED GAS SOURCE FOR UNDERWATER GUN OPERATION

3 ABSTRACT OF THE DISCLOSURE

4 The present invention relates to an underwater weapon having
5 a barrel with an opening through which a projectile is
6 discharged. The weapon further has an apparatus for pressurizing
7 the interior of the barrel to a pressure greater than the ambient
8 pressure to keep water from entering the gun barrel at any point
9 around the circumference of the muzzle opening. The pressurizing
10 apparatus includes a source of gas, a pressure regulator for
11 adjusting the flow of the gas and the pressure within the barrel,
12 and a distribution network for distributing the gas near the
13 muzzle opening and at an end of the barrel remote from the muzzle
14 opening.



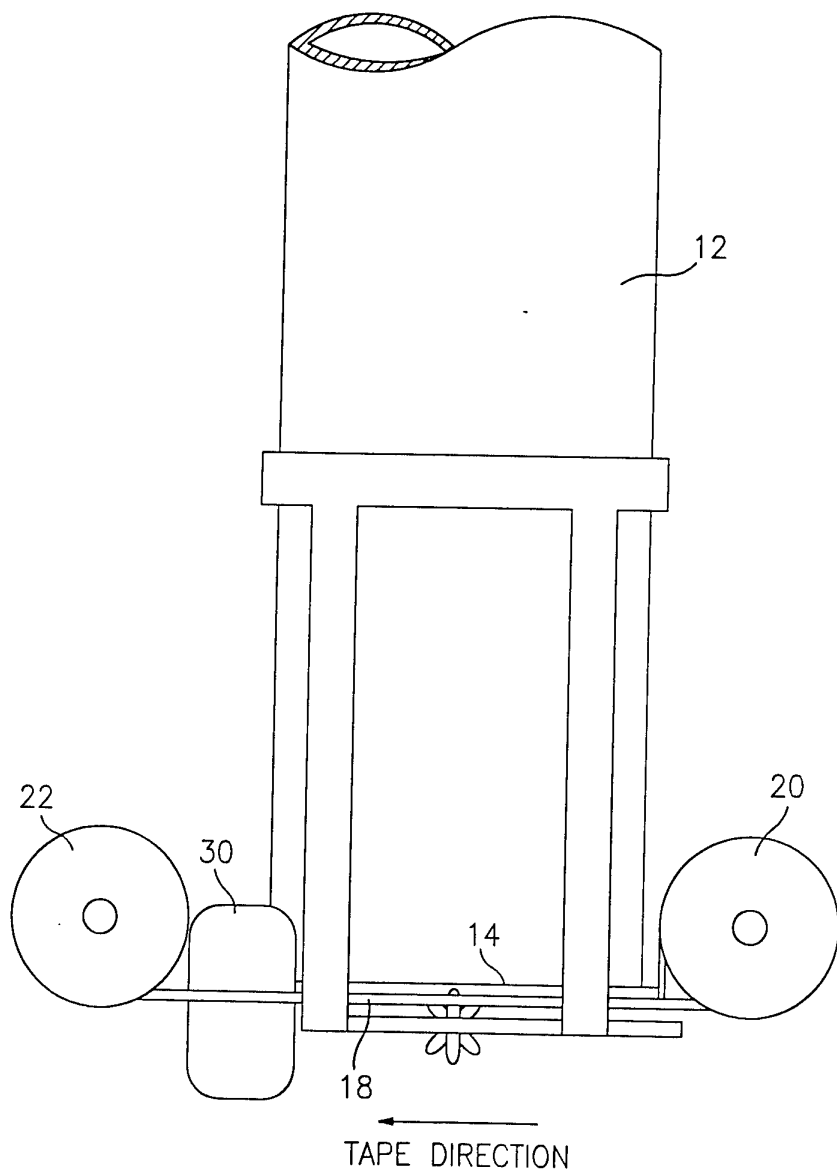


FIG. 4

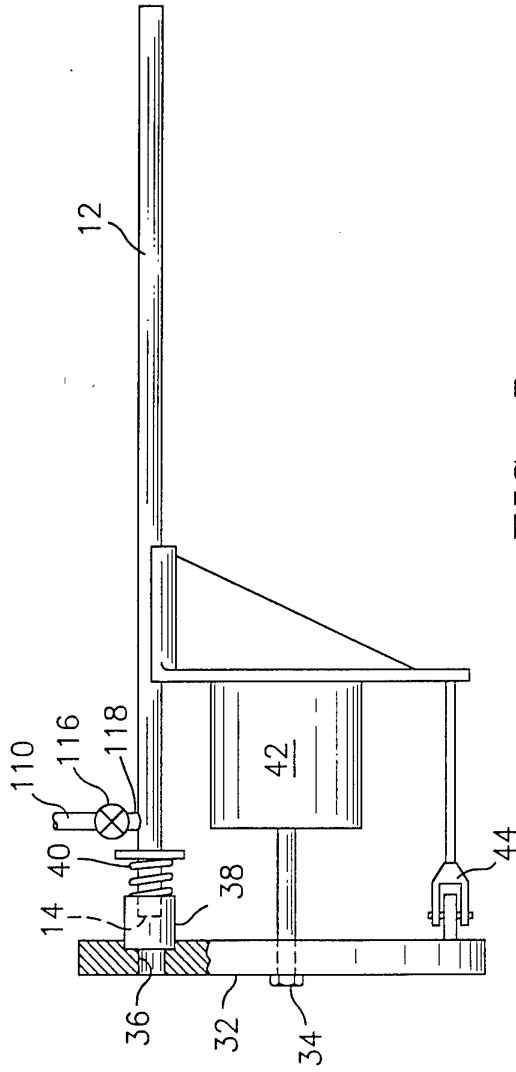


FIG. 5