US009927205B2

(12) **United States Patent**
Davis

(10) **Patent No.: US 9,927,205 B2**
(45) **Date of Patent: Mar. 27, 2018**

(54) **VORTEX RING-PRODUCING GUN WITH RECOILING NOZZLE**

(71) Applicant: **Jeffery M. Davis**, Manassas, VA (US)

(72) Inventor: **Jeffery M. Davis**, Manassas, VA (US)

(73) Assignee: **Jeffery M. Davis**, Manassas, VA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 202 days.

(21) Appl. No.: **14/622,107**

(22) Filed: **Feb. 13, 2015**

(65) **Prior Publication Data**

US 2015/0190820 A1 Jul. 9, 2015

Related U.S. Application Data

(60) Provisional application No. 61/944,733, filed on Feb. 26, 2014.

(51) **Int. Cl.**

F41B 11/643	(2013.01)
F41B 9/00	(2006.01)
F41B 11/89	(2013.01)
A63H 33/28	(2006.01)

(52) **U.S. Cl.**

CPC ***F41B 11/643*** (2013.01); ***A63H 33/28*** (2013.01); ***F41B 9/004*** (2013.01); ***F41B 9/0037*** (2013.01); ***F41B 9/0075*** (2013.01); ***F41B 11/89*** (2013.01)

(58) **Field of Classification Search**

CPC F41B 11/89; F41B 11/643; F41B 9/0037; F41B 9/004; F41B 9/0075; F41B 11/642; F41B 9/0031; F15D 1/009; B05B 1/06; B05B 3/18; B05B 3/00; B05B 11/3014; B05B 11/3059; B05B 11/306; B05B 11/3091; B05B 1/02; B05B 1/08; A63H 33/28; A63H 5/04

USPC 239/459, 526, 530, 532, 461, 579, 602, 239/541, 589; 124/55, 66; 446/24, 153

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

3,940,060	A *	2/1976	Viets	B64F 1/18 239/14.1
4,368,830	A *	1/1983	Soughers	B05B 11/306 222/153.13
2004/0164186	A1 *	8/2004	Kladders	A61M 15/0065 239/543
2005/0017089	A1 *	1/2005	Rohrschneider	B05B 11/306 239/333

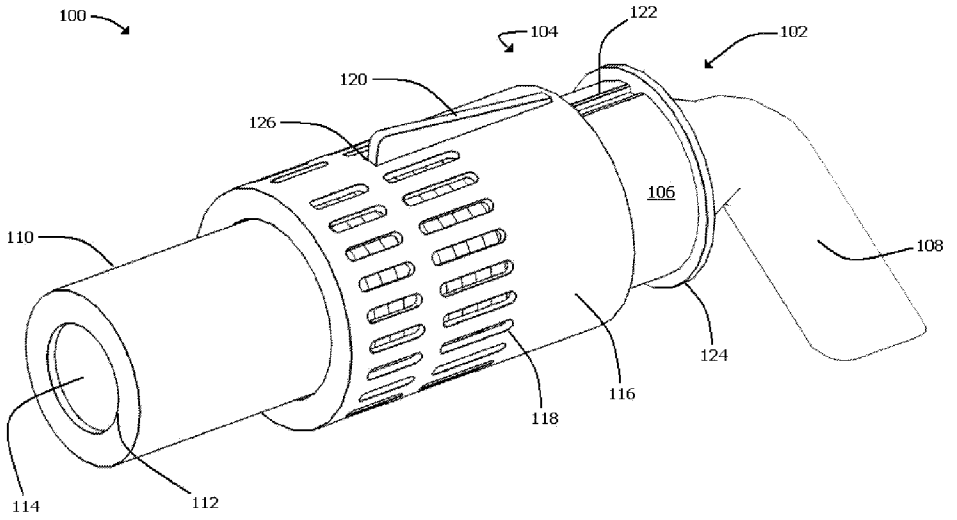
(Continued)

Primary Examiner — Christopher Kim
Assistant Examiner — Cody Lieuwen
(74) *Attorney, Agent, or Firm* — Hauptman Ham, LLP

(57) **ABSTRACT**

A vortex ring producing gun includes a body defining a first interior volume. The vortex ring producing gun includes a movable nozzle coupled with the body, comprising at least one nozzle opening, and defining a second interior volume. The vortex ring producing gun includes one or more conduits providing fluid communication between said first interior volume and said second interior volume. The vortex ring producing gun includes an energy storage element configured to bias the movable nozzle in a first direction. The vortex ring producing gun includes a latching key configured to hold the movable nozzle in a retained position against the bias from the energy storage element. The vortex ring producing gun includes a movable cocking/firing element configured to interact with the body, the energy storage element, the latching key, and the movable nozzle to selectively cock or fire the vortex ring-producing gun.

35 Claims, 11 Drawing Sheets



(56) **References Cited**

U.S. PATENT DOCUMENTS

2008/0264505	A1*	10/2008	Matsuo	B60H 1/34 137/808
2012/0052965	A1*	3/2012	Curry	A63H 33/28 472/128

* cited by examiner

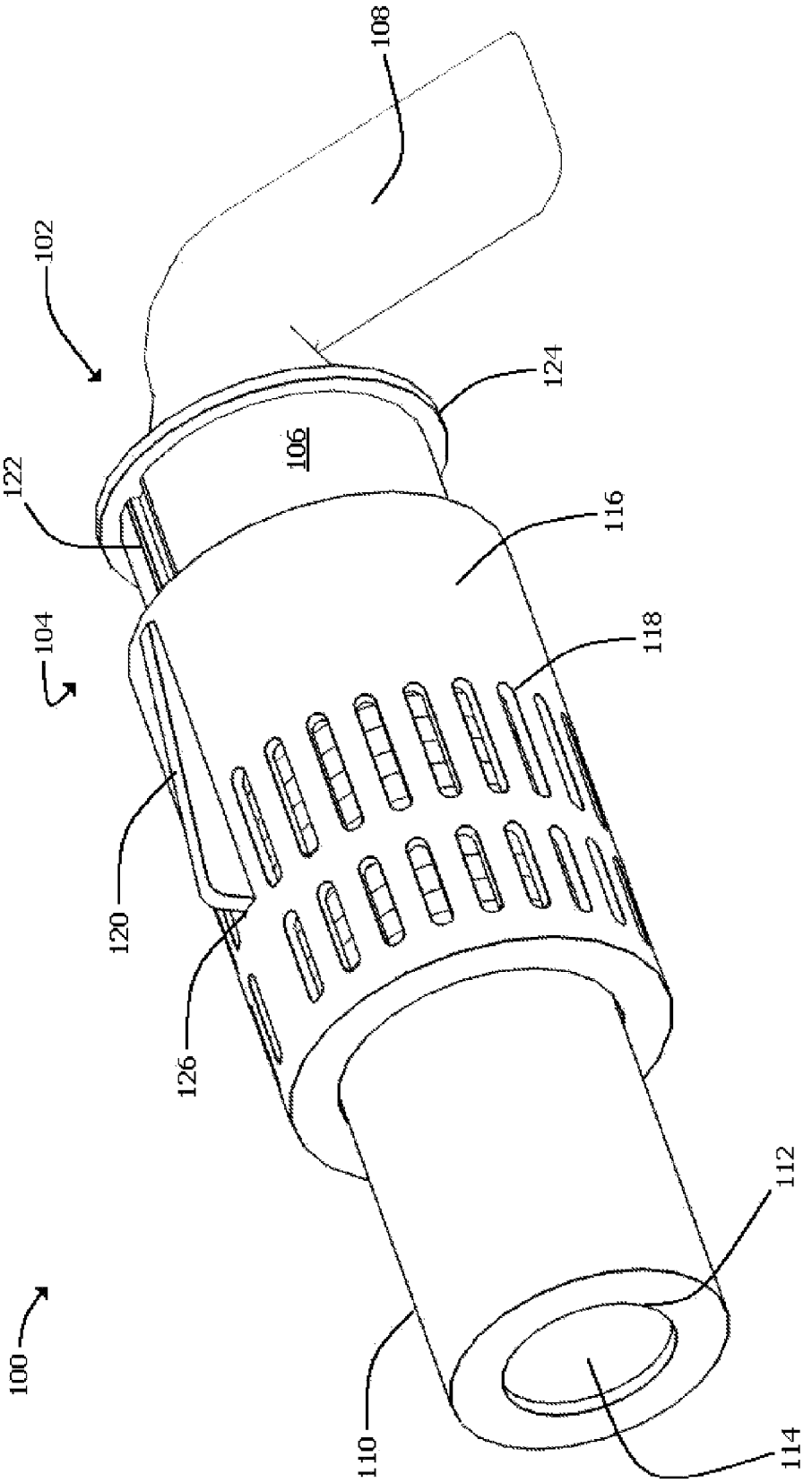


FIGURE 1

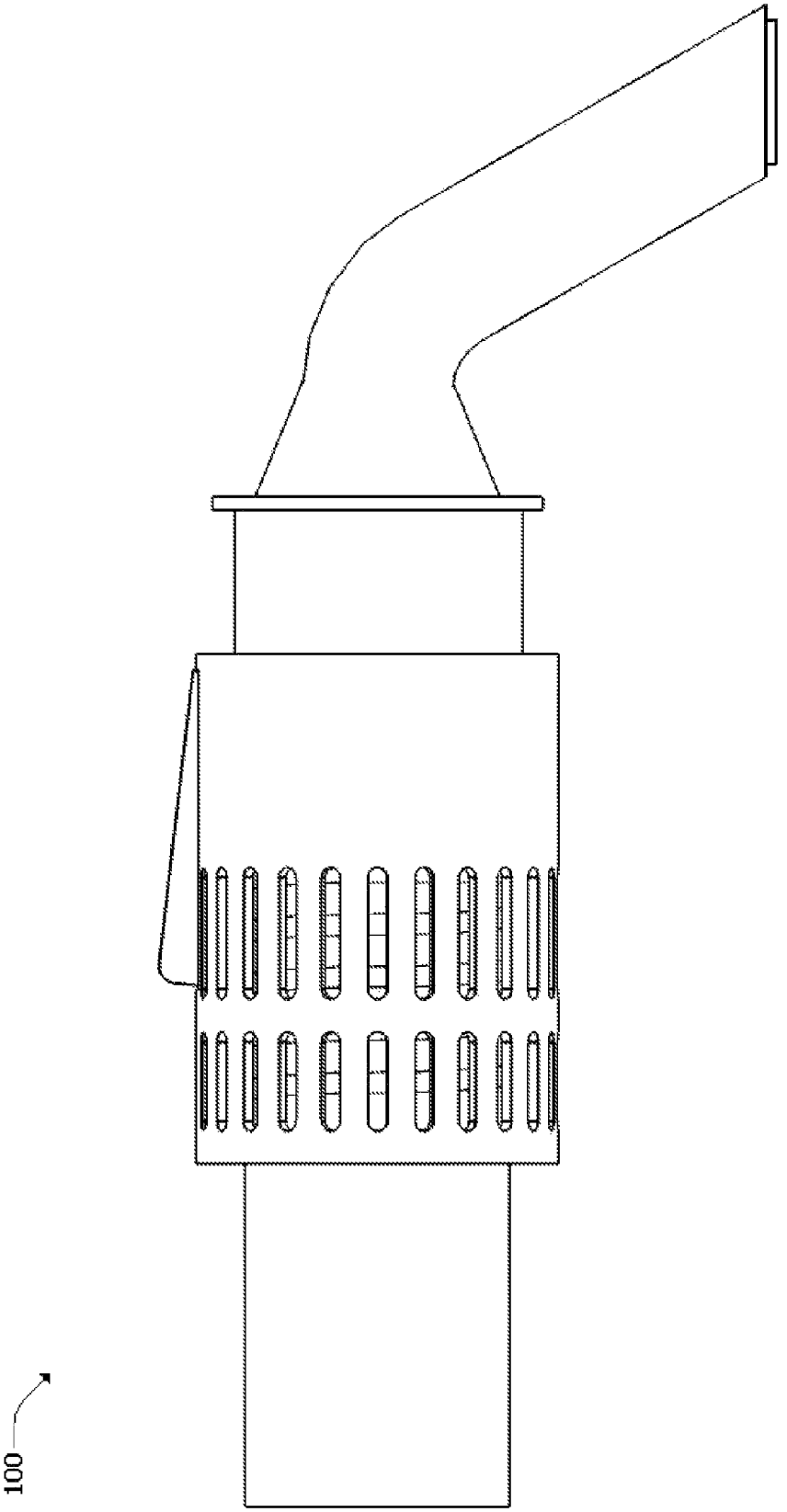


FIGURE 2

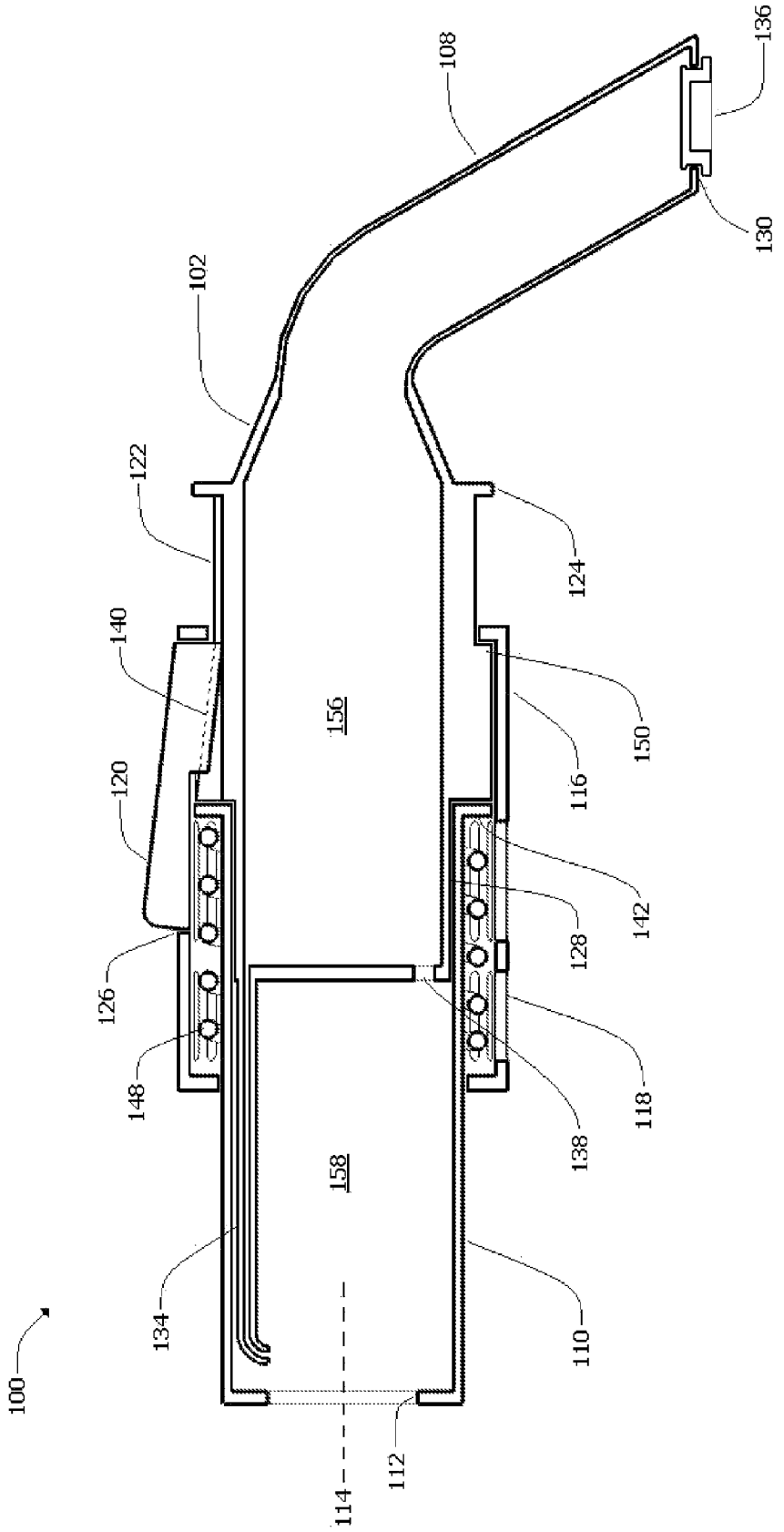

100
102
108
110
112
114
116
118
120
122
124
126
128
130
134
136
138
140
142
148
150
156
158

FIGURE 3

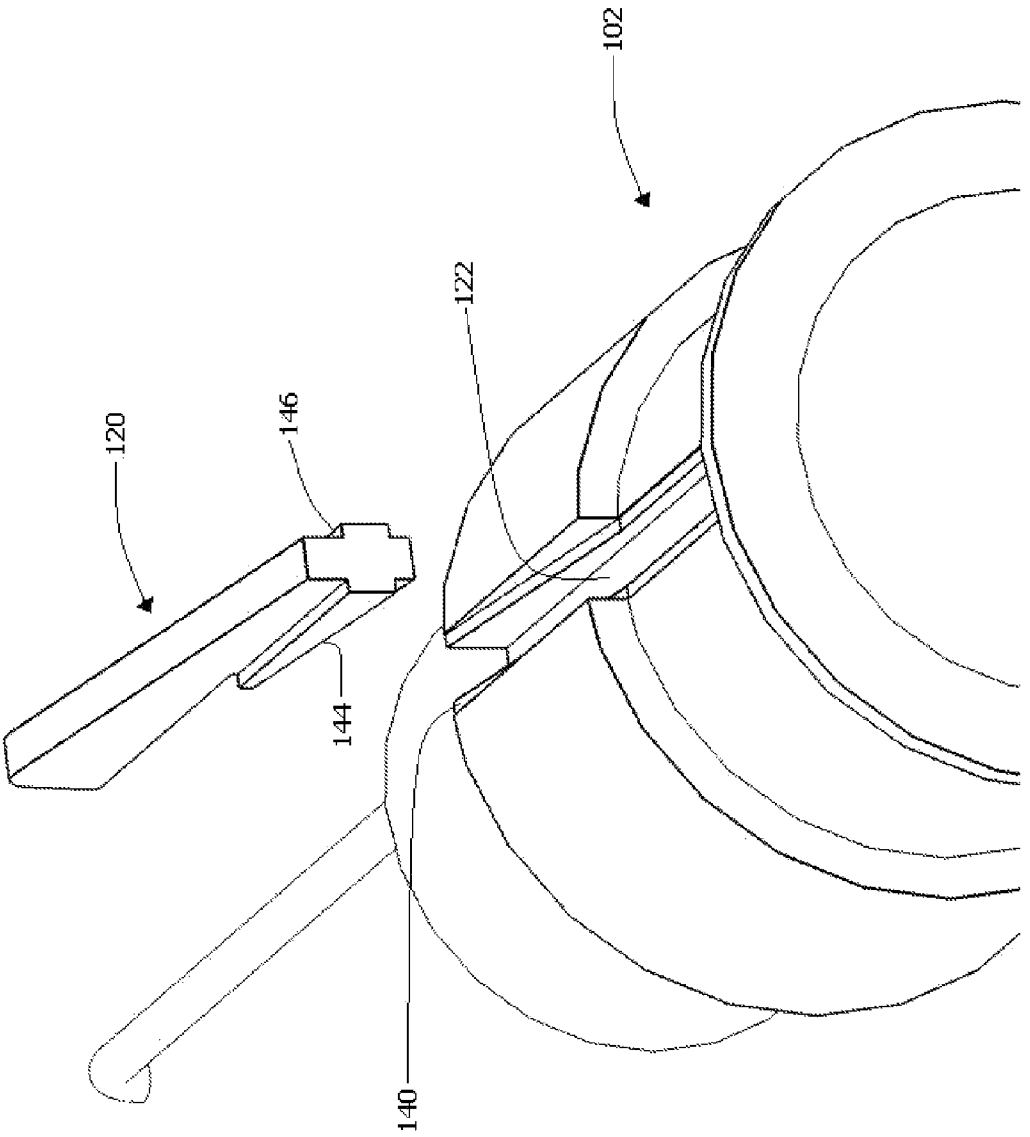


FIGURE 4

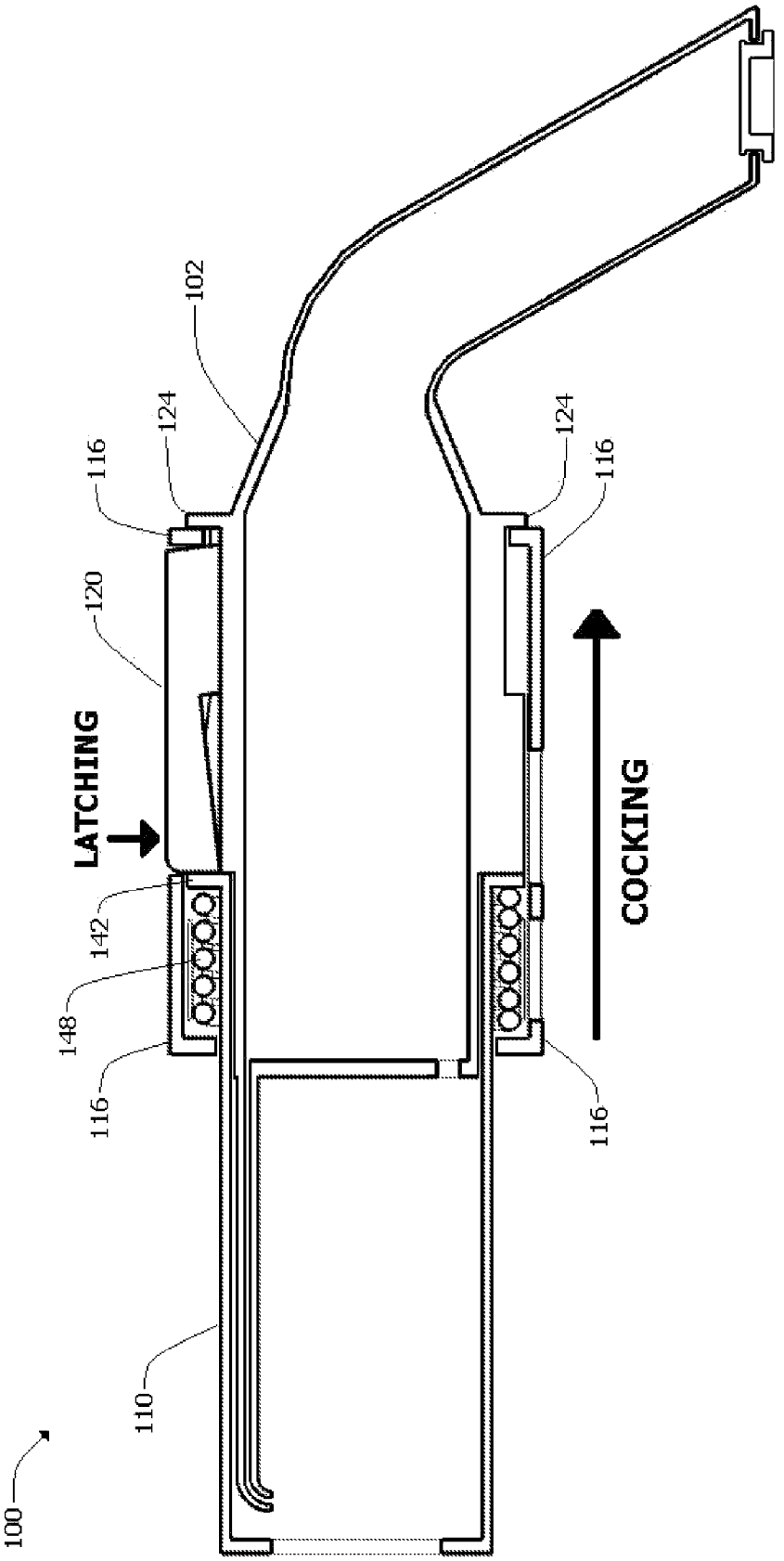

100
110
116
148
142
116
120
LATCHING
102
124
116
124
116
COCKING
116

FIGURE 5

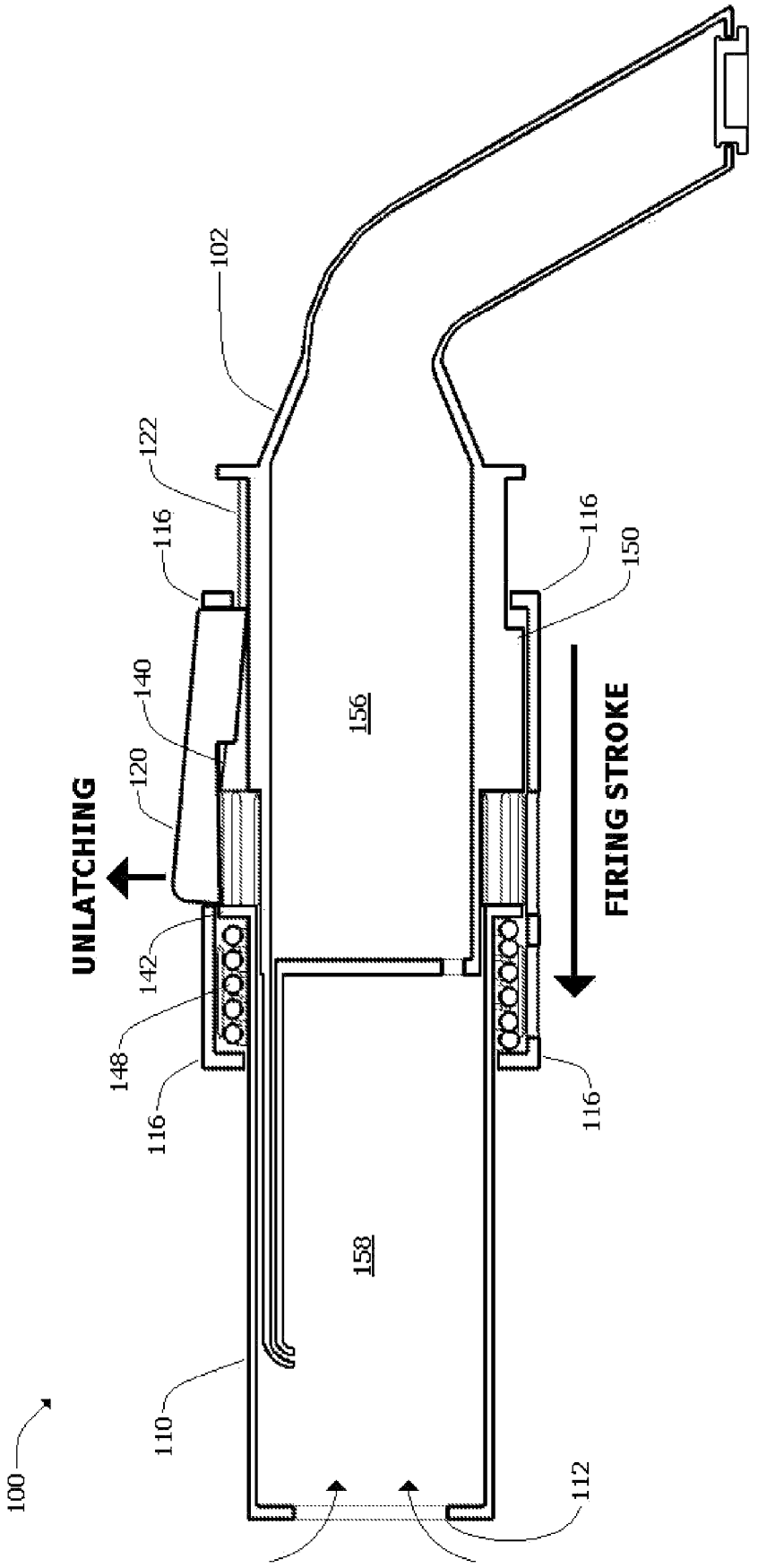

100
102
110
112
116
116
116
120
122
140
142
148
150
156
158
UNLATCHING
FIRING STROKE

FIGURE 6

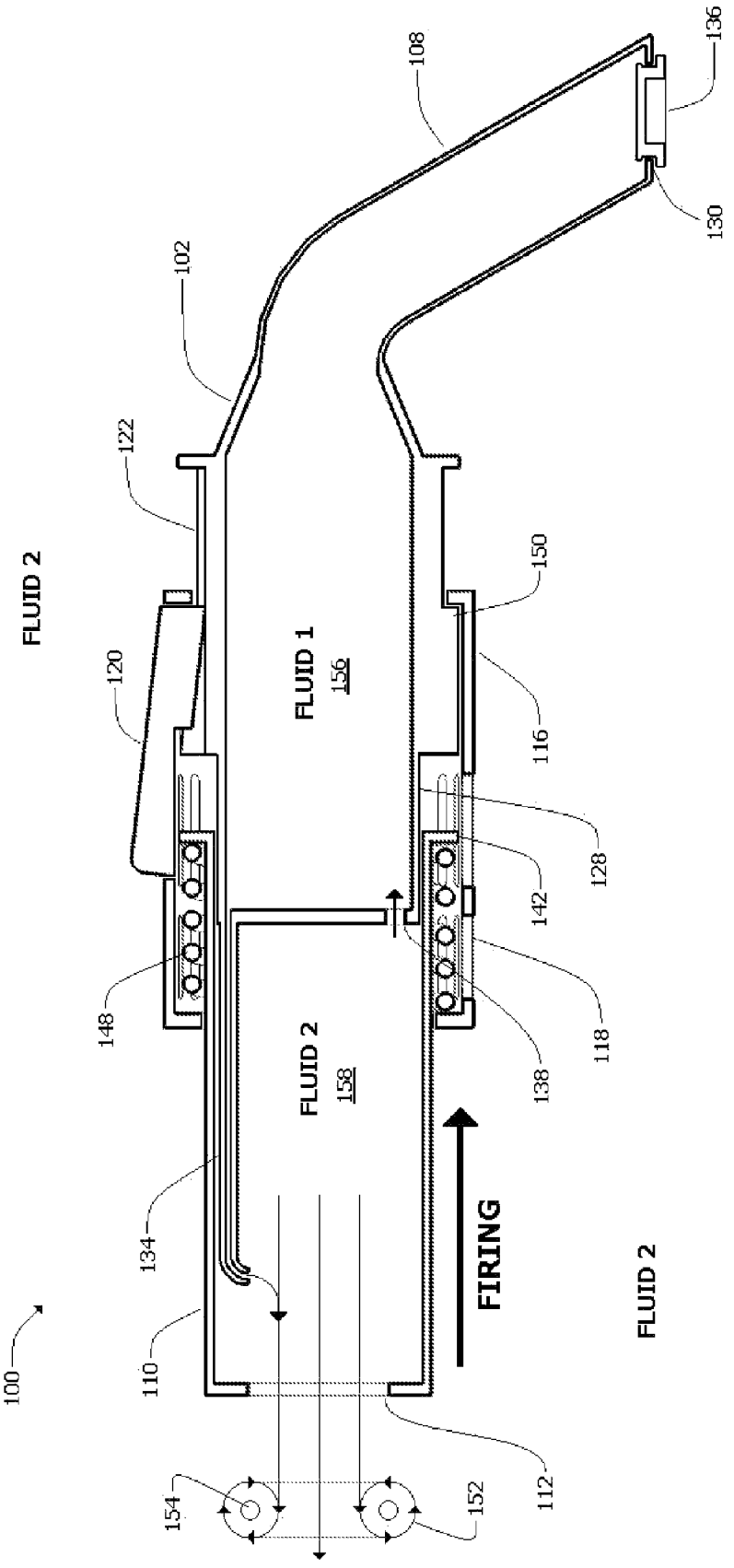

100
110
112
120
122
128
130
134
136
138
142
148
150
152
154
156
158
102
108
116
118
FLUID 2
FLUID 1
FLUID 2
FLUID 2
FIRING

FIGURE 7

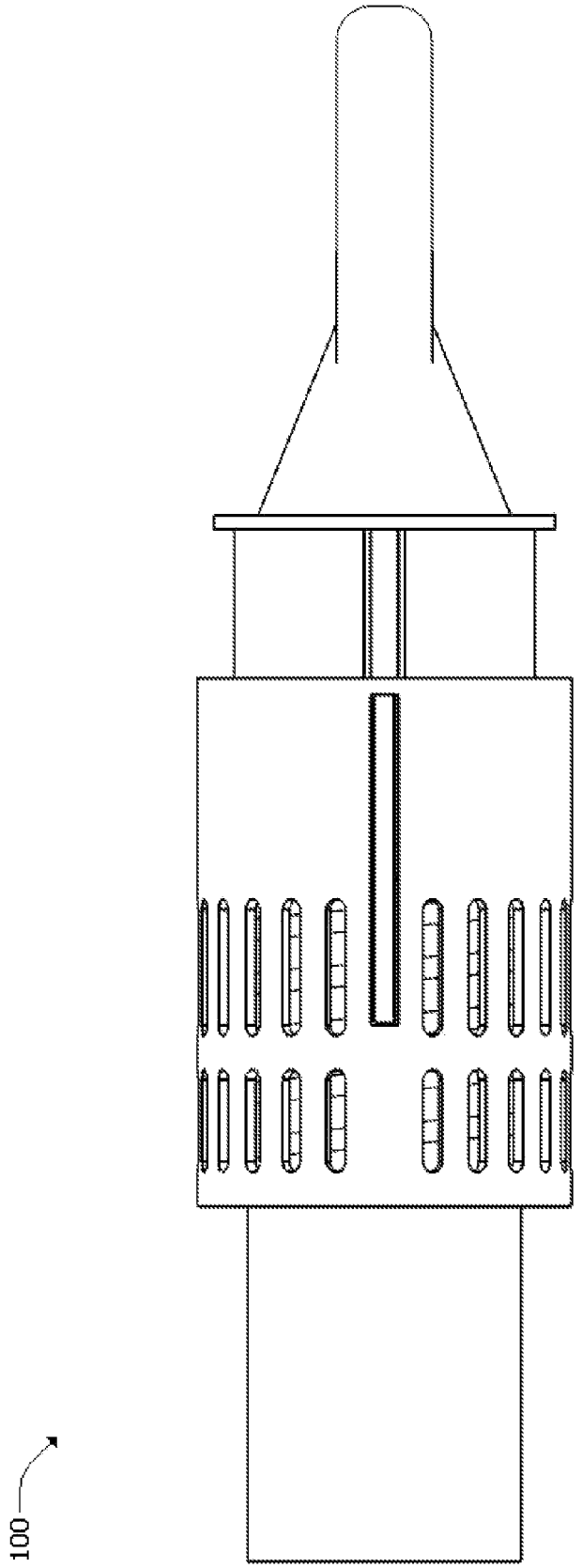


FIGURE 8

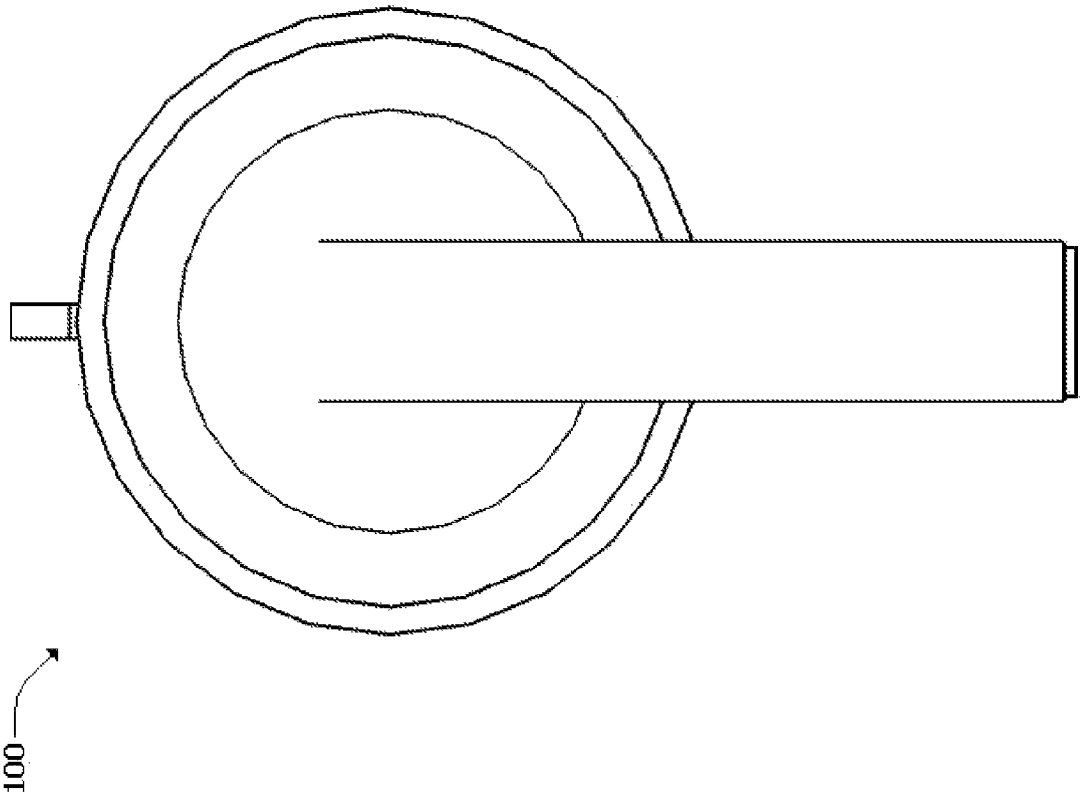


FIGURE 9

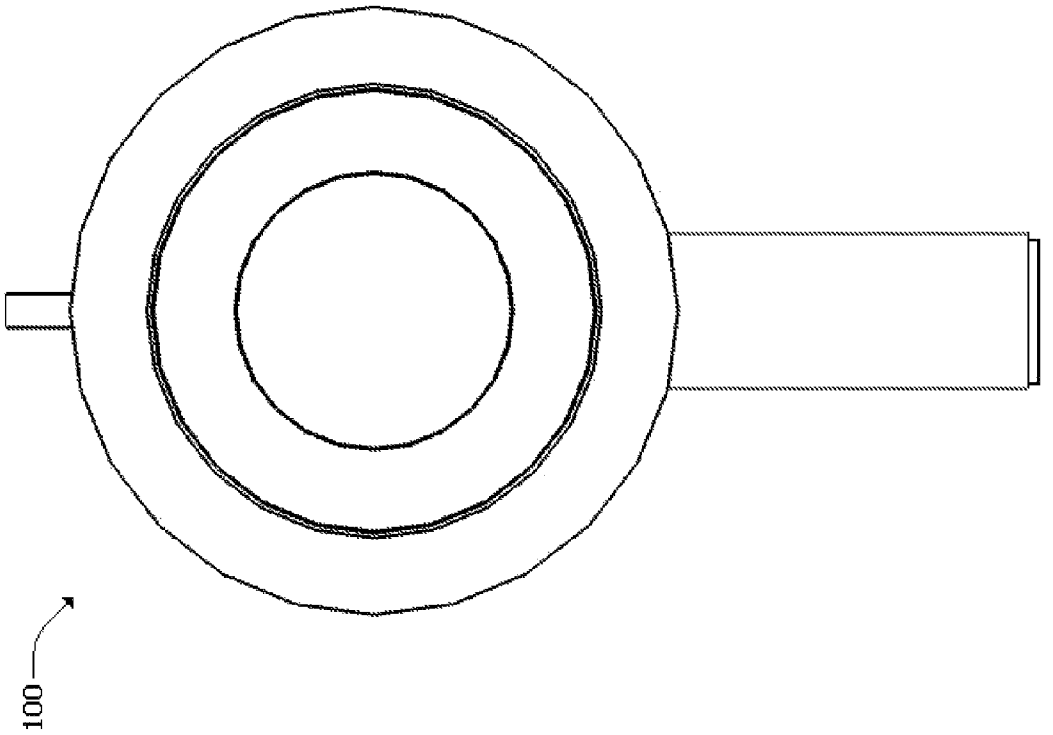


FIGURE 10

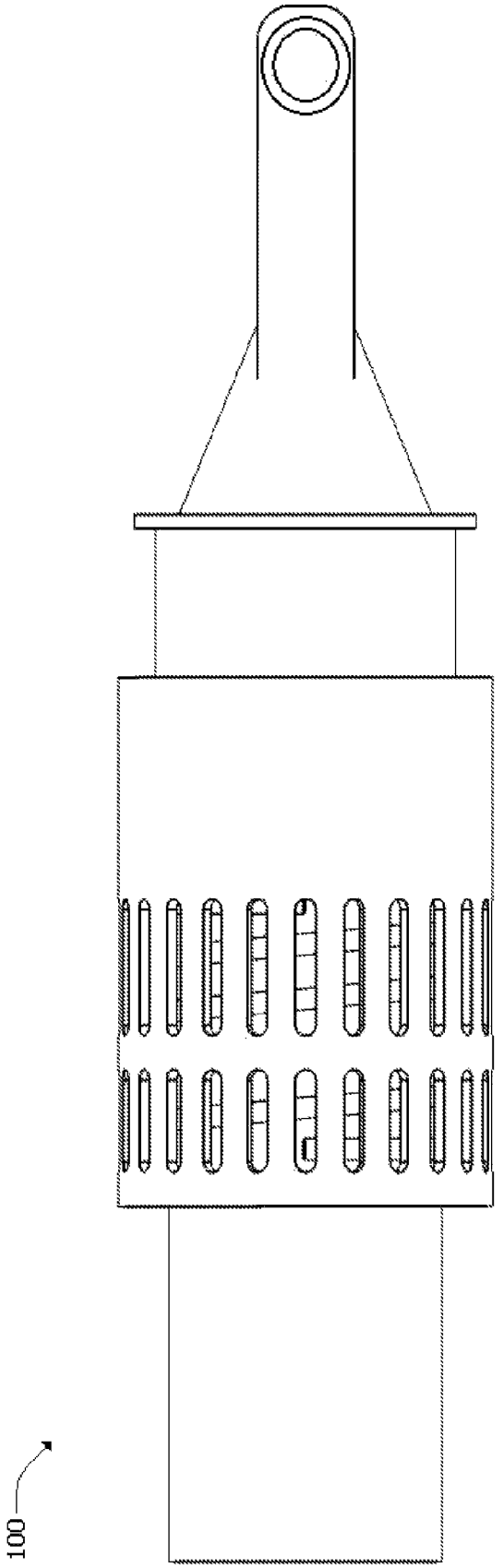


FIGURE 11

VORTEX RING-PRODUCING GUN WITH RECOILING NOZZLE

BACKGROUND

Novelty devices exist, such as toy guns, which produce vortex rings of air or water. Accuracy, entertainment value, and pressure relief have been among the considerations that have defined some of the features of such novelty devices. One of the primary concerns regarding pressure relief relates to the prospect of a child firing the toy after placing the nozzle against his, or another child's ear. If the nozzle is essentially sealed against the ear, then considerable pressure will be exerted on the ear when the toy is fired.

DESCRIPTION OF THE DRAWINGS

One or more embodiments are illustrated by way of example, and not by limitation, in the figures of the accompanying drawings, wherein elements having the same reference numeral designations represent like elements throughout and wherein:

FIG. **1** is an isometric view of a vortex ring-producing gun according to some embodiments;

FIG. **2** is a side plan view of the vortex ring-producing gun of FIG. **1**;

FIG. **3** is a side section view of the vortex ring-producing gun of FIG. **1** in a relaxed condition;

FIG. **4** is an exploded view of the latching key and keyway of the vortex ring-producing gun of FIG. **1**;

FIG. **5** is a side section view of the vortex ring-producing gun of FIG. **1** in a cocked condition;

FIG. **6** is a side section view of the vortex ring-producing gun of FIG. **1** in a pre-fire condition;

FIG. **7** is a side section view of the vortex ring-producing gun of FIG. **1** in a firing condition;

FIG. **8** is a top plan view of the vortex ring-producing gun of FIG. **1**;

FIG. **9** is a rear plan view of the vortex ring-producing gun of FIG. **1**;

FIG. **10** is a front plan view of the vortex ring-producing gun of FIG. **1**; and

FIG. **11** is a bottom plan view of the vortex ring-producing gun of FIG. **1**.

DETAILED DESCRIPTION

FIG. **1** is an isometric view of a vortex ring-producing gun **100** (also referred to herein as vortex ring gun, toy vortex gun, vortex gun, ring gun, toy gun, or gun) according to some embodiments. Operation of vortex ring gun **100** causes the production and propulsion of a vortex ring of fluid from a nozzle of the gun. In at least some embodiments, the vortex ring produced includes a second fluid, e.g., air, another gas, a colored fluid, a colorant material, or another suitable second fluid within the vortex ring. Vortex ring gun **100** includes a recoiling nozzle **110** (also referred to herein as movable nozzle, or nozzle). Recoiling nozzle **110** is capable of limiting a pressure experienced by an external target that is positioned immediately adjacent an output of the nozzle when the gun is fired.

Vortex ring gun **100** includes a body **102**, which, in at least some embodiments, is made of a molded plastic material. In at least some embodiments, body **102** comprises a right half **104** and a left half **106**, joined along a centerline of the gun. In at least some embodiments, right half **104** and left half **106** are substantially mirror images of each other. In at least some embodiments, body **102** is made of a single piece of material, e.g., a single molded piece. In at least some embodiments, body **102** is made of a shaped plastic material. In at least some embodiments, body **102** is made of a metal, wood, fiber, or other suitable material.

FIG. **2** is a side view of vortex gun **100**.

FIG. **3** is a side section view of vortex gun **100** in a relaxed condition. Body **102** is generally hollow and defines a first chamber **156**. Body **102** includes an opening **130** near a lowest extent of the body. Opening **130** provides fluid communication from first chamber **156** to an exterior of gun **100**. In at least some embodiments, gun **100** is able to receive a plug or cover **136** that is able to be inserted into or adjacent opening **130** to prevent fluid communication from first chamber **156** to the exterior of gun **100**.

Body **102** also includes a grip **108**. In at least some embodiments, grip **108** extends upward from opening **130**. In at least some embodiments the bottom of grip **108** is the lowest extent of body **102** and first chamber **156**.

Body **102** also includes a protrusion **128** on which nozzle **110** slides. The assembly of nozzle **110** together with body **102** defines a second chamber **158**. Second chamber **158** is in fluid communication with an exterior of gun **100** through a nozzle opening **112**.

Vortex ring gun **100** also includes a fluid conduit **134** for providing fluid communication between first chamber **156** and second chamber **158**. In at least some embodiments, fluid conduit **134** has a tubular structure. In at least some other embodiments, fluid conduit **134** is a hole in a surface of body **102**. In at least some embodiments, fluid conduit **134** connects an interior of body **102** to an exterior of the body. In at least some embodiments, one end of fluid conduit **134** is positioned at an upper end of body **102**. In at least some embodiments, one end of fluid conduit **134** is positioned at a lower end of body **102**.

Vortex ring gun **100** also includes a fluid conduit **138** for providing fluid communication between first chamber **156** and second chamber **158**. In at least some embodiments, fluid conduit **138** is omitted. In at least some embodiments, fluid conduit **138** is a hole in a surface of body **102**. In at least some embodiments, fluid conduit **138** connects an interior of body **102** to an exterior of the body. In at least some other embodiments, fluid conduit **138** has a tubular structure. In at least some embodiments, one end of fluid conduit **138** is positioned near a lower portion of body **102**. In at least some embodiments, one end of fluid conduit **138** is positioned near the upper portion of body **102**.

Body **102** also includes at least one keyway **122** in at least one surface of body **102**. Keyway **122** is a rectangular trough that includes at least one ramped surface **140** whose distance from a center axis of body **102** changes along a length of the axis of body **102**. In at least some embodiments, keyway **122** is a shape other than rectangular.

Body **102** also includes two ridges extending from an exterior surface of body **102**. A first ridge **124** is positioned on body **102** such that the first ridge interferes with a cocking/firing sleeve **116**, thereby defining a farthest rearward extent of sliding travel of cocking/firing sleeve **116** along the axis of body **102**. Cocking/firing sleeve **116** is also referred to as a cocking/firing element. Second ridge **150** is positioned on body **102** such that the second ridge interferes with cocking/firing sleeve **116**, thereby defining a farthest forward extent of sliding travel of cocking/firing sleeve **116** along the axis of body **102**.

Vortex ring gun **100** includes nozzle **110** coupled with body **102** of the gun. In at least some embodiments, nozzle **110** is generally cylinder-shaped. In at least some embodi-

ments, nozzle **110** includes a stepped cylindrical shape. In at least some embodiments, nozzle **110** is a stepped right cylindrical shape; however, other shapes are within the scope of the present embodiments, e.g., the nozzle in some embodiments is of a curvilinear nature. Nozzle **110** at least partially surrounds protrusion **128** of body **102** and includes nozzle opening **112** located distal from body **102**. Nozzle **110** defines a nozzle bore **114** longitudinally aligned with a center axis of protrusion **128** of body **102** and extending through the nozzle from a side adjacent the body to nozzle opening **112**. In at least some embodiments, nozzle **110** includes a flange **142** extending from an outer surface of the nozzle.

Gun **100** also comprises cocking/firing sleeve **116** that at least partially surrounds both body **102** and nozzle **110**. Cocking/firing sleeve **116** includes forty-six pressure-venting slots **118** circumferentially spaced around the exterior of the cocking/firing sleeve. In at least some embodiments, cocking/firing sleeve **116** includes greater or fewer than forty-six pressure venting slots **118**. In at least some embodiments, pressure-venting slots **118** are generally slit-shaped and include a rounded end. Cocking/firing sleeve **116** defines fluid passageways extending from an interior surface of cocking/firing sleeve **116** to the exterior of the cocking/firing sleeve and terminating at pressure venting slots **118**. In at least some embodiments, the defined fluid passageways extend radially away from a centerline of cocking/firing sleeve **116**. Cocking/firing sleeve **116** also includes a keyhole **126** into which at least a portion of a latching key **120** protrudes. In at least some embodiments, keyhole **126** has a rectangular shape; however other shapes are within the scope of the present embodiments.

Vortex ring gun **100** also includes latching key **120** that is generally rectangular in shape; however other shapes are within the scope of the present embodiments. During operation of vortex ring gun **100**, latching key **120** is constrained by cocking/firing sleeve **116** to slide along keyway **122** when cocking/firing sleeve **116** is slid along the axis of body **102**. In at least one position (the cocked position) along keyway **122**, latching key **120** serves to constrain the positions of nozzle **110** and cocking/firing sleeve **116** relative to each other (latched). In at least one other position (firing position) along keyway **122**, latching key **120** allows nozzle **110** and cocking/firing sleeve **116** to move freely relative to each other (unlatched).

Vortex gun **100** also includes an energy storage element **148** that is positioned between cocking/firing sleeve **116** and nozzle **110**, coaxial with nozzle **110**, and adjacent to flange **142** of the nozzle. In at least some embodiments, energy storage element **148** is a spring. In at least some embodiments, gun **100** includes a different energy storage element, e.g., an elastic material, a pressurized gas, or another suitable energy storage element. Energy storage element **148** is capable of storing the energy exerted by a user of vortex gun **100** during a manual cocking operation of vortex gun **100**. Energy storage element **148** is capable of releasing the stored energy causing the production of a vortex ring during a firing operation of gun **100**. Sliding the cocking/firing sleeve **116** back and forth along an axis of vortex ring gun **100** performs the alternate cocking and firing operations. In at least some embodiments, the cocking/firing operations are automated. In at least some other embodiments, the cocking/firing operations are powered by an energy source such as a battery, fuel, a compressed gas, or another suitable energy source.

FIG. **4** is an exploded view of latching key **120** and keyway **122** of vortex ring gun **100**. Latching key **120** includes at least one ramped surface **144** that interfaces with at least one ramped surface **140** of keyway **122** of body **102**. Latching key **120** also includes at least one protrusion **146** that interfaces with cocking/firing sleeve **116** and serves to retain latching key **120** within cocking/firing sleeve **116** and keyway **122**.

FIG. **5** is a side section view of vortex gun **100** in a cocked condition resulting from a cocking stroke. Vortex gun **100** is transitioned to the cocked condition by sliding cocking/firing sleeve **116** rearward on body **102** until sleeve **116** contacts first ridge **124** of body **102**. The rearward movement of cocking/firing sleeve **116** causes latching key **120** to slide rearward along keyway **122** until latching key **120** drops into a position between flange **142** of nozzle **110** and cocking/firing sleeve **116**. When latching key **120** is in a position between flange **142** of nozzle **110** and cocking/firing sleeve **116** the two components are latched together such that they do not slide relative to each other. The rearward movement of cocking/firing sleeve **116** during cocking also causes energy storage element **148** to become compressed between nozzle **110** and cocking/firing sleeve **116**, thereby storing energy exerted during cocking.

FIG. **6** is a side section view of vortex gun **100** in a pre-fire condition. The depicted pre-fire condition occurs prior to the end of a firing stroke. A firing stroke includes moving cocking/firing sleeve **116** forward on body **102** from the cocked position until cocking/firing sleeve **116** contacts second ridge **150**. During the firing stroke, cocking/firing sleeve **116**, latching key **120**, nozzle **110**, and energy storage element **148** all move forward together on body **102**. The firing stroke causes a volume of second chamber **158** to increase, and thereby draw fluid from outside the gun **100**, through nozzle opening **112**, into expanding second chamber **158**. The firing stroke also causes latching key **120** to slide up ramp **140** of keyway **122**. The movement of latching key **120** up ramp **140** of keyway **122** causes latching key **120** to slide up the surface of flange **142** of nozzle **110** toward an unlatched condition.

FIG. **7** is a side section view of vortex gun **100** in a firing condition. In this depiction, first chamber **156** of vortex gun **100** contains Fluid **1**, vortex gun **100** is surrounded by Fluid **2**, and second chamber **158** inside nozzle **110** is filled with Fluid **2**. Vortex gun **100** commences firing at the end of a firing stroke, i.e., when cocking/firing sleeve **116** is moved forward on body **102** such that sleeve **116** contacts second ridge **150**, said forward motion causing latching key **120** to move up ramp **140** of keyway **122** to an unlatched position where latching key **120** is clear of flange **142** of nozzle **110**. Since flange **142** is clear of latching key **120**, compressed energy storage element **148** accelerates nozzle **110** rearward on protrusion **128** of body **102**. The acceleration of nozzle **110** rearward compresses Fluid **2** inside nozzle **110** and forces Fluid **2** out through nozzle opening **112**. Fluid **2** exits through nozzle opening **112** and forms a circulating vortex ring **152** outside nozzle opening **112** of nozzle **110**. Vortex ring **152** includes a core **154** comprised of Fluid **1** that is entrained into Fluid **2** as Fluid **2** moves rapidly past the opening of fluid conduit **134**. Vortex ring **152** will exist in stable equilibrium with core **154** when Fluid **1** has a density that is less than the density of Fluid **2**. Also during firing, a portion of compressed Fluid **2** moves through conduit **138** into first chamber **156** to replace the portion of Fluid **1** that exited first chamber **156** through fluid conduit **134**. Firing is completed when vortex gun **100** has returned to the relaxed condition depicted in FIG. **3**, i.e., energy storage element **148** is fully expanded, and nozzle **110** is positioned as rearward as possible on protrusion **128** of body **102**.

One of ordinary skill in the art would recognize that the diameters and lengths of fluid conduits **134** and **138** are adjustable to control flows of Fluid **1** out of first chamber **156**, and Fluid **2** into first chamber **156**. In at least some embodiments, said flows are restricted such that Fluid **1** is only drawn out through conduit **134** when recoiling nozzle **110** causes Fluid **2** to flow rapidly past the opening of fluid conduit **134** during firing. In at least some embodiments, said flow is unrestricted to the extent that Fluid **1** flows out through fluid conduit **134** at a predetermined rate when the parts of the gun are at rest. In at least some other embodiments, said flow is unrestricted by removing plug or cover **136**. In at least some embodiments, fluid conduit **138** is not present.

In at least some embodiments, one or more additional fluid supply tanks are positioned on or near gun **100** and connected via one or more supply lines to body **102** or nozzle **110** of gun **100**. In at least some embodiments, different sizes, shapes, volumes, and/or positions of the fluid supply tank are contemplated. In at least some embodiments, the one or more additional fluid supply tanks include an opening through which a fluid, e.g., air, another gas, a colorant, a colored fluid, etc., is added.

In at least some embodiments, vortex gun **100** includes a supply line extending an open end above a water surface and connected at another end to body **102** or nozzle **110** of gun **100**. In at least some embodiments, the supply line is made of a rigid, flexible, or semi-rigid material. In at least some embodiments, the supply line also includes a one-way valve to allow entry of air from above the water level into body **102** or nozzle **110** of gun **100**, and prevent exit of the same. In at least some other embodiments, the one-way valve is positioned and/or attached or formed as part of body **102** or nozzle **110** of gun **100**. In at least some embodiments, plug or cover **136** includes an opening for receiving the supply line.

Disclosed herein is a novel design for toy vortex gun **100** that is usable underwater in a swimming pool or bathtub. Body **102** of toy gun **100** acts as a chamber to hold a volume of air, colored fluid, or one or more colored soluble pellets. The gun **100** is able to be cocked above or below the water surface. When gun **100** is first submerged, nozzle **110** is pointed upward to release air bubbles, and thereby fill the nozzle with water. Vortex gun **100** is cocked by holding body **102** fixed with one hand while pulling cocking/firing sleeve **116** rearward to a farthest extent with the other hand. The cocking action compresses the energy storage element **148** and latches nozzle **110** to cocking/firing sleeve **116** by action of latching key **120**. The vortex gun **100** is fired by holding body **102** fixed with one hand while pulling the cocking/firing sleeve **116** forward to a farthest extent with the other hand. At the end of the forward firing stroke latching key **120** unlatches nozzle **110** from the cocking/firing sleeve **116**, and the nozzle is rapidly accelerated rearward by the expansion of the compressed energy storage element **148**. Water inside recoiling nozzle **110** is compressed and thereby forced out nozzle opening **112** causing the emission of rotating vortex ring **152** that travels underwater. If body **102** of the toy gun **100** is loaded with air, the emitted vortex ring **152** will be composed of spinning water with core **154** of air. This air filled vortex ring will be visible underwater due to the difference in index of refraction of water and air. If body **102** of the gun **100** is filled with water, then the vortex ring **152** emitted from the toy gun is composed only of water, and is invisible as the vortex ring travels underwater. If one or more colored soluble pellets are placed inside body **102** of the gun **100** with water, or, if colored fluid is placed inside the body of the gun, then colored vortex rings **152** will be emitted from the gun. In all of the aforementioned configurations, vortex ring **152** carries energy away from gun **100** in the forms of angular momentum and translational momentum.

Vortex ring gun **100** disclosed herein can be repetitively cycled indefinitely between the cocking and firing states by sliding cocking/firing sleeve **116** back and forth between farthest extents on body **102** of the gun. The cycling between cocking and firing states is manual, or automated using a mechanism with an energy source such as a battery or compressed gas. The vortex gun cycling between cocking and firing states will produce a continuous series of vortex rings **152** having cores **154** composed of fluid drawn from inside the body of gun **100** until that fluid is depleted.

Toy vortex gun **100** disclosed herein utilizes recoiling nozzle **110** to provide pressure relief during a point blank firing situation. For example, if a child were to fire gun **100** disclosed herein with nozzle **110** against his ear, or another child's ear, the nozzle recoils a distance away from the child's head such that the fluid ejected from the nozzle may escape through the space between the recoiled nozzle and the child's head; thereby producing a lesser amount of pressure than if the nozzle had stayed effectively sealed against the child's head. Also, since vortex gun **100** disclosed herein utilizes recoiling nozzle **110** instead of a forward moving piston, loose fitting foreign objects such as sticks inserted into the nozzle will not be ejected from the gun when fired.

FIG. **8** is a top plan view of vortex gun **100**.

FIG. **9** is a rear plan view of vortex gun **100**.

FIG. **10** is a front plan view of vortex gun **100**.

FIG. **11** is a bottom plan view of vortex gun **100**.

One aspect of this description relates to a vortex ring producing gun. The vortex ring producing gun includes a body defining a first interior volume. The vortex ring producing gun includes a movable nozzle coupled with the body, comprising at least one nozzle opening, and defining a second interior volume. The vortex ring producing gun includes one or more conduits providing fluid communication between said first interior volume and said second interior volume. The vortex ring producing gun includes an energy storage element configured to bias the movable nozzle in a first direction. The vortex ring producing gun includes a latching key configured to hold the movable nozzle in a retained position against the bias from the energy storage element. The vortex ring producing gun includes a movable cocking/firing element configured to interact with the body, the energy storage element, the latching key, and the movable nozzle to selectively cock or fire the vortex ring-producing gun.

It will be readily seen by one of ordinary skill in the art that the disclosed embodiments fulfill one or more of the advantages set forth above. After reading the foregoing specification, one of ordinary skill will be able to affect various changes, substitutions of equivalents and various other embodiments as broadly disclosed herein. It is therefore intended that the protection granted hereon be limited only by the definition contained in the appended claims and equivalents thereof.

What is claimed is:

1. A vortex ring producing gun comprising:

a body defining a first interior volume;

a movable nozzle coupled with the body, comprising at least one nozzle opening, and defining a second interior volume;

one or more conduits providing fluid communication between said first interior volume and said second interior volume;

a movable cocking/firing sleeve at least partially surrounding the body and the moveable nozzle;

an energy storage element between a portion of the moveable nozzle and a first portion of the movable cocking/firing sleeve, wherein the energy storage element is configured to bias the movable nozzle toward the body; and

a latching key configured to hold the movable nozzle in a retained position against the bias from the energy storage element, wherein

the movable cocking/firing sleeve is configured to interact with the body, the energy storage element, the latching key, and the movable nozzle to selectively cock or fire the vortex ring-producing gun, and the vortex ring producing gun is configured to reduce a length of an external dimension of the vortex ring producing gun along an axis parallel to a central, longitudinal axis of a nozzle bore of the movable nozzle in response to firing the vortex ring producing gun, and

wherein the bias of the energy storage element is configured to accelerate the moveable nozzle toward the body when the latching key transitions from a latched condition to an unlatched condition, said acceleration of the moveable nozzle is configured to cause compression of the contents of the second interior volume for causing expulsion of at least a portion of said contents through the at least one nozzle opening, and for forming a vortex ring.

2. The vortex ring producing gun of claim **1**, wherein at least a portion of the body is a handgrip.

3. The vortex ring producing gun of claim **1**, further comprising an opening in the body that provides fluid communication between the first interior volume and an exterior of the body.

4. The vortex ring producing gun of claim **3**, wherein the opening in the body is positioned near a lowest extent of the body.

5. The vortex ring producing gun of claim **3**, wherein the opening is configured to receive a plug positioned for preventing fluid communication between the first interior volume and the exterior of the body.

6. The vortex ring producing gun of claim **3**, further comprising a cover positioned over said opening such that fluid communication between the first interior volume and the exterior of the body is prevented.

7. The vortex ring producing gun of claim **1**, wherein the movable nozzle is positioned at least partially on a protrusion of the body.

8. The vortex ring producing gun of claim **1**, wherein the movable nozzle is positioned at least partially in a cavity of the body.

9. The vortex ring producing gun of claim **1**, wherein the at least one nozzle opening of the movable nozzle is distal from the body, and provides fluid communication between the second interior volume and an exterior of the moveable nozzle.

10. The vortex ring producing gun of claim **1**, wherein a first conduit of the one or more conduits has a tubular structure.

11. The vortex ring producing gun of claim **10**, wherein the first conduit extends into the first interior volume.

12. The vortex ring producing gun of claim **11**, wherein one end of the first conduit extends to a lowest extent of the first interior volume.

13. The vortex ring producing gun of claim **10**, wherein the first conduit extends into the second interior volume.

14. The vortex ring producing gun of claim **13**, wherein one end of the first conduit extends to a highest extent of the second interior volume.

15. The vortex ring producing gun of claim **1**, wherein a conduit of the one or more conduits is a hole in the body.

16. The vortex ring producing gun of claim **1**, wherein a conduit of the one or more conduits is positioned at an upper extent of the body.

17. The vortex ring producing gun of claim **1**, wherein a conduit of the one or more conduits is positioned at a lower extent of the body.

18. The vortex ring producing gun of claim **1**, wherein the body comprises a keyway, wherein a long dimension of the keyway is parallel to an axis of motion of the cocking/firing sleeve.

19. The vortex ring producing gun of claim **18**, wherein the keyway has a lengthwise-sloped surface that is non-parallel to the axis of motion of the moveable cocking/firing sleeve.

20. The vortex ring producing gun of claim **19**, wherein the latching key has a sloped surface that interfaces with the lengthwise-sloped surface of the keyway.

21. The vortex ring producing gun of claim **20**, wherein the latching key is configured to move down the slope of the keyway during a cocking stroke and up the slope of the keyway during a firing stroke.

22. The vortex ring producing gun of claim **1**, wherein the body comprises a protrusion configured to limit a maximum extent of rearward travel of the moveable cocking/firing sleeve.

23. The vortex ring producing gun of claim **1**, wherein the body comprises a protrusion configured to limit a maximum extent of forward travel of the moveable cocking/firing sleeve.

24. The vortex ring producing gun of claim **1**, wherein the moveable cocking/firing sleeve comprises a keyhole into which at least a portion of the latching key extends, the interaction of said keyhole and portion of the latching key is configured to cause the moveable cocking/firing sleeve to be able to control the position of the latching key along a pathway parallel to an axis of motion of the cocking/firing sleeve.

25. The vortex ring producing gun of claim **1**, wherein the latching key comprises one or more protrusions configured to interfere with one or more surfaces of the cocking/firing sleeve such that the latching key is retainable within the cocking/firing sleeve.

26. The vortex ring producing gun of claim **1**, wherein the moveable cocking/firing sleeve comprises at least one pressure-venting channel that provides fluid communication between an interior and an exterior of the moveable cocking/firing sleeve.

27. The vortex ring producing gun of claim **1**, wherein the moveable cocking/firing sleeve is configured to transfer cocking energy to the energy storage element during a cocking stroke.

28. The vortex ring producing gun of claim **1**, wherein the energy storage element is a spring.

29. The vortex ring producing gun of claim **1**, wherein the portion of the moveable nozzle is a flange.

30. The vortex ring producing gun of claim **1**, wherein the first portion of the moveable cocking/firing sleeve is a flange.

31. The vortex ring producing gun of claim **1**, wherein the moveable cocking/firing sleeve is configured to move the

latching key to a latched condition during a cocking stroke, and an unlatched condition at the end of a firing stroke.

32. The vortex ring producing gun of claim **1**, wherein, in a cocked and latched condition, the latching key is positionable between the portion of the moveable nozzle and a second portion of the moveable cocking/firing sleeve, and the energy storage element is configured to provide a bias force against the portion of the moveable nozzle toward the second portion of the moveable cocking/firing sleeve for trapping the latching key between the portion of the movable nozzle and the second portion of the moveable cocking/firing sleeve.

33. The vortex ring producing gun of claim **32**, wherein the portion of the moveable nozzle is a flange.

34. The vortex ring producing gun of claim **32**, wherein the second portion of the moveable cocking/firing sleeve is a flange.

35. The vortex ring producing gun of claim **1**, wherein the moveable cocking/firing sleeve is configured to move the moveable nozzle away from the body during a firing stroke for causing the second interior volume to increase, and for drawing fluid into the second interior volume through the at least one nozzle opening.

* * * * *