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Spicer et al.

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(54) **COMPRESSED GAS PROJECTILE LAUNCHING DEVICES**

(71) Applicant: **KORE OUTDOOR (US), INC.**, Fort Wayne, IN (US)

(72) Inventors: **Louis Spicer**, Sewell, NJ (US); **Mark Pearce**, Lindenwold, NJ (US); **Robert W. Ambrose**, Marlton, NJ (US); **John Ronald Rice**, Stoke-on-Trent (GB)

(73) Assignee: **KORE OUTDOOR (US), INC.**, Fort Wayne, IN (US)

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§ 371 (c)(1),
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(51) **Int. Cl.**
F41B 11/52 (2013.01)
F41B 11/62 (2013.01)

(52) **U.S. Cl.**
CPC ***F41B 11/52*** (2013.01); ***F41B 11/62*** (2013.01)

(58) **Field of Classification Search**
CPC F41B 11/52; F41B 11/53; F41B 11/62
See application file for complete search history.

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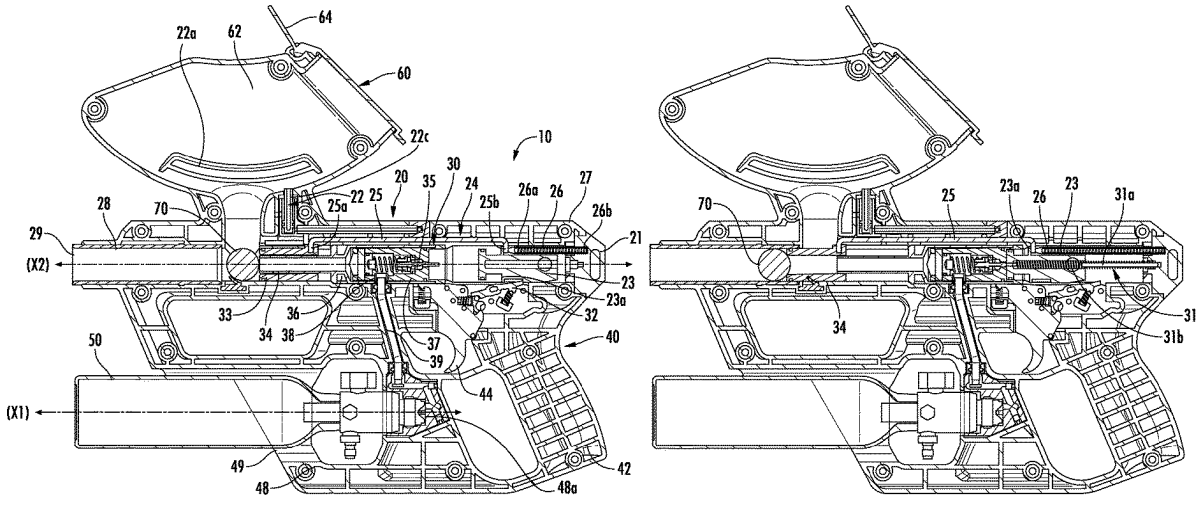
Primary Examiner — Bret Hayes
(74) *Attorney, Agent, or Firm* — Volpe Koenig

(57) **ABSTRACT**

Various projectile launching devices are disclosed herein. In one aspect, the projectile launching device includes a gas-powered projectile agitator, an anti-jam assembly, and a compressed gas canister frame positioned below a body of the device. In another embodiment, the projectile launching device includes a rear-loading hopper and a projectile agitator which is actuated by mechanical power via a linkage with a pump handle.

18 Claims, 30 Drawing Sheets



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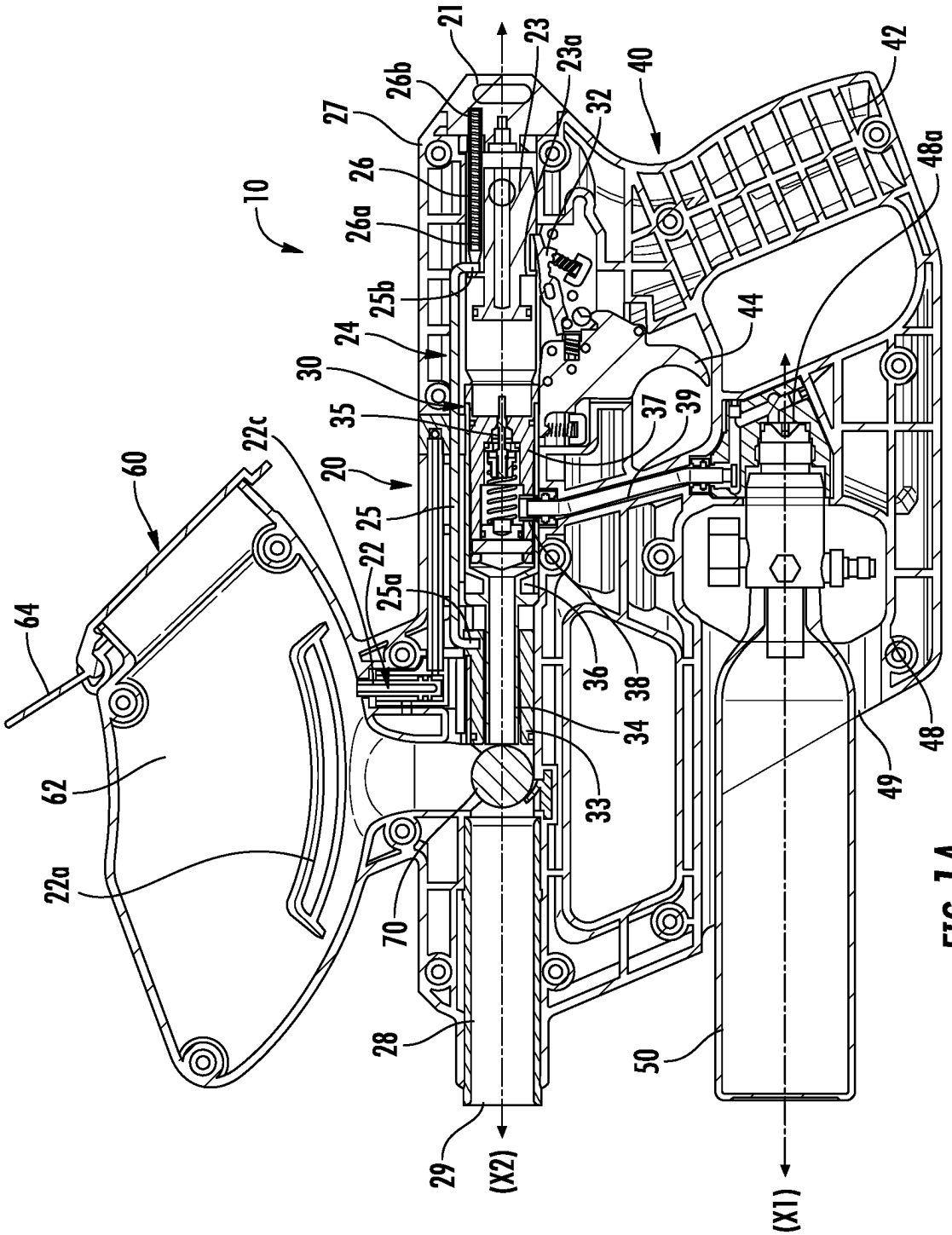
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FIG. 1A

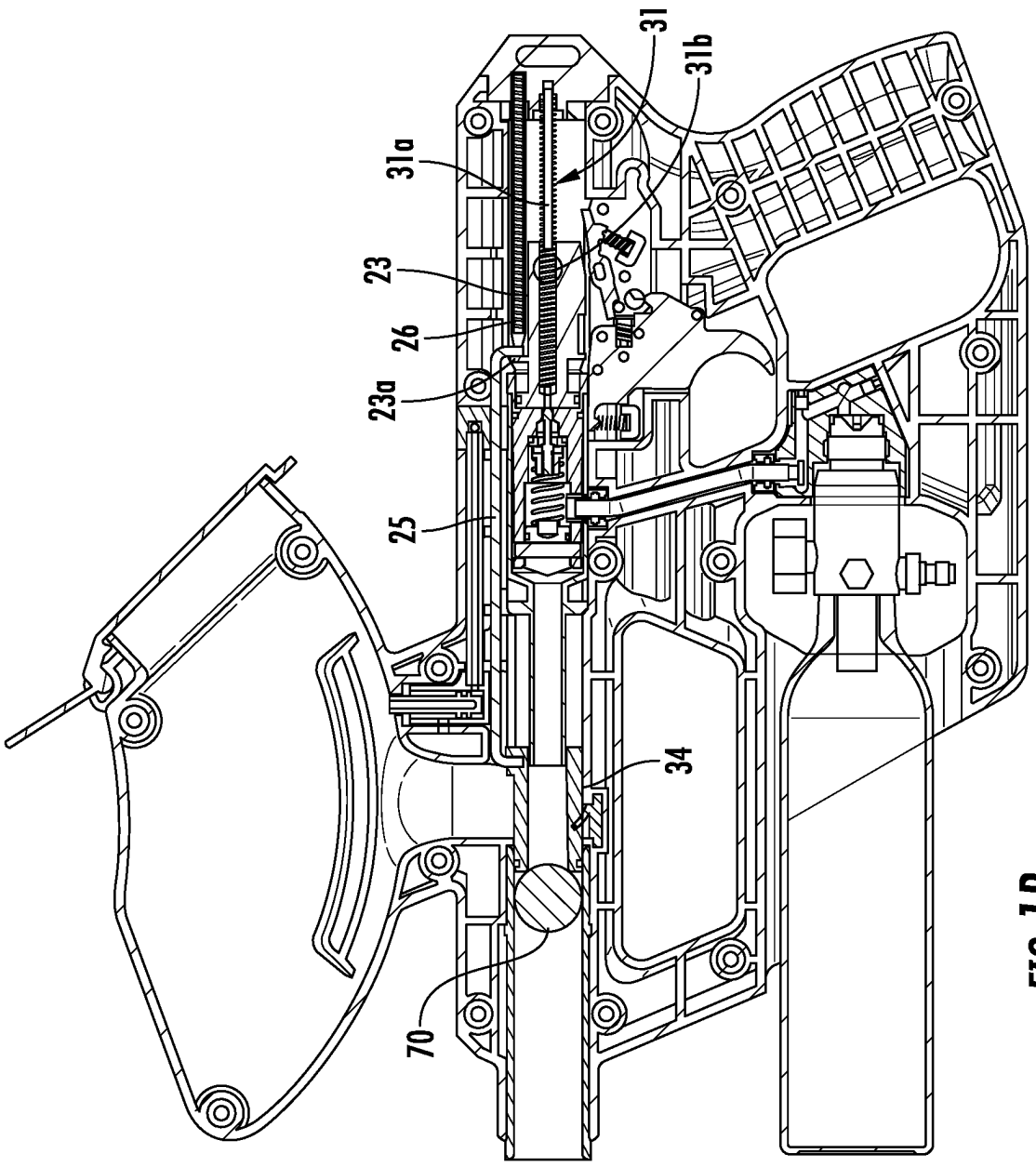


FIG. 1B

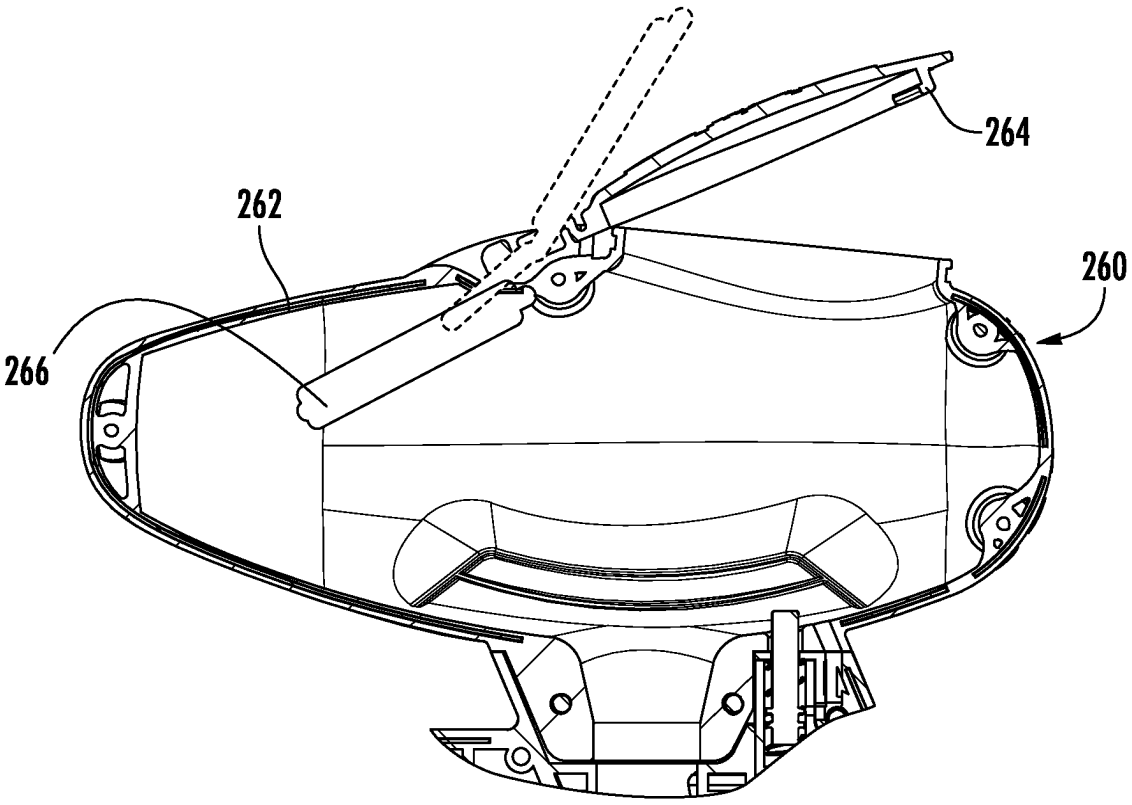


FIG. 2A

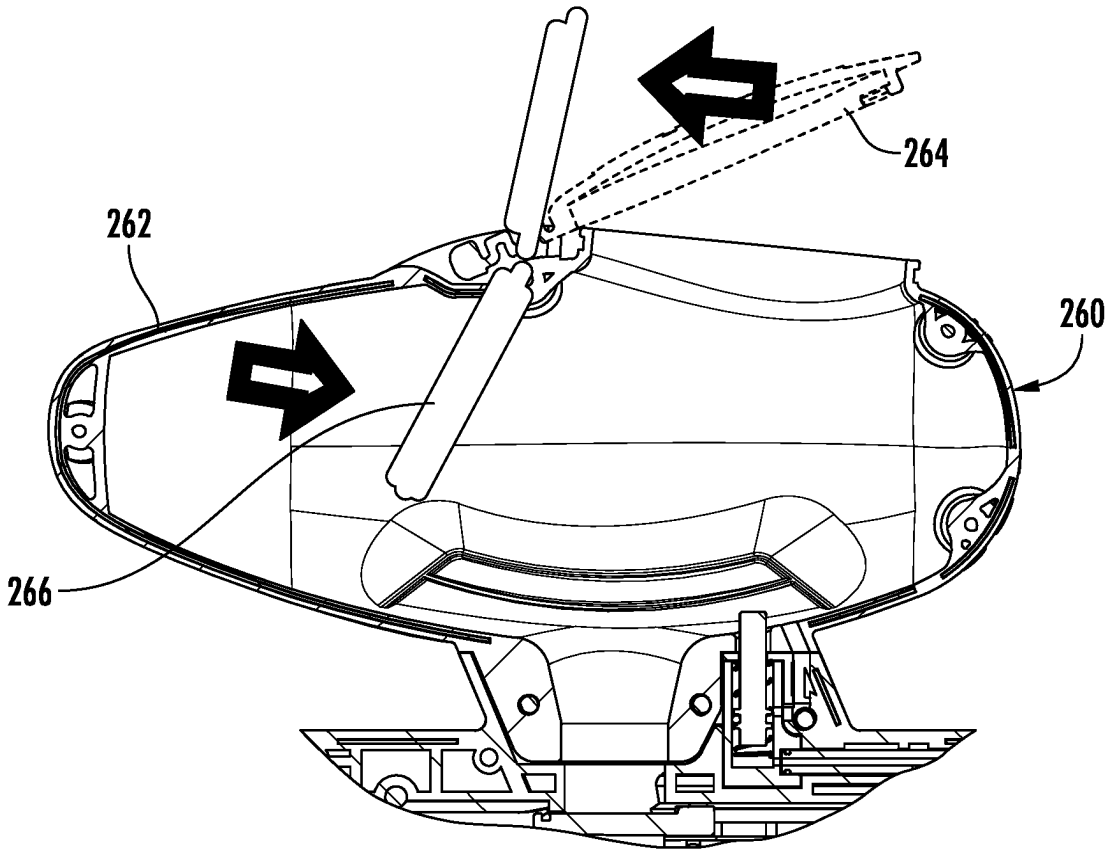


FIG. 2B

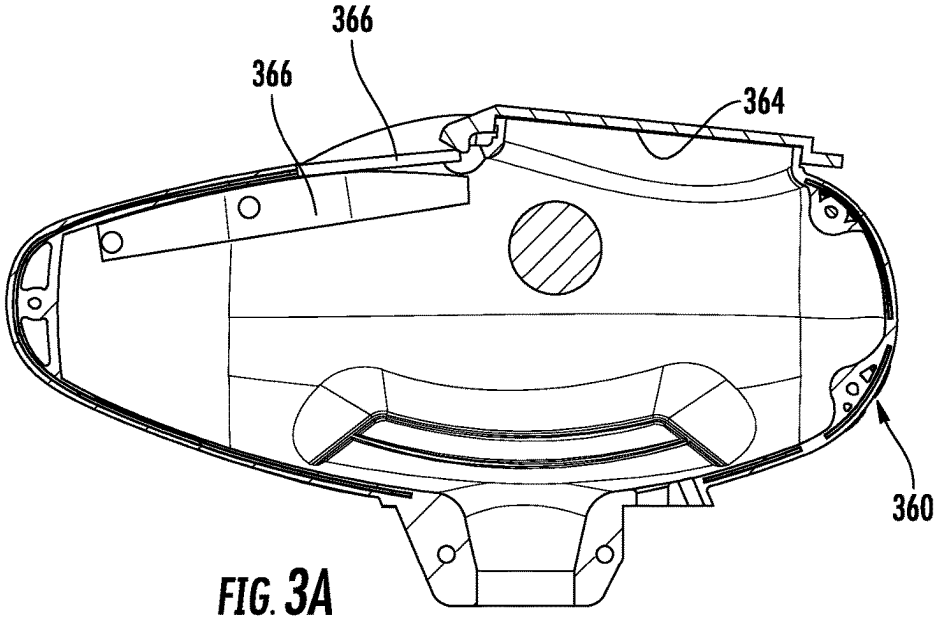


FIG. 3A

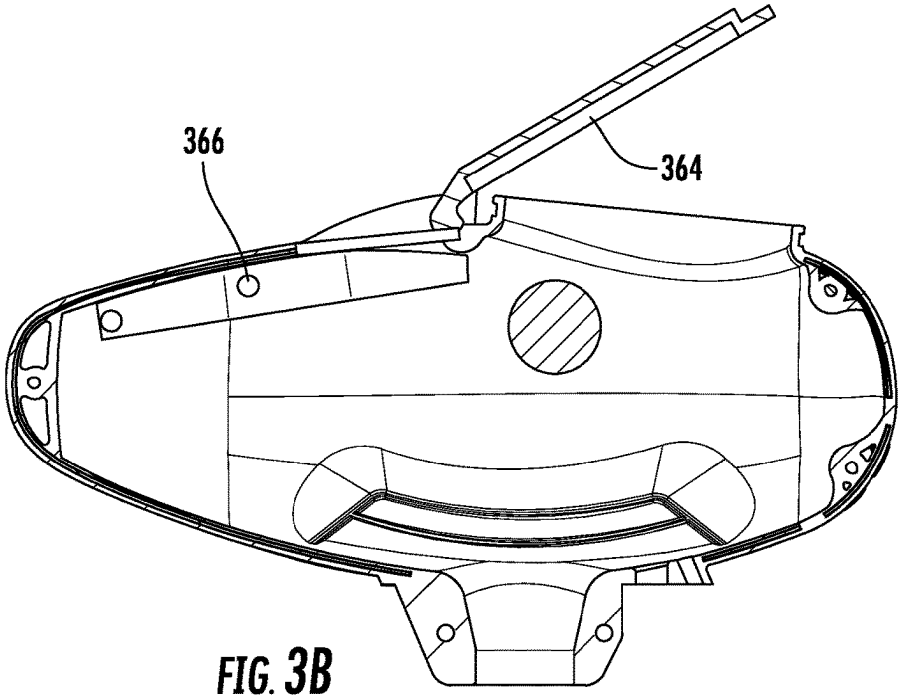


FIG. 3B

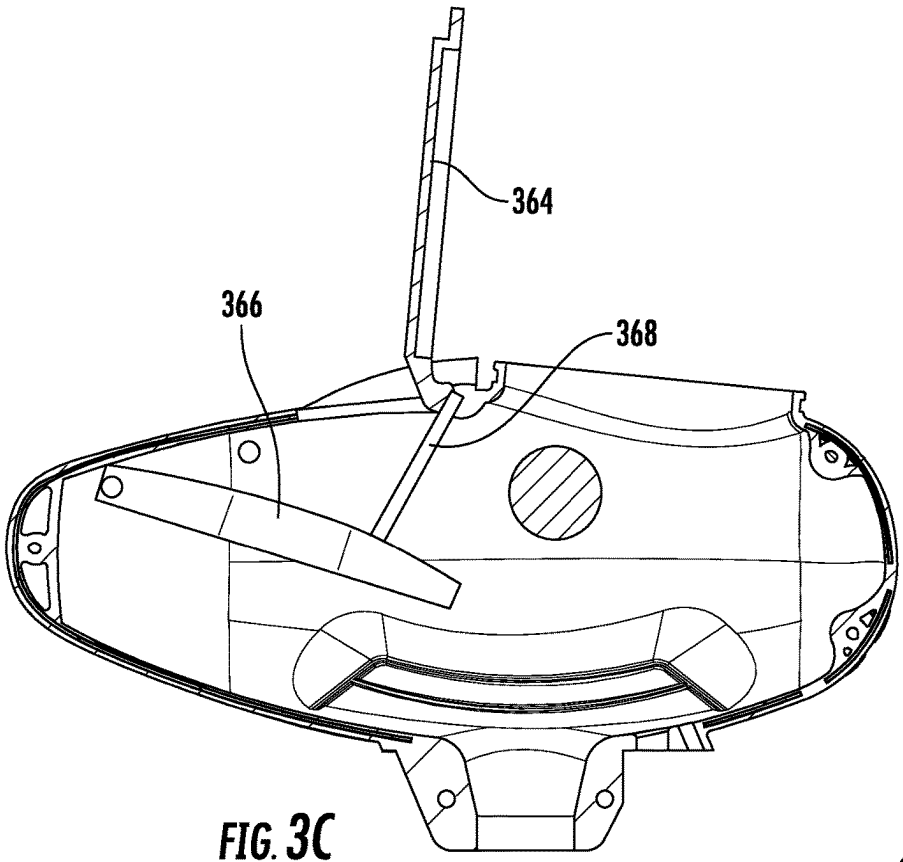
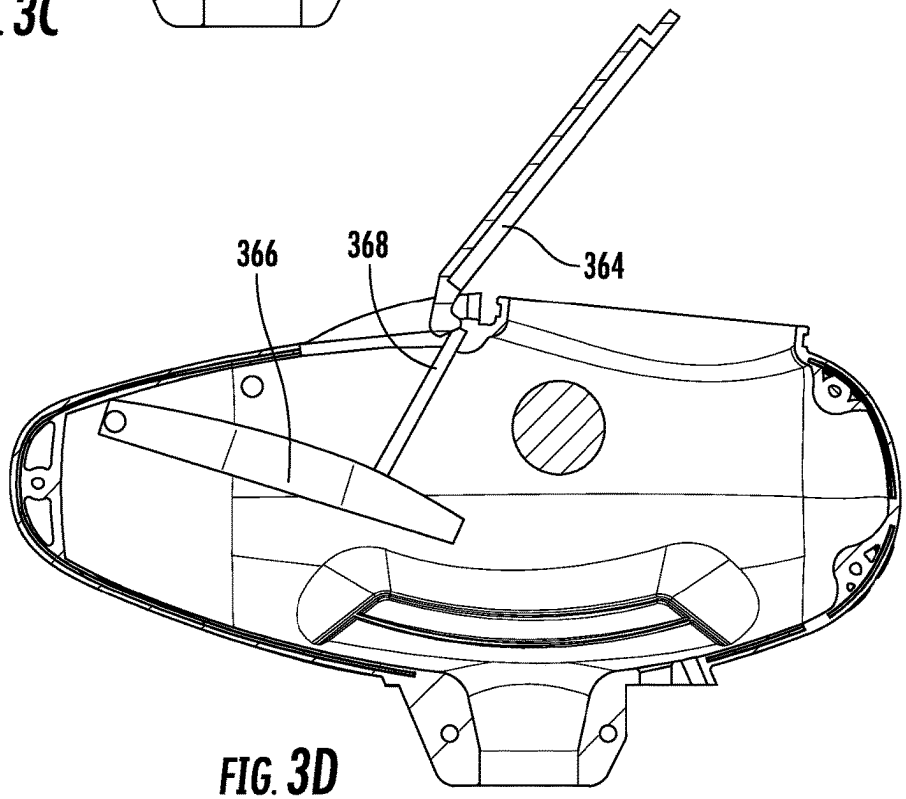


FIG. 3C



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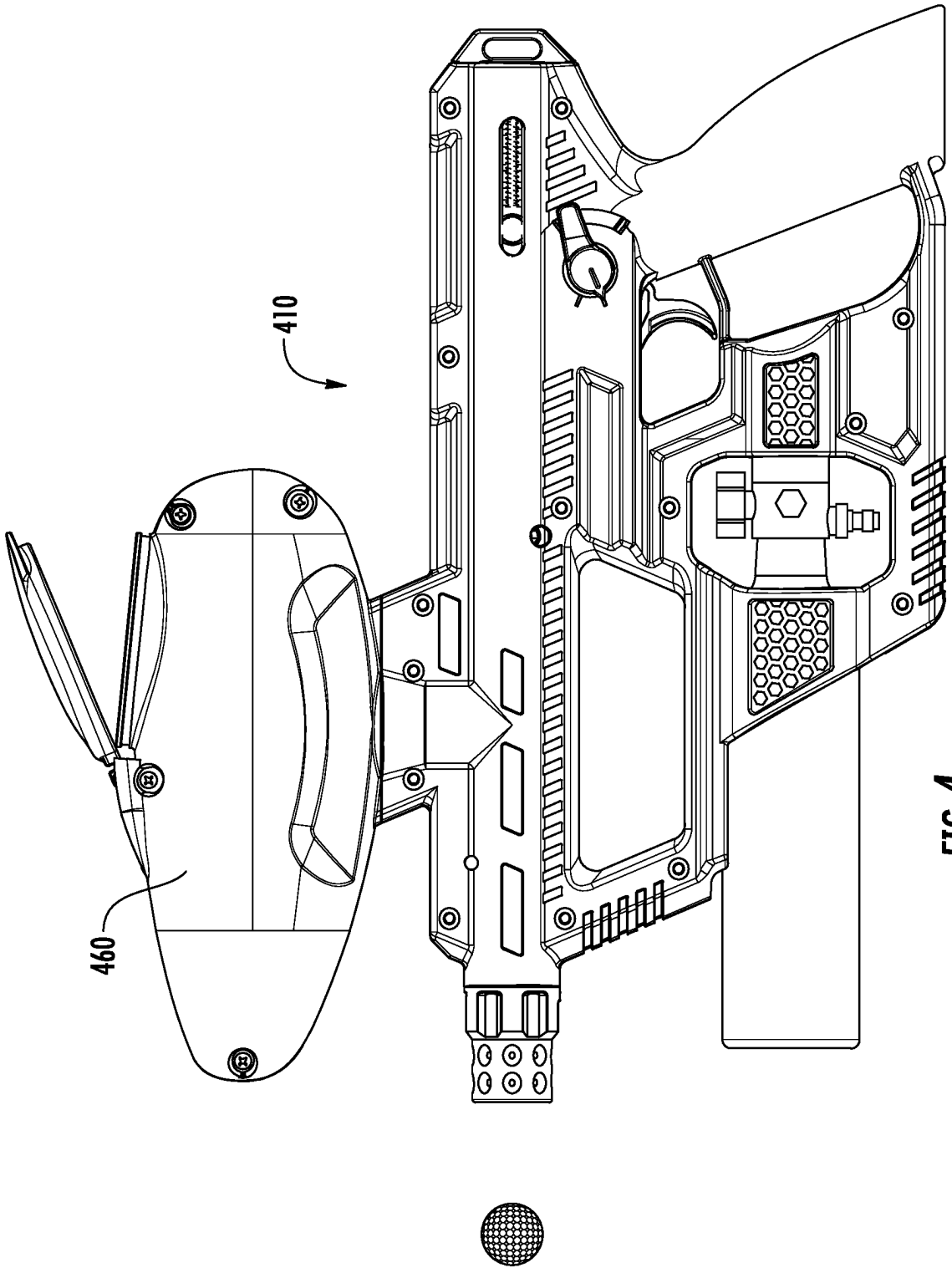

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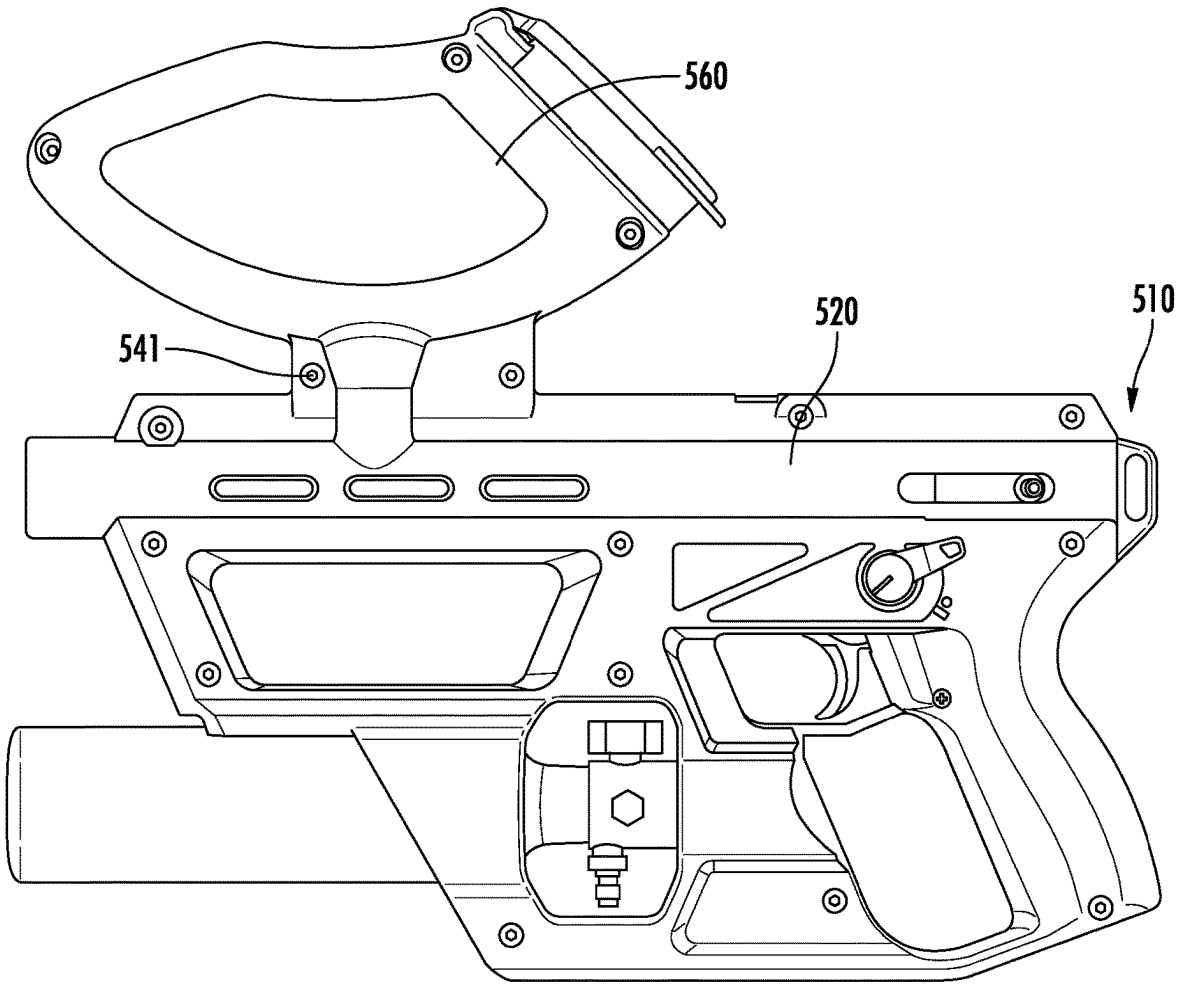

FIG. 5A

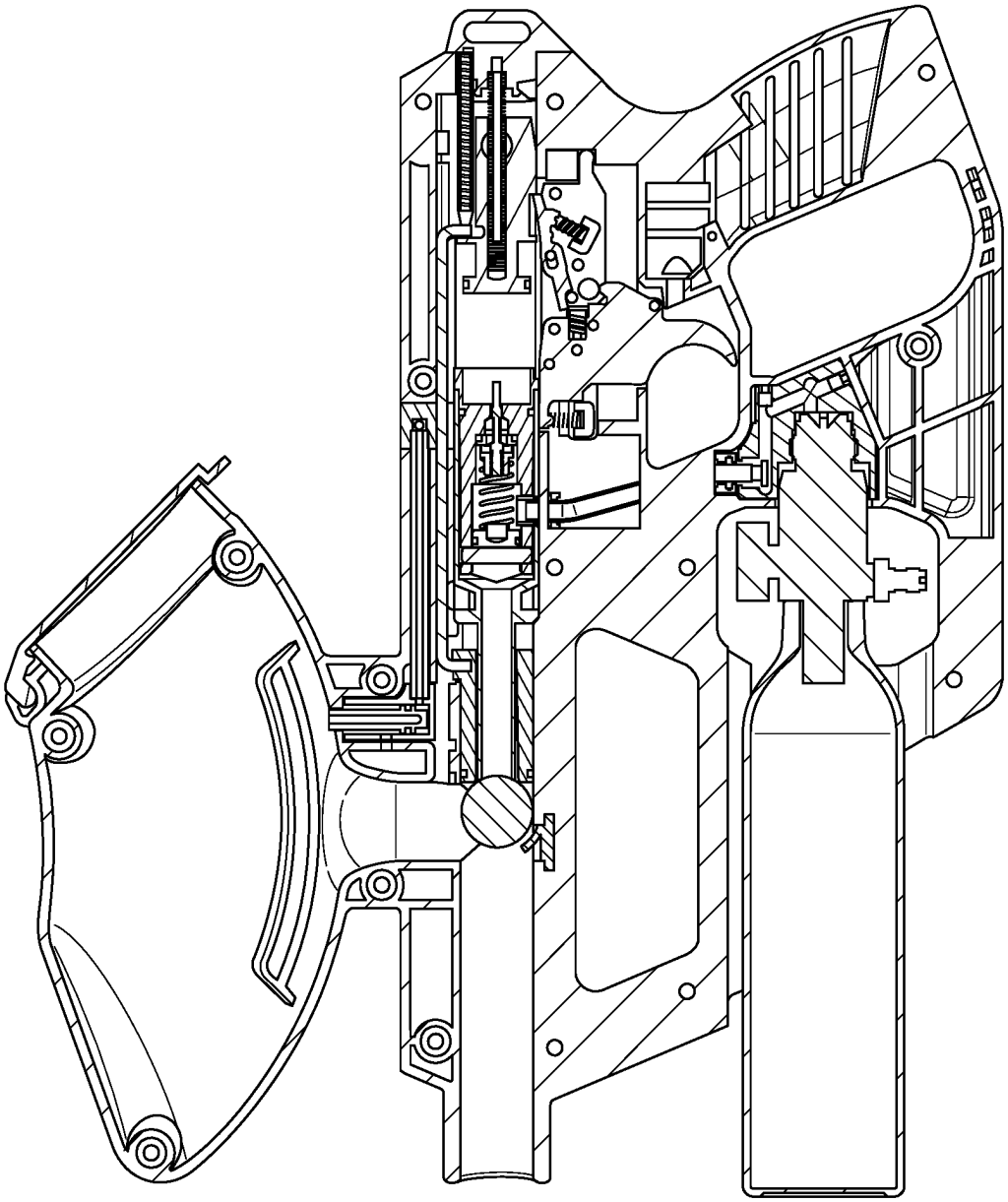

FIG. 5B

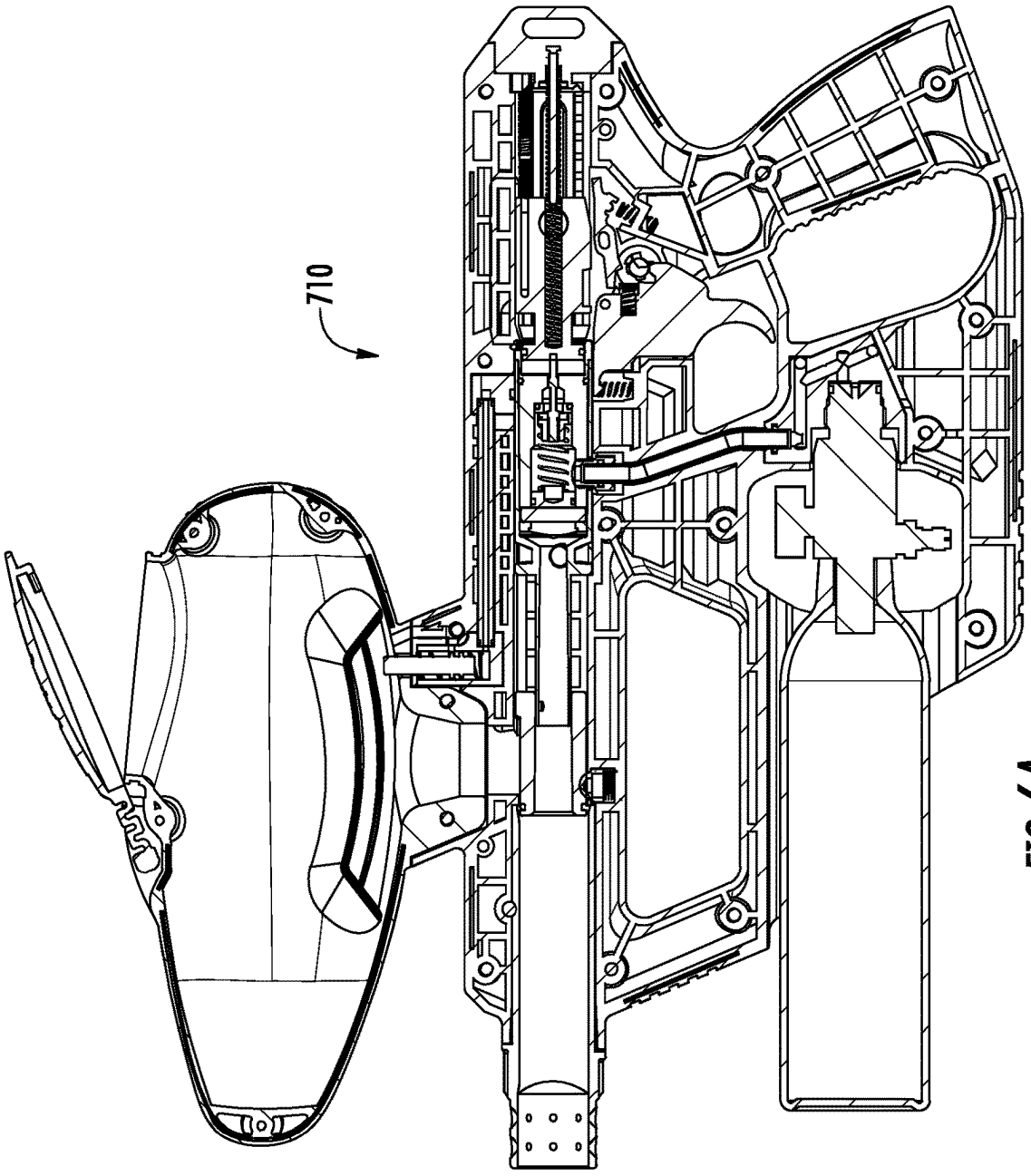

FIG. 6A

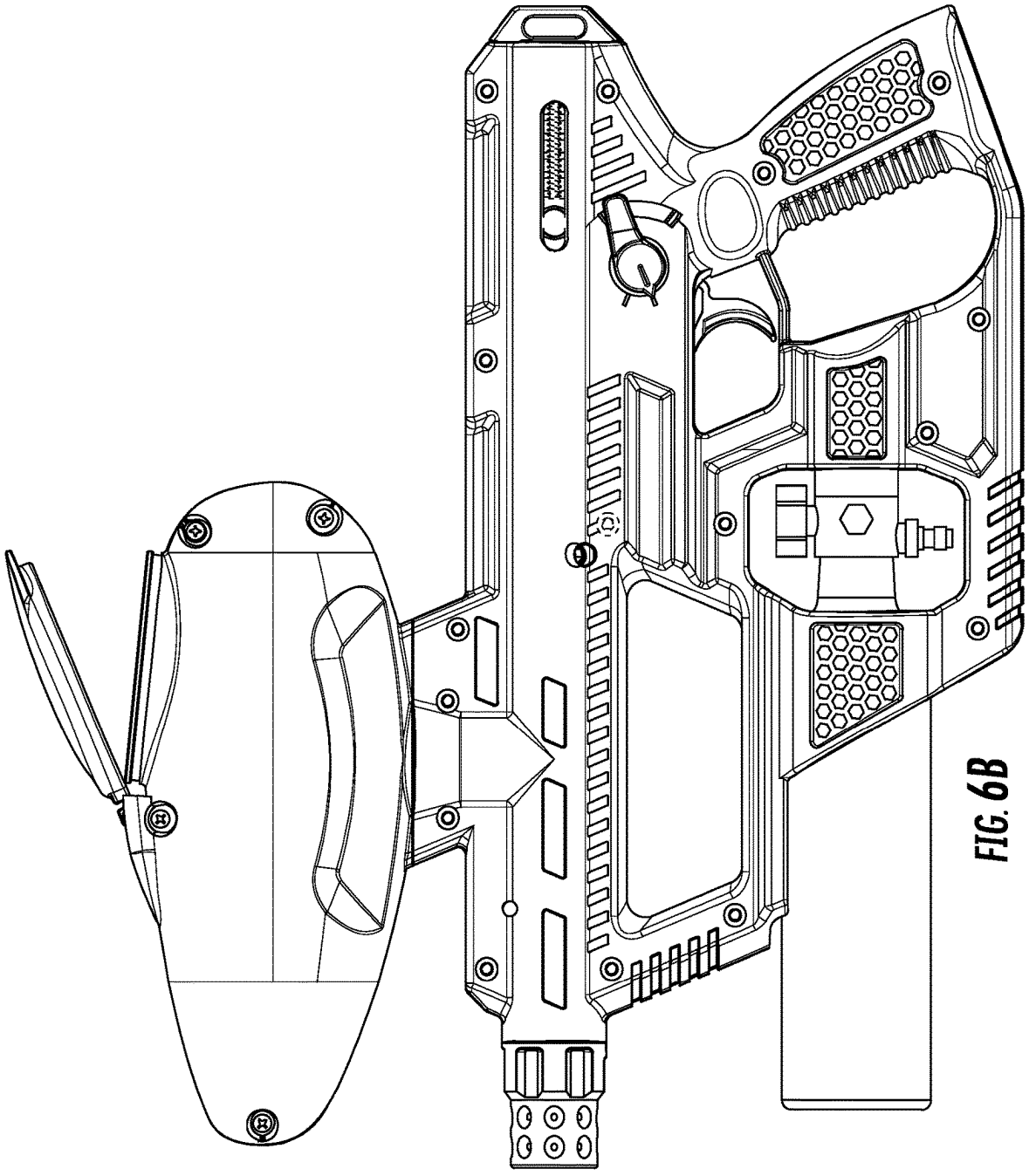

FIG. 6B

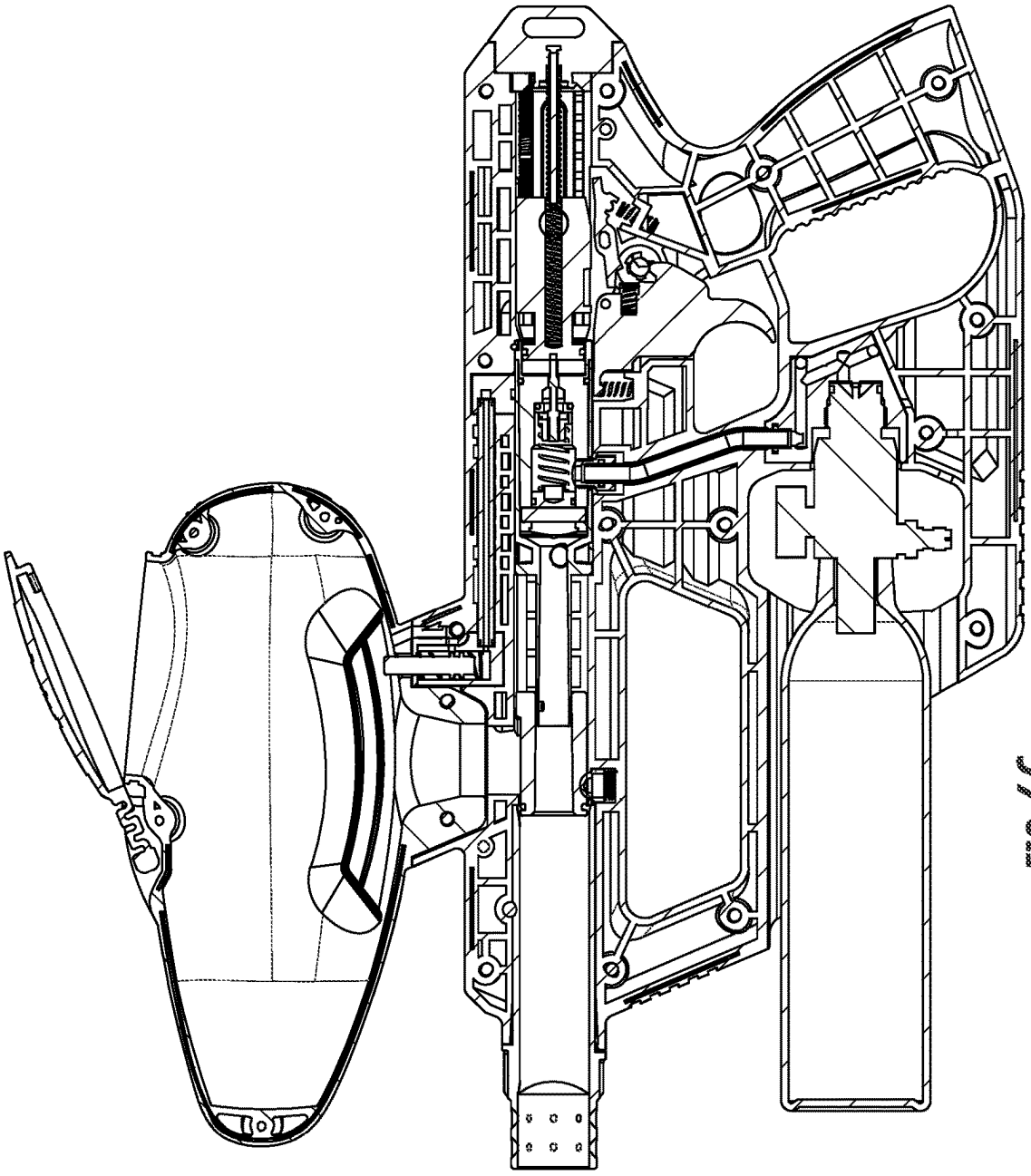

FIG. 6C

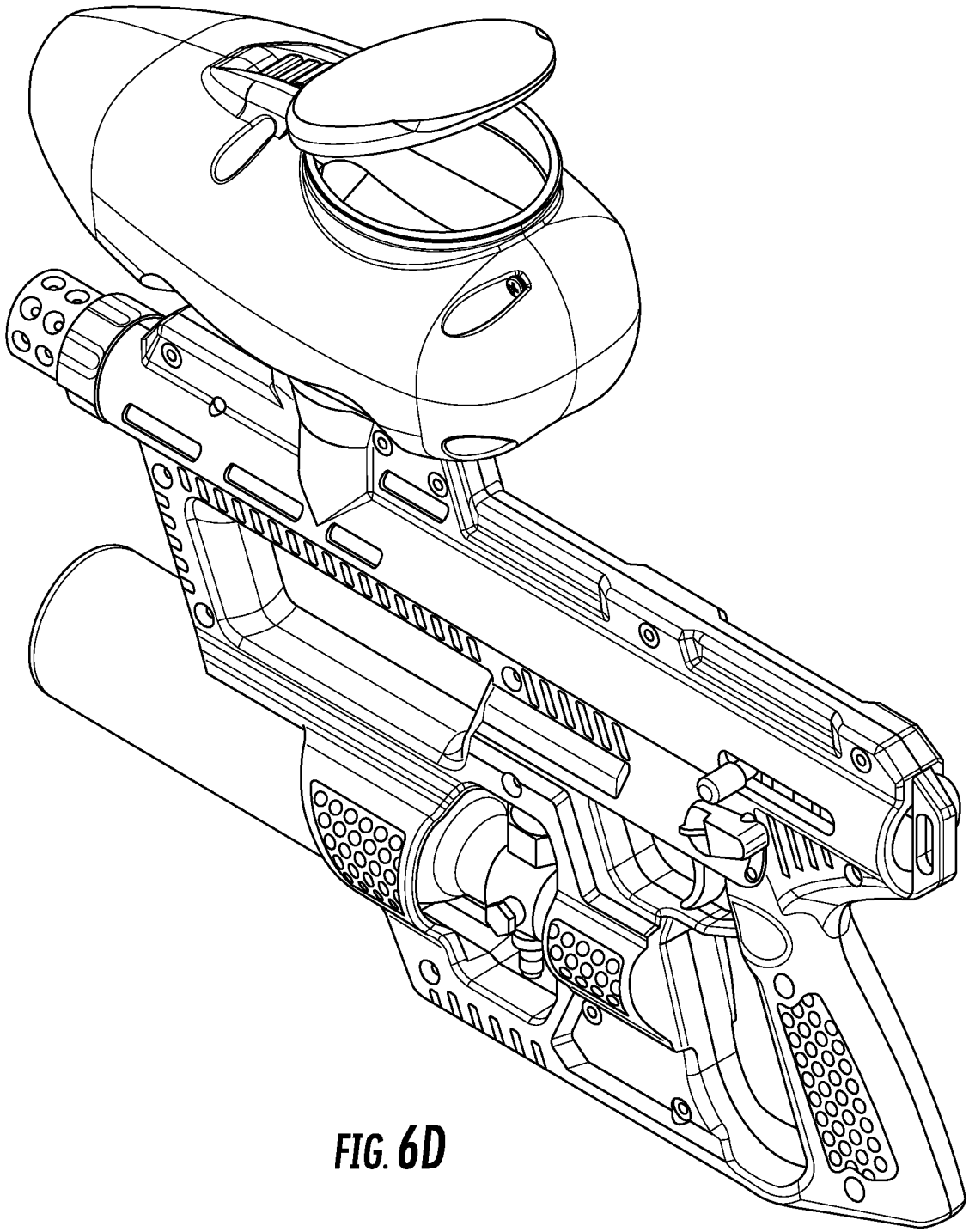

FIG. 6D

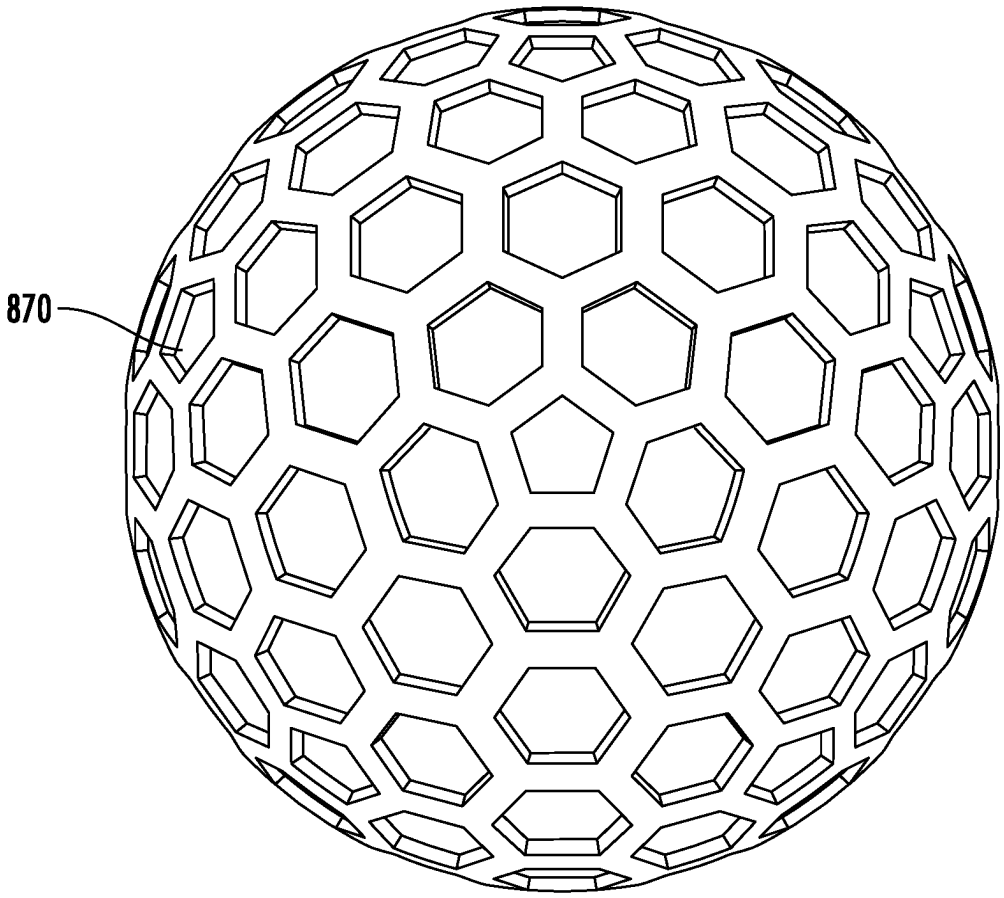

FIG. 7

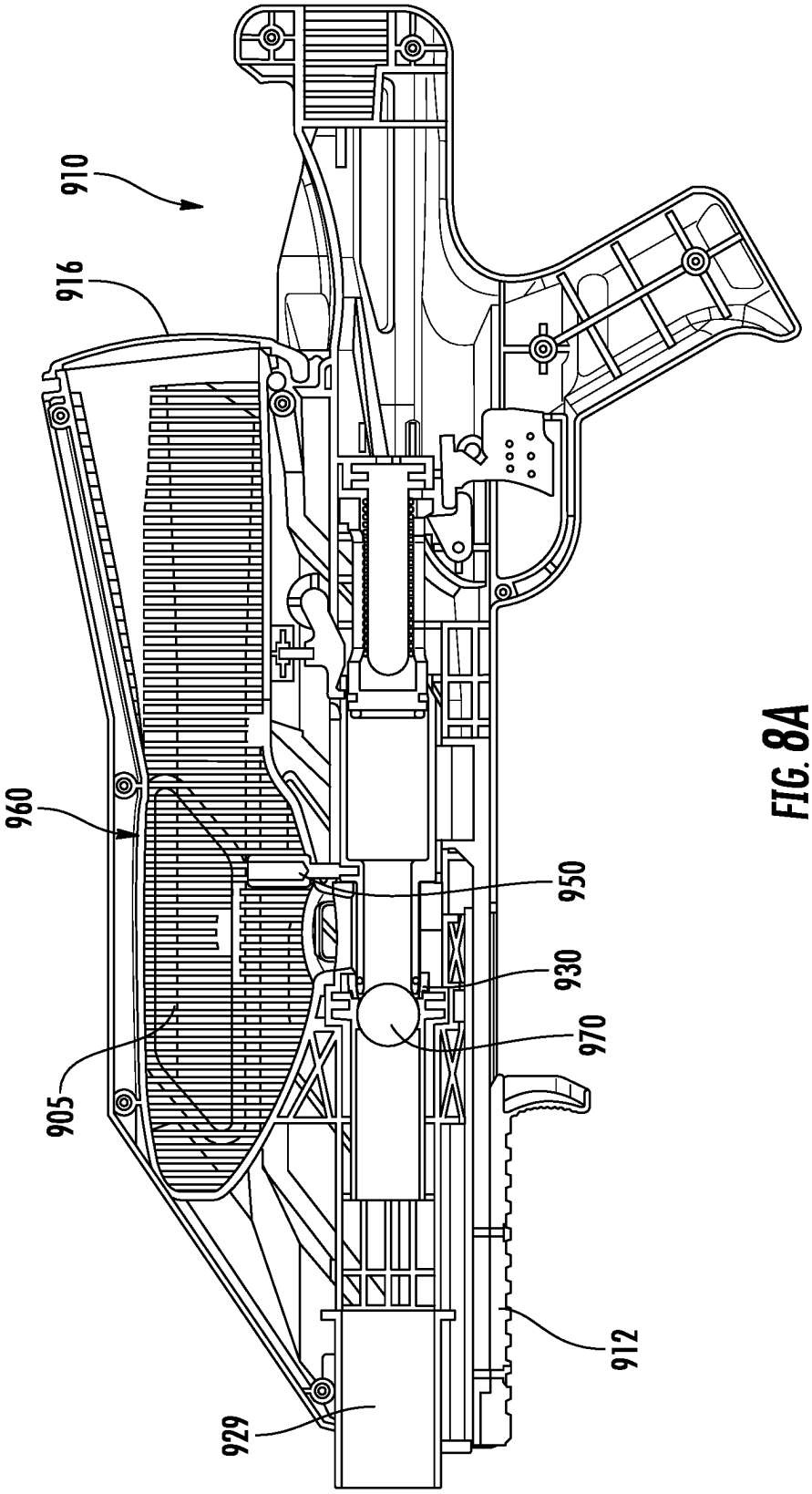

FIG. 8A

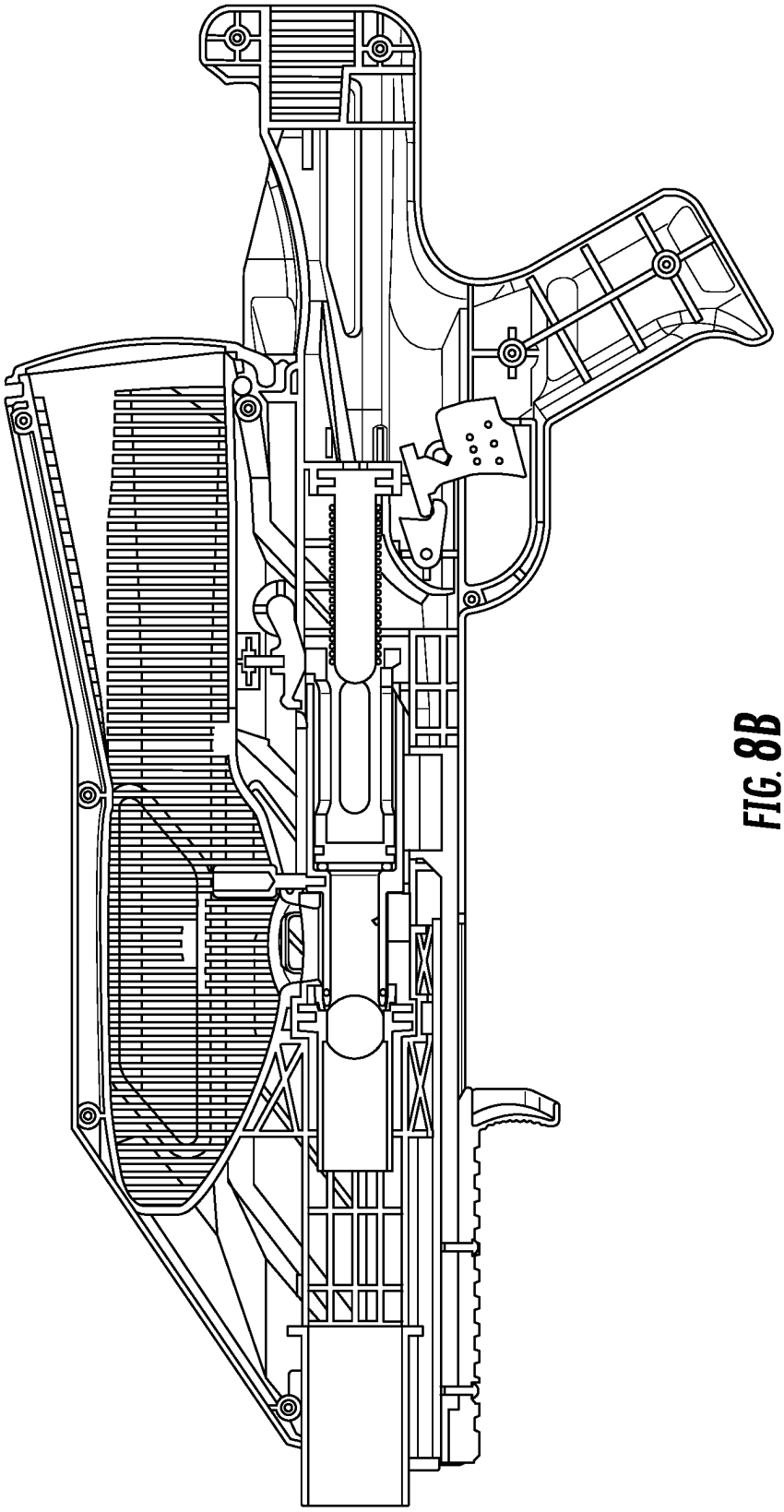

FIG. 8B

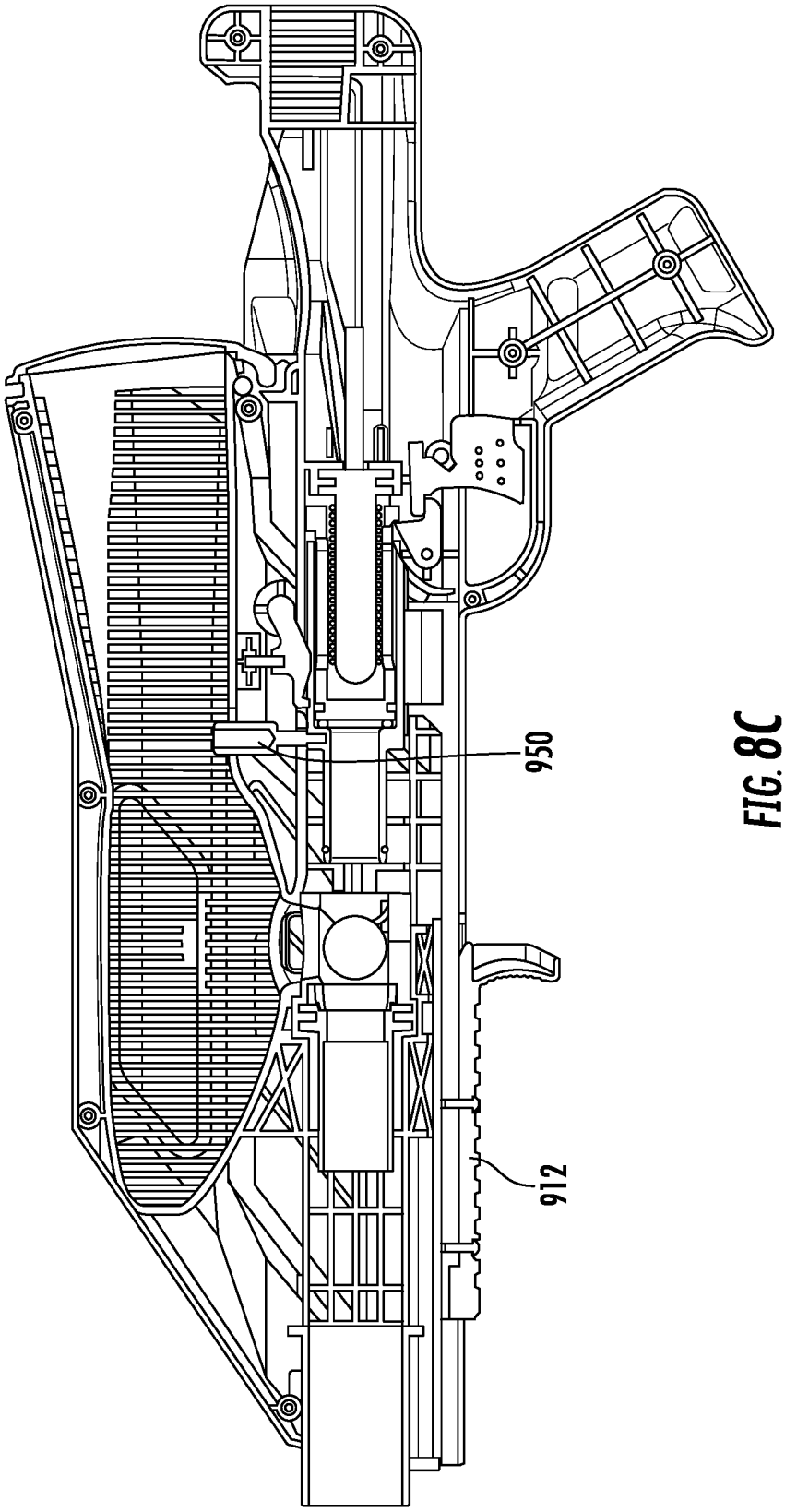

FIG. 8C

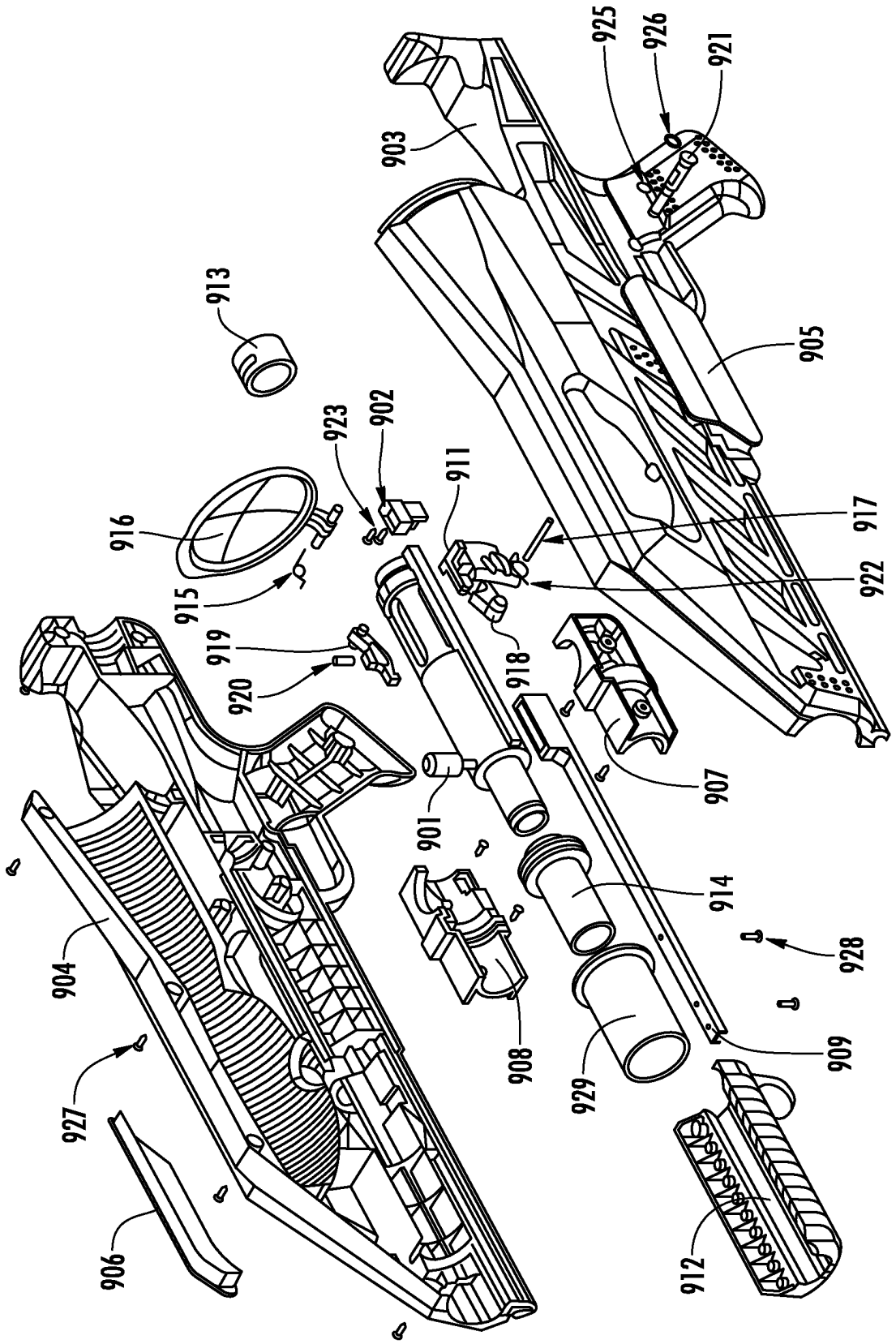
925
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FIG. 8D

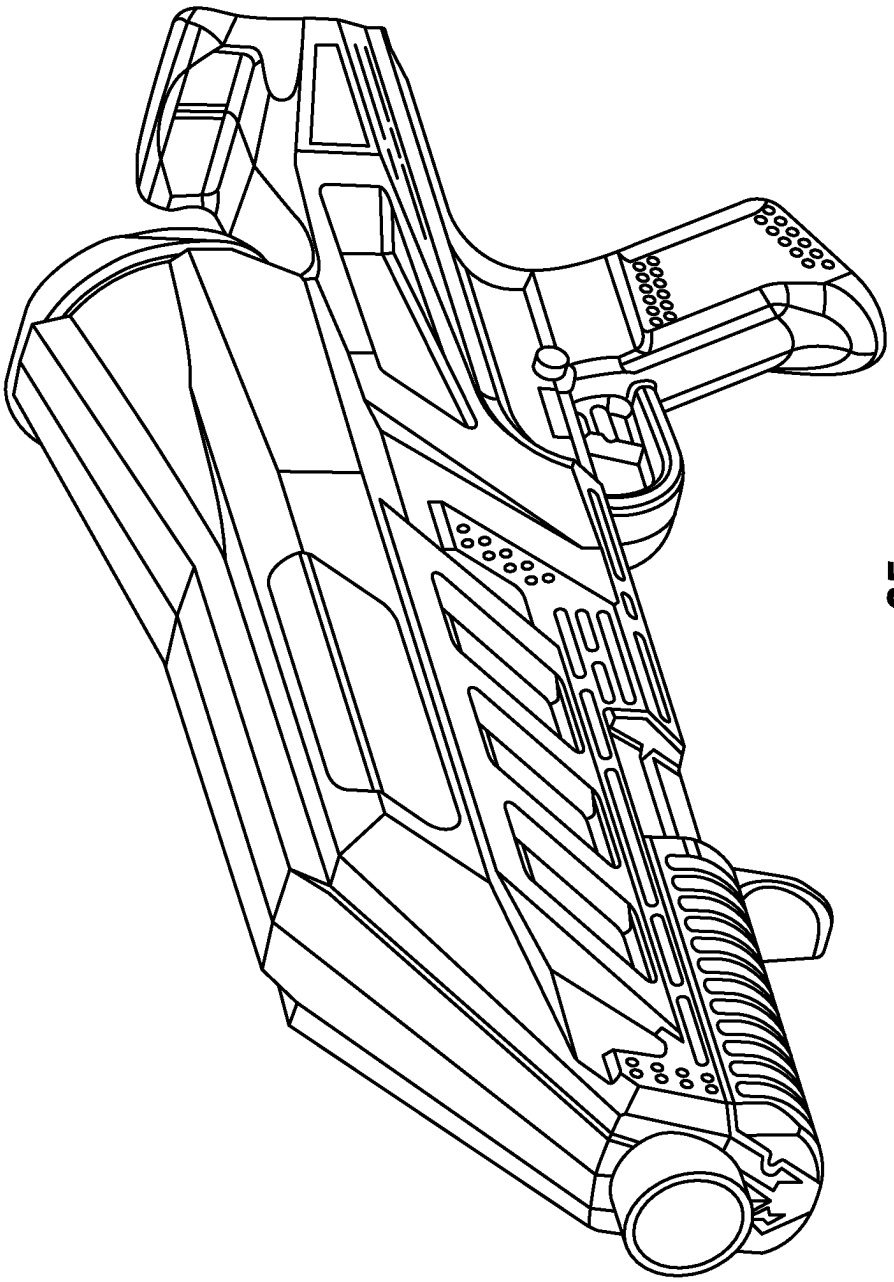

FIG. 8E

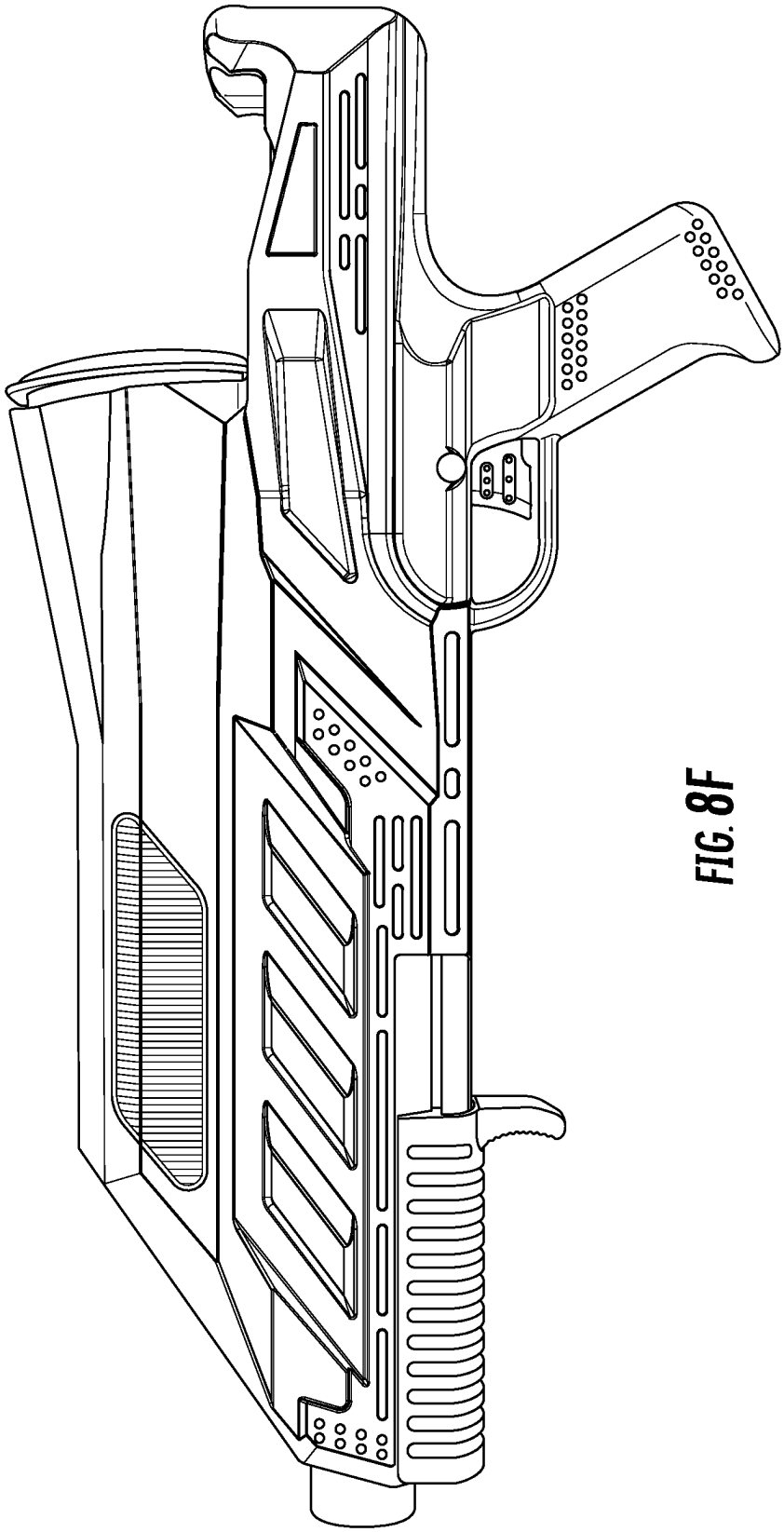

FIG. 8F

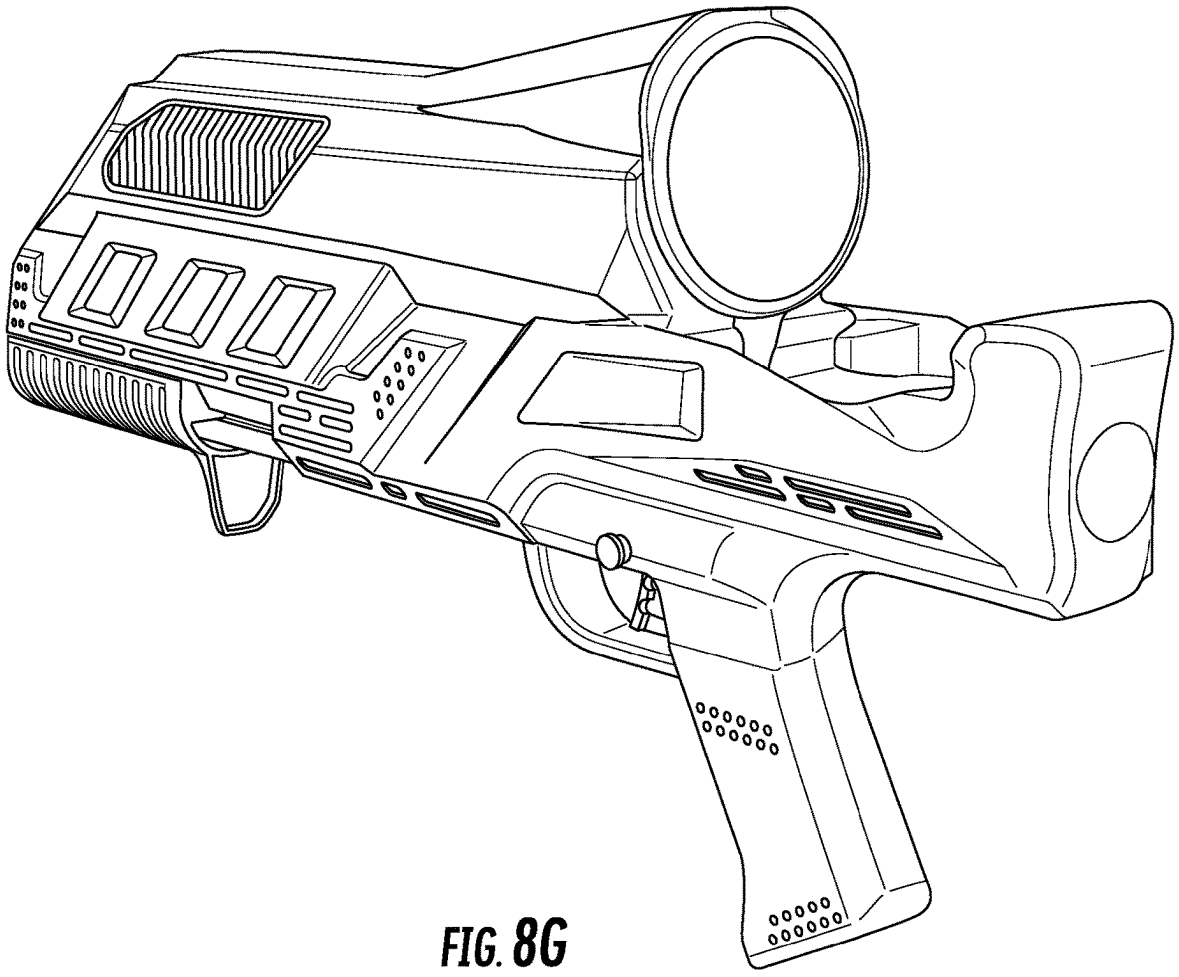

FIG. 8G

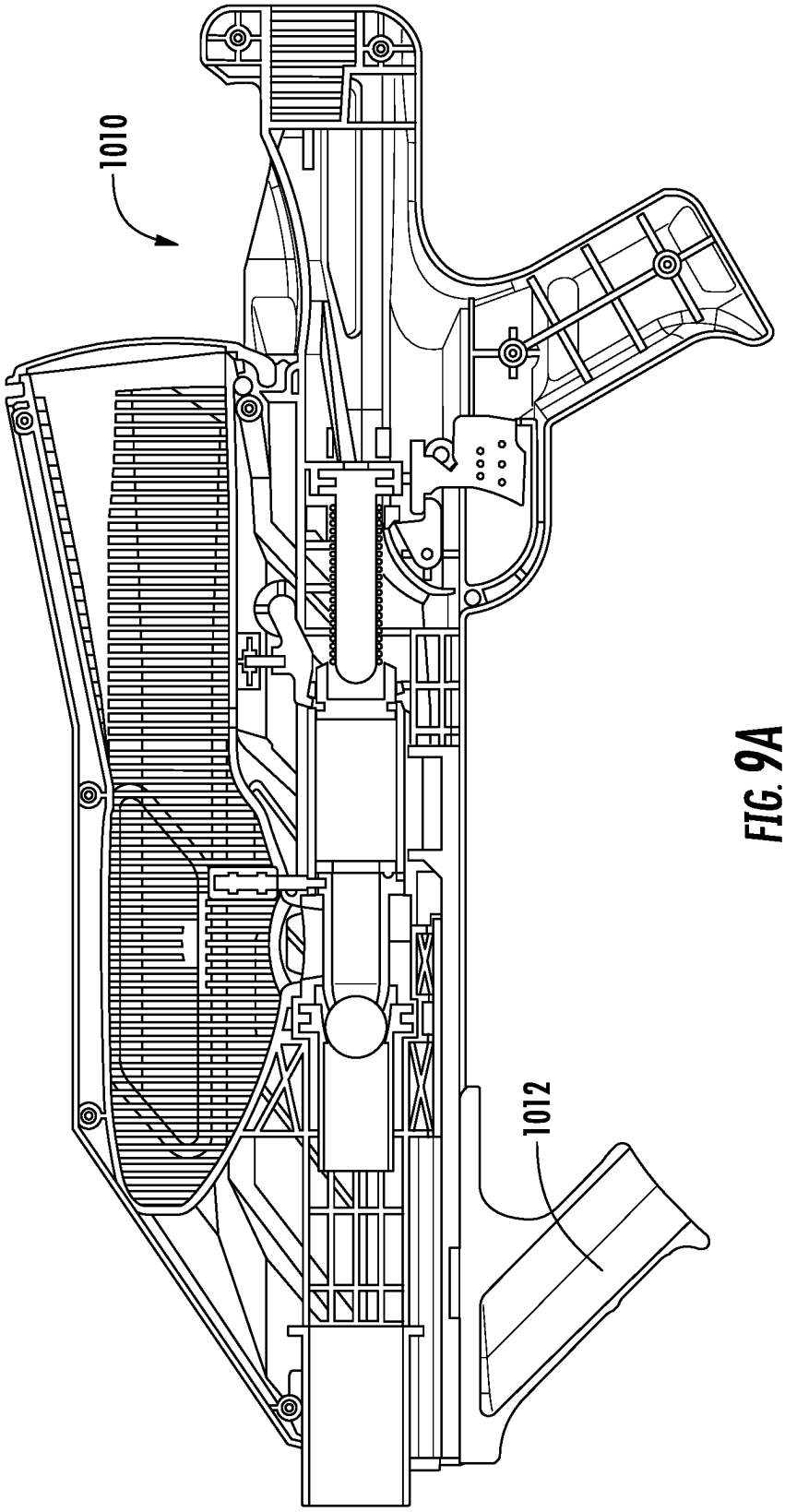

FIG. 9A

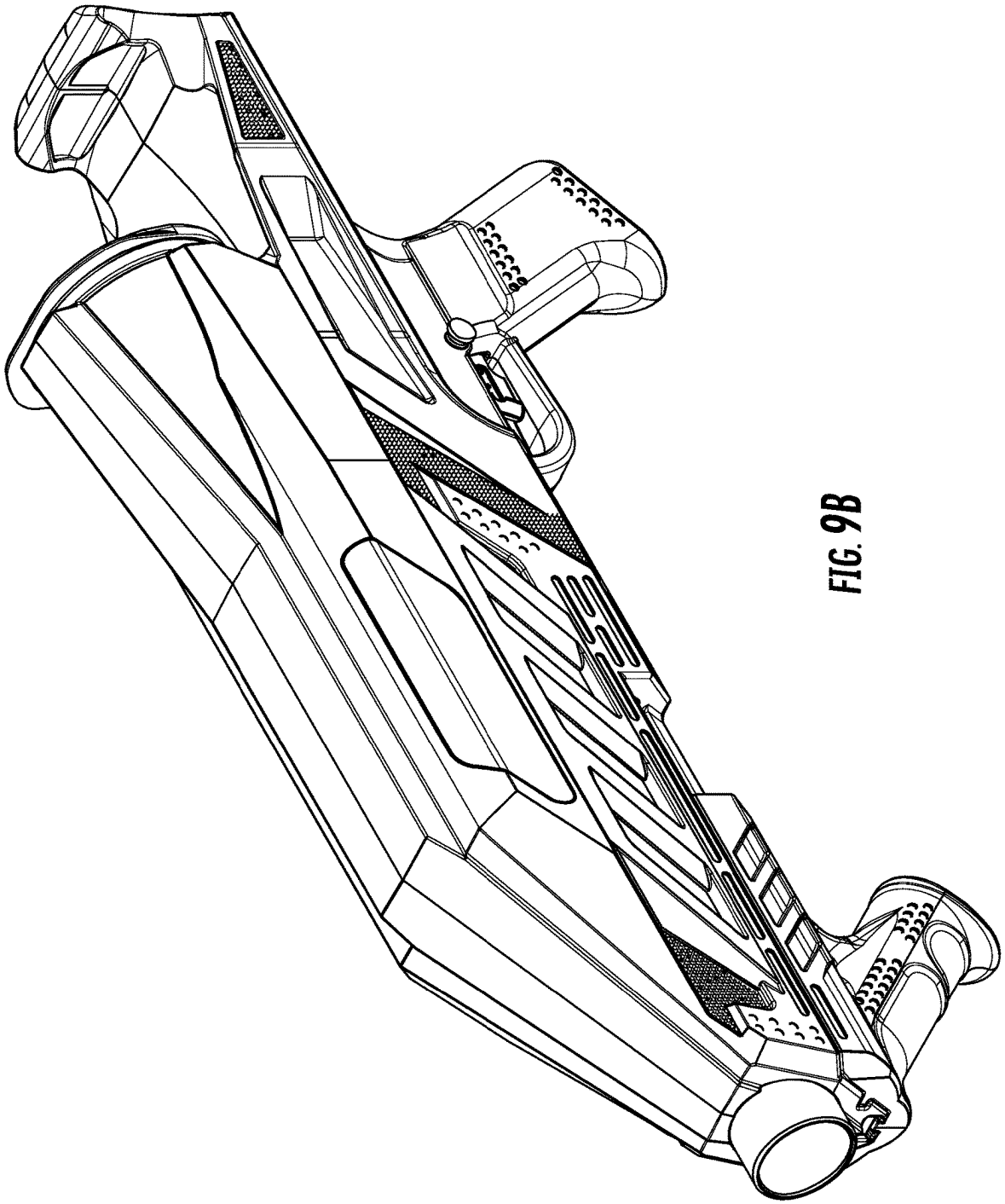

FIG. 9B

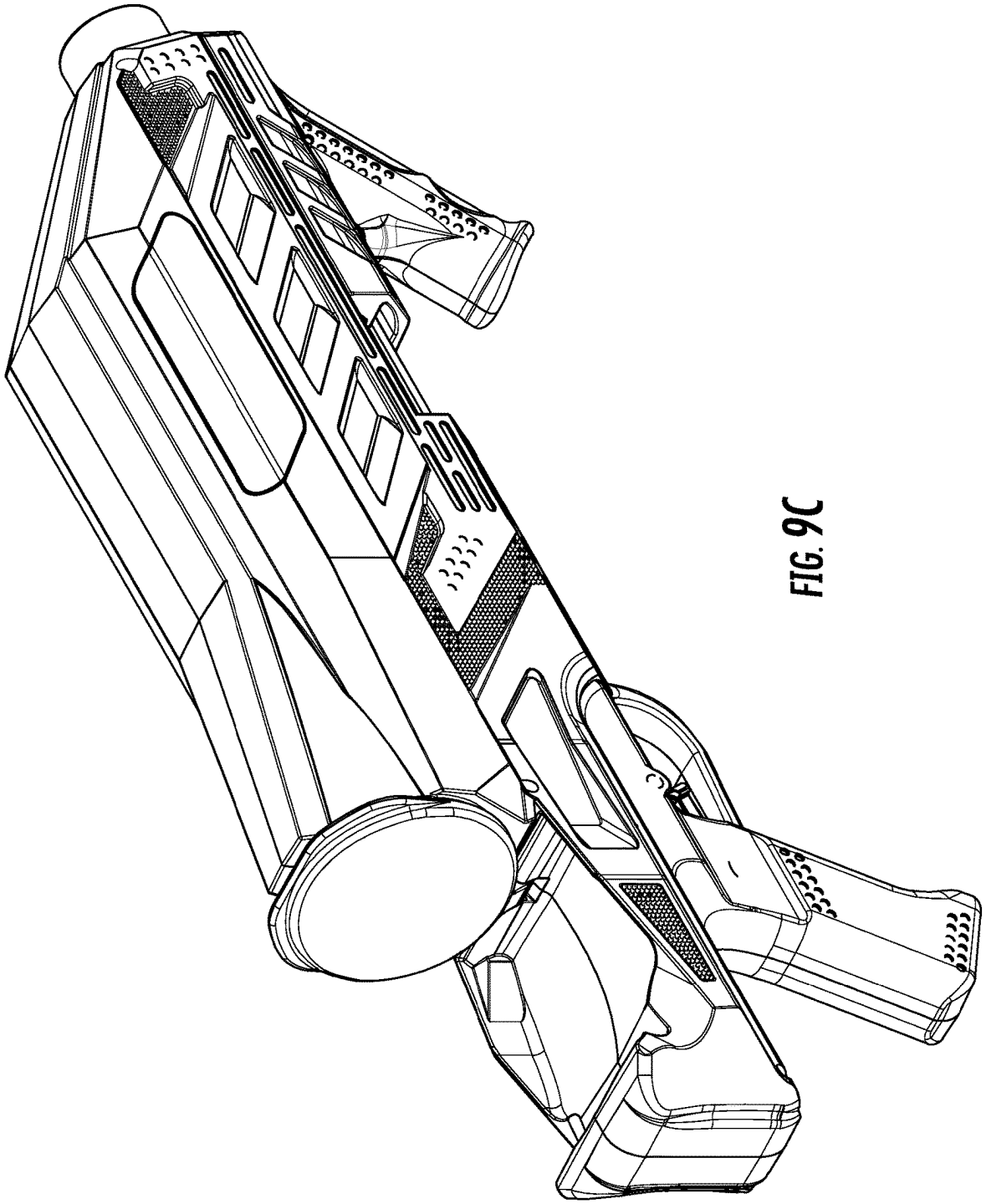

FIG. 9C

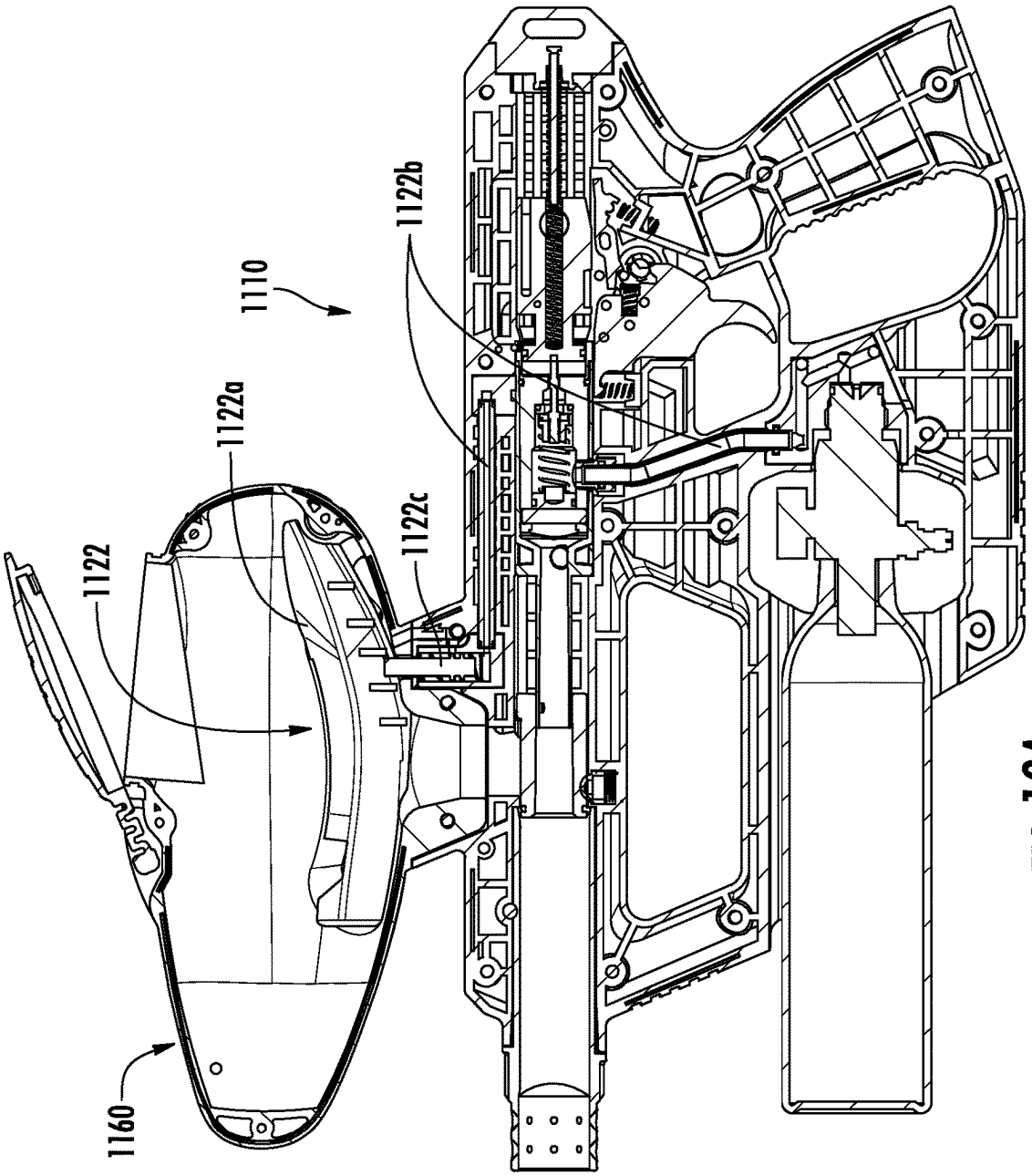

FIG. 10A

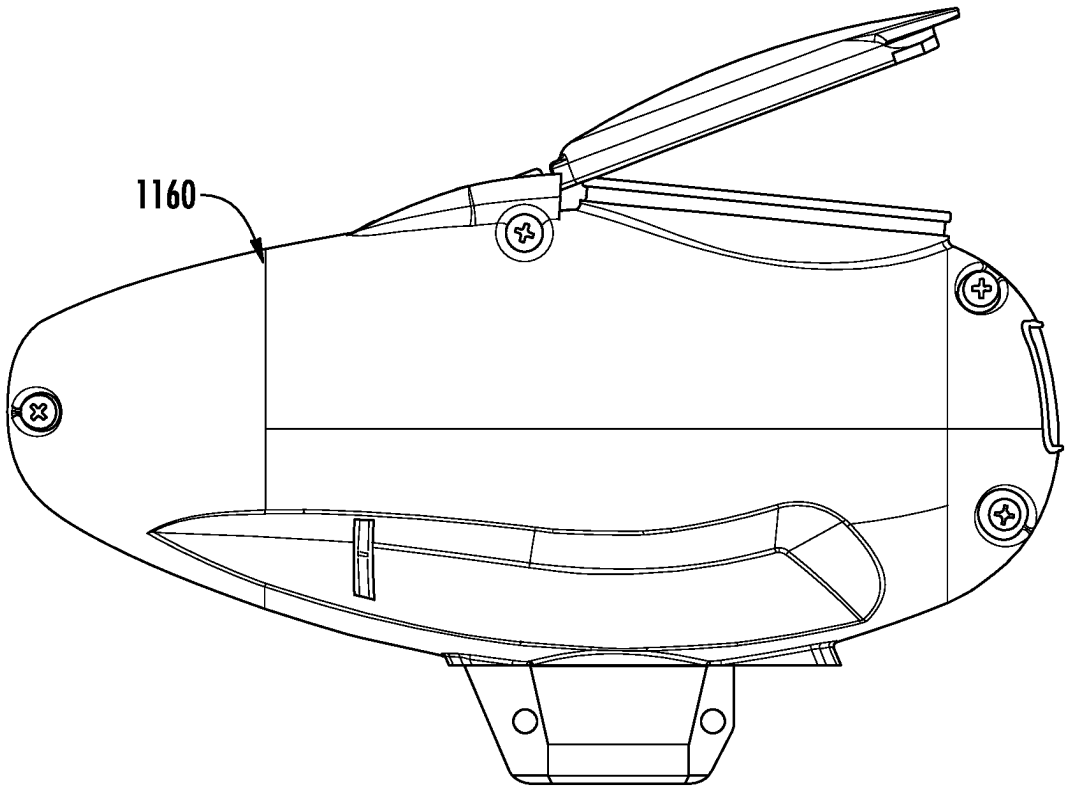

FIG. 10B

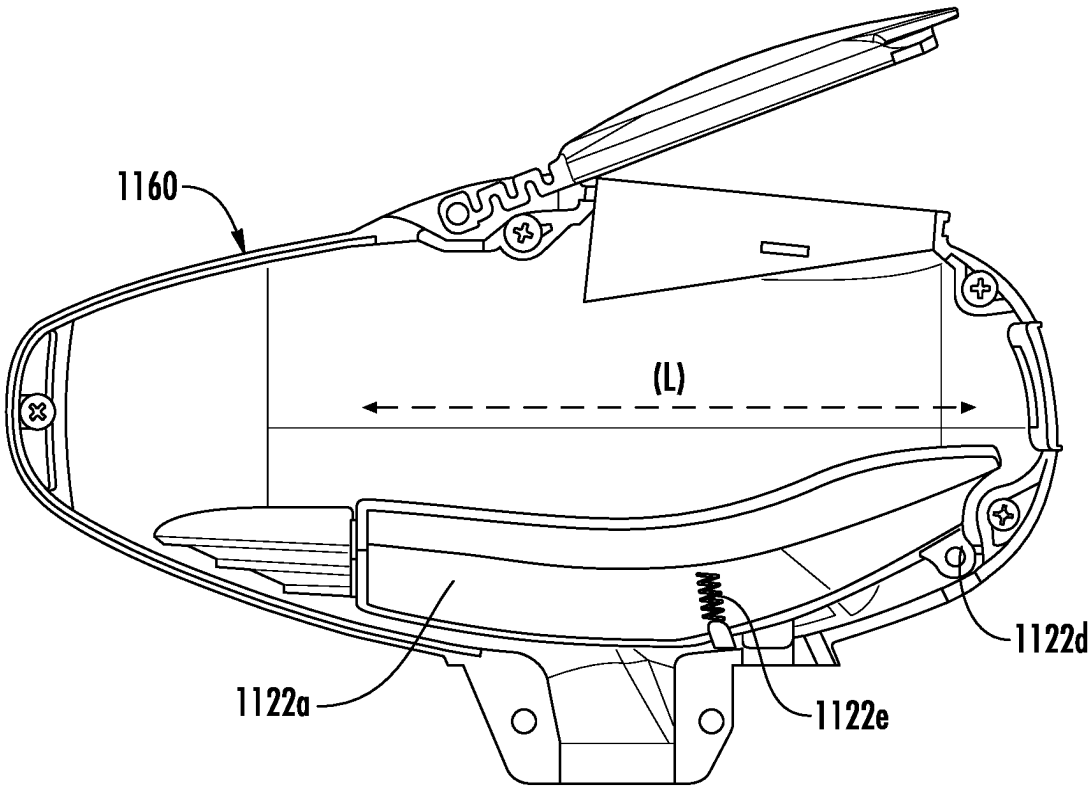

FIG. 10C

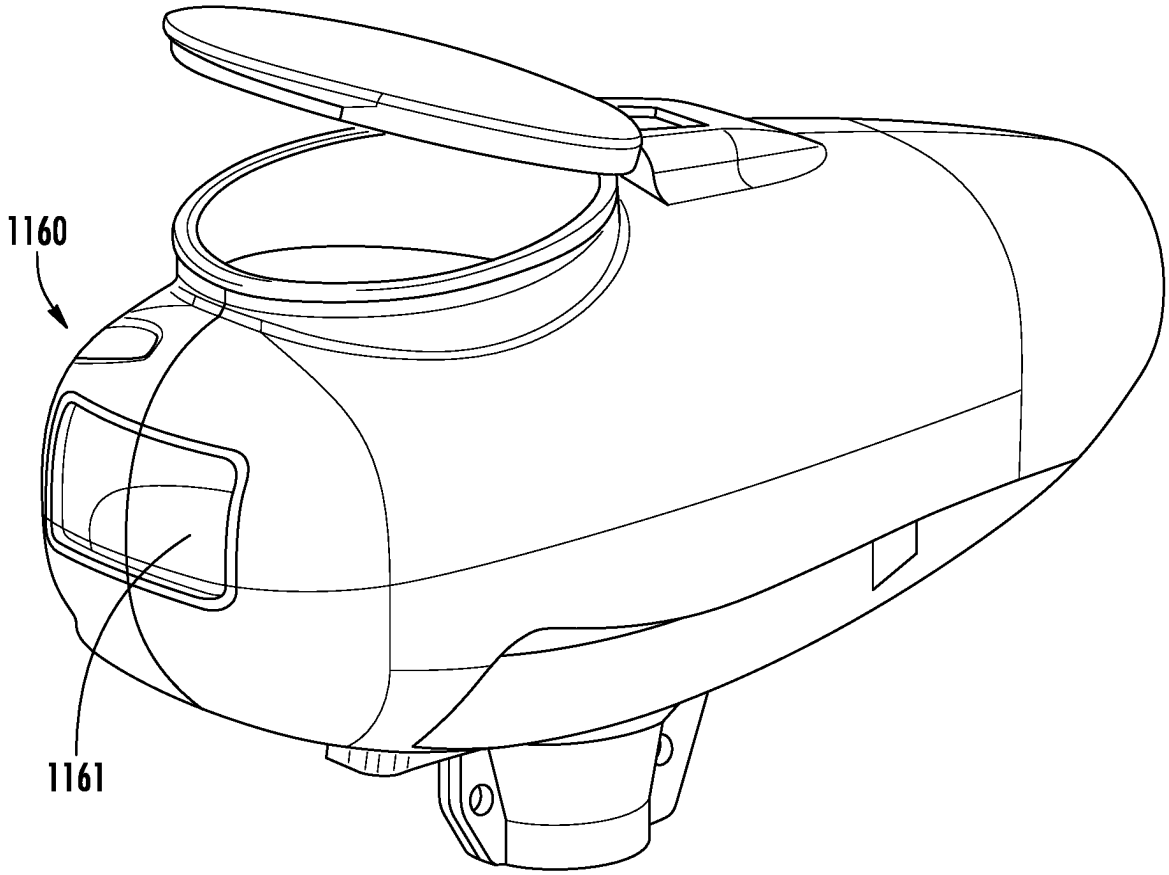

FIG. 10D

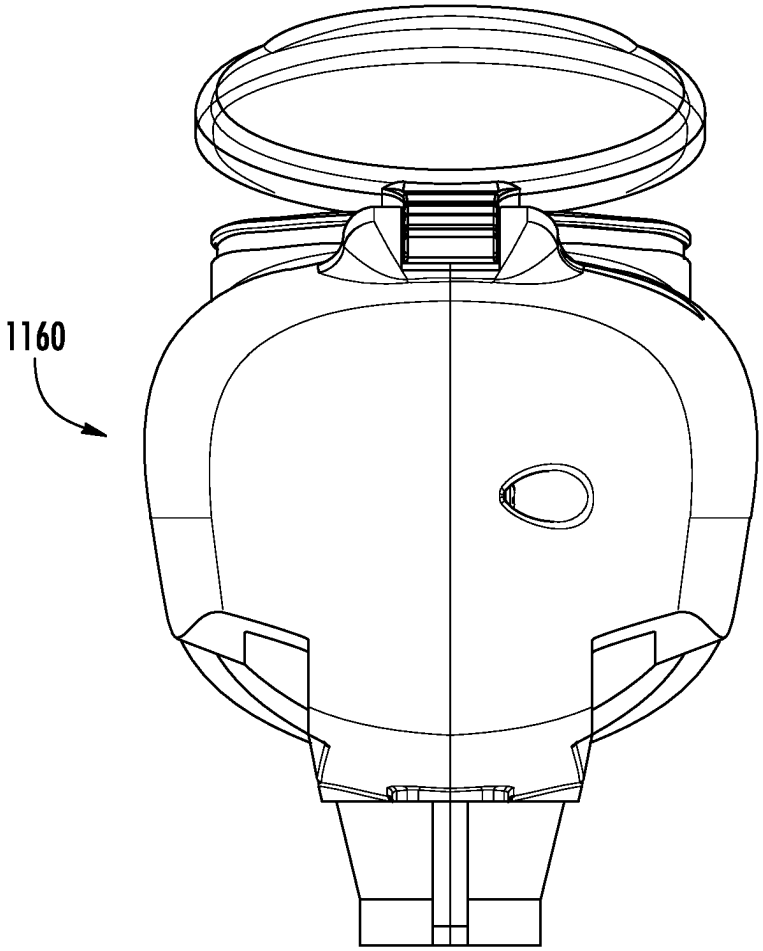

FIG. 10E

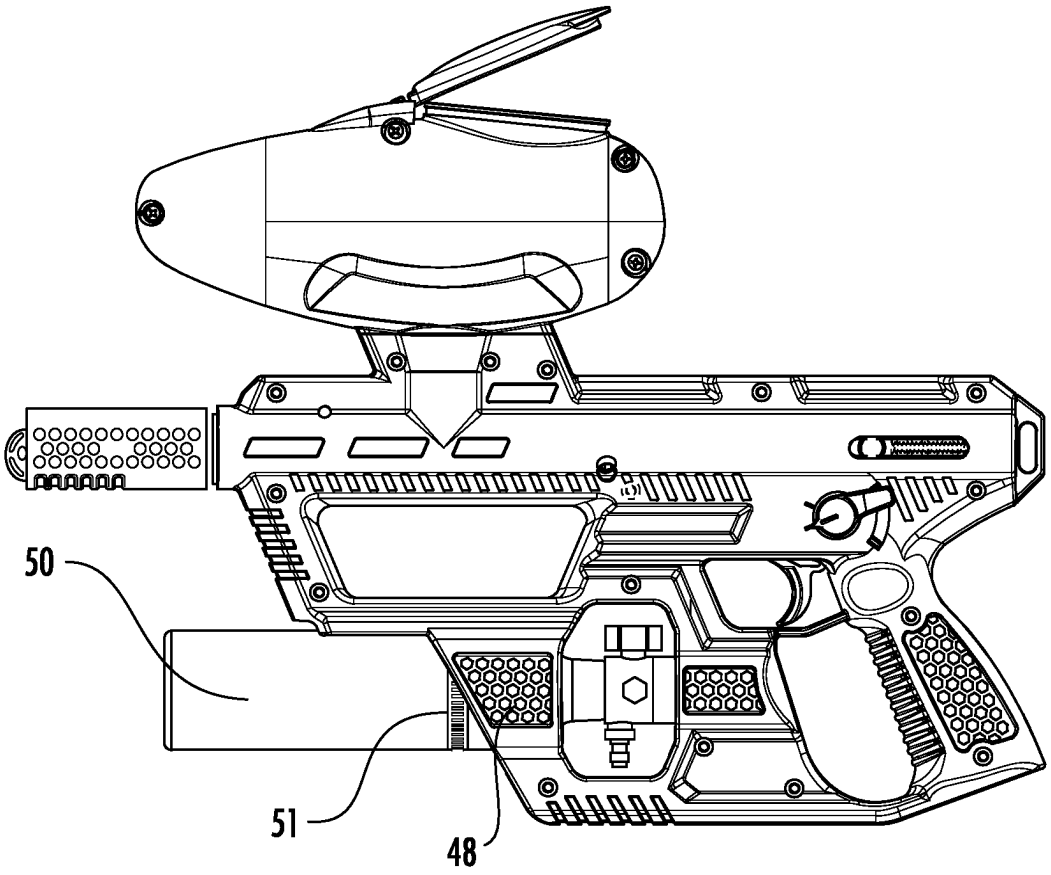

FIG. 11A

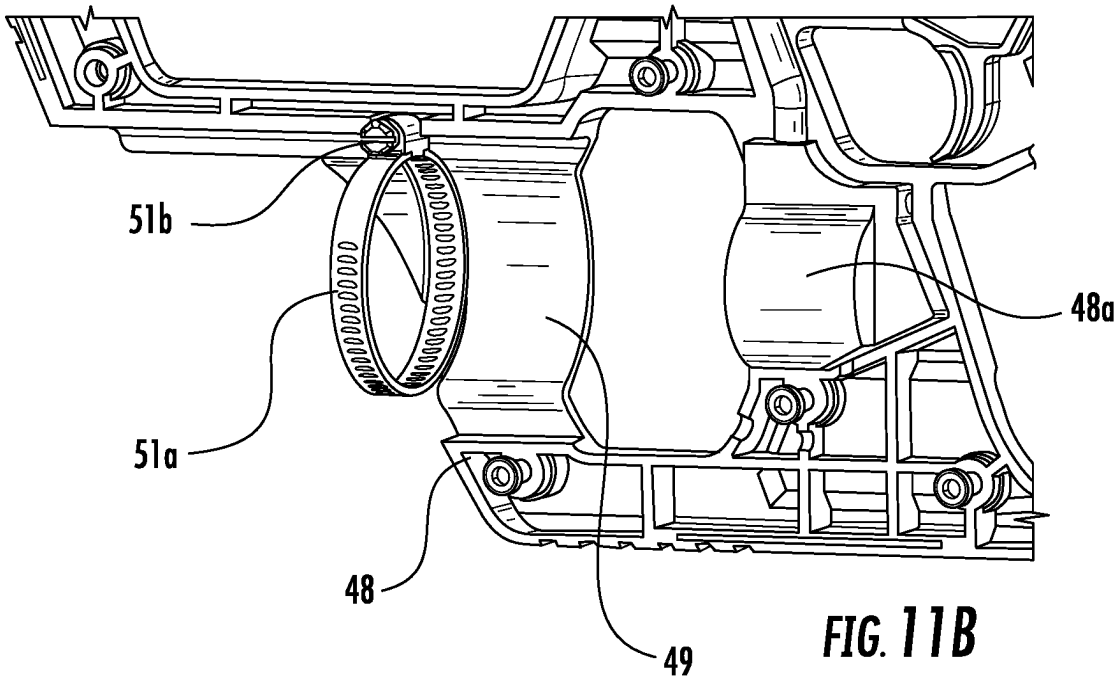

FIG. 11B

COMPRESSED GAS PROJECTILE LAUNCHING DEVICES

INCORPORATION BY REFERENCE

This application is a § 371 application of International Application No. PCT/US2021/052575, filed Sep. 29, 2021, which claims the benefit of U.S. Provisional Application No. 63/085,750, filed on Sep. 30, 2020, which is incorporated herein by reference as if fully set forth.

FIELD OF INVENTION

The present disclosure relates to the field of projectile launchers.

BACKGROUND

Various types of projectile launching devices are well known. Such projectile launching devices are shown and described, for example, in U.S. Pat. Nos. 10,704,859, 7,975,683, 9,658,027, and 8,950,387, the entire contents of all of which are incorporated by reference herein. Projectile launching devices can be configured to shoot paintballs, foam balls, pellets, or other types of projectiles. The energy required to fire projectiles in these devices can be supplied in a variety of ways. For example, some projectile launching devices rely on compressed gas to fire the projectiles. Other devices require manual pumping of a handle or mechanism to build up air pressure and load a firing spring.

One persistent issue with these devices includes jamming of projectiles in the hopper. This can result in the device malfunctioning or misfiring. Another common issue for these devices involves the safety of the user and any bystanders, particularly during loading and reloading of the projectiles.

It would be desirable to provide a projectile launching device that reliably fires, does not jam, and also includes safety features. It would further be desirable to provide a projectile launching device that is easy to load with projectiles. It would further be desirable to provide a projectile launching device that accommodates soft projectiles and does not cause such projectiles to jam on firing.

SUMMARY

A projectile launching device is disclosed herein. The projectile launching device includes a body, a grip assembly, and a hopper.

In one aspect, the body includes a projectile agitator assembly configured to selectively protrude into the hopper. The projectile agitator assembly can be gas actuated.

In one aspect, the body includes an anti-jam assembly. The anti-jam assembly can include a linkage and an anti-jam spring configured to allow the linkage to move rearward if a bolt of the device engages a jammed projectile.

In one aspect, the grip assembly includes a handle and trigger assembly arranged below a rear portion of the body, and a frame arranged below a front portion of the body. The frame is dimensioned to hold a compressed gas canister. Specifically, the frame includes an opening dimensioned to receive the compressed gas canister. In one aspect, the opening has a longitudinal axis (X1) extending parallel to a longitudinal axis (X2) of the body. The opening of the frame can be positioned below the hopper. The frame can be positioned below the trigger assembly. The frame can be positioned longitudinally inward from a projectile launching opening defined on the body. Preferably, an opening of the frame is circular and configured to be shaped so as to snugly hold a compressed gas canister of appropriate size.

In one aspect, the hopper includes a housing defining a container for projectiles, a lid attached to the housing, and a fill volume limiting wall arranged within the housing.

In one aspect, luminescent projectiles are also provided that are configured to be fired or launched by the projectile launching device.

In another embodiment, a grip for a compressed gas projectile launcher is provided. The grip includes a handle including a trigger assembly, and a frame attached to the handle. The frame defines a sleeve dimensioned to receive a compressed gas canister.

Another projectile launching device is disclosed that includes a body, a grip assembly, and a hopper. A lid is attached to a rear surface of the hopper. This device also includes a projectile agitator configured to: (i) extend at least partially inside of the hopper, and (ii) move relative to an interior chamber defined by the hopper.

Additional embodiments are disclosed herein.

BRIEF DESCRIPTION OF THE DRAWINGS

The foregoing Summary and the following Detailed Description will be better understood when read in conjunction with the appended drawings, which illustrate a preferred embodiment of the disclosure. In the drawings:

FIG. **1**A is a side cross-sectional view of a projectile launching device in a non-firing state or ready-to-fire or rearward state.

FIG. **1**B is a side cross-sectional view of the device of FIG. **1**A in a firing state or forward state.

FIG. **2**A is a side view of a hopper for the device of FIGS. **1**A and **1**B with a lid in an opening state.

FIG. **2**B is a side view of the hopper for the device of FIGS. **1**A and **1**B with a lid in an open state.

FIG. **3**A is a side view of the hopper with the lid in a closed position.

FIG. **3**B is a side view of the hopper with the lid in a partially open position.

FIG. **3**C is a side view of the hopper with the lid in a fully open position.

FIG. **3**D is an additional side view of the hopper with the lid in an opening position.

FIG. **4** is a side view of a projectile launching device according to another embodiment.

FIG. **5**A is a side view of a projectile launching device according to another embodiment.

FIG. **5**B is a side cross-sectional view of the projectile launching device according to FIG. **5**A.

FIG. **6**A is a side cross-sectional view of a projectile launching device according to another embodiment.

FIG. **6**B is a side view of the projectile launching device according to FIG. **6**A.

FIG. **6**C is a side cross-sectional view of the projectile launching device according to FIGS. **6**A-**6**B.

FIG. **6**D is a rear top perspective view of the projectile launching device according to FIGS. **6**A-**6**C.

FIG. **7** illustrates a projectile configured to be launched by any of the projectile launching devices illustrated herein.

FIG. **8**A is a side cross-sectional view of a projectile launching device according to another embodiment.

FIG. **8**B is a side cross-sectional view of the projectile launching device of FIG. **8**A with the triggering mechanism or assembly being engaged.

FIG. **8**C is a side cross-sectional view of the projectile launching device of FIGS. **8**A and **8**B in a non-firing state, ready to fire, or rearward state.

FIG. **8**D is an exploded view of the projectile launching device of FIGS. **8**A-**8**C.

FIG. **8**E is a front perspective view of the projectile launching device of FIGS. **8**A-**8**D.

FIG. **8**F is a side view of the projectile launching device of FIGS. **8**A-**8**E.

FIG. **8**G is a rear perspective view of the projectile launching device of FIGS. **8**A-**8**F.

FIG. **9**A is a side cross-sectional view of a projectile launching device according to another embodiment.

FIG. **9**B is a front perspective view of the projectile launching device of FIG. **9**A.

FIG. **9**C is a rear perspective view of the projectile launching device of FIGS. **9**A-**9**B.

FIG. **10**A is a side cross-sectional view of a projectile launching device including an agitator.

FIG. **10**B is a side view of a hopper of the device of FIG. **10**A.

FIG. **10**C is a side cross-sectional view of the hopper of FIGS. **10**A and **10**B.

FIG. **10**D is a rear perspective view of the hopper of FIGS. **10**A-**10**C.

FIG. **10**E is a front view of the hopper of FIGS. **10**A-**10**D.

FIG. **11**A is a side view of a projectile launching device including a cannister or tank locking feature.

FIG. **11**B is a magnified view of the cannister or tank locking feature of FIG. **11**A.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Certain terminology is used in the following description for convenience only and is not limiting. "Axially" refers to a direction along an axis (X) of an assembly. "Radially" refers to a direction inward and outward from the axis (X) of the assembly. "Circumferentially" refers to a direction extending along a curve or circumference of a respective element relative to the axis (X) of the assembly. The words "right," "left," "top," and "bottom" designate directions in the drawings to which reference is made. The words "a" and "one," as used in the claims and in the corresponding portions of the specification, are defined as including one or more of the referenced item unless specifically stated otherwise. This terminology includes the words above specifically mentioned, derivatives thereof, and words of similar import. The phrase "at least one" followed by a list of two or more items, such as "A, B, or C," means any individual one of A, B or C as well as any combination thereof.

A reference to a list of items that are cited as "at least one of a, b, or c" (where a, b, and c represent the items being listed) means any single one of the items a, b, or c, or combinations thereof. The terminology includes the words specifically noted above, derivatives thereof and words of similar import.

Referring to FIGS. **1**A and **1**B, an exemplary projectile launching device **10** is illustrated, which includes a body **20**, a grip assembly **40**, and a hopper **60**. The body **20** includes front portion **28** defining projectile launching opening **29** (which may be referred to or comprise a barrel or barrel assembly) and a rear portion **27**. The grip assembly **40** includes a handle **42** and trigger assembly **44** arranged below a rear portion **27** of the body **20**, and a frame **48** arranged below a front portion **28** of the body **20**. The frame **48** is dimensioned to hold a compressed gas canister **50**. The hopper **60** includes a housing **62** defining a receptacle or container for projectiles, and a lid **64** attached to the housing **62**.

The body **20** includes a generally cylindrical interior passage or space (which may also be known as a breech area or comprise a breech area) for housing at least some of the firing components (such as the hammer and valve components) of the device **10**.

A hammer **23** (also known as a ram, striker, or bolt) is disposed within the body **20** adjacent the rear portion **27**. The hammer **23** has a forward end facing a valve assembly **30** and the forward end of the hammer **23** is configured to contact a valve pin of the valve assembly **30**. As shown in FIGS. **1**A and **1**B, the hammer **23** can include a seat **23***a*. In one aspect, the seat **23***a* is defined as a radially extending flange or shoulder. The hammer **23** is retained in a cocked or ready position by a sear **32** that pivots to engage a portion of the hammer **23**. Actuation of the trigger assembly **44** (such as by pulling the trigger) disengages the sear **32** from the hammer **23**, allowing the hammer **23** to drive forward.

As shown in FIG. **1**B, a firing assembly **31** including a central post or guide **31***a* and a firing spring **31***b* is provided to drive the hammer **23** forward when the trigger assembly **44** is actuated. In one aspect, the central post **31***a* is dimensioned to extend within central openings or channel of the hammer **23** and firing spring **31***b* to align the hammer **23** and the firing spring **31***b*.

A bolt **33** is disposed within the body **20**. A firing tube **34** is partially disposed within the bolt **33**, such that the bolt **33** coaxially surrounds the firing tube **34**. Forward movement of the bolt **33** causes forward movement and loading of a projectile **70**.

The valve assembly **30** is disposed within the body **20** between the hammer **23** and the bolt **33**. The valve assembly **30** includes a valve pin **35** extending rearward toward the hammer **23**. The valve pin **35** includes a contact end configured to engage with the hammer **23**.

The body **20** can include an anti-jam assembly **24**. In one aspect, the anti-jam assembly **24** generally includes a linkage **25** and an anti-jam spring **26**, which are described in more detail herein.

The anti-jam spring **26** is disposed within the body **20**. The anti-jam spring **26** can be positioned between a rear end cap **21** of the body **20** and a region of the hammer **23**. In one aspect, a first end **26***a* of the anti-jam spring **26** engages in a region of the hammer **23**, and a second end **26***b* of the anti-jam spring **26** engages against the rear end cap **21**. It is appreciated that the anti-jam spring **26** can contact or press against any extension in the interior of the body to stop its rearward movement.

As shown in FIG. **1**A, the linkage or connecting rod **25** connects the hammer **23** (at a first end **25***a* of the linkage **25**) and the bolt **33** (at a second end **25***b* of the linkage **25**) for synchronized movement of the hammer **23** and the bolt **33**. In one aspect, the second end **25***b* of the linkage **25** is curved and engages against the seat **23***a* of the hammer **23**. The first end **25***a* of the linkage **25** can similarly be curved but the first end **25***a* engages with the bolt **33**.

The anti-jam spring **26** can engage directly against the second end **25***b* of the linkage **25**, or can be engaged against the hammer **23**, either directly or indirectly. In one aspect, the anti-jam spring **26** generally provides a biasing force (either directly or indirectly) against the seat **23***a* of the hammer **23**. The anti-jam spring **26** is generally configured to provide a damping force, shock absorption, or cushion that prevents the bolt **33** (via the linkage **25** connected to the hammer **23**) from inadvertently crushing or overly com-

pressing a stationary, jammed or misaligned projectile **70**. In one aspect, the anti-jam spring **26** and the linkage **25** can be secured against the hammer **23** without the need for any additional attachment or fastening means other than the biasing force provided by the anti-jam spring **26** against the linkage **25**, which engages against the seat **23***a* of the hammer **23**. If the bolt **33** presses against a projectile, the linkage **25** can move rearward and compress the anti-jam spring **26**. The linkage **25** will move rearwardly away from the hammer, and therefore, cease to provide, or provide less of, a forward force on the hammer, thus lessening the pressure or force on a projectile.

The valve assembly **30** includes a valve housing **36** and a valve body **37** disposed within the valve housing **36**. The valve body **37** includes an inlet port **38** for receiving gas under pressure from a gas line **39**. The valve body **37** also includes an outlet port for communicating gas under pressure from within the valve body **37** when the valve assembly **30** is actuated or open. A valve poppet or valve stem, including a sealing member such as a cup seal, is also disposed within the valve body **37**.

In one aspect, the body **20** includes a projectile agitator assembly **22** configured to selectively protrude into the hopper **60**. In one aspect, the projectile agitator assembly **22** is gas actuated, and may act as a gas-actuated piston. In one aspect, pressurized gas is supplied by the canister **50** to the projectile agitator assembly **22**, such that a post or piston **22***c* is driven vertically upward into an interior of the hopper **60**. The device **10** can include a poppet or other valve components in order to drive a post or piston into the interior of the hopper **60**. In one aspect, the projectile agitator assembly **22**, and more specifically the post or piston **22***c*, is configured to engage with a secondary element **22***a*, such as an agitating surface, floor panel, or other type of engagement element that is connected to an interior surface of the hopper and configured to selectively project inwards.

In one aspect, the supply of compressed gas to operate the projectile agitator assembly **22**, such as the piston **22***c*, may be supplied from different ports, and may be supplied directly from a valve, an exhaust port, or upstream or downstream (following the flow of compressed gas from a rearward portion of the body to a forward portion of the body) from a valve (i.e. the valve assembly **30**). In one aspect, the gas supplied to the projectile agitator assembly **22** is fed as exhaust or firing gas relative to the gas supplied for firing the projectiles. In a preferred embodiment, upon actuation of the valve, such as by the hammer hitting the valve stem, the released firing gas is channeled through a channel, passage or port to actuate the agitator assembly **22**. In this manner, the gas used to actuate the agitator assembly **22** may be considered upstream from the bolt **33** and firing tube **34**. One or more passages or channels can be supplied or positioned adjacent the valve assembly **30**, such that, upon actuation of the valve assembly **30**, gas used to actuate the agitator assembly **22** is channeled through a passage upstream of the bolt **33** and firing tube **34**. It is appreciated that those of skill in the art can adjust the placement or location of the passages used to feed gas to the agitator assembly **22**.

In one aspect, the grip assembly **40** includes a handle **42** and trigger assembly **44** arranged below a rear portion **27** of the body **20**, and a frame **48** arranged below a front portion **28** of the body **20**. The frame **48** includes an opening **49** dimensioned to receive and hold a compressed gas canister **50**. The frame **48** can include secondary features, such as a locking assembly as shown in FIGS. **11**A and **11**B. The compressed gas canister **50** generally includes threading around a neck portion of the compressed gas canister **50** that is configured to matingly engage with threading on a tank interface **48***a* of the frame **48**. The connection between the tank interface **48***a* and the compressed gas canister **50** can generally include screwing the compressed gas canister **50** relative to a threaded opening defined by the tank interface **48***a*, as is known in the art.

In one aspect, the opening **49** has a longitudinal axis (X1) extending parallel to a longitudinal axis (X2) of the body **20**. The opening **49** of the frame **48** can be positioned below the hopper **60**. The frame **48** is positioned below the trigger assembly **44**. In one aspect, the frame **48** is positioned longitudinally inward from a projectile launching opening **29** defined on the body **20**. The frame **48** preferably includes a circular or oblong opening **49** sized and shaped to receive the outer wall of a compressed gas canister **50** of appropriate size. The compressed gas canister **50** slides into the opening **49** to be position as in, for example, FIG. **1**A. Preferably, a front portion of the compressed gas canister **50** does not extend farther than a front of the device, or may be generally aligned with the projectile launching opening **29**. In this manner, the arrangement allows for the positioning of a compressed gas canister that is out of the way and does not obstruct a user while using the device.

As shown in FIGS. **2**A and **2**B, a fill volume limiting wall **266** can be arranged within a housing **262** of the hopper **260**. A linkage can be provided between the wall **266** and the lid **264** such that the wall **266** moves inside an interior chamber of the housing **262** when the lid **264** is opened, decreasing the volume of space within the housing. The wall **266** ensures that the hopper **260** cannot be overfilled or overloaded such that the projectiles **70** become jammed. For example, densely packing foam projectiles into the hopper, such foam projectiles being pliable, could cause lack of movement and a jam. Decreasing the available volume for filling the housing prevents such overfilling. In this manner, interior chamber of the housing has a first volume, and a decreased second volume as set by the fill volume limiting wall **266** when the lid is opened and the fill volume limiting wall **266** is moved to its decreased volume position.

FIGS. **3**A-**3**D illustrate another embodiment of a fill volume limiting wall **366** which is also connected to a lid **364**. As shown in FIGS. **3**A-**3**D, a linkage **368** is provided between the lid **364** and the wall **366**. The linkage **368** generally translates movement such that when the lid **364** is opened, then the wall **366** moves within the interior of the hopper **360**. The wall **366** can generally be positioned in an upper area of an interior of the hopper **360** while the lid **364** is closed, and then is generally shifted downward into a generally middle portion of the hopper **360** as the lid **364** is opened, showing a decreased interior chamber volume for receiving projectiles. One of ordinary skill in the art would understand that the wall **366** can be moved in a variety of ways based on opening of the lid **364**. Alternatively, the wall **366** can be moved or adjusted without relying on a position of the lid **364**.

FIGS. **2**A-**3**D generally illustrate the concept of linking an external feature of the hopper **260**, **360** to an internal feature, such as a volume limiting wall **266**, **366**, partition, or other type of boundary. As a user engages the external feature of the hopper **260**, **360**, such as the hopper lid **264**, **364**, then the internal feature (i.e. wall **266**, **366**) is moved or displaced. This configuration ensures that the volume of the hopper **260**, **360** changes when the lid **264**, **364** of the hopper **260**, **360** is moved between an opened and closed position and helps prevent overloading of the hopper **260**, **360** by

changing the volume of the hopper **260**, **360** via a partition, boundary, or volume limiting wall **266**, **366**.

FIG. **4** illustrates another embodiment of a projectile launching device **410**. In FIG. **4**, the device includes a hopper **460** having an oval-shaped or egg-shaped profile. All other aspects of the device are otherwise identical to the device **10** of FIGS. **1**A and **1**B.

FIGS. **5**A and **5**B illustrate another embodiment of a projectile launching device **510**, which is similar to the embodiment of FIGS. **1**A and **1**B except a frame **541** extending between the hopper **560** and the body **520** is modified. Specifically, the frame **541** connecting the hopper **560** and the body **520** extends straight upward instead of at an angle.

FIGS. **6**A-**6**D illustrate another embodiment for a projectile launching device **710** that is similar to the embodiment of FIGS. **1**A and **1**B. The projectile launching device **710** of FIGS. **6**A-**6**D does not include an anti-jam assembly.

FIG. **7** illustrates a projectile **870** that is configured to be launched by the projectile launching device **10** or any other projectile launching device from the other figures. In one aspect, the projectile **870** is luminescent or fluorescent. The projectile **870** can include a luminescent or fluorescent coating. Components of the projectile launching devices, such as a loader, feed neck, breech, barrel, hopper or container, etc., can include a black light charger unit which is configured to emit ultraviolet light which is absorbed and re-emitting by the luminescent or fluorescent projectiles.

FIG. **8**A-**8**G illustrate a different embodiment for a projectile launching device **910**. In this embodiment, the hopper **960** is a "rear-loading" configuration and includes a loading opening positioned on a rear side of the hopper **960**. A lid **916** for the hopper **960** is connected to the rear side of the hopper **960**, and the opening of the hopper **960** faces rearwardly when the device is oriented for use. The lid **916** is oriented generally vertically when the device is positioned for use and may be generally perpendicular to a longitudinal axis of the device body. Based on this arrangement, a user can load projectiles into the hopper **960** while the projectile launching device **910** is oriented with its muzzle directed towards the ground. Accordingly, a user can safely load projectiles into the hopper **960** without any risk of inadvertently firing projectiles at oneself or bystanders since the muzzle **929** is directed towards the ground during loading.

FIG. **8**D illustrates additional elements for the projectile launching device **910**. The projectile launching device **910** includes an engine assembly **901**, a slide stop assembly **902**, a left shell portion **903**, a right shell portion **904**, a left window panel **905**, a right window panel **906**, a left body portion **907**, a right body portion **908**, a rod cocking assembly with inserts **909**, a trigger **911**, a pump handle **912**, a plug stock **913**, a barrel with seal overmolded **914**, a spring torsion lid **915**, the lid with rip clip **916**, a dowel pin **917**, a sear **918**, a lock safety single cocking **919**, a spring single cocking safety lock **920**, a safety push button **921**, a spring sear **922**, two O-rings **925**, **926**, assembly screws **923**, **927**, **928**, and a ball latch or cradle **930**. The window panels **905**, **906** allow users to visually inspect and determine the quantity of projectiles remaining in the hopper **960**.

A projectile agitator **950** extends at least partially inside of the hopper **960** and is configured to move projectiles within the hopper **960**. As shown in FIGS. **8**A and **8**C, as the pump handle **912** is moved forward and backwards, the projectile agitator **950** likewise is moved forward and backwards within an interior area of the hopper **960**. One of ordinary skill in the art would understand that the projectile agitator **950** can be linked to various components of the projectile launching device **910**, such as the pump handle **912** or other components linked to the pump handle **912**. In one aspect, the projectile agitator **950** is configured to be driven forward and backward to agitate projectiles within the hopper **960**. The projectile agitator **950** may be shaped with a rounded outer surface so that it will not catch or snap projectiles or rupture projectiles. One of ordinary skill in the art would understand that any other type of motion, such as up and down motion or lateral motion, can be imparted on the projectile agitator **950**.

The ball cradle or detent **930** is configured to hold the projectiles **970** after loading and before firing. A user generally drives the pump handle **912** forward and backwards to generate a compressed air that is then used to fire the projectiles **970** down the barrel. Atmospheric air enters the engine assembly **901** when the pump handle **912** is driven backwards. This motion also compresses a spring within the engine assembly **901**.

The engine or firing assembly **901** generally includes the following features. A piston within the engine assembly **901** can include an abutment surface or seat configured to engage a compression spring when the piston is driven backwards (i.e. via pumping of the handle **912**). The compression spring is then compressed between the piston and an end cap or abutment. Force on the spring is then supplied by the user pulling the pump handle **912**, which is connected to an air concentration tube. The air concentration tube is connected to an impact ring, which is inside of the engine assembly **901**. The compression spring is compressed and the piston is pulled backwards until a front of a spring seat moves behind the sear **918**. The front of the spring seat engages the sear **918** and the compression spring is held in a compressed state until the projectile is fired. The pump handle **912** is then moved forward to load the projectile into the breach and seal off an input port. Atmospheric air pressure then enters the area in front of the piston. When the trigger is engaged, the sear **918** releases the energy of the compression spring, and the piston moves forward past side slots of the air focus tube to seal off a front portion of the air focus tube. Continued forward movement compresses the air and this compressed air travels through the impact ring and the breach to launch the projectile out of the barrel.

FIGS. **9**A-**9**C illustrate another embodiment for a projectile launching device **1010** that is substantially similar to the projectile launching device **910**, but has a modified pump handle **1012** that is angled away from the barrel assembly.

As shown in FIGS. **10**A-**10**E, a projectile launching device **1110** is disclosed that includes an agitator assembly **1122**, which may be provided generally as a moving surface or floor. In one aspect, the agitator assembly **1122** is arranged in the interior area of the hopper **1160**. The agitator assembly **1122** can generally include an agitating surface **1122***a*. In one aspect, the agitating surface **1122***a* partially forms a movable or displaceable floor panel of the hopper **1160**. One of ordinary skill in the art would understand that the agitating surface **1122***a* could be provided in any location of the hopper **1160**. The agitating surface **1122***a* is configured to be agitated or move relative to an inner chamber or interior area defined by the hopper **1160**. Movement of the agitating surface **1122***a* ensures that projectiles within the hopper **1160** do not jam or are not bunched together with each other. Various driving means can be provided to move the agitating surface **1122***a*. As shown in FIG. **10**A, a compressed air supply line **1122***b*, having an upper and lower portion, can be provided to selectively provide pressurized or compressed air to move the agitating surface **1122***a*, such as each time the poppet valve is

actuated. The air supply line **1122***b* is configured to be supplied by the same compressed gas cannister that generally provides the projectile firing power for the device **1110**.

In one aspect, a piston **1122***c* is in fluid connection with the compressed gas supplied to the compressed air supply line **1122***b* and is configured to abut the agitating surface **1122***a* and drive the agitating surface **1122***a*, such as in an upward direction. In one aspect, each time that the trigger is pulled or actuated, and the poppet valve associated with the piston **1122***c* is actuated, a portion of the compressed gas can be supplied or bled to the upper portion of the compressed air supply line **1122***b*, which actuates the piston **1122***c* and drives the agitating surface **1122***a* such as in an upward motion.

The agitating surface **1122***a* can be driven in a linear manner or in a rotational or pivoting manner, depending on how the agitating surface **1122***a* is connected to the hopper **1160**. As shown in FIG. **10**C, a pivot connection **1122***d* or hinge can connect the agitating surface **1122***a* to the hopper **1160**. A return spring **1122***e* can also be provided to bias the agitating surface **1122***a* to a lower or non-actuated position. The piston **1122***c* acts in an opposite direction from the return spring **1122***e*. During operation, the piston **1122***c* is driven upward when compressed air is fed to it, and then the return spring **1122***e* quickly pulls the agitating surface **1122***a* back downwards when compressed air is no longer fed to the piston **1122***c*.

As shown in FIG. **10**C, the agitating surface **1122***a* can have a length (L) that is at least half of a total length of the hopper **1160**. This relatively large surface area of the agitating surface **1122***a* provides a reliable way to dislodge projectiles. Preferably, the agitating surface **1122***a* does not cover the opening at the bottom of the hopper, or selectively partially covers a portion of the opening. As shown in FIG. **10**D, the rear face of the hopper can include a window **1161** so that the contents are visible to a user, and the level of projectiles in the hopper can be monitored.

In one aspect, the supply of compressed gas to operate the projectile agitator assembly **1122**, such as the piston **1122***c*, may be supplied from different ports, and may be supplied directly from a valve, an exhaust port, or upstream or downstream (following the flow of compressed gas from a rearward portion of the body to a forward portion of the body) from a valve (i.e. the valve assembly). In one aspect, the gas supplied to the projectile agitator assembly **1122** is fed as exhaust or firing gas relative to the gas supplied for firing the projectiles. In a preferred embodiment, upon actuation of the valve, such as by the hammer hitting the valve stem, the released firing gas is channeled through a channel, passage or port to actuate the agitator assembly **1122**. In this manner, the gas used to actuate the agitator assembly **1122** may be considered upstream from the bolt and firing tube. One or more passages or channels can be supplied or positioned adjacent the valve assembly, such that, upon actuation of the valve assembly, gas used to actuate the agitator assembly **1122** is channeled through a passage upstream of the bolt and firing tube. It is appreciated that those of skill in the art can adjust the placement or location of the passages used to feed gas to the agitator assembly **1122**.

FIGS. **11**A and **11**B illustrate another aspect of a projectile launching device. As shown in FIGS. **11**A and **11**B, the frame **48** of the projectile launching device includes an opening **29** dimensioned to receive the cannister or tank **50** of compressed air. A locking assembly **51** is provided on the frame **48** for further securing the tank **50**. The locking assembly **51** may be configured to engage a medial region of the tank **50**, in one aspect, but it is appreciated that the locking assembly **51** can be positioned to engage the tank **50** at other locations. The locking assembly **51** is generally configured to prevent unintentional rotation of the tank **50** when the tank **50** is screwed onto the projectile launching device at a tank interface or gas coupling **48***a* (which provides the compressed air to the firing mechanism and the agitating assembly). In this manner, when a user grips the tank as, for example, a foregrip during use, the tank will not rotate and disengage from the tank interface or gas coupling **48***a*, thus causing the projectile launching device not to fire. The locking assembly **51** can include a clamping ring in one aspect. In another aspect, the locking assembly **51** can have a clam shell type locking interface with the tank **50**. The locking assembly **51** can include a locking ring **51***a* and a securing element **51***b* configured to attach the locking assembly **51** to the frame **48**. The locking ring **51***a* is configured to engage around a circumference of tanks of varying sizes and can be adjusted via a user based on a size of the tanks. In one aspect, the locking assembly **51** can be partially concealed within the opening **49** of the frame **48**.

Having thus described the present disclosure in detail, it is to be appreciated and will be apparent to those skilled in the art that many physical changes, only a few of which are exemplified in the detailed description of the invention, could be made without altering the inventive concepts and principles embodied therein.

It is also to be appreciated that numerous embodiments incorporating only part of the preferred embodiment are possible which do not alter, with respect to those parts, the inventive concepts and principles embodied therein.

The present embodiment and optional configurations are therefore to be considered in all respects as exemplary and/or illustrative and not restrictive, the scope of the embodiments being indicated by the appended claims rather than by the foregoing description, and all alternate embodiments and changes to this embodiment which come within the meaning and range of equivalency of said claims are therefore to be embraced therein.

What is claimed is:

1. A projectile launching device comprising:

a hopper configured to retain projectiles;

a body including a projectile agitator assembly comprising a piston configured to selectively move within an interior of the hopper;

the projectile agitator assembly comprising an agitating panel separate from and unattached to the piston and configured to be moveable in response to a selective movement of the piston with respect to the agitating panel, the agitating panel comprising a generally concave upper surface curving away from an upper wall of the body and having a medial portion that extends toward an outlet opening of the body;

a grip assembly including a handle and a trigger assembly arranged below a rear portion of the body; and

a frame positioned below a barrel of the projectile launching device, the frame comprising an opening dimensioned to receive and support a compressed gas canister by surrounding a part of a compressed gas cannister other than a threaded portion of the compressed gas cannister such that at least a portion of the compressed gas canister is positioned below the barrel.

2. The projectile launching device according to claim **1**, wherein the piston is gas actuated.

3. The projectile launching device according to claim **1**, wherein the body includes an anti-jam assembly.

4. The projectile launching device according to claim 3, wherein the anti-jam assembly includes a linkage and an anti-jam spring.

5. The projectile launching device according to claim 1, wherein the frame comprises a sleeve defining the opening dimensioned to receive and support the compressed gas canister.

6. The projectile launching device according to claim 5, wherein the opening has a longitudinal axis (X1) extending parallel to a longitudinal axis (X2) of the body.

7. The projectile launching device according to claim 5, wherein the opening of the frame is positioned below the hopper.

8. The projectile launching device according to claim 1, wherein at least a portion of the frame is positioned below the trigger assembly.

9. The projectile launching device according to claim 1, wherein the frame is positioned longitudinally inward from a projectile launching opening defined on the body.

10. The projectile launching device according to claim 1, wherein the hopper includes a housing defining an interior chamber configured to retain the projectiles, a lid attached to the housing, and a fill volume limiting wall arranged within the housing that blocks a portion of the interior chamber.

11. The projectile launching device according to claim 1, further comprising luminescent projectiles that are configured to be launched by the projectile launching device.

12. The projectile launching device according to claim 1, wherein the agitating panel has at least one raised end as compared to the medial portion.

13. The projectile launching device according to claim 12, wherein a compressed gas configured for a firing operation of the launching device is diverted to operate the piston.

14. The projectile launching device according to claim 13, wherein a compressed air supply line is in communication with the piston, and the compressed air supply line is configured to provide a predetermined amount of a compressed air to the piston each time a trigger of the trigger assembly is actuated.

15. The projectile launching device according to claim 12, wherein the agitating panel is connected to an interior wall of the hopper via a pivot connection, and a return spring is provided to bias the agitating panel to a non-actuated position.

16. The projectile launching device according to claim 12, wherein the agitating panel has a length (L) that is at least half of a total length of the hopper.

17. The projectile launching device according to claim 1, wherein the hopper further comprises a fill volume limiting wall arranged within an interior of the hopper and connected to a lid, wherein a linkage is provided between the lid and the fill volume limiting wall such that the fill volume limiting wall is displaced when the lid is opened.

18. The projectile launching device according to claim 1, wherein at least portion of a housing of the hopper is transparent such that an interior chamber of the hopper is visible.

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