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(54) **PAINTBALL GUN LOADING METHODS AND APPARATUS**

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CPC ***F41B 11/57*** (2013.01); *F41B 11/53* (2013.01); *F41B 11/52* (2013.01)

(58) **Field of Classification Search**
USPC 124/48, 49, 51.1; 220/211, 230, 260
See application file for complete search history.

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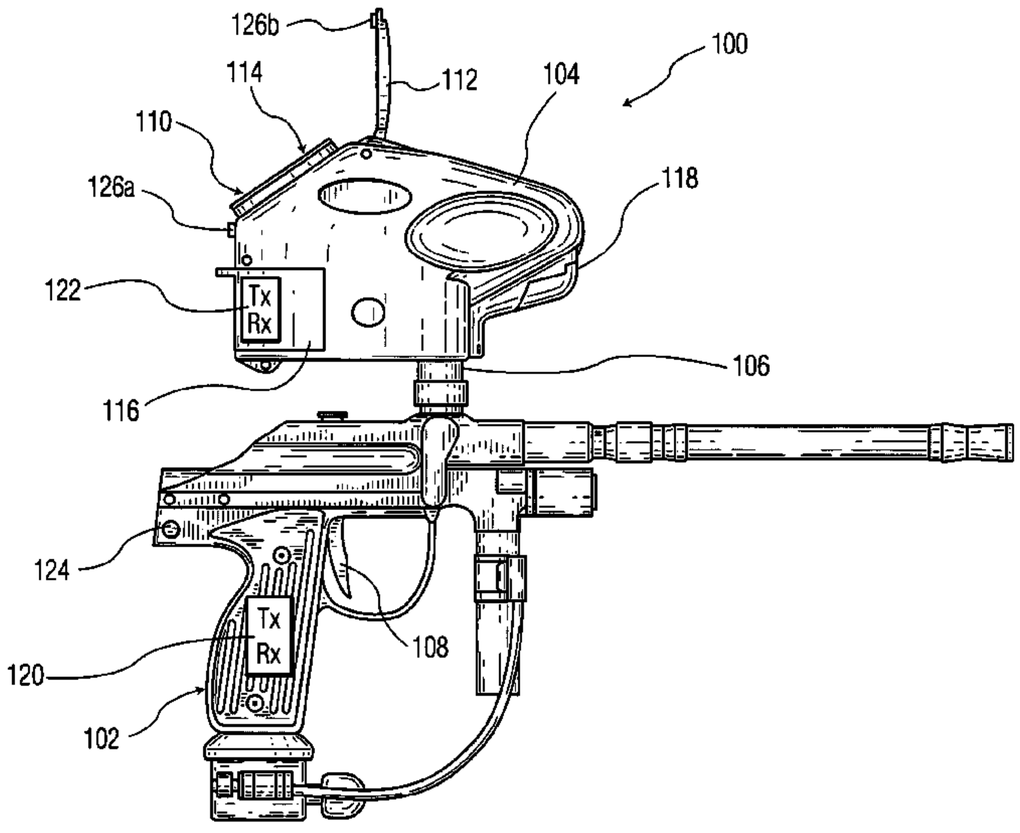
(57) **ABSTRACT**

Methods, apparatus, systems, and kits for loading paintballs into a feed tube of a paintball gun are disclosed. A loader includes a chamber for holding paintballs, a feed mechanism having a rotational feeder within the chamber that feeds paintballs from the chamber along a feed channel when rotating to fill the feed tube, and a drive mechanism that drives the rotational feeder of the feed mechanism, ceases to drive the rotational feeder responsive to stoppage of the rotational feeder, and periodically attempts to rotate the stopped rotational feeder. Paintballs are loaded from a loader into a feed tube of a paintball gun by driving a rotational feeder within the loader, the rotational feeder configured within the loader to feed paintballs into the feed tube when rotating, ceasing to drive the rotational feeder responsive to stoppage of the rotational feeder, and periodically attempting to rotate the stopped rotational feeder.

15 Claims, 12 Drawing Sheets



(51) **Int. Cl.**
F41B 11/53 (2013.01)
F41B 11/52 (2013.01)

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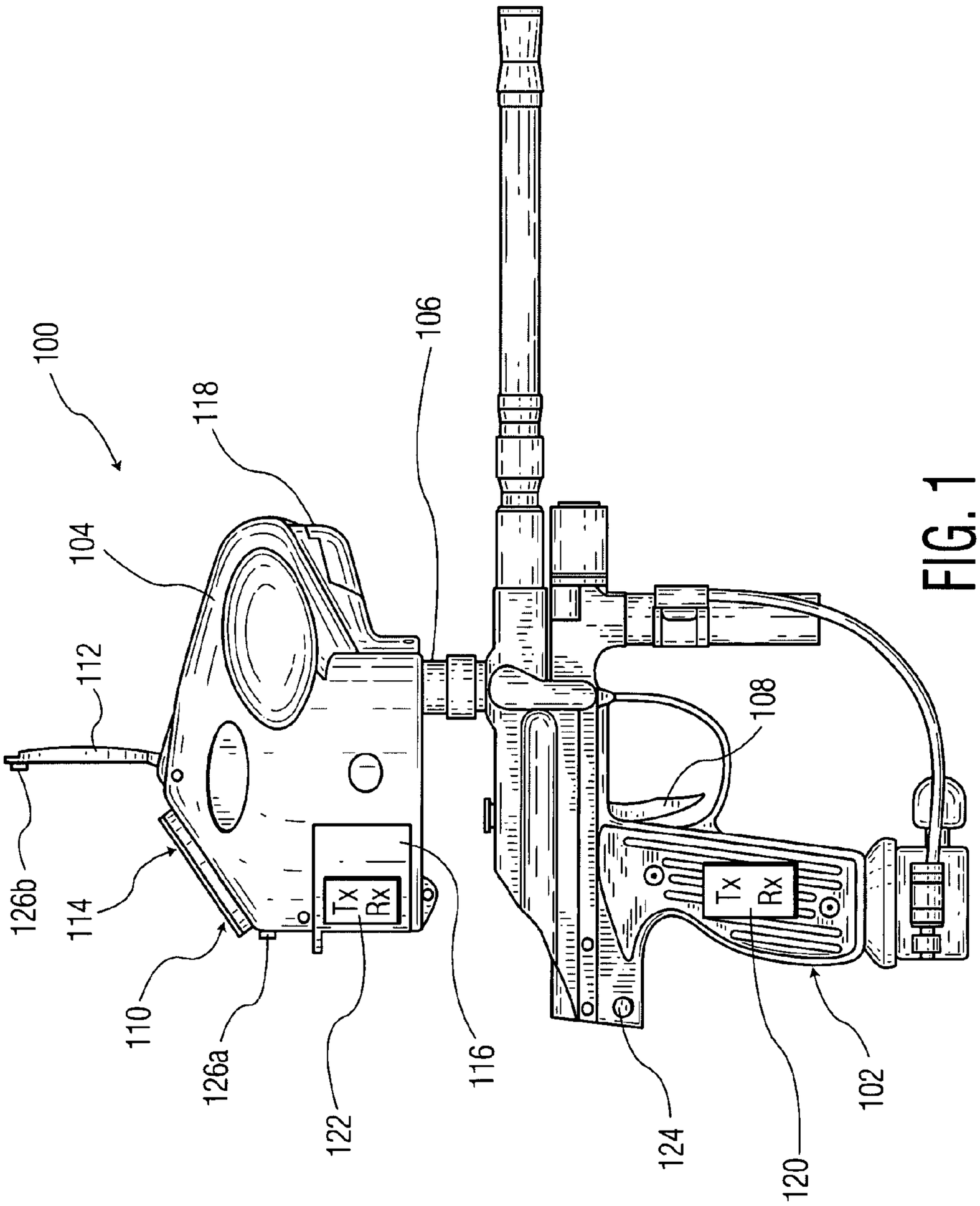
100
118
106
104
112
126b
114
110
126a
122
116
124
120
102
108
Tx
Rx
Tx
Rx

FIG. 1

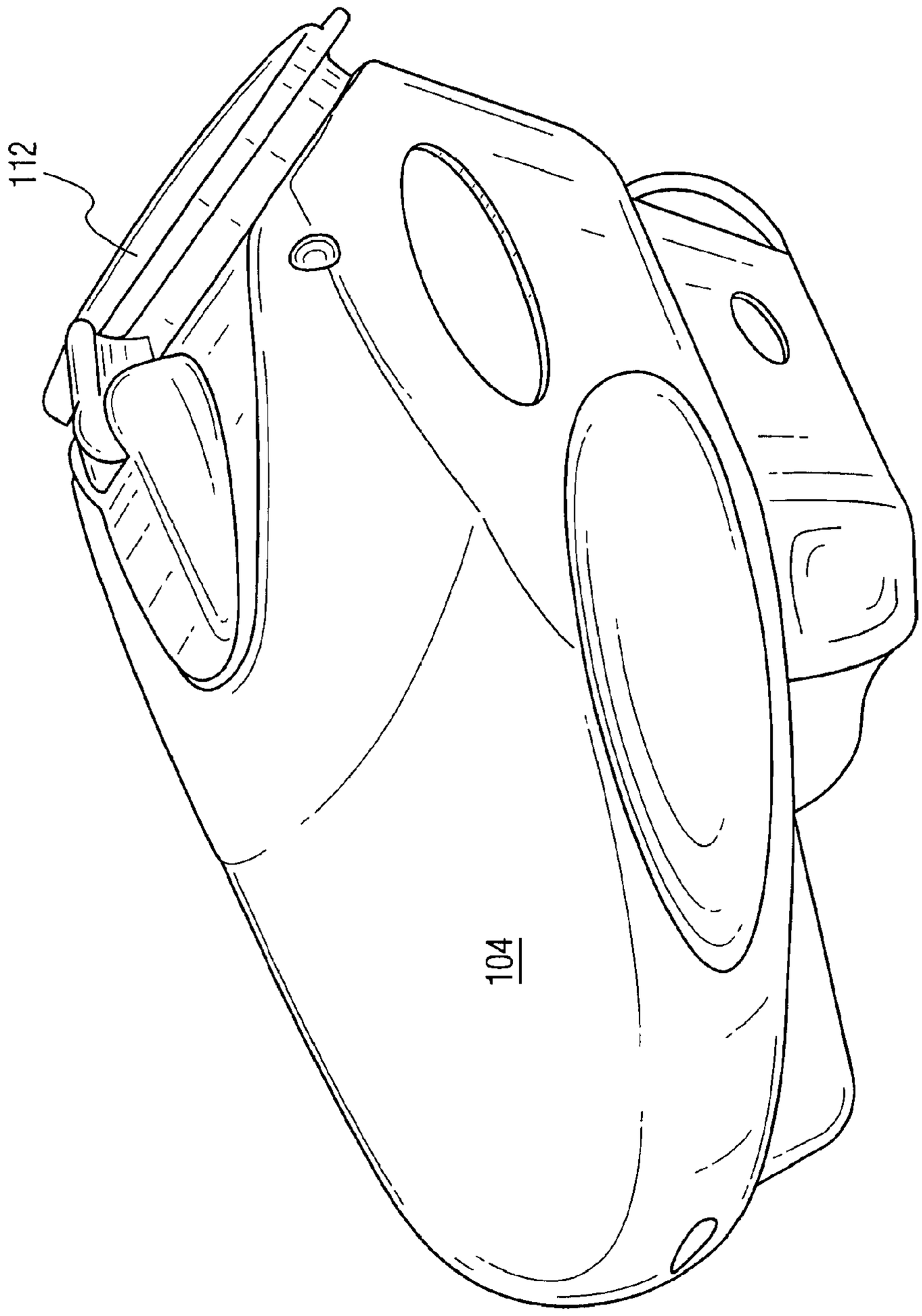

FIG. 2

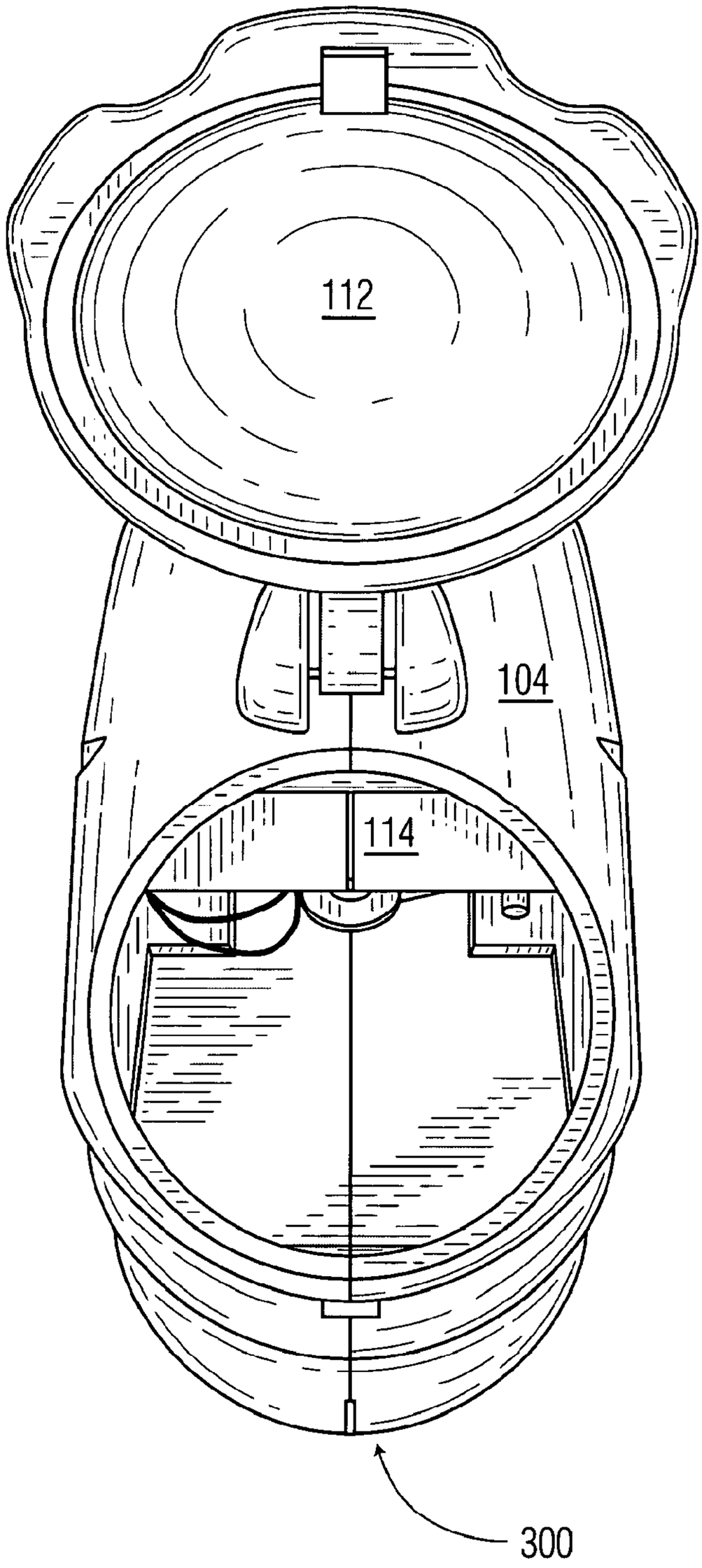

FIG. 3

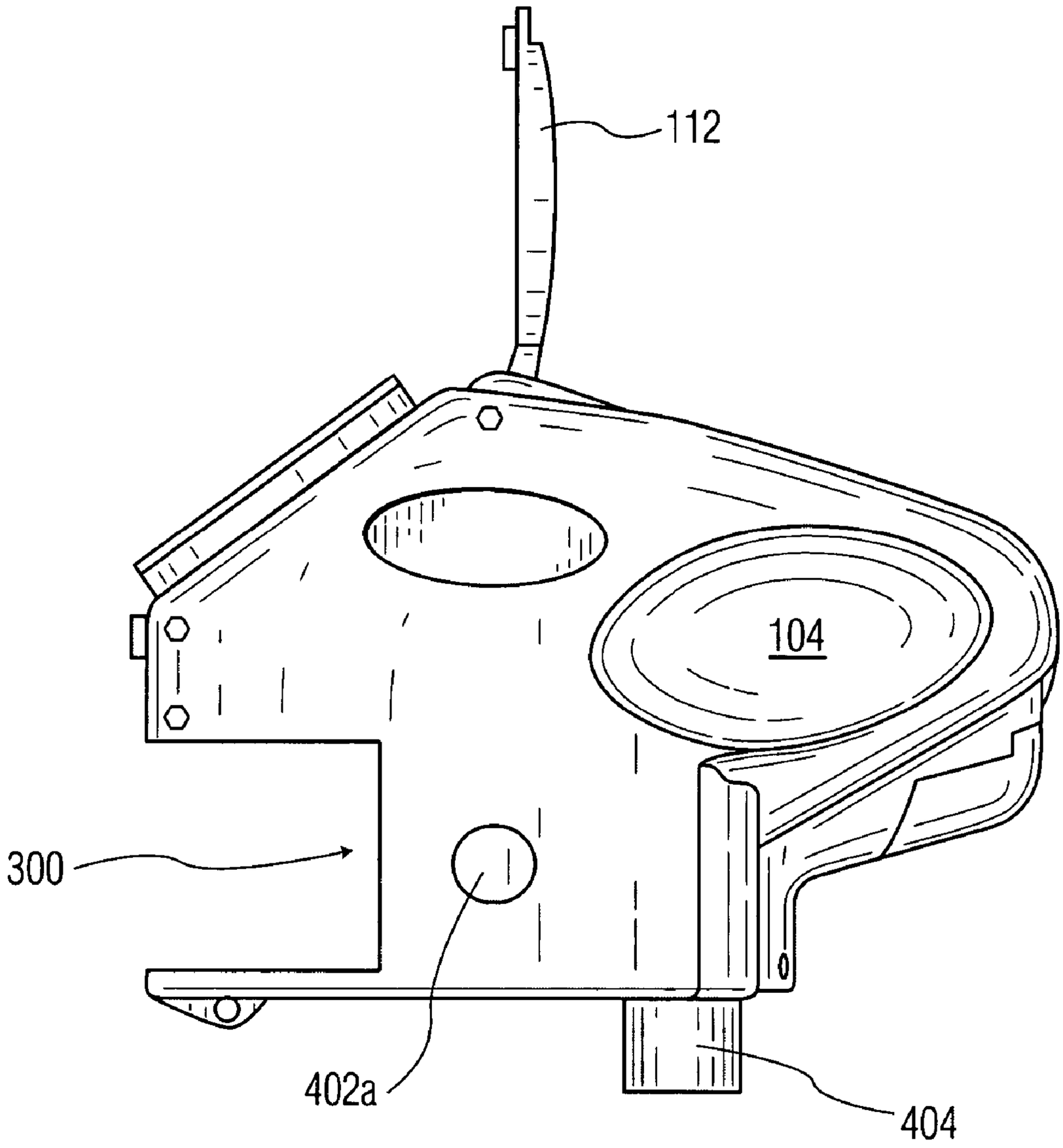

FIG. 4

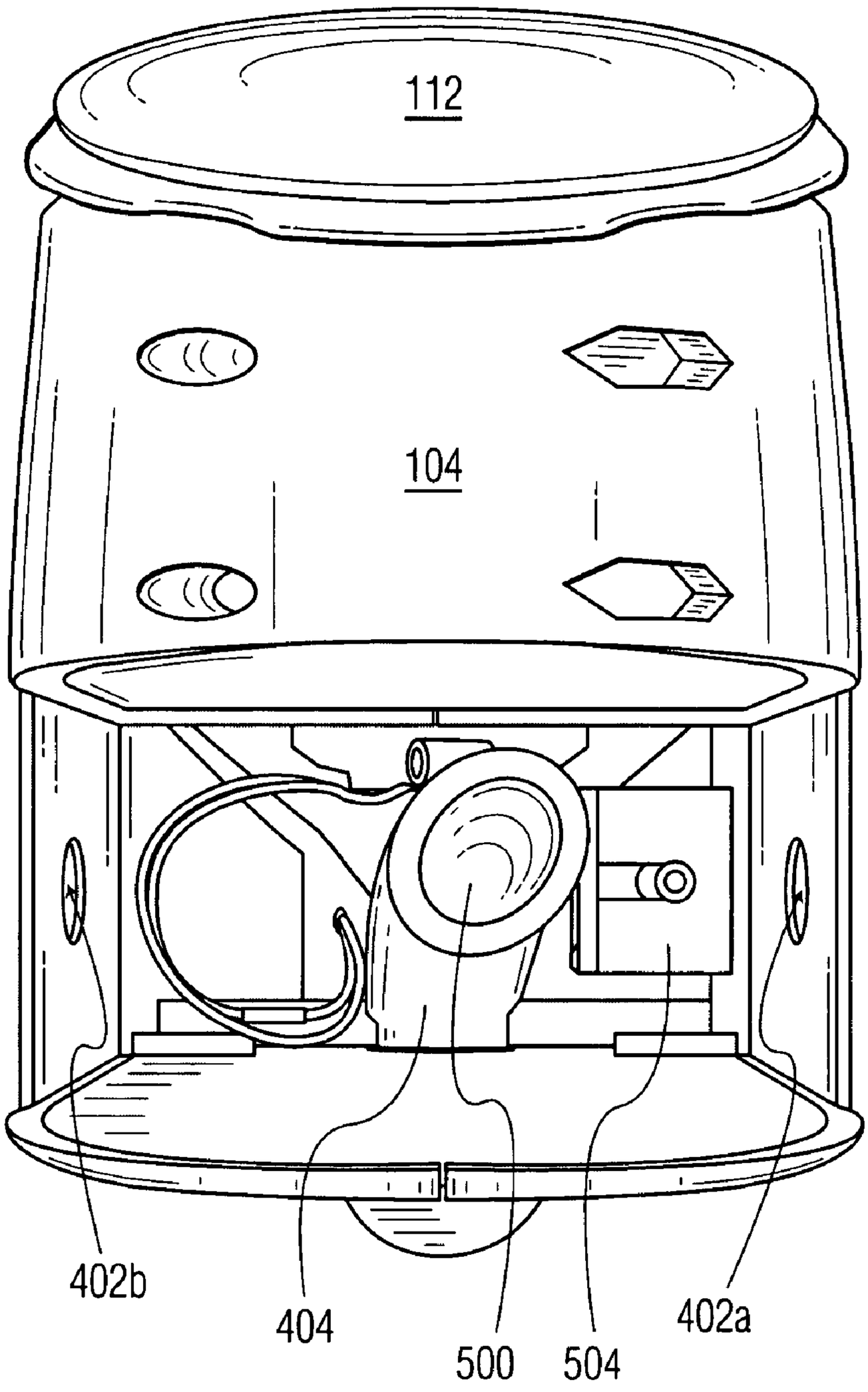

FIG. 5

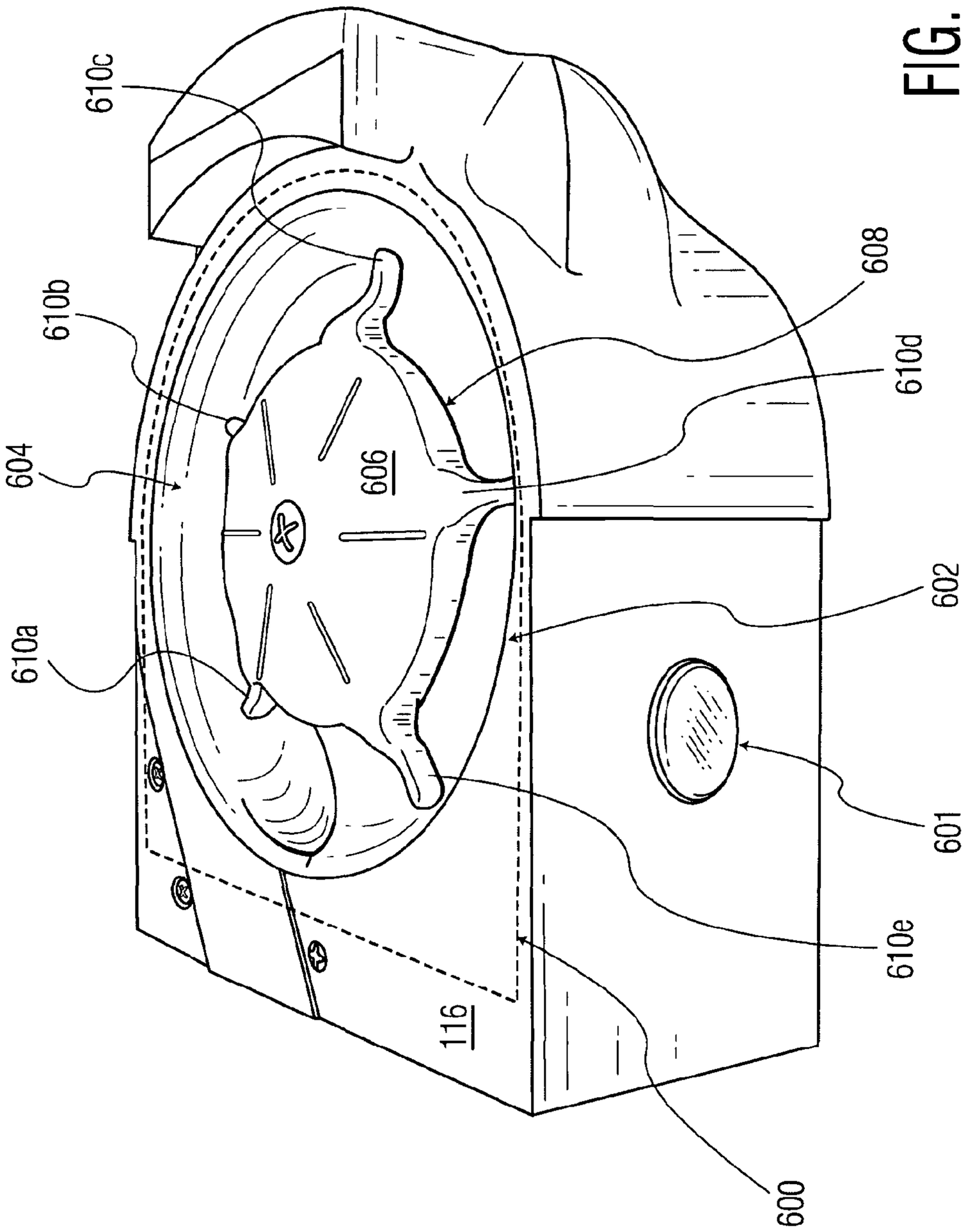

FIG. 6

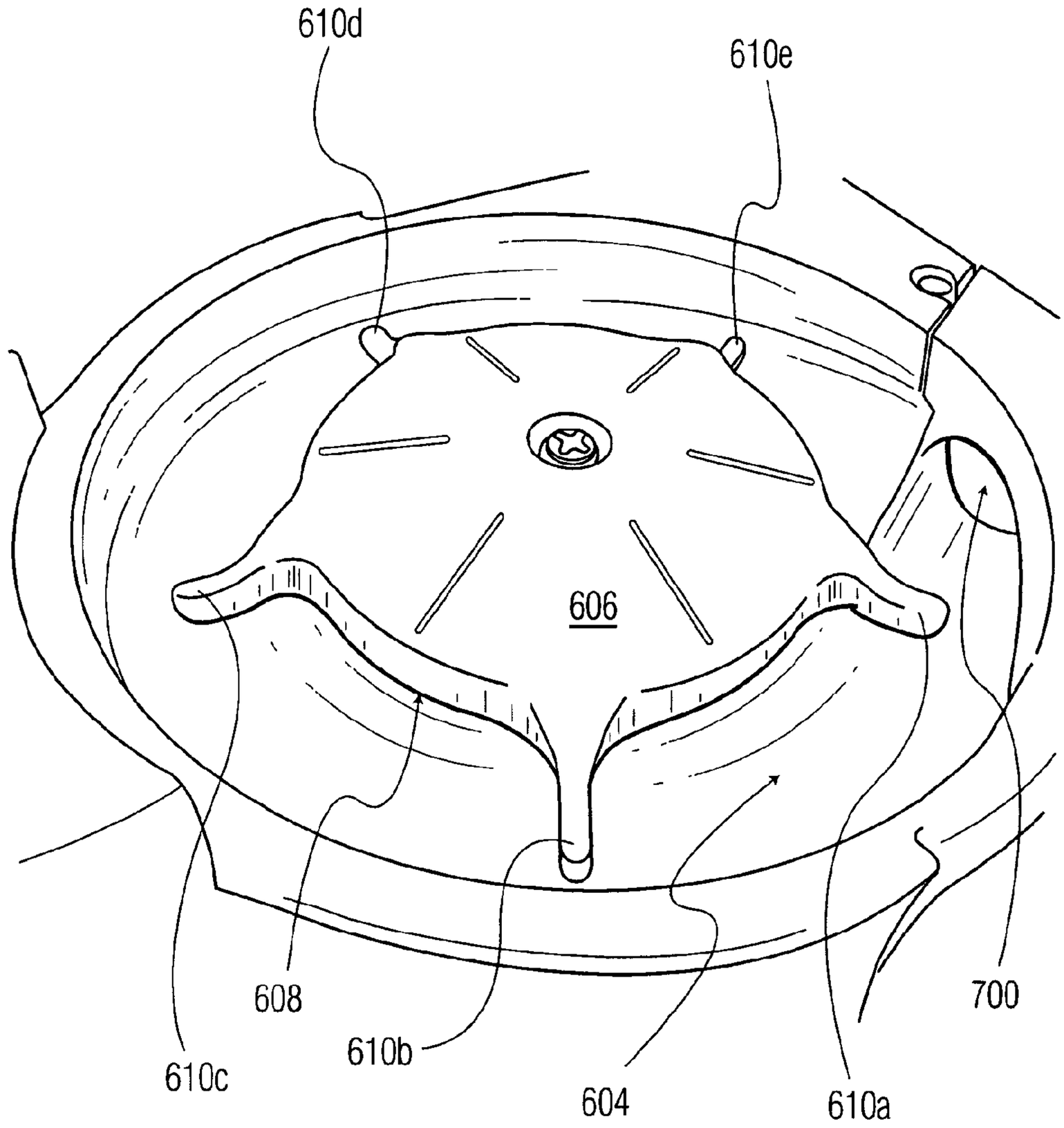

FIG. 7

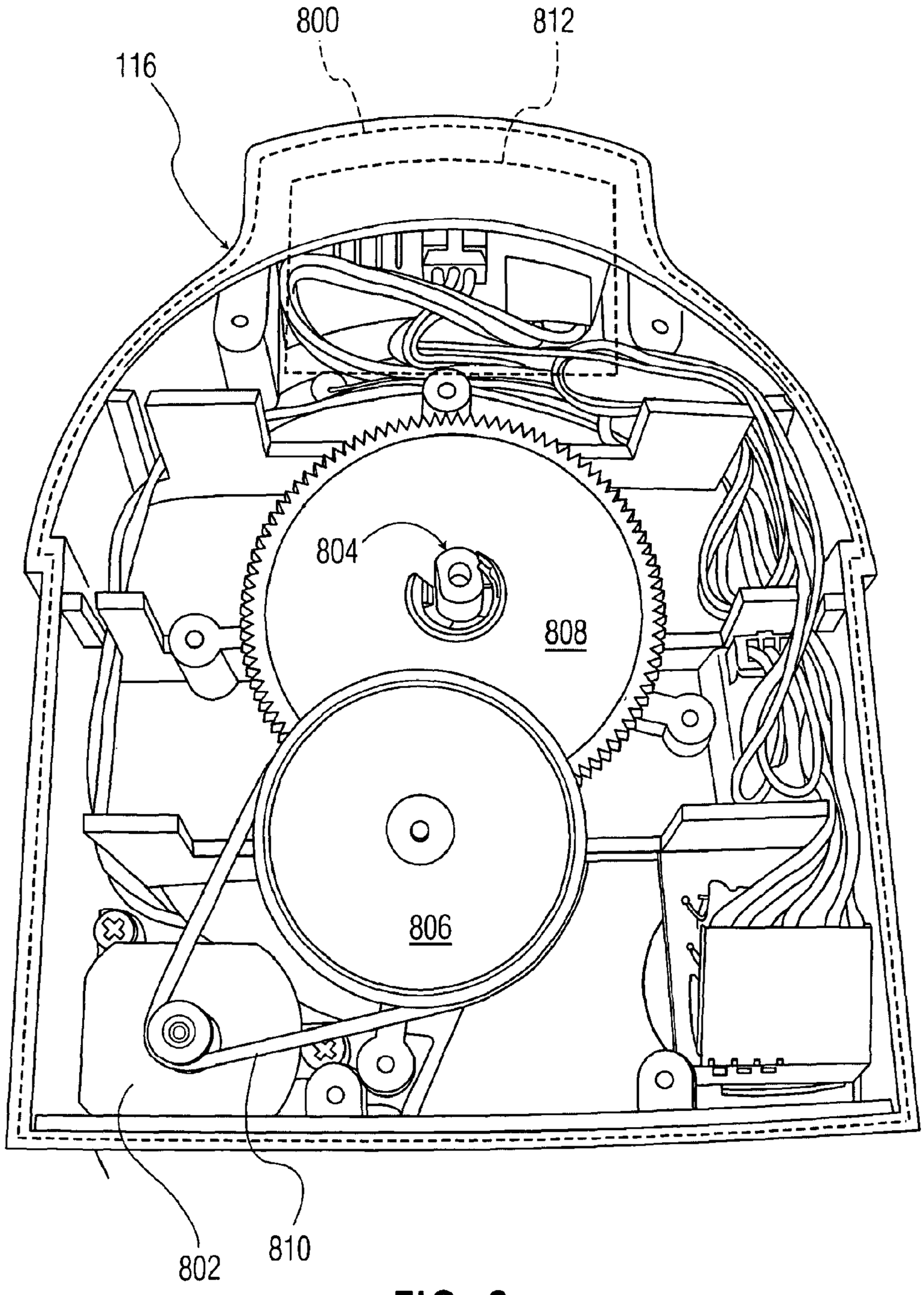

FIG. 8

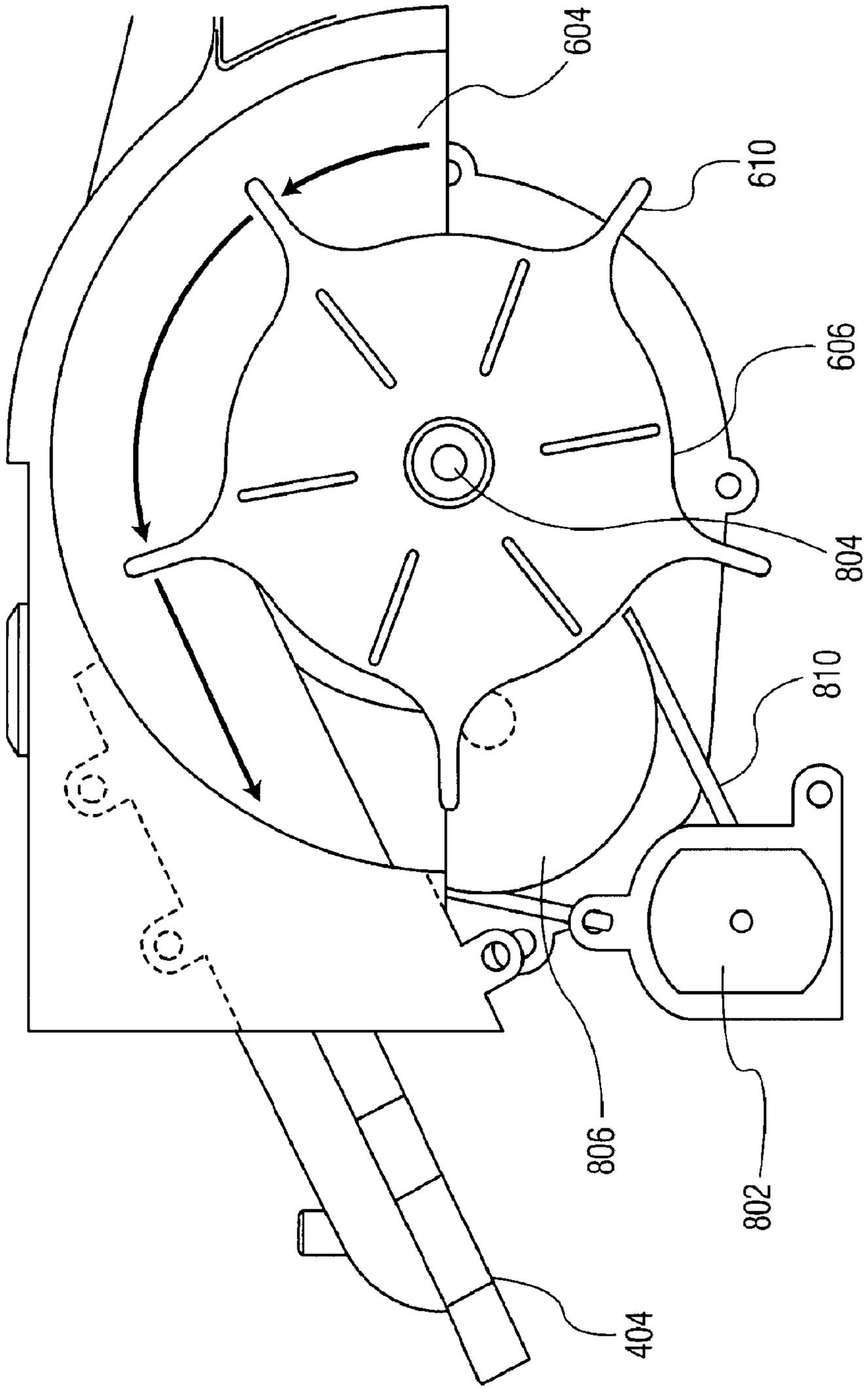

FIG. 9

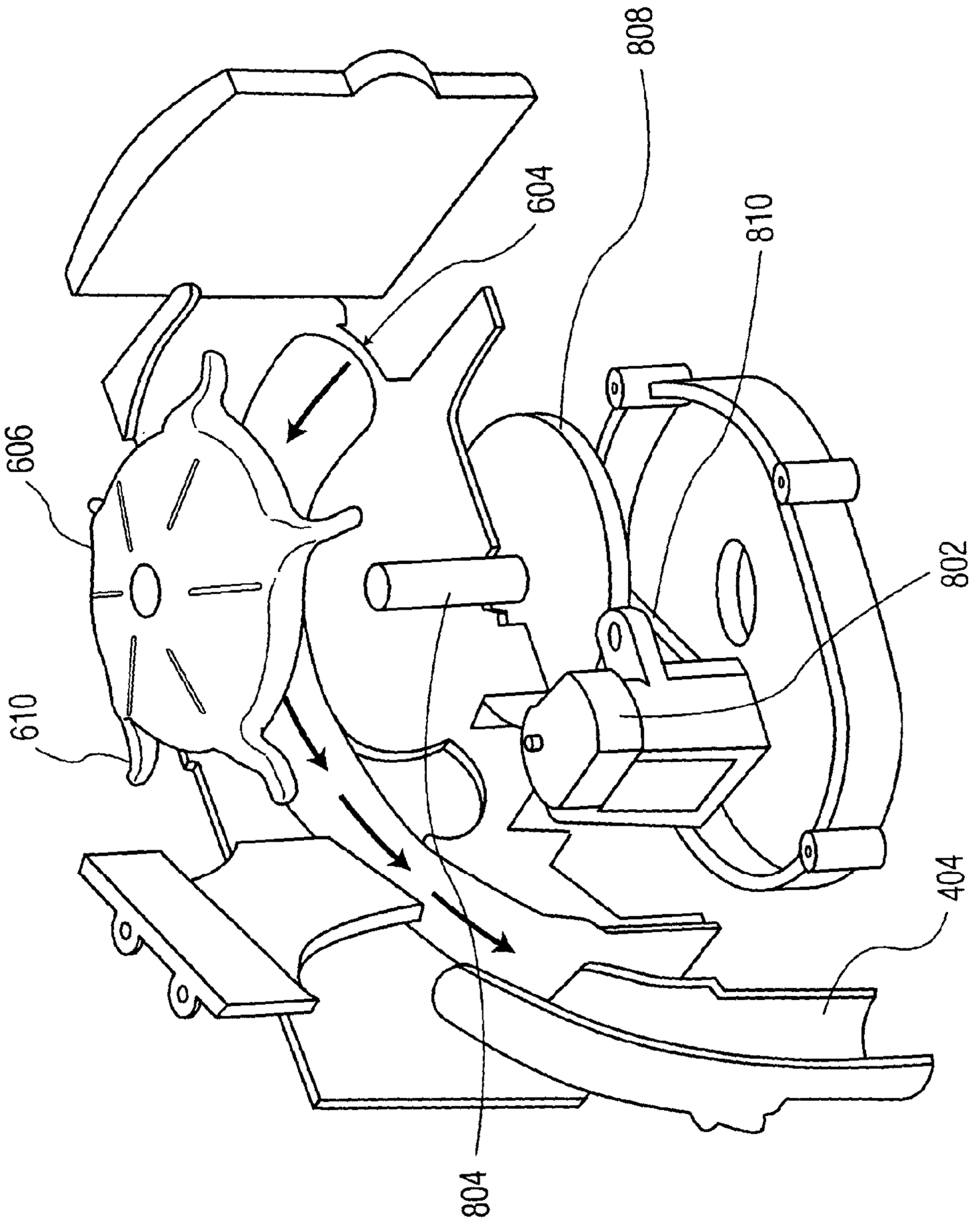

FIG. 10

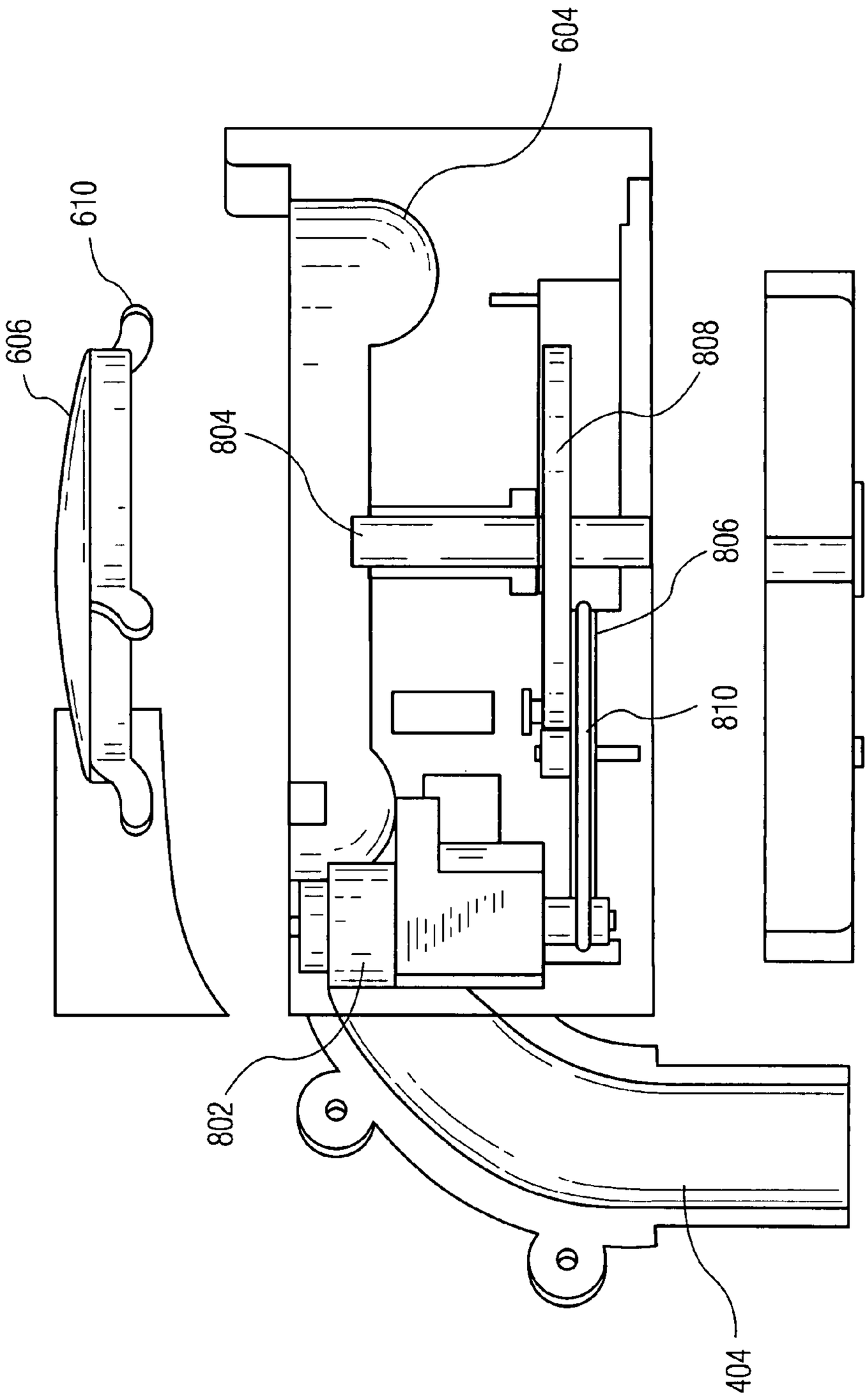

FIG. 11

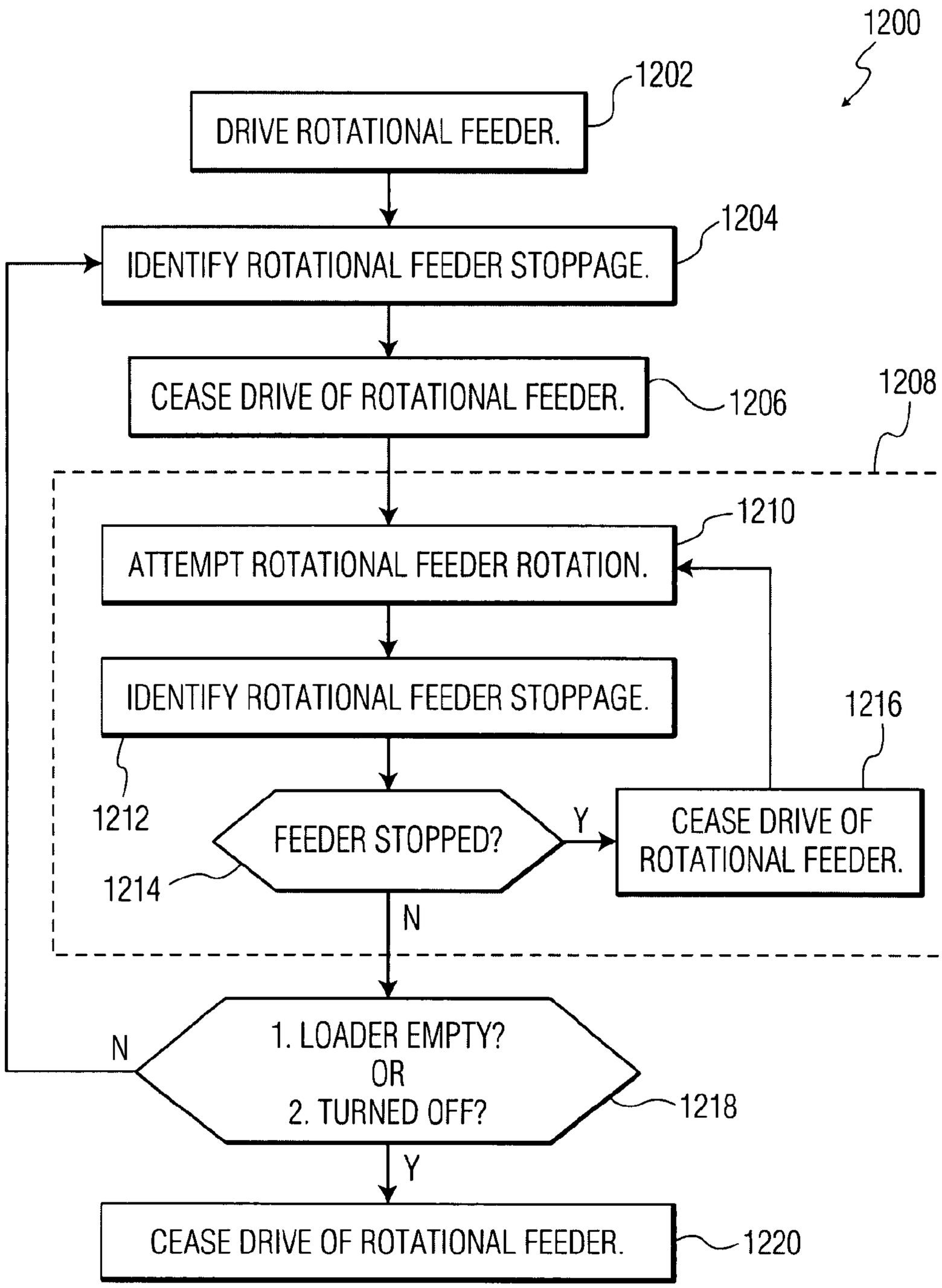
1200
DRIVE ROTATIONAL FEEDER.
1202
IDENTIFY ROTATIONAL FEEDER STOPPAGE.
1204
CEASE DRIVE OF ROTATIONAL FEEDER.
1206
1208
ATTEMPT ROTATIONAL FEEDER ROTATION.
1210
IDENTIFY ROTATIONAL FEEDER STOPPAGE.
1212
FEEDER STOPPED?
1214
Y
CEASE DRIVE OF ROTATIONAL FEEDER.
1216
N
1. LOADER EMPTY?
OR
2. TURNED OFF?
1218
N
Y
CEASE DRIVE OF ROTATIONAL FEEDER.
1220

FIG. 12

PAINTBALL GUN LOADING METHODS AND APPARATUS

Matter enclosed in heavy brackets [ ] appears in the original patent but forms no part of this reissue specification; matter printed in italics indicates the additions made by reissue; a claim printed with strikethrough indicates that the claim was canceled, disclaimed, or held invalid by a prior post-patent action or proceeding.

RELATED APPLICATIONS

This application *is a broadening reissue of U.S. Pat. No. 7,841,328, which issued from U.S. patent application Ser. No. 11/879,691, filed Jul. 19, 2007, entitled "PAINTBALL GUN LOADING METHODS AND APPARATUS," which* claims the benefit of the filing dates of U.S. *Provisional Patent* Application **[**Ser.**]** No. 60/831,662, entitled "DRIVE SYSTEM FOR LOADER OF PAINTBALL GUN," filed Jul. 19, 2006, and U.S. *Provisional Patent* Application **[**Ser.**]** No. 60/849,024, entitled "DRIVE SYSTEM FOR LOADER OF PAINTBALL GUN," filed Oct. 4, 2006, both of which are incorporated fully herein by reference *in their entireties*.

FIELD OF THE INVENTION

The present invention relates to paintball gun loaders and, more particularly, to methods and apparatus for loading paintballs into paintball guns.

BACKGROUND OF THE INVENTION

The game of paintball uses paintball guns to project balls of paint is ("paintballs") at opponents. A loading device ("loader") loads paintballs into a feed tube leading to the firing breach of the paintball guns. One performance measurement of a paintball gun is the rate at which it projects paintballs, commonly measured in balls per second ("BPS").

Conventional paintball guns and loaders used therewith may encounter time delays between the actuation of the firing sequence of the paintball gun to fire a paintball and the actuation of the loader to deliver more paintballs into the feed tube of the paintball gun. For example, the loader may wait for movement of paintballs within a neck of the loader leading to the feed tube of the paintball gun before actuation. Since high-end paintball guns typically have sensors in the breach of the gun to prevent firing until a paintball is fully inserted into the breach, the actuation of the loader effectively controls the maximum rate of fire. This may be undesirable for competitive players desiring a maximum rate of fire at any given time.

SUMMARY OF THE INVENTION

The present invention is embodied in methods, apparatus, systems, and kits for loading paintballs from a loader into a feed tube of a paintball gun. An exemplary loader includes a chamber for holding paintballs, a feed mechanism having a rotational feeder within the chamber that feeds paintballs from the chamber along a feed channel when rotating to fill the feed tube, and a drive mechanism that drives the rotational feeder of the feed mechanism, ceases to drive the rotational feeder responsive to stoppage of the rotational feeder, and periodically attempts to rotate the stopped rotational feeder.

In an exemplary embodiment, paintballs are loaded from a loader into a feed tube of a paintball gun by driving a rotational feeder within the loader, the rotational feeder configured within the loader to feed paintballs into the feed tube when rotating, ceasing to drive the rotational feeder responsive to stoppage of the rotational feeder, and periodically attempting to rotate the stopped rotational feeder.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention is best understood from the following detailed description when read in connection with the accompanying drawings, with like elements having the same reference numerals. When a plurality of similar elements are present, a single reference numeral may be assigned to the plurality of similar elements with a small letter designation referring to specific elements. When referring to the elements collectively or to a non-specific one or more of the elements, the small letter designation may be dropped. This emphasizes that according to common practice, the various features of the drawings are not drawn to scale. On the contrary, the dimensions of the various features are arbitrarily expanded or reduced for clarity. Included in the drawings are the following figures:

FIG. **1** is a side view of a paintball gun assembly including a paintball gun and a loader with a drive/feed mechanism installed in accordance with an aspect of the present invention;

FIG. **2** is a side perspective view of an exemplary loader with the drive/feed mechanism removed in accordance with an aspect of the present invention;

FIG. **3** is a top perspective view of an exemplary loader with the drive/feed mechanism removed in accordance with an aspect of the present invention;

FIG. **4** is a side view of an exemplary loader with the drive/feed mechanism removed in accordance with an aspect of the present invention;

FIG. **5** is a rear view of an exemplary loader with the drive/feed mechanism removed in accordance with an aspect of the present invention;

FIG. **6** is a plan view of an exemplary drive/feed mechanism in accordance with an aspect of the present invention;

FIG. **7** is a blown-up view of an exemplary rotational feeder of the drive/feed mechanism of FIG. **6** in accordance with an aspect of the present invention;

FIG. **8** is a bottom view of the exemplary drive/feed mechanism of FIG. **7** with a cover removed in accordance with an aspect of the present invention;

FIG. **9** is a schematic view of the exemplary drive/feed mechanism of FIG. **7** in accordance with an aspect of the present invention;

FIG. **10** is an exploded view of the exemplary drive/feed mechanism of FIG. **7** in accordance with an aspect of the present invention;

FIG. **11** is an elevation view of the exemplary drive/feed mechanism of FIG. **7** in accordance with an aspect of the present invention; and

FIG. **12** is a flow chart of exemplary steps for loading paintballs into a feed tube of a paintball gun in accordance with an aspect of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

FIG. **1** depicts an exemplary paintball gun assembly **100**. Paintball gun assembly **100** includes a paintball gun **102** and a loader **104** that loads paintballs into a feed tube **106** of paintball gun **102**. Paintball gun **102** and loader **104** may be supplied as components of a kit.

Paintball gun **102** includes a firing breach (not shown) connected to the feed tube **106** and a trigger **108**. A compressed gas source such as a cylinder tank (not shown) is typically secured to the paintball gun **102** to supply gas to the firing breach in order to launch/project a paintball located within the firing breach from the paintball gun **102**. The compressed gas source may contain carbon dioxide or nitric oxide; however, other compressible gasses may be used.

Actuation of trigger **108** results in paintball gun **102** projecting a paintball located in the firing breach, e.g., by introducing gas to the firing breach behind a paintball located therein. Additionally, actuation of trigger **108** may generate a firing signal, e.g., transmitted via an antenna (not shown) and a transceiver **120** such as a radio frequency (RF) transceiver located in the paintball gun **102** for reception at loader **104**. The firing signal may be generated using a sensor located in the vicinity of trigger **108**. Suitable sensors for use in generating the firing signal in response to the actuation of trigger **108** include magnetic sensors, mechanical sensors, electromechanical sensors, piezoelectric sensors, pressure sensors, accelerometers, etc. In an exemplary embodiment, the firing signal is an encoded signal including a unique identification number, for example.

In alternative embodiments, a firing signal may be generated by paintball gun **102** in response to detection of a paintball being fired, movement of a paintball within paintball gun **102**, paintball gun **102** completing a firing cycle, and/or movement of components within paintball gun **102**. Electromechanical sensors, infrared (IR) sensors, contact pads, optical sensors, sound sensors, shock sensors, piezoelectric sensors, or other such sensors may be used to detect paintball position and/or movement within paintball gun **102**, for example. Additionally, "anti-chop" sensors (such as optical sensors) within the firing breach of paintball gun **102** may be used to detect paintball position and/or movement within paintball gun **102**. Suitable detection methods will be understood by one of skill in the art from the description herein.

In other embodiments, a radar sensor (not shown) mounted on the loader **104** or in communication with loader **104** may be used to detect paintballs leaving paintball gun **102** in order to generate a firing signal and/or determine rate of fire, for example. The radar sensor may also be used to detect if paintballs are being fired at the operator of paintball gun **102**. Detection of paintballs being fired at the operator may be communicated to the operator via audio and/or visual signals presented by the loader **104**, e.g., via a speaker and/or display (not shown). Suitable radar sensors, audio devices, and visual devices will be understood by one of skill in the art from the description herein.

Loader **104** includes an opening **110**, a lid **112** for covering opening **110**, and a chamber **114** for holding paintballs. In FIG. **1**, lid **112** is depicted in an open position, thereby allowing the addition of paintballs to chamber **114**. A drive/feed mechanism **116** within loader **104** actuates a feeder mechanism including a rotational feeder (described below) to deliver paintballs from chamber **114** to feed tube **106** through a feed neck of loader **104** (described below). A power supply **118** supplies power to drive/feed mechanism **116**. In an exemplary embodiment, drive/feed mechanism **116** drives the rotational feeder, ceases to drive the rotational feeder responsive to stoppage of the rotational feeder, and periodically attempts to rotate the stopped rotational feeder.

Drive/feed mechanism **116** may include electronics (described below) including a circuit for receiving a firing signal from the paintball gun **102**, e.g., via an antenna (not shown) and a transceiver **122** such as an RF transceiver in the loader **104**. In an exemplary embodiment, the firing signal of an

operator's paintball gun is encoded with a unique identifier and the electronics are configured by the operator to recognize the unique identifier in order to prevent the drive/feed mechanism **116** from being activated by a firing signal transmitted by another paintball gun. The electronics may be configured by, first, pressing and holding a button associated with the electronics. Optionally, an indicator associated with the electronics may blink at a relatively slow rate to indicate the electronics are ready to receive configuration information. The trigger **108** of paintball gun **102** may then be actuated to transmit configuration information, which is received by the electronics. Optionally, an indicator associated with the electronics may blink at a relatively fast rate to indicate the electronics have been configured responsive to the configuration information.

In an exemplary embodiment, the lid **112** has a magnetic or electro-magnetic loader lid release. Transceiver **120** may be linked to a switching device **124** mounted onto the paintball gun **102**. Upon triggering switching device **124**, transceiver **120** transmits a lid signal that is received by transceiver **122**. The received lid signal prompts loader **104** to reverse the polarity of a magnet **126**a on the loader **104**, thereby repelling a corresponding magnet **126**b on lid **112** to force lid **112** open. This allows the operator of paintball gun **104** to push switching device **124** with the hand holding paintball gun **102** to open lid **112** and use the other hand to quickly and conveniently pour paintballs from a paintball pod into loader **104** without having to first manually open the lid using both hands. In an exemplary embodiment, the lid signal is an encoded signal that allows the same transceivers **120**/**122** to handle multiple signals, e.g., the lid signal and the firing signal described above. Although transceivers are illustrated (which include both a transmitter and a receiver), it will be understood by one of skill in the art from the description herein that a transmitter without a receiver may be employed if signals are only to be transmitted and a receiver without a transmitter may be employed if signals are only to be received.

In an exemplary embodiment, drive/feed mechanism **116** is part of a component that is separable from chamber **114**, which is part of another component. This allows drive/feed mechanism **116** to be manually removed from chamber **114** without tools (i.e., the components are releasably secured), which is known in the art as "field strippable." In alternative embodiments, the drive/feed mechanism **116** and chamber **114** may be at least substantially permanently connected. Additional details regarding loader **104** are described below.

FIG. **2** depicts a side perspective view of loader **104** with lid **112** in a closed position, thereby preventing paintballs within chamber **114** (FIG. **1**) from falling out. FIG. **3** depicts a top perspective view of loader **104** with lid **112** in the open position and drive/feed mechanism **116** (FIG. **1**) removed, leaving cavity **300**.

FIG. **4** depicts a side view of loader **104** with lid **112** in the open position and drive/feed mechanism **116** (FIG. **1**) removed. Drive/feed mechanism **116** (FIG. **1**) may be inserted into cavity **300** of loader **104**. Loader **104** includes an opening **402**a for mating with a projection on the drive/feed mechanism **116** to secure drive/feed mechanism **116** to loader **104**. Drive/feed mechanism **116** may be released by depressing the projection such that it is disengaged from opening **402**a. As illustrated in FIG. **5** (discussed below), a similar opening **402**b is present on the other side of loader **104**. FIG. **6** (discussed in further detail below) depicts a projection **601** on drive/feed mechanism **116** for mating with opening **402**b to secure drive/feed mechanism **116** to loader **104**. A similar projection for mating with opening **402**a is present on an

opposite surface of drive/feed mechanism **116**. Other suitable means for securing drive/feed mechanism **116** to loader **104** will be understood by one of skill in the art from the description herein. FIG. **4** further depicts a feed neck **404** of loader **104** that mates with the feed tube **106** (FIG. **1**) for supplying paintballs thereto.

FIG. **5** depicts a rear view of loader **104** with drive/feed mechanism **116** removed. A feed neck channel **500** defined within feed neck **404** leads from drive/feed mechanism **116** (when installed) to feed tube **106** of paintball gun **102** when loader **104** is attached to paintball gun **102**. A power connector **504** is connected to power source **118** (FIG. **1**). Power connector **504** mates with a corresponding power connector of drive/feed mechanism **116** (described below) when drive/feed mechanism **116** is installed within loader **104** to provide power from power source **118** to drive/feed mechanism **116**.

FIG. **6** depicts a top perspective view of drive/feed mechanism **116**. Drive/feed mechanism **116** includes a feed mechanism **600** and a drive mechanism (described below). Illustrated feed mechanism **600** includes a rotational feeder **602** that moves paintballs along a ball guide **604** into feed neck **404** when rotating to deliver paintballs to the feed tube **106** of paintball gun **102**. Together, ball guide **604** and feed neck **404** form a feed channel through which paintballs are delivered from the loader **104** to the feed tube **106**. In an exemplary embodiment, ball guide **604** slopes downward to form a spiral downward flow channel at an angle between about 5 degrees and about 15 degrees, for example.

In an exemplary embodiment, rotational feeder **602** includes a feed wheel **606** having a perimeter **608** and a plurality of fins (represented by five fins **610**a-e in the illustrated embodiment) extending from wheel perimeter **608**. The feed wheel **606** may be conical (as illustrated), flat, or another shape. The fins **610** may be spaced around perimeter **608** such that at least one paintball can be received between adjacent fins (e.g., between fins **610**a and **610**b). In an exemplary embodiment, fins **610** are located below a bottom slope of feed wheel **606** such that paintballs within loader **104** will fall between fins **610** and be pushed into the feed neck **404** instead of bouncing around above fins **610** and/or feed wheel **606**, which reduces the chance of paintball breakage. FIG. **7** depicts a close-up top perspective view of rotational feeder **602** and an opening **700** leading to feed neck channel **500**.

A spiral downward flow channel of ball guide **604** allows paintballs to follow the natural downward gravitational flow. This combined with the positioning of fins **610** on feed wheel **606** results in paintballs moving deeper into the ball guide **604**—allowing fins **610** to ride higher on the paintballs as they move closer to the feed neck **404**. This reduces the likelihood of a paintball coming out of the ball guide **604** or being disturbed during its movement toward feed neck **404**. When a paintball is in the last position before entering feed neck **404**, the position of this paintball will not allow another paintball to enter the ball guide **604**.

In an alternative exemplary embodiment, rotational feeder **602** may be replaced with an agitator (not shown), e.g., a device used to stir paintballs and prevent paintball jams in the loader.

FIG. **8** depicts a bottom perspective view of drive/feed mechanism **116**. Drive/feed mechanism **116** further includes a drive mechanism **800** that drives feed mechanism **600** (FIG. **6**). Illustrated drive mechanism **800** includes a drive motor **802** that drives a drive shaft **804** coupled to rotational feeder **602**, thereby driving rotational feeder **602**. In an exemplary embodiment, drive motor **802** drives rotational feeder **602** at a substantially constant spin rate, which enables smoother ball flow into the space between fins **610** of feed wheel **606** and into feed neck **404**, that is faster than the firing rate of paintball gun **102**, which reduces lag attributable to the loader **104**. Illustrated drive motor **802** drives a primary drive gear **806** that, in turn, drives a secondary drive gear **808**. Drive motor **802** drives primary drive gear **806** using a drive belt **810**. In an exemplary embodiment, drive belt **810** has teeth and/or is notched (not shown) to prevent slippage, fits between drive motor **802** and primary drive gear **808**, and turns without having a tight fit. The drive motor **802**, drive gears **806**/**808**, and drive belt **810** may be at least partially covered by a cover (not shown).

Drive motor **802** is controlled by electronics **812**. Electronics **812** may include one or more controller(s) for controlling drive motor **802**. The controller(s) may include a printed circuit board including discrete components (such as resistors, capacitors, solenoids, switches, etc.) and/or one or more microprocessor(s). In an exemplary embodiment, a microprocessor is programmed to control drive motor **802**. Additionally, switches (not shown) may be connected to the microprocessor to provide user input. For example, a first switch may be provided to reverse the direction of the drive motor **802** and a second switch may be provided to turn the drive mechanism **800** on/off, turn an optional RF module on/off, change the attempt frequency (described below) and/or change the speed of rotation of the drive shaft **804** and, thus, the rotational feeder **602**. Suitable microprocessors, discrete components, and switches, and programming of the microprocessors to provide the functionality herein described, will be understood by one of skill in the art from the description herein.

Electronics **812** may receive/transmit data from/to electronics (not shown) within paintball gun **102**, e.g., via transceivers **120**/**122** (FIG. **1**). For example, data from paintball gun **102** may be displayed on a display (not shown) of loader **104** such as a liquid crystal display (LCD) panel. Additionally, electronics **812** may allow communication with the paintball gun **102** so that they function as one unit to improve the overall performance of both. For example, paintball gun **102** could have performance programs that would help to speed up the rate of fire by allowing loader **104** to know in advance that paintball gun **102** will run a particular program, thereby permitting electronics **812** to optimize loader **104** for use with that program.

In addition, the display may be uses for displaying parameters relating to operation of the paintball gun **102** and/or loader **104**. For example, shot count, elapsed game time, paintball usage, battery life, remaining paintballs in loader **104**, etc. may be monitored by known controllers within the paintball gun **102** and/or electronics **812** of loader **104**, as appropriate. Parameters monitored by paintball gun **102** may be transferred to electronics **812** of loader **104** for display via transceivers **120**/**122**, and electronics **812** may display parameters monitored by and received directly from loader **104**. Selection of parameters displayed may be accomplished using selection elements (such as switches) coupled to electronics **812** of loader **104** and/or coupled to paintball gun **102** and transmitted to electronics **812** via transceivers **120**/**122**.

FIG. **9** is a schematic view of an exemplary drive/feed mechanism **116** and FIGS. **10** and **11** are side and elevation views, respectively. In an exemplary operation, drive motor **802** (under control of electronics **812**) moves drive belt **810**. Drive belt **810** turns primary drive gear **806** which, in turn, turns secondary drive gear **808** (FIG. **8**) coupled to drive shaft **804**. Drive shaft **804** is coupled to feed wheel **606**. Thus, drive motor **802** drives/rotates feed wheel **606**. In an exemplary embodiment, paintballs in chamber **114** (FIG. **1**) roll down a slope of feed wheel **606** and become seated in ball guide **604**

between adjacent feed wheel fins **610**. As feed wheel **606** rotates counterclockwise, feed wheel fins **610** urge the paintballs between adjacent fins along the ball guide **604** into feed neck **404**. Although the illustrated embodiments utilize counterclockwise rotation of the feed wheel **606** to load paintballs, other embodiments may be configured for clockwise rotation of the feed wheel **606**. In an exemplary embodiment, the feed wheel **606** may be rotated in a direction opposite to its normal operation.

FIG. **12** depicts a flow chart **1200** of exemplary steps for loading paintballs from a loader into a feed tube of a paintball gun. The exemplary steps are described with reference to FIGS. **1-11**. Although described with reference to FIGS. **1-11**, it will be understood that the exemplary steps may be employed with other loaders and paintball guns without departing from the scope of the present invention. Suitable loaders and paintball guns with which the exemplary steps may be employed will be understood by one of skill in the art from the description herein.

A step **1202**, a rotational feeder within a loader is driven. In an exemplary embodiment, drive motor **802** (under control of electronics **812**) drives rotational feeder **602** (e.g., feed wheel **606** and fins **610**) such that paintballs within ball guide **604** are moved along ball guide **604** into feed neck **404** and, thus, feed tube **106** of paintball gun **102**.

At step **1204**, stoppage of the rotational feeder is identified. In an exemplary embodiment, electronics **812** within drive mechanism **800** identify stoppage of the rotational feeder **602**. Electronics **812** may identify stoppage of rotational feeder **602** by detecting current and/or resistance increases in drive mechanism **800** due to stoppage of rotational feeder **602** which, in turn, stops drive motor **802**. Rotational feeder **602** may be stopped by one or more broken paintballs and/or a full feed tube **106** and feed neck **404**, for example. In an exemplary embodiment, a notched drive belt **810** is utilized. The notched drive belt reduces current draw or load on drive motor **802**, thereby increasing efficiency. Additionally, it reduces slippage which makes it easier to obtain accurate current and/or resistance measurements.

At step **1206**, driving of the rotational feeder is ceased responsive to stoppage of the rotational feeder. In an exemplary embodiment, drive motor **802** (under control of electronics **812**) ceases to drive rotational feeder **602** responsive to the identification of the stoppage of rotational feeder **602** in step **1204**.

At step **1208**, periodic attempts are made to rotate the stopped rotational feeder. Exemplary steps for periodically attempting to rotate the stopped rotational feeder are set forth in step **1210** through step **1216**. In an exemplary embodiment, a pro-active periodic attempt to rotate the stopped rotational feeder is performed at an attempt frequency. The attempt frequency may be a loader operation parameter actuated/selected, e.g., manually by an operator via electronics **812**, from one or more predefined attempt frequencies. For example, from between a first frequency (e.g., a frequency between about 0.25 and about 0.75 seconds) and a second frequency (e.g., a frequency between about 1.0 and about 5.0 seconds).

In an exemplary embodiment, electronics **812** may shorten the attempt is frequency (e.g., to a frequency between about 0.001 seconds or faster and about 0.1 seconds) in response to a firing signal (e.g., generated by paintball gun **102** and received via transceivers **120**/**122**). Upon identification of the stoppage of rotational feed **602** (described above) and/or after a predetermined period of time (e.g., 5-10 seconds), the attempt frequency may revert to the initial attempt frequency. In accordance with this embodiment, a firing event/operation, such as actuation of a trigger, may be detected by a sensor, which results in controller/transceiver **120** of paintball gun **102** being notified of the firing event/operation. Transceiver **120** then transmits a loader operation signal to transceiver **122** of loader **104**, which notifies controller/electronics **812**. Controller/electronics **812** then operate according to the shortened attempt frequency until stoppage of the rotational feeder is identified, at which time controller/electronics **812** change the attempt frequency back to the initial attempt frequency.

In an alternative exemplary embodiment, an attempt to rotate the rotational feeder may be initiated in response to the firing signal. In accordance with this embodiment, a firing event/operation, such as actuation of a trigger, may be detected by a sensor, which results in controller/transceiver **120** of paintball gun **102** being notified of the firing event/operation. Transceiver **120** then transmits a loader operation signal to transceiver **122** of loader **104**, which notifies controller/electronics **812** to operate the drive motor **802**.

Accordingly, drive mechanism **800** may use multiple means of pro-active engagement of the rotational feeder **602**. In an exemplary embodiment, a pulse or signal is preferably sent to actuate loader **104** prior to the cycling of paintball gun **102**. By the time paintball gun **102** has cycled its first shot, loader **104** preferably is at its maximum speed or feed rate, allowing paintball gun **102** to fire at its maximum or desired rate of fire or BPS. Pro-active actuation according to the present invention reduces delays that are caused by delayed ON signals for conventional "reactive" loaders.

At step **1210**, an attempt is made to rotate the stopped rotational feeder. In an exemplary embodiment, drive motor **802** (under control of electronics **812**) attempts to rotate rotational feeder **602**. Electronics **812** may include a timer (not shown) that increments a counter to control the frequency at which attempts are is made to rotate rotational feeder **602**. Upon the counter reaching a value associated with an attempt frequency, electronics **812** attempt to rotate rotational feeder **602** and resets the counter. Identification of a firing signal at electronics **812** may cause the electronics to reduce the value associated with the attempt frequency to a lower value associated with a shorter attempt frequency. Alternatively, electronics **812** may advance the counter (e.g., at a faster rate or to a predetermined value) to effectively shorten the attempt frequency in response to identification of the firing signal. In an alternative exemplary embodiment, electronics **812** may attempt to rotate rotational feeder **602** in response to the firing signal.

At step **1212**, stoppage of the rotational feeder is identified in response to the attempted rotation at step **1210**. In an exemplary embodiment, stoppage of the rotational feeder is performed as described above regarding step **1204**. In exemplary embodiments, identification of stoppage of rotational feeder **602** and/or passage of a predetermined period of time results in electronics **812** reestablishing the initial attempt frequency and/or counter rate described above with reference to step **1210**.

At step **1214**, a determination is made regarding stoppage of the rotational feeder. If the rotational feeder is stopped, processing proceeds at step **1216**. Otherwise, processing proceeds at step **1218**. In an exemplary embodiment, electronics **812** make the determination regarding stoppage of rotational feeder **602**.

At step **1216**, driving of the rotational feeder is ceased responsive to identification of the stoppage of the rotational feeder. In an exemplary embodiment, driving of rotational feeder **602** is ceased as described above regarding step **1206** and, thus, will not be described in further detail. Processing then proceeds at block **1210** with the attempted rotation and

cessation of driving steps repeating until a determination is made that the rotational feeder is no longer stopped, e.g., at step **1214**.

In an exemplary embodiment, step **1210** through step **1216** operate together as follows. Electronics **812** periodically attempt to supply power to drive motor **802**. The attempts may be timed such that they occur faster than the maximum firing rate (typically measured in cycles per second) of the paintball gun **102** with which loader **104** will be used. The drive motor **802** attempts to turn rotational feeder **602** to force paintballs into feed neck **404** when power is supplied. When feed neck **404** of loader **104** is full and the paintball stack in the loader neck **404** prevents rotational feeder **602** from turning, electronics **812** identify this stoppage through a current reading or resistance reading. At a calculated and appropriate current feedback, electronics **812** remove power from the drive motor **802**. If electronics **812** supply power to drive motor **802** and the paintball stack is full, the electronics **812** will remove power and wait a predefined period of time before re-supplying power (e.g., 0.5 or 3.0 seconds). This results in pulsation of the rotational feeder **602**. When a paintball is fired, thereby creating a void in the feed neck/feed tube, drive motor **812** continues to turn in response to the power supplied by electronics **812**.

At step **1218**, a determination is made regarding the drive mechanism **800**. In an exemplary embodiment, if either the drive mechanism **800** is turned off or the loader **104** is empty (e.g., the chamber **114** is empty or the loader does not include enough paintballs to fill feed neck **404**), processing proceeds at step **1220** with the drive motor **802** no longer driving the rotational feeder **602**. Otherwise, drive motor **802** continues to drive the rotational feeder **602** and processing continues at step **1204**. In an exemplary embodiment, a determination is made that the loader **104** is empty if the rotational feeder **602** has rotated continuously for a period of time (e.g., for 2 minutes or more). In alternative exemplary embodiment, sensors within the chamber **114** and/or feed neck **404** may be used to determine if the loader **104** is empty.

Additional implementations/embodiments of the present invention are now described. A wireless projectile loader system (e.g., a paintball gun and paintball loader therefore) is provided that includes a compressed gas gun (e.g., a paintball gun that uses compressed gas to launch projectiles such as paintballs) having at least one sensor for detecting a firing operation (e.g., actuation of the trigger of a paintball gun) and sending a sensor signal, a wireless transmitter in communication with the at least one sensor that is adapted to receive the sensor signal and send a wireless signal in response to the sensor detecting a firing operation, and a projectile loader (e.g., paintball loader) having an agitator, a motor for operating the agitator, and at least one wireless receiver in communication with the motor adapted to receive the wireless signal. The wireless projectile loader system may additionally include a controller in communication with the receiver for operating the motor. The controller may include a microprocessor.

Another wireless projectile loader system is provided that includes at least one sensor for detecting a firing operation of a compressed gas gun and sending a sensor signal, a wireless transmitter in communication with the at least one sensor that is adapted to receive the sensor signal and send a wireless signal in response to the sensor detecting a firing operation, and at least one wireless receiver for receiving the wireless signal that is in communication with a motor of a projectile loader and adapted to initiate operation of the motor in response to the wireless signal transmitted by the transmitter. The wireless projectile loader system may further include a controller in communication with one of the transmitter and the receiver. The controller may include a microprocessor.

A method of wirelessly operating a projectile loader is provided that includes detecting a firing operation of a compressed gas gun, wirelessly transmitting a signal in response to the firing operation, receiving the signal, and operating a motor of the projectile loader.

Another method of wirelessly operating a projectile loader is provided that includes providing a compressed gas gun having at least one sensor and at least one wireless transmitter in communication with the at least one sensor, providing a projectile loader having a motor and at least one wireless receiver in communication with the motor, detecting a firing operation of the compressed gas gun with the sensor, transmitting a demand signal (e.g., a signal generated in response to actuation of a paintball gun trigger) from the sensor to the wireless transmitter, wirelessly transmitting a loader operation signal (e.g., a signal for requesting operation of the loader motor) from the wireless transmitter to the wireless receiver, and operating the motor in response to the loader operation signal.

A wireless system for controlling operation of a projectile loader is provided that includes a compressed gas gun having a controller and a wireless transmitter in communication with the controller, and a projectile loader having a receiver for receiver wireless signals from the wireless transmitter and a controller for controlling an operation of the projectile loader. The wireless system may further include at least one user-actuated selection element in communication with the controller.

A method of controlling operation of a projectile loader is provided that includes selecting a projectile loader operation parameter, wirelessly transmitting a signal in response to the selection, receiving the signal, and controlling the operation of the projectile loader in response to the signal.

Another method of controlling operation of a projectile loader is provided that includes wirelessly transmitting a signal representing a projectile loader operation parameter, receiving the signal, and controlling the operation of the projectile loader in response to the signal. The method may further include selecting a projectile loader operation parameter prior to wirelessly transmitting the signal.

Although the present invention has been described for use with a loader of a paintball gun that attaches above the paintball gun, it may be used with other types of paintball loading objects (e.g., backpacks, etc.) and in other fields, as apparent to a person skilled in the art. For this reason, expressions such as "paintball," "gun," "loader," etc., as used herein should not be taken as to limit the scope of the present invention and includes all other kinds of guns and/or items with which the present invention could be used and may be useful. Indeed, although the drive system according to the present invention is preferably used in the paintball industry, it is to be understood by a person skilled in the art that it could be used for any other kind of dispensing device (e.g., gun, etc.) requiring the feeding of objects (balls, paintballs, etc.) from a drive system as described herein.

It is contemplated that the invention may be implemented in software running on a processor. In this embodiment, one or more of the above described steps may be implemented in software that controls the computer. This software may be embodied in a computer readable medium, for example, a memory, a magnetic or optical disk, a memory-card or an audio frequency, radio-frequency, or optical carrier wave.

While preferred embodiments of the invention have been shown and described herein, it will be understood that such embodiments are provided by way of example only. Numer-

ous variations, changes and substitutions will occur to those skilled in the art without departing from the scope of the present invention. Accordingly, it is intended that the appended claims cover all such variations as fall within the scope and range of equivalents of the invention.

What is claimed:

1. A loader for use with a paintball gun having a transmitter that transmits a signal, the loader comprising:

a receiver for receiving the signal from the paintball gun;

a chamber having an opening for receiving paintballs;

a lid coupled to the chamber, the lid having a closed position in which the opening is covered by the lid and an open position in which the opening is at least partially uncovered;

a feed neck attachable to a feed tube of a paintball gun; and

a loader lid release coupled to the receiver that maintains the lid in the closed position until released in response to reception of the signal by the receiver.

2. The loader of claim **1**, wherein the loader lid release comprises:

a first magnet positioned on the lid; and

a second magnet positioned on the chamber, the second magnet repelling the first magnet in response to reception of the signal by the receiver.

3. The loader of claim 1, wherein the loader is configured for use with a paintball gun that includes a trigger interconnected with the transmitter of the paintball gun for transmitting the signal in response to activation of the trigger.

4. The loader of claim 1, wherein the signal is a radio frequency (RF) signal and the receiver is an RF receiver.

5. The loader of claim 1, wherein the loader is configured for use with a paintball gun that includes a switch interconnected with the transmitter of the paintball gun for transmitting the signal responsive to the switch.

6. A loader for use with a paintball gun, the loader comprising:

a receiver for receiving a signal;

a chamber having an opening for receiving paintballs;

a feed neck attachable to a feed tube of a paintball gun;

a lid coupled to the chamber, the lid having a closed position in which the opening is covered by the lid and an open position in which the opening is at least partially uncovered; and

a loader lid release coupled to the receiver and configured to maintain the lid in the closed position until released in response to reception of the signal by the receiver.

7. The loader of claim 6, wherein the loader lid release comprises:

a first magnet positioned on the lid; and

a second magnet positioned on the chamber, the second magnet repelling the first magnet in response to reception of the signal by the receiver.

8. The loader of claim 6, wherein the loader is configured for use with a paintball gun that includes a transmitter for transmitting the signal to the loader.

9. The loader of claim 6, wherein the signal is a radio frequency (RF) signal and the receiver is an RF receiver.

10. The loader of claim 6, wherein the loader is configured for use with a paintball gun that includes a switch or trigger interconnected a transmitter for transmitting the signal responsive to activation of the switch or trigger.

11. A loader for a paintball gun, said loader comprising:

a chamber configured to house a quantity of paintballs to be supplied into the paintball gun;

a lid arranged over an opening to the chamber, said lid configured to prevent the quantity of paintballs from escaping from the chamber through the opening when the lid is in a closed position;

a magnetic closure mechanism configured to selectively retain the lid in the closed position over the opening; and

a magnetic release mechanism configured to selectively reverse a polarity of a magnet in the magnetic closure mechanism holding the lid in the closed position to cause the lid to open.

12. The loader of claim 11, wherein the magnetic release mechanism comprises:

a first magnet positioned on one of the lid or the chamber; and

a second magnet positioned on the other of the lid or the chamber, the second magnet repelling the first magnet in response to an opening signal.

13. The loader of claim 12, wherein the loader is configured for use with a paintball gun that includes a transmitter for transmitting the opening signal.

14. The loader of claim 12, wherein the loader further comprises a receiver configured to receive the opening signal from a transmitter, wherein the opening signal is a radio frequency (RF) signal and the receiver is an RF receiver.

15. The loader of claim 11, wherein the loader further comprises a receiver configured to receive a signal, and wherein the loader is configured for use with a paintball gun that includes a switch interconnected a transmitter for transmitting the signal responsive to activation of the switch to open the lid.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : RE45,490 E
APPLICATION NO. : 13/685994
DATED : April 28, 2015
INVENTOR(S) : Richmond Italia et al.

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

In the Specification

Please insert the following before the first paragraph, beginning at Column 1, Line 14:

--More than one reissue application has been filed. U.S. Patent Application No. 14/528,132 was filed on October 30, 2014, and is a broadening reissue divisional of this U.S. Patent Application No. 13/685,994, and a divisional of this U.S. Patent Application No. 13/685,994, now RE45,490, filed November 27, 2012 and issued April 28, 2015.--

Signed and Sealed this
Third Day of April, 2018

Andrei Iancu
Director of the United States Patent and Trademark Office