

Description

FIELD OF THE DISCLOSURE

[0001] The disclosure relates to a power tool, in particular to a pneumatic tool used to drive a fastener using compressed air as a power source.

BACKGROUND

[0002] In daily life, nail guns are used in circumstances of woodworking or in-house decoration. Nowadays, widely used nail guns are designed to be driven by air pressures, and are configured with air compressors and a long trachea during usage. However, existing nail guns often require frequent maintenance during use. For example, nails supplied from the nail box are prone to jamming during firing, and this often requires a very complicated disassembling process to open the barrel portions and clean up the stuck nails. In addition, with the increase of the usage time, the cylinder and the piston part inside the nail gun may easily result in more and more friction, which reduces the performance of the nail gun and may even affects its normal operation. Also, a gas spring structure used in the nail gun usually cannot be adjusted for its output power, and therefore it may cause an excessive output power for launching a shorter nail. Such excessive power will result in a reduction in the usage life of the entire nail gun.

SUMMARY OF THE INVENTION

[0003] Accordingly, embodiments of the disclosure provide an improved pneumatic tool which overcomes all or at least a part of the above technical problems.

[0004] In a first aspect of the disclosure, there is provided a pneumatic tool including a cylinder, a piston inside the cylinder which is adapted to reciprocate, and a piston rod connected to the piston. The piston has a first seal ring and a second seal ring fixed thereto. The first seal ring and the second seal ring are spaced apart along the cylinder axial direction and a storage space for storing lubricating oil is defined between the first seal ring and the second seal ring.

[0005] Preferably, the first seal ring and the second seal ring have different dimensions in the axial direction.

[0006] In another aspect of the disclosure, there is provided a pneumatic tool including a fastener box, a drive mechanism adapted to drive a fastener stored in a fastener box to eject, and an ejection passage for the ejection of the fastener. The pneumatic tool further includes a door member at least partially surrounding the ejection passage, which may be opened and closed for accessing the interior of the ejection passage.

[0007] Preferably, the door member automatically opens when a jam occurs in the ejection passage.

[0008] More preferably, the door member is connected to a spring to hold the door member in a closed state.

When a jam occurs in the ejection passage, the spring force of the spring is overcome, so that the door member is opened.

[0009] In another variant embodiment, the door member is connected to a user-actuated locking device. The locking device controls the closing and opening of the door member.

[0010] Preferably, the locking device is a latch including a bolt.

[0011] In another aspect of the disclosure, there is also provided a pneumatic tool including a cylinder, a driving piston reciprocating within the cylinder, a housing, and a high pressure gas chamber formed in the housing. An adjustable air hole device is provided between the high pressure gas chamber and the cylinder, and the adjustable air hole device is capable of varying the amount of air intake of the cylinder.

[0012] Preferably, the adjustable air hole device includes an air hole component and a cover, and both of them may rotate with respect to each other. The air hole component has air holes and the cover has vias. The air holes and the vias are adapted for partial alignment or full alignment to achieve a change in the amount of intake air.

[0013] More preferably, the number of the air holes and the number of the vias are four respectively.

[0014] In a variant embodiment, the cover is connected to and rotates with a user-actuated knob.

[0015] Thus, the pneumatic tools disclosed in the disclosure provide many advantages over those in the art. For example, a storage space may be arranged in the piston assembly which is defined by two seal rings together. Lubricating oil may be stored in the storage space so that the lubricating oil may be continuously replenished to the seal ring during use of the pneumatic tool. This allows the conditions in which original lubricating oil dries out due to an increase of the usage time and an increase in the frictional force to be avoided. In addition, by providing a side door in the ejection passage of the nozzle which can be opened and closed, the user may easily maintain the pneumatic tool without the use of an external tool in the case of a jam occurred in the pneumatic tool. After cleaning the stuck nail(s), the nail gun may immediately return back to its operational state. Finally, the adjustable air hole device is capable of adjusting the amount of high pressure gas entering the cylinder in the high pressure gas chamber of the pneumatic tool, and such adjustment may be conveniently performed externally by the user operating the knob. By adjusting the amount of intake air, the firing force and speed of the pneumatic tool may be effectively changed, so as to avoid unnecessary wear and tear to the pneumatic tool in small working conditions.

BRIEF DESCRIPTION OF THE FIGURES

[0016] The features and advantages of the disclosure may be further understood with reference to the remain-

ing portions of the specification and the figures; the same reference numbers in these figures denote the same components. In some cases, sub-tags are placed after a certain label and hyphen to indicate one of many similar components. When we refer to a label but do not specify one of the existing sub-tags, we mean all these similar components.

Figs. 1a and 1b respectively show an exploded view and an assembled view of a piston assembly in a pneumatic tool according to a first embodiment of the disclosure.

Fig. 2 shows an external view of the nail box and a vicinity of the nozzle in the pneumatic tool according to another embodiment of the disclosure.

FIG. 3 is an exploded view of a portion of the pneumatic tool shown in FIG.2.

Figs. 4a and 4b show an external view of a left door when closed on the pneumatic tool nozzle of Fig. 2 and when opened due to jammed nail(s).

Fig. 5 shows an external view of the nail box and a vicinity of the nozzle in the pneumatic tool according to another embodiment of the disclosure.

Figs. 6a and 6b show an external view of a left door when closed on the pneumatic tool nozzle of Fig. 5 and when opened due to jammed nail(s).

Fig. 7a shows the appearance of the air hole component in the pneumatic tool according to another embodiment of the disclosure.

Fig. 7b shows an external perspective view of the cover of the pneumatic tool in the same embodiment.

Fig. 8 is a cross-sectional perspective view of an air cylinder, a piston portion of the pneumatic tool and an adjustable air hole assembly of the same embodiment.

Figs. 9a and 9b are illustrations of the air hole assembly and the cover member when they are partially aligned and fully aligned, respectively.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0017] Embodiments of the disclosure adopt an improved pneumatic tool structure, thereby improving its operational performance and ease of maintenance. Other different benefits and advantages provided by various embodiments of the disclosure will be readily apparent from the following descriptions.

[0018] Firstly, refer to Figs.1 a and 1b. In a first embodiment of the disclosure, a piston portion of a pneumatic tool is disclosed. The pneumatic tool has a piston and cylinder structure commonly known as a "gas spring." As being well known to those skilled in the art, such pneumatic tools use high pressure gas as a power source to drive fasteners, while high pressure gas may be provided by an air compressor located external to the pneumatic tool. By regularly controlling a passage of high pressure gas into the cylinder, the pressure difference

between the high pressure gas at both ends of the piston and the atmospheric pressure causes the piston to reciprocate inside the cylinder. Therefore, the overall structure and working principles of the nail gun described above will not be repeated here.

[0019] Figs. 1a and 1b show a piston 20 adapted to move back and forth in the cylinder (not shown). The piston has a generally cylindrical shape. A piston rod 28 is attached to a rear end of the piston 20 and the piston rod 28 further connects to and drives the nailing structure (not shown) of the nail gun. At the front end of the piston 20, there are respectively a first seal ring 22 and a second seal ring 24. Here, Fig.1a shows a schematic view of the first seal ring 22 and the second seal ring 24 disassembled from the piston 20, while Fig.1b shows a schematic view of the first seal ring 22 and the second seal ring 24 integrally formed with the piston 20. The front end of the piston 20 shown in Fig.1a has a first annular groove 23, a second annular groove 25, and a portion 21 therebetween with a smaller diameter, and the three parts are defined by different partition walls 27. The first annular groove 23 and the second annular groove 25 respectively have dimensions corresponding to the first seal ring 22 and the second seal ring 24, so as to be able to accommodate the two seal rings. It can be seen in Fig. 1b that the first seal ring 22 and the second seal ring 24 are spaced apart from each other in the length direction of the piston rod 28, i.e., in the axial direction of the cylinder. Between the first seal ring 22 and the second seal ring 24, there is a storage space 26. The storage space is constituted by peripheries of the first seal ring 22 and the second seal ring 24, a corresponding annular cylinder wall and a portion of the piston 20 located at this position with a smaller diameter with respect to the first seal ring 22 and the second seal ring 24 together.

[0020] In use, lubricating oil stored in the storage space 26 may gradually penetrate to a peripheral position of the first seal ring 22 or the second seal ring 24 in contact with the cylinder wall with the increase of the usage time, thereby providing effective lubrication for the first seal ring 22 and the second seal ring 24. As a result, the following problems may be effectively solved: using the pneumatic tool for a long time resulting in the gradual volatilization of lubricants and increasing of the friction.

[0021] Refer now to Fig. 2 to Fig. 4b, another embodiment of the disclosure discloses a nail gun having an improved staple cleaning device. Figs.2 and 3 show a partial appearance of the nail gun and an exploded view of the components thereof, respectively. Note that only a part of a head frame 32 of the nail gun is shown in Fig. 2, so as to show a structure of the nailing passage inside it, whereas the head frame 32 is shown in its entirety in Fig. 3. In this activation tool, the head frame 32 is used to be assembled into one body with other various components (as described in detail below) and provides a passage to enable a drive mechanism of the nail gun to be in contact with nails in the nail box 30 and eject them (not shown). A first cover 46 and a second cover 36 are

fixed to the head frame 32 over and under in a side-by-side manner in a position of the head frame 32 near the nozzle frame. Meanwhile on the back of the first cover 46 and the second cover 36, a guide rail 50 provides an ejection passage for the nails. The first cover 46 and the second cover 36 therefore serve to partially cover the ejection passage of the guide rail 50. The first cover 46 and the second cover 36 both are connected to the head frame 32 by two common bolts 44. The second cover 36 is pivotally connected to the first cover 46 by a spindle 56. On the left and right sides of the first cover 46, the second cover 36 and the guide rail 50, there are respectively a left drive bracket 42 and a left door 40, and a right drive bracket 48 and a right door 52. The left drive bracket 42 and the right drive bracket 48 are fixedly connected to the head frame 32, and the left door 40 and the right door 52 are pivotally connected to the left drive bracket 42 and the right drive bracket 48, respectively. Therefore, the first cover 46, the upper portion of the guide rail 50, and the left drive bracket 42 and the right drive bracket 48 together define a portion of the nailing passage. Similarly, the second cover 36, the lower portion of the rail 50, and the left door 40 and the right door 52 together define another portion of the nailing passage. The nailing passage is in communication with a nail receiving space in the nail box 30. The left door 40 and the right door 52 are connected to each other by a spring 34. In the embodiment, the nail box and the nails stored therein are respectively a box of fastener nail and a fastener used by the pneumatic tool.

[0022] In use, the left door 40 and the right door 52 serve to facilitate cleaning of the nails stuck in the gun. In particular, Fig. 4a shows the nozzle portion of the nail gun without a jam. At this time, it can be seen that the spring 34 is now in its unstrained state. At this time, the left door 40 and the right door (not shown) tightly fit to a side of the second cover 36. At this time the nail gun is in a normal working condition. If a jamming condition occurs in the nailing passage, the stuck nails 58 will generally deflect from its normal orientation and extend to both sides of the nozzle and even being distorted. Such stuck nails 58 therefore rest against the left door 40 and/or the right door. Since the left door 40 and the right door are in fact pivotable with respect to the nailing passage, the left door 40 is opened by the nail 58 in the situation shown in Fig. 4b. At this time, the tension of the spring 34 is overcome, resulting in an increase in its length and the spring is in tension. Because the left door 40 is open, the user may conveniently remove the stuck nail 58 from the opening created in the left door 40 without removing any other portions of the nail gun. At the same time the above-described jam cleaning device does not need to use additional tools for carrying out the jam cleaning work. After the stuck nail 58 is cleaned, the left door and/or the right door are automatically reset due to the tension of the spring 34 to return to the state shown in Fig. 4a.

[0023] In a third embodiment of the disclosure, the nail

gun may also have another type of jam cleaning device. Referring to Fig. 5 to Fig. 6b, the appearance of the nailing portion of the nail gun shown here is substantially the same as in Fig. 2, and therefore the same components will not be described in detail herein. However, in the embodiment, opening and closing of the left door 140 and the right door (not shown) are no longer controlled by a spring. In contrast, a nail gun has a locking pin 138 on the outside of the second cover 36 with its head and tail end connected to a left drive bracket 142 and a right drive bracket (not shown), respectively. Specifically, the locking pin 138 passes through a connecting hole (not shown) on the left drive bracket 142 such that its head and the rest of it are respectively located on two sides of the connecting hole. The tail end of the locking pin 138 has an external thread, and the external thread may be screwed into a screw hole located on the right drive bracket. The locking pin 138, the left drive bracket 142 and the right drive bracket thus form a latch. In addition, unlike the mechanism shown in Fig. 2 to Fig. 4b, in this embodiment the left drive bracket 142 and the right drive bracket may pivot with respect to the head frame, while there is no relative pivoting between the left door 140 and the left drive bracket 142, the right door and the right drive bracket, or only a limited relative pivoting occurs. And, in order to facilitate the user to pull the left door 140 and the right door, there are also a tab 160 fixed on the top of it.

[0024] In use, the left door 140 and the right door and those in Figs. 2-4b also serve to facilitate to clean the nails stuck in the gun. However, the left door 140 and the right door do not open automatically in the embodiment. In contrast, the user needs to manually unscrew the bolt 138 in the case of a staple, enabling the left drive bracket 142 and/or the right drive bracket 142 to pivot. Then, the user may dial a paddle 160 on the left door 140 or the right door using his finger to open the left door 140 or the right door. When the left drive bracket 142 and/or the right drive bracket are pivoted, the left door 140 or the right door is correspondingly rotated with the left drive bracket 142 or the right drive bracket as a whole, so as to open an interior of the nailing passage to remove the stuck nail 158. Note that opening of the left door 140 or the right door here only requires unscrewing the bolt 138 to whatever extent, even if it is not completely separated from the right drive bracket. And although components such as the right door and the right drive bracket on the right side of the nailing passage are not shown here, they operate in exactly the same way as the equivalent components on the left.

[0025] In a fourth embodiment of the disclosure, an adjustable air hole device for a pneumatic tool is described. Figs. 7a to 8 show the structure of the adjustable air hole device. In Fig. 8, a portion of the pneumatic tool is shown, including a housing 262. A cylinder 264 formed by a cylinder wall 266 is centrally disposed in the interior of the housing 262. There is a cylinder head 287 at the end of the cylinder 264. The drive piston 220 is adapted to reciprocate in the cylinder 264, so as to drive a piston

rod 228 connected with the drive piston 220 to further drive the firing mechanism (not shown) to eject the fastener. On the other hand, the seal plug 268 is fixed in the interior of the housing 262 and located between the exterior of the cylinder wall 266 and the interior of the housing 262. The housing 262 and the seal plug 268 define a high pressure gas chamber 270 for temporarily storing high pressure gas. The structure described above is a structure of a pneumatic tool common in the art and therefore will not be further described herein.

[0026] The cylinder 264 may be in gaseous communication with the high pressure gas chamber 270 under certain conditions, such that both sides of the drive piston 220 have a high pressure and a low pressure (i.e., atmospheric pressure), respectively, creating a pressure difference and driving the piston. In the embodiment, the air pressure within the cylinder 264 is adjustable, and it may be accomplished by the adjustable air hole device described above. Specifically, at the bottom of the cylinder 264, an air hole member 274 and a cover member 276 fitted with the air hole member 274 are mounted. As shown in Figs. 7a and 7b, there are four air holes 280 arranged symmetrically around the center on the air hole assembly 274, and four corresponding vias 278 on the cover member 276. Four protruding locking posts 281 are on one surface of the air hole member 274. As shown in FIG. 8, the air hole member 274 is fixed on the cylinder head 287 by these locking posts 281, while a knob 284 is connected to a cover member 272 via the hinge 282. That is, the air hole member 274 is stationary with respect to the housing 262, and the cover member 272 may rotate with the knob 284.

[0027] In use, the user may manually rotate the knob 284 to adjust the amount of high pressure gas entering the cylinder 264 from the high pressure gas chamber 270, so as to control the output power of the pneumatic tool. Specifically, as the knob 284 is rotated to produce a rotation with respect to the housing 262, it will rotate with the cover 272. As shown in Figs. 9a and 9b, at different rotational positions of the cover 272, different air intake effects will be resulted due to different alignments with the air hole components 274. In the situation shown in Fig. 9a, the air hole 280 of the air hole assembly 274 are not completely aligned with the vias 278 of the cover 276 located below. That is, at this time, only a part of the cover 276 may be seen from the air hole 280 of the air hole member 274. At this time, high pressure gas entering above cylinder 264 is not the most. However, if the cover 272 in Fig. 9a is rotated in the clockwise direction, i.e., in the direction indicated by an arrow 283, then the positional relationship shown in Fig. 9b will be achieved. It can be seen from Fig. 9b that the air hole 280 of the air hole assembly 274 and the via 278 of the cover member 276 located below are completely aligned. At this time, the high pressure gas entering the cylinder 264 is the most. By rotating the cover 272 in the counterclockwise direction, it is possible to return again from the configuration in Fig. 9b to the configuration in Fig. 9a, or other air

hole/via alignment relationship to obtain different air intake.

[0028] Therefore, after introducing several embodiments, those skilled in the art may recognize that various modifications, additional structures, and equivalents may be used without departing from the essence of the disclosure. Accordingly, the above description should not be considered as a limitation to the scope of the disclosure as defined by the following claims.

[0029] For example, while the pneumatic tool shown in some of the embodiments above is a type of nail gun, those skilled in the art may recognize that other types of pneumatic tools, such as those for driving other types of fasteners, may also use the technical solution disclosed by this disclosure.

[0030] In addition, the number of vias or air holes included in the air hole assembly and the cover member in the embodiment is four. However, those skilled in the art may recognize that the number of vias or air holes may also vary according to other variations of the disclosure, not limited to four.

Claims

1. A pneumatic tool, comprising a cylinder, a piston inside the cylinder which is adapted to reciprocate, and a piston rod connected to the piston; the pneumatic tool **characterized in that** the piston comprises a first seal ring and a second seal ring fixed thereto, the first seal ring and the second seal ring spaced apart along a cylinder axial direction; and a storage space for storing lubricating defined between the first seal ring and the second seal ring.
2. The pneumatic tool according to claim 1, wherein the first seal ring and the second seal ring have different dimensions in the axial direction.
3. A pneumatic tool, comprising a fastener box, a drive mechanism adapted to drive a fastener stored in a fastener box to eject, and an ejection passage for the ejection of the fastener; the pneumatic tool further comprising a door member at least partially surrounding the ejection passage, which is adapted to be opened and closed for accessing an interior of the ejection passage.
4. The pneumatic tool according to claim 3, wherein the door member automatically opens when a jam occurs in the ejection passage.
5. The pneumatic tool according to claim 4, wherein the door member is connected to a spring to hold the door member in a closed state; when the jam occurs in the ejection passage, the spring force of the spring being overcome so that the door member is opened.

6. The pneumatic tool according to claim 3, wherein the door member is connected to a user-actuated locking device which controls closing and opening of the door member. 5
7. The pneumatic tool according to claim 6, wherein the locking device is a latch including a bolt.
8. A pneumatic tool comprising a cylinder, a driving piston reciprocating within the cylinder, a housing, and a high pressure gas chamber formed in the housing; **characterized in that** an adjustable air hole device is provided between the high pressure gas chamber and the cylinder, and the adjustable air hole device is capable of varying the amount of air intake of the cylinder. 10 15
9. The pneumatic tool according to claim 8, wherein the adjustable air hole device further comprises an air hole component and a cover, and both of which are adapted to rotate with respect to each other; the air hole component comprising air holes and the cover comprising vias; the air holes and the vias adapted for partial alignment or full alignment to achieve a change in the amount of intake air. 20 25
10. The pneumatic tool according to claim 9, wherein the number of the air holes and the number of the vias are four respectively. 30
11. The pneumatic tool according to claim 9 or 10, wherein the cover is connected to and rotates with a user-actuated knob.

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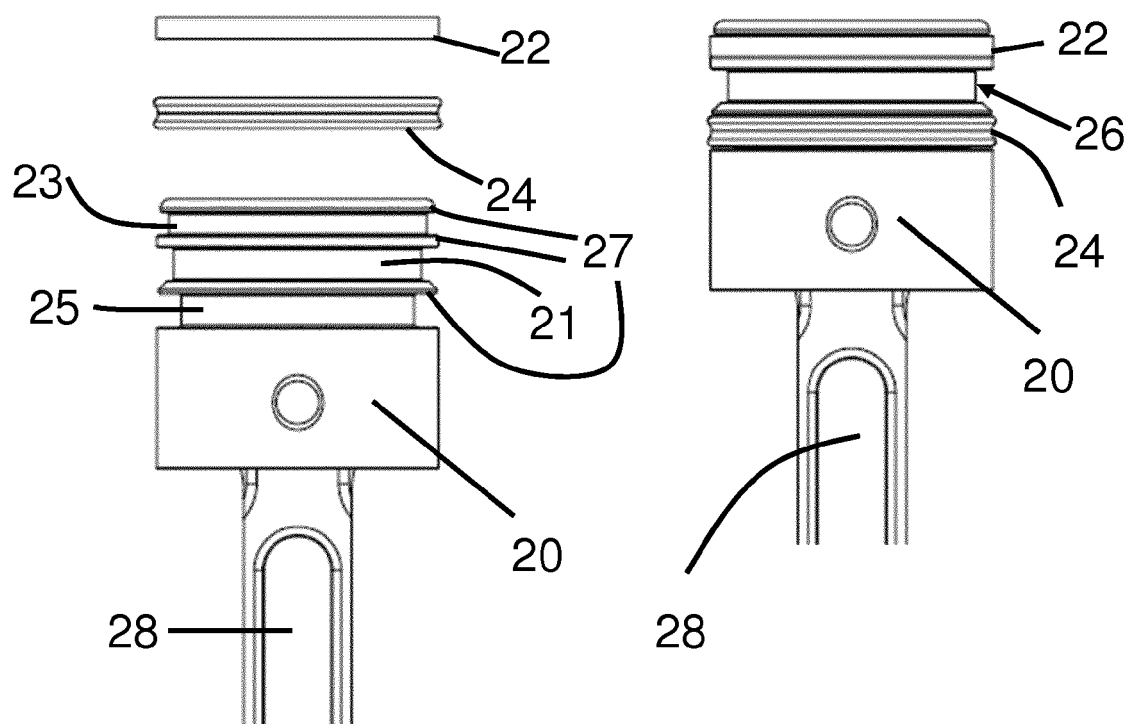


Fig. 1a

Fig. 1b

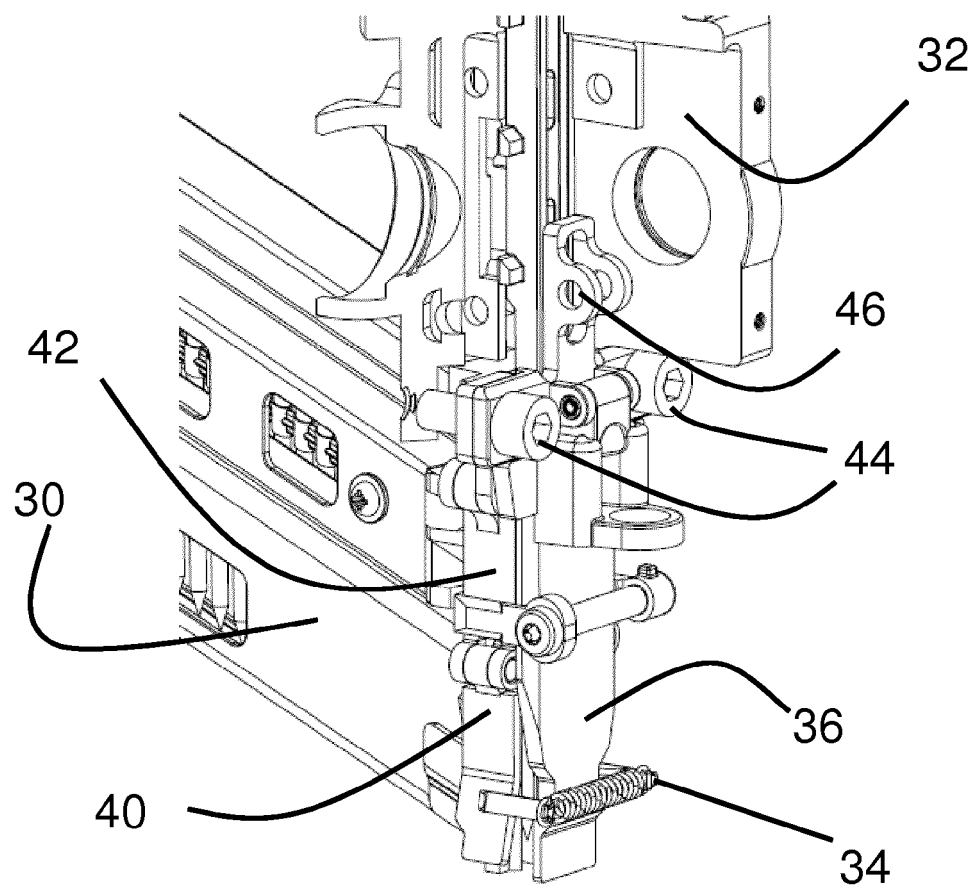


Fig. 2

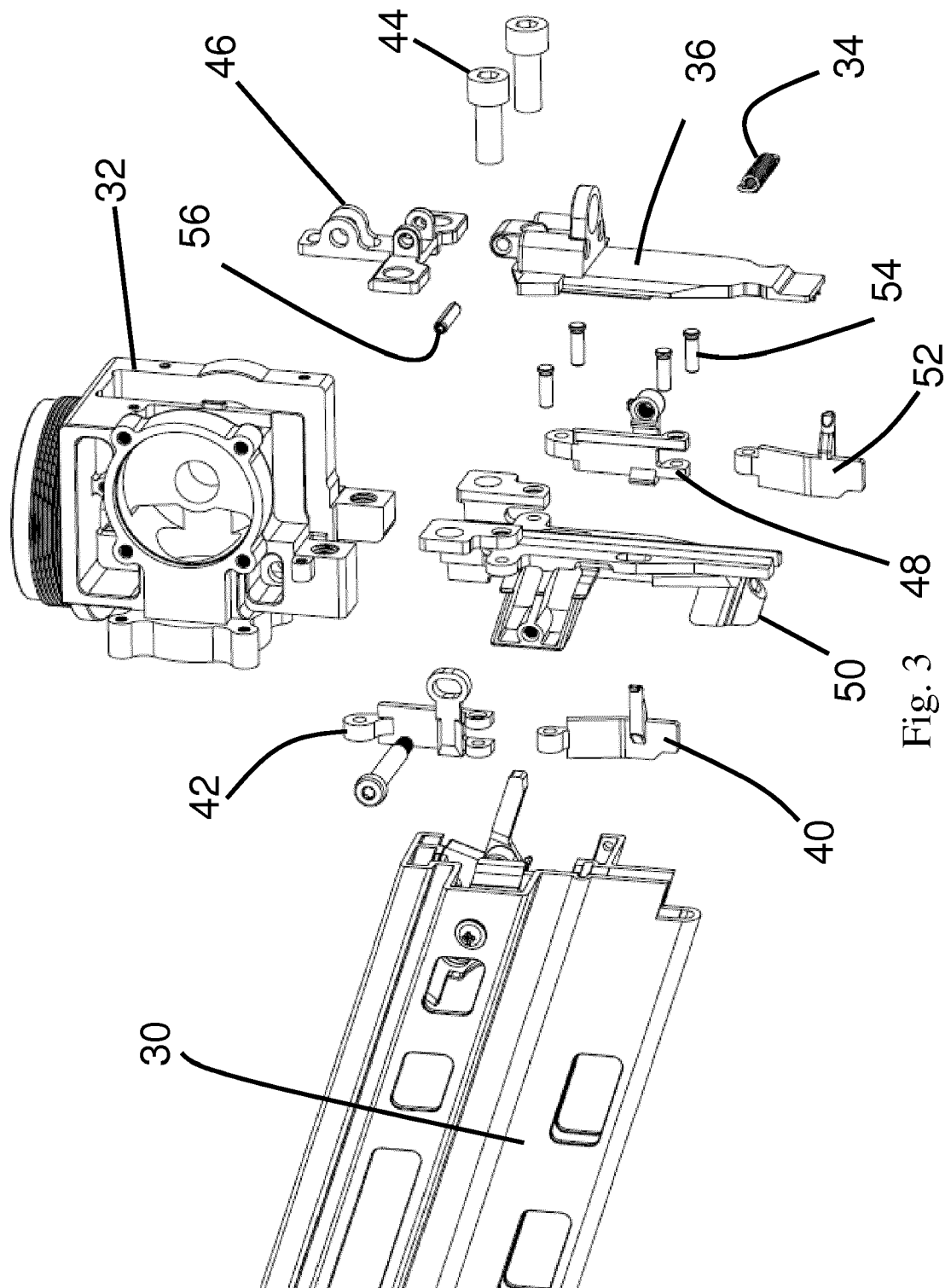


Fig. 3

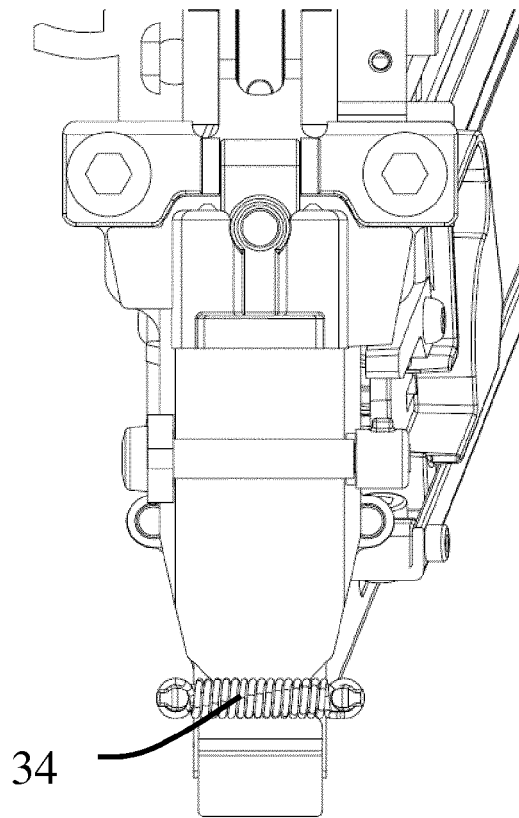


Fig. 4a

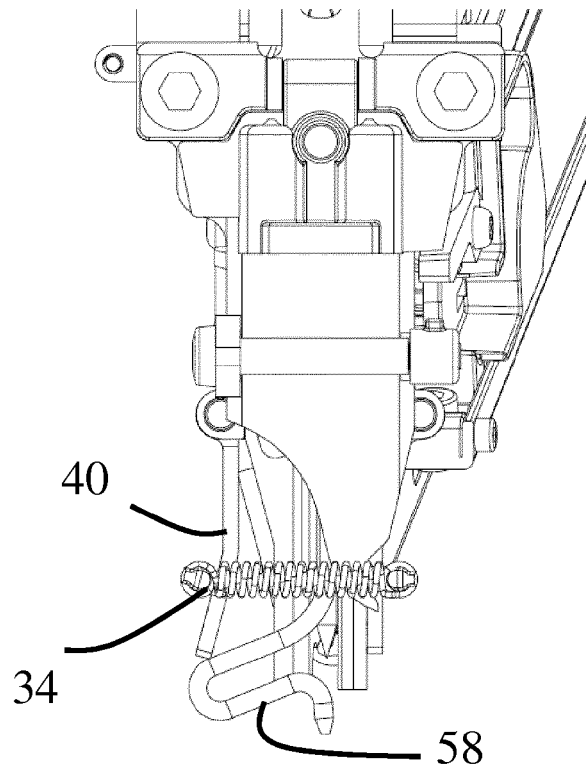


Fig. 4b

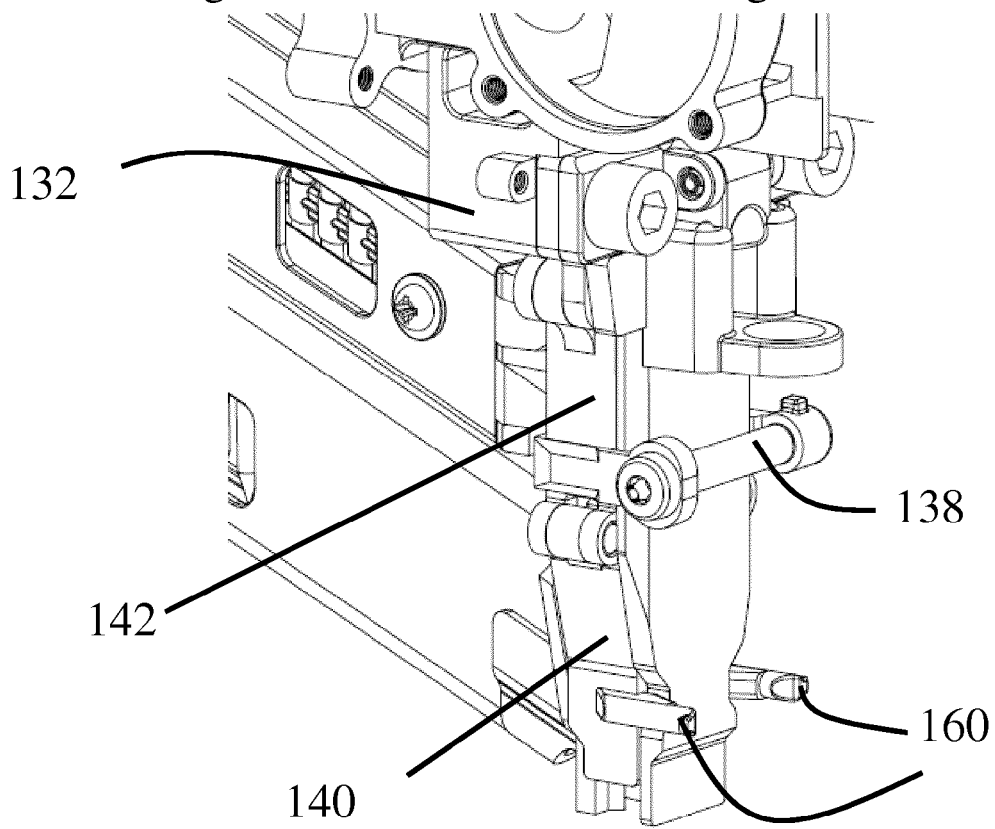


Fig. 5

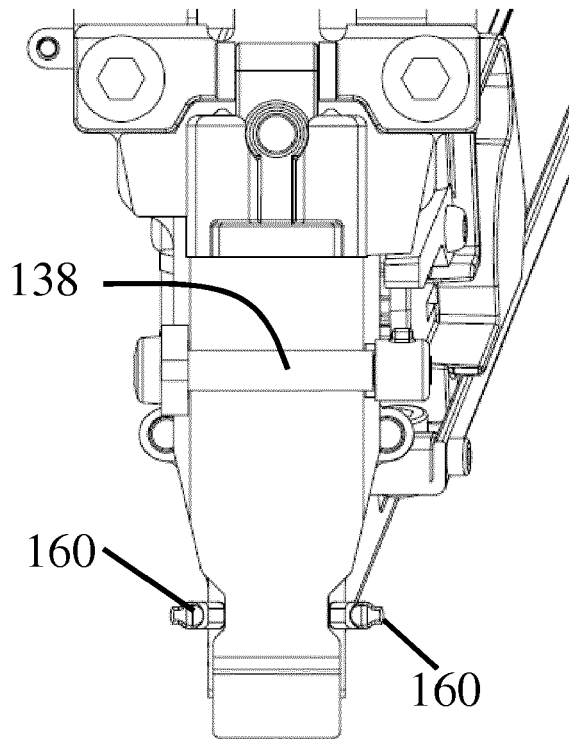


Fig. 6a

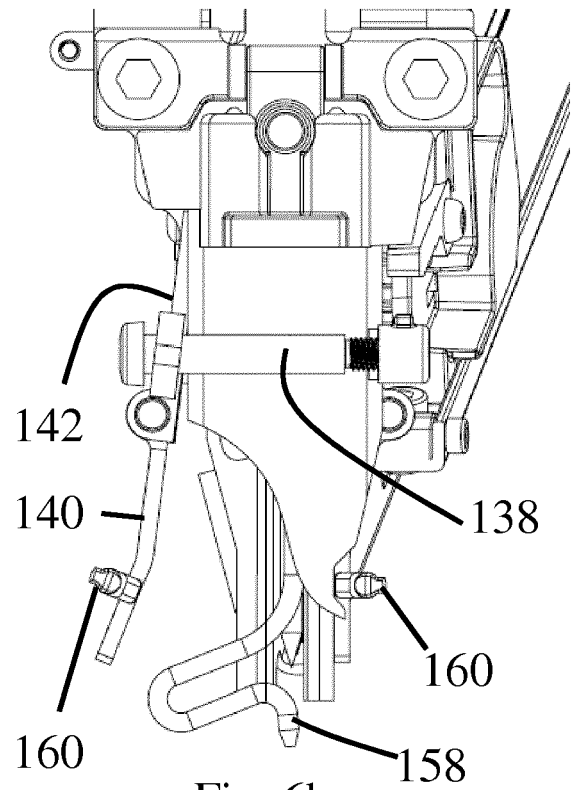


Fig. 6b

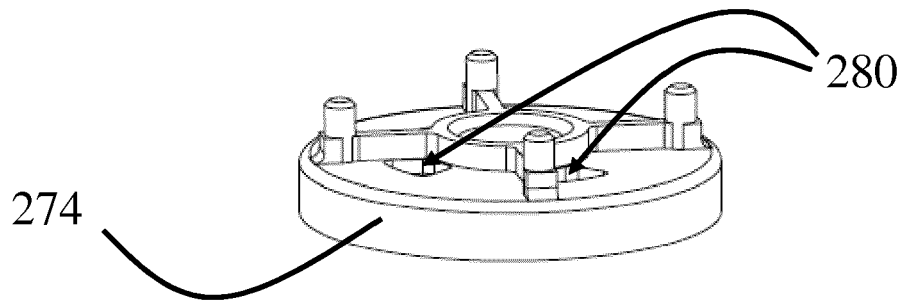


Fig. 7a

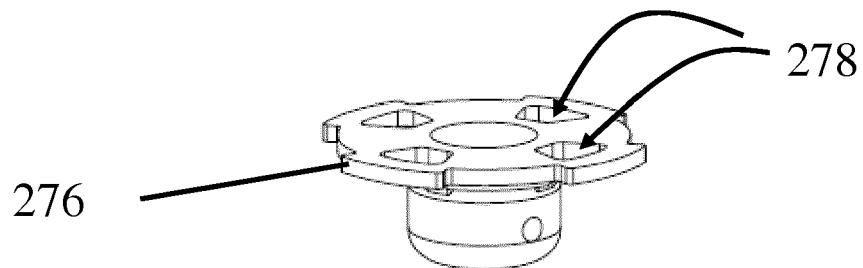


Fig. 7b

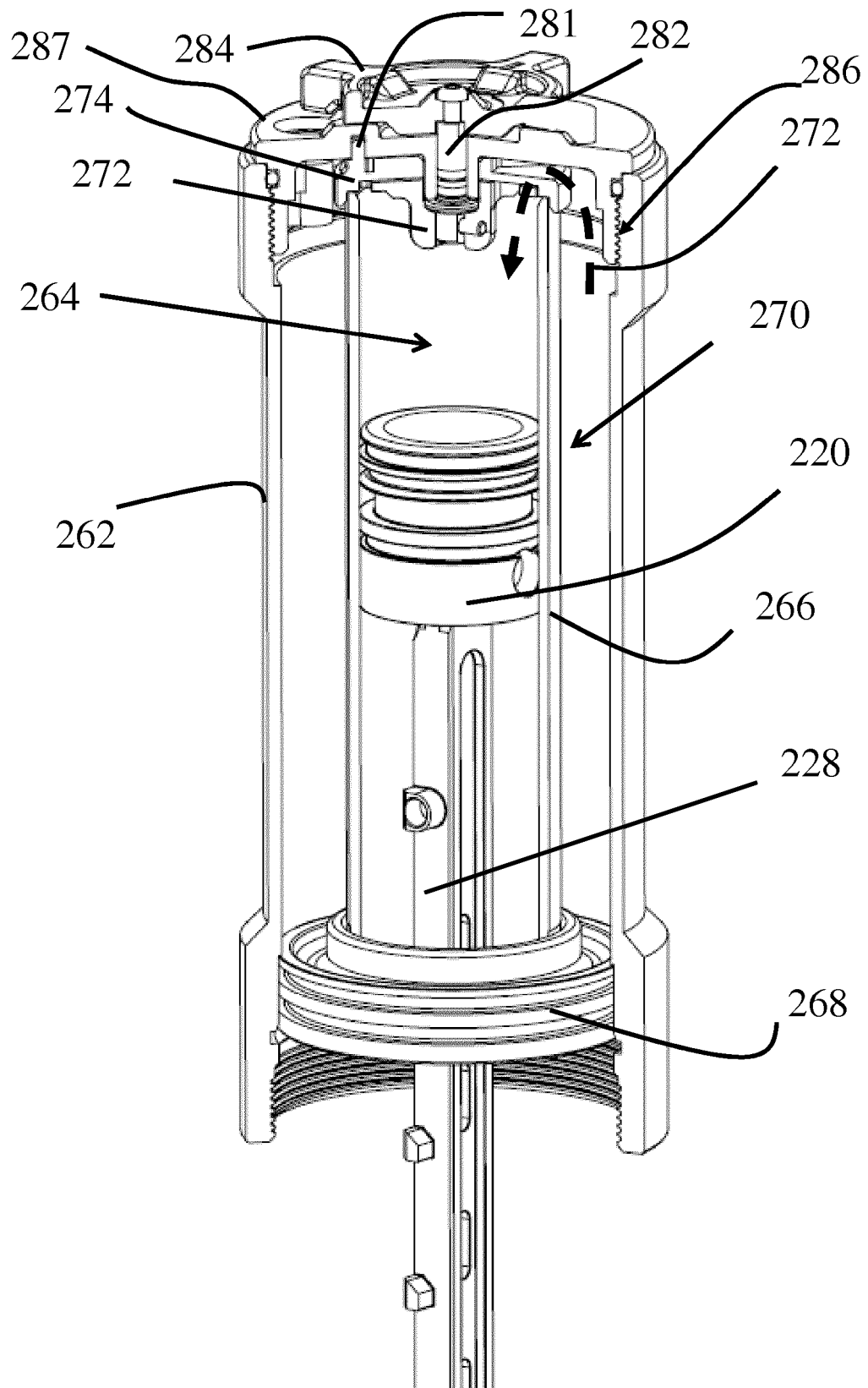


Fig. 8

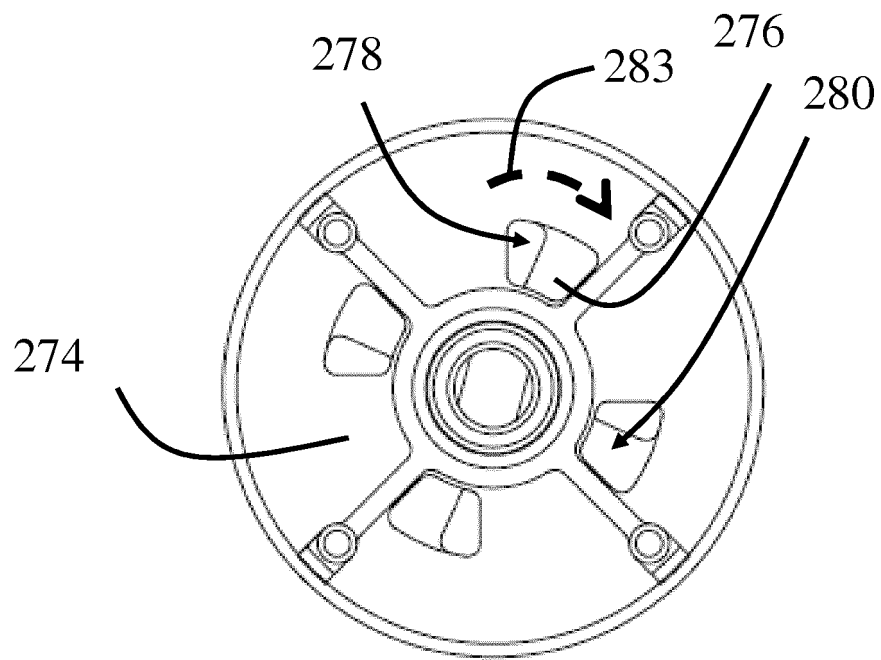


Fig. 9a

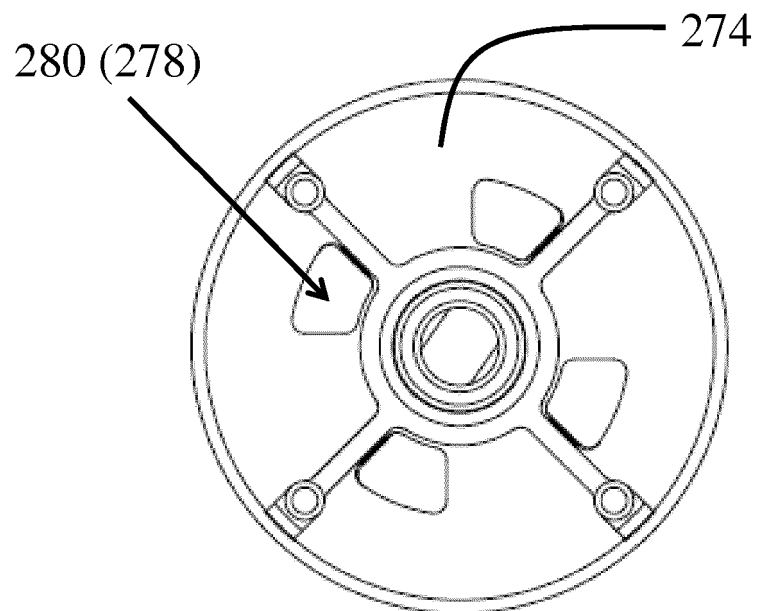


Fig. 9b