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(71) Applicant: **Chou, Wen-san**
Tainan City 745 (TW)

(72) Inventor: **Chou, Wen-san**
Tainan City 745 (TW)

(74) Representative: **Lang, Christian**
LangPatent Anwaltskanzlei
IP Law Firm
Rosenheimer Straße 139
81671 München (DE)

(54) PISTON BODY CONSTRUCTION OF AIR COMPRESSOR

(57) A piston body for an air compressor includes a head which defines an air receiving space indented into the top surface of the head, wherein the air receiving space is bounded by a bottom surface and a surrounding surface and having a top opening at the top surface of the head. In operation, the air pressure of the compressed air produced from reciprocating motion of the piston body can keep less than a safety pressure set for an object to be inflated, without using a mechanical safety valve. Therefore, the operational safety can be increased, and the manufacturing cost can be reduced.

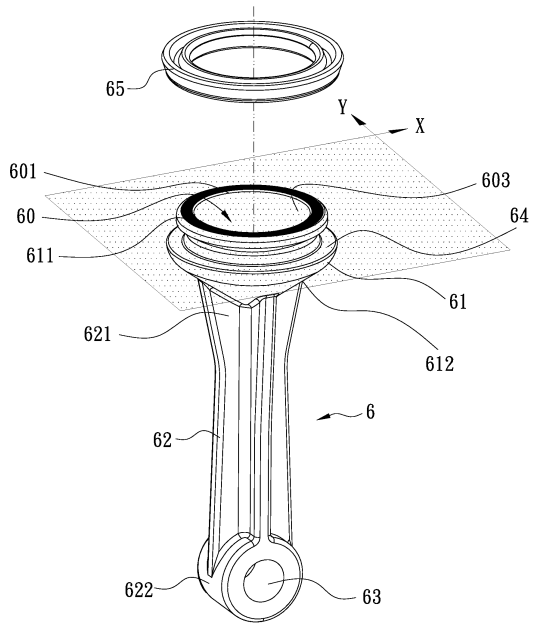

FIG. 1

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Description

(a) Technical Field of the Invention

[0001] The present invention relates to a piston body for an air compressor and, more particularly, to a piston body which defines an air receiving space to allow the pressure of the air supply of the air compressor to keep less than a safety pressure, so that the air compressor has no need to be installed with a mechanical safety valve; therefore, the manufacturing cost can be reduced.

(b) Description of the Prior Art

[0002] Air compressors are equipment that can be used to inflate objects. Generally, they are widely applied in inflating air cushions and tires. Some air compressors are manufactured in small size, so that they can be carried easily. Furthermore, they can be powered by a handheld DC power supply or a cigarette lighter socket in a vehicle, so that they can be operated conveniently and easily. FIGS.

[0003] 14 through 16 show two conventional air compressors, which generally comprise a cylinder 81 (or cylinder 91), a piston body 82 (or piston body 92), a motor 93, and a transmission mechanism including a gear 94 and a pinion 95, wherein the motor 93 can drive the pinion 95 mounted at an output axle of the motor 93 to rotate the gear 94, which in turn can drive the piston body 82 (or piston body 92), through a crankpin 96, to conduct reciprocating motion in the cylinder 81 (or cylinder 91) for producing compressed air in the cylinder. The compressed air can be transferred to an object desired to be inflated via an output 97 (see FIG. 16). Another output 98 (see also FIG. 16) can be directly or indirectly connected with a pressure gauge (not shown) to allow a user to read the air pressure in the object being inflated. Referring to FIGS. 14 and 15, the piston body 82 fitted in the cylinder 81 defines an intake channel 822 through its head 821. In FIG. 16, the head 921 of the piston body 92 fitted in the cylinder 91 is a solid structure that does not contain an intake channel. However, each of the air compressors has to be installed with a safety valve 84 (in FIG. 16, the safety valve is not shown). When a high pressure of the compressed air produced in the cylinder 81 (or cylinder 91) occurs, the safety valve 84 can be actuated to allow the compressed air to be released into the environment, so that the compressed air will not continue to flow into the object being inflated, thus guaranteeing the safety of the air compressor and the object. However, an air compressor installed with a safety valve will increase the manufacturing cost and thus is not an economical design.

[0004] In view of the foregoing, an extra safety valve, which is indispensible and has to be installed on a conventional air compressor for limiting its output air pressure, increases the manufacturing cost. For solving the disadvantage, the applicant has carefully investigated the operations of conventional air compressors and thus designed an air compressor that can achieve the effect of limiting air pressure without using a safety valve.

SUMMARY OF THE INVENTION

[0005] The present invention offers a solution for an air compressor, which can provide safe compressed air to an object without using a mechanical safety valve.

[0006] The solution provided by the present invention is concerned with a piston body as follows:

The piston body can be applied in an air compressor to conduct reciprocating motion in a cylinder of the air compressor for producing compressed air in the cylinder. The piston body comprises a head having a top surface which extends along a horizontal plane. The head defines an air receiving space indented into the top surface of the head, wherein the air receiving space is bounded by a bottom surface and a surrounding surface and having a top opening at the top surface of the head. As such, without using a mechanical safety valve, the pressure of compressed air produced in the cylinder does not exceed a safety pressure set for an object to be inflated.

[0007] The piston body further comprises a rod. The head forms a flat top flange at the periphery of the top opening of the air receiving space, and forms a bottom flange below the top flange, and defines an annular groove at its outer surface, between the top flange and the bottom flange, wherein the annular groove does not communicate with the air receiving space. The bottom flange of the head is joined to a first end of the rod. A second end of the rod defines a pivot hole. An air-tight ring is fitted into the annular groove of the head.

[0008] In another embodiment, the head may define a plurality of air receiving spaces, which have different shapes and depths and do not communicate with each other.

[0009] In a further embodiment, the head may define an intake channel extending downwardly from the bottom surface and communicating with the air receiving space. The bottom surface is provided with a mounting post. A resilient sheet is mounted on the mounting post provided on the bottom surface,. As such, upward strokes of the piston body will cause the resilient sheet to close the intake channel, while downward strokes of the piston body will cause the resilient sheet to be pivotally moved away from the bottom surface by outside air, so that outside air may enter an inner space of the cylinder.

[0010] With the above solution, due to the head of the piston body defining the air receiving space, the pressure of the compressed air produced from the reciprocating motion of the piston body will not exceed a safety pressure set for an object to be inflated. Thus, there is no need to install a mechanical safety valve to an air compressor employing the piston body of the present inven-

tion. In inflating an object, the air pressure in the object can keep less than a safety pressure thereof. Therefore, the operational safety can be increased, and the manufacturing cost can be reduced.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011]

FIG. 1 shows an exploded view of a first embodiment of a piston body of the present invention

FIG 2 shows a 3-dimensionally sectional view of the first embodiment of the piston body.

FIG. 3 shows a 3-dimensional view of an air compressor, which includes a box and a compressor unit installed in the box.

FIG. 4 shows a plan view of the air compressor.

FIG. 5 shows a schematically sectional view of a first embodiment of the air compressor, wherein the piston body is conducting a downward stroke, whereby outside air can be pulled into the interior of the cylinder.

FIG 6 shows a schematically sectional view of the first embodiment of the air compressor, wherein the piston body has conducted an upward stroke, whereby the air contained in the cylinder can be compressed in the cylinder to produce compressed air.

FIG. 7 shows a schematically sectional view of a second embodiment of the air compressor, wherein the piston body is conducting a downward stroke, whereby outside air can be pulled into the interior of the cylinder via an inlet of the cylinder.

FIG. 8 shows a schematically sectional view of the second embodiment of the air compressor, wherein the piston body has conducted an upward stroke, whereby the air contained in the cylinder can be compressed in the cylinder to produce compressed air.

FIG. 9 shows another schematically sectional view of the air compressor.

FIG. 10 shows a 3-dimensional view of the compressor unit.

FIG. 11 shows a schematically top plan view of the head of a third embodiment of the piston body.

FIG. 12 shows an exploded view of a second embodiment of the piston body.

FIG. 13 shows a 3-dimensionally sectional view of the second embodiment of the piston body.

FIG. 14 shows a schematically sectional view of a conventional air compressor, wherein the piston body is conducting a downward stroke, whereby outside air can be pulled into the interior of the cylinder.

FIG. 15 shows a schematically sectional view of the conventional air compressor, wherein the piston body has conducted an upward stroke, whereby the air contained in the cylinder can be compressed in the cylinder to produce compressed air.

FIG. 16 shows a schematically sectional view of another conventional air compressor, wherein the piston body has conducted an upward stroke.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0012] For further illustrating the technical contents of the present invention, various embodiments are provided in the following paragraphs.

[0013] Referring first to FIGS. 1 and 2, a piston body 6 according to a first embodiment of the present invention is shown, which generally comprises a head 61 and a rod 62 having a predetermined length. The head 61 has a top surface which extends along a horizontal plane (XY), wherein the head 61 defines an air receiving space 60 indented into the top surface of the head 61. The air receiving space 60 is bounded by a bottom surface 602 and a surrounding surface 603 and having a top opening 601 at the top surface of the head 61. The head 61 of the piston body 6 forms a flat top flange 611 at the periphery of the top opening 601 of the air receiving space 60, and forms a bottom flange 612 below the top flange 611, and defines an annular groove 64 at its outer surface, between the top flange 611 and the bottom flange 612, wherein the annular groove 64 does not communicate with the air receiving space 60. The bottom flange 612 of the head 61 is joined to a first end 621 of the rod 62. A second end 622 of the rod 62 defines a pivot hole 63. An air-tight ring 65, which functions as an O-ring, is fitted into the annular groove 64 of the head 61.

[0014] The piston body 6 can be applied in a compressor unit, the operation of which is shown in FIGS. 3 through 6, and 10, wherein the compressor unit 1 includes a main frame 10, a motor 11 mounted at the frame 10, a cylinder 2, and a transmission mechanism including a pinion 12 and a gear 13 engaged with the pinion 12. The gear 13 is provided with a crankpin 15 connected with the pivot hole 63 defined at the second end 622 of the rod 62 of the piston body 6. The cylinder 2 has a top wall 22, which serves as a top border of an inner space 21 of the cylinder 2. The top wall 22 defines an air exit 23 communicating with an air storage container 3 on the cylinder 2. The air storage container 3 is provided with a plurality of outlets 31, 32, 33. A plug 34 is placed on the exit hole 23 defined on the top wall 22 of the cylinder 2. A compression spring 36 is urged against the plug 34. The outlet 31 is connected with a hose 41. The outlet 32 is connected with a pressure gauge 42. The outlet 33 is connected with a relief valve 5, which includes a soft cap 51 provided at an innermost end thereof. The compressor unit 1 can be installed in a box 4 which is provided with a switch 45 for starting or stopping the compressor unit. The pressure gauge 42 installed at the compressor unit 1 can be exposed to the outside. The box 4 is provided with a button 46, which has a push bar 461 inserted through a mounting bolt 52 to touch the soft cap 51 of the relief valve 5. When a high pressure of an object being inflated is noticed, a user may depress the button 46 to have its push bar 461 touch the soft cap 51, so that the

soft cap 51 can be compressed and deformed to allow excessive air in the object to be released into ambient environment via the outlet 33 that connects the relief valve 5. The hose 41, which is connected to the outlet 31, can be accommodated in the box 4 and closed by a lid 47, so that the air compressor has an aesthetic appearance. FIGS. 3 and 4 show external appearances of the box 4 which accommodates the compressor unit 1. FIG. 9 shows an internal state of the box 4 which accommodates the compressor unit 1.

[0015] FIGS. 5 and 6 show two operational states of a first embodiment of an air compressor. The piston body 6 conducts reciprocating motion in the cylinder 2. An upward stroke of the piston body 6 can force the air contained in the inner space 21 of the cylinder 2 to enter the inner space 35 of the air storage container 3 (see FIG. 6), and then flow into an object to be inflated via the hose 41 connected to the outlet 31. A downward stroke of the piston body 6 allows outside air to enter the inner space 21 of the cylinder 2 via the gap between the piston body 6 and the inner surface 24 of the cylinder 2 (see FIG. 5). As such, repeated upward and downward strokes of the piston body 6 will have the object fully inflated. Due to the air receiving space 60 defined at the head 61 of the piston body 6, when the piston body 6 has conducted an upward stroke to reach top dead center, although the top flange 611 almost contacts the top wall 22 of the cylinder 2, the air receiving space 60 can store additional compressed air produced in the inner space 21 of the cylinder 2. This design can reduce the motion resistance of the piston body 6, so that the piston body 6 can conduct reciprocating motion more smoothly. Furthermore, in inflating an object, the air pressure in the object can keep less than a safety pressure, so that the operational safety can be ensured. Thus, there is no need to install a mechanical safety valve to an air compressor which employs the piston body 6. Of course, the piston body 6 can be applied to a second embodiment of the air compressor, in which the cylinder 2 is provided with an air inlet 26 and a resilient sheet 27 (see FIG. 7). When the piston body 6 conducts an upward stroke, the resilient sheet 27 can close the inlet 26 (see FIG. 8). When the piston body 6 conducts a downward stroke, outside air can move the resilient sheet 27 to be pivotally away from the air inlet 26, so that outside air may enter the inner space 21 of the cylinder 2, as shown in FIG. 7. For a cylinder with an inlet and a resilient sheet as mentioned above, the piston body 6 can achieve the same effect as the first embodiment of the air compressor.

[0016] FIGS. 12 and 13 show a second embodiment of the piston body, wherein the head 61 defines an intake channel 66 extending downwardly from the bottom surface 602 and communicating with the air receiving space 60. The bottom surface 602 is provided with a mounting post 67. A resilient sheet 68 is mounted on the mounting post 67 provided on the bottom surface_602. As such, upward strokes of the piston body 6 will cause the resilient sheet 68 to close the intake channel 66, while downward strokes of the piston body 6 will cause the resilient sheet 68 to be pivotally moved away from the bottom surface 602 by outside air, so that outside air may enter the inner space 21 of the cylinder 2.

[0017] In a third embodiment of the piston body 6, as shown in FIG 11, the head 61 of the piston body 6 may define a plurality of air receiving spaces (PI, P2, P3), which have different shapes and depths and do not communicate with each other.

[0018] In light of the foregoing, the piston body 6 of the present invention defines at least one air receiving space 60 at its head 61, so that an air compressor employing the piston body 6 has no need to be installed with a mechanical safety valve. Therefore, the manufacturing cost of the air compressor can be reduced, and the piston body 6 can conduct reciprocating motion more smoothly and safely. These features render the present invention novel and inventive.

Claims

1. A piston body for an air compressor, capable of conducting reciprocating motion in a cylinder (2) of the air compressor for producing compressed air in the cylinder (2), the piston body comprising a head (61) having a top surface which extends along a horizontal plane (XY), the head (61) defining an air receiving space (60) indented into the top surface of the head (61), the air receiving space (60) being bounded by a bottom surface (602) and a surrounding surface (603) and having a top opening (601) at the top surface of the head (61), whereby, without using a safety valve, the pressure of compressed air produced in the cylinder (2) does not exceed a safety pressure set for an object to be inflated.

2. The piston body of claim 1, further comprising a rod (62) and wherein the head (61) forms a flat top flange (611) at the periphery of the top opening (601) of the air receiving space (60), and forms a bottom flange (612) below the top flange (611), and defines an annular groove (64) at its outer surface, between the top flange (611) and the bottom flange (612), the annular groove (64) not communicating with the air receiving space (60); the bottom flange (612) of the head (61) is joined to a first end (621) of the rod (62), a second end (622) of the rod (62) defining a pivot hole (63); an air-tight ring (65) is fitted into the annular groove (64) of the head (61).

3. The piston body of claim 1, wherein the head (61) defines a plurality of air receiving spaces (PI, P2, P3), which have different shapes and depths and do not communicate with each other

4. The piston body of claim 1, wherein the head (61) defines an intake channel (66) extending downward-

ly from the bottom surface (602) and communicating with the air receiving space (60), bottom surface (602) being provided with a mounting post (67), a resilient sheet (68) being mounted on the mounting post (67) provided on the bottom surface (602), whereby upward strokes of the piston body will cause the resilient sheet (68) to close the intake channel (66), while downward strokes of the piston body will cause the resilient sheet (68) to be pivotally moved away from the bottom surface (602) by outside air, so that outside air may enter an inner space (21) of the cylinder (2).

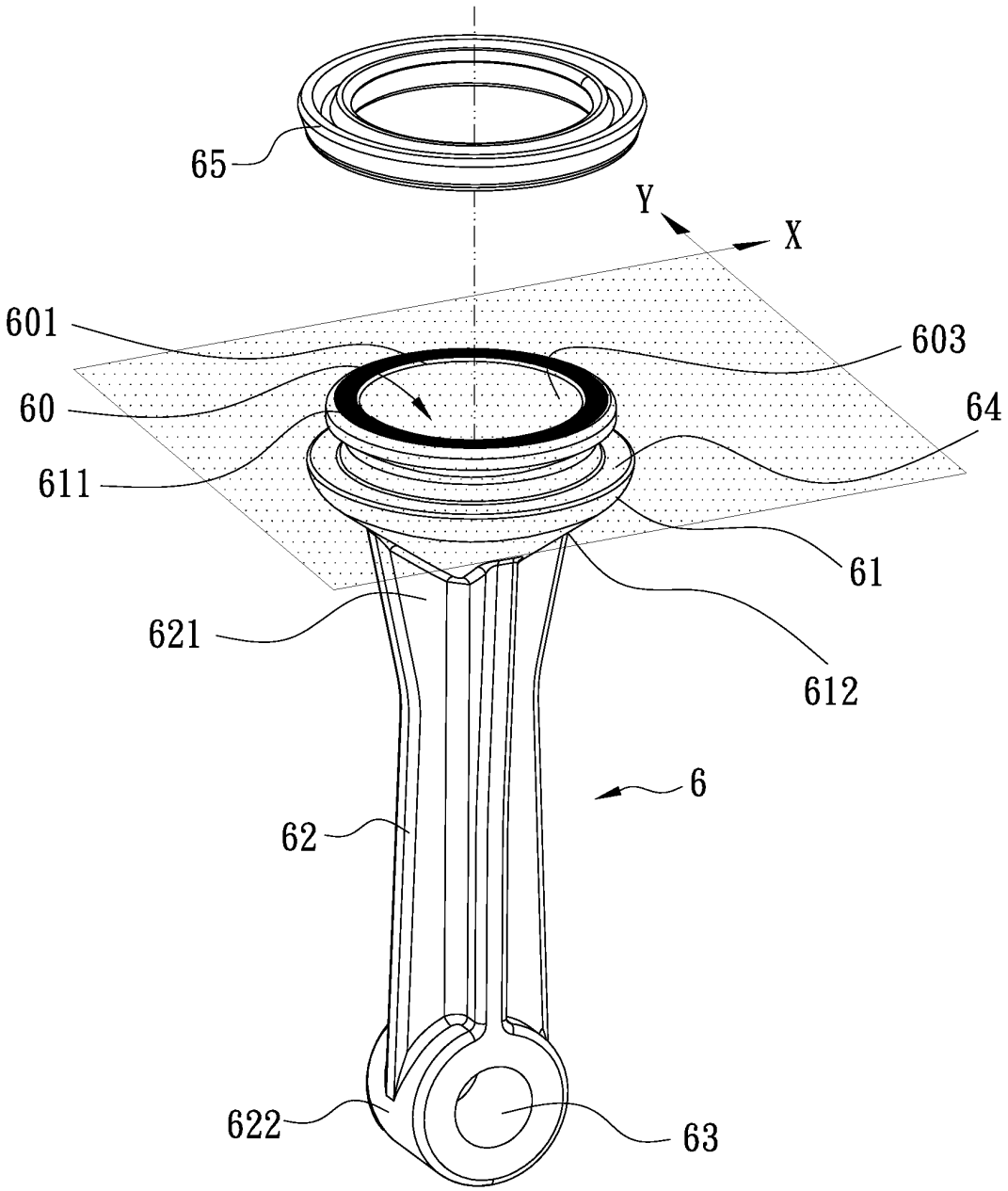

FIG. 1

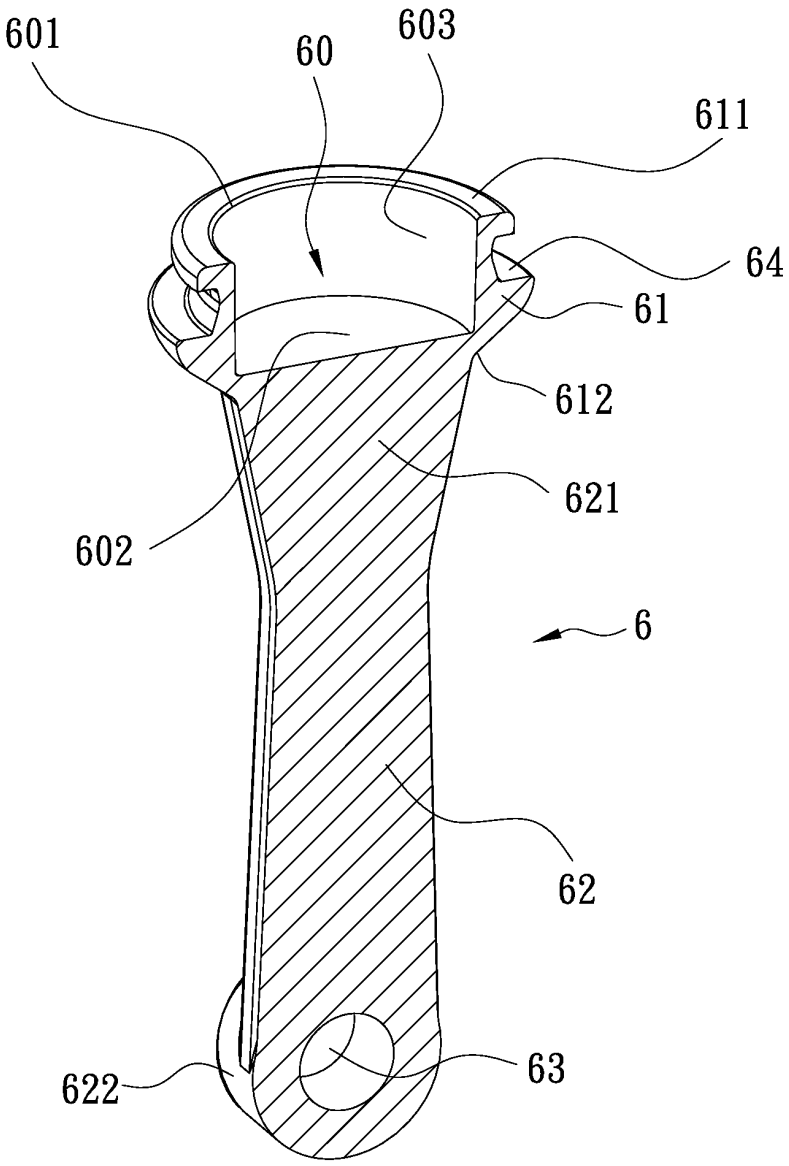

FIG. 2

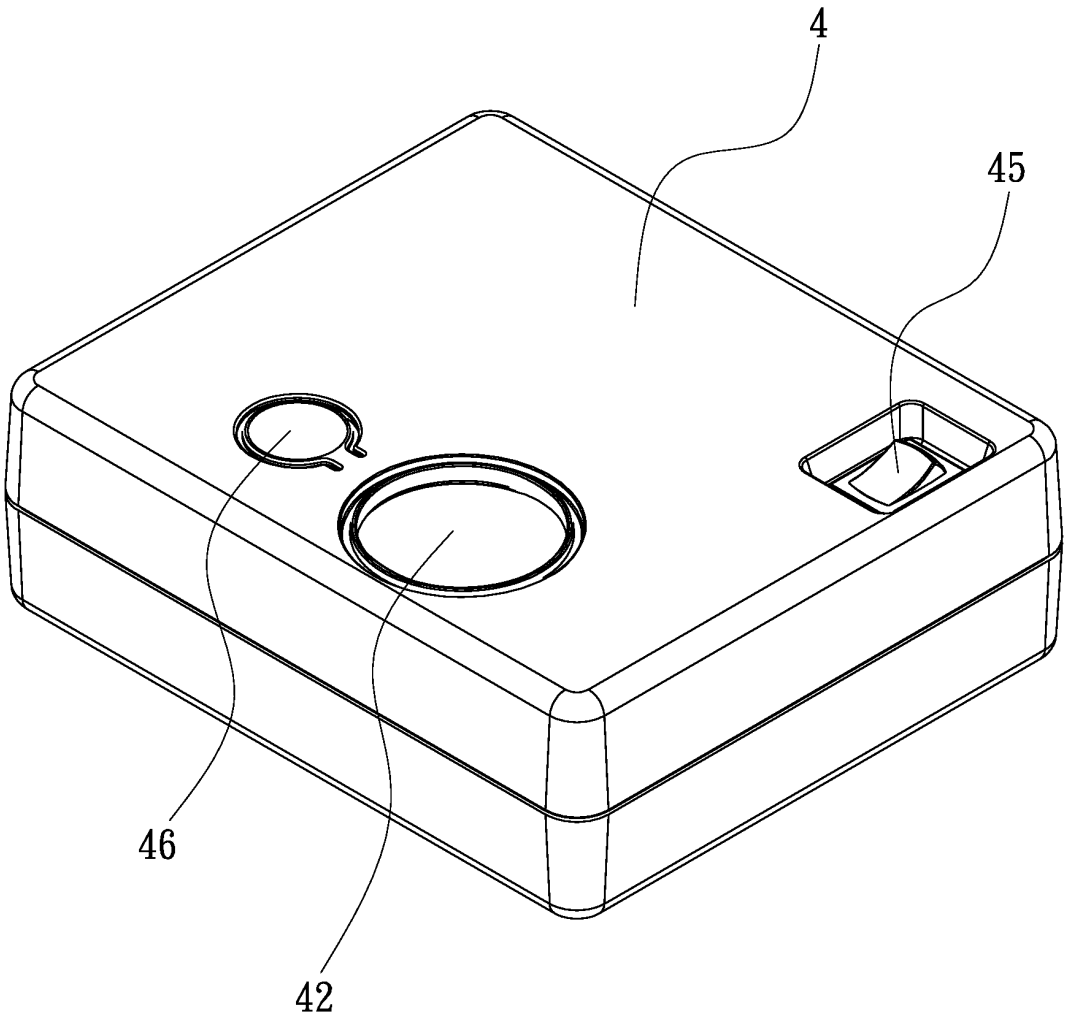

FIG. 3

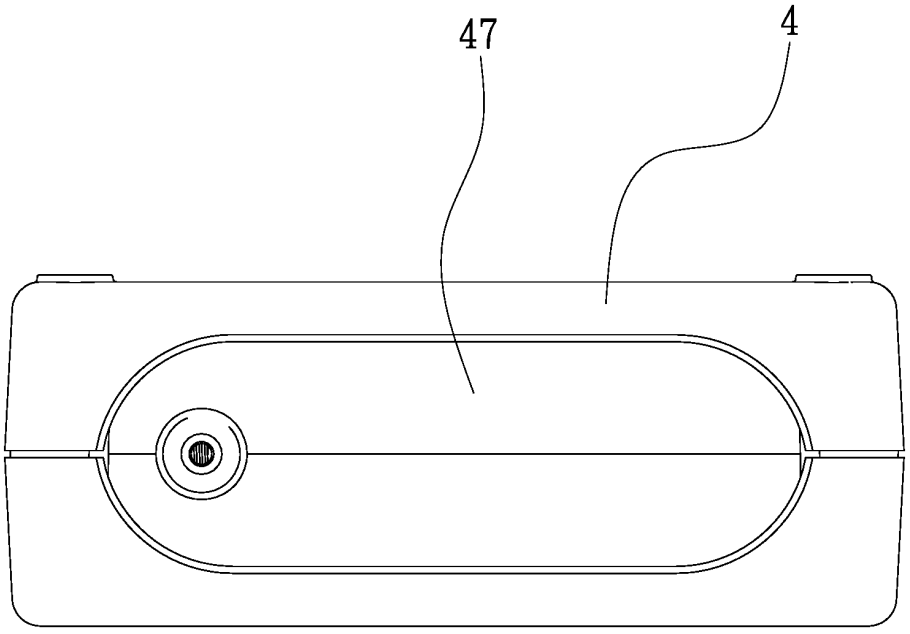

FIG. 4

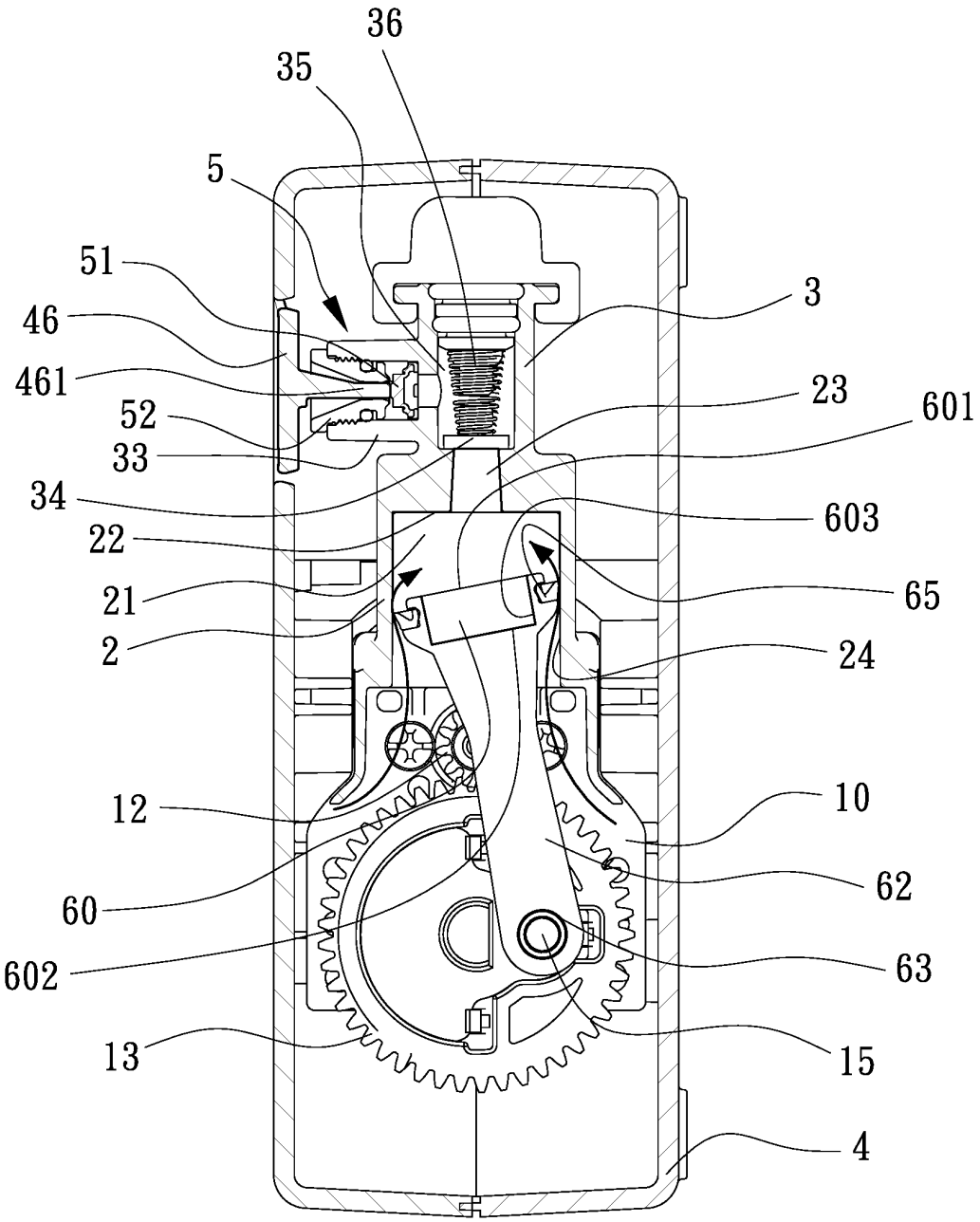
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FIG. 5

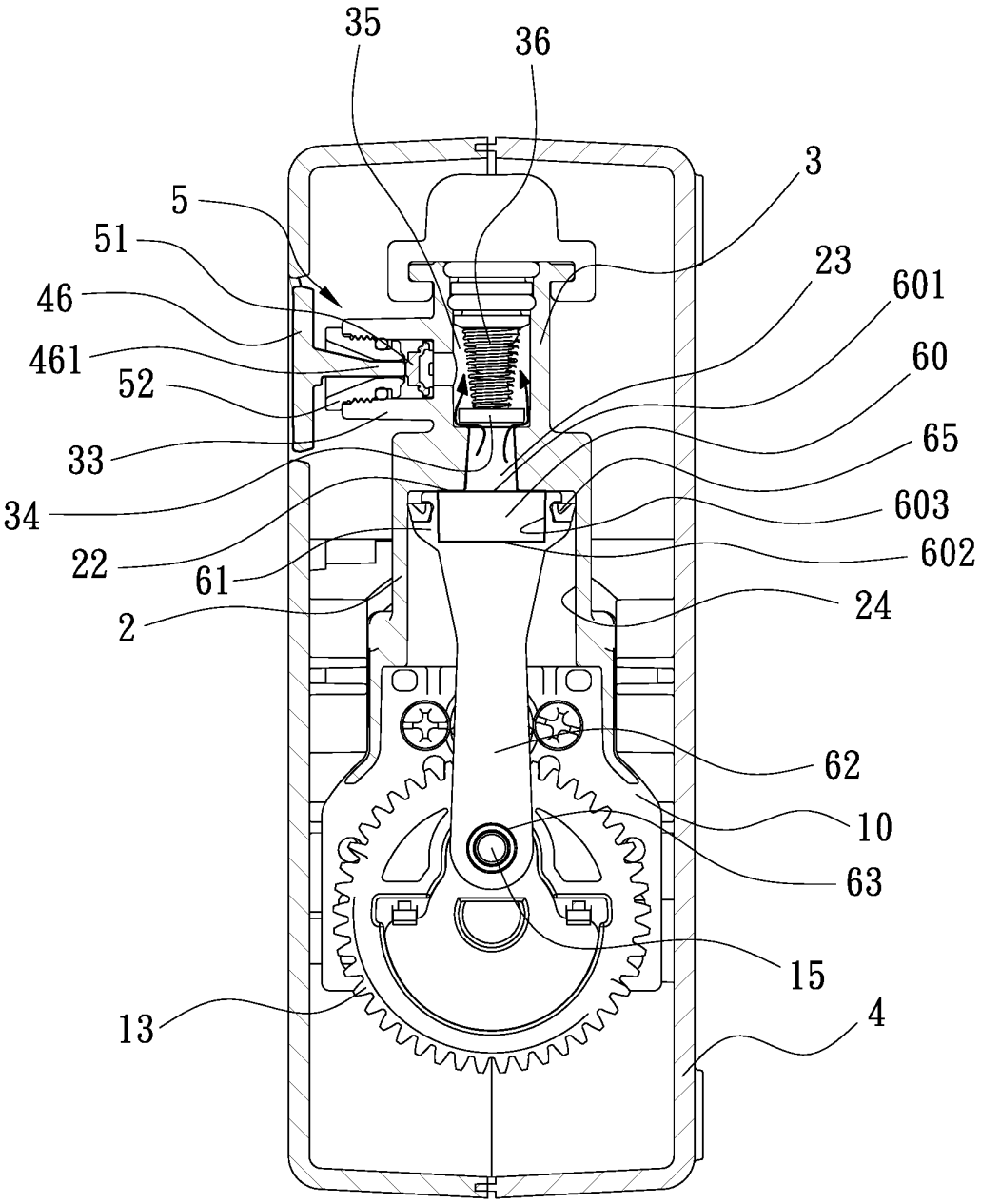
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FIG. 6

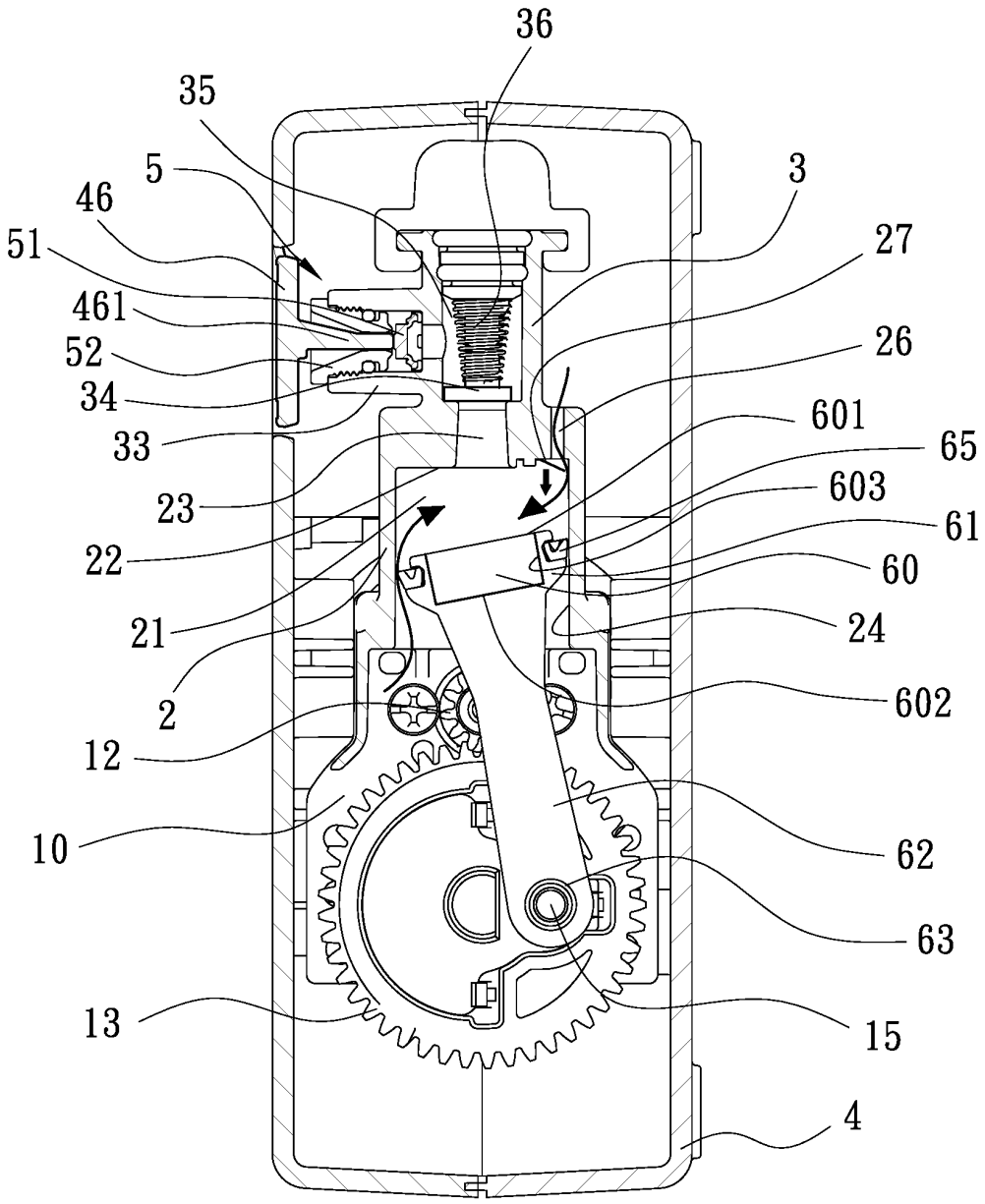
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FIG. 7

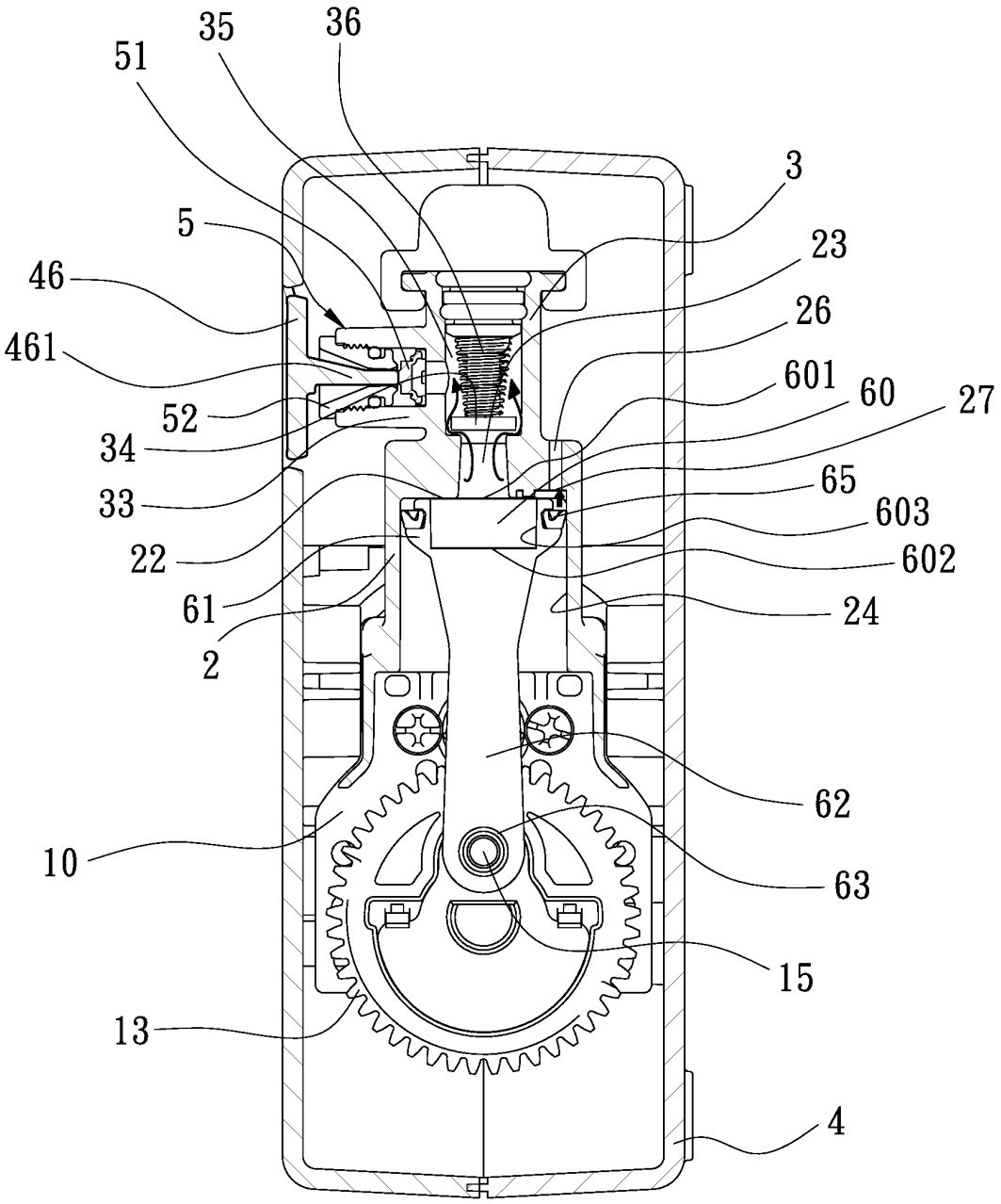
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FIG. 8

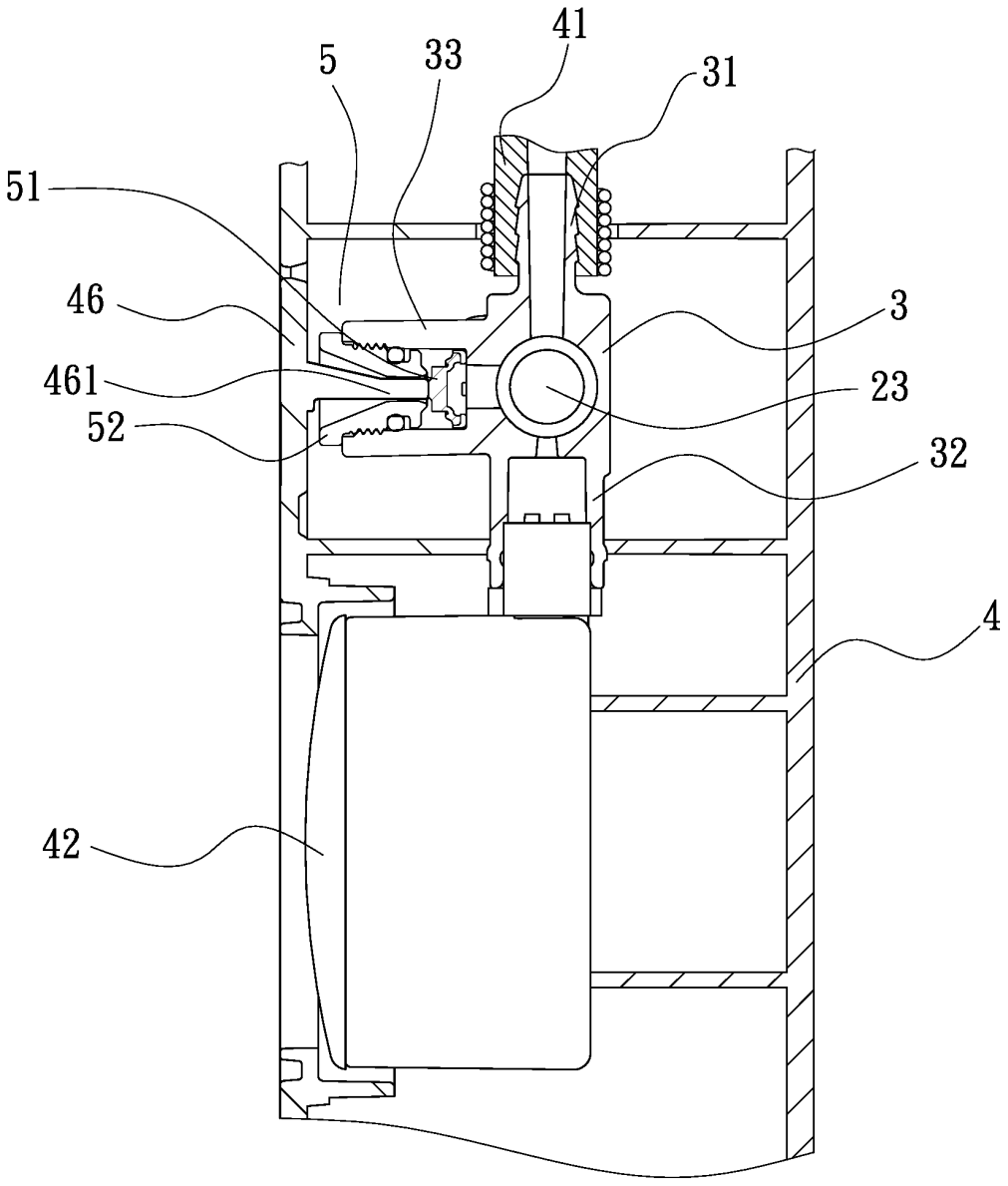

FIG. 9

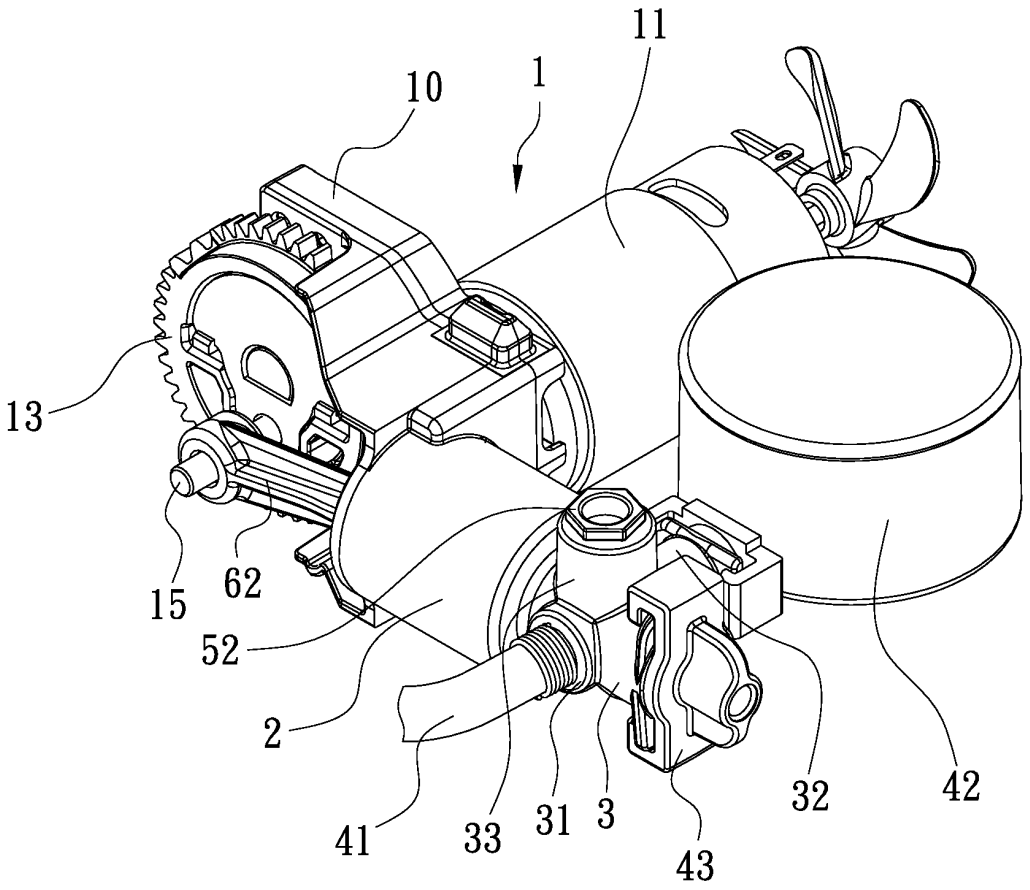

FIG. 10

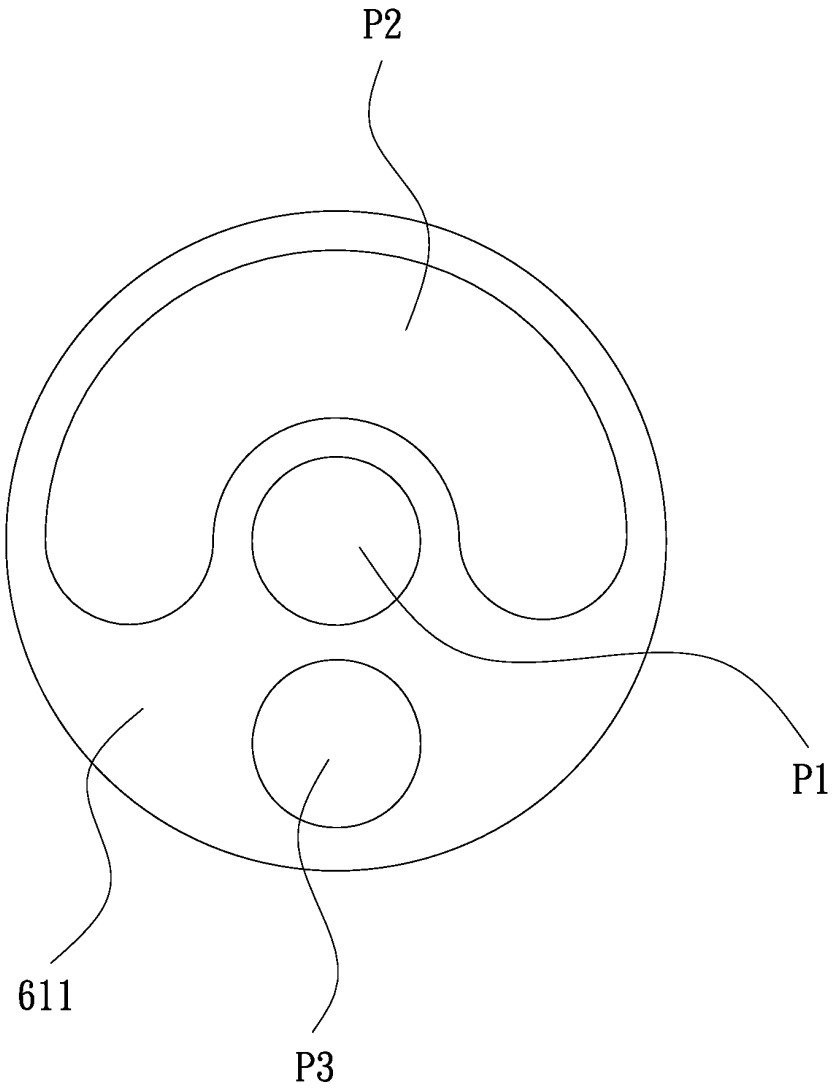

FIG. 11

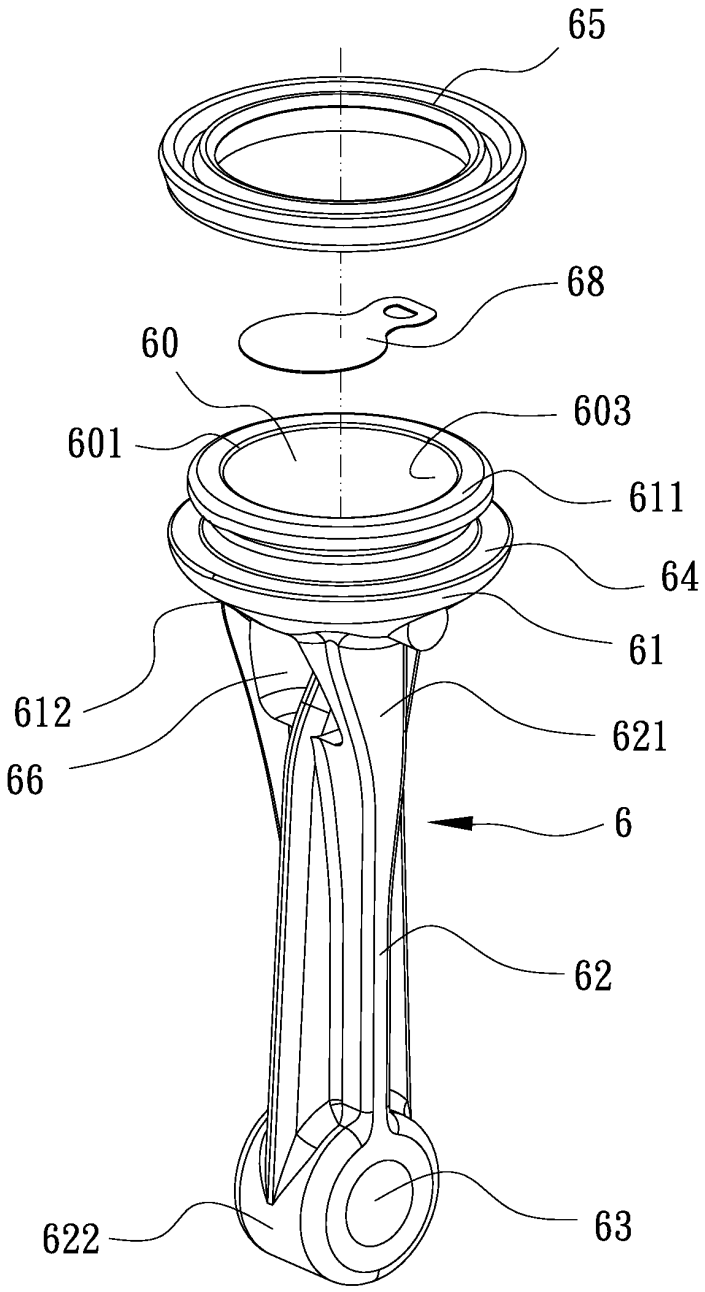

FIG. 12

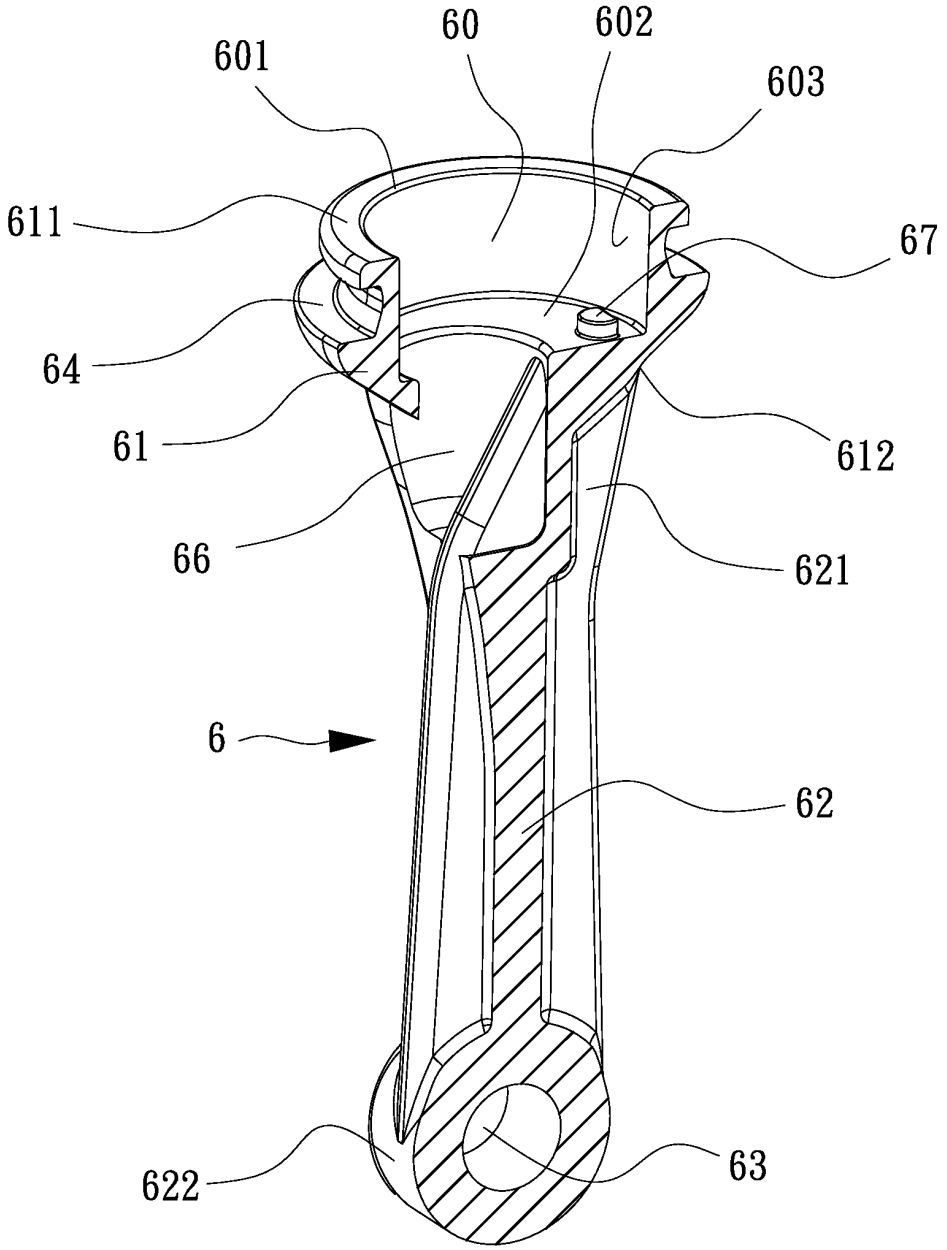

FIG. 13

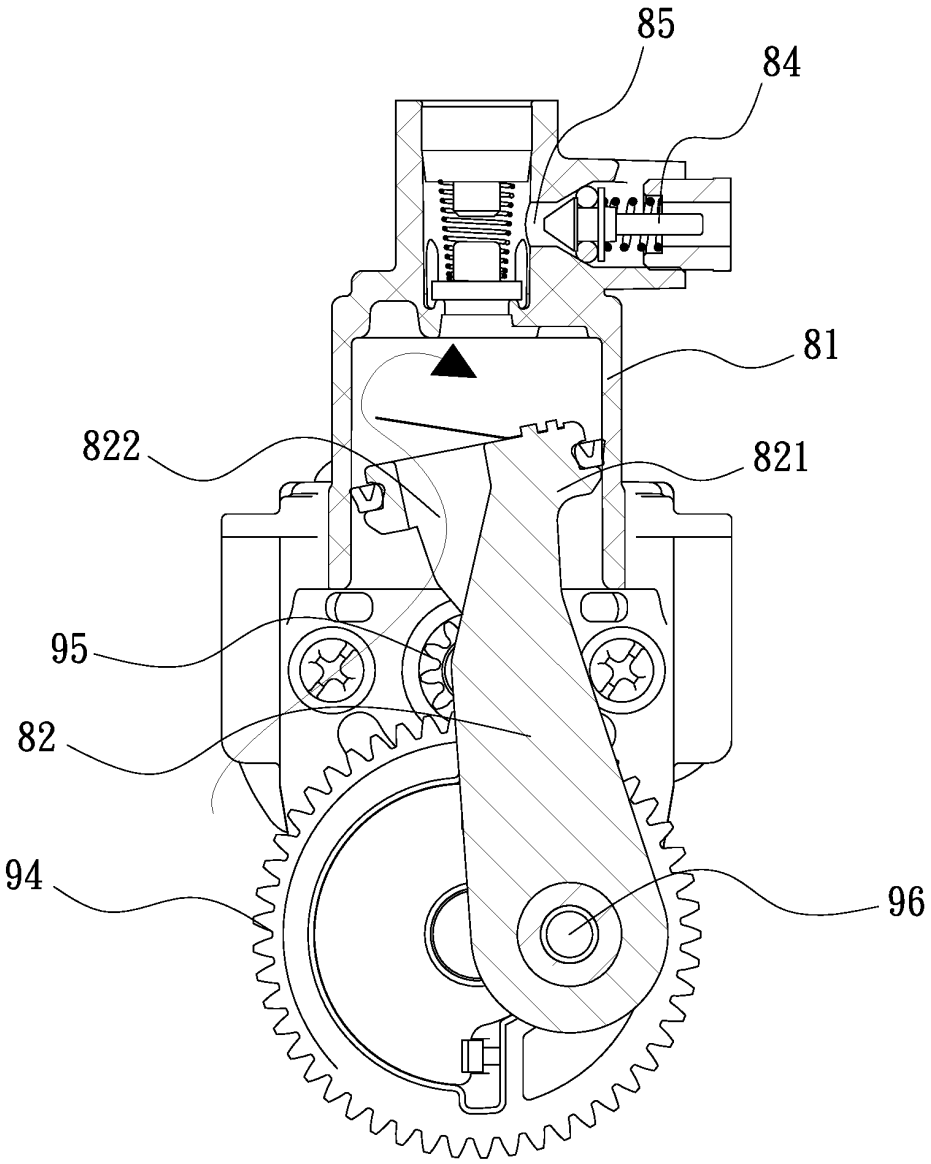

FIG. 14

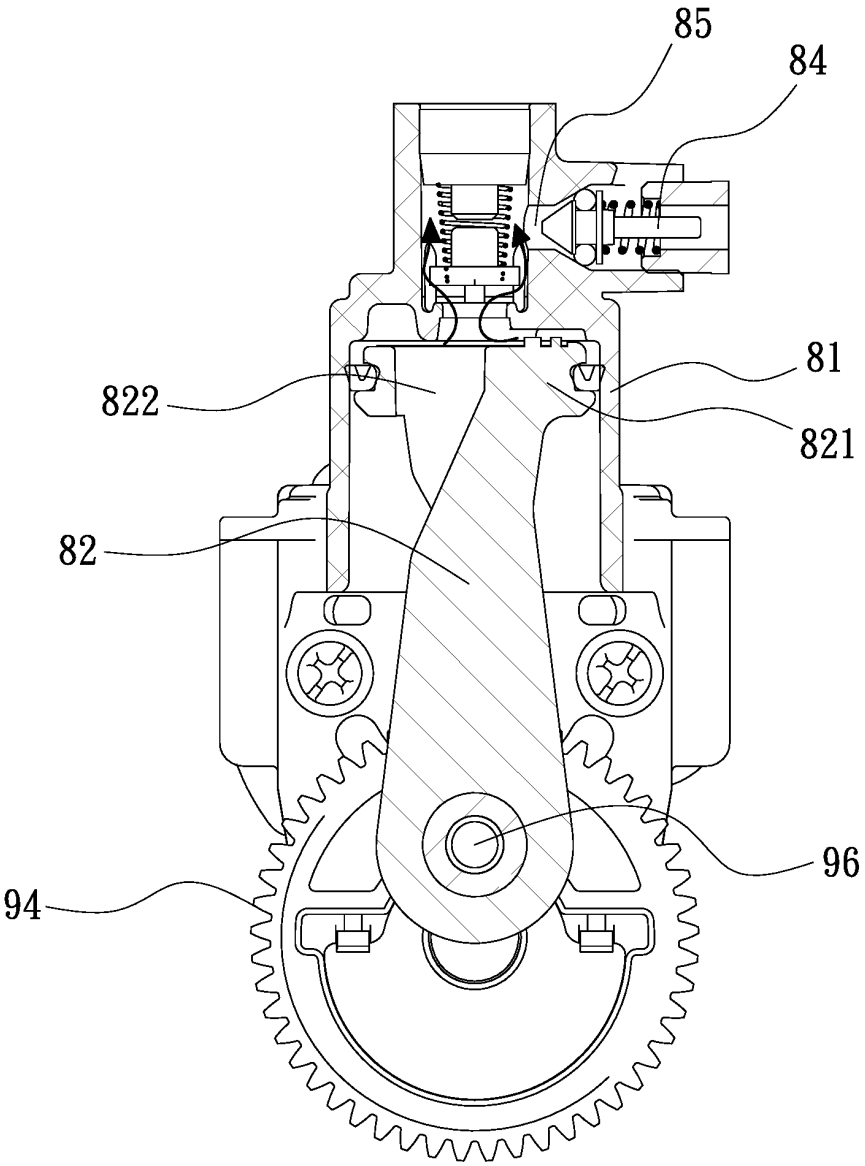

FIG. 15

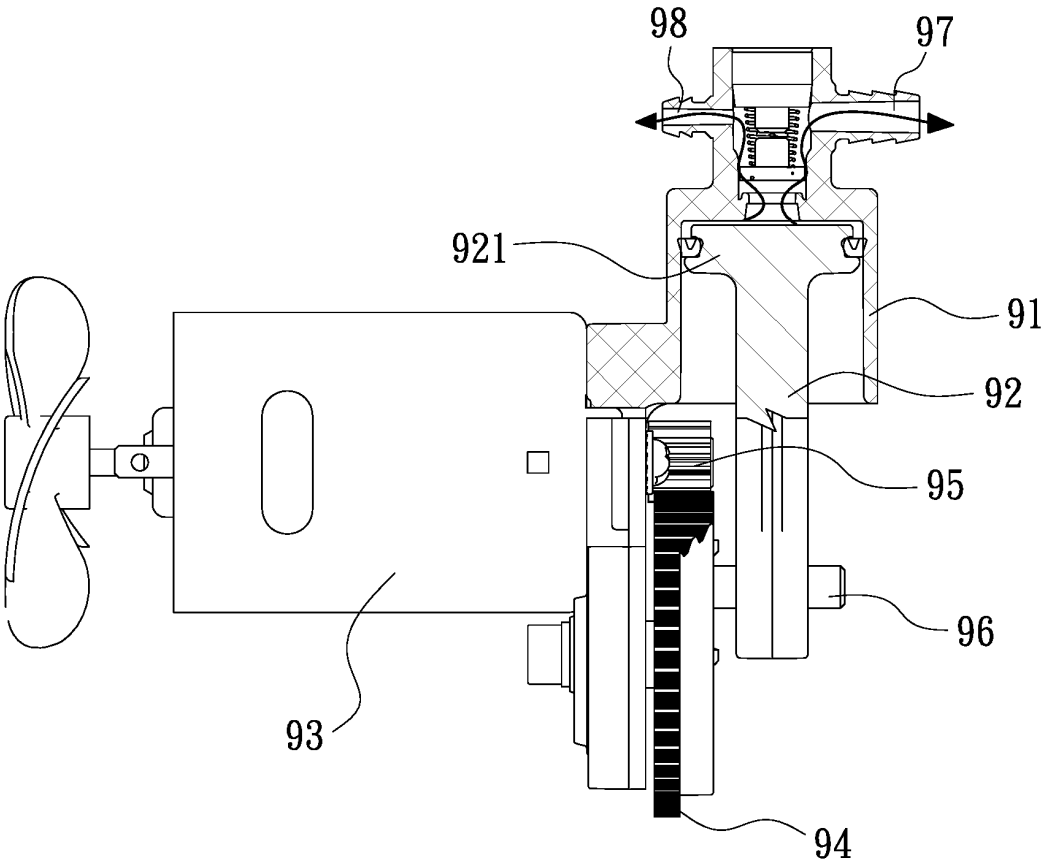

FIG. 16

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2013/071530

A. CLASSIFICATION OF SUBJECT MATTER

See the extra sheet
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC: F04B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

CNPAT, CNKI, WPI, EPODOC: air, compress+, pump+, bore?, groove?, opening?, U

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5655887 A (CHOU WEN-SAN) 12 August 1997 (12.08.1997) see description, column 2 line 32 to column 3 line28, figures 1-4	1-4
A	EP 1853608 A (JHOU WEN-SAN) 07 November 2007 (07.11.2007) the whole document	1-4
A	GB 145864 A (MORRIS HENRY PETIGOR) 30 June 1920 (30.06.1920) the whole document	1-4
A	US 3186633 A (GOMEZ MARTINEZ MARTIN) 01 June 1965 (01.06.1965) the whole document	1-4
A	US 2008237510 A1 (CHOU WEN SAN) 02 October 2008 (02.10.2008) the whole document	1-4
A	WO 2010066448 A1 (STEHLE MICHAEL) 17 June 2010 (17.06.2010) the whole document	1-4

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&"document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
21 October 2013 (21.10.2013)	21 November 2013 (21.11.2013)
Name and mailing address of the ISA State Intellectual Property Office of the P. R. China No. 6, Xitucheng Road, Jimenqiao Haidian District, Beijing 100088, China Facsimile No. (86-10) 62019451	Authorized officer LI, Zi Telephone No. (86-10) 62085142

Form PCT/ISA /210 (second sheet) (July 2009)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2013/071530

Patent Documents referred in the Report	Publication Date	Patent Family	Publication Date
US 5655887 A	12.08.1997	US 6135725 A	24.10.2000
EP 1852608 AB	07.11.2007	None	
GB 145864 A	30.06.1920	None	
US 3186633 A	01.06.1965	ES 268273 A	01.10.1961
		GB 930889 A	10.07.1963
US 2008237510 A1	02.10.2008	US 2007077157 A	05.04.2007
WO 2010066448 A1	17.06.2010	DE 102008061311 A	24.06.2010
		EP 2376781 A	19.10.2011
		US 2011277877 A	17.11.2011
		JP 2012511655 A	24.05.2012

Form PCT/ISA /210 (patent family annex) (July 2009)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2013/071530

Continuation of: second sheet

A. CLASSIFICATION OF SUBJECT MATTER

F04B 53/14 (2006.01) i

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