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(54) AIR COMPRESSOR APPARATUS

(57) An air compressor is disclosed, which provides compressed air having a pressure less than a safety pressure without using a safety valve, so that a tire can be inflated without exceeding a safety pressure thereof. One feature of the air compressor is that a tube is formed integrally with the air storage container and on the cylinder, wherein the tube defines therein an auxiliary air chamber communicating with the inner space of the cylinder but not communicating with the air storage container. When the piston body reaches top dead center, the head of the piston body almost contacts the top wall of the cylinder, whereby part of the compressed air may flow into the auxiliary air chamber, so that the piston body can conduct downward strokes more smoothly, and the compressed air can be prevented from exceeding a safety pressure set for an object to be inflated.

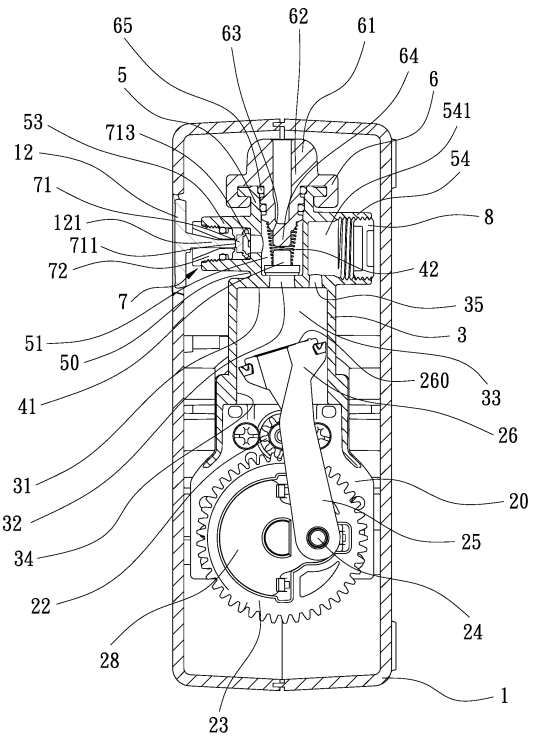

FIG. 4

EP 2 955 381 A1

Description

(a) Technical Field of the Invention

[0001] The present invention relates to an air compressor, which allows air supply to keep less than a safety pressure without using a mechanical safety valve, so that a tire can be inflated without exceeding a safety pressure thereof.

(b) Description of the Prior Art

[0002] The applicant has been dedicated to developing air compressors for a long time. At the early days, the applicant successfully converted a labor-intensive and complicated air compressor into an air compressor that is simple in structure and can be quickly assembled. In US Pat. No. 7,462,018, an outlet header is provided with a plurality of ducts or outlets, one of which can be connected with a mechanical safety valve. When a piston body, which conducts reciprocating motion in a cylinder, reaches top dead center, the head of the piston body almost contacts the top wall of the cylinder. Consequently, almost all the compressed air produced in the cylinder will enter the outlet header. However, in operating the air compressor, the pressure of the compressed air may exceed a safety pressure set for a tire to be inflated. For preventing an over-inflation, the air compressor should be installed with a safety valve which can automatically release air into the environment upon detecting a high pressure. However, after the safety valve has served for a period of time, the valve may be stuck, so that it cannot work properly when a high pressure of compressed air occurs. Thus, a tire may be excessively inflated to cause a blowout.

SUMMARY OF THE INVENTION

[0003] One object of the present invention is to provide an air compressor, which allows its air supply to keep less than a safety pressure without using a mechanical safety valve, so that a tire can be inflated without exceeding a safety pressure thereof and thus prevent a blowout.

[0004] To achieve the above object, the present invention offers a solution as follows:

[0005] The air compressor includes a box and an electrically operated compressor unit installed in the box, wherein a motor drivels a piston body to conduct reciprocating motion in a cylinder to produce compressed air, which can be transferred into an air storage container provided with a plurality of outlets; a tube is formed integrally with the air storage container and on the cylinder, the tube defining therein an auxiliary air chamber communicating with the inner space of the cylinder but not communicating with the inner space of the air storage container; when the piston body reaches top dead center, the head of the piston body almost contacts the top wall of the cylinder, whereby part of the compressed air produced in the cylinder may flow into the auxiliary air chamber, so that the piston body can conduct downward strokes more smoothly, and the compressed air can be prevented from exceeding a safety pressure set for an object to be inflated, without using a safety valve.

[0006] As described above, one feature of the present invention is that a tube is formed integrally with the air storage container and on the cylinder, and it defines therein the auxiliary air chamber communicating with the inner space of the cylinder but not communicating with the inner space of the air storage container; when the piston body reaches top dead center, the head of the piston body almost contacts the top wall of the cylinder, so that part of the compressed air produced in the cylinder may flow into the auxiliary air chamber, and thus downward strokes of the piston body can be conducted more smoothly, and furthermore, the pressure of the compressed air can be prevented from exceeding a safety pressure set for an object to be inflated, without using a mechanical safety valve.

[0007] As compared with conventional technology, the air compressor of the present invention allows its air supply to keep less than a safety pressure without using a mechanical safety valve, so that a tire can be inflated without exceeding a safety pressure thereof; at the same time, the manufacturing cost of the air compressor can be reduced, and the piston body can conduct downward strokes more smoothly.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008]

FIG 1 shows a 3-dimensional view of an air compressor, including a box and a compressor unit, according to one embodiment of the present invention.

FIG 2 shows an exploded view of the compressor unit.

FIG 3 shows another exploded view of the compressor unit.

FIG 4 shows a schematically sectional view of the air compressor.

FIG 5 shows an enlarged, partially sectional view of the air compressor shown in FIG 4.

FIG 6 shows a schematically sectional view of the air compressor, wherein a relief valve is actuated for releasing air into ambient environment.

FIG 7 shows a schematically sectional view of the air compressor, wherein an adjusting bolt is turned for adjusting the volume of an auxiliary air chamber.

FIG 8 shows another schematically sectional view of the air compressor.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0009] For further illustrating the technical contents of the present invention, one embodiment is provided in the

following paragraphs.

[0010] Referring first to FIGS. 1 through 4, an air compressor according one embodiment of the present invention is shown, which generally includes a box 1 and a compressor unit installed in the box 1, wherein the box 1 is provided with a switch 11, a button 12, and a transparent window 13. The compressor unit includes a cylinder 3, which allows a piston body 25 to operate therein, and a main frame 20, which is formed integrally with the cylinder 3 and used to mount a motor 21.

[0011] The main frame 20 also mounts a transmission mechanism, which includes a pinion 22 and a gear 23 provided with a counterweight 28 and a crankpin 24. The motor 21 is fitted with a cooling fan 27. The motor 21 can drive the transmission mechanism to have the piston body 25 conduct reciprocating motion along an inner surface 34 of the cylinder 3 to produce compressed air, which can overcome a compression spring 42 and thus push a plug 41 up, so that the compressed air can be transferred into an air storage container 5 via a main exit hole 32.

[0012] The air storage container 5 is provided with a plurality of outlets 52, 53, 55 (see also FIG 8), wherein the outlet 52 is connected with a hose 91; the outlet 53 is connected with a relief valve 7; the outlet 55 is connected with a pressure gauge 9. One primary feature of the present invention is that a tube 54 is formed integrally with the air storage container 5 and on the cylinder 3, wherein the tube 54 defines therein an auxiliary chamber 541 communicating with the inner space 33 of the cylinder 3 via an auxiliary exit hole 35. However, the auxiliary air chamber 541 of the tube 54 does not communicate with the inner space 51 of the air storage container 5. An adjusting bolt 8 is threadedly fitted into the tube 54 for adjusting the volume of the auxiliary chamber 541.

[0013] Referring now to FIGS. 4 through 7, the bottom 50 of the air storage container 5 is joined to the top wall 31 of the cylinder 3. The top wall 31 defines the main exit hole 32 and the auxiliary exit hole 35. The main exit hole 32 allows the inner space 33 of the cylinder 3 to communicate with the inner space 51 of the air storage container 5. The auxiliary exit hole 35 allows the inner space 33 of the cylinder 3 to communicate with the auxiliary chamber 541 of the tube 54. The plug 41 is placed on the main exit hole 32 defined on the top wall 31. A rectangular top cover 6 has a rotating handle 61 at its outer surface and a central column 62 extending from its inner surface (see FIG 5). The central column 62 has a base portion and a reduced portion 64 extending from the base portion, wherein a step 63 is formed between the base portion and the reduced portion 64. The base portion of the central column 62 is provided with a plurality of annular protrusions 621 and defines a plurality of annular grooves 622 at its outer surface. A plurality of seal rings 65 are fitted into the annular grooves 622 of the central column 62.

[0014] As shown in FIG 2, the top cover 6 can be coupled to the air storage container 5 by turning the rotating handle 61 for sealing the air storage container 5. One end of the compression spring 42 is engaged with the plug 41, while an opposite end of the compression spring 42 is engaged with a lowest one of the annular protrusions 621 of the central column 62.

[0015] Referring to FIGS. 3 and 5, the relief valve 7 includes a hollow soft cap 71 having a tip 711 and an annular portion provided with a plurality of spaced protrusions 712 at its outer surface. Between two adjacent protrusions 712 defines a gap 713. Amounting bolt 72 defines a central through hole 722 extending from an opening 721 at one end of the mounting bolt 72, wherein the central through hole 722 of the mounting bolt 72 has a diameter smaller than the opening 721 of the mounting bolt 72. The soft cap 71 is fitted in the outlet 53. The mounting bolt 72 is fitted into the outlet 53 to have an opposite end of the mounting bolt 72 located near the soft cap 71. The annular portion of the soft cap 71 is engaged with an inner surface of the outlet 53. The tip 711 of soft cap 71 is located near the opposite end of the mounting bolt 72. A push bar 121 of the button 12 is inserted through the central through hole 722 of the mounting bolt 72 to touch the tip 711 of the soft cap 71. The button 12 may be depressed to allow its push bar 121 to compress the soft cap 71 and thus deform the soft cap 71, so that excessive air in an object to be inflated can be released into ambient environment via the outlet 53 which connects the relief valve 7, as shown in FIGS. 5 and 6. The adjusting bolt 8 is threadedly fitted into the tube 54 for adjusting the volume of the auxiliary air chamber 541.

[0016] When the piston body 25 has conducted an upward stroke to reach top dead center, as shown in FIG 7, the top surface 260 of the head 26 of the piston body 25 almost contacts the top wall 31 of the cylinder 3. As a result, a large amount of the compressed air produced in the cylinder 3 can overcome the compression spring 42 to push the plug 41 up and thus flow into the inner space 51 of the air storage container 5 via the main exit hole 32 defined on the top wall 31 of the cylinder 3, and then can flow into an object to be inflated via one of the outlets 52, 53, 55. However, part of the compressed air may flow into the auxiliary air chamber 541 via the auxiliary exit hole 35. Therefore, the compressed air produced in the cylinder 3 will not exceed a safety pressure set for the object to be inflated; furthermore, this design allows downward strokes of the piston body 25 to be conducted more smoothly. Also, the upward movement of the plug 41 can be limited by the reduced portion 64 of the central column 62 of the top cover 6, as shown in FIGS. 7 and 8.

[0017] As shown in FIGS. 6 and 7, in case the air pressure in an inflated object exceeds a safety pressure thereof is noticed, a user may depress the relief valve 7 to release air into ambient environment to reduce the pressure.

[0018] In light of the foregoing, one feature of the present invention is that the cylinder 3 is provided with

the tube 54 defining the auxiliary air chamber 541 which communicates with the inner space 33 of the cylinder 3 via the auxiliary exit hole 35; the inner space 51 of the air storage container 5 communicates with the inner space 33 of the cylinder 3 via the main exit hole 32, while the auxiliary air chamber 541 of the tube 54 does not communicate with the inner space 51 of the air storage container 5; therefore, a large amount of the compressed air produced in the cylinder 3 can flow into the inner space 51 of the air storage container 5 via the main exit hole 32, and then can flow into an object to be inflated via one of the outlets provided at the air storage container 5; part of the compressed air produced in the cylinder 3 can flow into the auxiliary air chamber 541 via the auxiliary exit hole 35. This design can prevent the pressure of the compressed air from exceeding a safety pressure set for an object to be inflated, without using a mechanical safety valve; furthermore, downward strokes of the piston body 25 can be conducted more smoothly. These features render the present invention inventive.

[0019] The above embodiment and drawings are not for limiting the shape and style of the present invention. Persons with ordinary skills in the art can make variations or modifications to the embodiment without departing from the scope of the present invention.

Claims

1. An air compressor including a box (1) and an electrically operated compressor unit installed in the box (1), wherein a motor (21) drives a piston body (25) to conduct reciprocating motion in a cylinder (3) to produce compressed air, which is transferred into an air storage container (5) provided with a plurality of outlets (52, 53, 55);
   the air compressor **characterized in that**: a tube (54) is formed integrally with the air storage container (5) and on the cylinder (3), wherein the tube (54) defines therein an auxiliary air chamber (541) communicating with an inner space (33) of the cylinder (3) but not communicating with an inner space (51) of the air storage container (5); when the piston body (25) reaches top dead center, a head (26) of the piston body (25) almost contacts a top wall (31) of the cylinder (3), whereby part of the compressed air produced in the cylinder (3) flows into the auxiliary air chamber (541), so that the piston body (25) can conduct downward strokes more smoothly, and the compressed air can be prevented from exceeding a safety pressure set for an object to be inflated, without using a mechanical safety valve.

2. The air compressor of claim 1, further **characterized in that**: the box (1) is provided with a button (12); one of the outlets (52, 53, 55) is connected with a relief valve (7), which includes a hollow soft cap (71) having a tip (711) and an annular portion provided with multiple spaced protrusions (712) at its outer surface, between two adjacent protrusions (712) defining a gap (713); a mounting bolt (72) defining a central through hole (722) extending from an opening (721) at one end of the mounting bolt (72), the central through hole (722) of the mounting bolt (72) having a diameter smaller than the opening (721) of the mounting bolt (72), wherein the soft cap (71) is fitted in the outlet that connects the relief valve (7), the mounting bolt (72) is fitted into the outlet that connects the relief valve (7) to have an opposite end of the mounting bolt (72) located near the soft cap (71), the annular portion of the soft cap (71) is engaged with an inner surface of the outlet that connects the relief valve (7), the tip (711) of soft cap (71) is located near the opposite end of the mounting bolt (72), and a push bar (121) of the button (12) is inserted through the central through hole (722) of the mounting bolt (72) to touch the tip (711) of the soft cap (71); whereby the button (12) may be depressed to allow its push bar (121) to compress the soft cap (71) and thus deform the soft cap (71), so that excessive air in an object to be inflated may flow through the gaps (713) of the soft cap (71) and the central through hole (722) of the mounting bolt (72) to be released into ambient environment.

3. The air compressor of claim 1, further **characterized in that**: an adjusting bolt (8) is threadedly fitted into the tube (54) to define the auxiliary air chamber (541), the volume of the auxiliary air chamber (541) being adjusted by turning the adjusting bolt (8).

4. The air compressor of claim 1, further **characterized in that**: a bottom (50) of the air storage container (5) is joined to the top wall (31) of the cylinder (3), the top wall (31) defining a main exit hole (32) which allows the inner space (33) of the cylinder (3) to communicate with the inner space (51) of the air storage container (5); a plug (41) is placed on the main exit hole (32) of the top wall (31); a rectangular top cover (6) has a rotating handle (61) at its outer surface and a central column (62) extending from its inner surface, the central column (62) having a base portion and a reduced portion (64) extending from the base portion, wherein a step (63) is formed between the base portion and the reduced portion (64), the base portion of the central column (62) being provided with a plurality of annular protrusions (621) and defines a plurality of annular grooves (622) at its outer surface; a plurality of seal rings (65) are fitted into the annular grooves (622) of the central column (62); the top cover (6) is coupled to the air storage container (6) by turning the rotating handle (61) for sealing the air storage container (6); one end of a compression spring (42) is engaged with the plug (41), and an opposite end of the compression spring (42) is engaged with a lowest one of the annular protrusions

(621) of the central column (62).

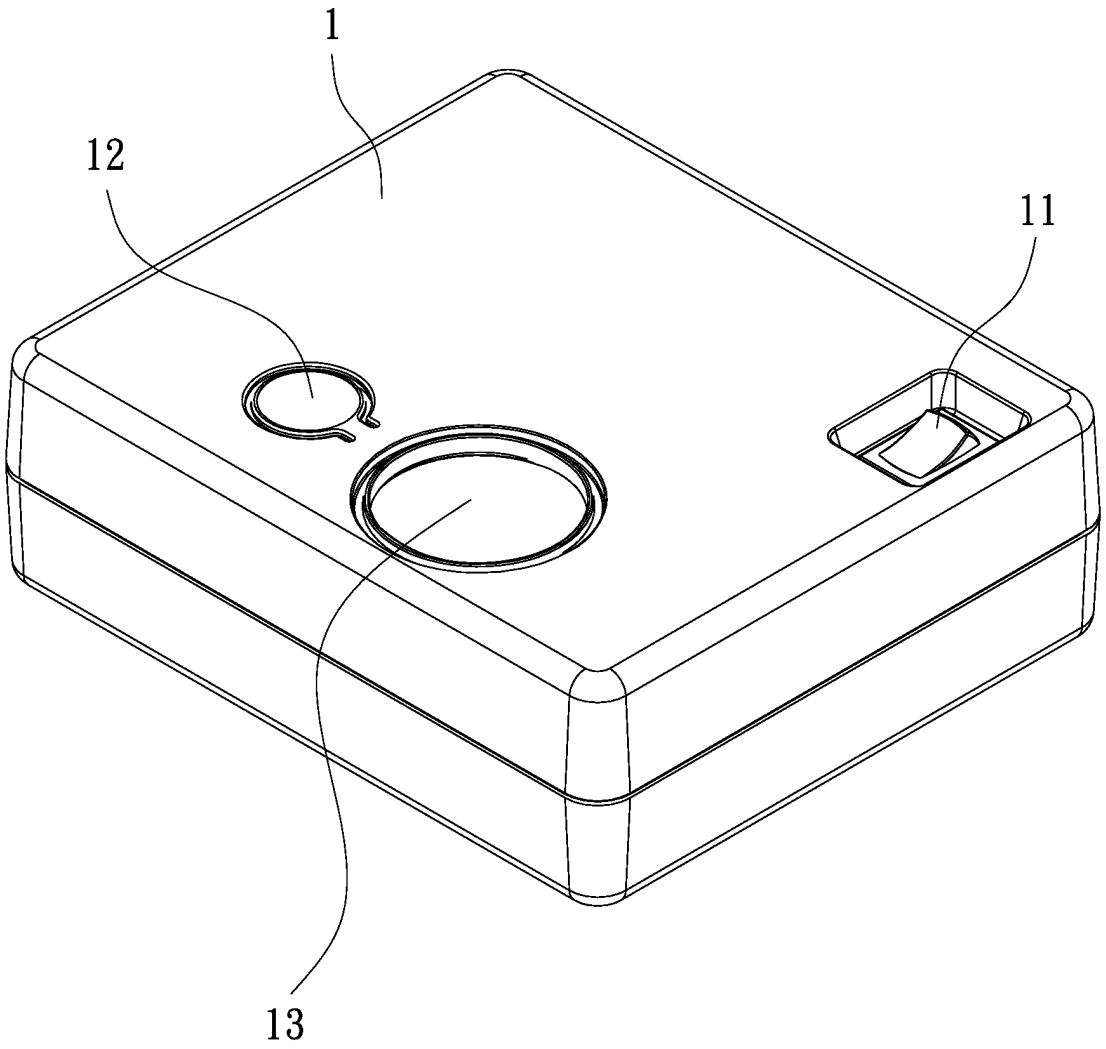

FIG. 1

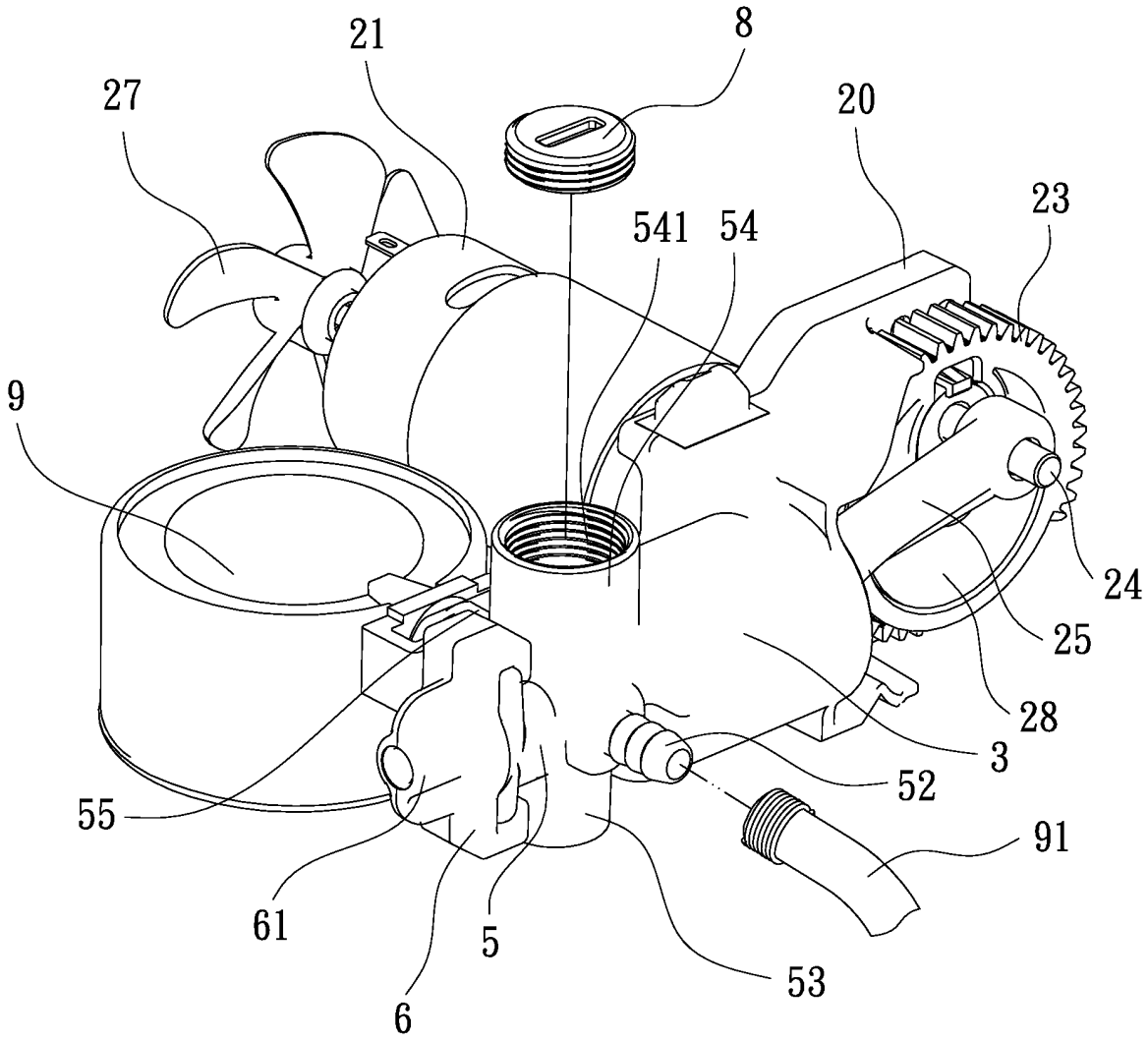

FIG. 2

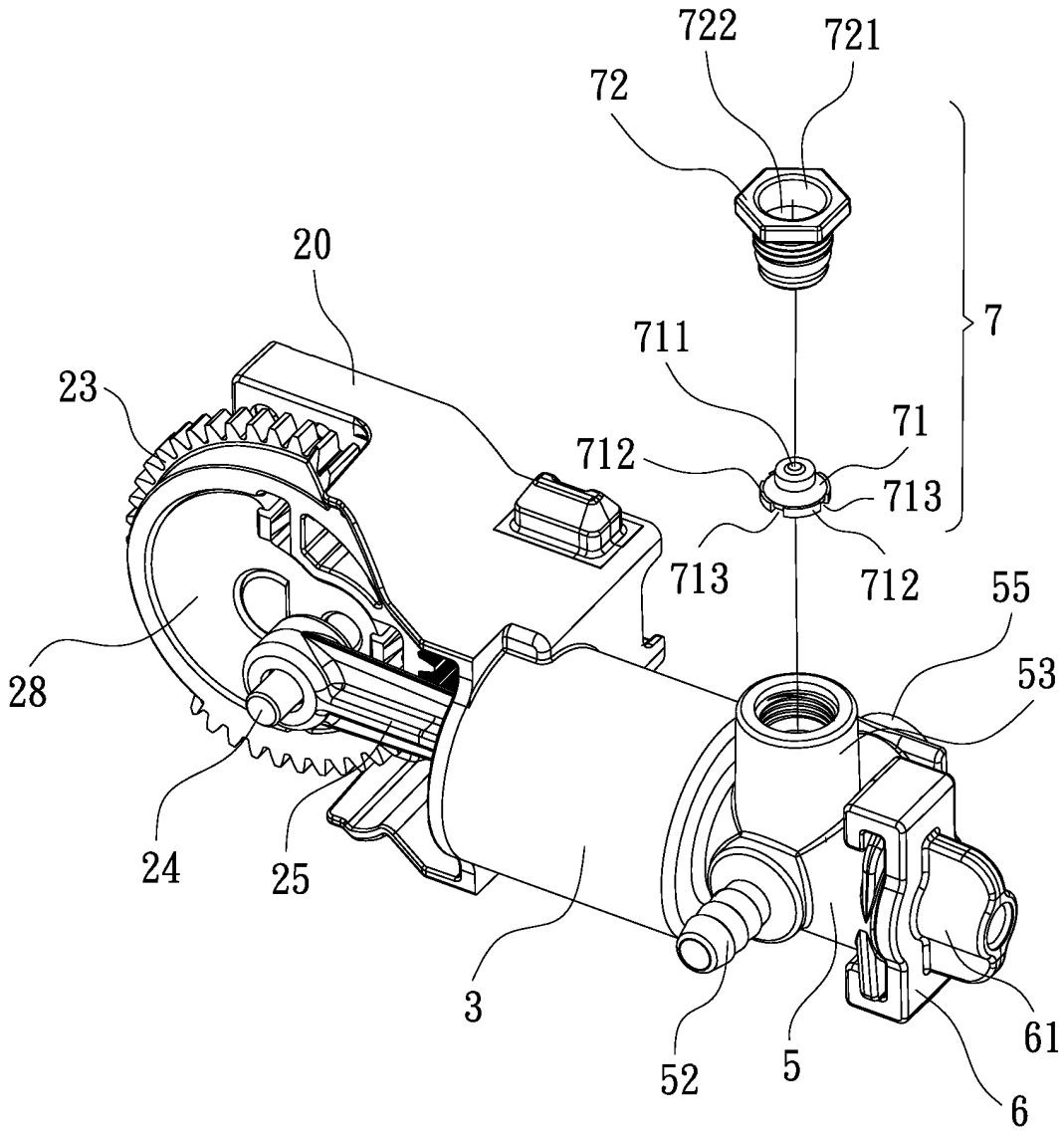

FIG. 3

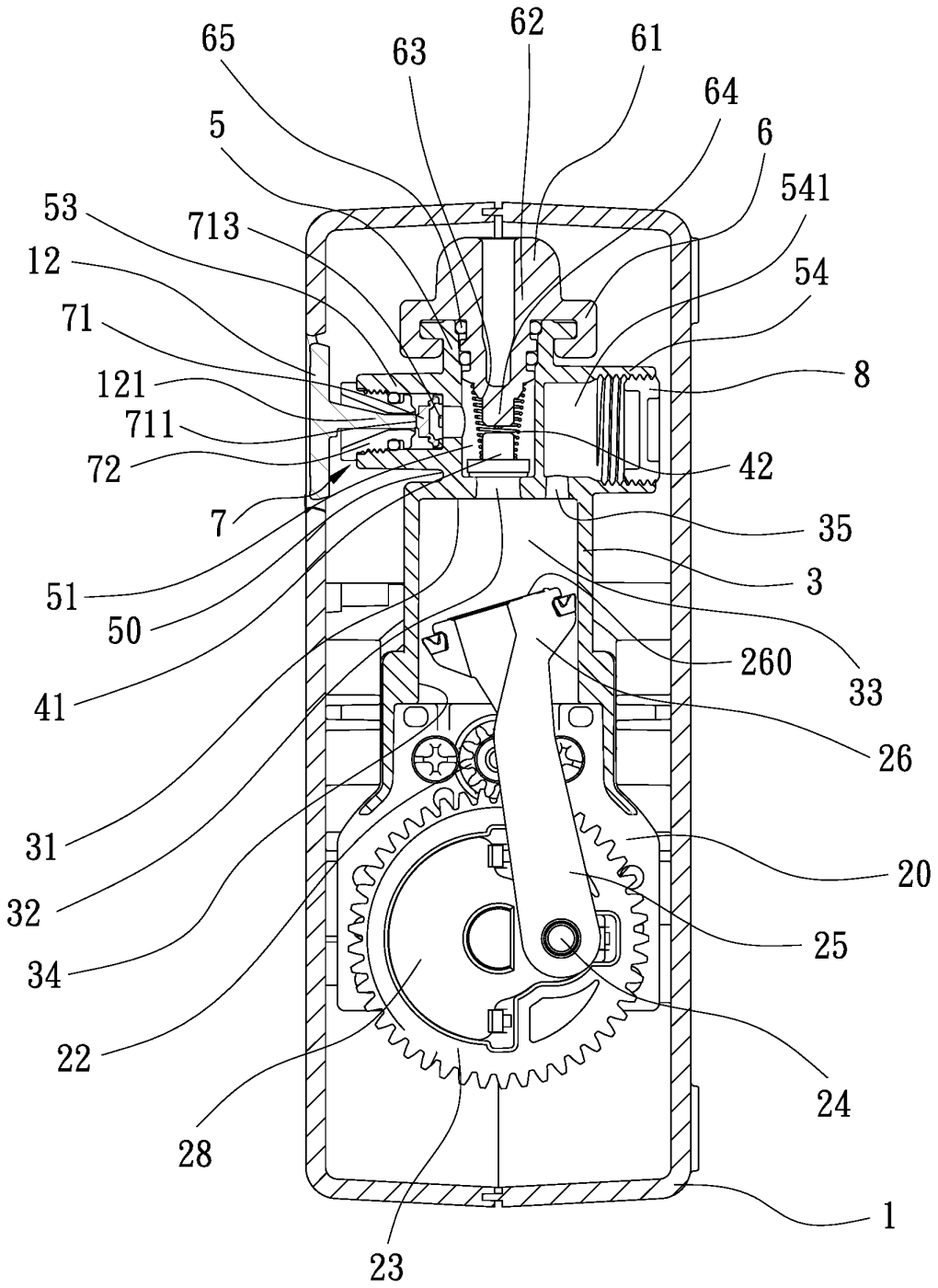
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FIG. 4

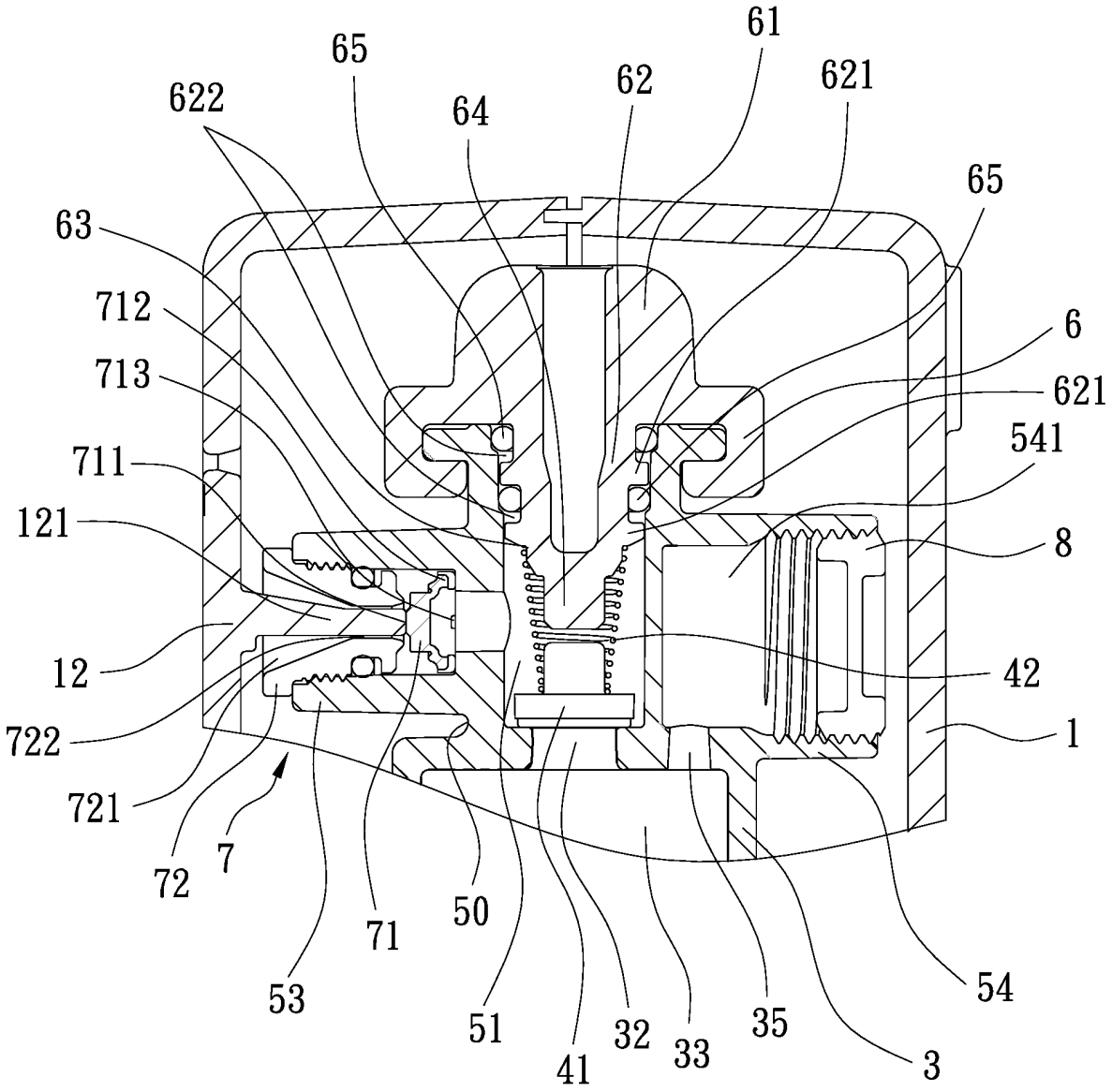
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FIG. 5

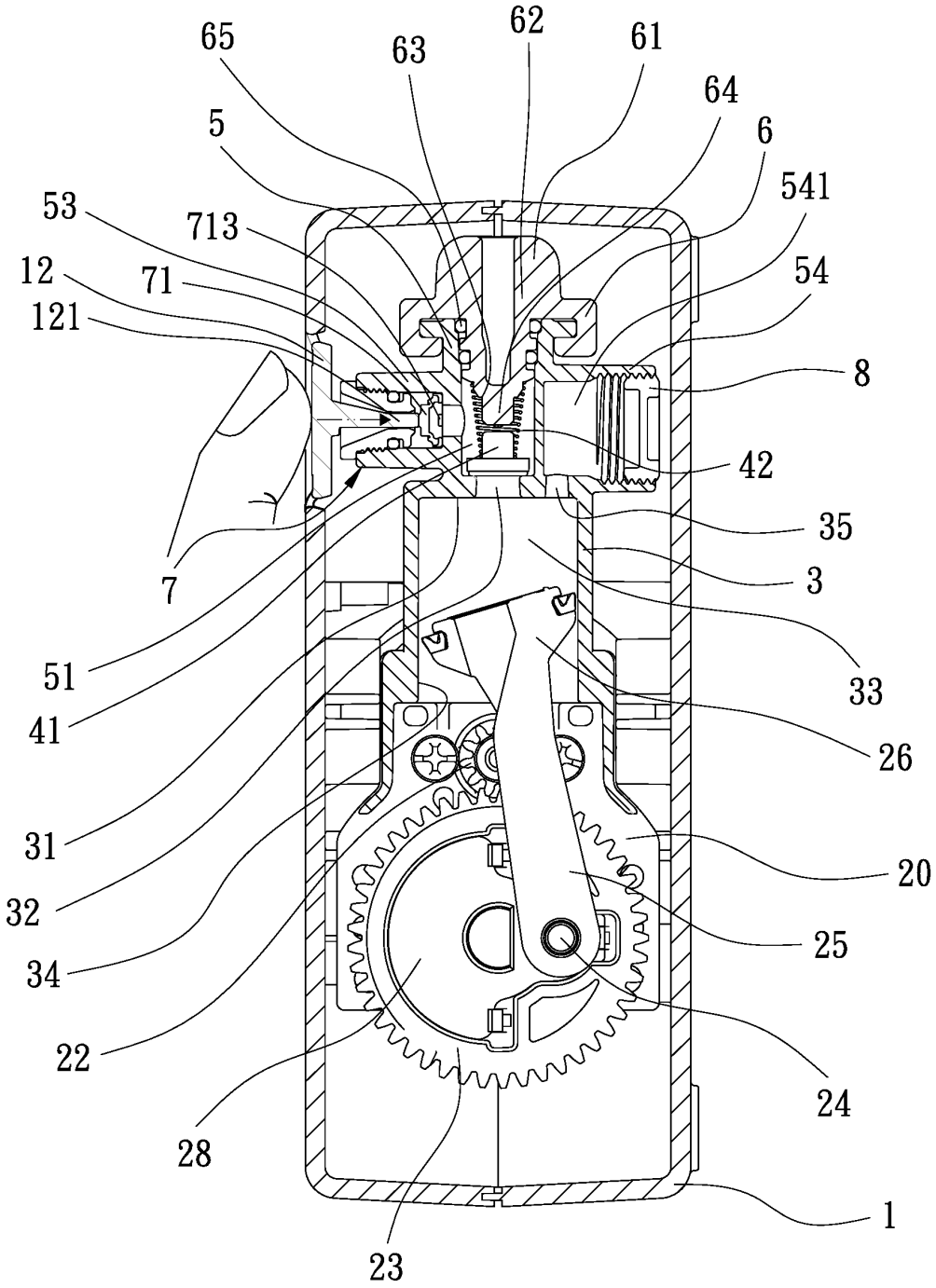
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FIG. 6

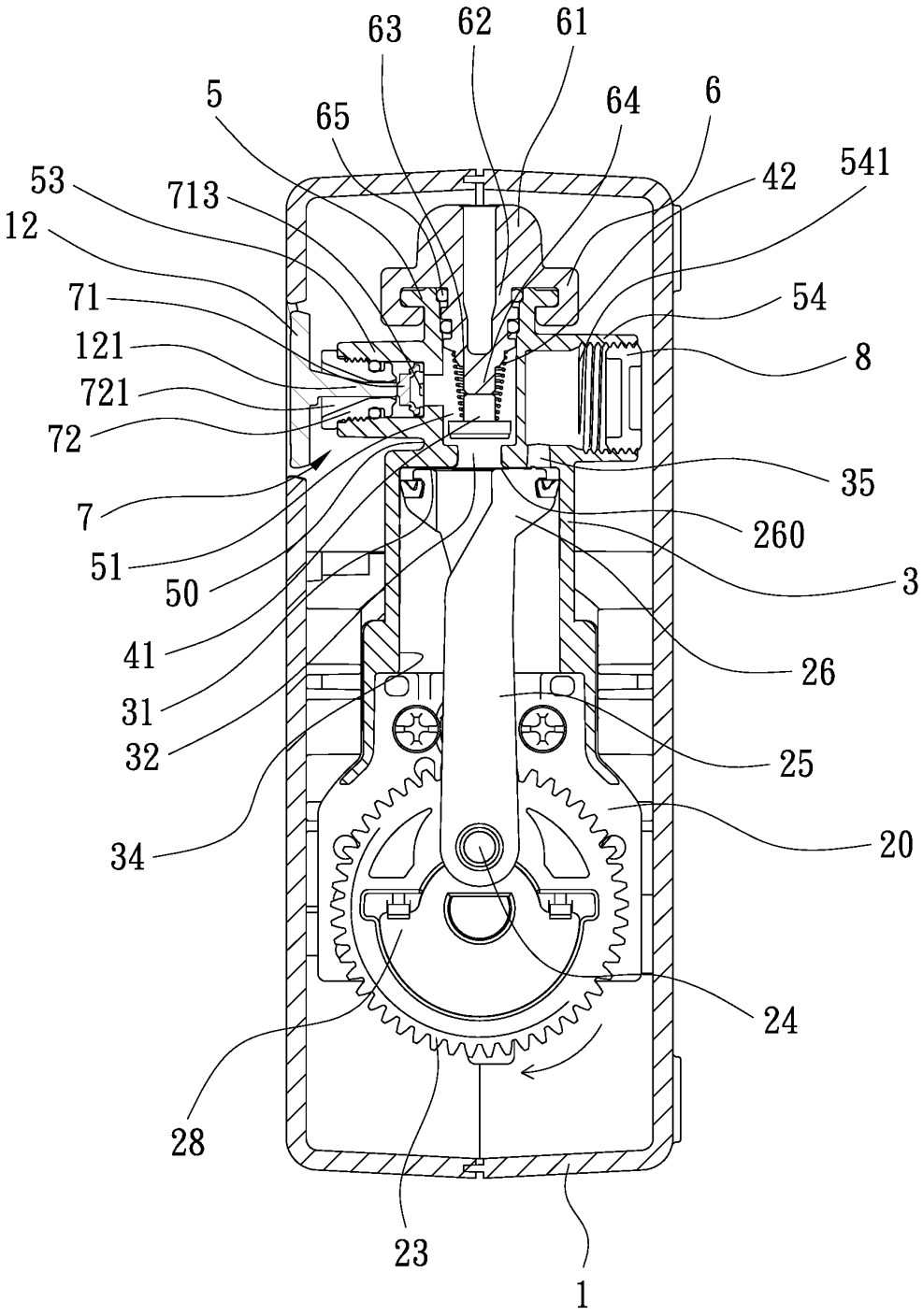
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FIG. 7

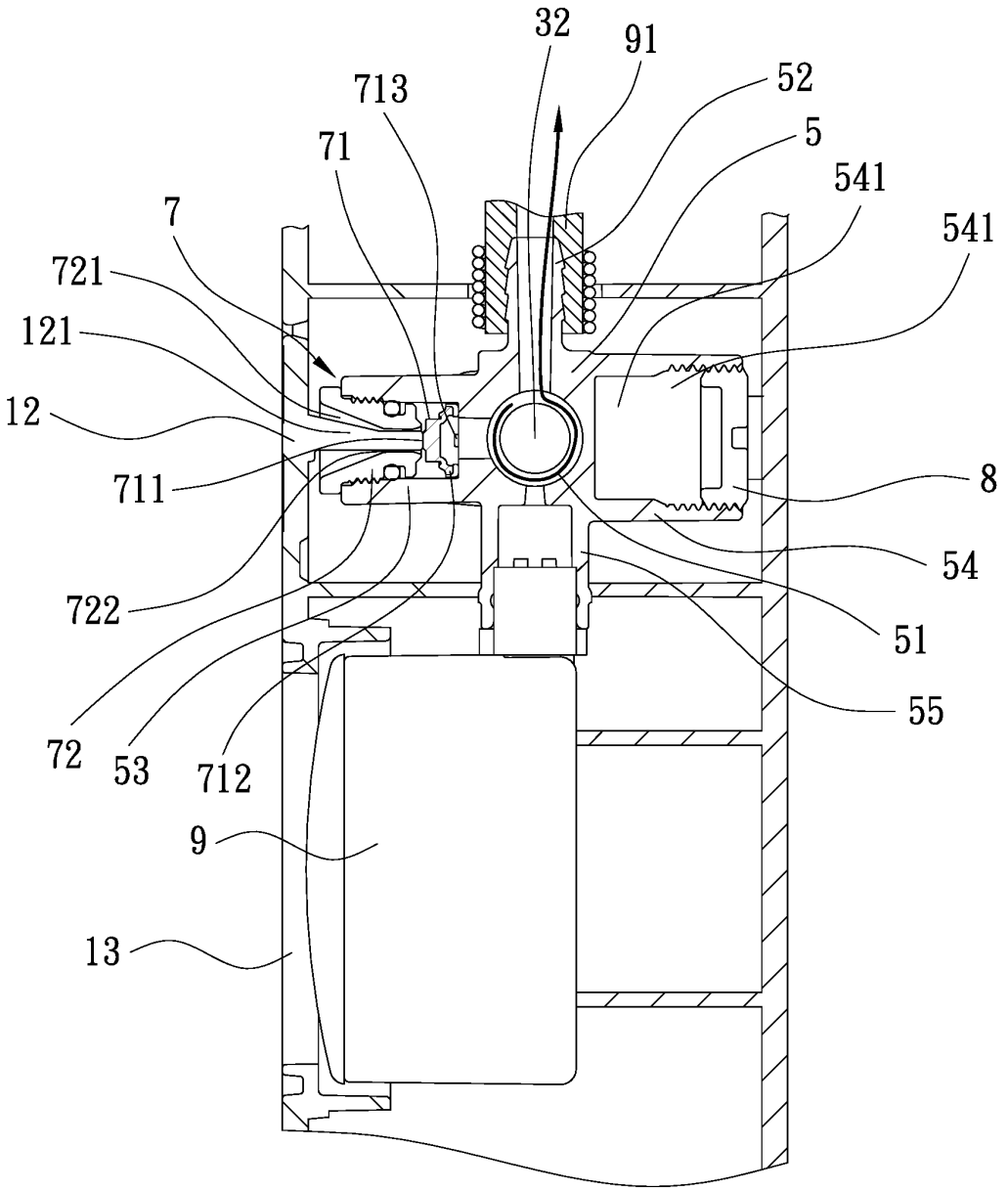
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FIG. 8

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2013/071532

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, F16K

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: compressor; ZHOU, Wensan; release valve, valve, nut

WPI, EPODOC: ZHOU W, JHOU W, compressor?, valve?, screw

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	CN 102465860 A (ZHOU, Wensan), 23 May 2012 (23.05.2012), description, paragraphs [0059]-[0060], and figures 1-4	1-4
Y	CN 1680158 A (ZHOU, Wensan), 12 October 2005 (12.10.2005), figure 1	1-4
Y	FR 2793284 A1 (RENAULT VEHICULES IND), 10 November 2000 (10.11.2000), figure 1	1-4
Y	CN 1473242 A (BRASIL COMPRESSORES SA), 04 February 2004 (04.02.2004), figure 3	1-4
A	US 2329401 A (INGERSOLL RAND CO.), 14 September 1943 (14.09.1943), the whole document	1-4

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

* Special categories of cited documents:

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"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
10 October 2013 (10.10.2013)	**14 November 2013 (14.11.2013)**
Name and mailing address of the ISA/CN: 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 **SHU, Hongning** Telephone No.: (86-10) **62085247**

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

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2013/071532

Patent Documents referred in the Report	Publication Date	Patent Family	Publication Date
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US 2329401 A	14.09.1943	None	

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

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2013/071532

CONTINUATION OF BOX A ON SECOND SHEET: CLASSIFICATION OF SUBJECT MATTER

F04B 49/24 (2006.01) i

F04B 49/035 (2006.01) i

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

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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