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(72) Inventor: **FENG, Yongbing**
Suzhou
Jiangsu 215168 (CN)

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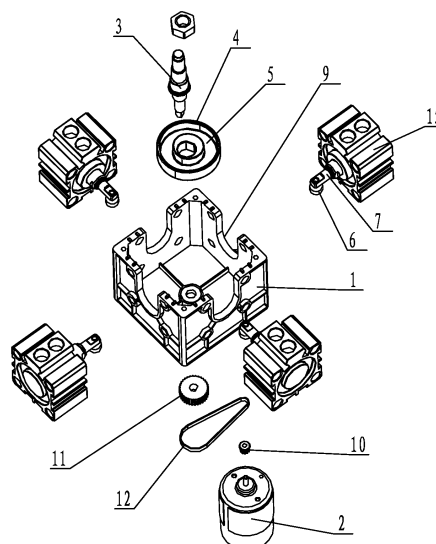
(74) Representative: **Michalski Hüttermann & Partner**
Patentanwälte mbB
Speditionstraße 21
40221 Düsseldorf (DE)

(71) Applicant: **Ecovacs Robotics (Suzhou) Co., Ltd.**
Suzhou, Jiangsu 215168 (CN)

(54) **VACUUM AIR PUMP AND GLASS-WIPING APPARATUS**

(57) A vacuum air pump and a glass-wiping device are provided. The air pump comprises a driving motor (2), an air pump body (1) and a piston air pump member (15), a rotating shaft (3) is provided in the air pump body, the driving motor transmits power to the rotating shaft via a transmission mechanism, a rotating wheel is fixed on the rotating shaft, a diameter-variable annular limitation groove (5) is formed in the rotating wheel; at least two piston air pump members are provided around the air pump body, a piston rod of each of the members is provided with a rolling element (6) at the end thereof, the rolling element is embedded in the annular limitation groove, the rotating shaft drives the rotating wheel to rotate, and the rolling element rolls within the diameter-variable annular limitation groove in the circumferential direction of the rotating shaft to thereby drive the piston rod (7) to make a reciprocating movement depending on the size change in radius of the diameter-variable annular limitation groove. The present invention may change the number of the piston air pump members so as to keep the structure simple and compact while increasing the air flow rate of the air pump, the piston rod performs a reciprocating movement uniformly and stably, and a plurality of pairs of the piston air pump members are installed at the same height, thereby reducing the volume in the shaft direction of the vacuum air pump.

FIG. 3



Description

Field of the Invention

[0001] The present invention relates to a vacuum air pump and a glass-wiping device, belonging to the technical field of mechanical manufacturing.

Back ground of the prior art

[0002] A glass-wiping robot in the prior art automatically cleans a glass by allowing a suction cup on the bottom of the machine body to be adsorbed onto the glass. The vacuum degree in the suction cup is generated by the vacuum air pump constantly performing pumping. The vacuum air pump in the prior art generally accomplishes the vacuum-pumping motion such that a motor drives two symmetrically installed pistons to perform reciprocating movement. Fig. 1 is a structural perspective view of the vacuum air pump in the prior art; and Fig. 2 is a sectional view of the vacuum air pump in the prior art. As shown in Fig. 1 in combination with Fig. 2, the vacuum air pump includes two cylinders A and B each having one air inlet hole 100A or 100B and one air outlet hole 200A or 200B, wherein the air inlet holes 100A and 100B are connected to the suction cup, and a balancing weight 300 is installed on the motor shaft 500 by overlapping with an eccentric shaft 400 radially, and wherein a bearing cone is fixed to the eccentric shaft 400, a bearing cup is fixed to the piston rods 600A and 600B, and the two piston rods 600A and 600B are disposed oppositely, and thus when the motor 700 rotates, the two piston rods 600A and 600B will make an expand and contract movement oppositely by the driving of the bearing 300 so that the two air cylinders A and B perform air inhaling and air exhausting respectively to pump constantly in the suction cup to maintain the vacuum degree therein.

[0003] The above vacuum air pump uses only a pair of pistons for vacuum pumping and thus the air flow of the air pump is small, and if the suction cup is lifted by particles on the glass surface, it will lose the vacuum degree soon, thereby making the machine body fall off the glass surface. If the air flow of the air pump increases, the suction cup may recovery the vacuum degree immediately even if air leakage occurs, thereby preventing the machine body from falling off. The air flow of the air pump may be increased by increasing the number of the air pumps, and according to the current way, it can be achieved only by stacking the piston rods on the motor shaft. As a result, the vacuum air pump will have a larger shaft length, and thus has a complicated and non-compact structure, which will significantly affect the appearance and volume of the glass-wiping robot.

Summary of the Invention

[0004] With view of the above, the present invention

provides a vacuum air pump and a glass-wiping device, in which the vacuum air pump may increase the number of piston air pump members as needed and may keep the structure simple and compact while increasing the air flow rate of the air pump. Even if the suction cup is lifted by particles on the glass surface, it will not lose the vacuum degree soon for the reason that the air flow rate of the vacuum air pump is so large that the glass-wiping device using the above-mentioned vacuum air pump effectively prevents the phenomenon that the machine body of the glass-wiping device falls off the glass surface.

[0005] The technical problem is solved by the following technical solutions of the present invention.

[0006] A vacuum air pump comprises a driving motor, an air pump body and a piston air pump member provided on the air pump body, a rotating shaft is provided in the air pump body, the driving motor transmits power to the rotating shaft through a transmission mechanism, a rotating wheel is fixed on the rotating shaft, a diameter-variable annular limitation groove is formed in one side surface of the rotating wheel; at least two piston air pump members are provided around the air pump body, a piston rod of each of the piston air pump members is provided with a rolling element at the end thereof, the rolling element is embedded in the diameter-variable annular limitation groove, the rotating shaft drives the rotating wheel to rotate, and the rolling element rolls in the circumferential direction of the rotating shaft within the diameter-variable annular limitation groove, thereby driving the piston rod to perform a reciprocating movement depending on the size change in radius of the diameter-variable annular limitation groove.

[0007] As needed, the diameter-variable annular limitation groove is an eccentric groove, an irregularly-shaped groove or an elliptical groove.

[0008] The piston air pump members are provided around the air pump body in pairs. The pair number of the piston air pump members may be one to three.

[0009] In order to adjust the air flow rate of the vacuum air pump as needed while keeping the simple and compact structure of the vacuum air pump, a plurality of pairs of the piston air pump members are uniformly provided at regular angle and interval in the circumferential direction of the eccentric wheel.

[0010] For reducing wear, the rolling element may be a bearing or a roller.

[0011] For ease of arrangement, the outer shape of the air pump body is a polygon prism or a cylinder.

[0012] For the stable connection of the piston air pump members with the air pump body, the air pump body is provided with positioning grooves, the positions of which correspond to the positions where the piston air pump members are provided and the shapes of which correspond to the outline shapes of the piston air pump members.

[0013] The present invention also provides a glass-wiping device comprising a suction unit and a walking unit, the glass-wiping device sucks onto the glass surface

through the suction unit, the suction unit includes a suction cup and a vacuum air pump, and the vacuum air pump supplies a vacuum suction force for the suction cup, wherein the vacuum air pump is the above-mentioned vacuum air pump.

[0014] As needed, various transmission mechanisms may be used to transmit the power from the driving motor to the rotating shaft, for example, the transmission mechanism may comprise a synchronous wheel provided on the shaft of the driving motor and a synchronous belt wheel provided on the rotating shaft, wherein the synchronous wheel and the synchronous belt wheel are connected to each other via a synchronous belt; and the transmission mechanism may also comprise a driving gear provided on the shaft of the driving motor and a driven gear provided on the rotating shaft, wherein the driving gear and the driven gear are engaged with each other.

[0015] From the above, the present invention provides a vacuum air pump in which the number of the piston air pump members may be increased as needed, and a plurality of the piston air pump members are connected to the air pump body through the diameter-variable annular limitation groove including the eccentric groove, the irregularly-shaped groove and the elliptical groove and the rolling element for keeping the structure simple and compact while increasing the air flow rate of the air pump, which both ensures that the piston rods each perform a reciprocating movement uniformly and stably and ensures that the plurality of pairs of the piston air pump members are installed at the same height, significantly reducing the volume in the shaft direction of the vacuum air pump,

[0016] The technical solutions of the present invention will be described in detail with reference to the following accomplishing drawings and specific embodiments.

Description of attached drawings

[0017]

Fig 1 is a structural perspective view of a vacuum air pump in the prior art;

Fig 2 is a sectional view of the vacuum air pump in the prior art;

Fig. 3 is an exploded structural view of the first embodiment of the present invention;

Fig. 4 is a sectional view of the first embodiment of the present invention;

Fig. 5 is a structural view of an assembly of the first embodiment of the present invention;

Fig. 6 is a structural view of an assembly of the second embodiment of the present invention;

Fig. 7 is a structural view of a diameter-variable annular limitation groove of the third embodiment of the present invention; and

Fig. 8 is a structural view of a diameter-variable annular limitation groove of the fourth embodiment of

the present invention.

Detailed Description of Preferred Embodiments

First Embodiment

[0018] Fig. 3 is an exploded structural view of the first embodiment of the present invention; Fig. 4 is a sectional view of the first embodiment of the present invention; and Fig. 5 is a structural view of an assembly of the first embodiment of the present invention. As shown in Figs. 3 to 5, the present invention provides a vacuum air pump comprising a driving motor 2, an air pump body 1 and a piston air pump member 15 provided on the air pump body 1, wherein a rotating shaft 3 is provided in the air pump body 1, the driving motor 2 transmits power to the rotating shaft 3 through a transmission mechanism, and a rotating wheel is fixed on the rotating shaft 3. A diameter-variable annular limitation groove 5 is formed on one side surface of the rotating wheel and may use various shapes, and in the present embodiment, the rotating wheel is an eccentric wheel 4 and thus the diameter-variable annular limitation groove 5 formed on one side surface of the eccentric wheel 4 is round. Four piston air pump members 15 are provided around the air pump body 1, the piston rod 7 of each of the piston air pump members 15 is provided with a rolling element 6 at the end thereof, the rolling element 6 is embedded in the diameter-variable annular limitation groove 5, the rotating shaft 3 drives the eccentric wheel 4 to rotate, and the rolling element 6 rolls in the circumferential direction of the rotating shaft 3 within the diameter-variable annular limitation groove 5, thereby driving the piston rod 7 to perform a reciprocating movement. For reducing wear, the rolling element 6 may be a bearing or the roller.

[0019] In order to adjust the air flow rate of the vacuum air pump while maintaining the simple and compact structure of the vacuum air pump if necessary, a plurality of the piston air pump members 15 are uniformly provided in the circumference direction of the eccentric wheel 4 at a regular angle and interval. The piston air pump members 15 may be provided in pairs around the air pump body 1, and the pair number may be one to three. That is, the number of the piston air pump members 15 provided around the air pump body 1 is either an odd number or an even number. Generally, when the diameter-variable annular limitation grooves 5 have a regular shape, the piston air pump members 15 are provided in pairs (i.e., the number of the piston air pump members 15 is an even number) around the air pump body 1 so that the strain applied to the output shaft of the motor is uniform; and when the diameter-variable annular limitation grooves 5 have an irregular shape, the piston air pump members 15 may be not provided in pairs (i.e., the number of the piston air pump members 15 is an odd number) around the air pump body 1. In this case, it will be appreciated that they may be also provided in pairs. For ease of arrangement, the outer shape of the air pump

body 1 is a polygon prism or a cylinder. In the embodiments shown in Figs. 3 to 5, the outer shape of the air pump body 1 is a quadrangular prism. Two pairs of piston air pump members 15 are provided (i.e., the number of the piston air pump members 15 is four) in the four directions of the air pump body 1.

[0020] As shown in Fig. 3, in order for the reliable connection of the piston air pump members 15 with the air pump body 1, the air pump body 1 is provided with positioning grooves 9, the positions of which correspond to the positions where the piston air pump members 15 are provided and the shapes of which correspond to the outer shapes of the piston air pump members 15. If necessary, various transmission mechanisms may be used to transmit power from the driving motor 2 to the rotating shaft 3. For example, the transmission mechanism in the present embodiment comprises a synchronous wheel 10 provided on the shaft of the driving motor 2 and a synchronous belt wheel 11 provided on the rotating shaft 3, wherein the wheels 10 and 11 are connected to each other via a synchronous belt 12.

[0021] As shown in Figs. 3 to 5, the operation process of the vacuum air pump of the present invention is as follows: when the vacuum air pump starts to operate, the driving motor 2 rotates, and its output shaft drives the rotating shaft 3 to rotate via the synchronous wheel 10, the synchronous belt 12 and the synchronous belt wheel 11. While the rotating shaft 3 rotates, the rolling element 6 (i.e., bearing or roller) embedded in the diameter-variable annular limitation groove 5 rolls in the circumferential direction of the rotating shaft 3 within the diameter-variable annular limitation groove 5, thereby driving the piston rod 7 to perform a reciprocating movement. Specifically, as the rolling element 6 rolls in the circumferential direction of the rotating shaft 3 within the diameter-variable annular limitation groove 5, the distance from the end of the piston rod 7 to the rotating center of the eccentric wheel 4 varies in different directions of the eccentric circumference of the eccentric wheel. With the propulsive force from the inside of the outer wall of the diameter-variable annular limitation groove 5, the end of the piston rod 7 is pulled towards the rotating center of the eccentric wheel 4 so that the piston rod 7 is gradually extended to the maximum length; and with the propulsive force from the outside of the inner wall of the diameter-variable annular limitation groove 5, the end of the piston rod 7 is pulled away from the rotating center of the eccentric wheel 4 so that the piston rod 7 is gradually retracted to the minimum length. Four piston rods 7 provided around the air pump body 1 perform the reciprocating movement in turns, thereby accomplishing vacuum pumping. As shown in Fig. 5, four piston air pump members 15 provided around the air pump body 1 are indicated by the numbers 1, 2, 3 and 4 respectively in the clockwise direction. When the eccentric wheel 4 rotates once, each of the cylinders connected to the eccentric wheel 4 performs the reciprocating movement for one time, and the four cylinders indicated by the numbers

1, 2, 3 and 4 each accomplish four states of air in, hold, hold and air out sequentially, hereby completing the vacuum pumping. During the motion process as discussed above, the diameter-variable annular limitation grooves 5 provide both driving and limiting functions.

Second Embodiment

[0022] Fig. 6 is a structural view of the assembly of the second embodiment of the present invention. As shown in Fig. 6, the difference of the present embodiment from the first embodiment is: in the present embodiment, the piston air pump members 15 are provided in three pairs, i.e., six piston air pump members 15 indicated by the numbers 1 to 6 are provided uniformly around the air pump body 1. For the reason that the number of the piston air pump members 15 becomes greater, the outer shape of the air pump body 1 is a cylinder, for ease of arrangement.

[0023] In addition, the transmission mechanism in the present embodiment has a different structure from that of the first embodiment, and comprises a driving gear provided on the shaft of the driving motor 2 and a driven gear provided on the rotating shaft 3, wherein the driving gear and the driven gear are engaged with each other.

[0024] Other technical features of the present embodiment are substantially the same as those of the first embodiment and their detailed description can be consulted in the first embodiment and will be omitted herein.

Third Embodiment

[0025] Fig. 7 is a structural view of a diameter-variable annular limitation groove of the third embodiment of the present invention. As shown in Fig. 7, the diameter-variable annular limitation groove in the present embodiment is an irregularly-shaped groove 1000. The piston air pump members 15 are provided around the air pump body in plural pairs, the piston rod 7 of each of the piston air pump members 15 is provided with a rolling element at the end, the rolling element is embedded in the irregularly-shaped groove 1000, the rotating shaft drives the rotating wheel to rotate, and the rolling element rolls within the irregularly-shaped groove 1000 in the circumferential direction of the rotating shaft to thereby drive the piston rod 7 to make a reciprocating movement depending on the size change in radius of the irregularly-shaped groove 1000.

The Fourth Embodiment

[0026] Fig. 8 is a structural view of a diameter-variable annular limitation groove of the fourth embodiment according to the present invention. As shown in Fig. 8, the diameter-variable annular limitation groove in the present embodiment is an elliptical groove 2000. The piston air pump members 15 are provided around the air pump body in plural pairs, the piston rod 7 of each of the piston

air pump members 15 is provided with a rolling element at the end, the rolling element is embedded in the elliptical groove 2000, the rotating shaft drives the rotating wheel to rotate, and the rolling element rolls within the elliptical groove in the circumferential direction of the rotating shaft, due to that the elliptical groove 2000 has long and short axes, to thereby drive the piston rod 7 to make a reciprocating movement depending on the size change in long and short axes of the elliptical groove 2000. In particular, when the elliptical groove 2000 is symmetrical with respect to the rotating shaft and the piston air pump members 15 are provided symmetrically in pairs and at two sides of the elliptical groove 2000, the piston rods 7 provided symmetrically are always on the equal-diameters (such as, the long axis or the short axis) of the elliptical groove simultaneously such that two sides of the rotating shaft are stressed equally to thereby achieve a better shock-absorbing effect.

[0027] The present invention also provides a glass-wiping device comprising a suction unit and a walking unit, the glass-wiping device sucks onto the glass surface through the suction unit, the suction unit includes a suction cup and a vacuum air pump, and the vacuum air pump supplies a vacuum suction force for the suction cup, wherein the vacuum air pump is any one of the vacuum air pumps present in the above-mentioned embodiments.

[0028] From the above, the present invention provides a vacuum air pump in which the number of the piston air pump members may be increased as needed so as to adjust the air flow rate of the vacuum air pump; and a plurality of pairs of the piston air pump members are connected to the air pump body through the diameter-variable annular limitation groove including the eccentric groove, the irregularly-shaped groove and the elliptical groove and the rolling element for keeping the structure simple and compact while increasing the air flow rate of the air pump, which both ensures that the piston rods each make a reciprocating movement uniformly and stably and ensures that the plurality of pairs of the piston air pump members are installed at the same height, significantly reduces the height in the shaft direction of the vacuum air pump, makes the structure more compact and thus saves space. Even if the suction cup is lifted by particles on the glass surface, it will not lose the vacuum degree soon due to that the air flow rate of the vacuum air pump is large, so that the glass-wiping device using the above-mentioned vacuum air pump effectively prevents the phenomenon that the machine body of the glass-wiping device falls off the glass surface.

Claims

1. A vacuum air pump comprises a driving motor (2), an air pump body (1) and a piston air pump member (15) provided on the air pump body, **characterized in that**, a rotating shaft (3) is provided in the air pump

body (1), the driving motor (2) transmits power to the rotating shaft (3) via a transmission mechanism, a rotating wheel is fixed on the rotating shaft (3), a diameter-variable annular limitation groove (5) is formed in one side surface of the rotating wheel; at least two piston air pump members (15) are provided around the air pump body (1), a piston rod (7) of each of the piston air pump members (15) is provided with a rolling element (6) at the end thereof, the rolling element (6) is embedded in the diameter-variable annular limitation groove (5), the rotating shaft (3) drives the rotating wheel to rotate, and the rolling element (6) rolls within the diameter-variable annular limitation groove (5) along the circumferential direction of the rotating shaft (3) to thereby drive the piston rod (7) to make a reciprocating movement depending on the size change in radius of the diameter-variable annular limitation groove.

2. The vacuum air pump of Claim 1, **characterized in that**, the diameter-variable annular limitation groove (5) is an eccentric groove, an irregularly-shaped groove or an elliptical groove.
3. The vacuum air pump of Claim 1, **characterized in that**, the piston air pump members (15) are provided around the air pump body (1) in pairs.
4. The vacuum air pump of Claim 3, **characterized in that**, the piston air pump members (15) are well-distributed provided in the circumferential direction of the rotating wheel at an equal angel interval.
5. The vacuum air pump of Claim 3, **characterized in that**, the pair number of the piston air pump members (15) is one to three.
6. The vacuum air pump of Claim 5, **characterized in that**, the outer shape of the air pump body (1) is a polygon prism or a cylinder.
7. The vacuum air pump of Claim 4, **characterized in that**, the air pump body (1) is provided with a positioning groove (9), the position of the positioning groove (9) corresponds to the position where the piston air pump member (15) is provided, and the shape of the positioning groove (9) corresponds to the outer shape of the piston air pump member (15).
8. The vacuum air pump of Claim 1, **characterized in that**, the transmission mechanism comprises a synchronous wheel (10) provided on the shaft of the driving motor and a synchronous belt wheel (11) provided on the rotating shaft (3), wherein the synchronous wheel (10) and the synchronous belt wheel (11) are connected to each other via a synchronous belt (12).

9. The vacuum air pump of Claim 1, **characterized in that**, the transmission mechanism comprises a driving gear provided on the shaft of the driving motor and a driven gear provided on the rotating shaft, wherein the driving gear and the driven gear are engaged with each other. 5
10. The vacuum air pump of Claim 1, **characterized in that**, the rolling element (6) is a bearing or a roller. 10
11. A glass-wiping device comprises a suction unit and a walking unit, the glass-wiping device is adsorbed onto the glass surface through the suction unit, the suction unit includes a suction cup and a vacuum air pump, and the vacuum air pump supplies a vacuum suction force for the suction cup, **characterized in that**, the vacuum air pump is the vacuum air pumps of any one of Claims 1 to 10. 15

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FIG. 1

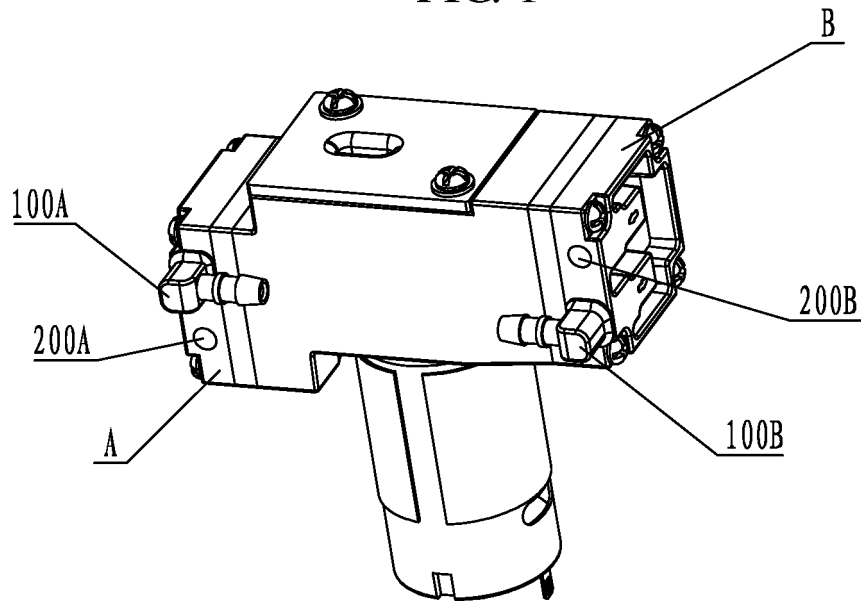


FIG. 2

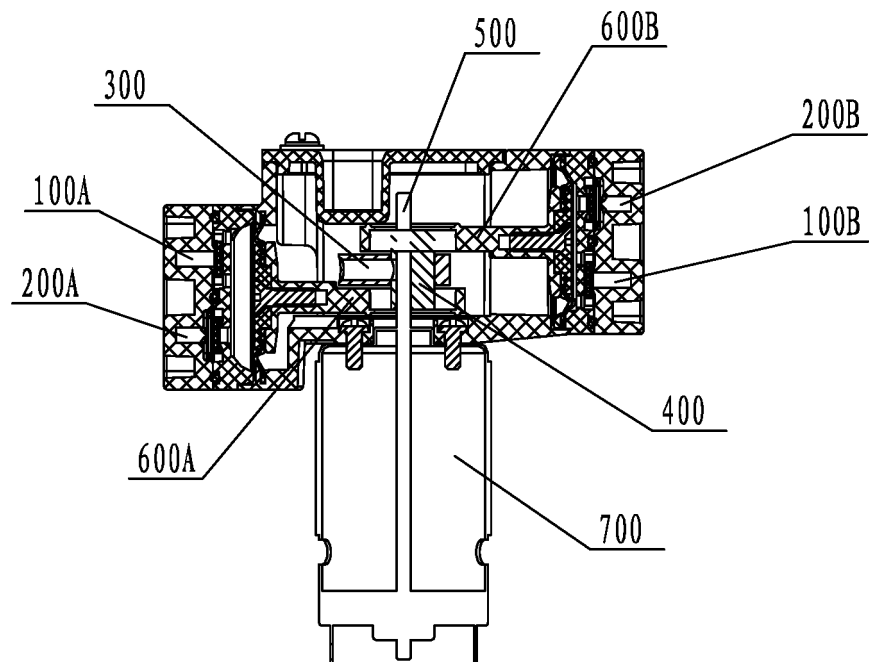


FIG. 3

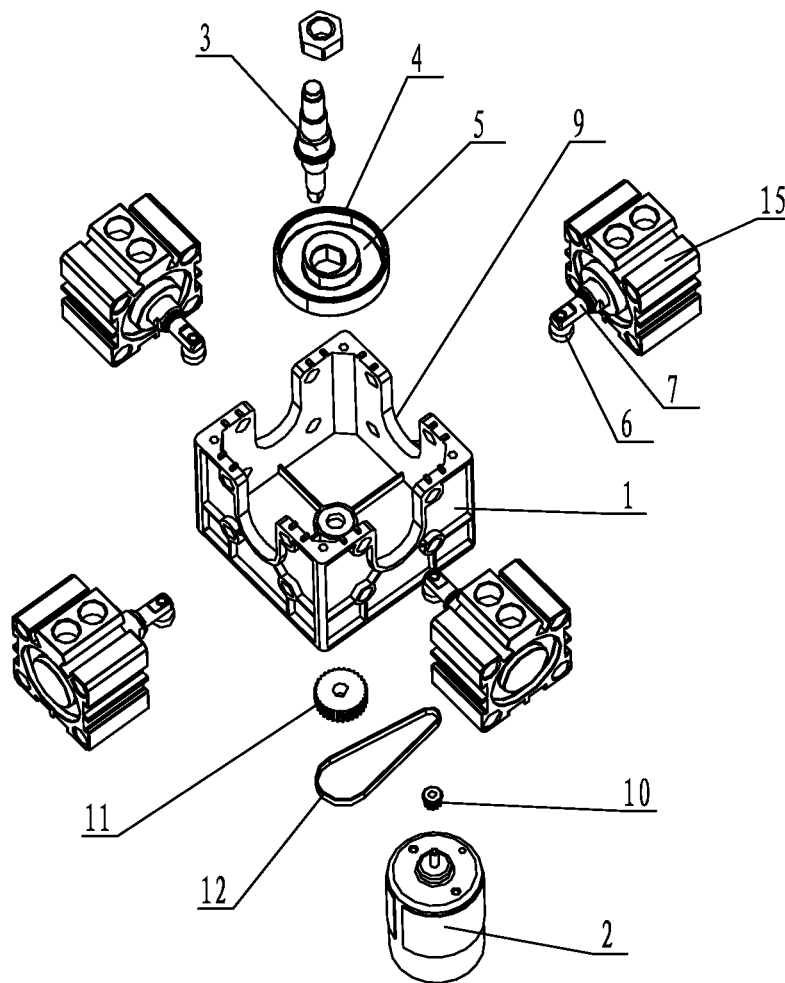


FIG. 4

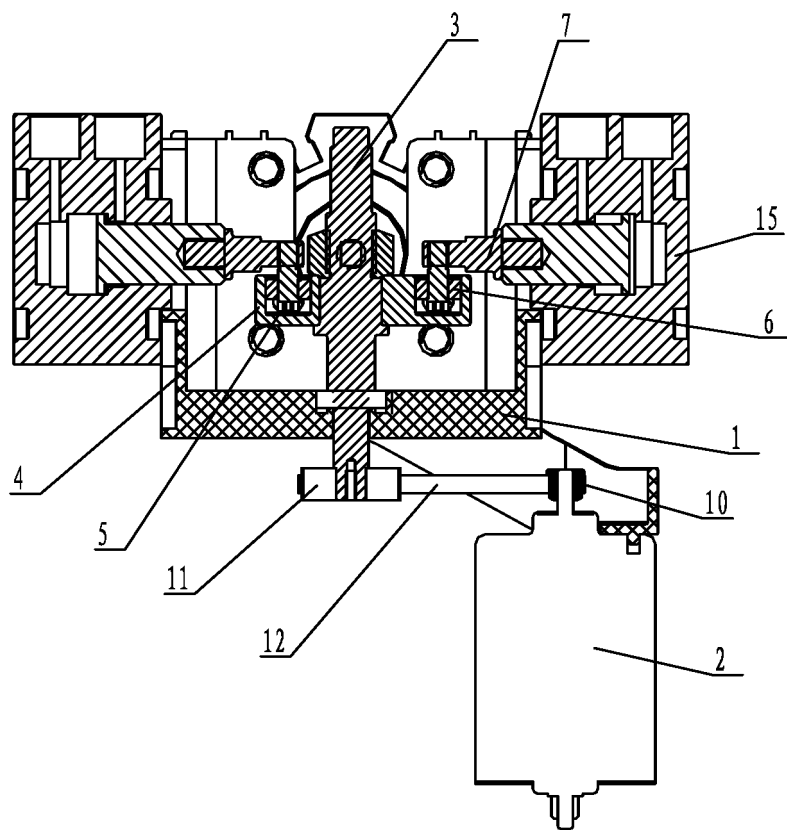


FIG. 5

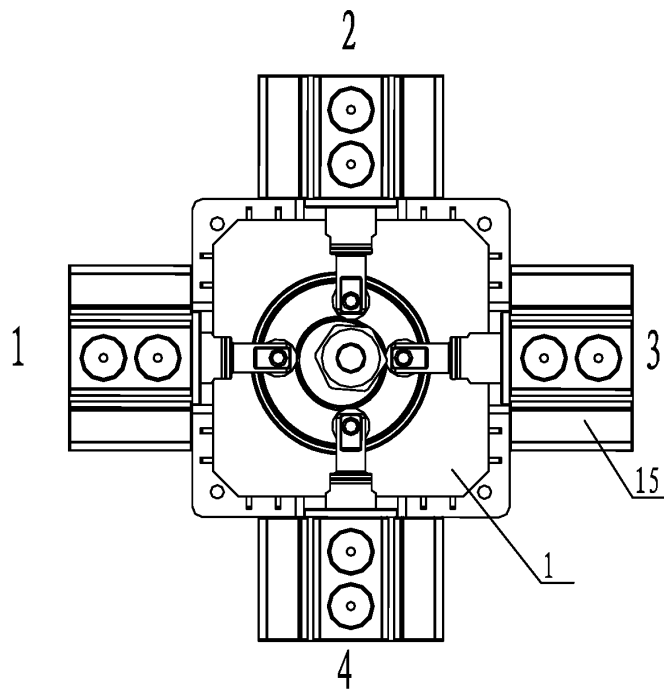


FIG. 6

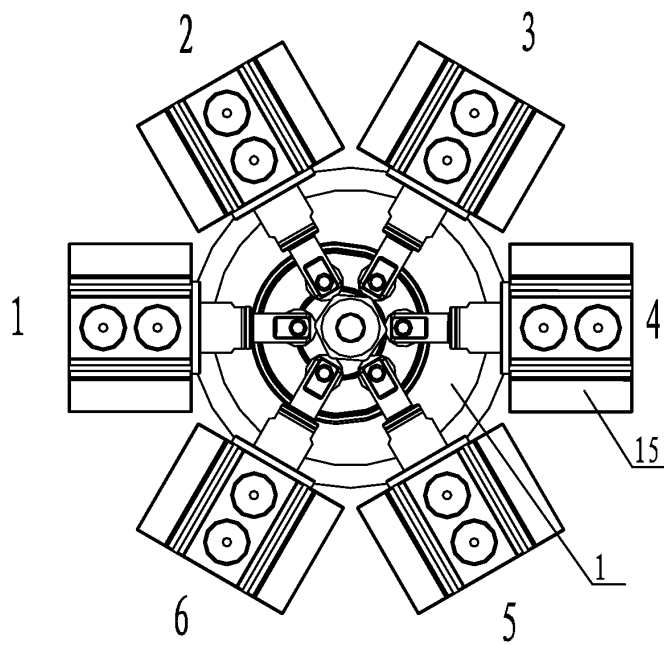


FIG. 7

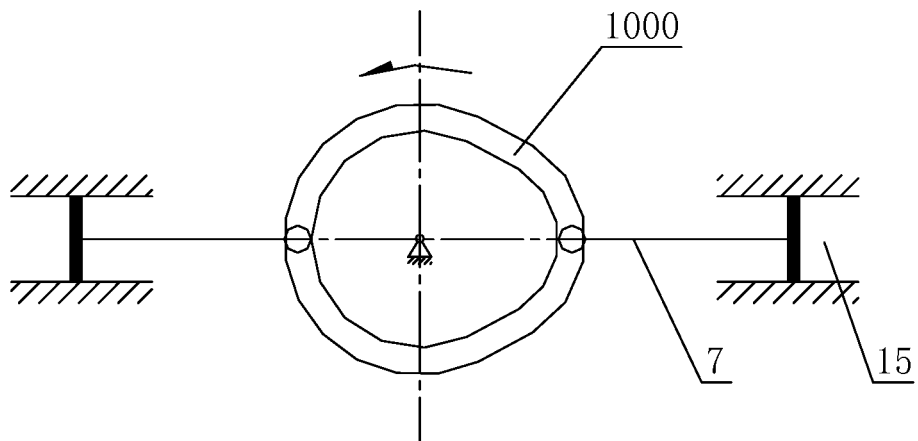
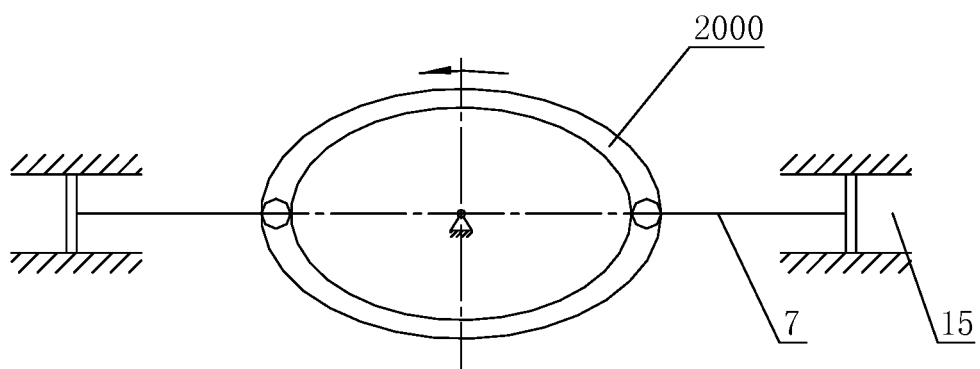


FIG. 8



INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2014/072978

A. CLASSIFICATION OF SUBJECT MATTER

F04B 35/01(2006.01) i; F04B 37/14 (2006.01) i; A47L 1/02 (2006.01) n

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)

F04B, A47L

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)

CNABS, VEN, TWTXT, CNKI: ECOVACS ROBOTICS, rotary slot, rotary ring, irregular, oval, piston rod, radius, change, variable diameter, vacuum, pump, piston, disc, table, ring, disk, wheel, pulley, rotat+, turn+, rotary, eccentric, groove, slot, clean+, window, glass

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
PX	CN 203130411 U (ECOVACS ROBOTICS (SUZHOU) CO., LTD.), 14 August 2013 (14.08.2013), claims 1-11	1-11
X	CN 101315074 A (ZHANG, Guiyun), 03 December 2008 (03.12.2008), description, particular embodiments, and figures 1-2	1-9
Y	CN 101315074 A (ZHANG, Guiyun), 03 December 2008 (03.12.2008), description, particular embodiments, and figures 1-2	2, 10, 11
Y	CN 101696681 A (ZHEJIANG HONGYOU AIR COMPRESSOR MANUFACTURING CO.,LTD.), 21 April 2010 (21.04.2010), description, paragraph 0025, and figures 1-4	2, 10, 11
Y	CN 202376015 U (WANG, Jingyu), 15 August 2012 (15.08.2012), description, paragraphs 0018-0022, and figure 1	11
A	CN 201802572 U (ZHONGHEYA CO., LTD.), 20 April 2011 (20.04.2011), the whole document	1-11

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

* Special categories of cited documents:	"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
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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	"&" document member of the same patent family

Date of the actual completion of the international search

13 May 2014 (13.05.2014)

Date of mailing of the international search report

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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

YU, Hui

Telephone No.: (86-10) 62413092

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2014/072978

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 2008152055 A1 (D.V.P. VACUUM TECHNOLOGY S.R.L.), 18 December 2008 (18.12.2008), the whole document	1-11
A	JP 2005256793 A (YOSHIMOTO SEISAKUSHO K. K.), 22 September 2005 (22.09.2005), the whole document	1-11

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

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/CN2014/072978

Patent Documents referred in the Report	Publication Date	Patent Family	Publication Date
CN 203130411 U	14.08.2013	None	
CN 101315074 A	03.12.2008	None	
CN 101696681 A	21.04.2010	None	
CN 202376015 U	15.08.2012	None	
CN 201802572 U	20.04.2011	None	
WO 2008152055 A1	18.12.2008	ITB 020070418 A1	15.12.2008
		ITB 020080177 A1	21.09.2009
JP 2005256793 A	22.09.2005	None	

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