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(54) **APPARATUS FOR ADJUSTING TOP CLEARANCE OF RECIPROCATING COMPRESSOR**

VORRICHTUNG ZUR EINSTELLUNG DES OBEREN SPIELS EINES HUBKOLBENKOMPRESSORS

APPAREIL DE RÉGLAGE DU DÉGAGEMENT SUPÉRIEUR D'UN COMPRESSEUR ALTERNATIF

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Description

Technical Field

[0001] The present invention relates to an apparatus for adjusting a top clearance of a reciprocating compressor, and more particularly, to an apparatus for adjusting a top clearance of a reciprocating compressor capable of readily adjusting a top clearance between a bottom surface of a piston and a valve, without the need to disassemble components.

Background Art

[0002] A reciprocating compressor is composed of a piston, a piston drive apparatus, a cylinder block, and a valve, and widely used in a compressor, a pump, or the like.

[0003] FIGS. 1A and 1B illustrate a swash plate type compressor disclosed in Korean Patent Registration No. 0519744, as an example of a reciprocating compressor.

[0004] As shown in FIG. 1A, the conventional variable displacement swash plate type compressor 10 includes a cylinder block 11 having a plurality of cylinder bores 11a arranged in parallel in a longitudinal direction at its inner periphery, a front housing 12 sealed in the front of the cylinder block 11, and a rear housing 13 sealed in the rear of the cylinder block 11 with a valve plate 13a interposed therebetween.

[0005] A crank chamber 14 is disposed inside the front housing 12. One end of a drive shaft 15 passing through the crank chamber 14 is rotatably installed at the center of the front housing 12 and the other end of the drive shaft 15 is supported by a bearing 11c at a center shaft hole 11b in the cylinder block 11.

[0006] In addition, a lug plate 16 and a swash plate 17 are installed on the drive shaft 15, and a spring 27 is interposed between the lug plate 16 and the swash plate 17 to resiliently support the swash plate 17 against the lug plate 16.

[0007] The lug plate 16 has a pair of power transmission projections 16a each having a straight hinge hole 16b and projecting from one surface thereof to be simultaneously rotated with the drive shaft 15. The swash plate 17 is inserted into the drive shaft 15 at a predetermined angle, and hinge pins 18 are inserted into the hinge holes 16b formed at the power transmission projections 16a of the lug plate 16, such that the swash plate 17 rotates with the lug plate 16, causing it to vary in inclination.

[0008] Further, shoes 20 are inserted into an outer periphery of the swash plate 17 to be slidably inserted into pistons 19 disposed in the cylinder bores 11a.

[0009] Therefore, as the swash plate 17 rotates in a tilted state, the pistons 19 inserted into the outer periphery of the swash plate 17 via the shoes 20 reciprocate in the cylinder bores 11a of the cylinder block 11.

[0010] In addition, the rear housing 13 has a suction chamber 21 and a discharge chamber 22. The valve plate 13a interposed between the rear housing 13 and the cylinder block 11 has suction ports 23 and discharge ports 24 corresponding to the cylinder bores 11a.

[0011] Each of the suction ports 23 and the discharge ports 24 formed at the valve plate 13a has a suction lid 25 and a discharge lid 26, respectively, which open and close the suction port 23 and the discharge port 24 in response to pressure variation caused by reciprocation of the piston 19.

[0012] Further, the rear housing 13 has a control valve 28 for communicating the crank chamber 14 with the suction chamber 21 such that a difference between a coolant suction pressure in the cylinder bore 11a and a pressure in the crank chamber 14 is varied to adjust inclination of the swash plate 17.

[0013] As described above, the conventional variable displacement swash plate type com pressor 10 adjusts inclination of the swash plate 17 in response to the pressure difference between a pressure in the crank chamber 14 and a suction pressure in the cylinder bore 11a, as shown in FIGS. 1A, 1B, and 2, to adjust a stroke of the piston 19 connected to the swash plate 17 depending on inclination variation of the swash plate 17, thereby varying discharge capacity of the compressor.

[0014] Meanwhile, as shown in FIG. 1B, there is a top clearance TC between the valve plate 13a and the piston 19. Although the top clearance TC is necessary to prevent a collision between the piston 19 and the valve plate 13a, it is practical to minimize the top clearance for increased compression efficiency.

[0015] In addition, the top clearance TC may be adjusted as necessary.

[0016] In this case, as shown in FIG. 1A, a thrust bearing 31 having a predetermined width is installed between the cylinder block 11 and the drive shaft 15.

[0017] Therefore, when the top clearance is modified depending on characteristics of the valve or piston, the only solution is to replace the thrust bearing 31. However, the replacement of the thrust bearing 31 requires disassembly of the entire set of components making the operation troublesome.

[0018] Moreover, if there is no fitting thrust bearing to produce the required top clearance, additional costs are incurred to manufacture a separate thrust bearing.

[0019] Meanwhile, FIG. 2 illustrates another swash plate type compressor disclosed in Korean Patent Registration No. 0529716.

[0020] In the conventional compressor, a top clearance is obtained by a bearing 78 interposed between two laces 77. In this case, the top clearance can be adjusted by changing the thickness of any of the two laces 77.

[0021] However, to precisely adjust the top clearance according to the conventional art, laces 77 of various thicknesses are needed, thereby causing storage and maintenance difficulties, and complicating assembly.

[0022] A compressor having an apparatus for adjusting as defined in the preamble of claim 1 is know e.g. from US Patent 5,063,829. The above problems can be gen-

erated in various reciprocating compressors that are composed of a pump, a piston, a piston drive unit, a valve, a cylinder block, and so on, as well as the aforementioned compressor.

Disclosure of Invention

Technical Problem

[0023] An object of the present invention is to provide an apparatus for adjusting a top clearance capable of precisely and conveniently adjusting the top clearance on the basis of characteristics of a valve or piston of a reciprocating compressor.

Technical Solution

[0024] An aspect of the invention provides an apparatus for adjusting a top clearance of a reciprocating compressor including: a housing, a cylinder block having a plurality of cylinder bores, pistons reciprocally accommodated in the cylinder bores, a piston drive means for driving the pistons, a drive shaft connected to the pistons, suction/discharge valves installed opposite to bottoms of the pistons, and a suction chamber and a discharge chamber formed in the housing through the medium of the suction/discharge valves, characterized in that the drive shaft has a conveyance nut threadedly engaged therearound, and in that when seen in an axial direction of the piston connection shaft, the conveyance nut may have a fixing groove having a plurality of prominences and depressions formed at the center of the conveyance nut in a circumferential direction, a fixing washer having prominences and depressions formed therearound may be installed in the fixing groove, and the fixing washer may pass through the drive shaft.

[0025] The fixing washer may be formed of a resilient thin plate, and may be resiliently inserted into the fixing groove of the conveyance nut.

[0026] The fixing washer may be fastened to the drive shaft in a rotational direction.

[0027] The drive shaft and the fixing washer coupled with the piston connection shaft may be formed in a polygonal shape having round corners or an oval shape.

[0028] The fixing groove of the conveyance nut, with which the fixing washer is coupled, may have a step formed therearound.

[0029] A thrust bearing may be installed in the front or rear of the conveyance nut.

[0030] The drive shaft is a drive shaft rotatably supported by the cylinder block, a swash plate may be installed at the drive shaft to simultaneously rotate with the drive shaft and vary the inclination thereof, and the piston may be reciprocally accommodated in the cylinder bore and be slidable back and forth with respect to the swash plate.

Brief Description of the Drawings

[0031] The above and other objects, features and advantages of the present invention will be more apparent from the following detailed description taken in conjunction with the accompanying drawings, in which:

[0032] FIG. 1A is a longitudinal cross-sectional view of a conventional swash plate type compressor;

[0033] FIG. 1B is an enlarged view of a top clearance of FIG. 1A;

[0034] FIG. 2 is a longitudinal cross-sectional view of another conventional swash plate type compressor;

[0035] FIG. 3 is a longitudinal cross-sectional view of a machine having an apparatus for adjusting a top clearance in accordance with an exemplary embodiment of the present invention;

[0036] FIG. 4 is an enlarged longitudinal cross-sectional view of the apparatus for adjusting a top clearance of FIG. 3;

[0037] FIG. 5 is a partial cross-sectional perspective view of FIG. 4; and

[0038] FIG. 6 is an exploded cross-sectional perspective view of FIG. 4.

Best Mode for Carrying Out the Invention

[0039] Hereinafter, exemplary embodiments of the present invention will be described with reference to FIGS 3 to 6.

[0040] First, a reciprocating compressor 1000 in accordance with the present invention includes a housing 100, a cylinder block 110 having a plurality of cylinder bores 110a, a drive shaft 140 rotatably supported by the cylinder block 110, a swash plate 150 connected to the drive shaft 140 and rotatably installed to vary its inclination, pistons 200 reciprocally accommodated in the cylinder bores 110a and capable of sliding back and forth with respect to the swash plate 150, a suction/discharge valve apparatus 300 installed opposite to a bottom surface of the piston 200, and a suction chamber 131 and a discharge chamber 132 formed at the housing 100 through the medium of the suction/discharge valve apparatus 300.

[0041] The housing 100 comprises a front housing 120 and a rear housing 130, interposing the cylinder block 110 therebetween.

[0042] In addition, the rear housing 130 has the suction chamber 131 and the discharge chamber 132. A valve plate 330 has suction ports 331 for communicating the cylinder bores 110a with the suction chamber 131, and discharge ports 332 for communicating the cylinder bores 110a with the discharge chamber 132.

[0043] Further, the suction ports 331 and the discharge ports 332 formed at the valve plate 330 include suction valves and the discharge valves for opening and closing the suction ports 331 and the discharge ports 332 in response to pressure variation depending on reciprocation of the pistons 200, respectively.

[0044] The cylinder block 110 has eight cylinder bores 110a. Coolant introduced from the suction chamber 131 by the pistons 200 reciprocating through the cylinder bores 110a is continuously compressed.

[0045] The drive shaft 140 is rotatably supported by the front housing 120 and the cylinder block 110 via a bearing 400.

[0046] Further, the swash plate 150 is slidably coupled with the pistons 200 by shoes 201.

[0047] Furthermore, the swash plate 150 has connection projections 155 formed at its front and rear parts. Connection links 600 are interposed between the connection projections 155 and the drive shaft 140, which are connected to each other by hinge pins 610. Therefore, the connection links 600 and the connection projections 155, and the connection links 600 and the drive shaft 140 can be hinged to each other.

[0048] Meanwhile, in accordance with the present invention, a top clearance adjusting apparatus 500 for adjusting a top clearance between the pistons 200 and the suction/discharge valve apparatus 300 is installed to appropriately adjust the top clearance which varies according to a deviation between the length of the valve or piston, and the length of the cylinder.

[0049] Specifically, a conveyance nut 510 may be threadedly engaged with the drive shaft 140. Therefore, the drive shaft 140 axially moves depending on rotation of the conveyance nut 510. That is, the conveyance nut 510 becomes a rotating drive part which rotates at the original place, not moving in an axial direction, and the drive shaft 140 becomes a driven rotation part. Of course, in order to prevent axial movement of the conveyance nut 510, a thrust bearing or an equivalent structure 530 is installed before or after the conveyance nut 510. However, unlike in the conventional art, once the thrust bearing is selected there is no need to change its specification.

[0050] In order to precisely adjust the top clearance TC, a conveyance distance per revolution of the conveyance nut 510 should be precisely set. That is, when the top clearance is determined, using the conveyance distance a user can rotate the conveyance nut 510 to precisely adjust the top clearance.

[0051] For this purpose, it is possible to set a circumferential scale indicator in the conveyance nut 510 to adjust the rotation.

[0052] Eventually, in order to adjust the top clearance by rotating the conveyance nut 510, the conveyance nut 510 is threadedly engaged with the drive shaft 140. Therefore, in order to fix the top clearance, even though the drive shaft is rotated, the conveyance nut 510 should be rotated in a state in which the rotated position is fixed to the drive shaft 140. For this purpose, the drive shaft 140 and the conveyance nut 510 require an anti-rotation structure.

[0053] As described above, the anti-rotation structure may be a fastening force of the threaded engagement itself which is between the drive shaft 140 and the conveyance nut 510.

[0054] However, in this case, the threaded engagement may loosen due to vibration and load variation of the compressor, and the drive shaft 140 and the conveyance nut 510 may be worn out or damaged under high-speed rotation and heavy load.

[0055] In order to solve the problems, a fixing washer 520 is coupled with the conveyance nut 510 through the drive shaft 140 to be fixed thereto.

[0056] Specifically, when seen in an axial direction, the conveyance nut 510 includes a fixing groove 511 having a plurality of prominences and depressions 512 formed at the center thereof in a circumferential direction, and the fixing washer 520 has prominences and depressions 522 formed in a circumferential direction thereof to be coupled with the fixing groove 511.

[0057] Therefore, precision of the top clearance can be determined depending on the number of the prominences and depressions 512 and 522 (in FIG. 4, fourteen). That is, under the condition that its strength can be sustained, the greater the number of prominences and depressions, the higher the precision of the top clearance.

[0058] When an axial movement distance of the drive shaft 140 moved by one revolution of the conveyance nut 510 is 1mm, the top clearance can be adjusted to the micron unit.

[0059] In addition, when the fixing washer 520 is made of a resilient hollow thin plate, the fixing washer 520 is resiliently inserted into the fixing groove 511 of the conveyance nut 510 to securely fix the conveyance nut 510.

[0060] Of course, the fixing washer 520 should be fixed to the drive shaft 140 without any relative rotation. For this purpose, as shown, the drive shaft 140 and the fixing washer 520 coupled with the drive shaft 140 have a triangular shape with round corners. However, when there is no relative rotation between the fixing washer 520 and the drive shaft 140, various shapes of structures (for example, a polygonal or oval shape) may be employed.

[0061] Eventually, when the drive shaft 140 is rotated, the fixing washer 520 fixed to the drive shaft 140 is rotated, and the conveyance nut 510 inserted into the fixing washer 520 is rotated therewith.

[0062] In addition, a step is circumferentially formed at the fixing groove 511 of the conveyance nut 510, with which the fixing washer 520 is coupled, to prevent the conveyance nut 510 from slipping in an axial direction during operation of the compressor.

[0063] Reference symbol P designates a pulley for receiving power from an engine (not shown) through a belt (not shown) to rotate the drive shaft 140.

[0064] Hereinafter, an adjustment example of the top clearance will be described.

[0065] When the conveyance nut 510 is rotated counterclockwise along a male thread formed on a surface of the drive shaft 140, the drive shaft 140 is spaced apart from the conveyance nut 510, and the swash plate 150 connected to the drive shaft 140 by the connection links 600, simultaneously moves forward with the pistons 200

linked to the swash plate 150 to increase the top clearance.

[0066] On the other hand, when the conveyance nut 510 is rotated clockwise, the top clearance is reduced.

[0067] The above-described top clearance adjusting apparatus 500 may be adapted to various reciprocating compressors including a piston, a cylinder block, a valve, and a piston drive unit. Various swash plate type or crank-slide link drive type mechanisms using rotational force of an engine may be adapted as the piston drive unit.

[0068] That is, the top clearance adjusting apparatus including the conveyance nut and the fixing washer is coupled with the piston connection shaft of the reciprocating compressor such as a pump, as well as the compressor shown in FIGS. 1 and 2, thereby readily enabling top clearance adjustment.

Industrial Applicability

[0069] As can be seen from the foregoing, it is possible to readily and precisely adjust a top clearance between a piston and a valve of a reciprocating compressor.

[0070] In addition, since the top clearance can be precisely adjusted, a dead volume caused by the top clearance can be minimized depending on characteristics of the valve and the piston.

[0071] Further, it is possible to mount a conveyance nut on a thrust bearing to support axial load.

[0072] While this invention has been described with reference to exemplary embodiments thereof, it will be clear to those of ordinary skill in the art to which the invention pertains that various modifications may be made to the described embodiments without departing from the scope of the invention as defined in the appended claims .

Claims

1. An apparatus (500) for adjusting a top clearance of a reciprocating compressor (1000) comprising: a housing (100), a cylinder block (110) having a plurality of cylinder bores (110a), pistons (200) reciprocally accommodated in the cylinder bores (110a), a piston drive means for driving the pistons (200), a drive shaft (140) connected to the pistons (200), suction/discharge valves (300) installed opposite to bottoms of the pistons (200), and a suction chamber (131) and a discharge chamber (132) formed in the housing (100) through the medium of the suction/discharge valves (300), **characterized in that**

   - the drive shaft (140) has a conveyance nut (510) threadedly engaged therearound, and **in that**
   - when seen in an axial direction of the drive shaft (140), the conveyance nut (510) has a fixing groove (511) having a plurality of prominences and depressions (512) formed at a center of the conveyance nut (510) in a circumferential direction, a fixing washer (520) having prominences and depressions (522) formed thereabround is installed in the fixing groove (511), and the fixing washer (520) passes through the drive shaft (140).

2. The apparatus (500) according to claim 1, **characterized in that** the fixing washer (520) is formed of a resilient thin plate, and is resiliently inserted into the fixing groove (511) of the conveyance nut (510).

3. The apparatus (500) according to claim 1, **characterized in that** the fixing washer (520) is fastened to the drive shaft (140) in a rotational direction.

4. The apparatus (500) according to claim 3, **characterized in that** the drive shaft (140) and the fixing washer (520) coupled with the drive shaft (140) are formed in a polygonal shape having round corners or an oval shape.

5. The apparatus (500) according to claim 2, **characterized in that** the fixing groove (511) of the conveyance nut (510), with which the fixing washer (520) is coupled, has a step formed therearound.

6. The apparatus (500) according to claim 1, **characterized in that** a thrust bearing (530) is installed in the front or rear of the conveyance nut (510).

7. The apparatus (500) according to any one of claims 1 to 6, **characterized in that** the drive shaft (140) is rotatably supported by the cylinder block (110), **in that** a swash plate (150) is installed at the drive shaft (140) to simultaneously rotate with the drive shaft (140) and vary the inclination thereof, and **in that** the piston (200) is reciprocally accommodated in the cylinder bore (110a) and is slidable back and forth with respect to the swash plate (150).

Patentansprüche

1. Gerät (500) zur Anpassung eines oberen Zwischenraums eines Kolbenkompressors (1000), umfassend: ein Gehäuse (100), einen Zylinderblock (110) mit einer Vielzahl von Zylinderbohrungen (110a), gegenseitig in den Zylinderbohrungen (110a) untergebrachte Kolben (200), einem Kolbenantriebsmittel zum Antreiben der Kolben (200), einem an die Kolben (200) angeschlossenen Kolbenantriebsmittel, einer an die Kolben (200) angeschlossenen Antriebswelle (140), Ansaug- / Abzugsventile (300), die gegenüber von Böden der Kolben (200) installiert sind, und eine Ansaugkammer (131) und eine Abzugskammer (132), die in dem Gehäuse (100) durch

die Mitte der Abzugs- / Ansaugventile (300) gebildet sind, **dadurch gekennzeichnet, dass**

- die Antriebswelle (140) einen Überführungsbolzen (510) hat, der mit Gewinde umfassend darin eingreift und dass
- der Überführungsbolzen (510), wenn er in axialer Richtung der Antriebswelle (140) betrachtet wird, eine Befestigungsnut (511) mit einer Vielzahl von Protuberanzen und Vertiefungen (512) hat, die an einem Zentrum des Überführungsbolzens (510) in einer umlaufenden Richtung gebildet sind, eine Befestigungsscheibe (520) mit Protuberanzen und Vertiefungen (522), die umgreifend geformt sind, in der Befestigungsnutz (511) installiert ist und die Befestigungsscheibe (520) durch die Antriebswelle (140) hindurchtritt.

2. Gerät (500) gemäß Anspruch 1, **dadurch gekennzeichnet, dass** die Befestigungsscheibe (520) aus einer federnden dünnen Scheibe geformt ist und federnd in die Befestigungsnut (511) des Überführungsbolzens (510) eingefügt ist.

3. Gerät (500) gemäß Anspruch 1, **dadurch gekennzeichnet, dass** die Befestigungsscheibe (520) an der Antriebswelle (140) in einer Drehrichtung befestigt ist.

4. Gerät (500) gemäß Anspruch 3, **dadurch gekennzeichnet, dass** die Antriebswelle (140) und die mit der Antriebswelle (140) gekoppelte Befestigungsscheibe (520) in einer polygonalen Form mit runden Ecken oder einer ovalen Form geformt sind.

5. Gerät (500) gemäß Anspruch 2, **dadurch gekennzeichnet, dass** die Befestigungsnut (511) des Überführungsbolzens (510), mit dem die Befestigungsscheibe (520) gekoppelt ist, einen umgreifend geformten Schritt hat.

6. Gerät (500) gemäß Anspruch 1, **dadurch gekennzeichnet, dass** ein Kugellager (530) an der Vorder- oder Rückseite des Überführungsbolzens (510) installiert ist.

7. Gerät (500) gemäß Anspruch 1 bis 6, **dadurch gekennzeichnet, dass** die Antriebswelle (140) rotierend vom Zylinderblock (110) getragen wird, dass eine Taumelscheibe (150) an der Antriebswelle (140) installiert ist, um gleichzeitig mit der Antriebswelle (140) zu rotieren und deren Neigung zu variieren, und dass der Kolben (200) wechselseitig in der Zylinderbohrung (110a) aufgenommen ist und in Bezug auf die Taumelscheibe (150) nach vorn und hinten gleitend ist.

Revendications

1. Appareil (500) de réglage d'un dégagement supérieur d'un compresseur alternatif (1000), comprenant: un boîtier (100), un bloc-cylindres (110) présentant une pluralité d'alésages de cylindre (110a), des pistons (200) logés de façon alternative dans les alésages de cylindre (110a), des moyens d'entraînement de piston pour entraîner les pistons (200), un arbre d'entraînement (140) qui est connecté aux pistons (200), des soupapes d'aspiration/décharge (300) installées à l'opposé des bases des pistons (200), et une chambre d'aspiration (131) et une chambre de décharge (132) formées dans le boîtier (100) au moyen des soupapes d'aspiration/décharge (300), **caractérisé en ce que**:

- l'arbre d'entraînement (140) comprend un écrou de transport (510) qui est engagé de façon vissée autour de celui-ci, et **en ce que**:
- lorsque l'on regarde dans une direction axiale de l'arbre d'entraînement (140), l'écrou de transport (510) présente une rainure de fixation (511) comportant une pluralité de protubérances et de dépressions (512) formées au centre de l'écrou de transport (510) dans une direction circonférentielle, une rondelle de fixation (520) comportant des protubérances et des dépressions (522) formées autour d'elle est installée dans la rainure de fixation (511), et la rondelle de fixation (520) passe à travers l'arbre d'entraînement (140).

2. Appareil (500) selon la revendication 1, **caractérisé en ce que** la rondelle de fixation (520) est constituée d'une plaque élastique mince, et est insérée de façon élastique dans la rainure de fixation (511) de l'écrou de transport (510).

3. Appareil (500) selon la revendication 1, **caractérisé en ce que** la rondelle de fixation (520) est attachée à l'arbre d'entraînement (140) dans une direction de rotation.

4. Appareil (500) selon la revendication 3, **caractérisé en ce que** l'arbre d'entraînement (140) et la rondelle de fixation (520) qui est couplée à l'arbre d'entraînement (140) sont formés avec une forme polygonale présentant des coins ronds, ou une forme ovale.

5. Appareil (500) selon la revendication 2, **caractérisé en ce que** la rainure de fixation (511) de l'écrou de transport (510), auquel la rondelle de fixation (520) est couplée, présente un gradin formé tout autour d'elle.

6. Appareil (500) selon la revendication 1, **caractérisé en ce qu'**un palier de butée (530) est installé à

l'avant ou à l'arrière de l'écrou de transport (510).

7. Appareil (500) selon l'une quelconque des revendications 1 à 6, **caractérisé en ce que** l'arbre d'entraînement (140) est supporté de façon rotative par le bloc-cylindres (110), **en ce qu'**une plaque oscillante (150) est installée sur l'arbre d'entraînement (140) afin de tourner simultanément avec l'arbre d'entraînement (140) et de faire varier l'inclinaison de celui-ci, et **en ce que** le piston (200) est logé de façon alternative dans l'alésage de cylindre (110a) et peut coulisser d'avant en arrière par rapport à la plaque oscillante (150).

[Fig. 1]

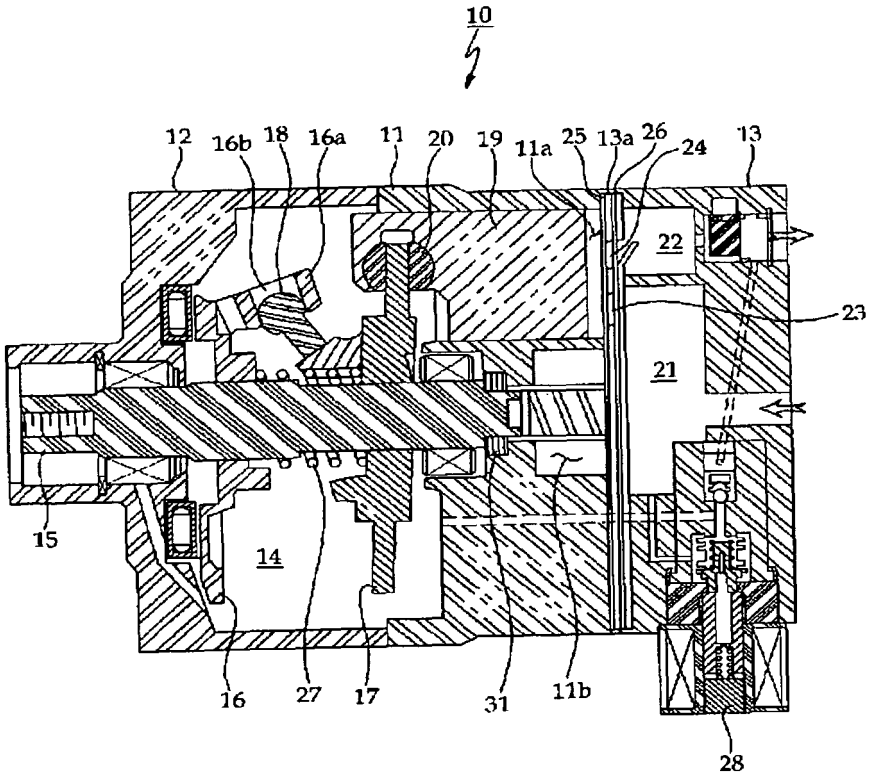


Fig 1a

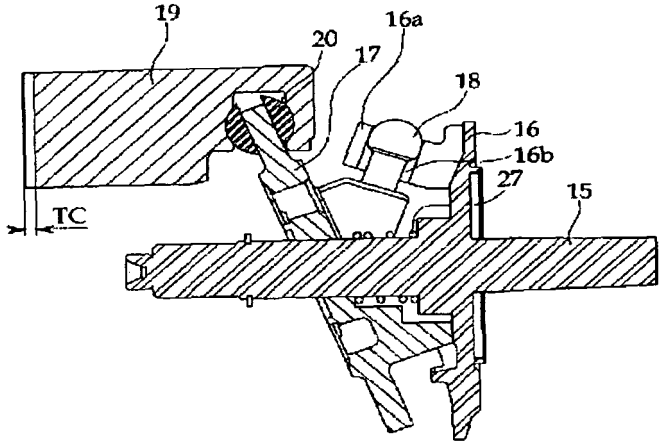
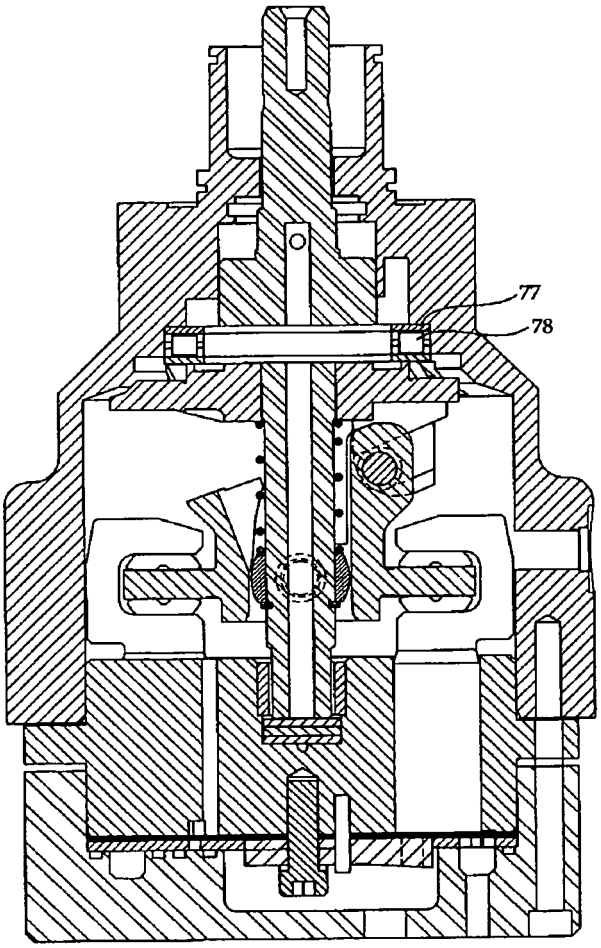
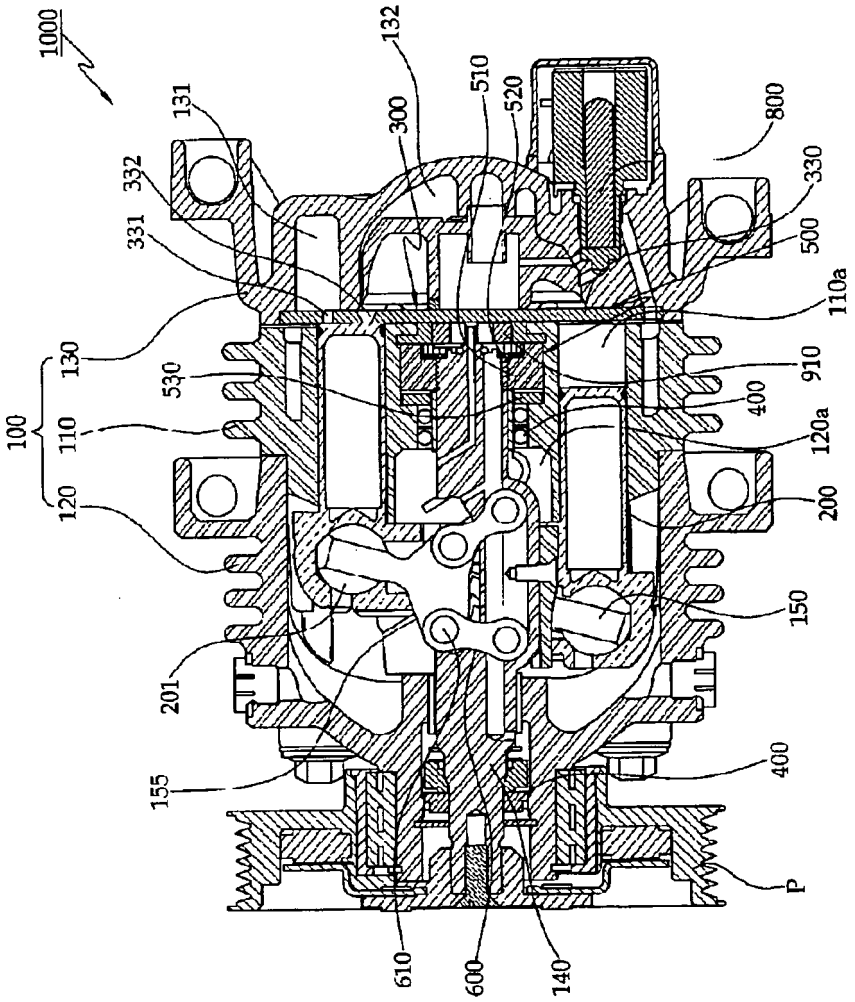


Fig 1b

[Fig. 2]



[Fig. 3]


1000
132
131
300
510
520
800
332
330
331
500
110a
130
530
910
100
110
400
120a
120
200
150
201
400
155
P
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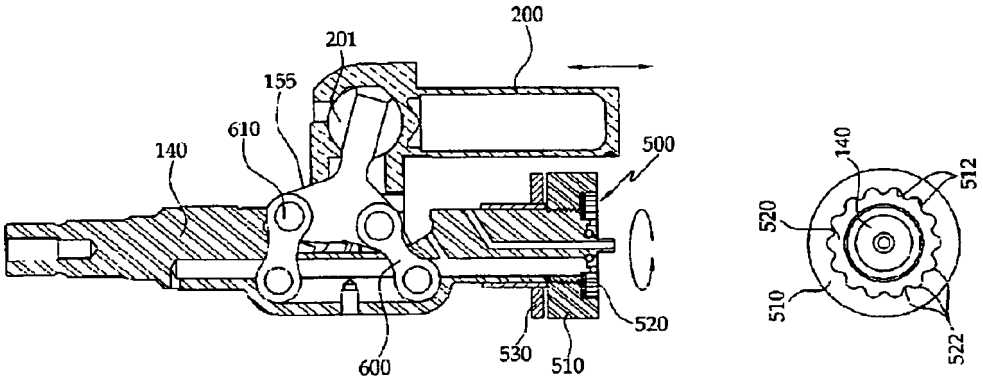
600
140

[Fig. 4]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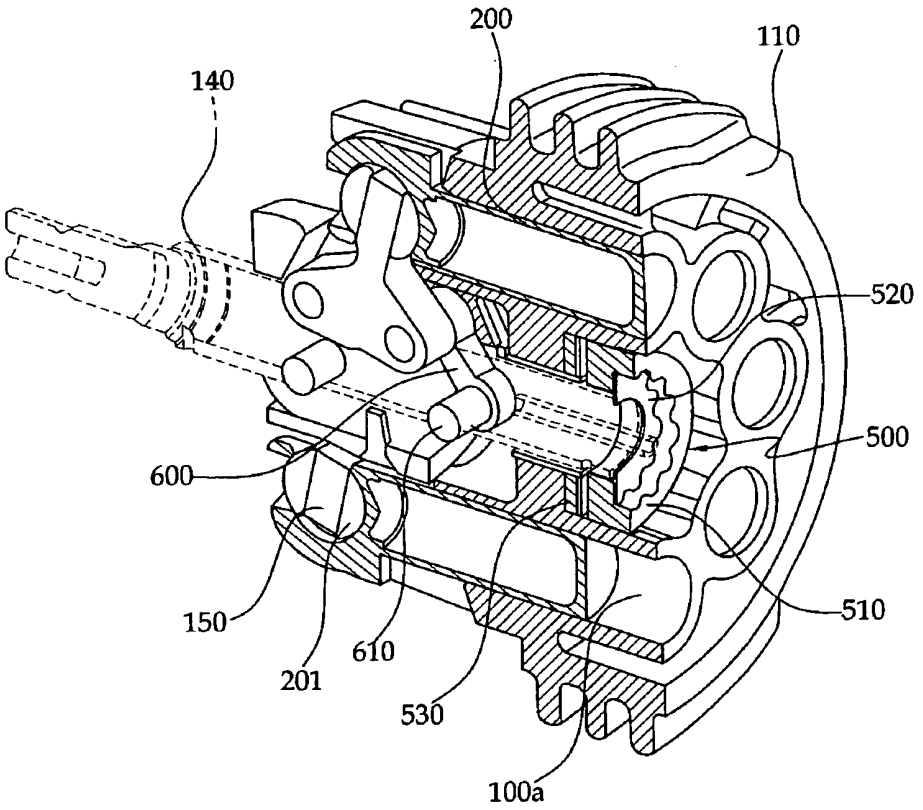
510
522

[Fig. 5]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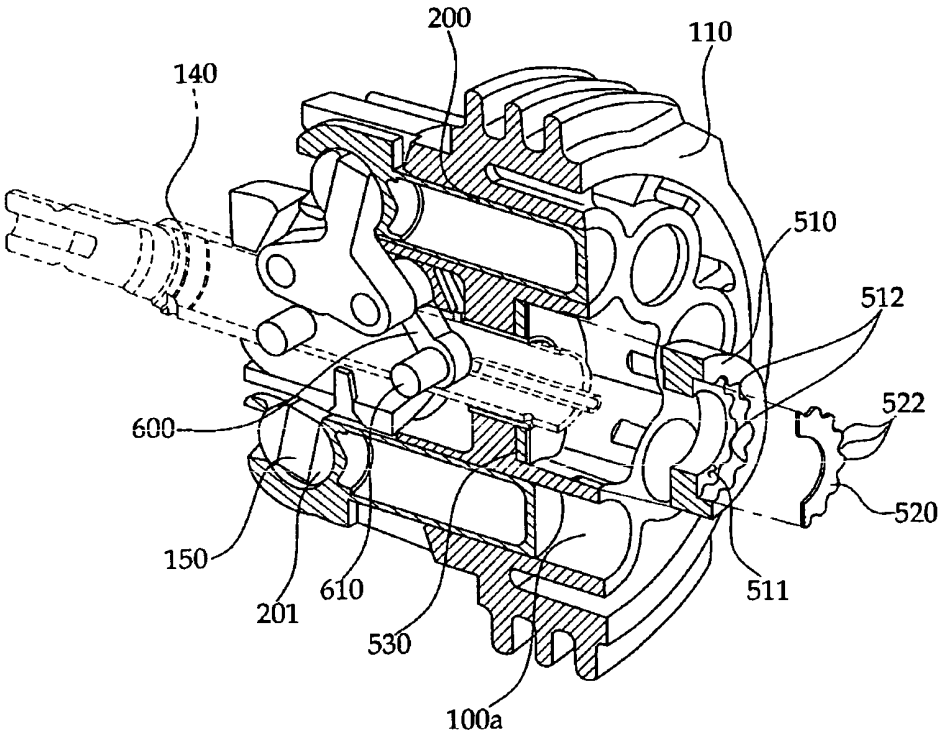
201
530
100a

[Fig. 6]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110
140
510
512
522
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511
201
530
100a

REFERENCES CITED IN THE DESCRIPTION

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