



(12) **EUROPEAN PATENT APPLICATION**
published in accordance with Art. 153(4) EPC

(43) Date of publication:
09.07.2008 Bulletin 2008/28

(51) Int Cl.:
F04B 27/08 (2006.01)

(21) Application number: **06812092.2**

(86) International application number:
PCT/JP2006/320963

(22) Date of filing: **20.10.2006**

(87) International publication number:
WO 2007/049523 (03.05.2007 Gazette 2007/18)

(84) Designated Contracting States:
DE FR GB

(30) Priority: **27.10.2005 JP 2005313123**

(71) Applicant: **Calsonic Kansei Corporation**
Tokyo 164-8602 (JP)

(72) Inventors:
• **MIYAJI, Toshikatsu**
5-chome, Nakano-ku, Tokyo 164-8602 (JP)

• **HIROSE, Ryuichi**
5-chome, Nakano-ku, Tokyo 164-8602 (JP)
• **ISHIKAWA, Naoki**
5-chome, Nakano-ku, Tokyo 164-8602 (JP)
• **KUBO, Satoshi**
5-chome, Nakano-ku, Tokyo 164-8602 (JP)

(74) Representative: **Grünecker, Kinkeldey,**
Stockmair & Schwanhäusser
Anwaltssozietät
Leopoldstrasse 4
80802 München (DE)

(54) **VARIABLE DISPLACEMENT COMPRESSOR**

(57) A variable capacity compressor includes a rotating member 21 fixed to a drive shaft 10 so as to rotate with the drive shaft 10, a sleeve 22 axially slidably attached to the drive shaft 10, a tilting member 24 tiltably attached to the sleeve 22 by a pivot pin 61, a linkage mechanism 40 connecting the rotating member 21 with

the tilting member 24 and configured to transfer a rotary torque of the rotating member 21 to the tilting member 24 as allowing the tilting member to be tiltable, and a tilting guide face 22c formed on the sleeve 22 and a tilting guide face 25d formed on the tilting member 24 which are formed as planes orthogonal to the pivot pin 61 and are configured to slidingly contact one another.

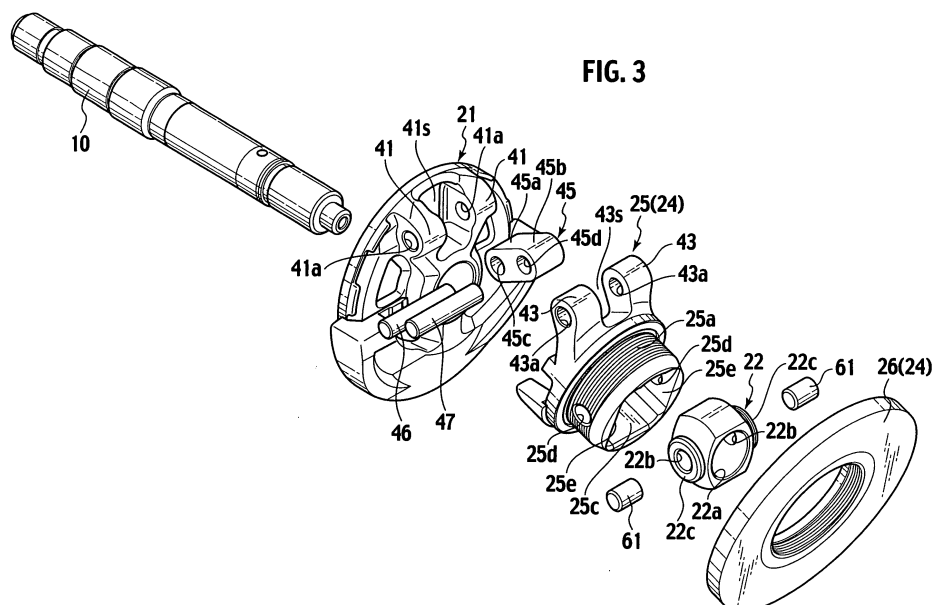


FIG. 3

Description

TECHNICAL FIELD

[0001] The present invention relates to a variable capacity compressor.

BACKGROUND ART

[0002] A conventional variable capacity compressor includes a drive shaft, a rotor which is fixed to the drive shaft and rotates integrally with the drive shaft, a sleeve which is axially slidably attached to the drive shaft, a swash plate which is tiltably attached to the sleeve, a link mechanism provided between the rotor and the swash plate to rotate the swash plate together with the rotor, and a piston which reciprocates in response to the rotation of the swash plate (see, for example, Japanese Patent Application Laid-Open Publications No. 2003-172417 and No. 10-176658). The linkage mechanism connects the rotor with the swash plate so as to permit change of an inclination angle of the swash plate while transferring rotary torque from the rotor to the swash plate. The changes of the inclination angle of the swash plate cause piston stroke to change.

[0003] Fig. 9 is a view of a linkage mechanism disclosed in the Publication No. 10-176658.

[0004] The linkage mechanism in Fig. 9 includes a pair of rotor arms 145, 146 which extend from a rotor 140 toward a swash plate 141 and are opposed to each other, a single swash plate arm 147 which extends from the swash plate 141 toward the rotor 140, and a pair of link arms 142A, 142B. These five arms 145, 142A, 147, 142B, and 146 are stacked in the torque transfer direction so that rotation of the rotor 140 is transferred to the swash plate. The link arms 142A, 142B have a first end which is rotatably linked to the rotor arms 145, 146 by a first linking pin 143 and a second end which is rotatably linked to the swash plate arm 147 by a second linking pin 144. With this, the link arms 142A, 142B rotate about the linking pin 143 with respect to the rotor arms 145, 146, and the swash arm 147 rotates about the linking pin 144 with respect to the link arms 142A, 142B. Therefore, the inclination angle of the swash plate 141 with respect to a drive shaft (not shown) is changeable.

DISCLOSURE OF THE INVENTION

[0005] When the compressor is operative, that is, when the drive shaft rotates, a contact between the rotor arm 145 and the link arm 142A and a contact between the link arm 142A and the swash plate arm 147 function as a torque transferring interface and also as a rotational slide-contact interfaces. In other words, the rotor arm 145 and the link arm 142A rotationally slides with respect to one another under a large pressure of the torque Ft. The link arm 142A and the swash plate arm 147 also rotationally slide with respect to one another under a large

pressure of the torque Ft. Accordingly, when changing the inclination angle of the swash plate 141, the slide friction at the contact between the rotor arm 145 and the link arm 142A becomes extremely high and the slide friction at the contact between the link arm 142A and the swash plate arm 147 also becomes extremely high.

[0006] And also, when the compressor is operative, that is, when the drive shaft rotates, the swash plate 141 receives a large compression reaction force Fp from the pistons that are connected to the swash plate 141. As shown in Fig. 9, the compression reaction force Fp can be applied to a position anterior to the linkage mechanism in the rotating direction, depending on the rotation speed (see Fig. 2). With this, torsion load is given to the swash plate arm 147 in a direction Y in the figure. Accordingly, the link 142 gets stuck in the swash plate 141 at two points (C, C) and this causes a further increased slide friction.

[0007] To solve the above problem, the Publication No. 2003-172417 has a washer between the rotor arm and the link arm and a washer between the link arm and the swash plate arm, but similar problems are remained.

[0008] The present invention is provided to solve the problem. An object of the present invention is to provide a variable capacity compressor capable of decreasing torsion load applied to a linkage mechanism.

[0009] An aspect of the present invention provides a variable capacity compressor. The variable capacity compressor includes: a rotating member fixed to a drive shaft and configured to rotate integrally with the drive shaft; a sleeve axially slidably attached to the drive shaft; a tilting member tiltably attached to the sleeve by a pivot pin; a linkage mechanism connecting the rotating member with the tilting member and configured to transfer a rotary torque of the rotating member to the tilting member as allowing the tilting member to tilt; a piston configured to reciprocate in response to rotation of the tilting member; and tilting guide faces respectively formed on the sleeve and the tilting member. The tilting guide faces are formed as planes orthogonal to the pivot pin and configured to slide one another.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010]

Fig. 1 is a cross-sectional view of a variable capacity compressor of a first embodiment according to the present invention;

Fig. 2 is a perspective view of an assembly in that a swash plate and a rotor are mounted to a driving shaft;

Fig. 3 is an exploded perspective view of the assembly;

Fig. 4 is a cross-sectional view of the assembly;

Fig. 5(a) is a cross-sectional view of the assembly along line Va-Va in Fig. 4, and Fig. 5(b) is a cross-sectional view of the assembly along line Vb-Vb in

Fig. 4;

Fig. 6 is a perspective view of an assembly in that a hub of the swash plate is mounded to a sleeve;

Figs. 7(a) to 7(c) are views of the assembly in that the hub of the swash plate is mounded to the sleeve, wherein Fig. 7(a) is a front view of the assembly, Fig. 7(b) is a side view of the assembly, and Fig. 7(c) is a cross-sectional view of the assembly along line VIIc-VIIc in Fig. 7(b);

Figs. 8(a) and 8(b) are cross-sectional views of the assembly along line VIII-VIII in Fig. 7(c), wherein Fig. 8(a) showing the state in that the hub is parallel to the sleeve, and Fig. 8(b) showing a condition in that the hub inclines with respect to the sleeve; and

Fig. 9 is a cross-sectional view of an example of a conventional linkage mechanism of a variable capacity compressor.

DETAILED DESCRIPTION OF THE INVENTION

[0011] A variable capacity compressor of an embodiment of the present invention will be described with reference to the accompanying drawings.

[0012] Fig. 1 is a cross-sectional view of the variable capacity compressor.

[0013] As shown in Fig. 1, the variable capacity compressor 1 of the present embodiment is a swash plate type variable capacity compressor. The variable capacity compressor 1 includes a cylinder block 2 having a plurality of cylinder bores 3 (see Fig. 2) placed evenly spaced apart in a circumferential direction, a front housing 4 attached to a front end of the cylinder block 2 and defining a crank chamber 5 with the cylinder block 2, and a rear housing 6 attached to a rear end of the cylinder block 2 via a valve plate 9 and defining a suction chamber 7 and a discharge chamber 8 therein. The cylinder block 2, the front housing 4, and the rear housing 6 are fixedly connected to one another by a plurality of bolts 13 so as to make up a housing of the compressor.

[0014] The valve plate 9 is formed with suction ports 11 that communicate the cylinder bores 3 with the suction chamber 7, and a discharge ports 12 that communicate the cylinder bores 3 with the discharge chamber 8.

[0015] A suction valve system (not shown) adapted to open or close the suction ports 11 is attached to the valve plate 9 on the cylinder block side. A discharge valve system (not shown) adapted to open or close the discharge ports 12 is attached to the valve plate 9 on the rear housing side. A gasket is interposed between the valve plate 9 and the rear housing 6 to maintain airtightness of the suction chamber 7 and the discharge chamber 8.

[0016] A drive shaft 10 is rotatably supported by radial bearings 15, 19 in center through holes 14, 18 which are bearing holes formed at center portions of the cylinder block 2 and the front housing 4. With this structure, the drive shaft 10 is rotatable in the crank chamber 5. A thrust bearing 20 is interposed between a front face of a later-described rotor 21 that is fixed to the shaft 10 and an

interior face of the front housing 6. A thrust bearing 16 is interposed between a rear end face of the shaft 10 and an adjustable screw 17 which is a stationary member fixed in the center through hole 14 of the cylinder block 2.

[0017] The crank chamber 5 accommodates the rotor 21, that is a "rotating member", fixed to the drive shaft 10, a sleeve 22 axially slidably attached to the drive shaft 10, and a swash plate 24, that is a "tilting member", pivotally attached to the sleeve 22 by pivot pins 61. In other words, the swash plate 24 is attached to the drive shaft 10 via the sleeve 22 and pivot pins 61, so that the swash plate 24 is tiltable with respect to the drive shaft 10 and is slidable in the axial direction of the drive shaft 10. In this embodiment, the swash plate 24 includes a hub 25 tiltably attached to the sleeve 22 and a swash plate body 26 fixed to a boss 25a of the hub 25.

[0018] Pistons 29 is slidably contained in the cylinder bore 3, and engaged with the swash plate 24 via a pair of hemispherical-shaped shoes 30, 30.

[0019] Between the rotor 21 as the rotating member and the hub 25 of the swash plate 24 as the tilting member, a linkage mechanism 40 is interposed. The linkage mechanism 40 transfers rotary torque from the rotor 21 to the swash plate 24 as allowing the inclination angle of the swash plate 24 to change.

[0020] When the sleeve 22 moves toward the cylinder block 2, the inclination angle of the swash plate 24 reduces. On the other hand, when the sleeve 22 moves away from the cylinder block 2, the inclination angle of the swash plate 24 increases. Reference number 53 in Fig. 1 represents a stopper such as a c-ring for a return spring 52. The stopper 53 is fixed in a circular groove formed on the drive shaft 10 to support the return spring 52 as compressing between the sleeve 22 and the stopper 53.

[0021] When the drive shaft 10 rotates, the rotor 21 rotates integrally with the drive shaft 10. The rotation of the rotor 21 is transferred to the swash plate 24 via the linkage mechanism 40. The rotation of the swash plate 24 is converted into a reciprocating movement of the pistons 29 so that the pistons 29 reciprocate in the cylinder bores 3. By the reciprocating movements of the pistons 29, refrigerant is sucked from the suction chamber 7 into the cylinder bores 3 through the suction ports 11 of the valve plate 9, compressed in the cylinder bores 3, and discharged to the discharge chamber 8 through the discharge ports 12 of the valve plate 9.

[0022] The variable capacity compressor includes a pressure control mechanism. The pressure control mechanism controls a pressure difference (pressure balance) between the crank chamber pressure P_c in back of the piston 29 and the suction chamber pressure P_s in front of the piston 29 so as to change the inclination angle of the swash plate 24 to change the piston stroke. When changing the piston stroke, the discharge capacity of the compressor changes.

[0023] The pressure control mechanism includes an extraction passage (not shown) that connects and com-

municates the crank chamber 5 with the suction chamber 7, a supply passage (not shown) that connects and communicates the crank chamber 5 with the discharge chamber 8, and a control valve 33 that is provided in the mid-stream of the supply passage to open and close the supply passage.

[0024] The extraction passage opens regardless of the opening and closing of the control valve 33, so that the refrigerant gas constantly flows through the extraction passage from the crank chamber 5 to the suction chamber 7.

[0025] When the control valve 33 opens the gas supply passage, the refrigerant flows from the discharge chamber 8 into the crank chamber 5 through the gas supply passage, and this increases the crank chamber pressure P_c . When the crank chamber pressure P_c increases, the inclination angle of the swash plate 24 decreases as the sleeve 22 moves toward the cylinder block 2. As a result, the piston stroke becomes smaller and the discharging amount decreases.

[0026] On the other hand, when the control valve 33 closes the gas supply passage, the refrigerant is gradually extracted from the crank chamber 5 to the suction chamber 7 through the gas extraction passage, and this causes a reduction in the pressure difference between the crank chamber pressure P_c and the suction chamber pressure P_s . As a result, the inclination angle of the swash plate 24 increases as the sleeve 22 moves away from the cylinder block 2, so that the piston strokes become longer and the discharging amount increase.

[0027] Next, a supporting structure of the swash plate will be described with reference to Figs. 2 to 8(b).

[0028] Fig. 2 is a perspective view of an assembly in that the swash plate and the rotor are mounted to the driving shaft. Fig. 3 is an exploded perspective view of the assembly. Fig. 4 is a cross-sectional view of the assembly. Fig. 5(a) is a cross-sectional view of the assembly along the line Va-Va in Fig. 4. Fig. 5(b) is a cross-sectional view of the assembly along the line Vb-Vb in Fig. 4. Fig. 6 is a perspective view of an assembly in that the hub of the swash plate is mounted to the sleeve. Fig. 7(a) is a front view of the assembly in that the hub of the swash plate is mounted to the sleeve. Fig. 7(b) is a side view of the assembly. Fig. 7(c) is a cross-sectional view of the assembly along the line VIIc-VIIc in Fig. 7(b). Figs. 8(a) and 8(b) are cross-sectional views of the assembly along the line VIII-VIII in Fig. 7(c), wherein Fig. 8(a) shows a condition in that the hub is parallel to the sleeve, and Fig. 8(b) shows a condition in that the hub inclines with respect to the sleeve.

[0029] First, the linkage mechanism 40 will be described in detail.

[0030] As shown in Figs. 3, 4 and 5(a), the linkage mechanism 40 includes a pair of arms 41, 41 that extend from the rotor 21 toward the hub 25 and face each other across a slit 41s, a pair of arms 43, 43 that extend from the hub 25 toward the rotor 21 and face each other across a slit 43s, and a linkage member 45 that is inserted in

the slit 41s (between the pair of arms 41, 41) of the rotor 21 and in the slit 43s (between the pair of arms 43, 43) of the swash plate 24. The pair of arms 41, 41 and 43, 43 are opposite in an orthogonal direction to the drive shaft 10, that is, a tangential direction of the rotation.

[0031] The width d_1 of the slit 41s of the rotor 21, that is, a distance d_1 between inner surfaces 41d, 41d of the arms 41, 41 and the width d_2 of the slit 43s of the hub 25, that is, a distance d_2 between inner surfaces 43d, 43d of the arms 43, 43 are formed the same. The width d_0 of the linkage member 45, that is, a distance d_0 between outer surfaces 45e, 45e of the linkage member is substantially the same as the distances d_1 and d_2 . With this structure, the linkage member 45 is slidably fit in the slits 41s, 43s so as to slidably contact each other.

[0032] A first end 45a of the linkage member 45 is pivotally attached to the pair of arms 41, 41 of the rotor 21 by a first linking pin 46. A second end 45b of the linkage member 45 is pivotally attached to the pair of arms 43, 43 of the swash plate 24 by a second linking pin 47. The linking pins 46, 47 are designed to extend in the orthogonal direction to the drive shaft 10, that is a tangential direction of the rotation.

[0033] In this embodiment, each the arms 41, 41 of the rotor 21 is formed with a bearing hole 41a in which the first linking pin 46 is rotatably fit. The first end 45a of the linkage member 45 is formed with a fixing hole 45c to which the first linking pin 46 is inserted with force and fixed. Each arms 43, 43 of the swash plate 24 is formed with a bearing hole 43a to which the second linking pin 47 is rotatably fit. The second end 45b of the linkage member 45 has a fixing hole 45d to which the second linking pin 47 is inserted with force and fixed. The first linking pin 46 and the second linking pin 47 are made in the same diameter and length.

[0034] Next, a pivot mechanism connecting the sleeve 22 with the hub 25 will be described with reference to Figs. 3 to 7.

[0035] The hub 25 is pivotally attached to the sleeve 22 by the pivot pins 61 extending in the orthogonal direction to the drive shaft 10 and pivots as being guided by the tilting guide face 25c, 25e extending in the orthogonal direction to the pivot pin 61.

[0036] The sleeve 22 is formed in a substantially cylindrical shape and is slidably attached to the drive shaft 10 in the axial direction. The sleeve 22 is formed with stationary holes 22b and 22b that are coaxially provided on both sides across the drive shaft 10. The stationary holes 22b and 22b extend orthogonal to the drive shaft 10 and fix the pivot pins 61 therein.

[0037] On the other hand, the hub 25 of the swash plate is formed with bearing holes 25b and 25b that are coaxially provided on both sides across the drive shaft 10. The bearing holes 25b and 25b extend orthogonal to the drive shaft 10. The sleeve 22 is attached in a center hole 25c of the hub 25, and the pivot pins 61 and 61 are inserted in the bearing holes 25b and 25b of the hub 25, so that, as shown in Figs. 8(a) and 8(b), the hub 25 is

tiltable with respect to the sleeve 25 about the pivot pins 61. As shown in Figs. 5 to 7, the sleeve 22 and the hub 25 are formed with the tilting guide faces 22c, 25e that slidably contact each other. The tilting guide faces 22c, 25e are provided on the both sides across the drive shaft 10 and are orthogonal planes to the pivot pin 61. With this structure, the hub 25 pivots with respect to the sleeve 22 about the pivot pin 61, as being guided by the tilting guide faces 25c, 25e.

Operation

[0038] An operation of the compressor of the embodiment will be explained.

[0039] When the drive shaft 10 rotates, the drive shaft 10 rotates integrally with the rotor 21. The rotation of the rotor 21 is transferred to the swash plate 24 via the linkage mechanism 40. The rotation of the swash plate 24 is converted into a reciprocating movement of the pistons 29 via the pairs of piston shoes 30, 30 so that the pistons 29 reciprocate in the cylinder bores 3. By the reciprocating movements of the pistons 29, refrigerant is sucked from the suction chamber 7 into the cylinder bores 3 through the suction ports 11 of the valve plate 9, compressed in the cylinder bores 3, and discharged to the discharge chamber 8 through the discharge ports 12 of the valve plate 9.

[0040] In order to change the amount of the discharge capacity, the control valve 33 is opened or closed. Opening or closing the control valve 33 change the pressure in the crank chamber 5 and the pressure balancing between back of the piston 29 and front of the piston 29 so that the piston stroke is changed.

[0041] More particularly, when the control valve 33 opens the gas supply passage, the high pressure refrigerant gas flows from the discharge chamber 8 into the crank chamber 5 through the gas supply passage, so that the crank chamber pressure P_c increases. When the crank chamber pressure P_c increases, the inclination angle of the swash plate 24 decreases as the sleeve 22 moves toward the cylinder block 2. As a result, the piston stroke becomes smaller and the discharging amount decreases. On the other hand, when the control valve 33 closes the gas supply passage, the refrigerant gas is gradually extracted from the crank chamber 5 to the suction chamber 7 through the gas extraction passage and this causes a reduction in the pressure difference between the crank chamber pressure P_c and the suction chamber pressure P_s . As a result, the inclination angle of the swash plate 24 increases as the sleeve 22 moves away from the cylinder block 2, so that the piston stroke becomes longer and the discharging amount increases.

[0042] When the compressor is operative, the swash plate 24 receives compression reaction force F_p from the piston 29. As shown in Fig. 2, the compression reaction force F_p can be applied to a position anterior to an upper dead center TDC of the swash plate 24 (i.e., a position where the linkage mechanism is located) in the rotation

direction, depending on the rotation speed of the drive shaft 10. This is because the compression reaction force from the piston 29 reaches a maximum value just before the end of the compression stroke of the piston, that is, just before the upper dead center of the piston. In such a case, the swash plate 24 receives the compression reaction force F_p at a position anterior to the dead center TDC in the rotating direction, so that the swash plate 24 receives torsion load.

[0043] In this embodiment, the torsion load is received on the tilting guide faces 22c, 25c as well as the link mechanism 40. Few torsion loads is thus given to the linkage mechanism 40 that is a rotary-slide interface configured to transfer a rotary-torque and this results in a reduction of slide friction in the linkage mechanism 40. That is to say, slide friction between the linkage member 45 and the arms 41, 43 is reduced. Concretely, slide friction between the outer surfaces 45e of the linkage member 45 and the inner faces 41d of the arms 41 is reduced and slide friction between the outer surfaces 45e of the linkage member 45 and the inner faces 43d of the arms 43 is reduced. Therefore, the controllability of the compressor is improved.

[0044] As shown Fig. 5, according to the compressor 1 of this embodiment, the width d_4 between a pair of the opposite tilting guide faces 22c, 22c is larger than the width d_0 of the first end 45a of the linkage member 45 and the width d_0 of the second end 45b of the linkage member 45. With this structure, more torsion load is received at the tilting guide faces 22c, 22c than at the linkage mechanism 40 so that the controllability of the compressor is further improved.

[0045] Here lists characterizations of the present embodiment.

[0046] (1) The present embodiment provides a variable capacity compressor. The compressor includes a rotating member 21 fixed to a drive shaft 10 and configured to rotate with the drive shaft 10, a sleeve 22 axially slidably attached to the drive shaft 10, a tilting member 24 tiltably attached to the sleeve 22 by a pivot pin 61, and a linkage mechanism 40 connecting the rotating member 21 with the tilting member 24 and configured to transfer a rotary torque of the rotating member 21 to the tilting member 24 as allowing the tilting member 24 to tilt. The sleeve 22 and the tilting member 24 are provided with tilting guide faces 22c, 25d that are formed as orthogonal planes orthogonal to the pivot pin 61 and are configured to slide one another. With this configuration, when the swash plate 24 receives compression reaction force F_p , both of the sleeve 22 and the linkage mechanism 40 receive torsion load. This decreases torsion load that is received by the linkage mechanism 40 that is configured to slide as transferring the rotary torque. Therefore, tilt angle of the tilting member 24 is smoothly changed so that controllability of the compressor is improved. In addition, the durability of the linkage mechanism 40 is improved and the linkage mechanism 40 is downsized.

[0047] (2) According to the present embodiment, the

linkage mechanism 40 includes an arm 41 extending from a rotating member 21 toward a tilting member 24, and an arm 43 extending from the tilting member 24 toward the rotating member 21 and directly or indirectly pivoted to the arm 41 of the rotating member by a linking pin (in the present embodiment, a first linking pin 46 and a second linking pin 47). With this structure, when changing the tilt angle of the tilting member 24, the components rotate about a pivot pin 61 of a sleeve 22 or the linking pin (in the present embodiment, the linking pins 46 and 47) of the linkage mechanism 40. Therefore, the friction is a rolling friction so that friction coefficient is extremely small. The controllability of the compressor is further improved.

[0048] (3) According to the present embodiment, the linkage mechanism 40 includes a pair of opposite arms 41 that extend from a rotating member 21 toward a tilting member 24, a pair of opposite arms 43 that extend from the tilting member 24 toward the rotating member 21, a linkage member 45 having a first end 45a that is slidably fit between the arms 41 and a second end 45b that is slidably fit between the arms 43, a first linking pin 46 that pivotally connects the first end 45a of the linkage member 45 with the arms 41 of the rotating member, and a second linking pin 47 that pivotally connects the second end 45b of the linkage member 45 with the arms 43 of the tilting member. With this structure, when changing the tilt angle of the tilting member 24, the components rotate about a pivot pin 61 of a sleeve 22 or the linking pins 46, 47 of the linkage mechanism 40. Therefore, the friction is a rolling friction so that friction coefficient is extremely small. The controllability of the compressor is further improved.

[0049] (4) According to the present embodiment, a pair of tilting guides 22c and a pair of the tilting guides 25e are provided on both sides of the driving shaft 10, and a width d4 between the pair of tilting guides 22c of the sleeve 22 is larger than the width d0 between the first end 45a of the linkage member 45 and the width d0 between the second end 45b of the linkage member 45. With this structure, the tilting guide faces 22c of the sleeve 22 receive heavier torsion load and the burden applied to the linkage mechanism 40 is reduced. Therefore, the controllability of the compressor is further improved.

INDUSTRIAL APPLICABILITY

[0050] The present invention is not limited to the embodiments described above. The present invention can be implemented with various modifications without departing from technical scope of the present invention.

Claims

1. A variable capacity compressor comprising:

a rotating member fixed to a drive shaft and con-

figured to rotate integrally with the drive shaft;
a sleeve axially slidably attached to the drive shaft;
a tilting member tiltably attached to the sleeve by a pivot pin;
a linkage mechanism connecting the rotating member with the tilting member and configured to transfer a rotary torque of the rotating member to the tilting member as allowing the tilting member to tilt;
a piston configured to reciprocate in response to rotation of the tilting member;
tilting guide faces respectively formed on the sleeve and the tilting member, the tilting guide faces formed as planes orthogonal to the pivot pin and configured to slidably contact one another.

2. The variable capacity compressor according to Claim 1, wherein the linkage mechanism comprising:

an arm extending from a rotating member toward the tilting member;
an arm extending from the tilting member toward the rotating member; and
a linking pin pivotally connecting the arm of the rotating member and the arm of the tilting member directly or indirectly.

3. The variable capacity compressor according to Claim 1, wherein the linkage mechanism comprising:

a pair of opposite arms extending from the rotating member toward the tilting member;
a pair of opposite arms extending from the tilting member toward the rotating member;
a linkage member having a first end that is slidably fit between the arms of the rotating member and a second end that is slidably fit between the arms of the tilting member,
a first linking pin pivotally connecting the first end of the linkage member and the arms of the rotating member; and
a second linking pin pivotally connecting the second end of the linkage member and the arms of the tilting member.

4. The variable capacity compressor according to Claim 3, wherein

a pair of tilting guides of the sleeve and a pair of the tilting guides of the tilting member are provided on both sides of the driving shaft, and
a width between the pair of tilting guides of the sleeve is larger than a width of the first end of the linkage member and a width of the second end of the linkage member.

FIG. 1

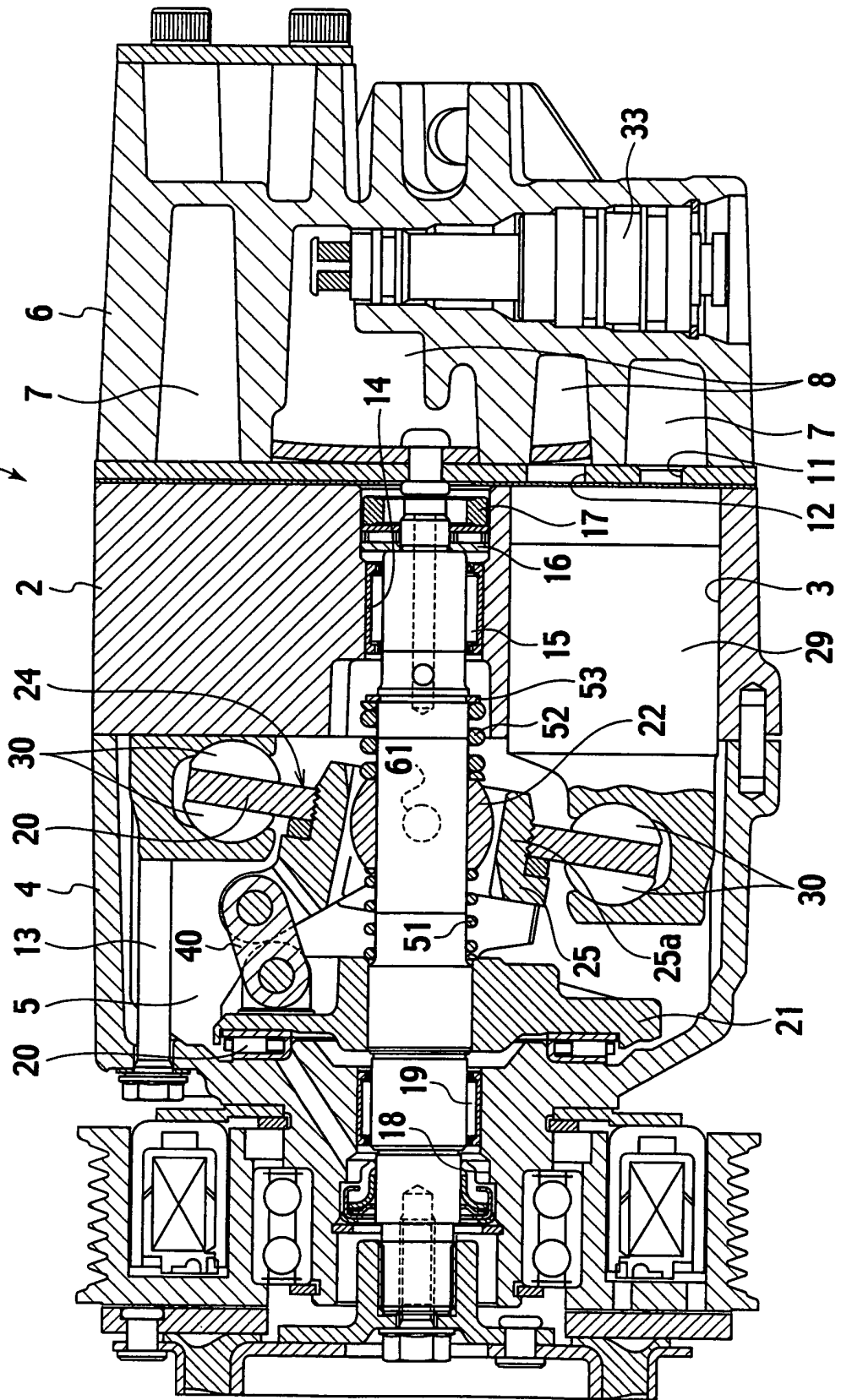


FIG. 2

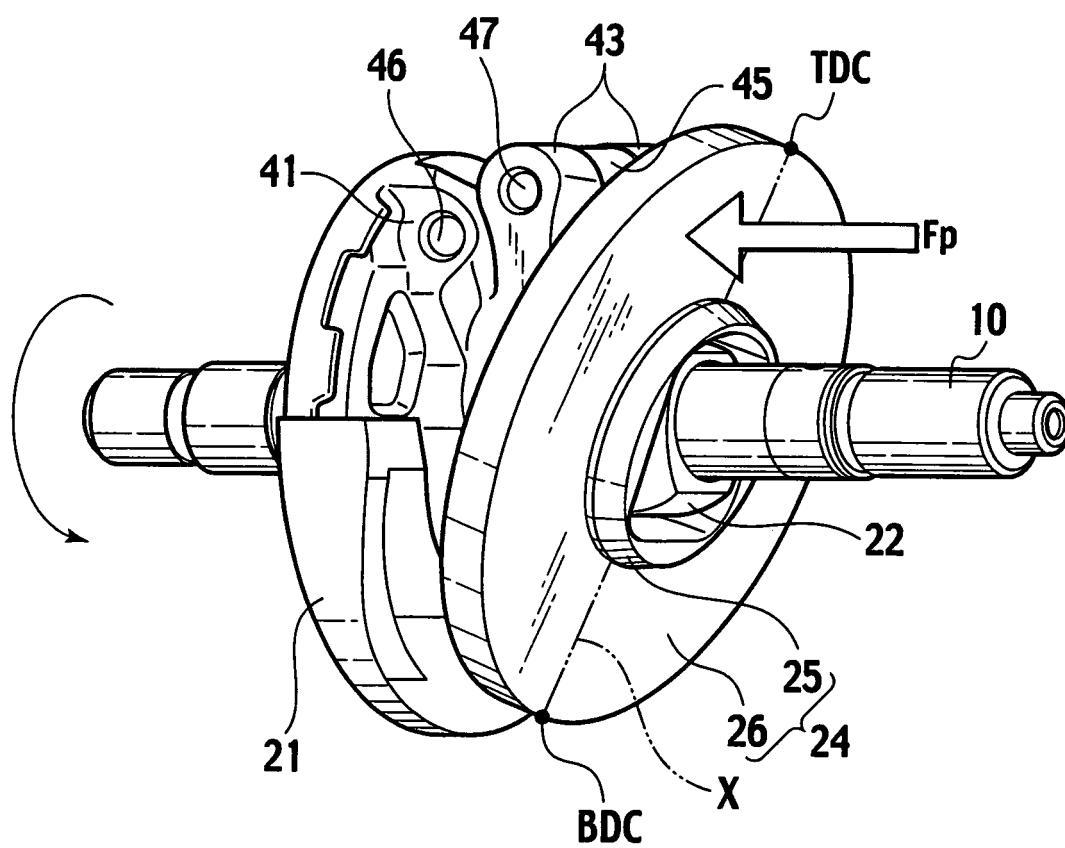


FIG. 3

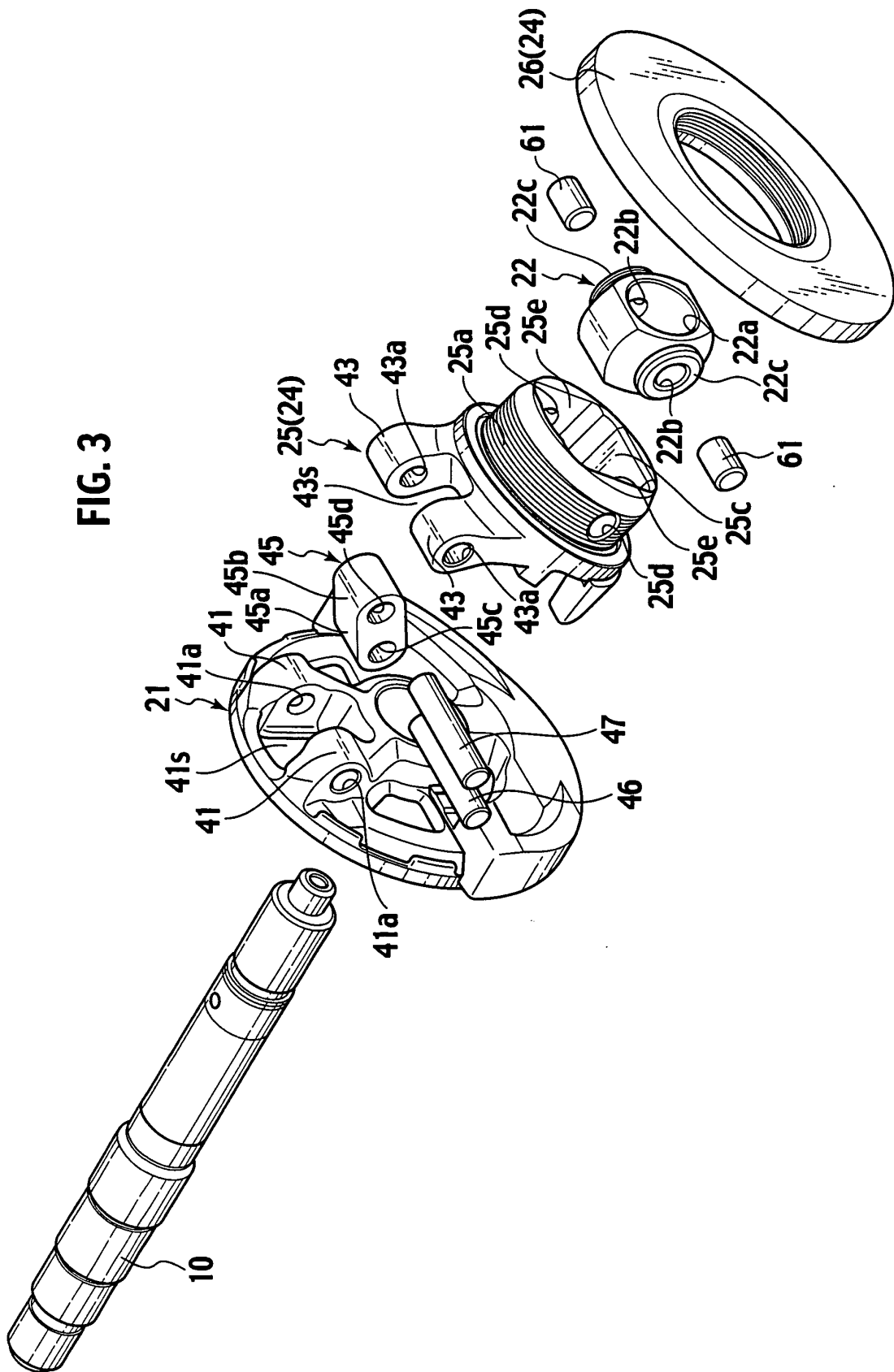


FIG. 4

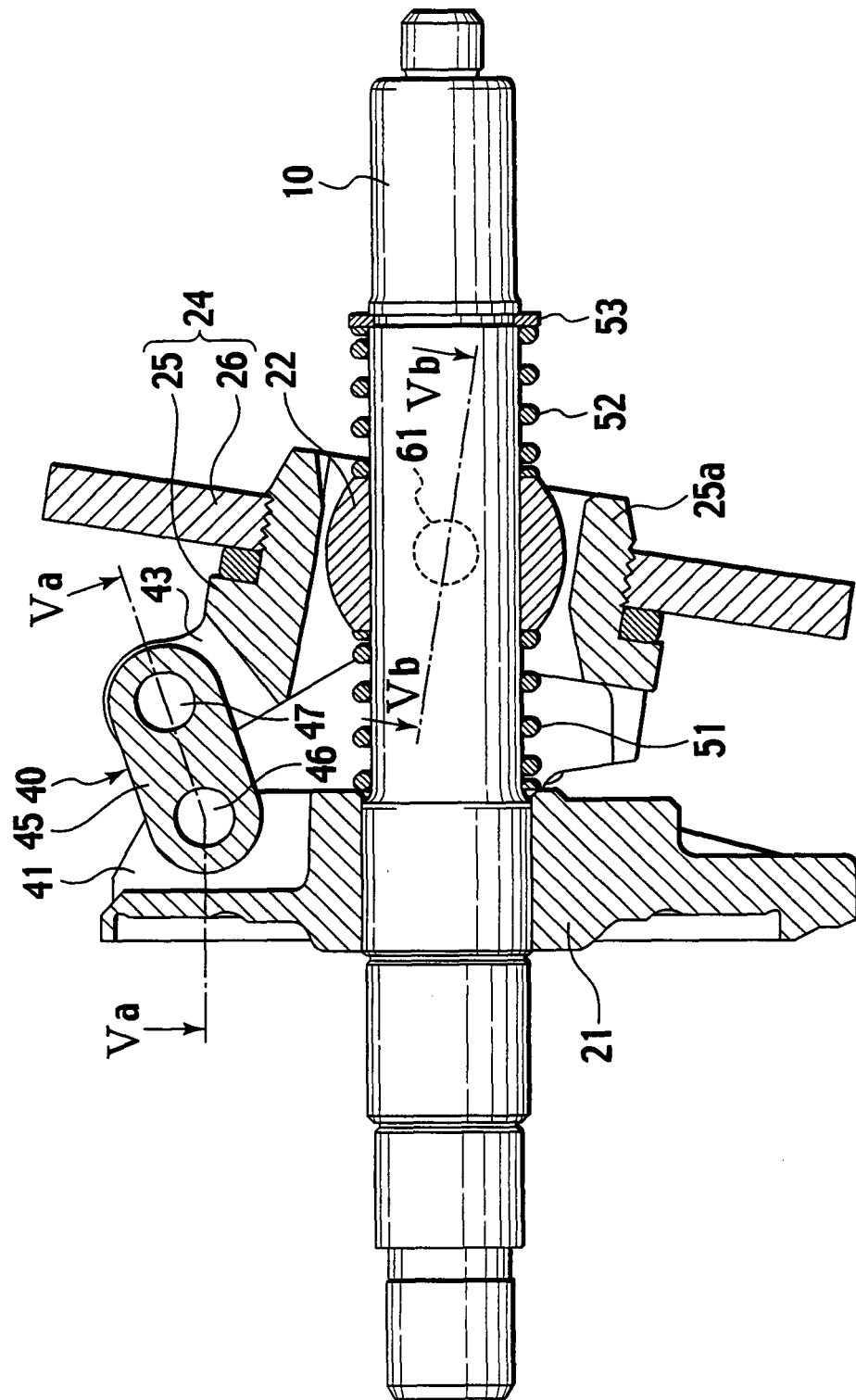


FIG. 5

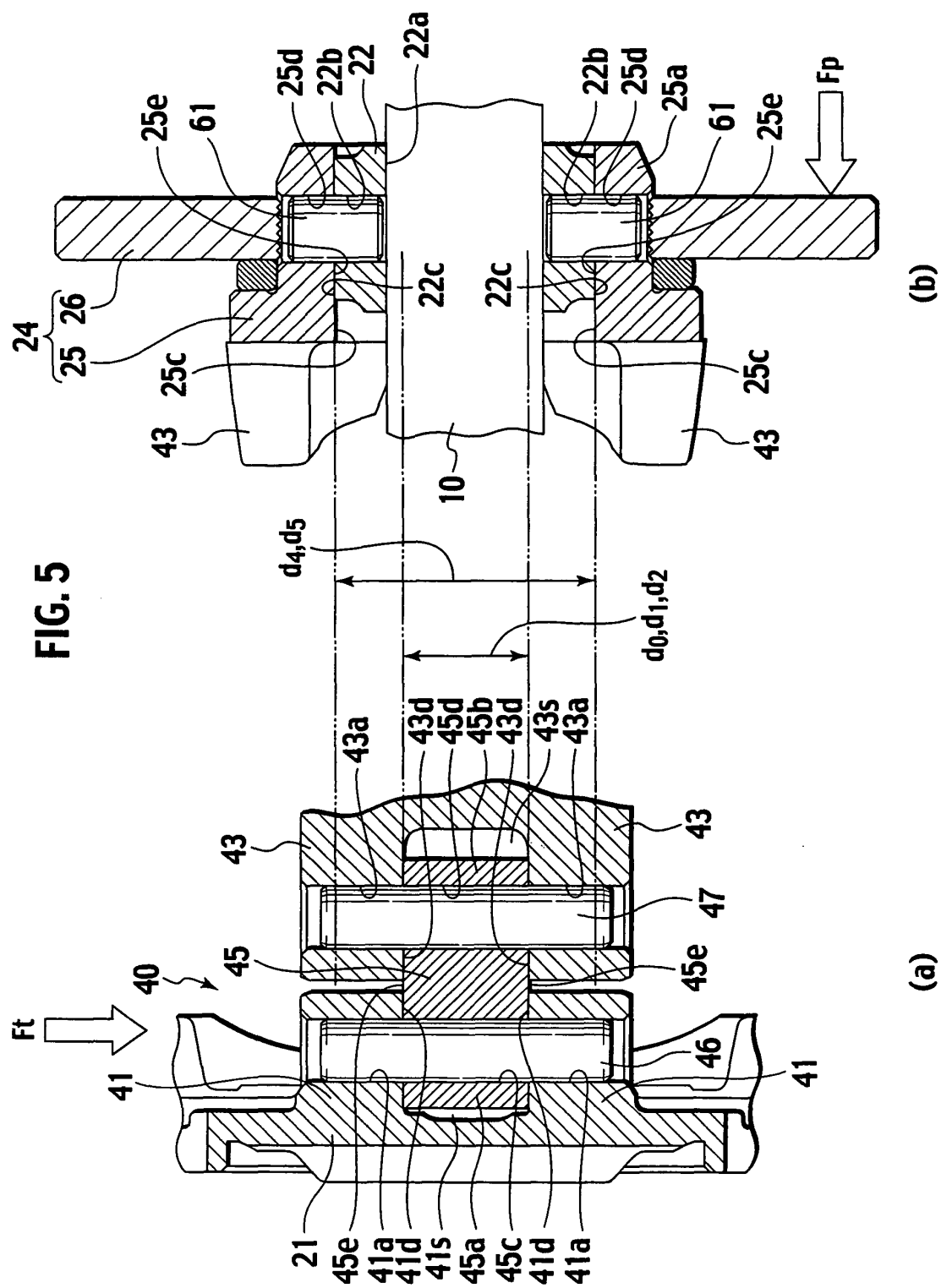


FIG. 6

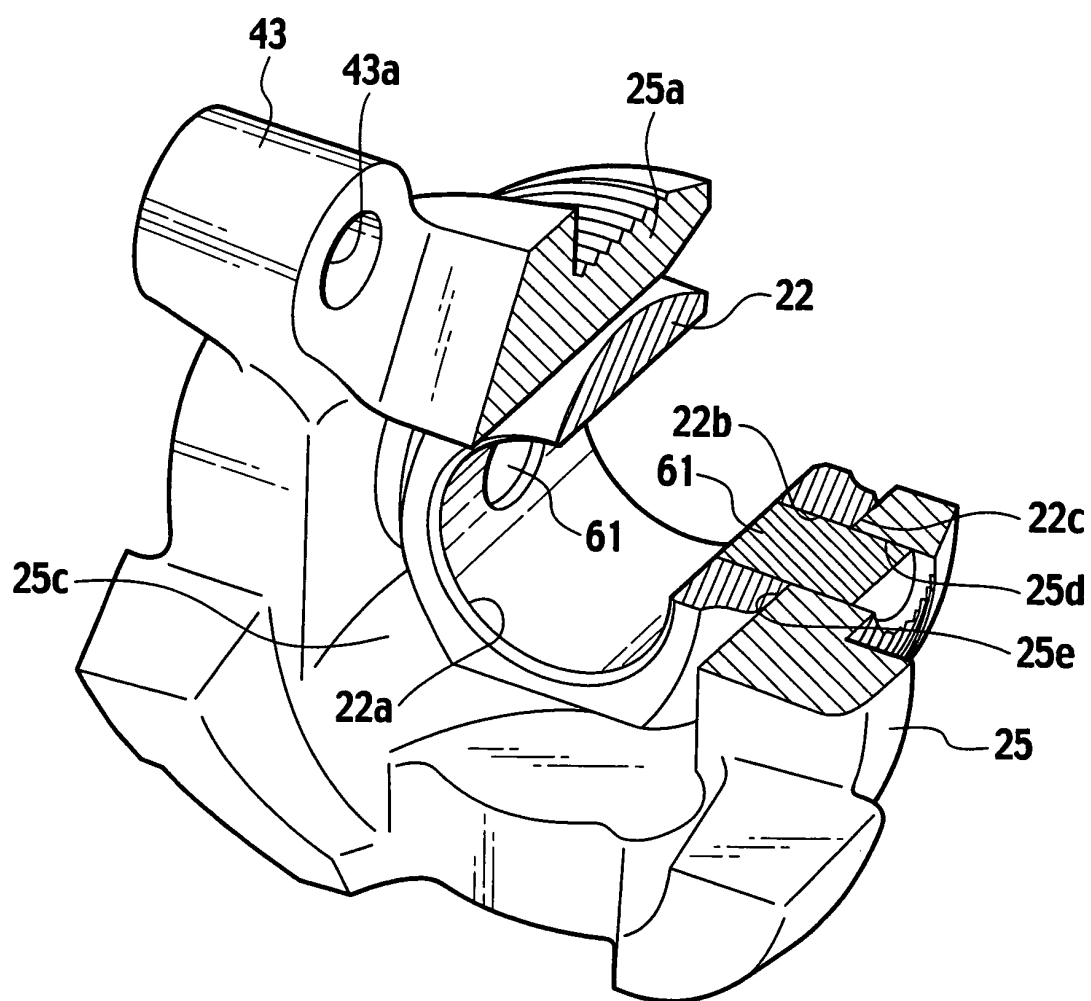


FIG. 7

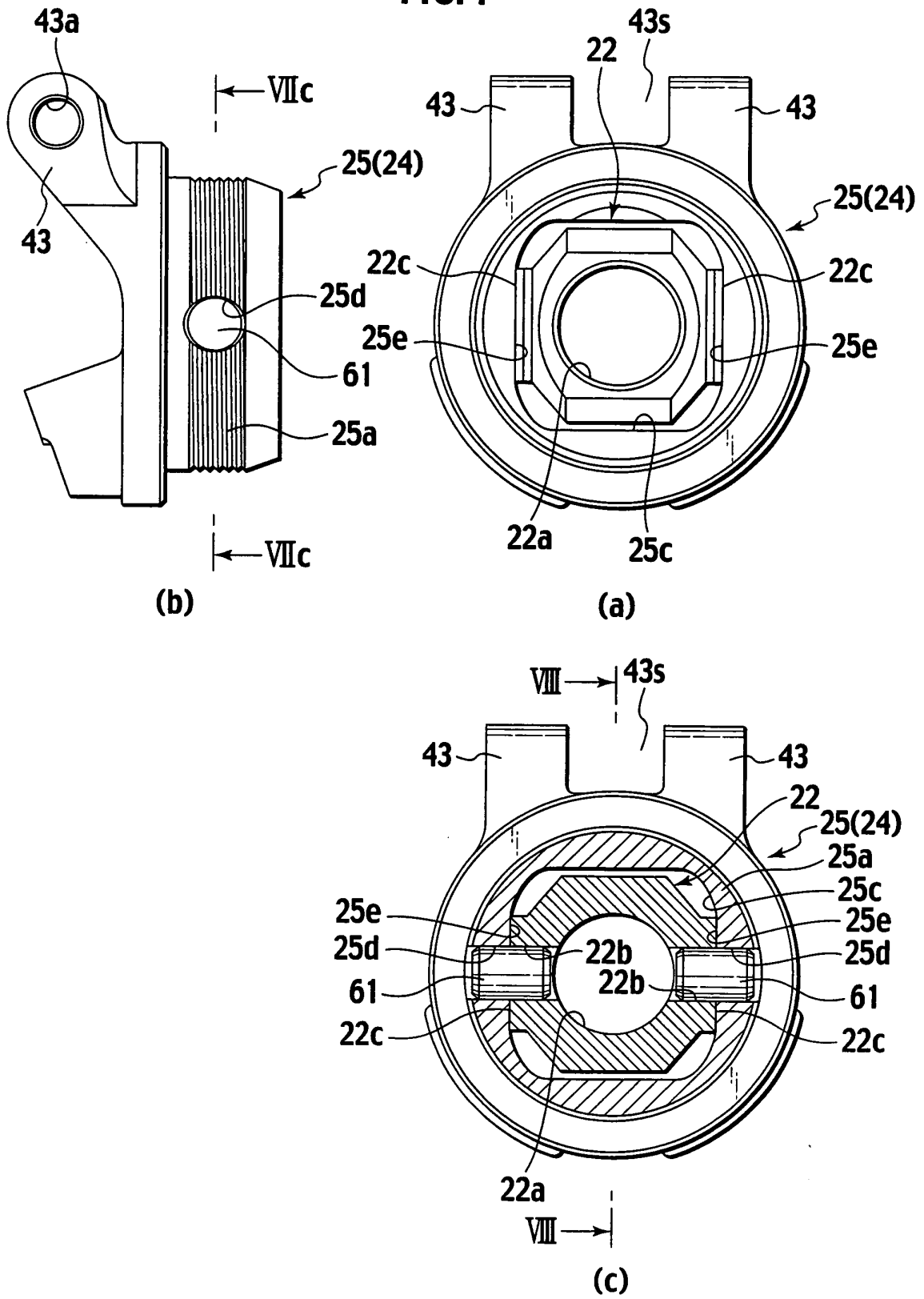
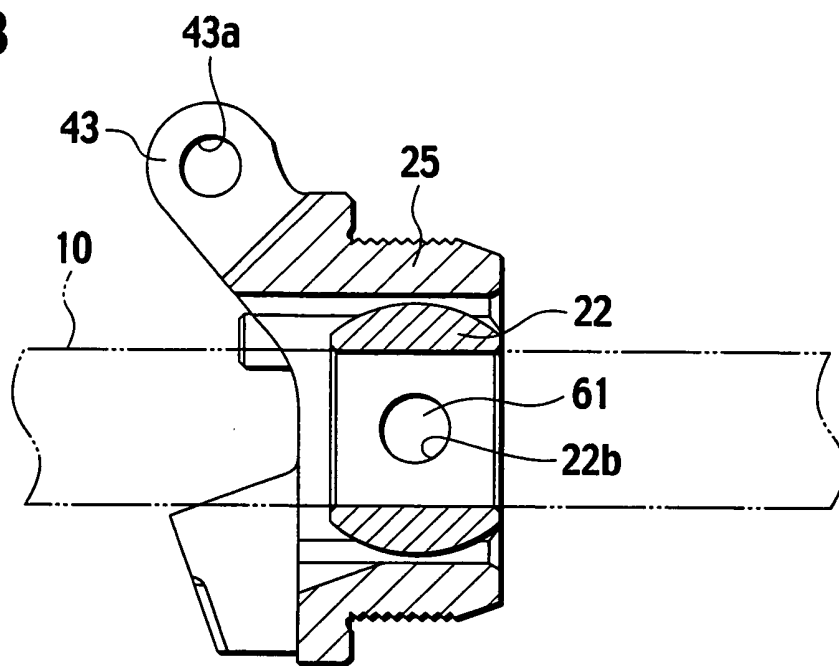
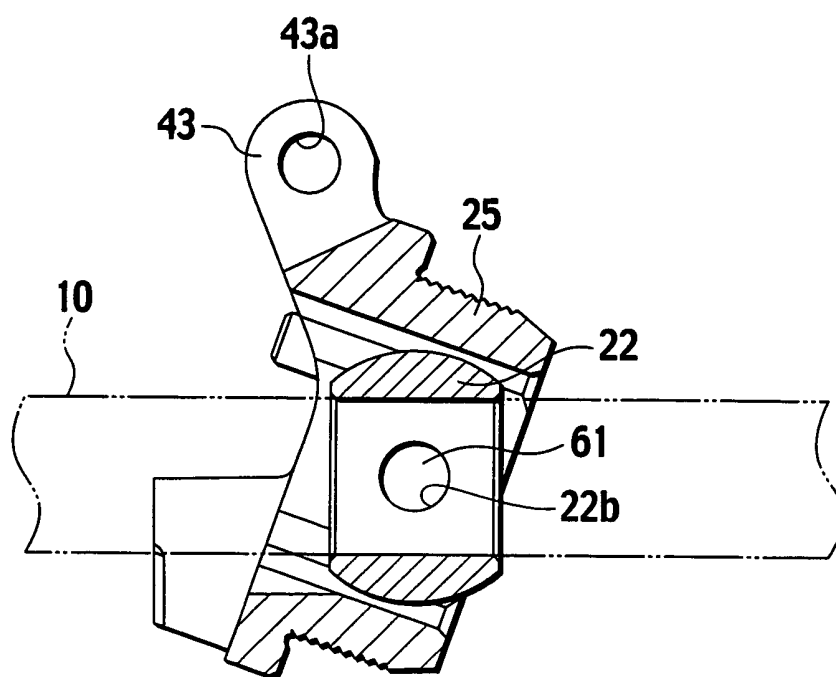


FIG. 8

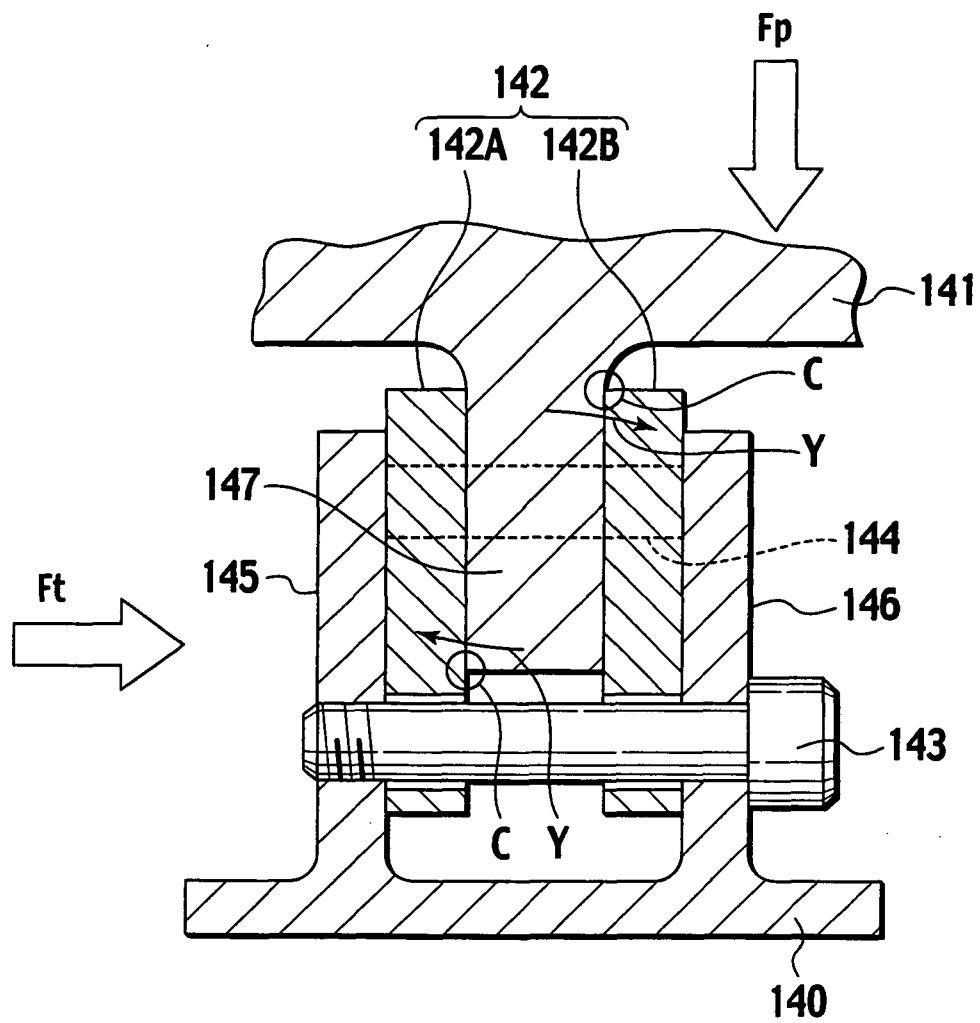


(a)



(b)

FIG. 9



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2006/320963

A. CLASSIFICATION OF SUBJECT MATTER

F04B27/08 (2006.01) i

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)

F04B27/08

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

Jitsuyo Shinan Koho	1922-1996	Jitsuyo Shinan Toroku Koho	1996-2007
Kokai Jitsuyo Shinan Koho	1971-2007	Toroku Jitsuyo Shinan Koho	1994-2007

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	JP 10-176655 A (Zexel Corp.), 30 June, 1998 (30.06.98), Par. Nos. [0034] to [0036]; Figs. 1 to 3 & US 5980216 A1 & EP 848162 A2	1, 2 3, 4
X Y	JP 2001-349274 A (Zexel Valeo Climate Control Corp.), 21 December, 2001 (21.12.01), Par. No. [0072]; Fig. 4 & US 2003/0136256 A1 & EP 1291522 A1 & WO 2001/094785 A1	1, 2 3, 4
Y	JP 2005-83325 A (Toyota Industries Corp.), 31 March, 2005 (31.03.05), Par. Nos. [0058] to [0061]; Fig. 5 (Family: none)	3, 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
11 January, 2007 (11.01.07)Date of mailing of the international search report
23 January, 2007 (23.01.07)Name and mailing address of the ISA/
Japanese Patent Office

Authorized officer

Facsimile No.

Telephone No.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2006/320963

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 2001-304103 A (Zexel Valeo Climate Control Corp.), 31 October, 2001 (31.10.01), Fig. 2 (Family: none)	4
A	JP 2001-41153 A (Zexel Valeo Climate Control Corp.), 13 February, 2001 (13.02.01), Full text; all drawings (Family: none)	1-4

Form PCT/ISA/210 (continuation of second sheet) (April 2005)

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- JP 2003172417 A [0002]
- JP 10176658 A [0002]