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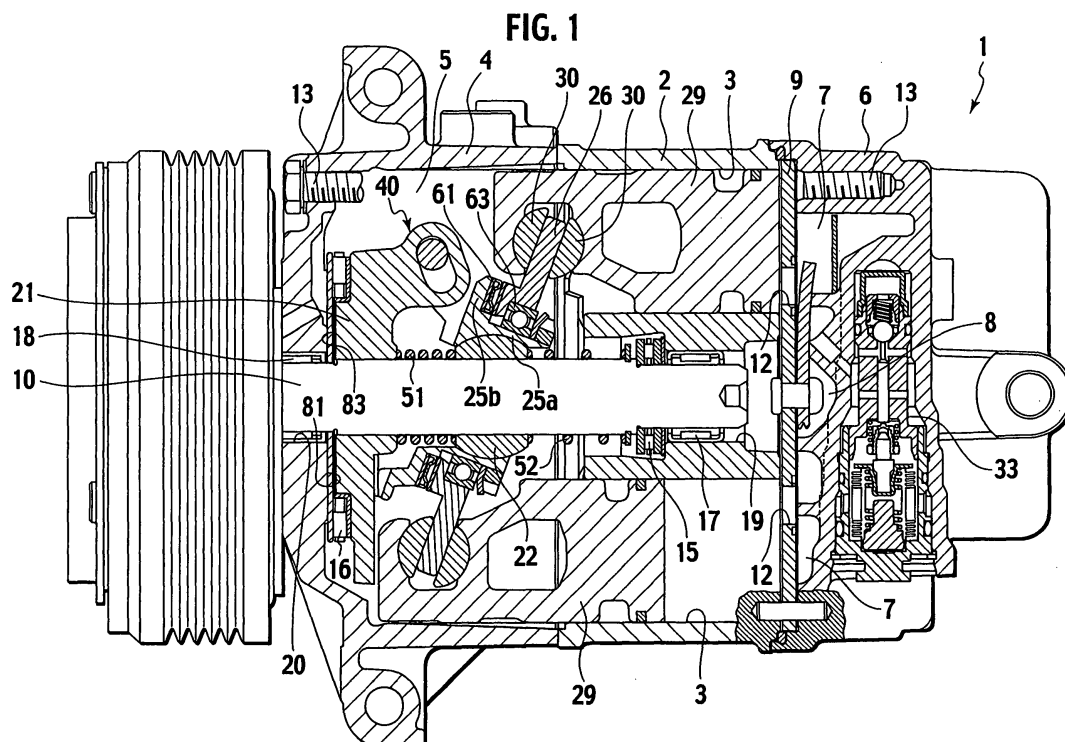
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(54) **Compressor**

(57) A compressor 1 includes a thrust bearing 61, a first member 25 and a second member 26 that face to each other while sandwiching the thrust bearing 61 there-

between, and a release portion 75 that allows deformation of an outer region of one of races 61a of the thrust bearing 61.



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Description

CROSS REFERENCE TO RELATED APPLICATIONS AND INCORPORATION BY REFERENCE

[0001] This application is based upon and claims the benefit of priority from the prior Japanese Patent Applications No. 2005-321101, filed on November 4th, 2005; the entire contents of which are incorporated herein by reference.

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0002] The present invention relates to a compressor, and, more particularly, to a compressor useable in a refrigeration cycle of a vehicular air conditioner or the like to compress refrigerant.

2. Description of the Related Art

[0003] As a conventional compressor, for example, there is a wobble plate type variable displacement compressor disclosed in Japanese Patent Application Laid-Open No. 2000-320455. The wobble plate type variable displacement compressor includes a shaft, a rotating base for integral rotation with the shaft, a wobble plate that is rotatably attached to the rotating base via a radial bearing and a thrust bearing, and pistons connected to an outer region of the wobble plate via pairs of hemispherical-shaped shoes. When the rotating base integrally rotates with the shaft, the wobble plate wobbles in a manner corresponding to the inclination angle of the rotating base, so that the pistons reciprocate.

[0004] The wobble plate does not rotate rapidly due to the friction with the shoes. Accordingly, the wobble plate type compressor has an advantage that the rotation moment (the torque) is small and the friction between the shoes and the wobble plate is low, compared to a swash plate type compressor in which a swash plate integrally rotates with a shaft.

SUMMARY OF THE INVENTION

[0005] In the wobble plate type compressor, a compression reaction force from the pistons is applied to an area around the upper dead center of the wobble plate. The compression reaction force is set off from the center of the shaft (the center of the wobble plate) so that the wobble plate is pressed in such a manner that the wobble plate inclines with respect to the rotating base. Accordingly, the strong force is applied to an outer region of the thrust bearing located between the wobble plate and the rotating base. This force causes the outer region of rolling elements of the thrust bearing to be subjected to excessive wear.

[0006] Japanese Patent Application Laid-Open No.

2003-328931 suggests locating a thrust bearing on an axial line of the pistons to receive the compression reaction force from the pistons. This location requires a large thrust bearing so that a flange formed on the rotating base and a flange formed on the wobble plate that sandwich the larger thrust bearing also have a large size.

[0007] The present invention was developed based on such a problem of the related art and provides a compressor in which damage of an outer region of a thrust bearing, caused by a compression reaction force, can be prevented without enlarging the size.

[0008] The first aspect of the present invention is a compressor including a thrust bearing having a pair of races; a first member and a second member sandwiching the thrust bearing therebetween; and a release portion that allows flexing of an outer region of one of races of the thrust bearing.

[0009] The second aspect of the present invention is a compressor including a thrust bearing; a first member and a second member sandwiching the thrust bearing therebetween; a first thrust receiving face formed on the first member and receiving the thrust bearing; and a second thrust receiving face formed on the second member and receiving the thrust bearing, at least one of the first thrust receiving face and second thrust receiving face being out of contact with an outer region of the thrust bearing.

[0010] The third aspect of the present invention is a compressor including a shaft; a rotating base configured to rotate with the shaft and having a first thrust receiving face; a wobble plate having a second thrust receiving face; a thrust bearing sandwiched between the first thrust receiving face and the second thrust receiving face such that the wobble plate is rotatable relative to the rotating base; and a piston engaged with the wobble plate for reciprocation corresponding to wobble movement of the wobble plate. One of the first thrust receiving face and the second thrust receiving face is out of contact with an outer region of the thrust bearing.

[0011] The fourth aspect of the present invention is a compressor including a compressor housing having a first thrust receiving face; a shaft rotatably supported by the housing; a rotor fixed to the shaft to rotate with the shaft and having a second thrust receiving face; a piston configured to reciprocate corresponding to rotation of the rotor; and a thrust bearing sandwiched between the first thrust receiving face and the second thrust receiving face. One of the first thrust receiving face and the second thrust receiving face is out of contact with an outer region of the thrust bearing.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012]

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

Fig. 2 is an enlarged sectional view showing a connecting structure between a wobble plate and a rotating base of the compressor;

Fig. 3 is an enlarged sectional view showing a connecting structure between a wobble plate and a rotating base of a compressor according to a second embodiment;

Fig. 4 is an enlarged sectional view showing a connecting structure between a wobble plate and a rotating base of a compressor according to a third embodiment;

Fig. 5 is an enlarged sectional view showing a connecting structure between a wobble plate and a rotating base of a compressor according to a fourth embodiment;

Fig. 6 is an enlarged sectional view showing a connecting structure between a wobble plate and a rotating base of a compressor according to a fifth embodiment; and

Fig. 7 is an enlarged sectional view showing a connecting structure between a housing and a rotor of a compressor according to a sixth embodiment.

DETAILED DESCRIPTION OF THE INVENTION

[0013] A compressor according to embodiments of the present invention will be described with reference to the drawings.

First Embodiment

[0014] Fig. 1 is an overall cross-sectional view showing a compressor according to the first embodiment. As shown in Fig. 1, the compressor 1 of the first embodiment is a wobble plate type variable displacement compressor. The compressor 1 includes a cylinder block 2 having a plurality of cylinder bores 3 located evenly spaced apart in a circumferential direction, a front head 4 attached to a front end of the cylinder block 2 and having a crank chamber 5 therein, and a rear head 6 attached to a rear end of the cylinder block 2 via a valve plate 9 and having a suction chamber 7 and a discharge chamber 8 therein. The cylinder block 2, the front head 4, and the rear head 6 are fixed to each other by a plurality of bolts 13 so as to compose a housing of the compressor.

[0015] The valve plate 9 has suction ports (not shown) that allow the cylinder bores 3 to communicate with the suction chamber 7 and discharge ports 12 that allow the cylinder bores 3 to communicate with the discharge chamber 8.

[0016] A valve system (not shown) adapted to open and close the suction ports is provided on the valve plate 9 at the cylinder block side. A valve system (not shown) adapted to open and close the discharge ports 12 is provided on the valve plate 9 at the rear head side.

[0017] A drive shaft 10 is supported by radial bearings 17, 18 in support bores or holes 19, 20 that are formed at central portions of the cylinder block 2 and the front

head 4 so that the drive shaft 10 is rotatable in the crank chamber 5. A thrust bearing 16 is interposed between a thrust receiving face 83 of a rotor 21, fixed to the shaft 10, and a thrust receiving face 81 of the front head 4. A thrust bearing 15 is interposed between a step (thrust receiving face) formed on the support bore 19 of the cylinder block 2 and a step (thrust receiving face) formed on the shaft 10.

[0018] The crank chamber 5 accommodates the rotor 21 fixed to the shaft 10, a sleeve 22 attached to the shaft 10 slidable in the axial direction, a rotating base 25 connected to the sleeve 22, such a ball joint structure, so as to be tiltable with respect to the axis of the shaft 10, a wobble plate 26 attached to the rotating base 25 via a radial bearing 63 and a thrust bearing 61 so as to be rotatable in a circumferential direction with respect to the rotating base 25, and a linkage mechanism 40 linking the rotor 21 and the rotating base 25 to transfer the rotation of the rotor 21 to the rotating base 25 as allowing changes of the inclination angle of the rotating base 25.

[0019] Pistons 29 are reciprocally disposed in the cylinder bores 3. Each piston 29 is connected to the outer region of the wobble plate 26 via a pair of hemispherical-shaped piston shoes 30.

[0020] With this structure, when the rotor 21 rotates with the shaft 10, the rotation of the rotor 21 is transferred to the rotating base 25 via the linkage mechanism 40 so that the rotating base 25 rotates with the rotor 21. When the rotating base 25 rotates, the wobble plate 26 wobbles corresponding to the inclination angle of a flange 25b of the rotating base 25, but does not rotate due to a sliding friction contact with the piston shoes 30. The wobble of the wobble plate 26 is converted into reciprocation of the pistons 29. By the reciprocation of the pistons 29, refrigerant is sucked from the suction chamber 7 into the cylinder bores 3 through the suction ports of the valve plate 9, and compressed in the cylinder bore 3, and discharged to the discharge chamber 8 through the discharge ports 12 of the valve plate 9.

[0021] The compressor 1 of the present embodiment is not a double-ended wobble plate type variable displacement compressor in which the pistons 29 are provided on both sides of the wobble plate 26. The present compressor is a single-ended wobble plate type variable displacement compressor on which the pistons 29 are provided in one side of the wobble plate 26.

Control of Variable Capacity

[0022] The inclination angle of the wobble plate 26 is changeable. When the wobble plate 26 is moved toward the cylinder block 2 against the return spring 52, the inclination angle of the wobble plate 26 decreases. On the other hand, when the wobble plate 26 is moved away from the cylinder block 2 against the return spring 51, the inclination angle of the wobble plate 26 increases.

[0023] The inclination angle of the wobble plate 26 corresponds to the piston strokes and the discharging

amount of the compressor 1. A pressure difference (pressure balance) between the crank chamber pressure P_c , in back of the pistons 29, and the suction chamber pressure P_s , in front of the pistons 29, makes a change in the inclination angle of the wobble plate 26 to change piston strokes. Accordingly, the compressor 1 has a pressure control mechanism. The pressure control mechanism includes a gas extraction passage (not shown) that allows the crank chamber 5 to communicate with the suction chamber 7, a gas supply passage (not shown) that allows the crank chamber 5 to communicate with the discharge chamber 8, and a control valve 33 that is provided in the midstream of the gas supply passage to open and close the gas supply passage.

Connecting structure between Wobble Plate and Rotating Base

[0024] A connecting structure between the wobble plate and the rotating base will be described with reference to Figs. 1 and 2.

[0025] As shown in Figs. 1 and 2, the rotating base 25 is formed with a substantially disk-like shaped flange 25b and a substantially tubular shaped boss 25a. The wobble plate 26 is connected to the flange 25b via the thrust bearing 61 and to the boss 25a via the radial bearing 63. The wobble plate 26 is attached to the rotating base 25 under a precompression provided in a direction of the thrust load by a washer 65 and an adjusting screw 67.

[0026] The radial bearing 63 includes a pair of races 63a, 63b, balls 63c as rolling elements for rolling between the pair of races 63a, 63b, and a retainer 63d for retaining the balls 63c between the pair of races 63a, 63b. The thrust bearing 61 includes a pair of races 61a, 61b, a plurality of column shaped needles 61c as rolling elements for rolling between the pair of races 61a, 61b, and a retainer 61d retaining the needles 61d between the pair of races 61a, 61b.

[0027] The compression reaction force F_p applied to the upper dead center of the wobble plate 26 or the area around the upper dead center is set off from the axis of the shaft 10, so that a thrust load between the rotating base 25 and the wobble plate 26 is off center from the axis of them. In other words, the rotating base 25 and the wobble plate 26 relatively rotate in a condition in which the wobble plate 26 is pressed in an inclined manner with respect to the rotating base 25. Therefore, outer regions of the needles 61c of the thrust bearing 61 are strongly pressed between the races 61a, 61b. As a result, the needles 61c may be subjected to excessive wear.

[0028] In order to prevent such damage of the needles 61c, an outer region of the race 61a is made so as to not contact with a thrust receiving face 71. In other words, the thrust receiving face 71 of the rotating base 25 has a slot or release portion 75 which allows flexure of the outer region of the race 61a. The release portion 75 is defined by a recess 76 (a stepped portion 76 in this embodiment) which is formed on the thrust receiving face 71 of the

rotating base 25 at an area corresponding to the outer region of the race 61a. The recess 76 is recessed from the other parts of the thrust receiving face 71. The recess 76 is formed in an annular shape along the outer region of the thrust bearing 61 and located at an inner side from outer ends of the needles 61c.

Effect

[0029] With the above described structure, the first embodiment achieves about the following effects.

(1) According to the present embodiment, the outer region of the race 61a of the thrust bearing 61 does not contact the thrust receiving face 71. In other words, the compressor 1 of the present embodiment includes the release portion 75 that allows elastic deformation of the outer region of the race 61a of the thrust bearing 61.

Such a structure prevents the outer regions of the needles 61c from being damaged by pressure from the races 61a, 61b since the end of the thrust bearing 61 is deformable even when the rotating base 25 and the wobble plate 26 relatively rotate in such a manner that the wobble plate 26 inclines relative to the rotating base 25 by the compression reaction force F_p applied around the upper dead center of the wobble plate 26.

(2) According to the present embodiment, the release portion 75 is defined by the recess (the stepped portion 76 in this embodiment) which is recessed from the thrust receiving face 71 of the rotating base 25 at an area corresponding to the outer region of the race 61a. Accordingly, the release portion 75 can comprise a simple structure.

Second Embodiment

[0030] In the first embodiment, a release portion 75 is defined by a recess (a stepped portion 76) which is formed on the thrust receiving face 71 of the rotating base 25 at an area corresponding to the outer region of the race 61a. However, for example, as shown in the second embodiment in Fig. 3, a recess may be provided as a linear slope 76B.

Third Embodiment

[0031] As shown in the third embodiment in Fig. 4, a recess may be provided as a curved slope 76C.

Fourth Embodiment

[0032] In the first embodiment, a release portion 75 is formed on only a thrust receiving face 71 of a rotating base 25. However, for example, as shown in the fourth embodiment in Fig. 5, a release portion 77 may be formed, as a stepped portion 78 or the like, on a thrust

receiving face 73 of a wobble plate 26 in addition to the release portion 75 formed on the thrust receiving face 71 of the rotating base 25.

Fifth Embodiment

[0033] As shown in the fifth embodiment in Fig. 6, for example, release portions 79, 80 may be defined by forming outer ends of at least one of the races 61a, 61b and needles 61c to project from thrust receiving faces 71, 73. In this case, the release portions can also comprise a simple structure.

Sixth Embodiment

[0034] In the above embodiments, the present invention is applied to a structure between the rotating base 25 and the wobble plate 26, which relatively rotate while sandwiching a thrust bearing 61 therebetween. However, as shown in the sixth embodiment in Fig. 7, the present invention may be applied to a structure between a housing 4 of the compressor 1 and a rotor 21, which relatively rotate while sandwiching a thrust bearing 16 therebetween. According to the sixth embodiment in Fig. 7, a recess (a stepped portion 86 in this embodiment) is formed on a thrust receiving face 81 of the housing 4, not on a thrust receiving face 83 of a rotor 21, so as to form a release portion 85. With this structure, an outer region of a race 16a, which contacts the thrust receiving face 81, can be deformable.

[0035] As described above, a compressor according to the present invention includes a first member and a second member that are relatively rotate while sandwiching a thrust bearing therebetween and a release portion that allows deformation of an outer region of one of the races of the thrust bearing. In other words, one of a thrust receiving face of the first member and a thrust receiving face of the second member is not in contact with the outer region of the thrust bearing. This structure prevents a rotating element in the thrust bearing from being excessively worn, since the outer region of one of the races of the thrust bearing is allowed to be deformed even when the first member and the second member relatively rotate when a heavy load is applied to the outer region of the thrust races due to a pressure.

[0036] Although the invention has been described above by reference to certain embodiments of the invention, the invention is not limited to the embodiments described above. Modification and variation of the embodiments can be made without departing from spirit or scope of the appended claims. Therefore, the embodiments are only for illustrative purpose and not limit the invention.

Claims

1. A compressor (1), comprising:

a thrust bearing (16, 61) having a pair of races; a first member (25, 4) and a second member (26, 21) sandwiching the thrust bearing (61, 16) therebetween; and a release portion (75, 77, 85) that allows deformation of an outer region of one of races of the thrust bearing (61, 16).

2. A compressor (1), comprising:

a thrust bearing (16, 61); a first member (25, 4) and a second member (26, 21) sandwiching the thrust bearing (61, 16) therebetween; a first thrust receiving face (71, 81) formed on the first member (25, 4) and receiving the thrust bearing (61, 16); and a second thrust receiving face (73, 83) formed on the second member (26, 21) and receiving the thrust bearing (61, 16), at least one of the first thrust receiving face (71, 81) and second thrust receiving face (73, 83) being out of contact with an outer region of the thrust bearing (61, 16).

3. The compressor (1) according to Claim 2, wherein the at least one of the thrust receiving faces has a recess (76, 78, 86) formed thereon at a portion facing to an outer region of the thrust bearing (61, 16) so that the at least one of the thrust receiving faces is out of contact with the outer region of the thrust bearing (61, 16).

4. The compressor (1) according to Claim 2, wherein the thrust bearing (61, 16) outwardly projects from the at least one of the thrust receiving faces so that the thrust receiving face is out of contact with an outer region of the thrust bearing (61, 16).

5. A compressor (1), comprising:

a shaft (10); a rotating base (25) configured to rotate with the shaft (10) and having a first thrust receiving face (71); a wobble plate (26) having a second thrust receiving face (73); a thrust bearing (61) sandwiched between the first thrust receiving face (71) and the second thrust receiving face (73) such that the wobble plate (26) is rotatable with respect to the rotating base (25), one of the first thrust receiving face (71) and the second thrust receiving face (73) being out of contact with an outer region of the thrust bearing (61); and a piston (29) engaged with the wobble plate (26) for reciprocation corresponding to a wobble of the wobble plate (26).

6. A compressor (1) comprising:

a housing (4) having a first thrust receiving face (81);
a shaft (10) rotatably supported by the housing (4);
a rotor (21) fixed to the shaft (10) to rotate with the shaft (10) and having a second thrust receiving face (83);
a thrust bearing (16) sandwiched between the first thrust receiving face (81) of the housing (4) and the second thrust receiving face (83) of the rotor (21), one of the first thrust receiving face (81) and the second thrust receiving face (83) being out of contact with an outer region of the thrust bearing (16); and
a piston (29) configured to reciprocate corresponding to rotation of the rotor (21).

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FIG. 1

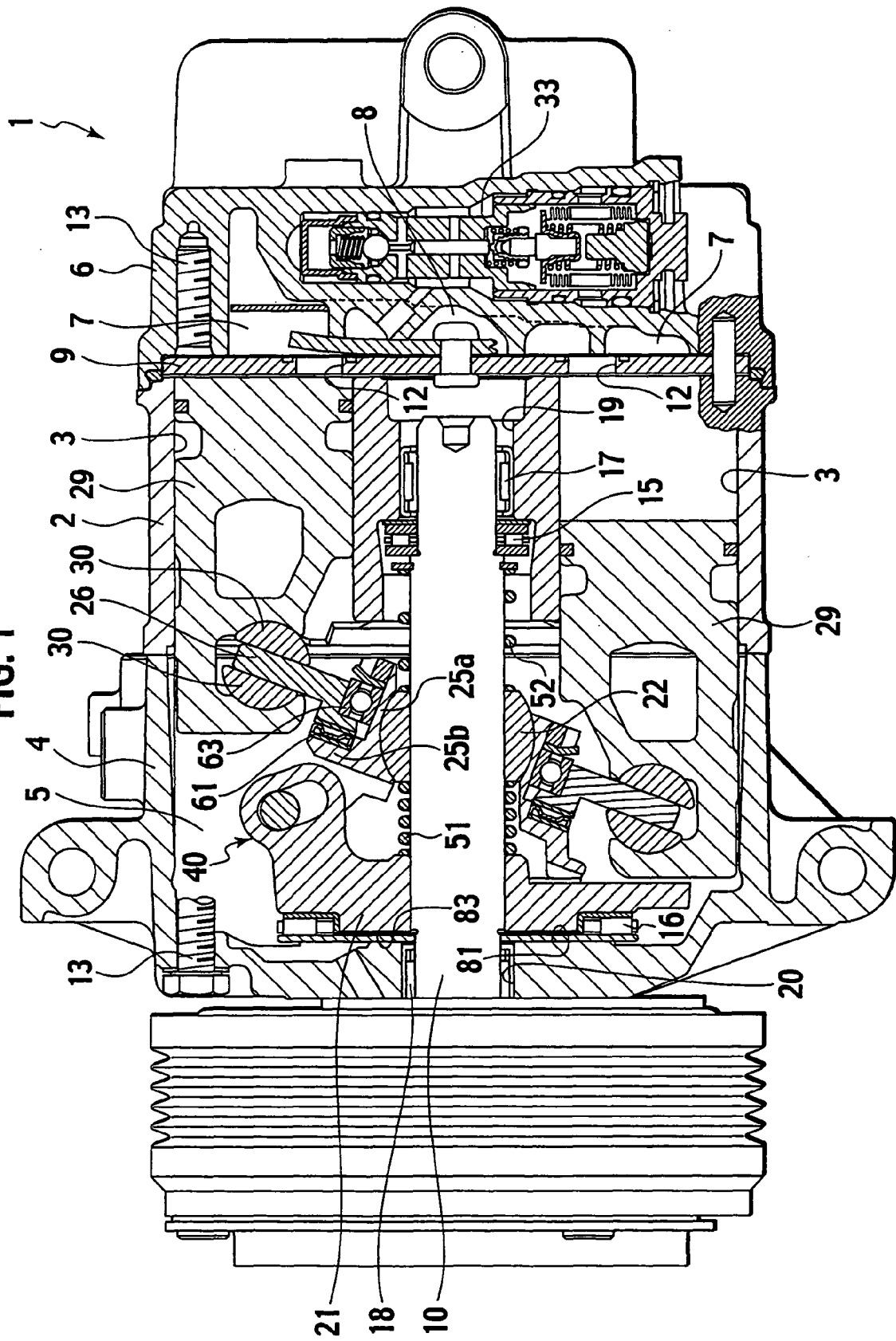


FIG. 2

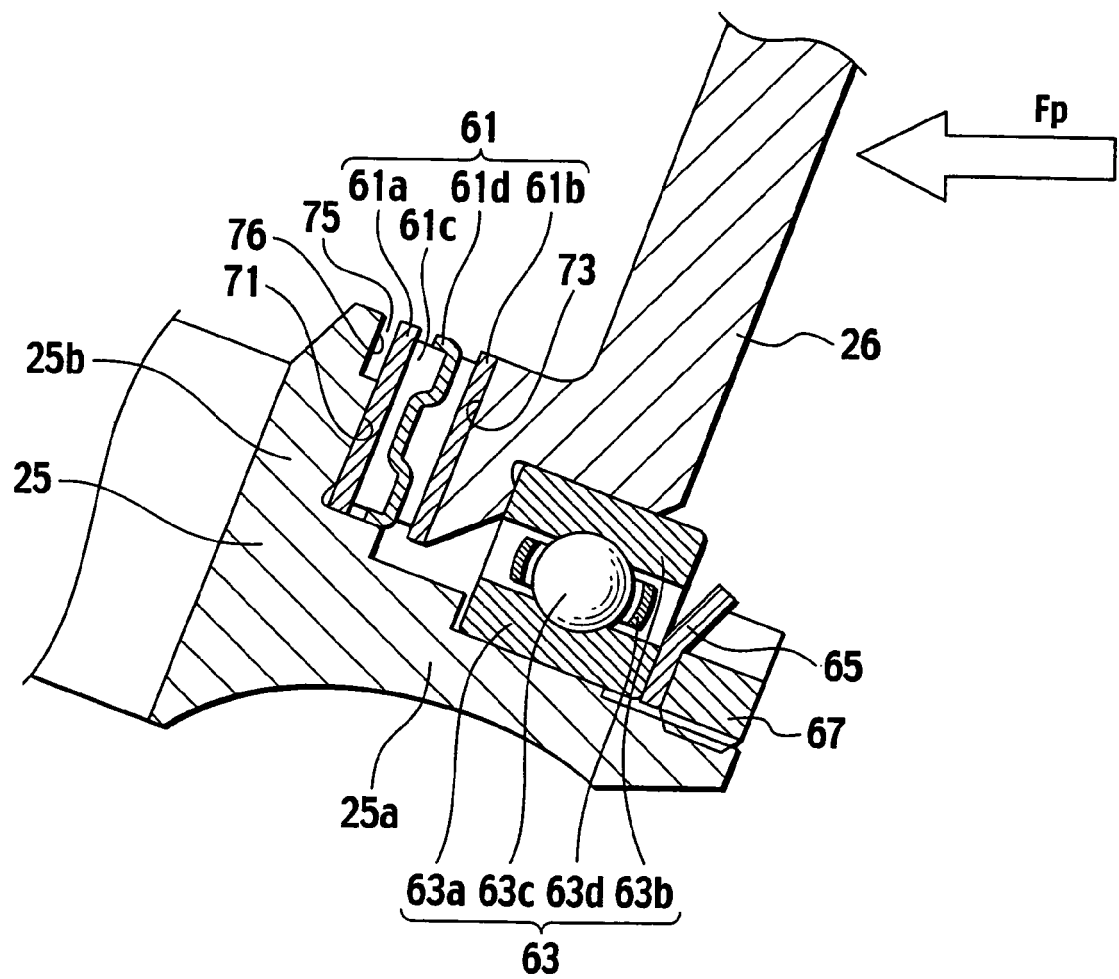


FIG. 3

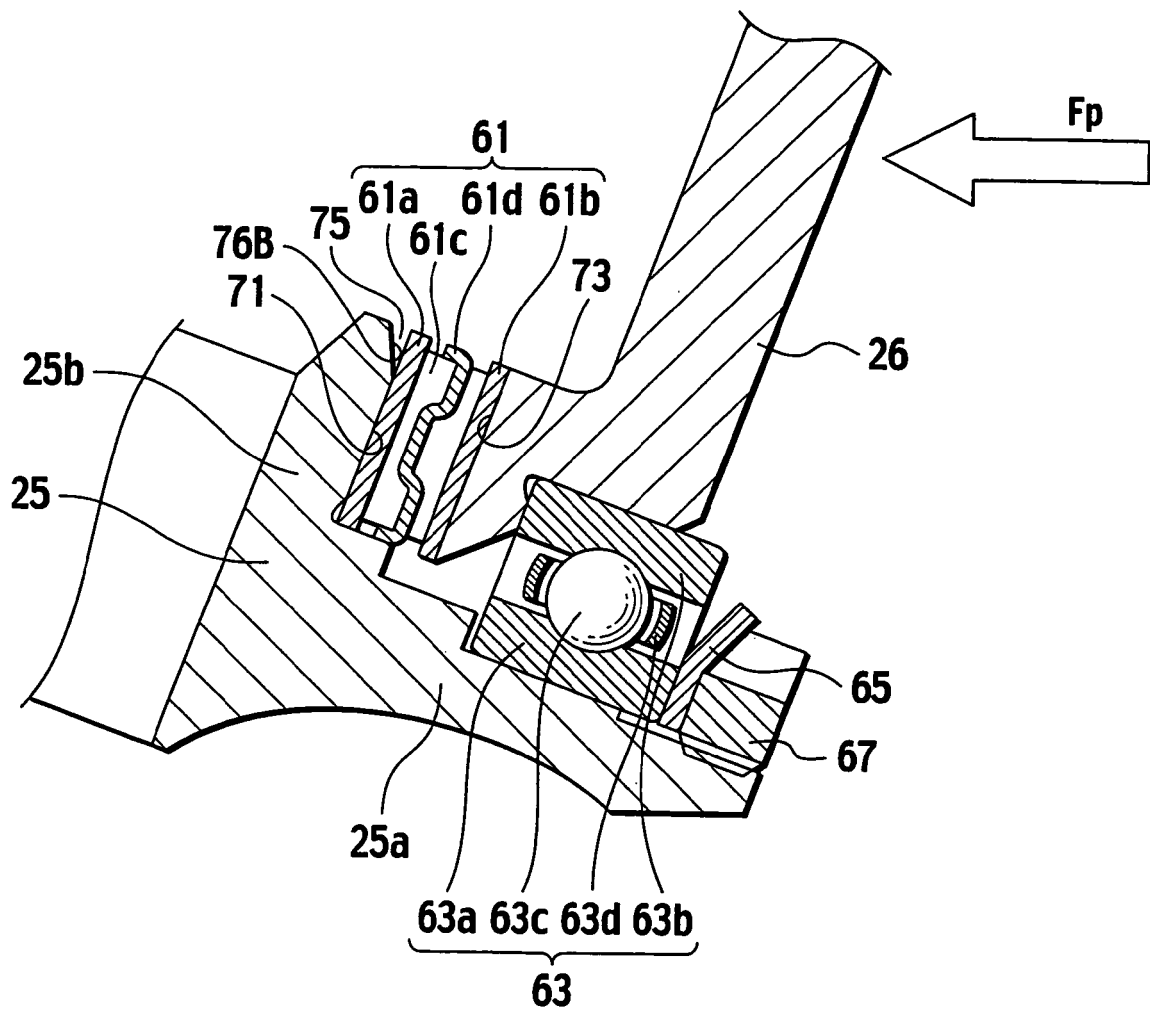


FIG. 4

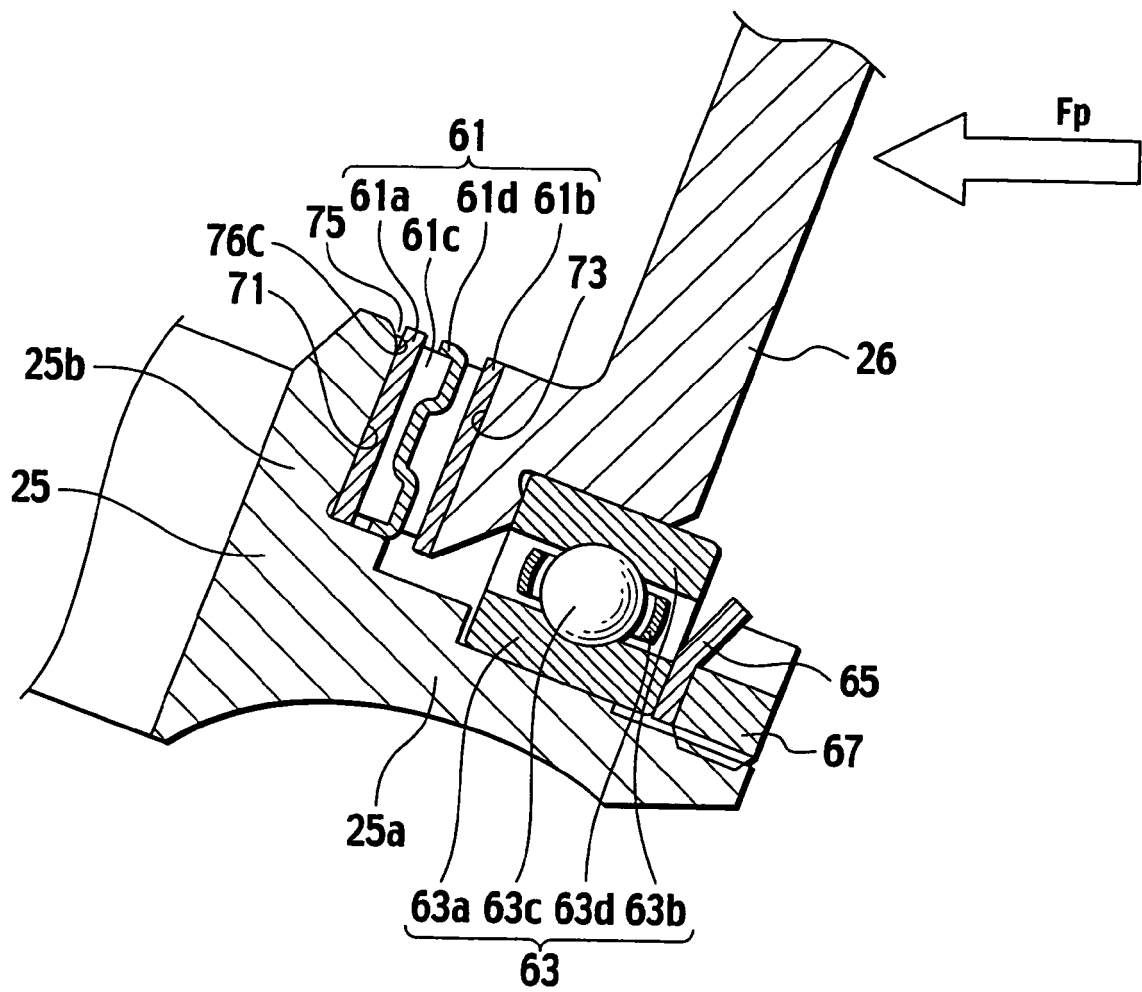


FIG. 5

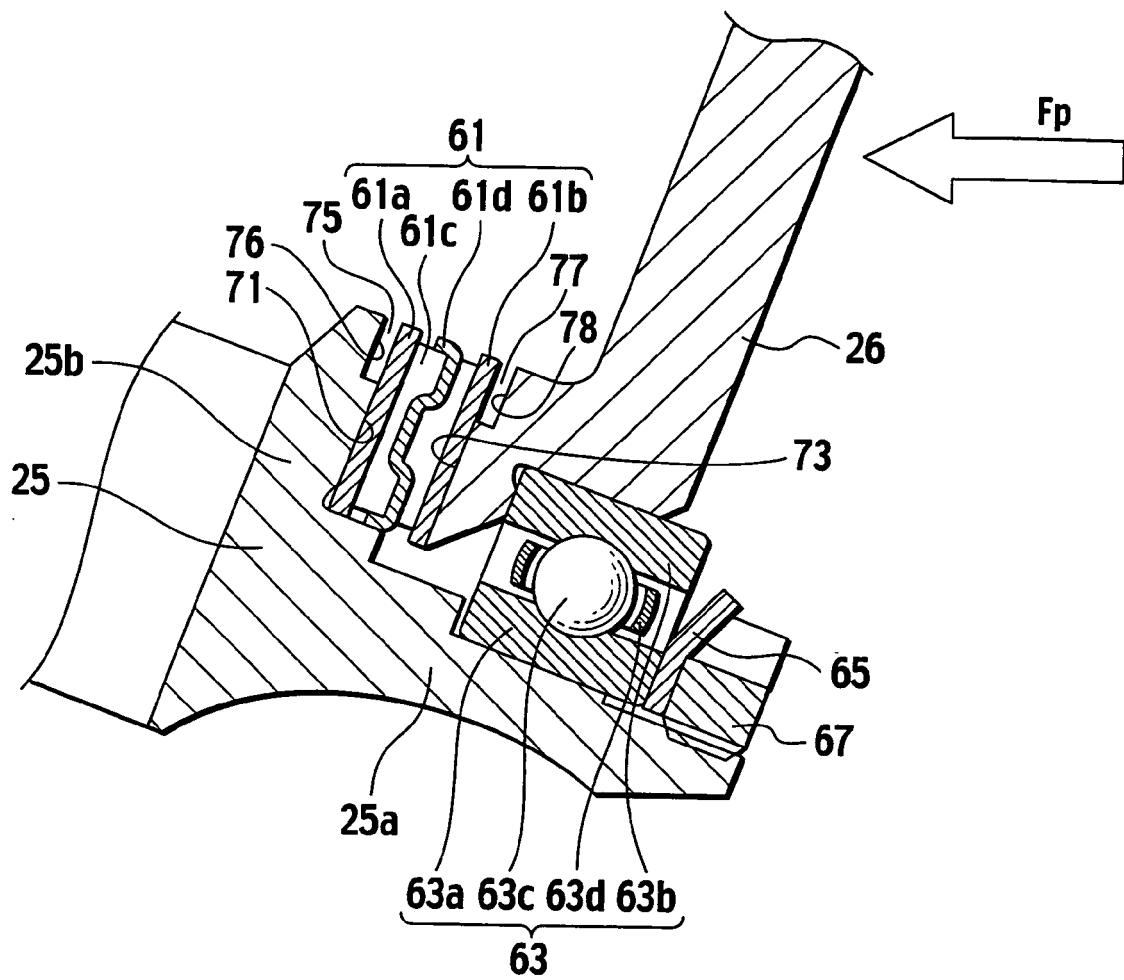


FIG. 6

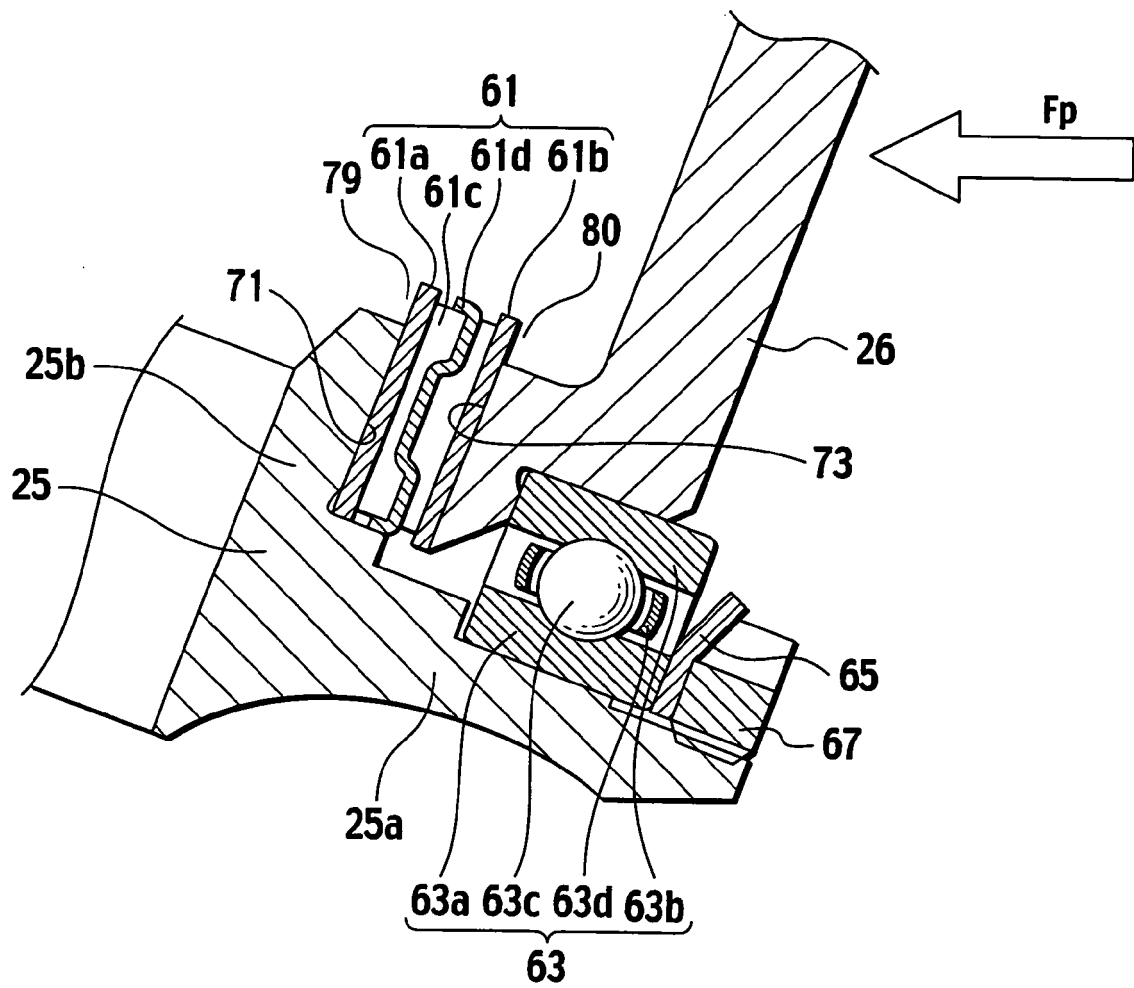
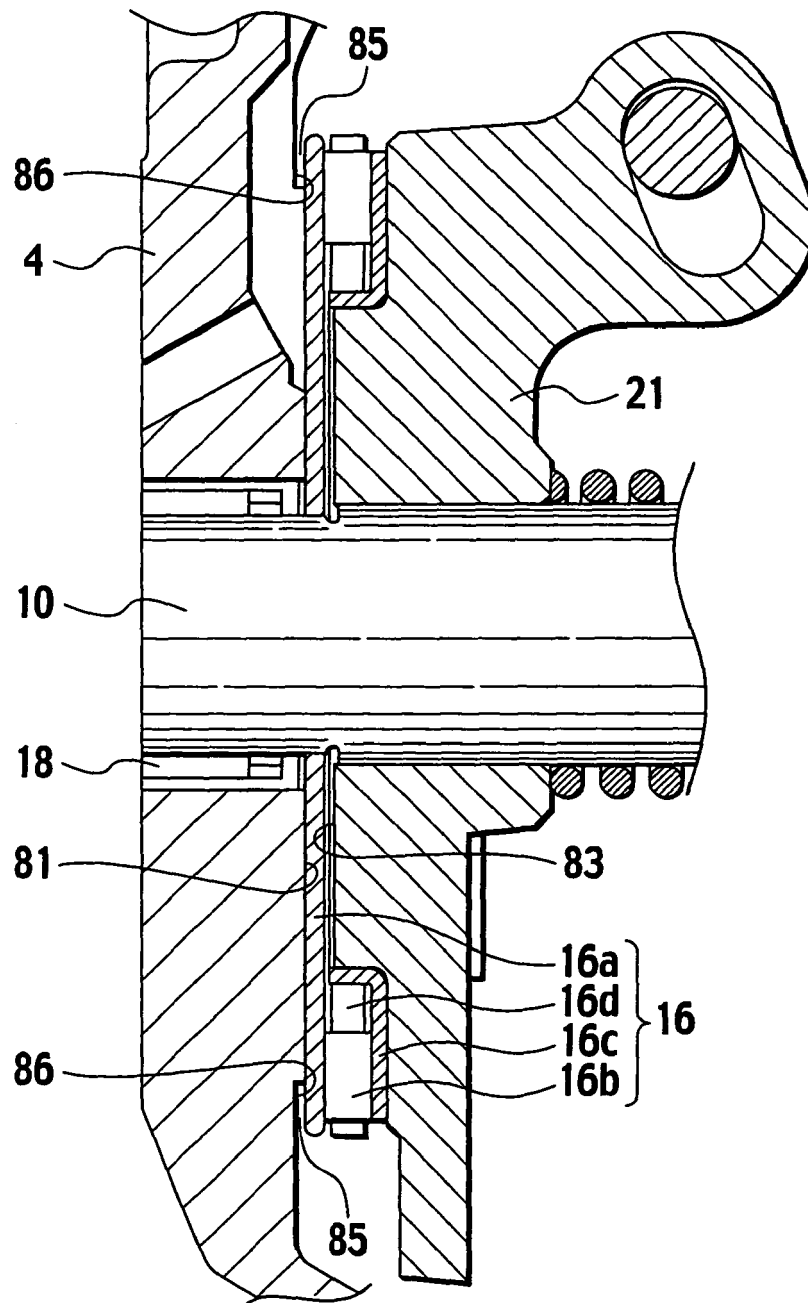


FIG. 7





European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 06 02 2860

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Place of search Munich		Date of completion of the search 15 January 2007	Examiner de Martino, Marcello
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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EPO FORM 1503 03.82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
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