(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 484 504 B1

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention of the grant of the patent:
04.04.2012 Bulletin 2012/14

(21) Application number: **04013169.0**

(22) Date of filing: **03.06.2004**

(51) Int Cl.:
F04C 2/10 *(2006.01)* ***F04B 23/10*** *(2006.01)*
F04C 11/00 *(2006.01)* ***F04C 2/344*** *(2006.01)*
F04C 2/08 *(2006.01)* ***F04C 15/00*** *(2006.01)*

(54) Fuel supply apparatus

Kraftstoffzufuhrvorrichtung

Appareil d'alimentation en carburant

(84) Designated Contracting States:
DE FR GB

(30) Priority: **04.06.2003 JP 2003159280**
21.04.2004 JP 2004125490

(43) Date of publication of application:
08.12.2004 Bulletin 2004/50

(73) Proprietor: **DENSO CORPORATION**
Kariya-city,
Aichi-pref. 448-8661 (JP)

(72) Inventor: **Suzuki, Masashi**
Kariya-city
Aichi-pref., 448-8661 (JP)

(74) Representative: **TBK**
Bavariaring 4-6
80336 München (DE)

(56) References cited:
DE-A- 19 630 975 **DE-U- 8 516 658**
FR-A- 606 708 **GB-A- 2 111 127**
US-A- 3 416 460 **US-A1- 2001 015 200**

- **PATENT ABSTRACTS OF JAPAN vol. 1996, no. 02, 29 February 1996 (1996-02-29) -& JP 07 279790 A (AISAN IND CO LTD), 27 October 1995 (1995-10-27)**

Note: Within nine months of the publication of the mention of the grant of the European patent in the European Patent Bulletin, any person may give notice to the European Patent Office of opposition to that patent, in accordance with the Implementing Regulations. Notice of opposition shall not be deemed to have been filed until the opposition fee has been paid. (Art. 99(1) European Patent Convention).

EP 1 484 504 B1

Description

[0001] This invention relates to a fuel supply apparatus as defined in the preamble of Claim 1. Such an apparatus is known from JP-A-07279790.

[0002] As one of prior art fuel injection pump, for example shown in US Patent Application Publication No. US 2003/0044288 A1, it is known to us that the fuel injection pump is provided with a feed pump for drawing fuel from a fuel tank and feeding the fuel to a main pump of the fuel injection pump.

[0003] As shown in Fig. 6, the feed pump comprises a pump element 110 to be driven by a cam shaft 100 of a main pump, a pump cover 120 for forming a rotor chamber and housing therein the pump element 110, and a pump plate 130 for closing an opening side of the rotor chamber in a liquid-sealing manner in combination with the pump cover 120, wherein the pump cover 120 is screwed to a side surface of a pump housing 140.

[0004] Furthermore, as shown in Fig. 7, the pump element 110 is a trochoid type comprising an outer rotor 111 having inner cogs and an inner rotor 112 disposed inside of the outer rotor and having outer cogs, wherein the number of cogs of the outer rotor 111 is larger than that of the inner rotor 112 by one cog, and wherein a rotational center 0a of the outer rotor 111 is eccentric from that 0i of the inner rotor 112. As a result, when the inner rotor 112 is driven by the cam shaft 100 and rotated, the outer rotor 111 is also rotated in conjunction with the inner rotor 112, so that a volume of a working chamber formed by adjacent cogs will be gradually changed to draw fuel from a fuel tank and pumps out the fuel to the main pump.

[0005] In the above described feed pump, as shown in Fig. 6, a side clearance between the pump cover 120 and the pump element 110 is made smaller to minimize amount of fuel leakage and to increase a fuel feed efficiency. If, however, the side clearance were made too small, there would occur a problem of an abnormal wear, seizure or the like, because variations of parts in manufacturing process may not be absorbed.

[0006] Document JP 7279790 discloses a fuel supply apparatus having the features of the preamble of claim 1. In particular, a fuel supply apparatus is disclosed comprising a trochoid type rotary pump being composed of an outer rotor having inner cogs, an inner rotor disposed inside of the outer rotor and having outer cogs, and a pumping chamber formed by the outer and inner rotors, the volume of which is varied in conjunction with rotation of the rotors, for pressurizing fuel sucked into the pumping chamber and discharging the pressurized fuel.

[0007] It is the object of the present invention to provide an improved fuel supply apparatus comprising a trochoid type rotary pump.

[0008] This object is solved by a fuel supply apparatus comprising the features of claim 1. Further developments are stated in the dependent claims.

[0009] According to the structure of claim 1, pressures (thrust pressures) on both sides of the rotor in the axial direction are equalized, since the side clearances formed at both sides of the rotor are communicated with each other through those multiple through-holes formed in the rotor. As a result, uniform side clearances on both sides of the rotor can be attained. In other words, it has become possible to float the rotor. Accordingly, the fuel feed efficiency can be increased by making much smaller the side clearance formed at both sides of the rotor in its axial direction, and the problems of the abnormal wear, seizures and the like can be suppressed because metal contacts between the rotor forming the side clearances and other parts can be suppressed.

[0010] Because of the through-holes formed in the inner rotor, which is driven by a cam shaft, the inner rotor can be floated. As a result, metal contacts between the inner rotor and other parts are suppressed during the rotation of the inner rotor, and thereby the problems of the abnormal wear, seizures and the like can be suppressed.

[0011] According to claim 2, an outer rotor of the rotary pump is provided with multiple through-holes, which pass through in the axial direction.

[0012] Since the through-holes are formed in the outer rotor in addition to the through-holes in the inner rotor, thrust pressures to the outer rotor can be likewise equalized. As a result, the outer rotor can be positively floated together with the inner rotor.

[0013] According to claim 3, the rotary pump is used as a feed pump of a fuel injection pump for diesel engines, wherein the feed pump is formed with a circular rotor chamber and comprises a pump cover for housing the pump element of the inner and the outer rotors in the rotor chamber, and a pump plate for closing an open end of the rotor chamber in a liquid-sealing manner together with the pump cover. The pump plate is formed with fuel ports to be communicated to the rotor chamber, and the pump cover is screwed to a side surface of a housing of the fuel injection pump, so that the pump plate is pressed against the side surface.

[0014] According to the above structure, the side clearance between the pump element and the pump cover as well as the side clearance between the pump element and the pump plate can be made smaller to increase the fuel feed efficiency and thereby increase a pump performance as the feed pump.

[0015] The above and other objects, features and advantages of the present invention will become more apparent from the following detailed description made with reference to the accompanying drawings. In the drawings:

Fig. 1 is a cross-sectional view of a feed pump according to an example not covered by the claims of the present invention;

Fig. 2 is a front view of a pump element of the feed pump shown in Fig. 1;

Fig. 3 is a cross-sectional view of a fuel injection

pump to which the feed pump of figure 1 is applied;
Fig. 4 is a front view of a pump element according to an embodiment of the present invention;
Fig. 5 is a front view of a pump rotor according to an example not covered by the claims of the present invention;
Fig. 6 is a cross-sectional view of a prior art feed pump; and
Fig. 7 is a front view of a pump element of the feed pump shown in Fig. 6.

(First Embodiment)

[0016] The present invention will be explained below with reference to the embodiments.

[0017] In an example not covered by the claims of the present invention a fuel supply apparatus of the invention is used in a fuel injection pump of a common rail fuel injection system for diesel engines.

[0018] Fig. 1 is a cross-sectional view of a feed pump, Fig. 2 is a front view of a pump element, and Fig. 3 is a cross-sectional view of a fuel injection pump.

[0019] As shown in Fig. 3, the fuel injection pump 1 is provided with a main pump 2 for pressurizing and pumping out fuel and a feed pump 3 (See Fig. 1) for drawing the fuel from a fuel tank (not shown) and feeding the fuel to the main pump 2.

[0020] The main pump 2 comprises a cam shaft 4 to be rotated being driven by a diesel engine (not shown), a pump housing 5 for rotationally supporting the cam shaft 4, a plunger 7 being driven by the cam shaft 4 for reciprocally moving in a cylinder 6, and so on.

[0021] A cam 8 which has a circular cross-sectional configuration is fixed to the cam shaft 4, wherein a rotational center thereof is eccentric to that of the cam shaft. A cam ring 10 is rotationally supported at an outer periphery of the cam 8 over a bush 9. A pair of flat surfaces are formed in the cam ring 10, wherein the flat surfaces are opposing to each other in a radial direction of the cam 8.

[0022] A pair of cylinder heads 11 is assembled to the pump housing 5 in a liquid-sealing manner, wherein the cylinder heads 11 are opposing to each other in the radial direction of the cam shaft 4.

[0023] The cylinder head 11 is formed with a cylinder 6, into which the plunger 7 is inserted, a pump-out port 12 to be communicated with the cylinder 6, and so on. A check valve 13 is assembled to the cylinder head at an opposite side of the cylinder 6. A pipe joint 15 is screwed into the cylinder head at an outlet side of the pump-out port 12 for connecting to a fuel pipe 14.

[0024] The check valve 13 is disposed between a fuel passage (not shown) to be communicated with a feed pump and the cylinder 6. The check valve 13 will be opened during a suction stroke at which the plunger 7 will be downwardly moved in the cylinder 6 (inwardly moved), to introduce fuel fed from the feed pump 3 into the inside of the cylinder 6, whereas the check valve 13 will be closed during a pumping out stroke at which the plunger 7 will be upwardly moved in the cylinder 6 (outwardly moved) so that the fuel introduced into the cylinder 6 is prevented from flowing back to the feed pump 3.

[0025] The pump-out port 12 is formed with a small diameter port and a large diameter port. A seat surface of a circular conic is formed between the small and large diameter ports (See Fig. 3). A ball valve 17 is disposed in the pump-out port 12 and is urged by a spring 16 towards the seat surface, so that the small and large diameter ports are blocked by this ball valve 17.

[0026] The ball valve 17 will be lifted from the seat surface when a pressure of fuel, which is pressurized by the plunger 7 during the pumping out stroke, becomes higher than the urging force of the spring 16, and thereby the small and large diameter ports are communicated with each other.

[0027] The plunger 7 has a plunger head 7a at its inner side end and the plunger head 7a is urged by a spring 18 and pressed against an outer surface (flat surface) of the cam ring 10. When the rotation of the cam shaft 4 is transmitted to the cam ring 10 via the cam 8, the cam ring 10 moves with an orbital motion along its orbit which is displaced from the rotational center of the cam shaft 4 by a certain distance, while the cam ring 10 is keeping its orientation (The cam ring 10 is not rotated on its axis and on an axis of the cam 8). As a result, the plunger 7 pressed against the flat surface of the cam ring 10 is reciprocally moved in the cylinder 6.

[0028] The feed pump 3 comprises a pump element PE, a pump cover 19 and a pump plate 20, as explained below. The feed pump 3 is fixed to a side surface of the pump housing 5 by bolts 21, as shown in Fig. 3.

[0029] The pump element PE is a well known trochoid type pump, comprising an outer rotor 22 having inner cogs and an inner rotor 23 disposed inside of the outer rotor 22 and having outer cogs, wherein the inner rotor is connected to the cam shaft 4 via a key so that the inner rotor will be rotated by the cam shaft 4.

[0030] The outer rotor 22 has cogs, the number of which is larger than that of the inner rotor 23 by one cog, and the rotational center 0a of the outer rotor 22 is eccentrically displaced from the rotational center 0i of the inner rotor 23 (See Fig. 2). Accordingly, when the inner rotor 23 is rotated by the cam shaft 4, the outer rotor 22 is rotated in conjunction with the inner rotor 23, so that the volume of working chambers formed by the cogs will be changed to pump out the fuel drawn from the fuel tank to the main pump 2.

[0031] As shown in Fig. 2, through-holes 22a and 23a, which pass through the outer and inner rotors 22 and 23 in an axial direction, are respectively formed in the outer rotor 22 and the inner rotor 23. There are provided with multiple through-holes 22a and 23a in the outer and inner rotors 22 and 23, and those through-holes are formed at an equal distance in a circumferential direction (more exactly, at every cog top portion of the outer and inner rotors 22 and 23) .

[0032] The pump cover 19 is formed with a circular rotor chamber 19a for housing therein the pump element PE, as shown in Fig. 1. An inner diameter of the rotor chamber 19a is made slightly larger than an outer diameter of the pump element PE (namely, an outer diameter of the outer rotor 23), so that the outer rotor 23 may be rotated therein. Awidth of the rotor chamber 19a is made slightly larger than a width of the pump element PE (a thickness in a longitudinal direction), so that side clearances of a certain distance between the pump element PE and inner surfaces of the pump chamber are kept.

[0033] The pump plate 20 is assembled to the pump cover 19 in a liquid-sealing manner to close an opening of the rotor chamber 19a. The pump plate 20 is formed with a center bore, through which the cam shaft 4 passes, and fuel ports 20a (an inlet port and an outlet port) around the center bore (See Fig. 1). The fuel ports 20a are communicated to the working chambers 24 formed between the outer rotor 22 and the inner rotor 23.

[0034] An operation of the above example will be explained. In the above feed pump 3, the multiple through-holes 22a and 23a are respectively formed in the outer and inner rotors 22 and 23 and furthermore those multiple through-holes 22a and 23a are arranged at equal distance in the circumferential direction of the rotors 22 and 23. Since the side clearances formed on the both sides of the rotors 22 and 23 in the axial direction are communicated with each other through those multiple through-holes 22a and 23a, the pressures in the thrust direction at the both sides of the rotors 22 and 23 will be equalized. As a result, uniform side clearances can be obtained at both sides of the rotors 22 and 23.

[0035] According to the above structure, the outer and inner rotors 22 and 23 can be floated without contacting with the pump cover 19 and the pump plate 20. In particular, since the through-holes 23a are formed at every cog top portions of the inner rotor 23, which correspond to an outer periphery of the inner rotor, an inclination of the inner rotor 23 can be effectively suppressed and thereby the uniform side clearances at both of the longitudinal sides along the peripheries of the inner rotor 23 can be obtained.

[0036] Accordingly, the problems of the abnormal wear and seizures and the like can be suppressed by preventing the metal contacts between the pump element PE and the pump cover 19 and the pump plate 20, to finally increase the performance of the feed pump 3, even when the side clearances between the pump element PE and the pump cover 19 are made smaller to increase the fuel feed efficiency.

[0037] In the above example, the through-holes 22a and 23a are formed in the both outer and inner rotors 22 and 23. It is, however, possible to obtain a sufficient effect (suppress of the abnormal wear and seizures, or the like), when the through-holes 23a are formed only in the inner rotor 23 which is directly driven by the cam shaft 4.

[0038] Fig. 4 is a front view of pump element PE according to an embodiment of the present invention.

[0039] In this embodiment, the multiple through-holes 22a and 23a are formed in the outer and inner rotors 22 and 23 at equal distance in the circumferential direction. It is, however, not necessary to arrange the through-holes at equal distance. As shown in Fig. 4, the through-holes 23a can be formed in the inner rotor 23 at non-equivalent distances in the circumferential direction. Although only the through-holes for the inner rotor 23 are shown in Fig. 4, the through-holes 22a can be formed in the outer rotor 22 at non-equivalent distances in the circumferential direction, as in the same manner for the inner rotor 23.

[0040] Fig. 5 is a front view of a rotor 25 according to a further example not covered by the claims of the present invention,

[0041] in which the rotary pump is applied to a vane type pump.

[0042] The vane type pump has, as shown in Fig. 5, a rotor 25 formed with multiple vane grooves 25a at its outer periphery at equal distance in the circumferential direction, and vanes 26 respectively and movably inserted into the vane grooves 25a.

[0043] When the multiple through-holes 25b are formed in the rotor 25 and the rotor 25 is floated, as in the same manner to the first embodiment, metal contacts with other parts can be prevented and thereby the problems of the abnormal wear and seizures and the like can be suppressed.

[0044] In this example as shown in Fig. 5, the through-holes 25b are formed at both sides to the respective vanes 26 and the circumferential distance of the through-holes 25b between the respective vanes 26 is arranged to be equal to each other. However, the circumferential distance of the through-holes 25b is not necessary to be equal but to be non-equivalent.

[0045] The above embodiment of the invention the fuel supply apparatus of the invention is used in the fuel injection pump of the common rail fuel injection system for diesel engines. The present invention is not limited to these embodiments, and the present invention can be used for a fuel pump for a gasoline engine.

[0046] A fuel feed pump according to the present invention improves its pump performance by making smaller side clearances in an axial direction at both sides of a pump element PE.

[0047] Multiple through-holes (22a and 23a) passing through in an axial direction are respectively formed at top portions of cogs of the outer rotor (22) and the inner rotor (23), which form a pump element (PE) of a feed pump (3). Accordingly, pressures in the thrust direction at both axial sides of the rotors (22 and 23) can be equalized, since the side clearance formed at both axial sides of the rotors (22 and 23) are communicated with each other. As a result, since the rotors (22 and 23) can be floated, without contacting with the pump cover (19) and the pump plate (20), the abnormal wear and seizures can be suppressed, even when side clearance between the pump cover (19) and the pump element (PE) is made

smaller.

Claims

1. A fuel supply apparatus comprising:

   a trochoid type rotary pump (3) being composed of

   - an outer rotor (22) having inner cogs
   - an inner rotor (23) disposed inside of the outer rotor (22) and having outer cogs, the inner rotor (23) being connected to a cam shaft (4) by means of a key member, and
   - a pumping chamber (24) formed by the outer and inner rotors (22, 23), volume of which is varied in conjunction with rotation of the rotors (22, 23), for pressurizing fuel sucked into the pumping chamber (24) and discharging the pressurized fuel, and side clearances are formed at both sides of the inner rotor (23) are communicated with each other through those through holes (23a)

   wherein multiple through-holes (23a) are formed in the outer cogs of the inner rotor (23) in its axial direction,
   wherein the rotary pump (3) is
   characterized in that
   said multiple through-holes (23a) are arranged at non-equal distances in the circumferential direction such that the outer clog which is closest to the said key-member and the outer clog which is diametrically opposed to the said key-member do not contain a through-hole.

2. A fuel supply apparatus according to claim 1, wherein
   the outer rotor (22) is provided with multiple through-holes (22a), which pass through in the axial direction, one through-hole (22a) at every cogs of the outer rotor (22).

3. A fuel supply apparatus according to claim 1, wherein the fuel supply apparatus is a fuel injection pump (1) for a diesel engine for which the rotary pump (3) is used as a feed pump,
   wherein the feed pump (3) comprises:

   a circular rotor chamber (19a);
   a pump cover (19) for housing a pump element (PE) of the inner and the outer rotors (22 and 23) in the rotor chamber (19a) in a liquid-sealing manner together with the pump cover (19),
   wherein the pump plate (20) is formed with fuel ports (20a) to be communicated to the rotor chamber (19a), and the pump cover (19) is screwed to a side surface of a housing (5) of the fuel injection pump (1), so that the pump plate (20) is pressed against the side surface.

Patentansprüche

1. Kraftstoffzuführvorrichtung, mit:

   einer Trochoidenrotationspumpe (3), die aufgebaut ist aus

   - einem äußeren Rotor (22) mit Innenverzahnung
   - einem innerhalb der äußeren Rotors (22) eingerichteten inneren Rotor (23) mit Außenverzahnung, wobei der innere Rotor (23) durch ein Passfederbauteil mit einer Nokkenwelle (4) verbunden ist, und
   - einer Pumpenkammer (24), die durch den äußeren und den inneren Rotor (22, 23) ausgebildet ist und deren Volumen mit der Drehung der Laufräder (22, 23) variiert, zur Druckbeaufschlagung eines in die Pumpenkammer (24) eingesaugten Kraftstoffs und zum Ausstoßen des druckbeaufschlagten Kraftstoffs, und
   - Seitenspielräumen, die an beiden Seiten des inneren Rotors (23) miteinander durch solche Durchgangslöcher (23a) verbunden sind, wobei eine Mehrzahl Durchgangslöcher (23a) in der Außenverzahnung des inneren Rotors (23) in dessen axialer Richtung ausgebildet ist,

   wobei die Rotationspumpe (3)
   dadurch gekennzeichnet ist, dass
   die Mehrzahl Durchgangslöcher (23a) in ungleichen Abständen in der Umfangsrichtung angeordnet ist, so dass der dem Passfederbauteil nächstliegende Außenzahn und der dem Passfederbauteil diametral gegenüberliegende Außenzahn kein Durchgangsloch aufweisen.

2. Kraftstoffzuführvorrichtung nach Anspruch 1, wobei der äußere Rotor (22) mit einer Mehrzahl in der axialen Richtung durchgehenden Durchgangslöchern (22a) vorgesehen ist, wobei ein Durchgangsloch (22a) an jedem Zahn des äußeren Rotors (22) vorgesehen ist.

3. Kraftstoffzuführvorrichtung nach Anspruch 1, wobei die Kraftstoffzuführvorrichtung eine Kraftstoffeinspritzpumpe (1) für einen Dieselmotor ist, für den die Rotationspumpe (3) als eine Speisepumpe verwendet wird,
   wobei die Speisepumpe (3) aufweist:

eine kreisförmige Rotorkammer (19a);
eine Pumpenabdeckung (19) zur Aufnahme eines Pumpenbauteils (PE) aus innerem und äußerem Rotor (22 und 23) in der Rotorkammer (19a) auf eine zusammen mit der Pumpenabdeckung (19) flüssigkeitsabdichtende Art und Weise,
wobei die Pumpenplatte (20) mit der Rotorkammer (19a) zu verbindenden Kraftstofföffnungen (20a) versehen ist und die Pumpenabdeckung (19) an eine Seitenfläche eines Gehäuses (5) der Kraftstoffeinspritzpumpe (1) geschraubt ist, so dass die Pumpenplatte (20) gegen die Seitenfläche gedrückt ist.

Revendications

1. Appareil d'alimentation en carburant, comprenant :

une pompe rotative de type trochoïde (3) composée de

- un rotor extérieur (22) possédant des dents intérieures,
- un rotor intérieur (23) disposé à l'intérieur du rotor extérieur (22), et possédant des dents extérieures, le rotor intérieur (23) étant relié à un arbre à cames (4) au moyen d'un élément clavette, et
- une chambre de pompage (24) formée par les rotor extérieur et intérieur (22, 23), dont le volume est varié conjointement à la rotation des rotors (22, 23), pour mettre sous pression le carburant aspiré dans la chambre de pompage (24) et refouler le carburant mis sous pression, et des espaces libres latéraux sont formés sur les deux côtés du rotor intérieur (23) et sont mis en communication l'un avec l'autre par l'intermédiaire de ces trous débouchants (23a)

dans lequel de multiples trous débouchants (23a) sont formés dans les dents extérieures du rotor intérieur (23) dans son sens axial,
dans lequel la pompe rotative (3) est
caractérisée en ce
que lesdits multiples trous débouchants (23a) sont agencés à des distances inégales dans le sens circonférentiel de sorte que la dent extérieure qui est la plus proche dudit élément clavette et la dent extérieure qui est diamétralement opposée audit élément clavette ne contiennent pas de trou débouchant.

2. Appareil d'alimentation en carburant selon la revendication 1, dans lequel le rotor extérieur (22) est pourvu de multiples trous débouchants (22a), qui passent à travers dans le sens axial, un trou débouchant (22a) à chaque dent du rotor extérieur (22).

3. Appareil d'alimentation en carburant selon la revendication 1, dans lequel l'appareil d'alimentation en carburant est une pompe d'injection de carburant (1) pour un moteur diesel pour lequel la pompe rotative (3) est utilisée en tant que pompe d'alimentation,
dans lequel la pompe d'alimentation (3) comprend :

une chambre de rotor circulaire (19a) ;
un couvercle de pompe (19) pour loger un élément pompe (PE) des rotors intérieur et extérieur (22 et 23) dans la chambre de rotor (19a) de manière étanches aux liquides conjointement au couvercle de pompe (19),
dans lequel la plaque de pompe (20) est formée avec des orifices de carburant (20a) destinés à être miss en communication avec la chambre de rotor (19a), et le couvercle de pompe (19) est vissé sur une surface latérale d'un corps (5) de la pompe d'injection de carburant (1), pour que la plaque de pompe (20) soit comprimée contre la surface latérale.

FIG. 1

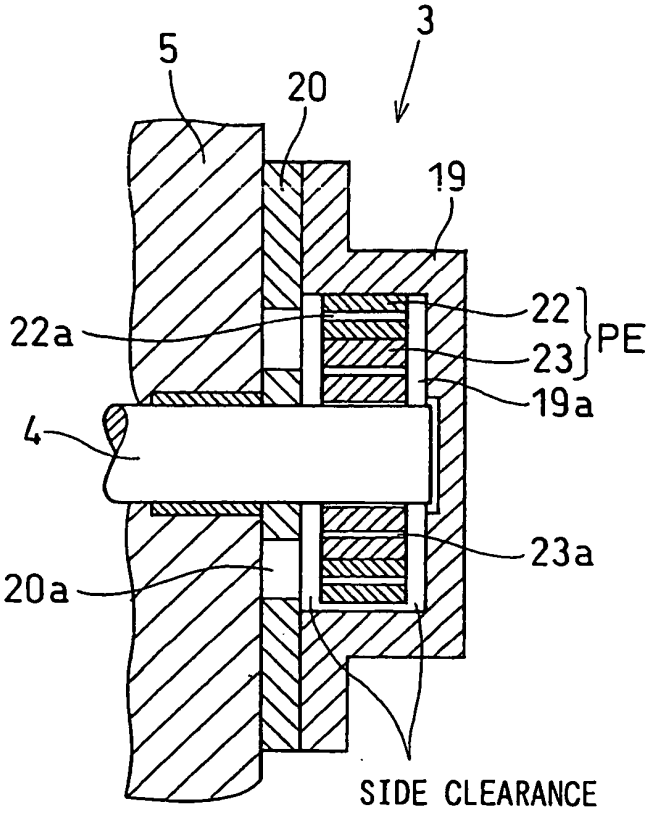

3
5
20
19
22
PE
22a
23
19a
4
23a
20a
SIDE CLEARANCE

FIG. 2

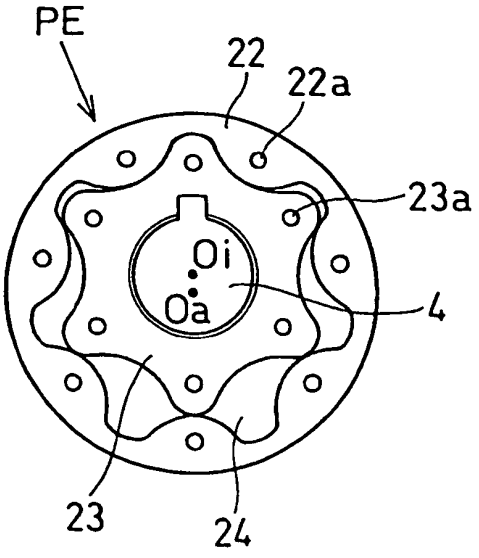

PE
22
22a
23a
Oi
Oa
4
23
24

FIG. 3

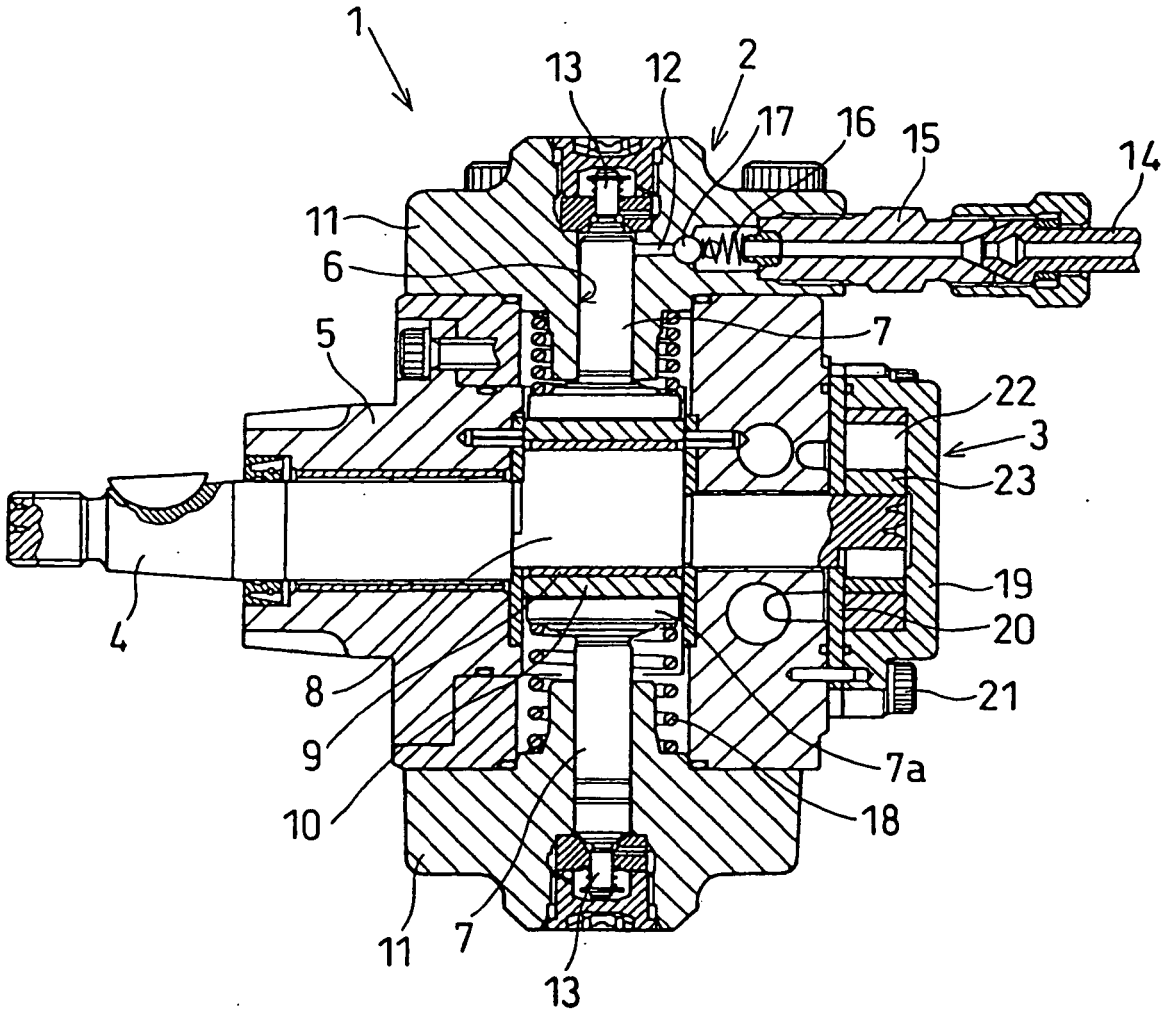


FIG. 4

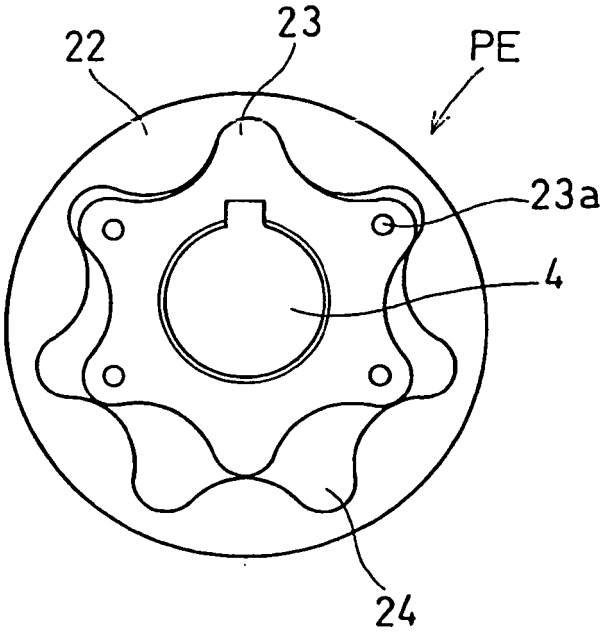


FIG. 5

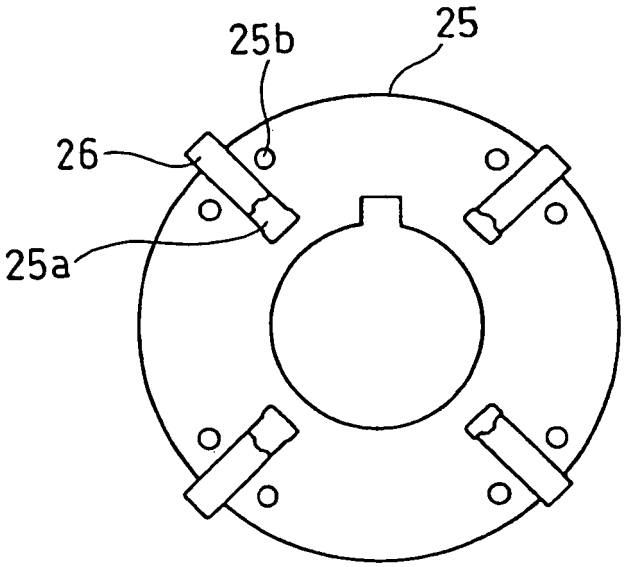


FIG. 6
PRIOR ART

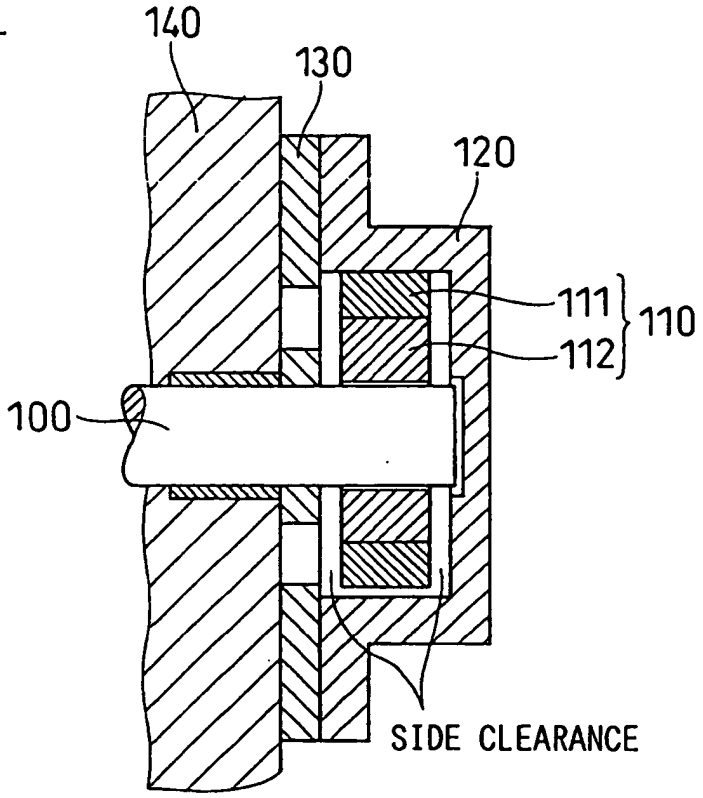
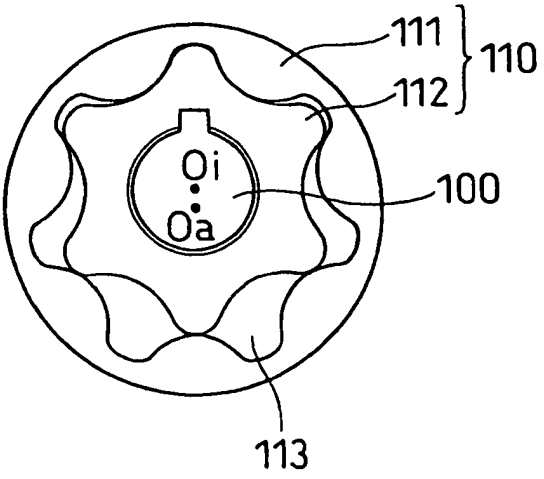


FIG. 7
PRIOR ART



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 07279790 A **[0001]**
- US 20030044288 A1 **[0002]**
- JP 7279790 B **[0006]**