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

(11) EP 3 306 095 B1

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention of the grant of the patent:
22.04.2020 Bulletin 2020/17

(21) Application number: **16799829.3**

(22) Date of filing: **12.05.2016**

(51) Int Cl.:
F04C 14/06 *(2006.01)* ***F04B 49/02*** *(2006.01)*
F04C 2/10 *(2006.01)* ***F04C 13/00*** *(2006.01)*

(86) International application number:
PCT/JP2016/064163

(87) International publication number:
WO 2016/190121 (01.12.2016 Gazette 2016/48)

(54) **OIL SUPPLY DEVICE AND METHOD OF CONTROLLING ELECTRIC OIL PUMP**

ÖLVERSORGUNGSVORRICHTUNG UND VERFAHREN ZUR STEUERUNG EINER ELEKTRISCHEN ÖLPUMPE

DISPOSITIF D'ALIMENTATION EN HUILE ET PROCÉDÉ DE COMMANDE DE POMPE À HUILE ÉLECTRIQUE

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR

(30) Priority: **25.05.2015 JP 2015105767**

(43) Date of publication of application:
11.04.2018 Bulletin 2018/15

(73) Proprietor: **Mikuni Corporation**
Tokyo 101-0021 (JP)

(72) Inventors:
- **YASHIMA, Kan**
Takizawa-shi
Iwate 020-0643 (JP)
- **DOI, Takashi**
Takizawa-shi
Iwate 020-0643 (JP)

(74) Representative: **Becker & Kurig Partnerschaft**
Patentanwälte PartmbB
Bavariastrasse 7
80336 München (DE)

(56) References cited:
JP-A- H0 429 774
JP-A- H0 960 594
JP-A- H11 164 584
JP-A- 2004 353 624
JP-A- 2007 291 962
JP-U- H0 630 482
US-A1- 2001 055 528

EP 3 306 095 B1

Description

[Technical Field]

[0001] The present invention relates to an oil supply device in which negative pressure generated inside a pump chamber is reduced or eliminated when an electric oil pump is to be shut down, and a method of controlling an electric oil pump.

[Background Art]

[0002] Oil supply devices used for cooling a motor of a hybrid car, a generator, and the like employ an electric oil pump. Rotary volumetric change pumps are widely used as the electric oil pump (for example, refer to Patent Literature 1).

[0003] The operation of a rotary volumetric change pump is disclosed in Patent Literature 2, and the operation will be described simply using the drawings. Fig. 4(a), Fig. 4(b), Fig. 4(c), Fig. 4(d) and Fig. 4(e) are operation diagrams for describing an operation of the rotary volumetric change pump in which a rotor rotates, in the order of Fig. 4(a), Fig. 4(b), Fig. 4(c), Fig. 4(d) and Fig. 4(e). Here, the drawings illustrate an example of steps of intaking, compressing, and discharging oil 40 performed in one pump chamber. Regions filled with the oil are indicated with oblique lines.

[0004] A rotary volumetric change pump 20 is provided with an inner rotor 21 and an outer rotor 22 of which the numbers of teeth are different from each other. In the structure, the inner rotor 21 serves as an external gear, the outer rotor 22 serves as an internal gear, and each of the rotors has a tooth form formed based on a trochoid curve. In Fig. 4(a), Fig. 4(b), Fig. 4(c), Fig. 4(d) and Fig. 4(e), the inner rotor 21 has four teeth, and the outer rotor 22 has five teeth. However, this is merely an example, and the numbers of teeth may vary. A circumscribed portion of the outer rotor 22 is accommodated in a round casing (not illustrated). The centers of the inner rotor 21 and the outer rotor 22 do not coincide with each other, thereby being configured to be provided with a certain eccentricity. In such a configuration, when rotation is applied to the inner rotor 21, the outer rotor 22 rotates with a delay in the same direction. Fig. 4(a), Fig. 4(b), Fig. 4(c), Fig. 4(d) and Fig. 4(e) illustrates an example of clockwise rotation as indicated with the arrow.

[0005] When the inner rotor 21 and the outer rotor 22 rotate, gears mesh with each other at a location where the distance between both the gears is short, and a gap is formed at a location where the distance between both the gears is long. When the gap is widened or narrowed due to such movement, the oil 40 is forcibly suctioned into the gap or is discharged from the gap, thereby allowing operation of a pump.

[0006] In Fig. 4(a), Fig. 4(b), Fig. 4(c), Fig. 4(d) and Fig. 4(e), when the inner rotor 21 and the outer rotor 22 rotate clockwise, the oil 40 starts to be taken into a pump chamber through an intake side 31 as illustrated in Fig. 4(a), and when the inner rotor 21 and the outer rotor 22 further rotate, more oil 40 is taken in as illustrated in Fig. 4(b).

[0007] Next, in Fig. 4(c), the oil 40 is in the maximum intake state, and therefrom a compressing step illustrated in Fig. 4(d) and thereafter is started. Lastly, as illustrated in Fig. 4(e), the oil 40 is discharged from the pump chamber through a discharge side 33 and is pressure-fed toward a cooling subject device 17.

[0008] The rotary volumetric change pump 20 is driven when a brushless DC motor or the like causes the inner rotor 21 to rotate. The operation of the motor is configured to be controlled by an electric oil pump controller in response to a command from a host controller (for example, refer to Patent Literature 1).

[0009] When the rotary volumetric change pump 20 is used, the oil 40 is taken into the pump chamber through the intake side 31 and negative pressure is generated inside the pump chamber. Particularly, when the oil temperature is low, the viscosity of the oil 40 increases and the oil 40 is unlikely to be taken in. Consequently, higher negative pressure is generated.

[0010] When being in circumstances in which the negative pressure inside the pump chamber is high as described above, if the rotary volumetric change pump 20 is shut down, there are cases where air enters the pump chamber due to the influence of the negative pressure. Empirically, it has been ascertained that when the kinematic viscosity coefficient of oil is equal to or higher than approximately 1,000 mm^2/s, the negative pressure inside the pump chamber reaches a state of having dropped 30 kPa from atmospheric pressure, and air enters the pump chamber through a seal portion. When the pump is restarted in a state in which air has entered the pump chamber, it is difficult for the oil 40 to be supplied or to circulate smoothly until the oil temperature of the oil 40 sufficiently rises and the kinematic viscosity coefficient of the oil is lowered.

[0011] Actual examples, in which such circumstances are likely to be caused, include a case where after a parked vehicle is exposed to a low temperature for many hours, an engine is started, and the engine is instantly shut down. Specifically, the examples include circumstances where after a vehicle is exposed to outside air overnight in a cold region or the like, an engine is started in the early morning, and the engine is shut down before the engine is sufficiently warmed up. It is generally considered that an electric oil pump is started and shut down in response to a start and a shutdown of an engine.

[0012] In such circumstances, above all, since the vehicle has been exposed to outside air overnight, oil is in a state in which the viscosity coefficient is high compared to when being at an ordinary temperature. Accordingly, since the oil is unlikely to be taken in smoothly when the engine is started, significant negative pressure is generated on the intake side of the pump chamber compared to when being at an ordinary temperature. If the engine is shut down in a state in which such negative pressure is applied, excessively low pressure is applied to the intake side of the pump chamber compared to atmospheric pressure. Consequently, in some cases, air enters the pump chamber through the intake side.

[0013] US 2001/055528 A1 discloses a progressive cavity pumping system for use in pumping an associated aggregate material. The progressive cavity pumping system includes a pump housing, a rotor member operatively received in the pump housing, a prime mover coupled to the rotor member, and a controlling means for actuating the prime mover.

[0014] JP 2004-353624 A discloses a control device for a motor-driven liquid pump configured to detect rotational frequency of the liquid pump to determine whether the pump is biting foreign matter. If it is determined that foreign matter has entered the pump, the control device rotates the electric motor in a reverse direction followed by at least one rotation in the forward direction.

[0015] JP H06 30482 U discloses an inner gear pump including a reservoir to store lubricating oil when the pump is not active, so as to speed up priming of the pump upon reactivation.

[Citation List]

[Patent Literature]

[0016]

[Patent Literature 1]
Japanese Unexamined Patent Application Publication No. 2014-131453
[Patent Literature 2]
Japanese Unexamined Patent Application Publication No. 2002-339874

[Summary of Invention]

[Technical Problem]

[0017] In consideration of the foregoing circumstances, an object of the present invention is to provide an oil supply device in which negative pressure inside a pump chamber is reduced or eliminated when an electric oil pump is shut down, thereby preventing air from entering the pump chamber and allowing oil to be supplied or to circulate smoothly, and a method of controlling an electric oil pump.

[Solution to Problem]

[0018] In order to achieve the object, according to the present invention, there is provided an oil supply device according to the subject-matter of claim 1.

[0019] In addition, according to the present invention, there is provided a method of controlling an electric oil pump according to the subject-matter of claim 4.

[0020] Here, in the oil supply device and the method of controlling an electric oil pump, the predetermined angle, by which the rotary volumetric change pump is caused to rotate in the direction opposite to the rotation direction during oil supply, may be 360 degrees with respect to the inner rotor. In addition, the kinematic viscosity coefficient of oil to be supplied using the rotary volumetric change pump may be equal to or higher than 1,000 mm^2/s.

[Advantageous Effects of Invention]

[0021] When the oil supply device and the method of controlling an electric oil pump according to the present invention are employed, it is possible to avoid a state in which negative pressure is high inside a pump chamber of the rotary volumetric change pump when the electric oil pump is shut down, and it is possible to prevent air from entering the pump chamber through an intake side. Therefore, when being actuated afterward, the electric oil pump has an effect that a sufficient amount of oil can be smoothly applied immediately after the electric oil pump is actuated.

[Brief Description of Drawings]

[0022]

Fig. 1 is a block diagram of an oil supply device of the present invention.

Fig. 2 illustrates a simplified diagram of an electric oil pump showing the internal structure.

Fig. 3 is a flow chart of control over a motor conducted by the electric oil pump controller.

Fig. 4(a), Fig. 4(b), Fig. 4(c), Fig. 4(d) and Fig. 4(e) are operation diagrams for describing an operation of a rotary volumetric change pump in which a rotor rotates, in the order of Fig. 4(a), Fig. 4(b), Fig. 4(c), Fig. 4(d) and Fig. 4(e).

[Description of Embodiments]

[0023] Hereinafter, an embodiment of the present invention will be described with reference to the accompanying drawings.

[0024] Fig. 1 is a block diagram of an oil supply device 10 of the present invention. In addition, Fig. 2 illustrates a simplified diagram of an electric oil pump showing the internal structure. The oil supply device 10 of the present invention causes cooling oil 40 to circulate, thereby cooling a cooling subject device 17 such as an electric motor and a generator. The oil supply device 10 includes a rotary volumetric change pump 20 and an electric oil pump 11 provided with a motor 12 which operates the rotary volumetric change pump 20.

[0025] Similar to rotary volumetric change pumps in the related art, the rotary volumetric change pump 20 has a structure in which an inner rotor 21 serves as an external gear, an outer rotor 22 serves as an internal gear, and each of the rotors has a tooth form formed based on a trochoid curve. A circumscribed portion of the outer rotor 22 is accommodated in a round casing. The centers of the inner rotor 21 and the outer rotor 22 do not coincide with each other, thereby being provided with a certain eccentricity. A gap between the inner rotor 21 and the outer rotor 22 becomes the inside of a pump chamber. When each of the rotors rotates, the gap which is the inside of the pump chamber is widened or narrowed, thereby allowing operation of a pump. A place, at which the gap is widened when the inner rotor 21 and the outer rotor 22 rotate, becomes an intake side 31 of the pump chamber, and a place at which the gap is narrowed becomes a discharge side 33 of the pump chamber. The intake side 31 of the pump chamber and the discharge side 33 of the pump chamber are the places which are each surrounded by the bold line in Fig. 2.

[0026] The cooling oil 40 accumulated in an oil sump of an oil pan 15 is suctioned up through an intake port 30 by the rotary volumetric change pump 20, and the cooling oil 40 is pressure-fed to the cooling subject device 17, such as the electric motor and the generator, through a discharge port 32 via an oil cooler 16. The oil cooler 16 radiates heat of the oil 40 passing through. Then, the oil 40 which has cooled the cooling subject device 17 is configured to return to the oil pan 15.

[0027] The rotary volumetric change pump 20 is operated when a movement of the motor 12 is transmitted to the inner rotor 21, and the operation of the motor 12 is controlled by an electric oil pump controller 13. A host controller 14 sends a control signal to this electric oil pump controller 13.

[0028] When the electric oil pump 11 is shut down, negative pressure is generated on the intake side 31 of the pump chamber in the rotary volumetric change pump 20. As described above, when the negative pressure increases, there is a possibility that air will enter the pump chamber. Particularly, it is known that when the viscosity coefficient of oil is high (for example, when the kinematic viscosity coefficient of oil is equal to or higher than approximately 1,000 mm^2/s), since the oil is unlikely to be taken in, the negative pressure is likely to increase, thereby easily resulting in such a phenomenon.

[0029] Therefore, in the present invention, before the electric oil pump 11 is shut down, the rotary volumetric change pump 20 is caused to rotate reversely by a predetermined angle so that the negative pressure is reduced or eliminated, thereby preventing air from entering the pump chamber. The motor 1 2 is controlled by the electric oil pump controller 13. A step of controlling the motor 12 carried out by the electric oil pump controller 13 will be described below using the drawings. Fig. 3 is a flow chart of control over the motor 12 conducted by the electric oil pump controller 13.

[0030] First, in Step S10 at the start, work is performed to turn on power, for example, an engine of a vehicle is started.

[0031] Next, in Step S11, the electric oil pump controller 13 receives a motor control signal. Then, in Step S12, it is determined whether or not the received control signal has changed.

[0032] In Step S12, when the control signal has not changed, the state is retained as it is, and the electric oil pump controller 13 waits for reception of a control signal again. When the control signal has changed in Step S12, the process proceeds to Step S13, and it is determined whether or not the control signal is for operation or not.

[0033] In Step S13, when it is determined that the control signal is for operation, the process proceeds to Step S14, and the motor 12 is caused to rotate normally. In Step S13, when it is determined that the control signal is not for operation, that is, in a case of a control signal for shutdown, the process proceeds to Step S15, and the motor 12 is caused to temporarily stop. Furthermore, the process proceeds to Step S16, and the motor 12 is caused to rotate reversely by a certain amount of rotation, thereby eliminating the negative pressure inside the pump chamber. Lastly, the process proceeds to Step S17, and the motor 12 is completely shut down. Naturally, the angle of the reverse rotation required to eliminate the negative pressure is determined depending on various factors such as the viscosity coefficient of oil and the shapes of rotors. Therefore, the angle varies case by case. However, in order to suppress generation of excessive negative pressure, it is considered that a sufficient effect can be obtained when the inner rotor 21 is caused to rotate reversely by 360 degrees.

[0034] In devices in the related art, when a control signal for a shutdown is received, it is usual that a motor is instantly shut down. However, as described above, the present invention is characterized in that after it is determined that a control signal is not for operation any longer, a step is performed at all times, in which the motor is caused to temporarily stop, the motor is caused to rotate reversely, and the motor is then completely shut down. If it is intended to determine whether or not the motor is to be caused to rotate reversely in accordance with the magnitude of negative pressure inside the pump chamber, the oil pressure has to be measured, so that there is a need to separately provide a device therefor. However, in the present invention, the motor is caused to rotate reversely at all times, and the angle of the reverse rotation is set in advance within a range in which a sufficient effect can be obtained and the circulation of oil is not affected. Accordingly, even though no extra device is provided, it is possible to achieve a sufficient effect.

[0035] In this manner, if air can be prevented from entering the pump chamber by reducing or eliminating the negative pressure, when the pump is restarted, the pump chamber is in a state of being filled with oil. Therefore, even before the oil temperature sufficiently rises and the kinematic viscosity coefficient of the oil is lowered, it is possible to achieve an effect that the oil sufficiently circulates and the oil can be smoothly discharged.

[0036] The configuration of the present invention is not limited to only oil pumps used for cooling a device and can also be widely utilized in devices in which fluid having a high viscosity coefficient is supplied and circulates.

[Reference Signs List]

[0037]

10 Oil supply device
11 Electric oil pump
12 Motor
13 Electric oil pump controller
14 Host controller
20 Rotary volumetric change pump
21 Inner rotor
22 Outer rotor
30 Intake port
31 Intake side of pump chamber
32 Discharge port
33 Discharge side of pump chamber
40 Oil

Claims

1. An oil supply device (10) comprising:

an electric oil pump (11) in which a rotary volumetric change pump (20) provided with an inner rotor (21) and an outer rotor (22) is operated by a motor (12), and
characterized in further comprising:
an electric oil pump (11) controller which controls the motor (12) such that when the electric oil pump (11) is to be shut down, the rotary volumetric change pump (20) is caused to temporarily stop and to rotate by a predetermined angle in a direction opposite to a rotation direction during oil supply, and the electric oil pump (11) is then shut down, so that the negative pressure on an intake side (31) of a pump chamber in the rotary volumetric change pump (20) is reduced or eliminated, thereby preventing air from entering the pump chamber.

2. The oil supply device (10) according to claim 1, wherein the predetermined angle, by which the rotary volumetric change pump (20) is caused to rotate in the direction opposite to the rotation direction during oil supply, is 360 degrees with respect to the inner rotor (21).

3. The oil supply device (10) according to claim 1 or 2, wherein a kinematic viscosity coefficient of oil to be supplied using the rotary volumetric change pump (20) is equal to or higher than 1,000 mm^2/s.

4. A method of controlling an electric oil pump (11), **characterized in** comprising:
controlling a motor (12) such that when the electric oil pump (11), in which a rotary volumetric change pump (20) provided with an inner rotor (21) and an outer rotor (22) is operated by the motor (12), is to be shut down, the rotary volumetric change pump (20) is caused to temporarily stop and to rotate by a predetermined angle in a direction opposite to a rotation direction during oil supply so that the negative pressure on an intake side (31) of a pump chamber in the rotary volumetric change pump (20) is reduced or eliminated, thereby preventing air from entering the pump chamber, and the electric oil pump (11) is then stopped.

5. The method of controlling an electric oil pump (11) according to claim 4,
wherein the predetermined angle, by which the rotary volumetric change pump (20) is caused to rotate in the direction opposite to the rotation direction during oil supply, is 360 degrees with respect to the inner rotor (21).

6. The method of controlling an electric oil pump (11) according to claim 4 or 5,
wherein a kinematic viscosity coefficient of oil to be supplied using the rotary volumetric change pump (20) is equal to or higher than 1,000 mm^2/s.

Patentansprüche

1. Ölversorgungsvorrichtung (10), umfassend:

eine elektrische Ölpumpe (11), in der eine rotierende Volumenänderungspumpe (20), bereitgestellt mit einem Innenrotor (21) und einem Außenrotor (22), durch einen Motor (12) betrieben wird; und
dadurch gekennzeichnet, dass sie ferner umfasst:
eine elektrische Ölpumpen (11) Steuerung, die den Motor (12) steuert, so dass, wenn die elektrische Ölpumpe (11) abgeschaltet werden soll, die rotierende Volumenänderungspumpe (20) veranlasst wird, vorübergehend anzuhalten und sich um einen vorbestimmten Winkel in einer Richtung entgegengesetzt zu einer Rotationsrichtung während der Ölversorgung zu drehen, und die elektrische Ölpumpe (11) dann abgeschaltet wird, so dass der negative Druck auf einer Einlassseite (31) von einer Pumpenkammer in der rotierenden Volumenänderungspumpe (20) reduziert oder eliminiert ist, dadurch Luft vom Eintreten in die Pumpenkammer abgehal-

ten wird.

2. Ölversorgungsvorrichtung (10) gemäß Anspruch 1, wobei der vorbestimmte Winkel, durch den die rotierende Volumenänderungspumpe (20) veranlasst wird, in die Richtung entgegengesetzt der Drehrichtung während der Ölversorgung zu drehen, 360 Grad in Bezug auf den Innenrotor (21) beträgt.

3. Ölversorgungsvorrichtung (10) gemäß Anspruch 1 oder 2,
wobei ein kinematischer Viskositätskoeffizient des zuzuführenden Öls unter Verwendung der rotierenden Volumenänderungspumpe (20) gleich oder höher als 1.000 mm^2/s ist.

4. Verfahren zum Steuern einer elektrischen Ölpumpe (11), **dadurch gekennzeichnet, dass** sie umfasst: Steuern eines Motors (12), sodass, wenn die elektrische Ölpumpe (11), in der eine rotierende Volumenänderungspumpe (20), bereitgestellt mit einem Innenrotor (21) und einem Außenrotor (22), durch den Motor (12) betrieben wird, abgeschaltet werden soll, wobei die rotierende Volumenänderungspumpe (20) veranlasst wird, vorübergehend anzuhalten und sich um einen vorbestimmten Winkel in einer Richtung entgegengesetzt zu einer Drehrichtung während der Ölversorgung zu drehen, sodass der negative Druck auf einer Einlassseite (31) einer Pumpenkammer in der rotierende Volumenänderungspumpe (20) reduziert oder eliminiert ist, dadurch Luft vom Eintreten in die Pumpenkammer abgehalten wird und die elektrische Ölpumpe (11) dann angehalten wird.

5. Verfahren zum Steuern einer elektrischen Ölpumpe (11) gemäß Anspruch 4,
wobei der vorbestimmte Winkel, durch den die rotierende Volumenänderungspumpe (20) veranlasst wird, sich in die Richtung entgegengesetzt der Drehrichtung zu drehen, während Ölversorgung, 360 Grad in Bezug auf den Innenrotor (21) beträgt.

6. Verfahren zum Steuern einer elektrischen Ölpumpe (11) gemäß Anspruch 4 oder 5,
wobei ein kinematischer Viskositätskoeffizient des zuzuführenden Öls unter Verwendung der rotierenden Volumenänderungspumpe (20) gleich oder größer als 1.000 mm^2/s ist.

Revendications

1. Dispositif d'alimentation en huile (10) comprenant :

une pompe à huile électrique (11) dans laquelle une pompe de changement volumétrique rotative (20) pourvue d'un rotor intérieur (21) et d'un rotor extérieur (22) est actionnée par un moteur (12), et
caractérisé en ce qu'il comprend en outre :
une commande (11) de pompe à huile électrique qui commande le moteur (12) de manière à ce que, lorsque la pompe à huile électrique (11) doit être fermée, la pompe de changement volumétrique rotative (20) est amenée à s'arrêter temporairement et à tourner à raison d'un angle prédéterminé dans un sens opposé à un sens de rotation pendant l'alimentation en huile, et que la pompe à huile électrique (11) est ensuite fermée, de sorte que la pression négative sur un côté admission (31) d'une chambre de pompe dans la pompe de changement volumétrique rotative (20) est réduite ou supprimée, en empêchant ainsi l'air d'entrer dans la chambre de pompe.

2. Dispositif d'alimentation en huile (10) selon la revendication 1,
dans lequel l'angle prédéterminé à raison duquel la pompe de changement volumétrique rotative (20) est amenée à tourner dans le sens opposé au sens de rotation pendant l'alimentation en huile est de 360 degrés par rapport au rotor intérieur (21).

3. Dispositif d'alimentation en huile (10) selon la revendication 1 ou 2,
dans lequel un coefficient de viscosité cinématique de l'huile à fournir en utilisant la pompe de changement volumétrique rotative (20) est égal ou supérieur à 1000 mm^2/s.

4. Procédé de commande d'une pompe à huile électrique (11), **caractérisé en ce qu'**il comprend :
la commande d'un moteur (12) de manière à ce que, lorsque la pompe à huile électrique (11), dans laquelle une pompe de changement volumétrique rotative (20) est prévue avec un rotor intérieur (21) et un rotor extérieur (22) est actionnée par le moteur (12), doit être fermée, la pompe de changement volumétrique rotative (20) est amenée à s'arrêter temporairement et à tourner à raison d'un angle prédéterminé dans un sens opposé à un sens de rotation pendant l'alimentation en huile, de sorte que la pression négative sur un côté admission (31) d'une chambre de pompe dans la pompe de changement volumétrique rotative (20) est réduite ou supprimée, en empêchant ainsi l'air d'entrer dans la chambre de pompe, et que la pompe à huile électrique (11) est ensuite arrêtée.

5. Procédé de commande d'une pompe à huile électrique (11) selon la revendication 4,
dans lequel l'angle prédéterminé à raison duquel la pompe de changement volumétrique rotative (20) est amenée à tourner dans le sens opposé au sens

de rotation pendant l'alimentation en huile est de 360 degrés par rapport au rotor intérieur (21).

6. Procédé de commande d'une pompe à huile électrique (11) selon la revendication 4 ou 5, dans lequel un coefficient de viscosité cinématique de l'huile à fournir en utilisant la pompe de changement volumétrique rotative (20) est égal ou supérieur à 1000 mm^2/s.

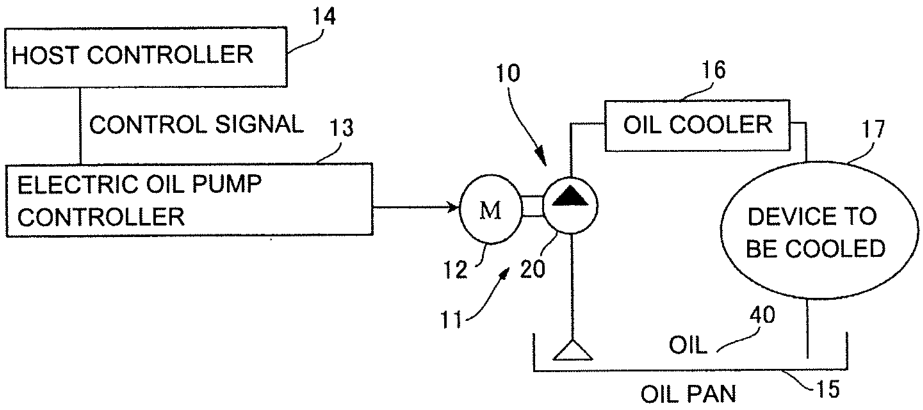
14
HOST CONTROLLER
CONTROL SIGNAL
13
ELECTRIC OIL PUMP
CONTROLLER
10
16
OIL COOLER
17
DEVICE TO
BE COOLED
M
12
20
11
40
OIL
OIL PAN
15

FIG. 1

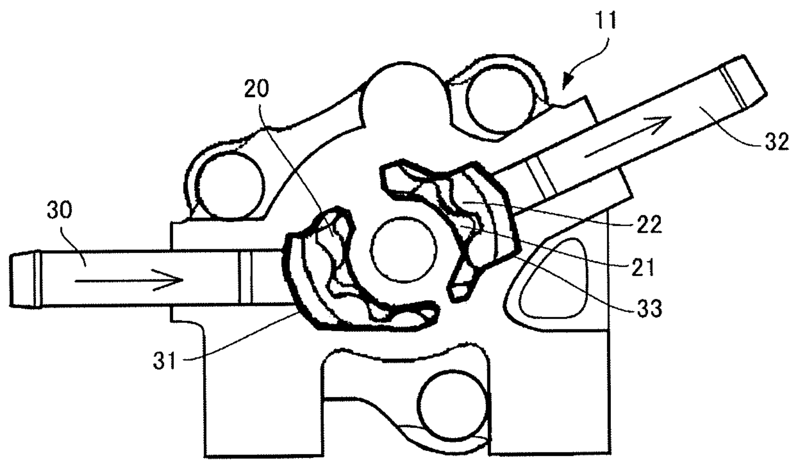
11
20
32
30
22
21
33
31

FIG. 2

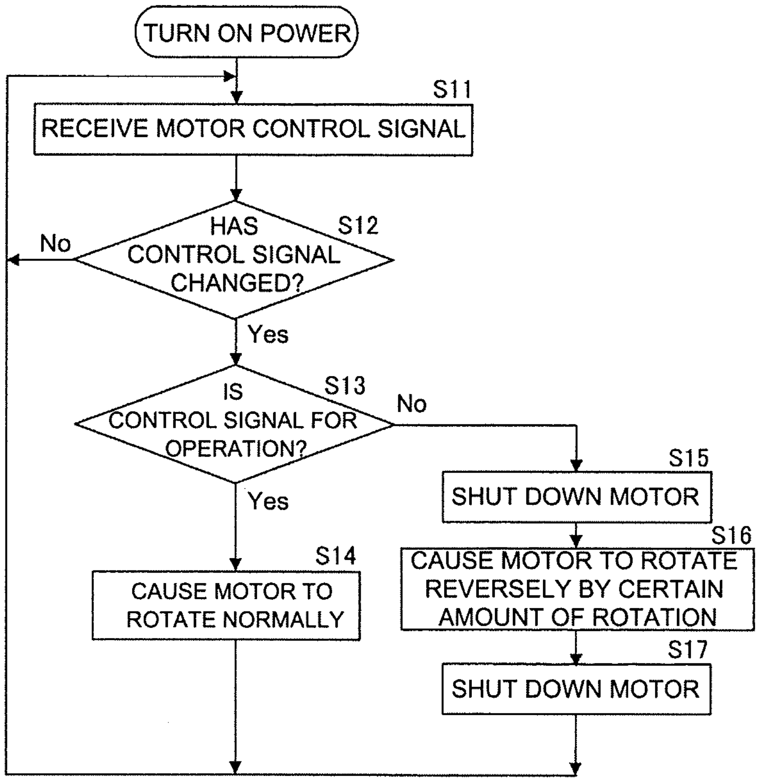
TURN ON POWER
S11
RECEIVE MOTOR CONTROL SIGNAL
HAS CONTROL SIGNAL CHANGED?
S12
No
Yes
IS CONTROL SIGNAL FOR OPERATION?
S13
No
Yes
S14
CAUSE MOTOR TO ROTATE NORMALLY
S15
SHUT DOWN MOTOR
S16
CAUSE MOTOR TO ROTATE REVERSELY BY CERTAIN AMOUNT OF ROTATION
S17
SHUT DOWN MOTOR

FIG. 3

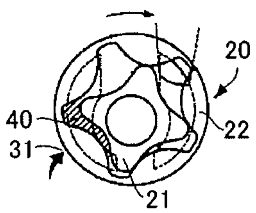

FIG. 4(a)

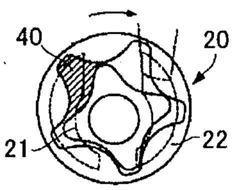

FIG. 4(b)

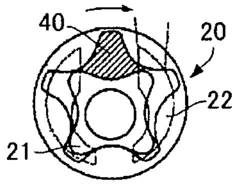

FIG. 4(c)

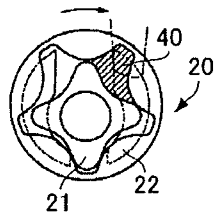

FIG. 4(d)

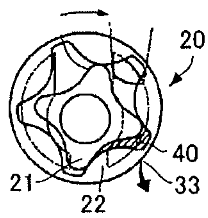

FIG. 4(e)

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

- US 2001055528 A1 **[0013]**
- JP 2004353624 A **[0014]**
- JP H0630482 U **[0015]**
- JP 2014131453 A **[0016]**
- JP 2002339874 A **[0016]**