



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

(43) Date of publication:  
**14.10.2015 Bulletin 2015/42**

(51) Int Cl.:  
**F04D 13/02<sup>(2006.01)</sup> F04D 29/42<sup>(2006.01)</sup>**

(21) Application number: **13860855.9**

(86) International application number:  
**PCT/JP2013/081348**

(22) Date of filing: **21.11.2013**

(87) International publication number:  
**WO 2014/087845 (12.06.2014 Gazette 2014/24)**

(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**  
Designated Extension States:  
**BA ME**

(72) Inventors:  
• **SAKURAI, Junichiro**  
Kariya-shi, Aichi 448-8650 (JP)  
• **SUZUKI, Yosuke**  
Kariya-shi, Aichi 448-8650 (JP)

(30) Priority: **04.12.2012 JP 2012265496**

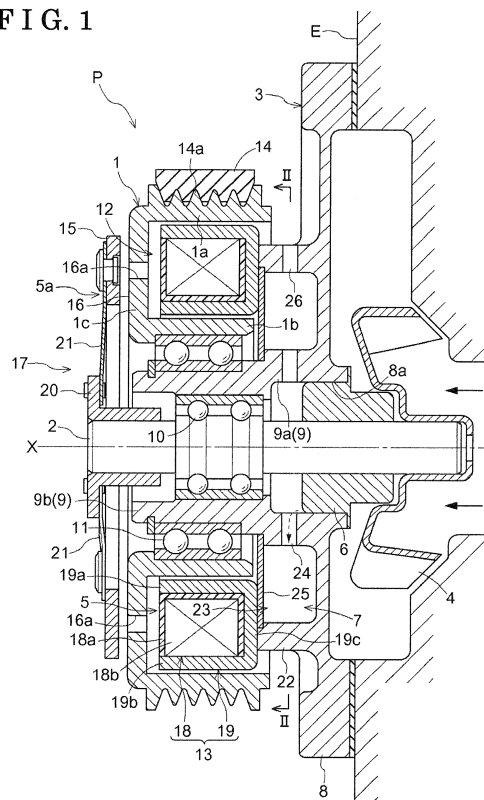
(74) Representative: **Kramer Barske Schmidtchen**  
**Patentanwälte PartG mbB**  
**European Patent Attorneys**  
**Landsberger Strasse 300**  
**80687 München (DE)**

(71) Applicant: **Aisin Seiki Kabushiki Kaisha**  
**Kariya-shi Aichi 448-8650 (JP)**

(54) **WATER PUMP**

(57) A water pump that does not easily drain a liquid stored in a liquid storage space outside is provided. The water pump includes a driving rotary body being drivingly rotated by a drive mechanism, a pump shaft rotating by a power transmission from the driving rotary body, a housing being inserted with the pump shaft, an impeller being fixed at one end side of the pump shaft, an electromagnetic clutch including a clutch portion being disposed at the other end side of the pump shaft, the clutch portion switching on and off the power transmission from the driving rotary body to the pump shaft, a mechanical seal being disposed at a position between the impeller and the clutch portion, the mechanical seal being mounted between the pump shaft and the housing, and the liquid storage space allowing to store the liquid leaking out from a side of the impeller to a side of the clutch portion via the mechanical seal. The electromagnetic clutch includes a yoke holding an electromagnetic coil. The liquid storage space is formed at the housing. The yoke is in contact with the housing.

**FIG. 1**



**Description****TECHNICAL FIELD**

**[0001]** This invention relates to a water pump which includes a driving rotary body being drivingly rotated by a drive mechanism, a pump shaft rotating by a power transmission from the driving rotary body, a housing being inserted with the pump shaft, an impeller being fixed at one end side of the pump shaft, an electromagnetic clutch including a clutch portion being disposed at the other end side of the pump shaft, the clutch portion switching on and off the power transmission from the driving rotary body to the pump shaft, a mechanical seal being disposed at a position between the impeller and the clutch portion, the mechanical seal being mounted between the pump shaft and the housing, and a liquid storage space allowing to store a liquid leaking out from a side of the impeller to a side of the clutch portion via the mechanical seal. This invention relates to the water pump in which the electromagnetic clutch includes a yoke holding an electromagnetic coil and the liquid storage space is formed at the housing.

**BACKGROUND ART**

**[0002]** A mechanical seal mounted between a pump shaft and a housing prevents a liquid from leaking out while allowing a seal member fixed at a side of the pump shaft and a seal member fixed at a side of the housing to relatively slide with each other. Thus, the liquid cannot be prevented from leaking out from a side of an impeller to a side of a clutch portion through a gap between the seal members.

**[0003]** According to Patent Document 1, in order not to drain a liquid leaking out via a mechanical seal outside a housing, a water pump in which a liquid storage space which is able to store such a liquid is formed at the housing is disclosed. The housing is formed with an opening portion opening the liquid storage space to a side of a yoke and is provided with a cap which closes the opening portion. The cap is formed with a drain hole which is able to drain the liquid stored in the liquid storage space outside the housing. Further, the water pump is configured such that the heat of the yoke heated by a heat generated by the energization to the electromagnetic coil is conducted to the housing via a fixing bracket fixing the yoke to the housing to heat the liquid storage space and the heat of the yoke vaporizes the liquid stored in the liquid storage space. Accordingly, the liquid and the vapor stored in the liquid storage space can be drained outside the housing via the drain hole formed at the cap.

**DOCUMENT OF PRIOR ART****PATENT DOCUMENT**

**[0004]** Patent Document 1: JP2010-242623A

**OVERVIEW OF INVENTION****PROBLEM TO BE SOLVED BY INVENTION**

**[0005]** According to the water pump described in Patent Document 1, because the heat of the yoke that is heated by generation of heat of the electromagnetic coil is conducted to the housing via the fixing bracket, the heat of the yoke is easily radiated outside the fixing bracket before heating the liquid storage space sufficiently. Thus, even if the heat of the yoke is conducted to the housing, the liquid storage space cannot be easily and sufficiently heated. As a result, because an amount of the liquid which can be vaporized at the liquid storage space is reduced, the liquid stored in the liquid storage space is increased early and is easily drained outside from the drain hole. In a case where the liquid stored in the liquid storage space is drained outside from the drain hole, there is an inconvenience of misunderstanding, arising from a trace of the drain, that a trouble of unexpected leak of the liquid from the pump occurs. The present invention is made in light of the above-described circumstance and a purpose of the present invention is to provide a water pump that does not easily drain a liquid stored in a liquid storage space outside.

**MEANS FOR SOLVING PROBLEM**

**[0006]** According to the first characterized construction of this invention, a water pump includes a driving rotary body being drivingly rotated by a drive mechanism; a pump shaft rotating by a power transmission from the driving rotary body; a housing being inserted with the pump shaft; an impeller being fixed at one end side of the pump shaft; an electromagnetic clutch including a clutch portion being disposed at the other end side of the pump shaft, the clutch portion switching on and off the power transmission from the driving rotary body to the pump shaft; a mechanical seal being disposed at a position between the impeller and the clutch portion, the mechanical seal being mounted between the pump shaft and the housing; and a liquid storage space allowing to store a liquid leaking out from a side of the impeller to a side of the clutch portion via the mechanical seal; wherein the electromagnetic clutch includes a yoke holding an electromagnetic coil; the liquid storage space is formed at the housing; and the yoke is in contact with the housing.

**[0007]** According to the water pump of this construction, the yoke is in contact with the housing. Accordingly, the heat held at the yoke that is heated by a heat generated by the energization to the electromagnetic coil is effectively conducted to the housing without involving a member intervening between the yoke and the housing. Thus, according to the water pump of this configuration, because the temperature of the liquid storage space is easily increased and because an amount of the liquid which can be vaporized at the liquid storage space is increased, the early increase of the liquid stored in the

liquid storage space is prevented. Accordingly, because the liquid stored in the liquid storage space is not easily drained outside, the inconvenience of the misunderstanding that the trouble of the unexpected leak of the liquid from the pump occur may not occur easily.

**[0008]** According to the second characterized construction of this invention, the housing is formed with an opening portion opening the liquid storage space to a side of the yoke; and the yoke is positioned so as to close the opening portion.

**[0009]** According to this construction, because the heat held at the yoke is radiated to the liquid storage space without involving the housing, the increase of the temperature at the liquid storage space can be facilitated.

**[0010]** According to the third characterized construction of this invention, a surface of the yoke facing the liquid storage space is provided with a projecting and recessed portion.

**[0011]** According to this construction, a heat radiation area from the yoke to the liquid storage space can be increased.

**[0012]** According to the fourth characterized construction of this invention, a bottom portion of the liquid storage space is defined by a bottom surface which becomes lower as being closer to a side of the yoke.

**[0013]** According to this construction, because the liquid flowing into the liquid storage space is flown to the side of the yoke by its own weight, the evaporation of the liquid can be facilitated.

## BRIEF DESCRIPTION OF DRAWINGS

### [0014]

[Fig. 1] Longitudinal cross sectional view showing a water pump according to this invention [Fig. 2] Cross sectional view taken along the line II-II in Fig. 1

[Fig. 3] Longitudinal cross sectional view showing a water pump of a second embodiment according to this invention

## MODE FOR CARRYING OUT THE INVENTION

**[0015]** Embodiments of this invention will be explained hereunder on the basis of the drawings.

[First embodiment]

**[0016]** Fig. 1 shows a water pump P for circulating cooling water, the water pump P mounted to an engine E (an example of a drive mechanism) for a vehicle according to this invention.

**[0017]** The water pump P includes a drive pulley (an example of a driving rotary body) 1, a pump shaft 2, a pump housing 3, an impeller 4, an electromagnetic clutch 5, a mechanical seal 6 and a liquid storage space 7. The drive pulley 1 is drivingly rotated by the engine E. The pump shaft 2 rotates by a power transmission from the

drive pulley 1. The pump housing 3 is inserted with the pump shaft 2. The impeller 4 is fixed at one end side of the pump shaft 2. The electromagnetic clutch 5 includes a clutch portion 5a being disposed at the other end side of the pump shaft 2, the clutch portion 5a switching on and off the power transmission from the drive pulley 1 to the pump shaft 2. The mechanical seal 6 is disposed at a position between the impeller 4 and the clutch portion 5a, and is mounted between the pump shaft 2 and the pump housing 3. The liquid storage space 7 allows to store a liquid leaking out from a side of the impeller 4 to a side of the clutch portion 5a via the mechanical seal 6.

**[0018]** The pump housing 3 is integrally formed with a fixed flange portion 8 and a cylindrical shaft portion 9 which are made from a metal material, for example, aluminum alloy. The fixed flange portion 8 is fixed to an engine E. The cylindrical shaft portion 9 is formed in a cylindrical shape and is inserted with the pump shaft 2. The fixed flange portion 8 is formed with a circular shaft through hole 8a which is centered on a rotary axis X. The cylindrical shaft portion 9 is coaxial with the rotary axis X so as to be communicated with the shaft through hole 8a and is integrally formed with the fixed flange portion 8.

**[0019]** The cylindrical shaft portion 9 is integrally provided with a large diameter cylindrical shaft portion 9a which is continuously provided with the fixed flange portion 8 and a small diameter cylindrical shaft portion 9b which is continuously provided with the large diameter cylindrical shaft portion 9a. The inner diameter of the large diameter cylindrical shaft portion 9a is formed to include the same diameter as the diameter of the shaft through hole 8a. The inner diameter of the small diameter cylindrical shaft portion 9b is formed to include the diameter smaller than the diameter of the shaft through hole 8a.

**[0020]** The pump shaft 2 is inserted to be positioned inside the shaft through hole 8a and the cylindrical shaft portion 9 and is rotatably supported at an inner circumferential side of the small diameter cylindrical shaft portion 9b about the rotary axis X via a pump bearing 10. The mechanical seal 6 is mounted between an outer circumferential portion of the pump shaft 2 and an inner circumferential portion of the shaft through hole 8a.

**[0021]** The drive pulley 1 is rotatably supported at an outer circumferential side of the small diameter cylindrical shaft portion 9b about the rotary axis X via a pulley bearing 11. Thus, the pump shaft 2 and the drive pulley 1 are relatively rotatably supported about the rotary axis X.

**[0022]** The drive pulley 1 is made from a magnetic body material, for example, an iron material or a nickel alloy material, and is integrally provided with a cylindrical outer circumferential wall 1a, a cylindrical inner circumferential wall 1b and a side end wall 1c. The outer circumferential wall 1a is centered on the rotary axis X. The inner circumferential wall 1b is disposed at an inner side of the outer circumferential wall 1a and is centered on the rotary axis X. The side end wall 1c connects each end portion of the outer circumferential wall 1a and the inner circum-

ferential wall 1b, the end portions which are disposed opposite to a side of the impeller 4. The side end wall 1c is disposed in an orientation orthogonal to the rotary axis X.

[0023] The drive pulley 1 is formed with an annular space 12 which is surrounded by the outer circumferential wall 1a, the inner circumferential wall 1b and the side end wall 1c, and which opens to the side of the impeller 4. An electromagnetic solenoid 13 of the electromagnetic clutch 5 is positioned inside the annular space 12.

[0024] A belt wound portion 14a wound with a drive belt 14 is formed at an outer circumferential surface of the outer circumferential wall 1a. The pulley bearing 11 is disposed such that an outer race is in contact with an inner circumferential surface of the inner circumferential wall 1b. A clutch surface 16 attracting an armature (a clutch plate) 15 is formed at an outer surface side of the side end wall 1c, the outer surface side which is disposed in a direction opposite to a side of the electromagnetic solenoid 13. The side end wall 1c is formed with plural through holes 16a which is long in a circumferential direction and which penetrates the clutch surface 16. The through holes 16a are disposed apart from one another at an interval in the circumferential direction.

[0025] The drive belt 14 is hung and wound around an output pulley provided at the crankshaft of the engine E and the drive pulley 1 and drivingly rotates the drive pulley 1 continuously when starting up the engine E. The switching of the power transmission operated by the electromagnetic clutch 5 is controlled on the basis of detection results of a temperature sensor (not shown in the drawings) detecting, for example, the water temperature of cooling water.

[0026] For example, in a case where the water temperature of cooling water is low, for example, immediately after the startup of the engine E (when the engine E is not sufficiently warmed), the electromagnetic clutch 5 is maintained off state (disconnected state) to facilitate the warm up. In a case where the water temperature of cooling water exceeds a predetermined value, the electromagnetic clutch 5 is switched to an on state (connected state) to circulate cooling water by the drive rotation of the impeller 4.

[0027] The electromagnetic clutch 5 is configured with the electromagnetic solenoid 13 which is housed in the annular space 12 of the drive pulley 1, and a clutch unit 17 which integrally rotates with the pump shaft 2. A magnetic circuit which applies the magnetic flux transmitted from the electromagnetic solenoid 13 on the armature 15 is formed on the drive pulley 1.

[0028] The electromagnetic solenoid 13 includes a solenoid portion 18 which generates the magnetic flux by energization, and a yoke 19 which is made from a magnetic body material, for example, an iron material or a nickel alloy material to transmit the magnetic flux transmitted from the solenoid portion 18 to the drive pulley 1.

[0029] The yoke 19 is integrally formed with an inner cylindrical portion 19a, an outer cylindrical portion 19b

and an annular connection plate portion 19c to be formed in an annular shape including the C-shape cross section. The inner cylindrical portion 19a and the outer cylindrical portion 19b are formed in a cylindrical shape and are coaxially disposed with the rotary axis X. The connection plate portion 19c connects each end portion of the inner cylindrical portion 19a and the outer cylindrical portion 19b, the end portions disposed at the side of the impeller 4. The inner cylindrical portion 19a is disposed close to the inner circumferential wall 1b, and the outer cylindrical portion 19b is disposed close to the outer circumferential wall 1a, and the connection plate portion 19c is disposed in the orientation orthogonal to the rotary axis X.

[0030] At the solenoid portion 18, a bobbin 18a is wound with an electromagnetic coil 18b and is fitted inside the yoke 19. Thus, the electromagnetic clutch 5 includes the yoke 19 which holds the electromagnetic coil 18b inside the yoke 19.

[0031] The clutch unit 17 includes a bush 20 which is fitted onto an end portion of the pump shaft 2, and plural spring plates 21 which bias the annular armature 15 to be away from the side end wall 1c of the drive pulley 1 while supporting the armature 15 to the bush 20.

[0032] The armature 15 is made from a magnetic body, for example, an iron material or a nickel alloy material. A plate material which can be elastically deformed as spring steel is used for the spring plates 21, and one end is connected to a flange portion of the bush 20 and the other end is connected to the armature 15.

[0033] When the electromagnetic solenoid 13 is not energized, the armature 15 is away from the clutch surface 16 of the side end wall 1c by the biasing force of the spring plates 21 and the electromagnetic clutch 5 has been switched in the off state.

[0034] When the electromagnetic solenoid 13 is energized, a part of the magnetic flux formed at the magnetic circuit which is configured by the yoke 19 and the drive pulley 1 leaks outward via the through hole 16a of the side end wall 1c and affects the armature 15. The armature 15 is attracted to the clutch surface 16 and the electromagnetic clutch 5 is switched to be in the on state. Accordingly, the clutch unit 17 configures the clutch portion 5a which switches on and off the power transmission from the drive pulley 1 to the pump shaft 2.

[0035] At a side of the fixed flange portion 8 which is close to the yoke 19, the fixed flange portion 8 configuring the pump housing 3 is integrally provided with a cylindrical wall portion 22 which is coaxial with the rotary axis X, and the cylindrical wall portion 22 is fixed to the yoke 19.

[0036] The liquid storage space 7 is formed annularly and is disposed between the cylindrical wall portion 22 and the large diameter cylindrical shaft portion 9a. An opening portion 23 opening the liquid storage space 7 to the side of the yoke 19 is formed between respective end portions of the cylindrical wall portion 22 and the large diameter cylindrical shaft portion 9a. At the yoke 19, the connection plate portion 19c is directly in contact with the

cylindrical wall portion 22 and is positioned so as to close an outer circumferential side portion of the opening portion 23 of the liquid storage space 7.

**[0037]** At the large diameter cylindrical shaft portion 9a, an inflow hole 24 which flows, for example, cooling water leaking out from the mechanical seal 6 to a side of the pump bearing 10 to the liquid storage space 7 by its own weight is formed through in a cylindrical diameter direction. As shown in Fig. 2, each of drain holes 26 which can drain, for example, cooling water vaporized in the liquid storage space 7 outside is formed through at an upper portion and a side portion of the cylindrical wall portion 22. The drain hole 26 may be single or plural, and can drain water vapor of cooling water (liquid) W stored in the liquid storage space 7 to an upper side of the pump housing 3.

**[0038]** Accordingly, because the heat held at the yoke 19 that is heated by the heat generated by the energization to the electromagnetic coil 18b can be effectively conducted to the liquid storage space 7 via the connection plate portion 19c and the cylindrical wall portion 22, the evaporation of cooling water stored in the liquid storage space 7 can be facilitated.

**[0039]** A plate-shaped cap 25 which is made of resin or metal and which closes the entire circumference and the entire area of the opening portion 23 of the liquid storage space 7 is mounted so as to be in contact with a plate surface of the connection plate portion 19c. Alternatively, the yoke 19 can be exposed to the liquid storage space 7 by including the cap 25 which closes only a gap between the yoke 19 and the cylindrical shaft portion 9 or by not being mounted with the cap 25.

[Second embodiment]

**[0040]** Fig. 3 shows another embodiment of a water pump P according to this invention. According to this embodiment, a lower side portion of the liquid storage space 7 is defined by a bottom surface 27 which becomes lower as being closer to the side of the yoke 19. That is, the inclination bottom surface 27 which becomes lower as being closer to the side of the yoke 19 is formed at a portion of a lower end side, in a vertical direction, of the inner circumferential surface of the cylindrical wall portion 22.

**[0041]** By including the bottom surface 27 which is inclined as described above, cooling water flowing into the liquid storage space 7 is flown to be close to the side of the yoke 19 by its own weight and the evaporation of cooling water can be facilitated. Other construction is identical to the first embodiment.

[Third embodiment]

**[0042]** A surface of the yoke 19 which exposes to and faces the liquid storage space 7 can be provided with a projecting and recessed portion by being formed with, for example, a projecting and recessed surface or a rough

surface at the surface of the yoke 19, or, by being projectingly fixed with, for example, a metal fin, which are not shown in the drawings. By including the projecting and recessed portion, the heat radiation area from the yoke 19 to the liquid storage space 7 may be further increased to enhance the evaporation effect of cooling water.

[Other embodiment]

**[0043]** 1. According to a water pump of this invention, a yoke and a housing which are made from a magnetic body material may be integrally formed.

## INDUSTRIAL APPLICABILITY

**[0044]** The water pump of this invention can be applied to various types of water pumps which include electromagnetic clutches.

## EXPLANATION OF REFERENCE NUMERALS

### [0045]

1	driving rotary body
2	pump shaft
3	housing
4	impeller
5	electromagnetic clutch
5a	clutch portion
6	mechanical seal
7	liquid storage space
18b	electromagnetic coil
19	yoke
23	opening portion
27	bottom surface
E	drive mechanism

## Claims

1. A water pump, comprising:

- a driving rotary body being drivingly rotated by a drive mechanism;
- a pump shaft rotating by a power transmission from the driving rotary body;
- a housing being inserted with the pump shaft;
- an impeller being fixed at one end side of the pump shaft;
- an electromagnetic clutch including a clutch portion being disposed at the other end side of the pump shaft, the clutch portion switching on and off the power transmission from the driving rotary body to the pump shaft;
- a mechanical seal being disposed at a position between the impeller and the clutch portion, the mechanical seal being mounted between the

- pump shaft and the housing; and  
a liquid storage space allowing to store a liquid  
leaking out from a side of the impeller to a side  
of the clutch portion via the mechanical seal;  
wherein 5  
the electromagnetic clutch includes a yoke hold-  
ing an electromagnetic coil;  
the liquid storage space is formed at the hous-  
ing; and  
the yoke is in contact with the housing. 10
2. The water pump according to claim 1, wherein  
the housing is formed with an opening portion open-  
ing the liquid storage space to a side of the yoke; and  
the yoke is positioned so as to close the opening 15  
portion.
3. The water pump according to claim 2, wherein a sur-  
face of the yoke facing the  
liquid storage space is provided with a projecting and 20  
recessed portion.
4. The water pump according to claim 1, wherein a bot-  
tom portion of the liquid  
storage space is defined by a bottom surface which 25  
becomes lower as being closer to a side of the yoke.
5. The water pump according to claim 2, wherein a bot-  
tom portion of the liquid  
storage space is defined by a bottom surface which 30  
becomes lower as being closer to the side of the  
yoke.
6. The water pump according to claim 3, wherein a bot-  
tom portion of the liquid 35  
storage space is defined by a bottom surface which  
becomes lower as being closer to the side of the  
yoke.

40

45

50

55

FIG. 1

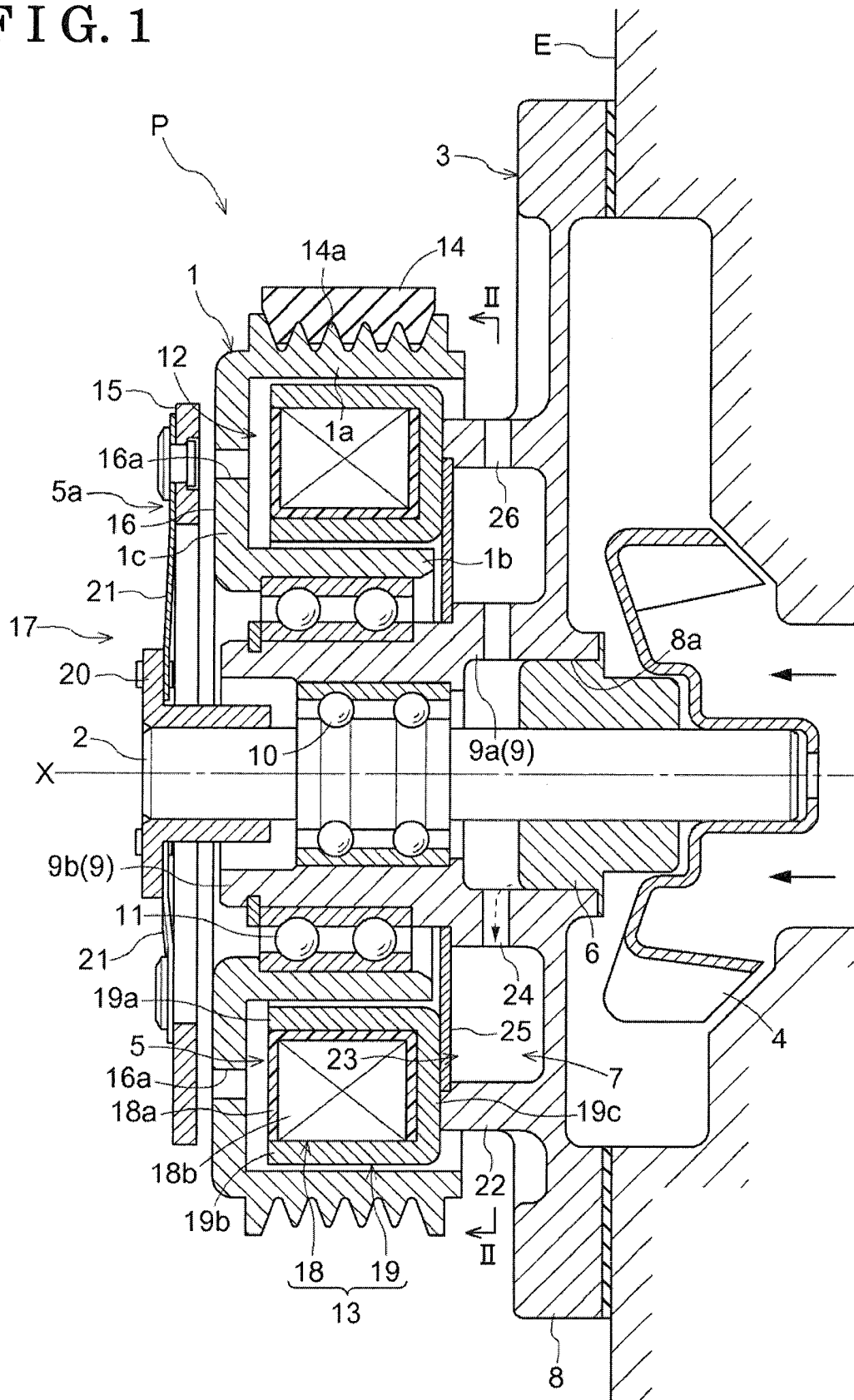


FIG. 2

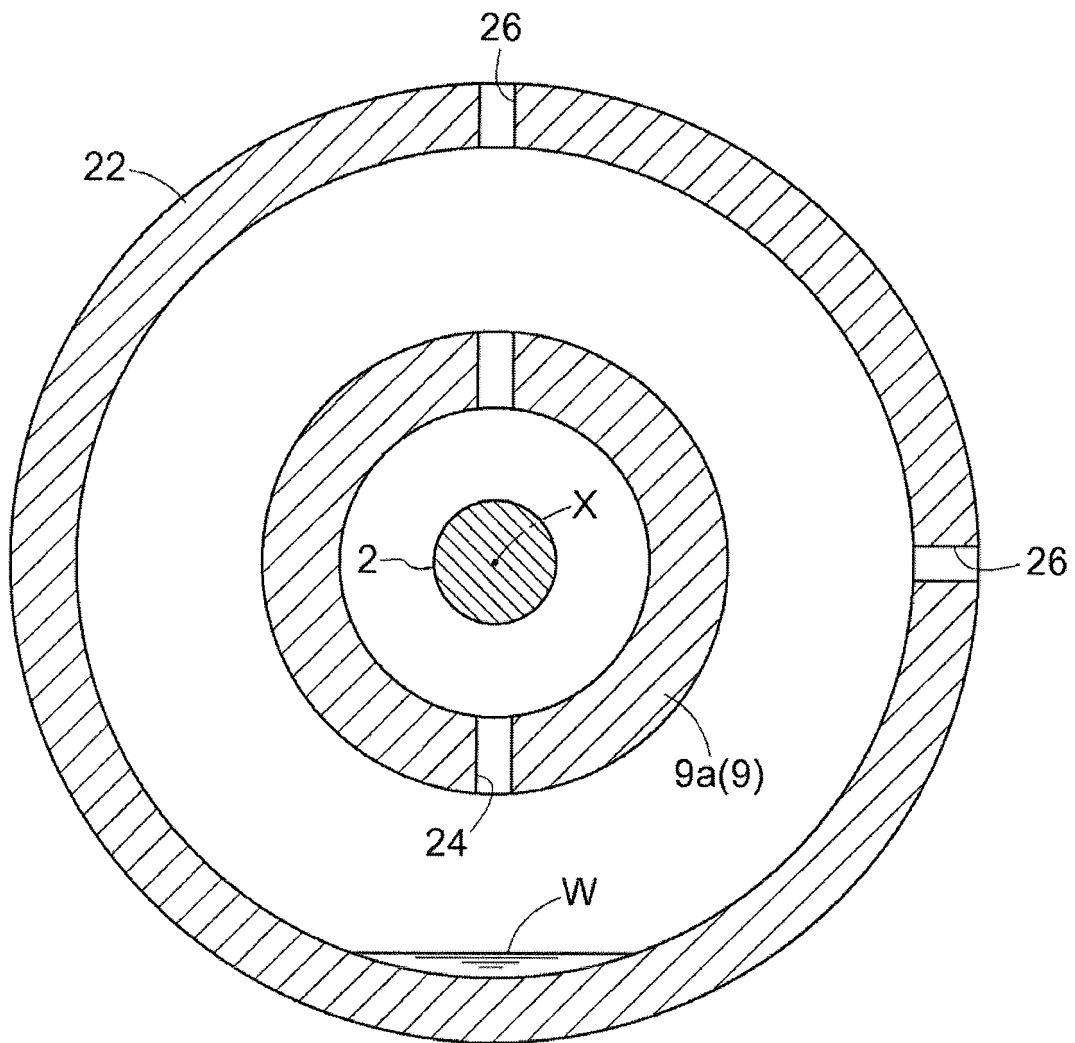
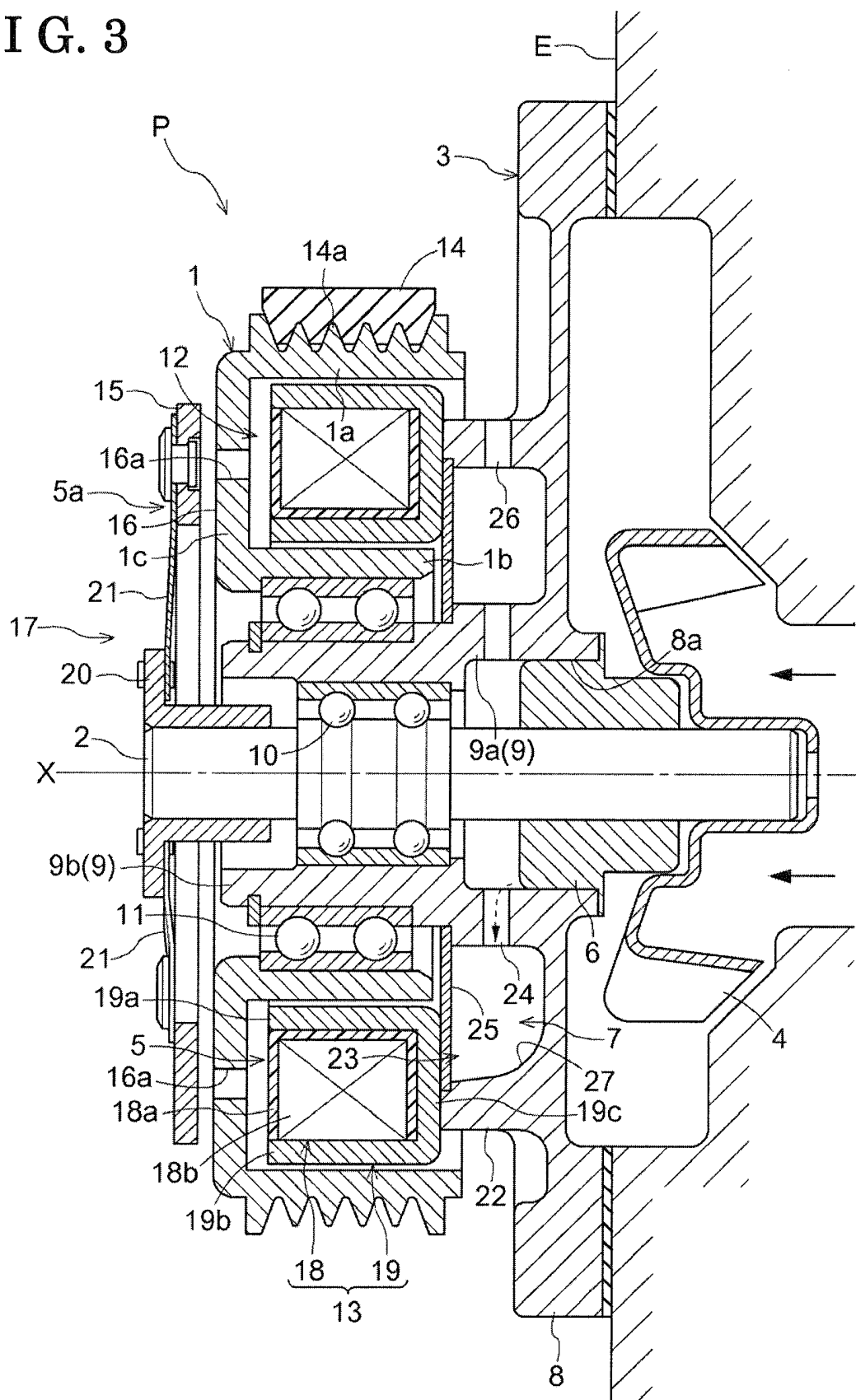


FIG. 3



## INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2013/081348

## A. CLASSIFICATION OF SUBJECT MATTER

F04D13/02(2006.01)i, F04D29/42(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)

F04D13/02, F04D29/42, F01P5/10-5/12

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 1996-2014

Kokai Jitsuyo Shinan Koho 1971-2014 Toroku Jitsuyo Shinan Koho 1994-2014

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.
A	JP 2010-242623 A (Hitachi Automotive Systems, Ltd.), 28 October 2010 (28.10.2010), entire text; all drawings (Family: none)	1-6
A	JP 2012-516959 A (Melling do Brasil Componentes Automotivos Ltda.), 26 July 2012 (26.07.2012), entire text; all drawings & US 2012/0020812 A1 & EP 2356348 A & WO 2010/058233 A1	1-6

☒ 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

"&amp;" document member of the same patent family

Date of the actual completion of the international search  
20 January, 2014 (20.01.14)Date of mailing of the international search report  
28 January, 2014 (28.01.14)Name and mailing address of the ISA/  
Japanese Patent Office

Authorized officer

Facsimile No.

Telephone No.

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2013/081348

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 7-310548 A (Aichi Machine Industry Co., Ltd.), 28 November 1995 (28.11.1995), fig. 1 to 3 (Family: none)	1-6

Form PCT/ISA/210 (continuation of second sheet) (July 2009)

**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 2010242623 A [0004]