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

(11) **EP 4 102 077 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
14.12.2022 Bulletin 2022/50

(21) Application number: **22177047.2**

(22) Date of filing: **02.06.2022**

(51) International Patent Classification (IPC):
F04D 13/14 *(2006.01)* ***F04D 15/00*** *(2006.01)*
F04D 29/60 *(2006.01)*

(52) Cooperative Patent Classification (CPC):
F04D 13/14; F04D 15/0072; F04D 29/605

(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
Designated Validation States:
KH MA MD TN

(30) Priority: **07.06.2021 JP 2021095054**

(71) Applicant: **Ebara Corporation**
Tokyo 144-8510 (JP)

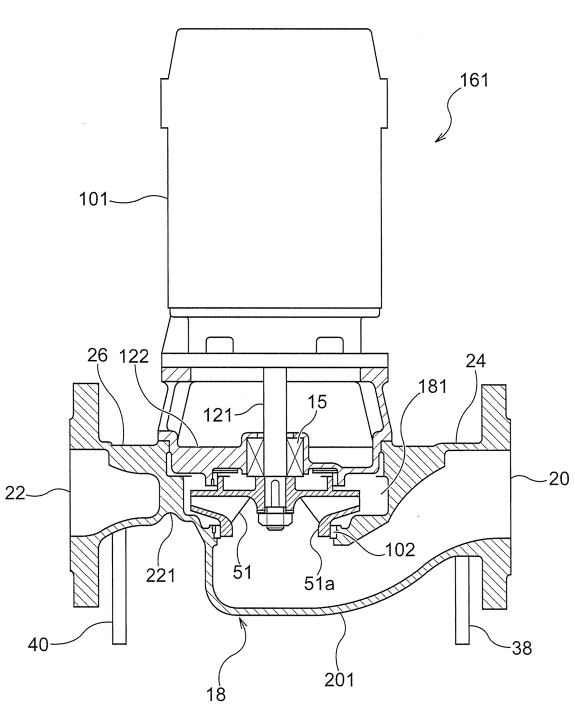
(72) Inventors:
- **OGAWA, Soichiro**
  Tokyo, 144-8510 (JP)
- **SUZUKI, Keitaro**
  Tokyo, 144-8510 (JP)
- **RANA, Epsha**
  Tokyo, 144-8510 (JP)

(74) Representative: **Schmidbauer, Andreas Konrad**
Wagner & Geyer Partnerschaft mbB
Patent- und Rechtsanwälte
Gewürzmühlstrasse 5
80538 München (DE)

(54) **PUMP CASING**

(57) There is provided a pump casing improved in stability of installed pumps. A pump casing 18 includes a first pump casing 181, a first suction passage portion 201 connected to the first pump casing 181, and a first discharge passage portion 221 connected to the first pump casing 181. The pump casing 18 further includes a second pump casing 182, a second suction passage portion 202 connected to the second pump casing 182, and a second discharge passage portion 222 connected to the second pump casing 182. The pump casing 18 further includes a suction branching portion 24 connected to the first suction passage portion 201 and the second suction passage portion 202, a discharge merging portion 26 connected to the first discharge passage portion 221 and the second discharge passage portion 222, a first leg portion 38 provided in the suction branching portion 24, and a second leg portion 40 provided in the discharge merging portion 26.

Fig. 2



EP 4 102 077 A1

Description

[0001] The present invention relates to a pump casing.

[0002] A pump apparatus is conventionally used for various applications in various kinds of houses and in a site such as a factory. For example, an inline pump in which a pump section and a motor section are integrated, and a suction port and a discharge port of a pump are arranged on the same line is widely used because the inline pump is easily attachable in a middle of a pipe. In a case where the inline pump is installed in a construction facility, it is desirable to avoid stoppage of liquid supply when one inline pump has failed or one inline pump is subjected to periodic inspection.

[0003] To avoid stoppage of liquid supply, a case where two inline pumps are installed in parallel such that one of the inline pumps can back up the other inline pump is seen in markets in Europe. There is a product that is called a twin pump in which two inline pumps are arranged in parallel, one suction port and one discharge port are connected to the two inline pumps, and the two inline pumps share one suction port and one discharge port. Note that, in the following, in a case where the two inline pumps do not share one suction port and one discharge port, namely, in a case where each of the two inline pumps includes one suction port and one discharge port, each of the pumps is called a single pump.

[0004] In the case where the twin pump is installed, if trouble occurs on one of the pumps, or the like, parts other than a casing of the pump having the trouble are detached, and an upper part of the casing is covered with a blank flange. Examples of the parts other than the casing include an electric motor disposed on the upper part of the casing, a rotary shaft coupled to the electric motor, and an impeller fixed to the rotary shaft and housed in the casing. In the twin pump, operation can be continued by the other pump during a pump maintenance period or during a period when a spare part for the failed pump is prepared.

[0005] A product desirably saves space and has a long lifetime, and a pump manufacturer performs internal development in order to meet the demands. To meet the request, in a case of the twin pump, a length of a header pipe to branch a pipe into pipes for two single pumps or to merge pipes can be reduced as compared with a case where the two single pumps are arranged in parallel. Further, a valve such as a check valve for backflow prevention is shared by the two pumps configuring the twin pump, which makes it possible to achieve space saving. As a result, the twin pump manufacturer can meet space saving required by a customer. Further, alternately operating the two pumps configuring the twin pump makes it possible to simply double the pump lifetime.

[0006] In a case where the single pump, namely, a pump in which two inline pumps are installed in parallel is manufactured, a horizontal surface of a portion where the pump comes into contact with a floor, for example, a pump bottom surface portion and a leg bottom surface portion is processed for each pump. Further, in a case where a single pump is installed, adjustment of a gap between a floor surface and the pump, and adjustment of a levelness of the pump are performed for each pump.

[0007] In the case of the twin pump, however, pump casings for two pumps are integrally manufactured, and floor contact portions for the two pumps are also accordingly integrally manufactured. Therefore, horizontality of the floor contact portion for each pump is required in manufacturing and at installation, as well as mutual horizontality of the two pumps is required in manufacturing and at installation at the same time. Arrangement and process accuracy of the floor contact portions influence on self-standing ability at installation of the pump and a suppression degree of noise and vibration during operation of the pumps.

[0008] PTL 1: International Publication No. WO 2018/137019

[0009] An aspect of the present invention is made to solve such issues, and an object thereof is to provide a pump casing improved in stability of installed pumps.

[0010] To solve the above-described issues, according to a first aspect, a pump casing used for a pump apparatus to transfer a liquid, includes: a first pump casing; a first suction passage portion connected to the first pump casing; a first discharge passage portion connected to the first pump casing; a second pump casing; a second suction passage portion connected to the second pump casing; a second discharge passage portion connected to the second pump casing; a suction branching portion connected to the first suction passage portion and the second suction passage portion; a discharge merging portion connected to the first discharge passage portion and the second discharge passage portion; a first leg portion provided in the suction branching portion; and a second leg portion provided in the discharge merging portion.

[0011] In the present aspect, the first leg portion is provided in the suction branching portion, and the second leg portion is provided in the discharge merging portion. Since the leg portions are provided in the suction branching portion and the discharge merging portion, stability of the pump casing is increased. Occurrence of noise and vibration during operation of pumps can be suppressed as compared with an existing pump casing. Therefore, it is possible to provide the pump casing improved in stability of the installed pumps.

[0012] According to a second aspect, in the pump casing according to the first aspect, at least one of the first leg portion and the second leg portion includes a screw hole.

[0013] According to a third aspect, in the pump casing according to the first or second aspect, at least one of the first leg portion and the second leg portion includes a base part.

[0014] According to a fourth aspect, the pump casing according to any one of the first to third aspects further includes a third leg portion provided in at least one of the

first pump casing and the second pump casing.

[0015] According to a fifth aspect, the pump casing according to any one of the first to fourth aspects further includes a fourth leg portion provided in at least one of the first discharge passage portion and the second discharge passage portion.

[0016] According to a sixth aspect, the pump casing according to any one of the first to fifth aspects further includes a fifth leg portion provided in at least one of the first suction passage portion and the second suction passage portion.

[0017] According to a seventh aspect, a pump apparatus includes: a first electric motor; a first rotary shaft coupled to the first electric motor; a first impeller fixed to the first rotary shaft and housed in the first pump casing; a second electric motor; a second rotary shaft coupled to the second electric motor; a second impeller fixed to the second rotary shaft and housed in the second pump casing; and the pump casing according to any one of the first to sixth aspects.

Fig. 1 is a schematic view illustrating an embodiment of a pump casing;
Fig. 2 is a schematic view illustrating an embodiment of a first pump apparatus;
Fig. 3 is a top view of the pump casing;
Fig. 4 is a perspective view of the pump casing; and
Fig. 5 is a bottom view of the pump casing;

[0018] Some embodiments of the present invention are described below with reference to drawings. Note that, in the following embodiments, the same or equivalent members are denoted by the same reference numerals, and repetitive descriptions are omitted in some cases. Further, characteristics described in each of the embodiments are applicable to another embodiment without conflicting with each other.

[0019] Fig. 1 is a schematic view illustrating an embodiment of a pump casing 18 according to the present invention. The pump casing 18 is used for a pump apparatus 16 to transfer a liquid. One pump casing 18 includes a first pump casing 181, a first suction passage portion 201 connected to the first pump casing 181, and a first discharge passage portion 221 connected to the first pump casing 181. The pump casing 18 further includes a second pump casing 182, a second suction passage portion 202 connected to the second pump casing 182, and a second discharge passage portion 222 connected to the second pump casing 182.

[0020] The pump casing 18 further includes a suction branching portion 24 connected to the first suction passage portion 201 and the second suction passage portion 202, and a discharge merging portion 26 connected to the first discharge passage portion 221 and the second discharge passage portion 222. The first pump casing 181, the first suction passage portion 201, the first discharge passage portion 221, the second pump casing 182, the second suction passage portion 202, the second discharge passage portion 222, the suction branching portion 24, and the discharge merging portion 26 are integrally formed as a casting. Some of these portions, for example, the first discharge passage portion 221, the second discharge passage portion 222, and the discharge merging portion 26 may be manufactured as castings other than the other portions.

[0021] The suction branching portion 24 corresponds to a section from a suction port 20 to a part branched to the first suction passage portion 201 and the second suction passage portion 202. More specifically, the suction branching portion 24 corresponds to a section from the suction port 20 to a start end part 58 of the first suction passage portion 201, and a section from the suction port 20 to a start end part 60 of the second suction passage portion 202. The discharge merging portion 26 corresponds to a section from a part where the first discharge passage portion 221 and the second discharge passage portion 222 merge with each other to a discharge port 22. More specifically, the discharge merging portion 26 corresponds to a section from a terminal end part 281 of the first discharge passage portion 221 to the discharge port 22, and a section from a terminal end part 282 of the second discharge passage portion 222 to the discharge port 22. The suction port 20 of the pump apparatus 16 is a connection portion between the pump apparatus 16 and a pipe (not illustrated) on a suction side of the pump apparatus 16. The discharge port 22 of the pump apparatus 16 is a connection portion between the pump apparatus 16 and a pipe (not illustrated) on a discharge side of the pump apparatus 16.

[0022] The pump apparatus 16 includes a first pump apparatus 161 and a second pump apparatus 162. The first pump apparatus 161 and the second pump apparatus 162 may have the same configuration or different configurations. In the present embodiment, the first pump apparatus 161 and the second pump apparatus 162 substantially have the same configuration. In other words, a first impeller 51, the first pump casing 181, and the first discharge passage portion 221 respectively have the same dimensional shapes as a second impeller 52, the second pump casing 182, and the second discharge passage portion 222. A rotation direction 54 of the first impeller 51 is the same as a rotation direction 56 of the second impeller 52. On the other hand, the dimensional shape of the first suction passage portion 201 and the dimensional shape of the second suction passage portion 202 are slightly different from each other.

[0023] In the present embodiment, the first pump apparatus 161 and the second pump apparatus 162 are centrifugal pumps; however, the first pump apparatus 161 and the second pump apparatus 162 are not limited to the centrifugal pumps as long as the first pump apparatus 161 and the second pump apparatus 162 are non-positive displacement pumps. In other words, the first pump apparatus 161 and the second pump apparatus 162 may be turbine pumps, axial-flow pumps, or mixed flow pumps.

[0024] Since the first pump apparatus 161 and the second pump apparatus 162 substantially have the same configuration, the configuration of the first pump apparatus 161 is described with reference to Fig. 2. Fig. 2 is a schematic view illustrating an embodiment of the first pump apparatus 161. The first pump apparatus 161 includes a first electric motor 101, a first rotary shaft 121 coupled to the first electric motor 101, and the first impeller 51 that is fixed to the first rotary shaft 121 and is housed in the first pump casing 181.

[0025] Although not illustrated, the second pump apparatus 162 also have a second electric motor, a second rotary shaft coupled to the second electric motor, and the second impeller 52 that is fixed to the second rotary shaft and is housed in the second pump casing 182, as with the first pump apparatus 161.

[0026] In the first pump apparatus 161, the first impeller 51 is a centrifugal impeller. The rotary shaft 121 is rotatably supported by a bearing (not illustrated). The rotary shaft 121 and the first impeller 51 are integrally rotatable. The rotary shaft 121 and the first impeller 51 are rotated by the electric motor 101. A liner ring 102 is disposed around a fluid inlet 51a of the first impeller 51. The liner ring 102 is fixed to the first pump casing 181.

[0027] A casing cover 122 is disposed between the electric motor 101 and the first pump casing 181. An opening at an upper part of the first pump casing 181 is closed by the casing cover 122. The electric motor 101 is fixed to the casing cover 122. The first pump casing 181 and the casing cover 122 are formed as castings. A shaft sealing device 15 sealing a gap between the rotary shaft 121 and the casing cover 122 is disposed on a rear side of the first impeller 51. The shaft sealing device 15 is held by the casing cover 122. Examples of the shaft sealing device 15 include a mechanical seal. The above-described blank flange (not illustrated) is disposed at a position of the casing cover 122 at maintenance or the like. The blank flange is attached by using screw holes 62 (see Fig. 3) circumferentially arranged for attachment of the casing cover 122. The blank flange has a disk shape, and includes, on an outer edge of the blank flange, attachment holes circumferentially arranged at positions corresponding to the screw holes 62.

[0028] The pump casing 18 includes the suction branching portion 24 including the suction port 20, and the discharge merging portion 26 including the discharge port 22. The first impeller 51 is disposed inside the first pump casing 181. The suction port 20 and the discharge port 22 are arranged on one straight line. The pump apparatus 16 in which the suction port 20 and the discharge port 22 are arranged on one straight line is called an inline pump apparatus. In the present embodiment, two inline pumps are arranged in parallel, one suction port and one discharge port are connected to the two inline pumps, and the two inline pumps share one suction port and one discharge port. When the two inline pumps share one suction port and one discharge port, these pumps configure one twin pump as a whole. The pump casing 18 includes a first leg portion 38 provided in the suction branching portion 24, and a second leg portion 40 provided in the discharge merging portion 26.

[0029] A difference between one inline pump as a twin pump and two inline pumps (two single pumps) arranged in parallel is described. In the two single pumps arranged in parallel, discharge ports of the single pumps are connected to respective pipes on a discharge side, and the two pipes are then merged to form one pipe on a downstream side. Further, on a suction side, one pipe is branched into two pipes, and the two pipes are connected to suction ports of the respective single pumps. In contrast, in the twin pump, two discharge passage portions are merged at the discharge merging portion 26 on the discharge side, and the merged passage portion is connected to a pipe at the discharge port 22 of the twin pump. Further, on the suction side of the twin pump, a pipe is connected to the suction port 20 of the pump, and is then branched into two suction passage portions through the suction branching portion 24.

[0030] When the electric motor 101 rotates the first impeller 51, the liquid flows into the pump casing 18 from the suction port 20. More specifically, the liquid flows into the first suction passage portion 201 from the suction port 20, and then flows into the fluid inlet 51a of the first impeller 51 through the first suction passage portion 201. The rotating first impeller 51 applies velocity energy to the liquid, and the velocity energy of the liquid flowing through the first pump casing 181 is converted into pressure. The pressurized liquid is discharged from the pump casing 18 through the discharge port 22.

[0031] Various methods of operating the first pump apparatus 161 and the second pump apparatus 162 are usable. A method of operating only one of the first pump apparatus 161 and the second pump apparatus 162 and stopping the other pump apparatus, or a method of operating both of the first pump apparatus 161 and the second pump apparatus 162 at the same time is usable. As illustrated in Fig. 1, the discharge merging portion 26 includes an on-off valve 28. The on-off valve 28 closes the discharge passage portion connected to the stopped pump apparatus based on operation states of the first pump apparatus 161 and the second pump apparatus 162.

[0032] For example, when the first pump apparatus 161 operates and the second pump apparatus 162 stops, the on-off valve 28 is moved to a position 282 illustrated by a dotted line by hydraulic pressure from the first discharge passage portion 221, to close the second discharge passage portion 222. When the second pump apparatus 162 operates and the first pump apparatus 161 stops, the on-off valve 28 is moved to a position 281 illustrated by a dashed line by hydraulic pressure from the second discharge passage portion 222, to close the first discharge passage portion 221. When the first pump apparatus 161 and the second pump apparatus 162 both operate at the same time, the on-off valve 28 is moved to an intermediate position 283 illustrated by a solid line

by hydraulic pressure from the first discharge passage portion 221 and hydraulic pressure from the second discharge passage portion 222.

[0033] Figs. 3 to 5 each illustrate a configuration of the single pump casing 18. Fig. 3 is a top view of the pump casing 18. Fig. 4 is a perspective view of the pump casing 18. Fig. 5 is a bottom view of the pump casing 18. Figs. 3 to 5 each illustrate the pump casing 18 in a state where the components other than the pump casing 18, namely, the first electric motor 101, the first rotary shaft 121, the first impeller 51, the second electric motor, the second rotary shaft, the second impeller 52, and the like are detached from the pump apparatus 16. The suction port 20 is provided in a suction flange 34. The suction flange 34 is to connect the pump casing 18 to a pipe. The discharge port 22 is provided in a discharge flange 36. The discharge flange 36 is to connect the pump casing 18 to a pipe.

[0034] As illustrated in Fig. 5, the pump casing 18 includes the first leg portion 38 provided in the suction branching portion 24, and the second leg portion 40 provided in the discharge merging portion 26. In the existing pump casing, no leg portion is provided in the suction branching portion 24 and the discharge merging portion 26. In the existing pump casing, the leg portions are provided in the first pump casing 181 and the second pump casing 182. The reason is because a bottom part of the first pump casing 181 and a bottom part of the second pump casing 182 are located at the lowest positions in the pump apparatus 16 as illustrated in Fig. 2.

[0035] It is expected that vibration and noise of the pump apparatus 16 are reduced by the first leg portion 38 and the second leg portion 40, for the following reasons. Even in a case where only one of the pump apparatuses operates in the twin pump, vibration is inevitably transferred to the other pump apparatus. Therefore, an installation condition for suppression of vibration and noise is more difficult in the twin pump than in the single pump. In the case of the single pump, it is sufficient to suppress vibration and noise of one pump apparatus. In the case of the twin pump, however, vibration and noise conditions are complicated because of influence of vibration and noise from the other pump apparatus. The suction branching portion 24 and the discharge merging portion 26 serve as generation sources of vibration and noise. When the first leg portion 38 and the second leg portion 40 are respectively added to the suction branching portion 24 and the discharge merging portion 26, it is possible to reduce vibration and noise of the pump apparatus 16 as compared with the existing pump apparatus.

[0036] At least one of the first leg portion 38 and the second leg portion 40 illustrated in Fig. 5 preferably includes a screw hole. In the present embodiment, the second leg portion 40 includes a screw hole 42. The screw hole 42 is used for various purposes. The screw hole 42 is used to install the pump apparatus 16. Further, the screw hole 42 is used when the pump casing 18 is placed on a processing tool and is upside down (pump casing 18 is hung down from processing tool) in manufacturing of the pump casing 18.

[0037] At least one of the first leg portion 38 and the second leg portion 40 preferably includes a base part. In the present embodiment, the second leg portion 40 includes a base part 44. The base part 44 may be a flange. The base part 44 is provided in order to increase stability of an attachment state of the pump apparatus 16 when the pump apparatus 16 is installed or in manufacturing of the pump casing 18.

[0038] A third leg portion is preferably provided in at least one of the first pump casing 181 and the second pump casing 182. In the present embodiment, as illustrated in Fig. 5, two leg portions 46 are provided in the first pump casing 181, and two leg portions 48 are provided in the second pump casing 182.

[0039] A fourth leg portion may be provided in at least one of the first discharge passage portion 221 and the second discharge passage portion 222. A fifth leg portion may be provided in at least one of the first suction passage portion 201 and the second suction passage portion 202.

[0040] Although the exemplary embodiments of the present invention are described above, the above-described embodiments of the present invention are to facilitate understanding of the present invention, and do not limit the present invention. Needless to say, the present invention can be modified and improved without departing from the spirit of the present invention, and includes equivalents thereof. Further, the components described in the claims and the specification can be optionally combined or omitted within a range where at least a part of the above-described issues is solved or within a range where at least a part of the effects is achieved.

16 Pump apparatus
18 Pump casing
20 Suction port
22 Discharge port
24 Suction branching portion
26 Discharge merging portion
28 On-off valve
34 Suction flange
36 Discharge flange
38 First leg portion
40 Second leg portion
42 Screw hole
44 Base part
46 Leg portion
48 Leg portion
51 First impeller
52 Second impeller
101 Electric motor
101 First electric motor
121 Rotary shaft
121 First rotary shaft
161 First pump apparatus

162 Second pump apparatus
181 Pump casing
181 First pump casing
182 Second pump casing
201 First suction passage portion
202 Second suction passage portion
221 First discharge passage portion
222 Second discharge passage portion

Claims

1. A pump casing used for a pump apparatus to transfer a liquid, the pump casing comprising:

a first pump casing;
a first suction passage portion connected to the first pump casing;
a first discharge passage portion connected to the first pump casing;
a second pump casing;
a second suction passage portion connected to the second pump casing;
a second discharge passage portion connected to the second pump casing;
a suction branching portion connected to the first suction passage portion and the second suction passage portion;
a discharge merging portion connected to the first discharge passage portion and the second discharge passage portion;
a first leg portion provided in the suction branching portion; and
a second leg portion provided in the discharge merging portion.

2. The pump casing according to claim 1, wherein at least one of the first leg portion and the second leg portion includes a screw hole.

3. The pump casing according to claim 1 or 2, wherein at least one of the first leg portion and the second leg portion includes a base part.

4. The pump casing according to any one of claims 1 to 3, further comprising a third leg portion provided in at least one of the first pump casing and the second pump casing.

5. The pump casing according to any one of claims 1 to 4, further comprising a fourth leg portion provided in at least one of the first discharge passage portion and the second discharge passage portion.

6. The pump casing according to any one of claims 1 to 5, further comprising a fifth leg portion provided in at least one of the first suction passage portion and the second suction passage portion.

7. A pump apparatus, comprising:

a first electric motor;
a first rotary shaft coupled to the first electric motor;
a first impeller fixed to the first rotary shaft and housed in the first pump casing;
a second electric motor;
a second rotary shaft coupled to the second electric motor;
a second impeller fixed to the second rotary shaft and housed in the second pump casing; and
the pump casing according to any one of claims 1 to 6.

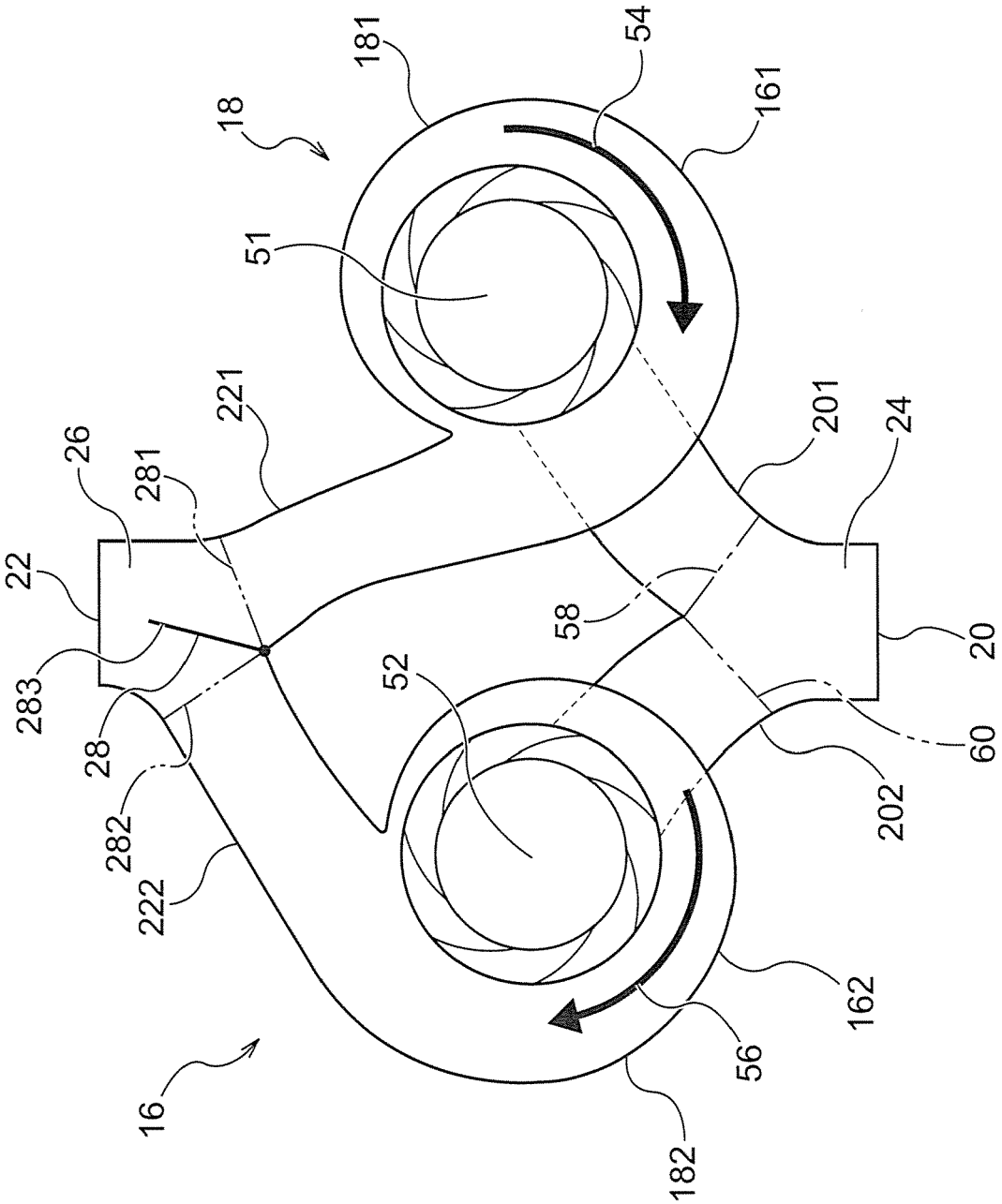
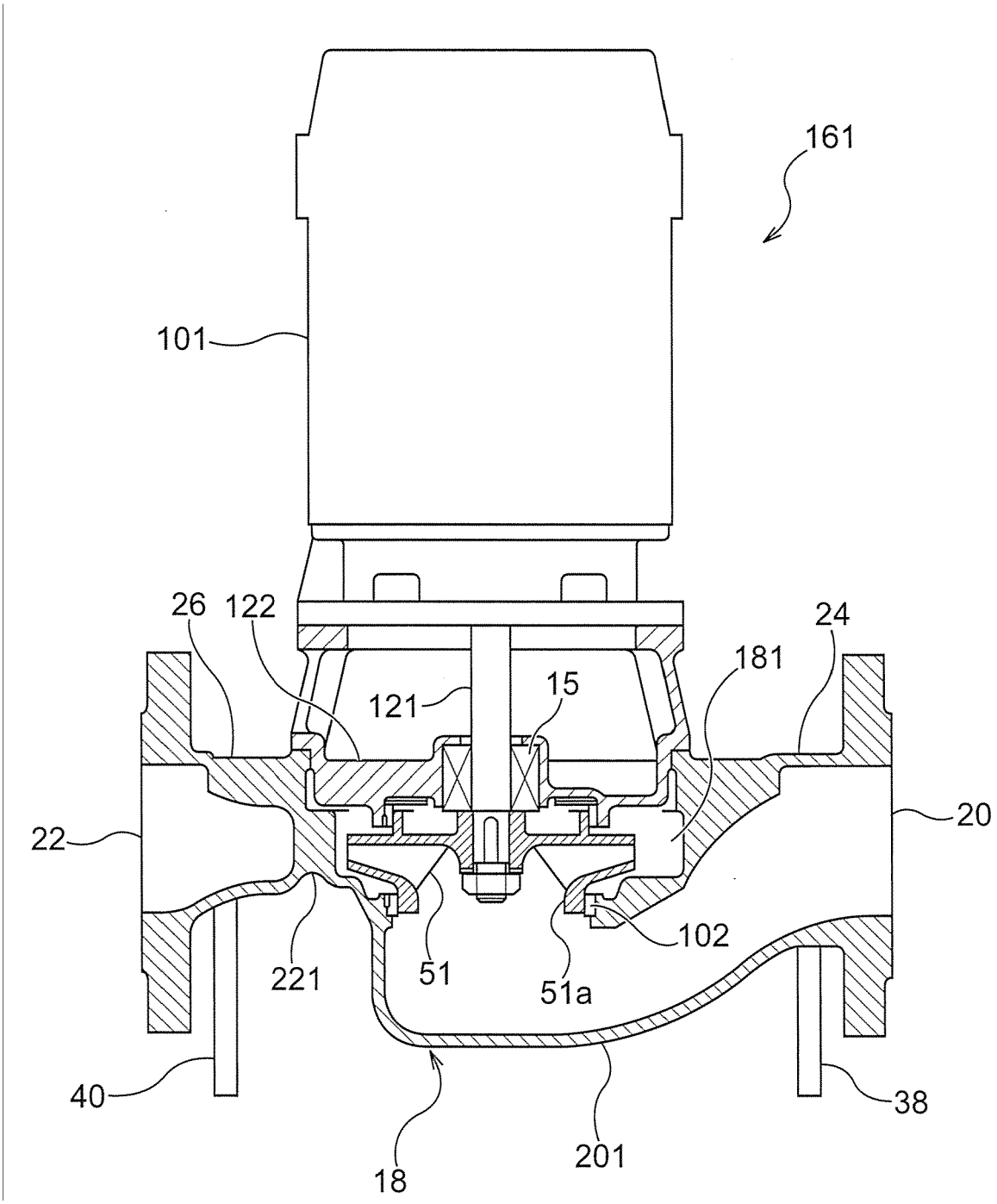

18
181
54
161
51
221
26
281
201
24
22
58
20
283
52
28
60
282
202
222
162
56
16
182

Fig. 1

Fig. 2



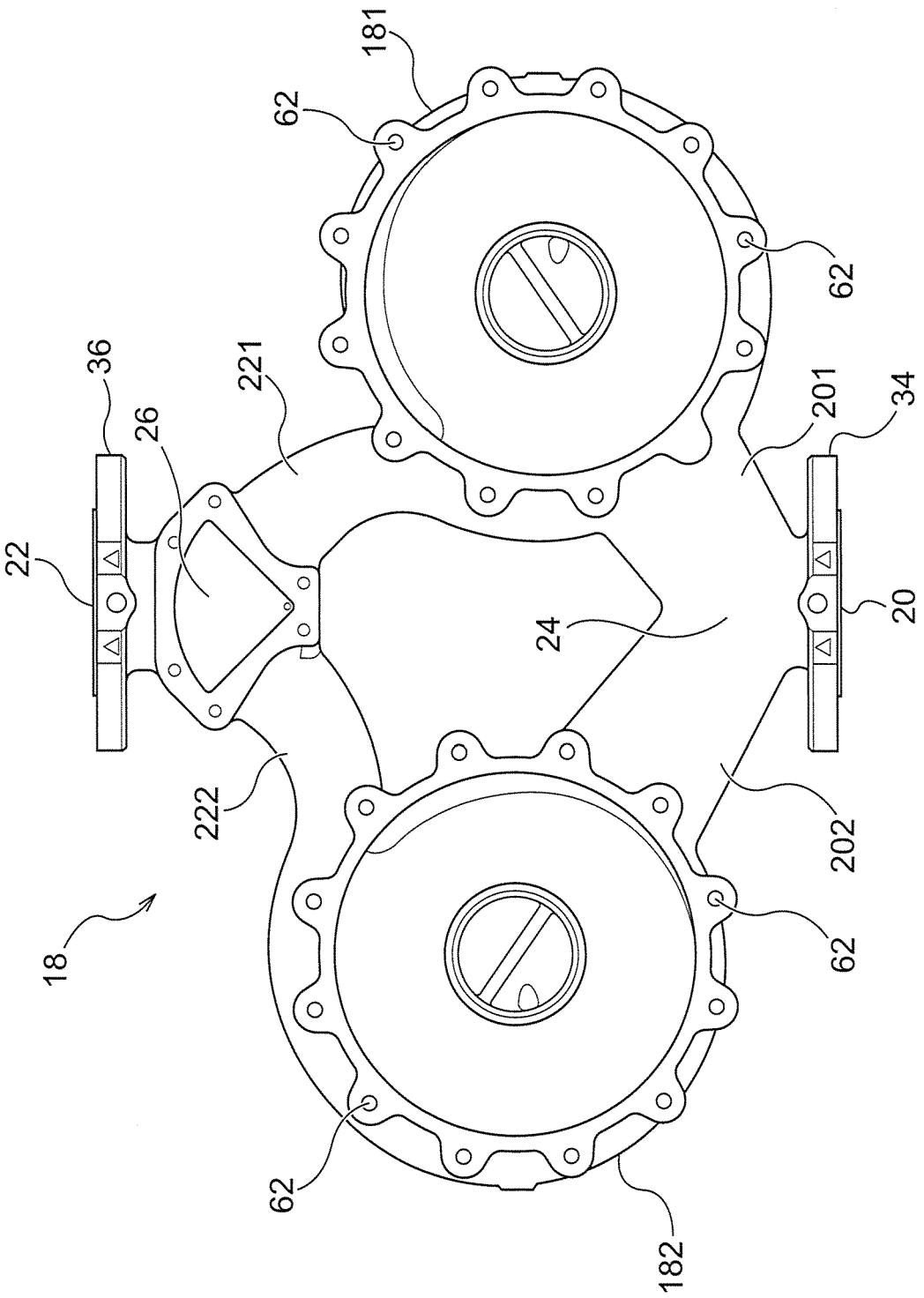


Fig. 3

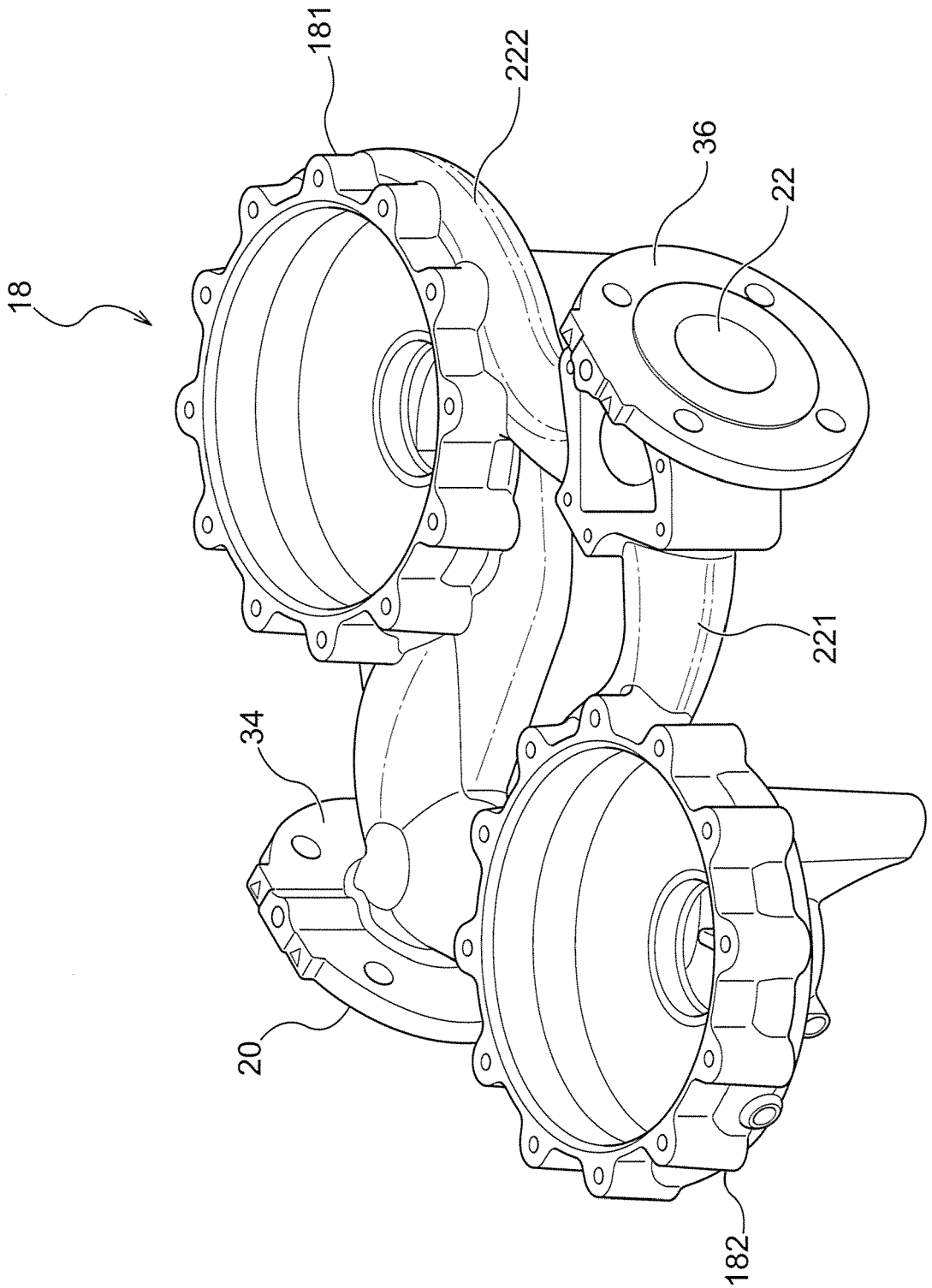


Fig. 4

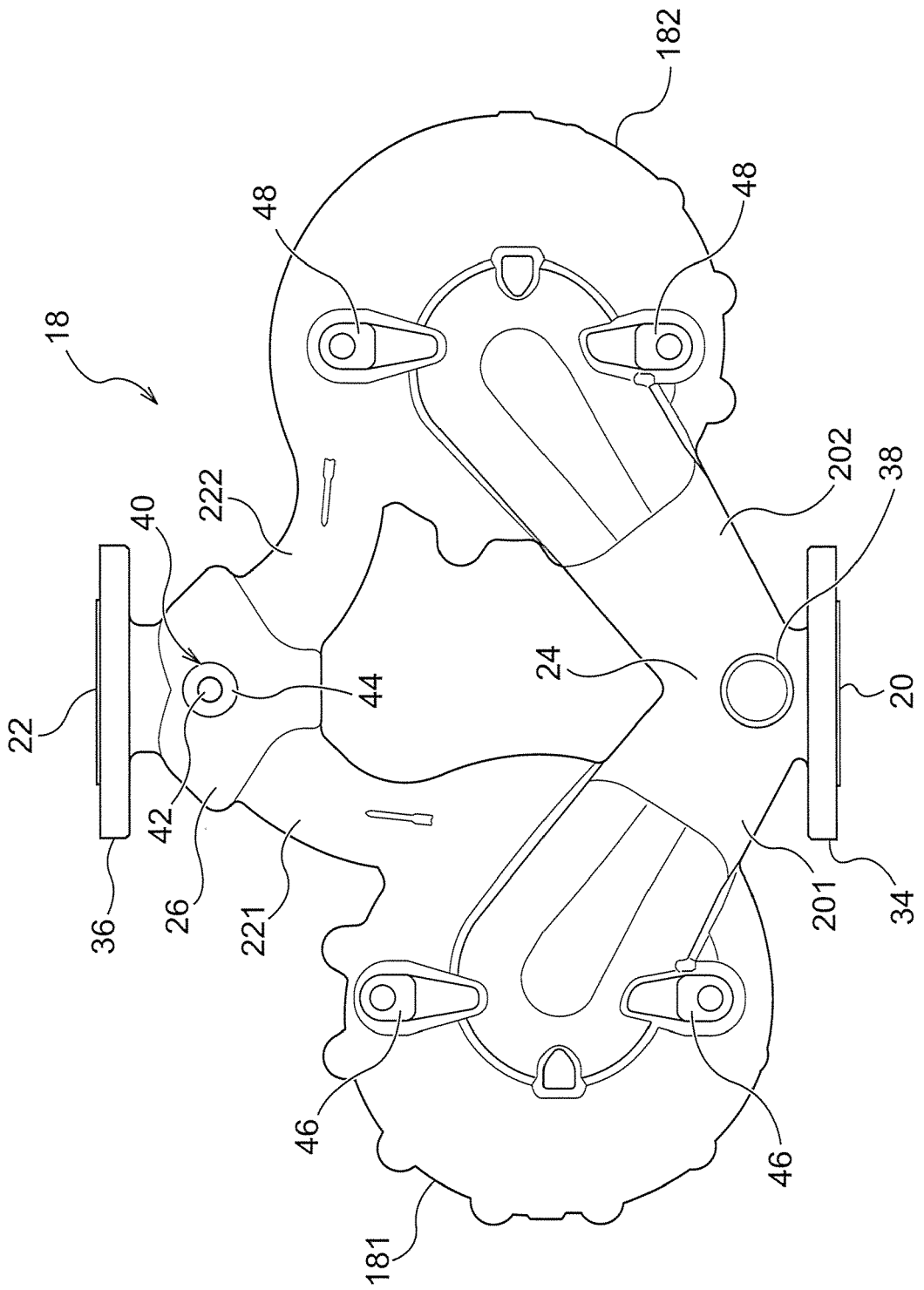


Fig. 5

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 22 17 7047

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 2019/063441 A1 (SCHLITTLER WILLIAM [US] ET AL) 28 February 2019 (2019-02-28)	1,7	INV.
Y	* figures 1-5 *	2-6	F04D13/14
	-----		F04D15/00
			F04D29/60
Y	WO 2019/244590 A1 (EBARA CORP [JP]) 26 December 2019 (2019-12-26)	2-6	
	* figures 1-8 *		

X	EP 3 171 036 A1 (ADWATEC OY [FI]) 24 May 2017 (2017-05-24)	1,7	
	* figures 1-5 *		

TECHNICAL FIELDS SEARCHED (IPC)
F04D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	25 October 2022	Morales Gonzalez, M

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

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 22 17 7047

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

25-10-2022

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2019063441 A1	28-02-2019	CA 3012651 A1	28-02-2019
		US 2019063441 A1	28-02-2019
WO 2019244590 A1	26-12-2019	CN 112292533 A	29-01-2021
		JP 2020002948 A	09-01-2020
		US 2021115940 A1	22-04-2021
		WO 2019244590 A1	26-12-2019
EP 3171036 A1	24-05-2017	EP 3171036 A1	24-05-2017
		US 2017150646 A1	25-05-2017

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

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

- WO 2018137019 A **[0008]**