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(71) Applicant: **LSK GRANIT KY** [FI/FI]; Halmetie 6 A4,
79100 LEPPÄVIRTA (FI).

(72) Inventor: **KIRJAVAINEN, Leo**; Halmetie 6 A4, 79100
LEPPÄVIRTA (FI).

(74) Agent: **KOIVISTO PATENTIT OY**; Finlaysoninkuja 9,
33210 Tampere (FI).

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(54) Title: FLUID PUMP

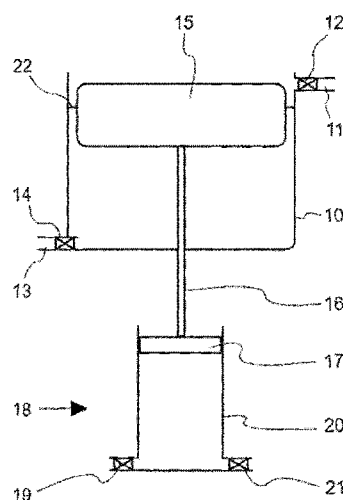


Fig. 1a

(57) Abstract: A fluid pump, comprising a flotation basin (10), a charging conduit (11) and a charging valve (12) for filling the flotation basin (10) with fluid; a discharge conduit (13) and a discharge valve (14) for emptying the flotation basin (10) of fluid; a float (15) which is arranged to float in the fluid of the flotation basin (10); a piston pump (18), wherein the piston (17) moves the fluid; a transfer means (16) which is connected to the float (15) for transferring the vertical movement of the float outside the flotation basin (10); and the transfer means (16) being connected to move the piston (17) of the piston pump (18) outside the flotation basin (10). The float (15) controls the charging valve (12) to close and the discharge valve (14) to open when the flotation basin (10) has filled up. The float (15) also controls the charging valve (12) to open and the discharge valve (14) to close when the flotation basin (10) has emptied out.



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FLUID PUMP

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OBJECT OF THE INVENTION

The invention relates to fluid transfer systems. Specifically, the object of the invention is a fluid pump which utilises the potential energy of a fluid storage.

10 BACKGROUND OF THE INVENTION

It is known to transfer fluid, for example water, by means of water wheels, pumps or other fluid transfer systems. Usually, the driving force of a fluid transfer system is generated by means of a device which uses external energy. Devices utilising the potential energy of water are usable in environments where
15 a natural reservoir also has a natural sluice. Many fluid transfer systems are complex and require regular maintenance.

Finnish utility model 2862 discloses a fluid transfer system which utilises the potential energy of water by running water into a vertically movable basin. Under the basin is a piston pump, on the piston of which is directed the weight
20 of the basin. As the basin fills with water, the weight of the basin brings about a downward movement of the piston under the basin and causes the water to move.

SUMMARY OF THE INVENTION

25 The aim of the invention is to eliminate, or at least alleviate, the above-mentioned disadvantages. The aim of the invention is especially to present a fluid pump which utilises the potential energy of a fluid.

The fluid pump according to the invention is characterised by what is disclosed in claim 1. The fluid pump comprises a flotation basin, a charging conduit and a charging valve for filling the flotation basin with fluid. The charging conduit may be connected, for example, to a water reservoir or basin, the surface of which is higher than the fluid pump. Examples of basins include lakes, rivers and rapids. A reservoir may be a fluid storage made for the purpose which stores potential energy. The fluid may be water or other fluid suitable for storing potential energy. The fluid pump comprises a discharge conduit and a discharge valve for emptying the flotation basin of fluid. The discharge conduit leads to a discharge basin with a fluid level lower than the flotation basin. The fluid pump further comprises a float which is arranged to float in the fluid in the flotation basin and a piston pump in which the piston moves the fluid. According to the invention, the pump comprises transfer means connected to the float for transferring the vertical movement of the float outside the flotation basin. The transfer means is connected to move the piston of the piston pump outside the flotation basin. In a filling flotation basin, the buoyant force exerted on the float lifts the transfer means upwards. In an emptying flotation basin, the weight of the float presses the transfer means downwards.

In one exemplified embodiment, the float comprises means for filling the float with fluid when the flotation basin is filled with fluid and means for emptying the float of fluid when the flotation basin is empty. The internal volume of the float can be utilised by varying either the buoyant force acting upwards or the weight acting downwards. When the float is empty, the controllable valve is closed, and the flotation basin is filled with water. In this state, the buoyant force of the float is at its highest.

In one exemplified embodiment, the transfer means is a vertical bar fixed to the float and arranged to reciprocate vertically with the float. In one exemplified embodiment, the transfer means is a bar leading upwards from the flotation basin and fixed to the float and arranged to move vertically with the float.

In one exemplified embodiment, the flotation basin comprises a lead-through for transferring the movement of the vertical bar below the flotation basin, and the vertical bar is connected to the piston of the piston pump.

5 In one exemplified embodiment, the float controls the charging valve to close and the discharge valve to open when the flotation basin has filled up. The float controls the charging valve to open and the discharge valve to close when the flotation basin has emptied.

10 The fluid pump can be implemented on a large scale. By means of the potential energy contained in the fluid, the fluid can be transferred higher than its starting level. With a suitable pipe or channel arrangement, the fluid pump is applicable, for example, to an irrigation system. The fluid pump can be used, for example, to implement a water reservoir located higher than the initial water level. The fluid pump can be implemented so as to be non-polluting, fully autonomous and almost completely maintenance-free.

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LIST OF FIGURES

The invention is described in greater detail in the following by means of embodiments, with reference to the accompanying drawing, in which

20 Figure 1a shows schematically an example of an embodiment of the fluid pump in the first state;

Figure 1b shows schematically an embodiment of the fluid pump in the second state;

Figure 2 shows schematically an example of an embodiment with alternative transfer means; and

25 Figure 3 shows schematically an example of an embodiment.

DETAILED DESCRIPTION OF THE INVENTION

Figure 1a shows schematically an embodiment of the fluid pump according to the invention, where the flotation basin 10 is filled up, and Figure 1b shows the same basin when the flotation basin 10 is empty. In the fluid pump, the flotation
5 basin 10 is arranged to operate between these two states.

The flotation basin 10 is positioned in such a way that fluid, for example water, can be conveyed into it from an external water storage through a charging conduit 11. The freely flowing water is regulated by a charging valve 12. When the charging valve is open, the flotation basin 10 fills with water. In one
10 example, the external water storage is a lake, river or similar natural water storage. The water level 22 of the flotation basin 10 is lower than the surface of the external water storage. The flotation basin 10 can be emptied through the discharge conduit 13. The discharge conduit 13 is lower than the surface of the external water storage. This can be implemented, for example, inland by means
15 of a sufficiently long water pipe system. The emptying of the flotation basin 10 can be regulated by means of a discharge valve 14. The operation of the charging valve 12 and the discharge valve 14 can be arranged to be automatic, for example, by connecting the valves to follow the movement of the float 15.

In one embodiment, the float 15 is designed to close and open the charging valve 12 and the discharge valve 14, for example, by covering and uncovering the valves in the manner known from two-stroke engines. The float 15 may control the charging valve 12 to close and the discharge valve 14 to open when the flotation basin 10 has filled up. Similarly, the float 15 may control the charging valve 12 to open and the discharge valve 14 to close when the
25 flotation basin 10 has emptied.

The float 15 is arranged to float in the fluid collected in the flotation basin 10, for example, water. The alternating emptying and filling of the flotation basin 10 generates a vertical movement of the surface of the water 22 which the float 15 follows. A transfer means 16 is connected to the float 15 for transferring the
30 vertical movement outside the flotation basin 10. In this example, the transfer

means 16 is a vertical bar; it may alternatively be a lever, chain or other mechanical structure which transmits the movement outside the flotation basin 10. The transfer means 16 may be supported by bearings. The flotation basin 10 may comprise a sealed lead-through for transmitting the movement of the vertical bar 16 under the flotation basin 10, whereupon the vertical bar 16 is connected to the piston 17 of the piston pump 18.

The transfer means 16 is connected to a piston pump 18, wherein the piston 17 moves the fluid. Various types of prior art piston pumps 18 can be connected to the fluid pump. In one example, the piston 17 moves vertically in a cylinder 20. The inlet valve 21 allows fluid to fill in the cylinder 20 while the piston 17 and the float 15 move upwards. The inlet valve 21 closes as the piston 17 and the float 15 move downwards, whereupon the discharge valve 13 opens. In one embodiment, the inlet valve 21 is a non-return valve.

The float 15 presses the piston 17 downwards with gravity. The combined mass of the float 15, transfer means 16 and piston 17 generates a pressure which can be calculated from the force acting downwards divided by the surface area of the piston 17 with respect to the cylinder 20. When the pressure exceeds the natural hydrostatic pressure of the fluid pumped by the piston pump 18, the fluid pump raises the fluid storage of the fluid higher. The float 15 is arranged to be sufficiently heavy for the mass of the float 15 to suffice to lift the fluid through the outlet valve 19 into the discharge conduit and further to utilisation. The mass of the float 15 generates pressure in the discharge conduit through to the outlet valve 19. Similarly, the buoyant force of the float 15 suffices to lift the piston 17 in the cylinder 20. The flotation basin 10 and the float 15 can be dimensioned in such a way that the pressure from the outlet valve 19 through to the discharge conduit rises to a usable level, sufficiently high compared to the difference in height between the charging conduit 11 and discharge conduit 13 of the fluid or water storage utilised in the arrangement.

In one embodiment, the rising piston generates an underpressure in the cylinder 20, which opens the inlet valve 21. In one embodiment, pressure in the charging conduit opens the inlet valve 21 when the piston 17 rises upwards. In one

embodiment, the charging conduit of the inlet valve 21 is connected to the same fluid storage as the charging conduit 11 of the flotation basin 10. In one embodiment, the fluid pump is used to transfer a different fluid by utilising the potential energy of the fluid storage connected to the charging conduit, for example, pumping oil by means of the flow of lake water.

Figure 2 shows schematically an example of an embodiment, wherein the transfer means 16 is implemented in an alternative manner. In this example, the transfer means is provided as a bar which transfers the vertical movement of the float 15 to the piston 17 from above with respect to the flotation basin 10. In this example, no lead-through is formed in the flotation basin for the transfer means 16. The transfer means 16 may be a vertical bar or other structure. The piston pump 18 may be positioned above the flotation basin 10, whereupon, for example, the underpressure generated in the cylinder 20 sucks the fluid through the inlet valve 21 into the piston pump 18.

Figure 3 shows schematically an example of an embodiment, wherein the float 15 comprises means 31 for filling the float 15 with fluid when the flotation basin 10 is filled with fluid and means 31 for emptying the float 15 of fluid when the flotation basin 10 is empty. The Figure only shows the flotation basin 10 part of the fluid pump. The inner volume of the float 15 can be utilised by varying either the upwards acting buoyant force or the downwards acting weight. The means 31 for filling and/or emptying the float 15 include, for example, a controllable valve. When the flotation basin 10 is filled up, the controllable valve 31 is opened and the float 15 is allowed to sink, while being at least partly filled with fluid, downwards in the flotation basin 10, in some embodiments to the bottom of the flotation basin 10. When the float 15 has filled sufficiently with fluid, the controllable valve 31 is closed and the discharge valve 14 is opened. Thus, the total mass of the float 15 in the empty flotation basin 10 includes the fluid inside it and the force pressing the piston 17 is greater. When the piston 17 is in its extreme position, the float 15 is at the bottom of the flotation basin 10 and the flotation basin 10 is empty, the controllable valve 31 is opened and the fluid is allowed to flow out of the float 15.

The invention is not limited merely to the foregoing embodiments, but various modifications are possible within the scope of the inventive idea defined in the claims.

CLAIMS

1. A fluid pump, comprising:
a flotation basin (10);
a charging conduit (11) and a charging valve (12) for filling the flotation
basin (10) with fluid;
a discharge conduit (13) and a discharge valve (14) for emptying the
flotation basin (10) of fluid;
a float (15) which is arranged to float in the fluid of the flotation basin
(10);
a piston pump (18), wherein the piston (17) moves the fluid;
a transfer means (16) which is connected to the float (15) for transferring
the vertical movement of the float outside the flotation basin (10); and
the transfer means (16) being connected to move the piston (17) of the
piston pump (18) outside the flotation basin (10),
characterised in that the float (15) controls the charging valve (12) to
close and the discharge valve (14) to open when the flotation basin (10)
has filled up; and
the float (15) controls the charging valve (12) to open and the discharge
valve (14) to close when the flotation basin (10) has emptied out.
2. A fluid pump according to claim 1, **characterised in that** the float (15)
comprises means for filling the float (15) with fluid when the flotation
basin (10) is filled with fluid and means for emptying the float (15) of fluid
when the flotation basin (10) is empty.
3. A fluid pump according to claim 1 or claim 2, **characterised in that** the
transfer means (16) is a vertical bar which is fixed to the float (15) and
arranged to move vertically with the float (15).
4. A fluid pump according to claim 3, **characterised in that** the flotation
basin (10) comprises a lead-through for transmitting the movement of the

vertical bar under the flotation basin (10), and the vertical bar is connected to the piston (17) of the piston pump (18).

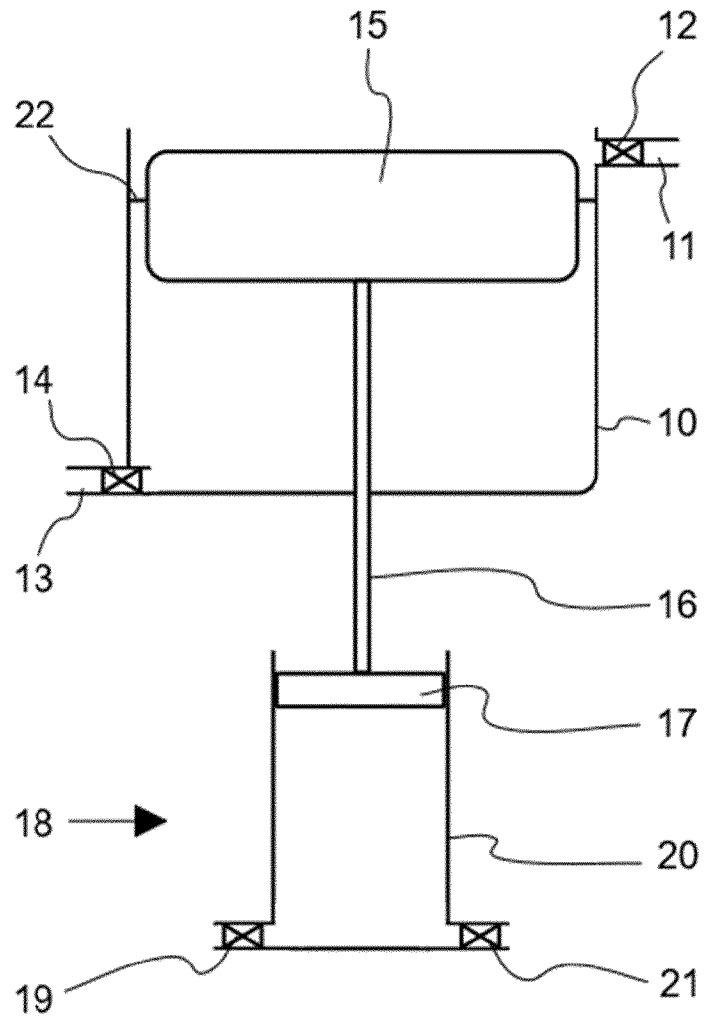


Fig. 1a

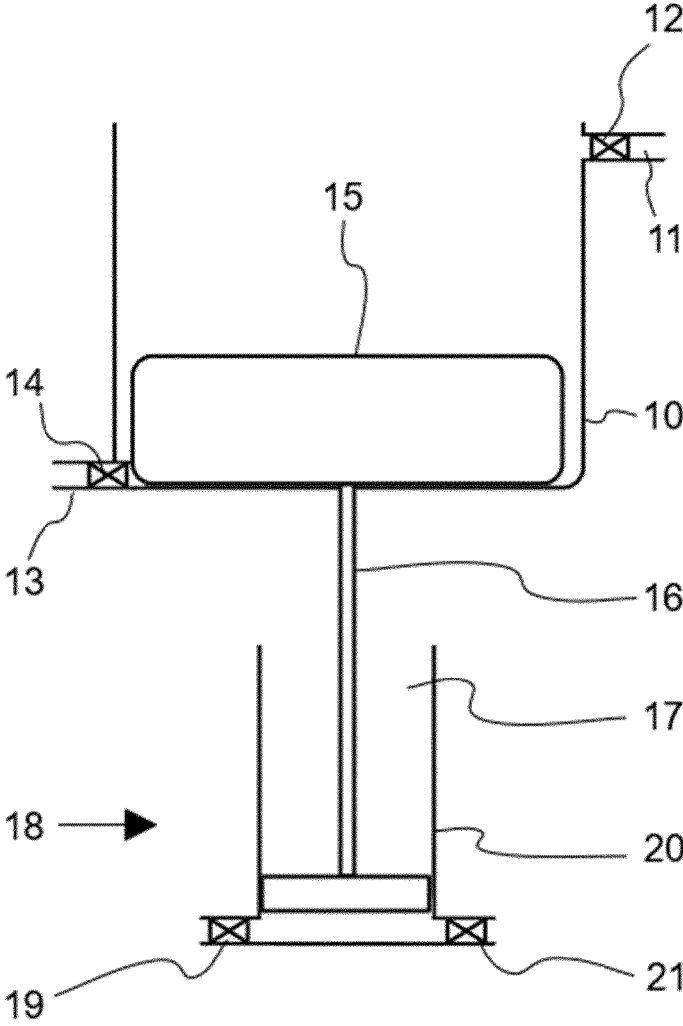


Fig. 1b

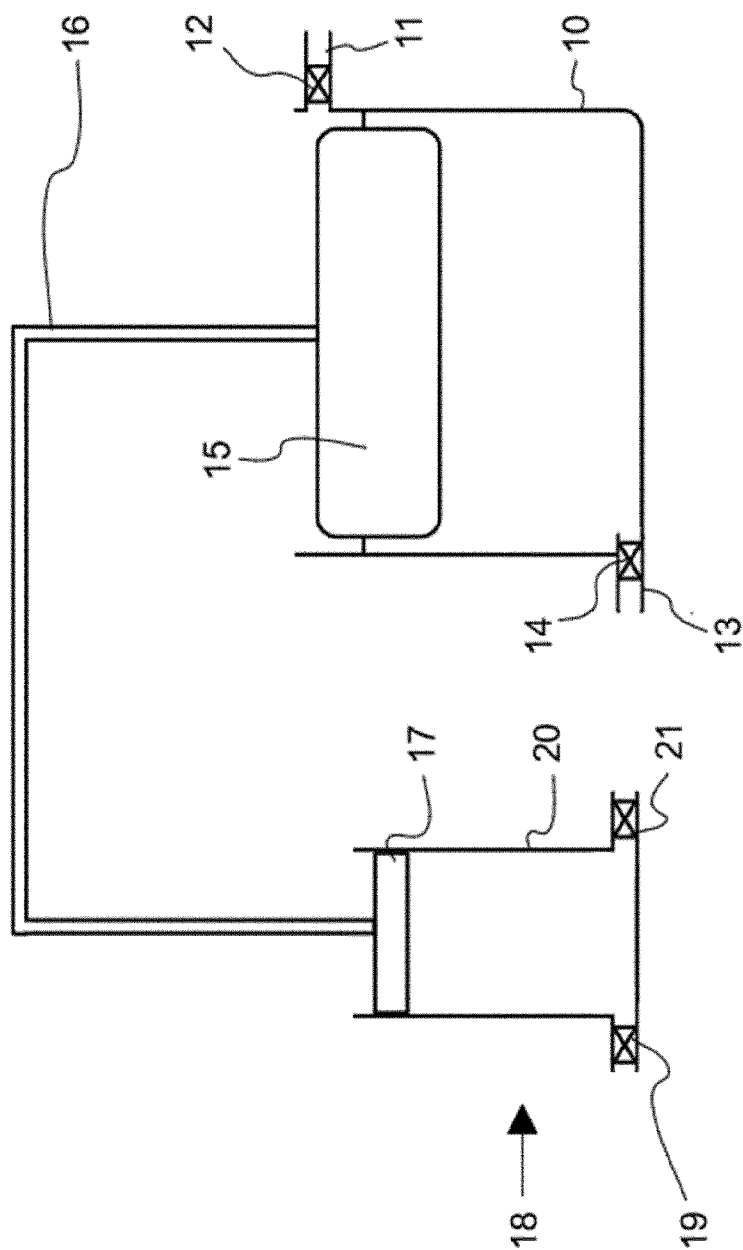


Fig. 2

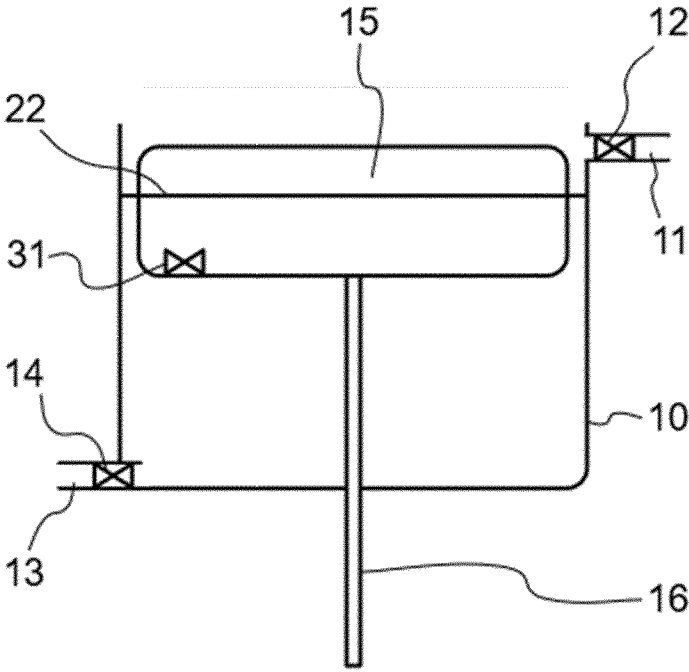


Fig. 3

INTERNATIONAL SEARCH REPORT

International application No.

PCT/FI2019/050655

A. CLASSIFICATION OF SUBJECT MATTER

See extra sheet

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)

IPC: F04B, F03B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
FI, SE, NO, DK

Electronic data base consulted during the international search (name of data base, and, where practicable, search terms used)

EPODOC, EPO-Internal full-text databases, Full-text translation databases from Asian languages, WPIAP

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4739182 A (KENDERI TIBOR [HU]) 19 April 1988 (19.04.1988) abstract; column 2, lines 28-54; column 3, lines 38-52; figure 1	1, 3, 4
X	JP 2014190302 A (SUKEHARA KUNIFUMI) 06 October 2014 (06.10.2014) figures 10-15 and 17 & abstract [online] EPOQUENET EPODOC & WPI & machine translation into English by ThomsonReuters [online] EPOQUENET TXPJPEA paragraph [0029]	1, 3, 4
Y		2
Y	US 4207741 A (RAINEY DON E [US]) 17 June 1980 (17.06.1980) abstract, figures 1-4	2
A	FR 2162787 A5 (ROMAN JEAN) 20 July 1973 (20.07.1973) page 1, line 30 – page 2, line 13; page 2, line 22 – page 3, line 6; and figure 1	1-4

☐ Further documents are listed in the continuation of Box C.
 ☒ See patent family annex.

* Special categories of cited documents:	"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
"A" document defining the general state of the art which is not considered to be of particular relevance	"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
"D" document cited by the applicant in the international application	"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
"E" earlier application or patent but published on or after the international filing date	"&" document member of the same patent family
"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	

Date of the actual completion of the international search 03 December 2019 (03.12.2019)	Date of mailing of the international search report 13 December 2019 (13.12.2019)
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INTERNATIONAL SEARCH REPORT

International application No.

PCT/FI2019/050655

CLASSIFICATION OF SUBJECT MATTER

IPC

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INTERNATIONAL SEARCH REPORT
Information on Patent Family Members

International application No.
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