



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
12.06.2019 Bulletin 2019/24

(51) Int Cl.:
D06F 39/08 (2006.01)

(21) Application number: **17206526.0**

(22) Date of filing: **11.12.2017**

(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:
MA MD TN

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(54) **PUMP FOR A WASHING MACHINE, WASHING MACHINE AND METHOD**

(57) There is disclosed a pump (226) for a washing machine. The pump (226) comprises a water inlet (228) and a water outlet (229). The pump (226) further comprises a sensor (240). A movable element (242) is con-

structed and arranged to be actuated when the sensor indicates a blocked material (250) in the pump. Actuation of the movable element (242) is configured to create a vacuum for dislodging the blocked material (250).

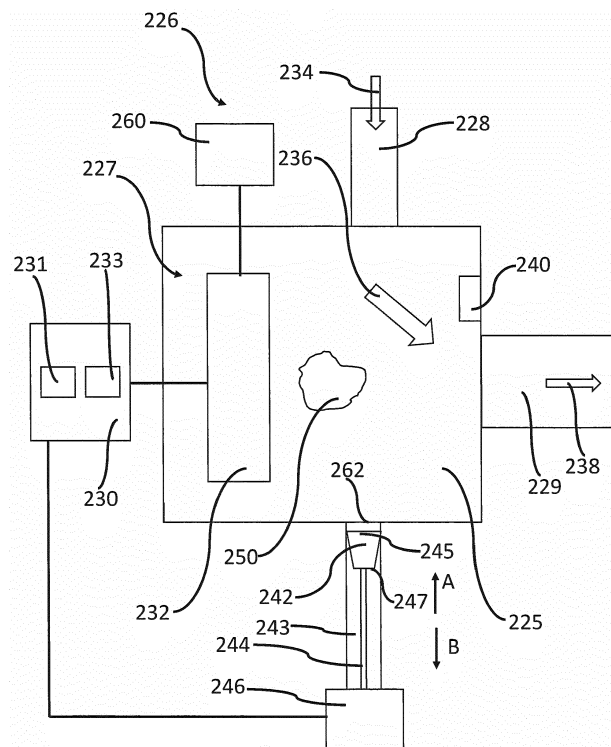


Fig. 2

Description

Technical Field

[0001] The present disclosure relates to a pump for a washing machine. The present disclosure also relates to a washing machine comprising such a pump. The present disclosure also relates to a method of controlling such a pump.

Background

[0002] Washing machines are used for washing washable items, including garments such as clothes. Typically a washing machine comprises a water pump that is used for draining waste water from a drum of the washing machine.

Summary

[0003] According to a first aspect disclosed herein, there is provided a pump for a washing machine comprising: a water inlet and a water outlet; a sensor; and a movable element constructed and arranged to be actuated when the sensor indicates a blocked material in the pump, actuation of the movable element configured to create a vacuum for dislodging the blocked material.

[0004] According to an example, the movable element is connected to a motor, driving of the motor configured to cause a reciprocating movement of the movable element.

[0005] According to an example, the motor being selectively drivable in a first direction and a second direction opposite to the first direction, so as to provide the reciprocating movement of the movable element.

[0006] According to an example, the movable element connected to the motor via one or more cams, the one or more cams constructed and arranged to cause the reciprocating movement of the movable element when the motor is driven.

[0007] According to an example, the movable element located in a channel, the channel in fluid communication with an interior of the pump.

[0008] According to an example, the movable element is cone shaped.

[0009] According to an example, the pump comprises a pumping mechanism for drawing water from a drum of the washing machine to the pump, the pumping mechanism arranged to be de-activated when the movable element is actuated.

[0010] According to an example, the sensor comprises a flow meter.

[0011] According to an example, the pump is configured to actuate the movable element when a water flow rate in the pump falls below a threshold value.

[0012] According to a second aspect there is provided a washing machine comprising a pump according to any of the first aspects.

[0013] According to a third aspect, there is provided a method of operating a pump of a washing machine, comprising: in response to receiving a signal from a sensor in the pump indicative of a blocked material in the pump, causing actuation of a movable element so as to create a vacuum for dislodging the blocked material.

[0014] According to an example, the method comprises causing a motor to be driven so as to cause the actuation of the movable element.

[0015] According to an example, the method comprises causing the actuation of the movable element in response to determining that a water flow rate in the pump has fallen below a threshold value.

[0016] According to an example, the method comprises de-activating a pumping mechanism of the pump when the movable element is actuated.

[0017] According to an example, the method comprises re-activating the pump when a water flow rate in the pump rises above a threshold value.

Brief Description of the Drawings

[0018] To assist understanding of the present disclosure and to show how embodiments may be put into effect, reference is made by way of example to the accompanying drawings in which:

Figure 1 shows schematically a washing machine according to an example.

Figure 2 shows schematically a pump for a washing machine, according to an example.

Figure 3 shows schematically a flow chart of a method according to an example.

Detailed Description

[0019] Washing machines typically comprise a rotatable drum for rotating items (e.g. garments or clothes) placed in the drum. Typically a washing machine comprises a pump that is used for draining water from the drum. This water may be waste water, e.g. water that has been used in the drum when washing the items. The waste water may comprise materials or debris from the items being washed e.g. fabric, lint, foodstuffs etc. Sometimes, this material can block the drain pump. In such a situation the washing machine cannot drain the waste water, and the machine may cease working at least until the pump has been cleaned and/or serviced. Accordingly the pump may need to be cleaned periodically in order for the washing machine to properly function.

[0020] Figure 1 schematically shows a washing machine 102 according to an example. The washing machine 102 comprises a main body portion 104 and a drum 106 which is arranged to hold one or more garments or items of a washing load to be washed and/or dried. Washing detergent and/or fabric softener may also be placed

directly in to the drum 106. Alternatively washing detergent and/or fabric softener may be placed in to a tray or dispenser 112 arranged for this purpose. In this example a dispenser 112 is arranged to hold washing detergent, and a dispenser 114 is arranged to hold fabric softener. A user interface 108 is provided which enables a user to select one or more washing and/or drying parameters and/or settings e.g. duration, temperature etc. A display 110 is also provided which outputs information to a user of the washing machine. For example information displayed on the display 110 may be information regarding options selected via user interface 108, and/or information regarding a washing cycle in progress such as time remaining etc. The washing machine 102 also comprises a controller shown schematically at 130. The controller 130 comprises a memory and a processor. The controller 130 is configured and arranged for controlling operations of the washing machine 102.

[0021] The washing machine 102 also comprises a suitable power connection shown schematically at 120, enabling the washing machine 102 to be connected to an electricity supply such as mains electricity. The washing machine 102 also comprises a suitable water inlet shown schematically at 122, and a suitable water outlet shown schematically at 124. The water inlet 122 and water outlet 124 may for example enable connection to a mains water supply.

[0022] The washing machine 102 also comprises a drain pump, shown schematically at 126, for draining water from the drum 106.

[0023] Figure 2 shows a pump 226 (e.g. a drain pump) of a washing machine in more detail (e.g. equivalent to drain pump of 126 in Figure 1). The pump 226 comprises a main body portion 227. The pump 226 comprises an inlet 228 and an outlet 229. Water is schematically shown at 234 flowing in to inlet 228, and water is schematically shown at 238 flowing out of outlet 229. For example water may flow to inlet 228 from a drum of the washing machine. Water may flow from outlet 229 of the pump to a main outlet of the washing machine (e.g. the outlet 124 in Figure 1). The water pump 226 comprises an interior 225 defining a water flow path between the inlet 228 and outlet 229. Water is schematically shown at 236 flowing in the flow path.

[0024] A pumping unit or pumping mechanism is schematically shown at 232. In operation the pumping mechanism 232 causes water to be drawn from the drum of the machine to the inlet 228 of the pump 226, and then out of the outlet 229. The pumping mechanism 232 may comprise, for example, an impeller. In this example the pumping mechanism 232 is driven by a motor 260.

[0025] As explained above, material (e.g. lint) may become blocked or stuck in the pump 226. This may reduce the effectiveness of the pump or cause the pump to malfunction. In the example of Figure 2 blocked material is schematically shown at 250. The material 250 may for example become stuck to pumping mechanism 232, or stuck to another surface or component in the pump (e.g.

a filter), or stuck in the inlet 228 or outlet 229. The blocked material 250 may reduce the flow rate of water through the pump 226, and may even completely block the flow of water.

[0026] A sensor is schematically shown at 240. The sensor 240 is constructed and arranged to determine when there is blocked material in the pump 226. In one example the sensor 240 is configured to monitor a flow rate of water in the pump 226. The sensor 240 may therefore in some examples be a flow meter. In another example the sensor 240 may be an optical sensor or camera configured to detect blocked material.

[0027] A controller is schematically shown at 230. The controller 230 comprises a memory 231 and a processor 233. The controller 230 may comprise a microcontroller unit (MCU). The controller 230 may, in some examples, control only operations of the pump 226. In other words in some examples the controller 230 is comprised in pump 226. In an alternative example the controller 230 may be part of the washing machine, and also control other operations of the washing machine. For example controller 230 may be equivalent to controller 130 of Figure 1. In some examples control of pump 226 is distributed between a controller in the pump and a main controller of the washing machine.

[0028] A movable element is schematically shown at 242. The movable element 242 is housed in a channel 243. The channel 243 is in fluid communication with interior 225 of pump 226. The movable element 242 is connected to motor 246 via connection or linkage 244. In some examples the connection 244 is connected to a gear or gear train of the motor 246. The connection 244 is constructed and arranged to convert rotational movement of motor 246 in to linear movement of movable element 242. In examples this enables the movable element 242 to reciprocate back and forth in channel 243 i. e. in the directions of arrows A and B. In one example the reciprocation is caused by selectively driving the motor 246 in forward and reverse directions. In another example the reciprocation is enabled by a mechanical arrangement e.g. one or more cams.

[0029] In the example of Figure 2 a longitudinal axis of channel 243 is substantially perpendicular to a longitudinal axis of outlet 229. In the example of Figure 2 the channel 242 is located adjacent to, and in fluid communication with but separate from interior 225 of pump 226. Therefore in some examples the movable element does not enter the interior 225, even when at a full extent of its reciprocation in the direction of arrow A. Therefore there may be considered to be a boundary 262 between the channel 243 and the interior 225 of the pump 226, the movable element arranged so that it does not cross the boundary 262. As discussed above the channel 243 is in fluid communication with the interior 225, and therefore this boundary 262 may be considered a non-physical or notional boundary. Accordingly, in normal operation of the pump 226 when there is no blockage, the movable element does not interfere with or restrict flow of water

in the interior of the pump 226.

[0030] In the example of Figure 2 the movable element is cone shaped or comprises a truncated cone. In the example of Figure 2 the cone shaped movable element 242 comprises a long edge or base 245, and a short edge or apex 247. The base or long edge 245 faces the interior 225 of the pump 226. The apex or short edge 247 is connected to the connection 244. According to some examples a periphery of the base 245 of the movable element 242 is a tight fit in the channel 243. In some examples the movable element 242 comprises an airtight and/or watertight seal against an inner surface of the channel 243. In some examples the movable element 242 comprises a seal or gasket to provide the airtight and/or watertight seal.

[0031] The controller 230 is in communication with sensor 240 and motor 246. By receiving information from sensor 240 (e.g. information of flow rate), then the controller 230 can determine when there is blocked material in the pump 226. For example, it may be determined that there is a blockage in the pump 226 when the flow rate falls below a threshold level or value.

[0032] In response to determining a blockage in the pump 226, the controller activates the motor 246 so as to actuate the movable element 242. As the movable element 242 is reciprocated back and forth in the channel 243, when moving in direction A the pressure in interior 225 increases, and when moving in direction B the pressure in interior 225 decreases. This causes a vacuum to be formed in the channel 243 and/or interior 225 of pump 226. To this end the movable element 242 may be considered part of a vacuum pump. The created vacuum has an effect of attracting the stuck or blocked material 250 so as to dislodge it from where it is stuck. The dislodged material may then pass out of the outlet 229 and away to mains drainage. In some examples, once the material 250 has been dislodged then the flow rate in the pump will increase. In response to detecting the increased flow rate (e.g. detecting that the flow rate is above a threshold value) then actuation of the movable element 242 can be stopped or de-activated, for example by switching off motor 246 or placing the motor 246 in an idle state.

[0033] In some examples the motor 260 which drives the pumping mechanism 232 may be considered a first motor, and the motor 246 which drives the movable element 242 may be considered a second motor.

[0034] Figure 3 schematically shows a method according to an example, which is described in conjunction with Figure 2.

[0035] At S1, the process starts.

[0036] At S2, a determination is made by controller 230 as to whether the pump 226 is blocked. This determination may be made continuously or periodically. This determination may be made by using information from sensor 240. For example where the sensor 240 is a flow-meter, it may be determined that the pump is blocked when the flow rate falls below a threshold value. If the determination at S2 is "No", then the process loops back

to S1.

[0037] If the determination at S2 is "Yes", then the process proceeds to S3 where the first motor, i.e. motor 260 driving the pumping mechanism 232, is stopped or placed in an idle state. The controller 230 may cause this de-activation of the motor 260.

[0038] Then, at S4, the second motor, i.e. motor 246 driving the movable element 242, is started or activated, so as to begin reciprocation of movable element 242. The controller 230 may cause this activation of the motor 260.

[0039] In some examples S4 occurs before S3. In some examples S3 and S4 may take place simultaneously.

[0040] At S5 it is determined by the controller 230 whether the pump is blocked. In other words it is determined whether actuation of the movable element 242 has caused dislodging of the blocked material. Again, this determination may be made using information from sensor 240. For example where the sensor 240 is a flow-meter, it may be determined that the pump 226 is blocked when the flow rate falls below a threshold value.

[0041] There may be a predetermined delay between S4 and S5 e.g. 30 seconds. Step S5 may occur periodically (e.g. every 30 seconds), or continuously.

[0042] If it is determined that the pump 226 is still blocked, i.e. the determination at S5 is "yes", then the process proceeds to S6 where operation of the second motor 246 is continued (and the first motor 260 remains in an idle or stopped state).

[0043] When it is determined by the controller 230 that the pump 226 is no longer blocked, then the process proceeds to S7. Determining that the pump is no longer blocked may be in response to the controller 230 receiving an appropriate signal from the sensor 240. For example where the sensor 240 is a flow-meter, it may be determined that the pump 226 is not blocked when the flow rate is at or above a threshold value. At S7, the second motor 246 controlling the movable element 242 is stopped or placed in an idle state, so as to stop movement of movable element 242.

[0044] Then, at S8, the first motor 260 is started or moved from an idle state to an active state, so as to re-start operation of the pumping mechanism 232.

[0045] In some example S8 occurs before S7. In some examples S7 and S8 occur simultaneously.

[0046] In some examples all of the features shown in Figure 2 (apart from material 250) are provided as part of a self-contained pump assembly. This allows a pump assembly (e.g. as shown in Figure 2) to be quickly and easily fitted and/or retrofitted to a washing machine.

[0047] It will be understood that the processor or processing system or circuitry referred to herein may in practice be provided by a single chip or integrated circuit or plural chips or integrated circuits, optionally provided as a chipset, an application-specific integrated circuit (ASIC), field-programmable gate array (FPGA), digital signal processor (DSP), graphics processing units

(GPUs), etc. The chip or chips may comprise circuitry (as well as possibly firmware) for embodying at least one or more of a data processor or processors, a digital signal processor or processors, baseband circuitry and radio frequency circuitry, which are configurable so as to operate in accordance with the exemplary embodiments. In this regard, the exemplary embodiments may be implemented at least in part by computer software stored in (non-transitory) memory and executable by the processor, or by hardware, or by a combination of tangibly stored software and hardware (and tangibly stored firmware).

[0048] Reference is made herein to data storage for storing data, such as memory. This may be provided by a single device or by plural devices. Suitable devices include for example a hard disk and non-volatile semiconductor memory.

[0049] Although at least some aspects of the embodiments described herein with reference to the drawings comprise computer processes performed in processing systems or processors, the invention also extends to computer programs, particularly computer programs on or in a carrier, adapted for putting the invention into practice. The program may be in the form of non-transitory source code, object code, a code intermediate source and object code such as in partially compiled form, or in any other non-transitory form suitable for use in the implementation of processes according to the invention. The carrier may be any entity or device capable of carrying the program. For example, the carrier may comprise a storage medium, such as a solid-state drive (SSD) or other semiconductor-based RAM; a ROM, for example a CD ROM or a semiconductor ROM; a magnetic recording medium, for example a floppy disk or hard disk; optical memory devices in general; etc.

[0050] The examples described herein are to be understood as illustrative examples of embodiments of the invention. Further embodiments and examples are envisaged. Any feature described in relation to any one example or embodiment may be used alone or in combination with other features. In addition, any feature described in relation to any one example or embodiment may also be used in combination with one or more features of any other of the examples or embodiments, or any combination of any other of the examples or embodiments. Furthermore, equivalents and modifications not described herein may also be employed within the scope of the invention, which is defined in the claims.

Claims

1. A pump for a washing machine comprising:

a water inlet and a water outlet;
a sensor; and
a movable element constructed and arranged to be actuated when the sensor indicates a

blocked material in the pump, actuation of the movable element configured to create a vacuum for dislodging the blocked material.

2. A pump according to claim 1, the movable element connected to a motor, driving of the motor configured to cause a reciprocating movement of the movable element.

3. A pump according to claim 2, the motor being selectively drivable in a first direction and a second direction opposite to the first direction, so as to provide the reciprocating movement of the movable element.

4. A pump according to claim 2, the movable element connected to the motor via one or more cams, the one or more cams constructed and arranged to cause the reciprocating movement of the movable element when the motor is driven.

5. A pump according to any of claims 1 to 4, the movable element located in a channel, the channel in fluid communication with an interior of the pump.

6. A pump according to any of claims 1 to 5, wherein the movable element is cone shaped.

7. A pump according to any of claims 1 to 6, the pump comprising a pumping mechanism for drawing water from a drum of the washing machine to the pump, the pumping mechanism arranged to be de-activated when the movable element is actuated.

8. A pump according to any of claims 1 to 7, the sensor comprising a flow meter.

9. A pump according to claim 8, the pump configured to actuate the movable element when a water flow rate in the pump falls below a threshold value.

10. A washing machine comprising a pump according to any of claims 1 to 9.

11. A method of operating a pump of a washing machine, comprising:

in response to receiving a signal from a sensor in the pump indicative of a blocked material in the pump, causing actuation of a movable element so as to create a vacuum for dislodging the blocked material.

12. A method according to claim 11, comprising causing a motor to be driven so as to cause the actuation of the movable element.

13. A method according to claim 11 or claim 12, comprising causing the actuation of the movable element

in response to determining that a water flow rate in the pump has fallen below a threshold value.

14. A method according to any of claims 11 to 13, comprising de-activating a pumping mechanism of the pump when the movable element is actuated. 5
15. A method according to claim 14, comprising re-activating the pump when a water flow rate in the pump rises above a threshold value. 10

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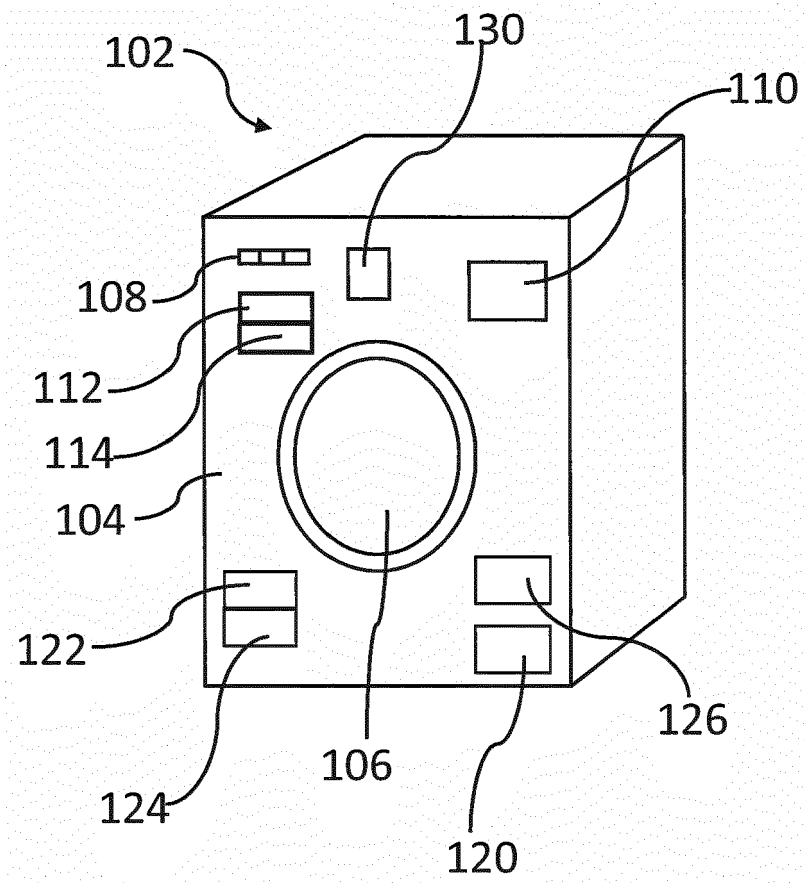


Fig. 1

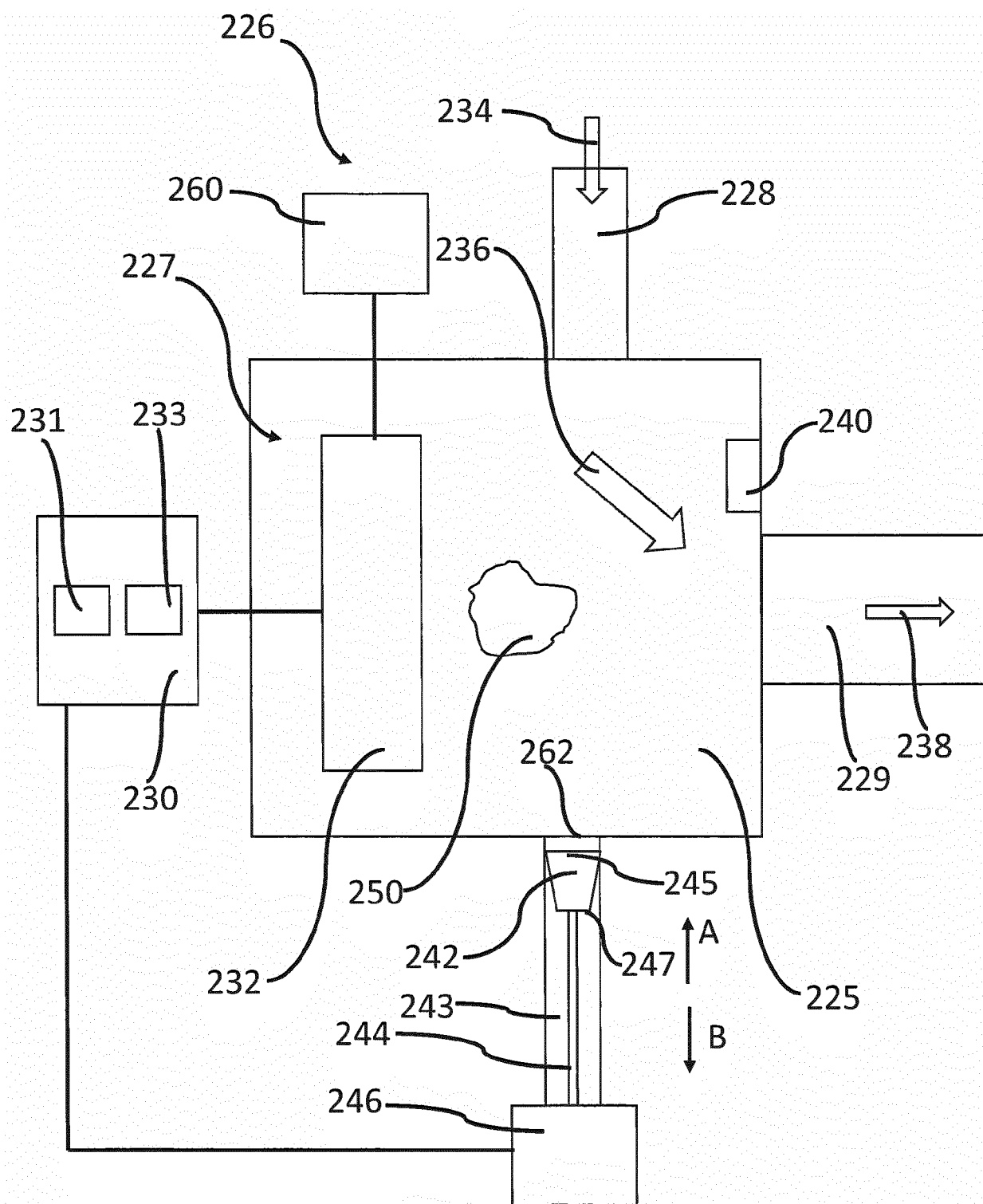


Fig. 2

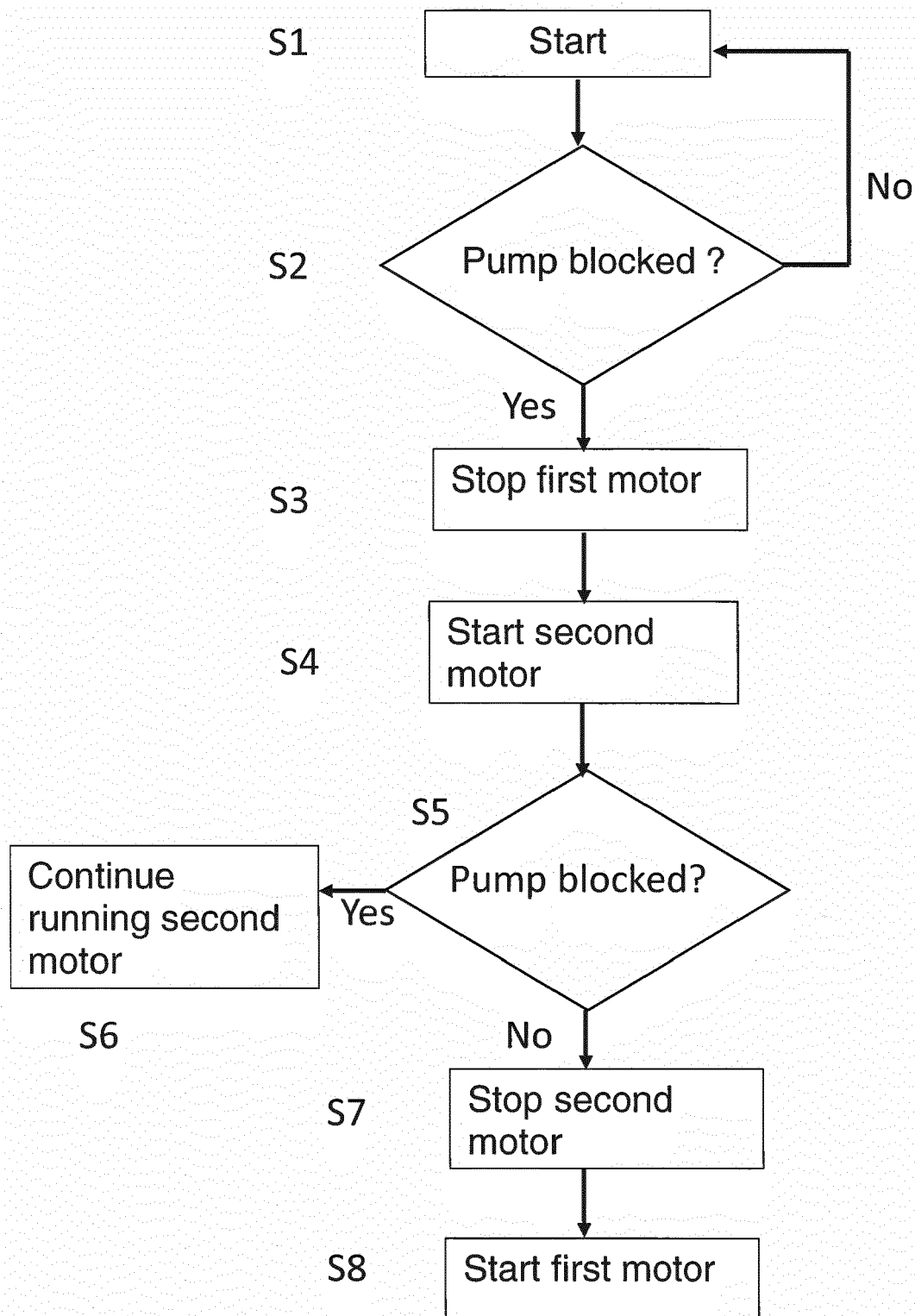


Fig. 3



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Application Number
EP 17 20 6526

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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	

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**ANNEX TO THE EUROPEAN SEARCH REPORT
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5 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
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