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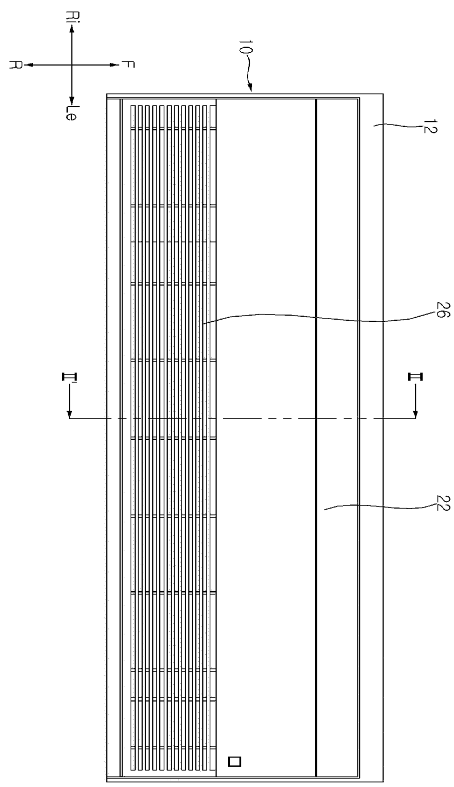
(54) ## AIR CONDITIONER

(57) An air conditioner is disclosed. The air conditioner includes a case including an inlet and an outlet formed therein, a blowing fan disposed in the case to blow air from the inlet to the outlet, a heat exchanger disposed in the case to exchange heat with air flowing in the case, a drain pan disposed below the heat exchanger to collect condensed water falling down from the heat exchanger, and a drain pump disposed on one side of the drain pan to discharge condensed water collected in the drain pan to the outside of the case. When the level of the condensed water reaches the reference level, the drain pump is turned on.

FIG. 1



EP 4 379 285 A1

Description

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application claims the priority benefit of Korean Patent Application No. 10-2022-0166273, filed on December 2, 2022 in the Korean Intellectual Property Office, the disclosure of which is incorporated herein by reference.

BACKGROUND OF THE INVENTION

1. Field of the invention

[0002] The present disclosure relates to an air conditioner, and more particularly, to an air conditioner including a drain pump.

2. Description of the Related Art

[0003] An air conditioner may include an indoor unit disposed in an indoor space to exchange heat with indoor air. The indoor unit is disposed in an indoor space to exchange heat with air in the indoor space and discharge the heat-exchanged air to the indoor space. In this process, condensed water generated in the heat-exchanged air may be collected in the indoor unit. A drain pan for collecting the condensed water is disposed in the indoor unit. In addition, a drain pump may be disposed in the indoor unit in order to discharge the condensed water collected in the drain pan to the outside.

[0004] If a space is present below the drain pan in the indoor unit, the drain pump may be mounted below the drain pan to discharge water. However, in the case of a ceiling-mounted type air conditioner or a wall-mounted type air conditioner, because there is no sufficient space below a drain pan, a self-priming pump may be disposed above the drain pan in order to pump condensed water in a self-priming manner and discharge the condensed water.

[0005] However, the self-priming pump is problematic in that loud noise is generated because an impeller rotates at high speed in order to pump a small amount of water.

[0006] Korean Patent Laid-Open Publication No. 10-2002-0047698 discloses a noise reduction method using a structure in which a sound insulation member is mounted in order to prevent transmission of driving noise of an internal impeller and fluid flow noise, a structure for preventing inflow of air into an inlet in order to reduce inflow noise, and a structure for preventing backflow of remaining condensed water when operation of the impeller stops.

SUMMARY OF THE INVENTION

[0007] It is an object of the present disclosure to provide an air conditioner capable of minimizing noise during operation of a drain pump.

[0008] It is another object of the present disclosure to provide an air conditioner capable of minimizing noise through control of a drain pump.

[0009] It is still another object of the present disclosure to minimize noise through optimal rotational speed (RPM) control satisfying required performance of a drain pump during operation thereof.

[0010] The objects of the present disclosure are not limited to the above-described objects, and other objects not mentioned herein may be clearly understood by those skilled in the art from the following description.

[0011] In order to accomplish the above and other objects, an air conditioner according to an embodiment of the present disclosure includes a case including an inlet and an outlet formed therein, a blowing fan disposed in the case to blow air from the inlet to the outlet, a heat exchanger disposed in the case to exchange heat with air flowing in the case, a drain pan disposed below the heat exchanger to collect condensed water falling down from the heat exchanger, and a drain pump disposed on one side of the drain pan to discharge condensed water collected in the drain pan to the outside of the case, wherein, when the level of the condensed water reaches the reference level, the drain pump is turned on.

[0012] An air conditioner according to an embodiment of the present disclosure further includes a water level switch configured to operate when a level of the condensed water reaches a reference level.

[0013] The drain pump may operate at a predetermined specific speed for a specific time period.

[0014] The drain pump may operate while increasing in speed in a stepwise manner for a specific time period.

[0015] The drain pump may operate at a predetermined specific speed, and may then be turned off when an applied current becomes lower than a reference current value.

[0016] The drain pump may operate at a predetermined specific speed, and may then be turned off when motor torque becomes lower than a reference torque value.

[0017] The drain pump may operate while increasing in speed in a stepwise manner, and may then be turned off when an applied current becomes lower than a reference current value.

[0018] The drain pump may operate while increasing in speed in a stepwise manner, and may then be turned off when motor torque becomes lower than a reference torque value.

[0019] An air conditioner according to an embodiment of the present disclosure further includes d a water level sensor configured to detect a level of the condensed water.

[0020] The drain pump may operate at different speeds depending on water levels detected by the water level sensor.

[0021] The reference level may be a minimum water level detectable by the water level sensor.

[0022] The reference level may be 0 mm or more.

BRIEF DESCRIPTION OF THE DRAWINGS

[0023] The above and other objects, features, and other advantages of the present disclosure will be more clearly understood from the following detailed description taken in conjunction with the accompanying drawings, in which:

FIG. 1 is a bottom view of an air conditioner according to an embodiment of the present disclosure;
FIG. 2 is a cross-sectional view taken along line II-II' in FIG. 1;
FIG. 3 is a perspective view of a drain pan and a drain pump according to an embodiment of the present disclosure;
FIG. 4 is a schematic block diagram of internal components of the air conditioner according to an embodiment of the present disclosure;
FIGs. 5 and 6 are diagrams referenced to explain conventional operation of the drain pump;
FIGs. 7 to 15 are diagrams referenced to explain control of the drain pump of the air conditioner according to the embodiment of the present disclosure; and
FIG. 16 is a diagram referenced to explain control of the drain pump of the air conditioner according to the embodiment of the present disclosure.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0024] Hereinafter, exemplary embodiments of the present disclosure will be described in detail with reference to the accompanying drawings. However, the present disclosure may be embodied in many different forms and should not be construed as being limited to the embodiments set forth herein.

[0025] In the drawings, illustration of parts unrelated to the description is omitted to clearly and briefly describe the present disclosure, and the same or extremely similar components are denoted by the same reference numerals throughout the specification.

[0026] As used herein, the terms with which the names of components are suffixed, "module" and "unit", are assigned to facilitate preparation of this specification, and are not intended to suggest unique meanings or functions. Accordingly, the terms "module" and "unit" may be used interchangeably.

[0027] FIG. 1 is a bottom view of an air conditioner according to an embodiment of the present disclosure, FIG. 2 is a cross-sectional view taken along line II-II' in FIG. 1, and FIG. 3 is a perspective view of a drain pan and a drain pump according to an embodiment of the present disclosure.

[0028] An air conditioner according to an embodiment of the present disclosure includes a case 10, which includes a space defined therein, an inlet 14 formed in one side thereof, and an outlet 16 formed in the other side thereof, a blowing fan 18, which is disposed in the case 10 to form a flow of air from the inlet 14 to the outlet 16, a heat exchanger 20, which exchanges heat with air flowing in the case 10, a drain pan 30, which is disposed below the heat exchanger 20 to collect condensed water falling down from the heat exchanger 20, and a drain pump 40, which discharges the condensed water collected in the drain pan 30 to the outside of the case 10.

[0029] The case 10 may include a base panel 12, in which the inlet 14 through which air flows thereinto and the outlet 16 through which air escapes therefrom are formed, and an upper cover 11, which is disposed on the base panel 12 and defines a space in which the blowing fan 18 and the heat exchanger 20 are disposed.

[0030] The air conditioner may include a vane 22, which is movably disposed in the base panel 12 to adjust the blow direction of the air flowing to the outlet 16, a filter 24, which removes foreign substances from the air introduced through the inlet 14, and an inlet grille 26, which covers a lower side of the inlet 14 of the base panel 12.

[0031] The blowing fan 18 is disposed above the outlet 16. The drain pan 30 is disposed above the base panel 12 at a position between the inlet 14 and the outlet 16. The heat exchanger 20 may be disposed such that a spacing distance from the base panel 12 gradually decreases in a direction from the inlet 14 toward the outlet 16.

[0032] The drain pan 30 may be disposed below the heat exchanger 20 to collect condensed water falling down from the heat exchanger 20.

[0033] The drain pan 30 may include a first drain pan 30a disposed below the heat exchanger 20 and a second drain pan 30b disposed on one side of the first drain pan 30a and extending in a forward-backward direction.

[0034] The first drain pan 30a has a structure extending in a leftward-rightward direction in which the heat exchanger 20 is disposed. The first drain pan 30a extends in a direction in which the rotation axis of the blowing fan 18 extends.

[0035] The second drain pan 30b may be disposed on the left or right side of the first drain pan 30a. Referring to FIG. 3, the second drain pan 30b may be disposed on the right side of the first drain pan 30a and may have a structure extending backward.

[0036] The drain pump 40 is disposed on one side of the drain pan 30. Referring to FIG. 3, the drain pump 40 may be disposed on one side of the second drain pan 30b.

[0037] The drain pump 40 may include a pump housing (not shown), an impeller (not shown) rotatably disposed in the pump housing (not shown), and a pump motor (not shown) configured to rotate the impeller.

[0038] The air conditioner further includes a water level sensor 96, which is disposed on one side of the pump housing and is configured to detect a level of the condensed water collected in the drain pan 30. Alternatively, the air conditioner further includes a water level switch (not shown) configured to operate when the level of the condensed water collected in the drain pan 30 reaches a predetermined level.

[0039] FIG. 4 is a schematic block diagram of internal components of the air conditioner according to an embodiment of the present disclosure.

[0040] Referring to FIG. 4, the air conditioner includes a sensor unit 140, a controller 110, a drain pump 40, and a memory 120.

[0041] The controller 110 controls overall operation of the air conditioner. For example, the controller 110 may control components of a refrigeration cycle, such as a compressor 130, to perform cooling/heating operation.

[0042] The memory 120 may store data necessary for operation of the air conditioner. The memory 120 may store setting data on operation of the air conditioner, control data for control of operation, operation record, data received from other devices, and sensing data of the sensor unit 140.

[0043] The controller 110 may control the air conditioner to perform cooling operation or heating operation. The controller 110 may generate a control command in response to data input from various sensors of the sensor unit 140 to control the air conditioner.

[0044] The sensor unit 140 includes a plurality of sensors configured to sense the operation/state of the air conditioner. In particular, the sensor unit 140 includes a water level switch configured to operate when the level of condensed water reaches a reference level or a water level sensor 96 configured to detect the level of condensed water.

[0045] In addition, the controller 110 may control operation of the drain pump 40 based on the level of condensed water. In detail, the controller 110 may adjust current applied to a motor of the drain pump 40 to control the drain pump 40.

[0046] The drain pump 40 is mounted above the drain pan 30. When the level of condensed water in the drain pan 30 reaches a predetermined level, the controller 110 may control the drain pump 40 to suction and discharge the condensed water. In this case, the amount of condensed water collected in the drain pan may be expressed as a water level, and the water level may be monitored and measured through the water level switch or the water level sensor 96.

[0047] Conventionally, the drain pump 40 is always maintained in an on state, and the water level switch serves to turn the drain pump 40 off or to monitor whether turning the drain pump 40 off is possible. In contrast, according to the embodiment of the present disclosure, the water level switch or the water level sensor 96 serves to turn the drain pump 40 on. That is, while the conventional art is configured such that the drain pump 40 operates at all times, the embodiments of the present disclosure are configured such that the drain pump 40 operates only when necessary.

[0048] FIGs. 5 and 6 are diagrams referenced to explain conventional operation of the drain pump. FIG. 5 illustrates a current applied during conventional operation of the drain pump in which the drain pump rotates at a specific RPM and operates at all times, and FIG. 6 illustrates operation logic thereof.

[0049] Referring to FIGs. 5 and 6, the compressor 130 operates (S610), and the controller waits a specific time period t1 (S620), and applies a motor activating current I1 to the drain pump 40 to turn the drain pump 40 on (S630).

[0050] When a specific motor driving current I2 corresponding to the specific RPM is reached (S640), the operation of the drain pump 40 is maintained (S650). That is, application of the specific motor driving current I2 is maintained.

[0051] When a user turns the air conditioner off (S660), the operation of the drain pump 40 is stopped (S670).

[0052] As described above, in the conventional art, the drain pump is activated in conjunction with activation of the product, and operates at a constant rotational speed until turned off. Most drain pumps applied to actual products use a BLDC motor that is variable in rotational speed. However, as shown in FIGs. 5 and 6, once activated, the drain pump continuously operates at a designed constant rotational speed. Since there is no change in rotational speed of the drain pump in spite of change in the environment (e.g., humidity, water level, etc.), the operational efficiency thereof is very low.

[0053] In contrast, according to the embodiments of the present disclosure, when the level of condensed water reaches the predetermined level, the water level switch is turned on, and accordingly, the drain pump 40 is also turned on. In addition, according to the embodiments of the present disclosure, the drain pump 40 operates at an optimal or minimum rotational speed only when necessary. In the conventional art, since the drain pump 40 continuously operates at 3100 to 3200 RPM, large noise is generated. In contrast, according to the embodiments, the drain pump 40 operates at minimum RPM satisfying required performance thereof, and therefore, noise generation is minimized. Here, the term noise includes electromagnetic noise generated from the motor. However, electromagnetic noise from the motor is relatively small. The term noise mostly refers to flow noise that increases in a square (exponential function) fashion as the specific speed (of fluid machinery) increases.

[0054] FIGs. 7 to 15 are diagrams referenced to explain control of the drain pump of the air conditioner according to the embodiment of the present disclosure.

[0055] FIG. 7 illustrates a current applied when the drain pump rotates at a specific speed (RPM) for a specific time period, and FIG. 8 illustrates operation logic thereof.

[0056] Referring to FIGs. 7 and 8, when the water level switch recognizes a specific water level (reference level), the drain pump 40 may operate at a predetermined speed for a predetermined time period.

[0057] When the level of condensed water reaches the specific water level (reference level), the water level switch is turned on (S810), and the controller 110 applies a motor activating current I1 to the drain pump 40 to turn the drain pump 40 on (S820).

[0058] When a specific motor driving current I2 corresponding to the specific RPM is reached (S830), the controller 110 maintains operation of the drain pump 40 (S840). In addition, after operation for a specific time period t2 (S850), the controller 110 stops operation of the drain pump 40 (S860). That is, application of the specific motor driving current I2 is maintained for the specific time period t2.

[0059] FIG. 9 illustrates a current applied when the drain pump rotates while increasing in speed (RPM) in a stepwise manner for a specific time period, and FIG. 10 illustrates operation logic thereof.

[0060] Referring to FIGs. 9 and 10, when the water level switch recognizes a specific water level (reference level), the drain pump 40 may operate while increasing in speed (RPM) in a stepwise manner for a specific time period.

[0061] When the level of condensed water reaches the specific water level (reference level), the water level switch is turned on (S1010), and the controller 110 applies a motor activating current I1 to the drain pump 40 to turn the drain pump 40 on (S1020). In addition, the controller 110 increases the motor activating current I1 in a stepwise manner (S1020).

[0062] When a specific motor driving current I2 corresponding to the specific RPM is reached (S1030), the controller 110 maintains operation of the drain pump 40 (S1040). In addition, after operation for a specific time period t2 (S1050), the controller 110 stops operation of the drain pump 40 (S1060). That is, application of the specific motor driving current I2 is maintained for the specific time period t2.

[0063] FIG. 11 illustrates a current applied when the drain pump rotates at a specific speed (RPM) until the applied current (torque) is reduced, and FIG. 12 illustrates operation logic thereof.

[0064] Referring to FIGs. 11 and 12, when the water level switch recognizes a specific water level (reference level), the drain pump 40 may operate while rotating at a predetermined speed until the applied current (torque) is reduced.

[0065] When the level of condensed water reaches the specific water level (reference level), the water level switch is turned on (S1210), and the controller 110 applies a motor activating current I1 to the drain pump 40 to turn the drain pump 40 on (S1220).

[0066] When a specific motor driving current I2 corresponding to the specific RPM is reached (S1230), the controller 110 maintains operation of the drain pump 40 (S1240). When motor torque decreases sharply and becomes less than a reference torque value (S1250), the controller 110 stops operation of the drain pump 40 (S1260). In addition, when the specific motor driving current I2 decreases sharply and becomes less than a reference current value (S1250), the controller 110 stops operation of the drain pump 40 (S1260).

[0067] FIG. 13 illustrates a current applied when the drain pump rotates while increasing in speed (RPM) in a stepwise manner and operates until the applied current (torque) is reduced, and FIG. 14 illustrates operation logic thereof.

[0068] Referring to FIGs. 13 and 14, when the water level switch recognizes a specific water level (reference level), the drain pump 40 may rotate while increasing in speed (RPM) in a stepwise manner and may operate until the applied current (torque) is reduced.

[0069] When the level of condensed water reaches the specific water level (reference level), the water level switch is turned on (S1410), and the controller 110 applies a motor activating current I1 to the drain pump 40 to turn the drain pump 40 on (S1420). In addition, the controller 110 increases the motor activating current I1 in a stepwise manner (S1420).

[0070] When a specific motor driving current I2 corresponding to the specific RPM is reached (S1430), the controller 110 maintains operation of the drain pump 40 (S1440). When motor torque decreases sharply and becomes less than a reference torque value (S1450), the controller 110 stops operation of the drain pump 40 (S1460). In addition, when the specific motor driving current I2 decreases sharply and becomes less than a reference current value (S1450), the controller 110 stops operation of the drain pump 40 (S1460).

[0071] In the conventional art, the drain pump is activated in conjunction with activation of the product, and operates at a constant rotational speed until turned off. In contrast, according to the embodiments of the present disclosure, the drain pump operates at an optimal or minimum rotational speed only when necessary.

[0072] When the level of condensed water reaches a predetermined water level, the drain pump 40 may be turned on by the water level switch. In this case, the operation combinations shown in FIGs. 7, 9, 11, and 13 may be obtained.

- Operation at Specific Rotational Speed (RPM) + Operation for Specific Time Period
- Operation at Stepwise Rotational Speed (RPM) + Operation for Specific Time Period
- Operation at Specific Rotational Speed (RPM) + Operation until Reduction in Applied Current
- Operation at Stepwise Rotational Speed (RPM) + Operation until Reduction in Applied Current

(Reduction in Applied Current: Reduction in Torque, Complete Discharge of Fluid)

[0073] FIG. 15 is a diagram showing change in noise depending on RPM of the drain pump. Referring to FIG. 15, it can be seen that noise (0.5 m) increases by about 10 dB(a) as the rotational speed of the drain pump increases by 1000 RPM. Further, after the rotational speed of the drain pump exceeds a predetermined RPM (e.g., 2500 RPM), noise increases in an approximately square (exponential function) fashion. In the conventional art, the rotational speed of the drain pump increases sharply from 0 RPM to 3200 RPM, and noise (0.5 m) up to 32 dB(a) frequently occurs while the drain pump suctions water. The above-described four operation combinations of the present disclosure may prevent occurrence of large noise.

[0074] Meanwhile, according to an embodiment of the present disclosure, when the level of condensed water detected by the water level sensor 96 reaches the reference level, the drain pump 40 may be turned on.

[0075] FIG. 16 is a diagram referenced to explain control of the drain pump of the air conditioner according to the embodiment of the present disclosure.

[0076] Referring to FIG. 16, when the water level sensor 96 recognizes a specific water level (reference level), the drain pump 40 may be turned on (S1610).

[0077] The drain pump 40 operates at different speeds depending on the water levels detected by the water level sensor 96 (S1620). The controller 110 applies a specific motor driving current in for each water level to the drain pump 40 for a specific time period (S1620).

[0078] Meanwhile, the reference level may be a minimum water level that is detectable by the water level sensor. For example, the reference level may be 0 mm or more.

[0079] For example, the water level may have up to 12 levels. When the water level is a negative (-) level, i.e., lower than 0 mm, the water level sensor 96 may not recognize the water level. The negative (-) level is defined as one water level. In this case, the drain pump 40 does not operate (turned off).

[0080] When the water level reaches each of the levels (defined according to a water level condition), the drain pump operates at a specific rotational speed (RPM) corresponding to the reached level according to preset operation control logic. For example, when the water level is classified into a total of 12 levels, the rotational speed of the drain pump may be set differently depending on the 12 levels as follows.

Water Level Lower Than 0 mm: Water Level Not Recognized, Drain Pump OFF
Water Level of 0 mm: RPM 1300 (Drain Pump Activated)
Water Level of 1 mm: RPM 1500
Water Level of 2 mm: RPM 1700
Water Level of 3 mm: RPM 1900
Water Level of 4 mm: RPM 2100
Water Level of 5 mm: RPM 2300
Water Level of 6 mm: RPM 2500
Water Level of 7 mm: RPM 2700
Water Level of 8 mm: RPM 2900
Water Level of 9 mm: RPM 3000
Water Level of 10 mm: RPM 3100

[0081] The rotational speed for each water level may be determined taking into consideration maximum rotational speed of commercially available drain pumps and minimum rotational speed satisfying performance stored in each performance map.

[0082] When the specific motor driving current In for each water level corresponding to the speed (RPM) for each water level is reached (S1630), the controller 110 maintains operation of the drain pump 40 (S1640).

[0083] Thereafter, when there is a change in the water level detected by the water level sensor 96 (S1650), the above-described processes S1610 to S1640 are repeated.

[0084] Meanwhile, when the water level becomes lower than 0 mm and thus is not recognized, the controller 110 stops operation of the drain pump 40 (S1260).

[0085] According to the embodiments of the present disclosure, the drain pump 40 always operates at an optimal or minimum rotational speed, thereby minimizing noise.

[0086] As is apparent from the above description, according to at least one of the embodiments of the present disclosure, an air conditioner capable of minimizing noise during operation of a drain pump may be provided.

[0087] According to at least one of the embodiments of the present disclosure, it may be possible to minimize noise through control of a drain pump.

[0088] According to at least one of the embodiments of the present disclosure, it may be possible to minimize noise through optimal rotational speed (RPM) control satisfying required performance of a drain pump during operation thereof.

[0089] Various other effects may be directly or implicitly disclosed in the above detailed description of the present disclosure.

[0090] The air conditioner and the operation method thereof according to the present disclosure are not limited to the configurations and methods of the embodiments described above, but all or part of the embodiments may be selectively combined so as to be modified into various forms.

[0091] Although the present disclosure has been described with reference to specific embodiments shown in the drawings, it is apparent to those skilled in the art that the present disclosure is not limited to those exemplary embodiments and is embodied in many forms without departing from the scope of the present disclosure, which is described in the following claims. These modifications should not be individually understood from the technical spirit or scope of the present disclosure.

Claims

1. An air conditioner comprising:

a case (10) comprising an inlet (14) and an outlet (16) formed therein;
a blowing fan (18) disposed in the case (10) and

configured to form an air flow from the inlet (14) to the outlet (16);
a heat exchanger (20) disposed in the case (10) and configured to exchange heat with air flowing in the case (10);
a drain pan (30) disposed below the heat exchanger (20) and configured to collect condensed water falling down from the heat exchanger (20); and
a drain pump (40) disposed on one side of the drain pan (30) and configured to discharge condensed water collected in the drain pan (30) to an outside of the case (10) ;
wherein, when a level of the condensed water reaches a reference level, the drain pump (40) is turned on.

2. The air conditioner according to claim 1, further comprises:
a water level switch configured to operate when the level of the condensed water reaches the reference level.

3. The air conditioner according to claim 1 or 2, wherein the drain pump (40) is configured to operate at a predetermined specific speed for a specific time period.

4. The air conditioner according to claim 1 or 2, wherein the drain pump (40) is configured to operate while increasing in speed in a stepwise manner for a specific time period.

5. The air conditioner according to any one of claims 1, 2 or 3, wherein the drain pump (40) is configured to operate at a predetermined specific speed, and to turn off when an applied current becomes lower than a reference current value.

6. The air conditioner according to any one of claims 1, 2 or 3, wherein the drain pump (40) is configured to operate at a predetermined specific speed, and to turn off when a motor torque becomes lower than a reference torque value.

7. The air conditioner according to any one of claims 1, 2 or 4, wherein the drain pump (40) is configured to operate while increasing in speed in a stepwise manner, and to turn off when an applied current becomes lower than a reference current value.

8. The air conditioner according to any one of claims 1, 2 or 4, wherein the drain pump (40) is configured to operate while increasing in speed in a stepwise manner, and to turn off when a motor torque becomes lower than a reference torque value.

9. The air conditioner according to any one of claims 1 to 8, further comprising:
a water level sensor (96) configured to detect the level of the condensed water.

10. The air conditioner according to claim 9, wherein the drain pump (40) is configured to operate at different speeds depending on water levels detected by the water level sensor (96).

11. The air conditioner according to claim 9 or 10, wherein the reference level is a minimum water level detectable by the water level sensor (96).

12. The air conditioner according to any one of claims 1 to 11, wherein the reference level is 0 mm or more.

13. A method of operating an air conditioner according to any one of claims 1 to 12,
wherein the operation of the drain pump (40) is controlled based on the level of condensed water, such that the drain pump (40) operates at a predetermined speed (RPM) or a stepwise increasing speed (RPM) for a predetermined time period (t2) when a level of the condensed water reaches a reference level.

FIG. 1

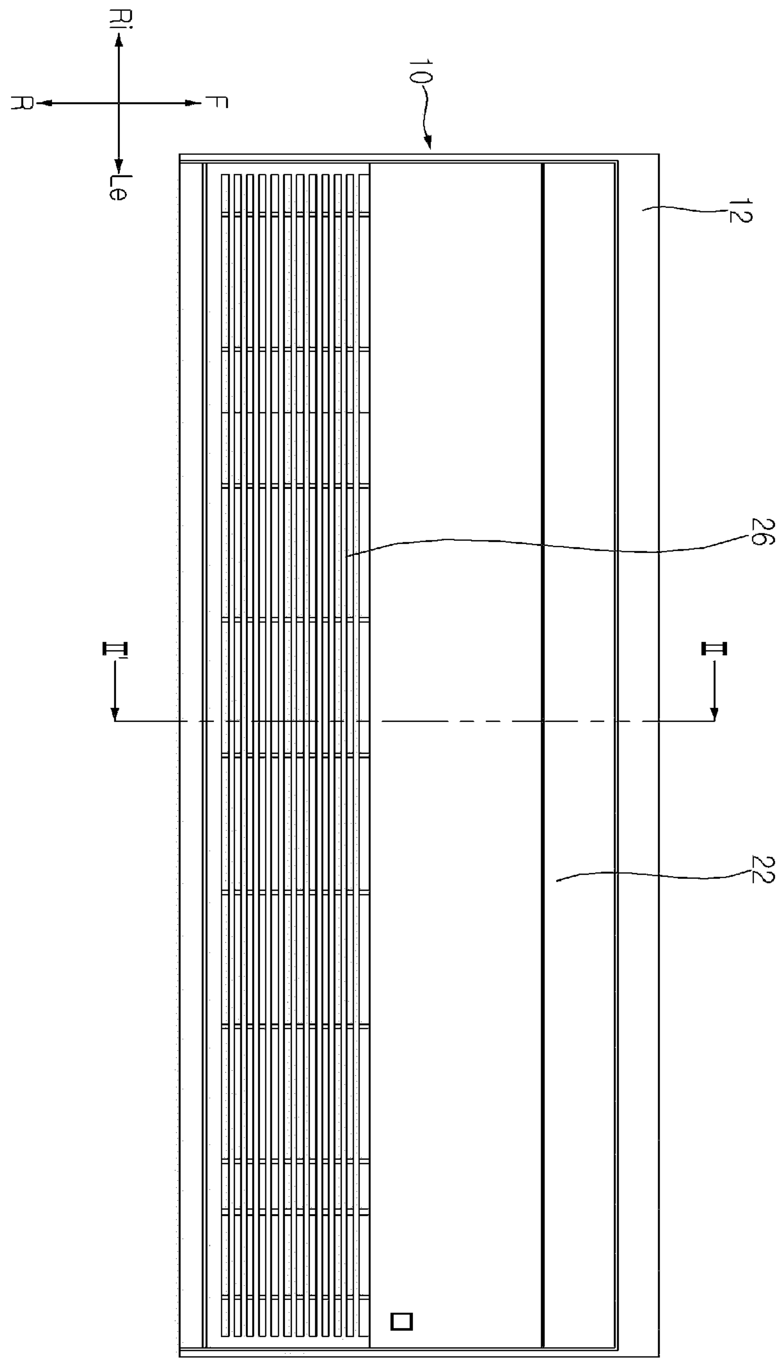


FIG. 2

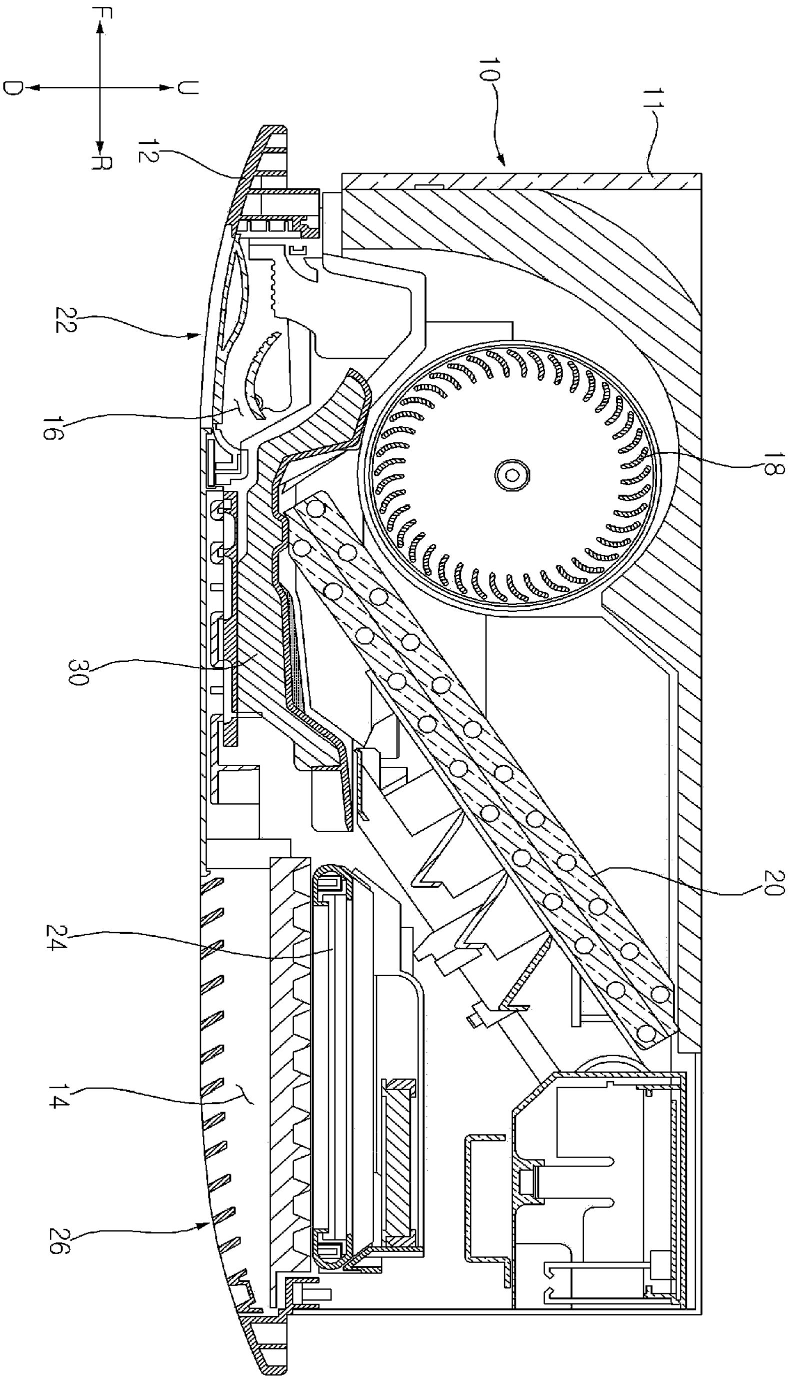


FIG. 3

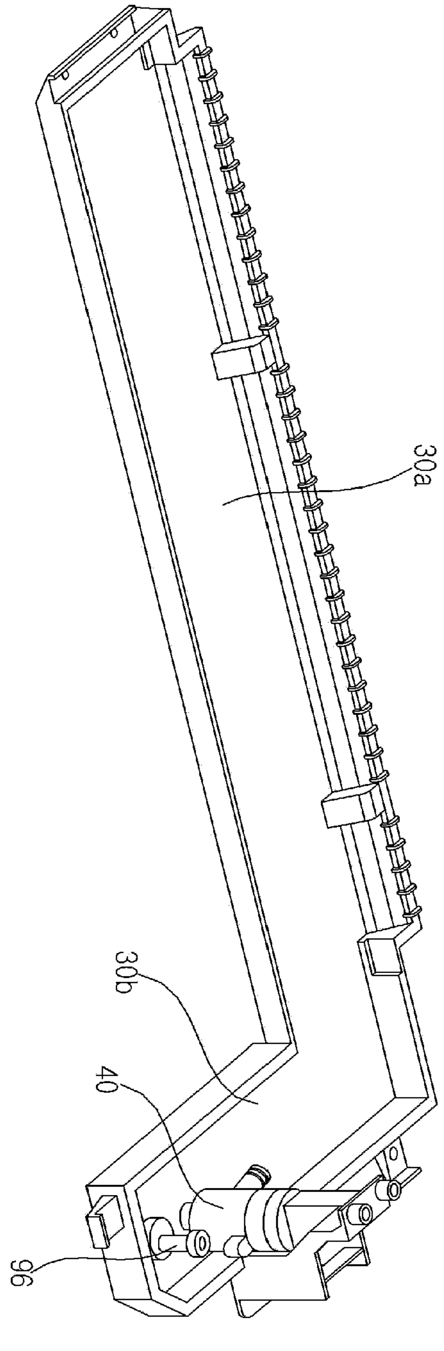


FIG. 4

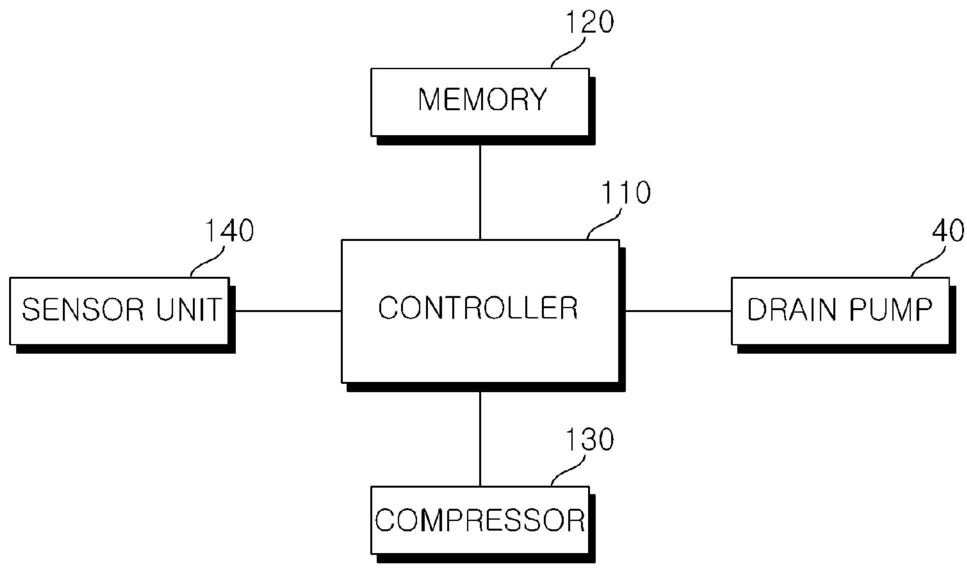

120
MEMORY
110
140
40
SENSOR UNIT
CONTROLLER
DRAIN PUMP
130
COMPRESSOR

FIG. 5

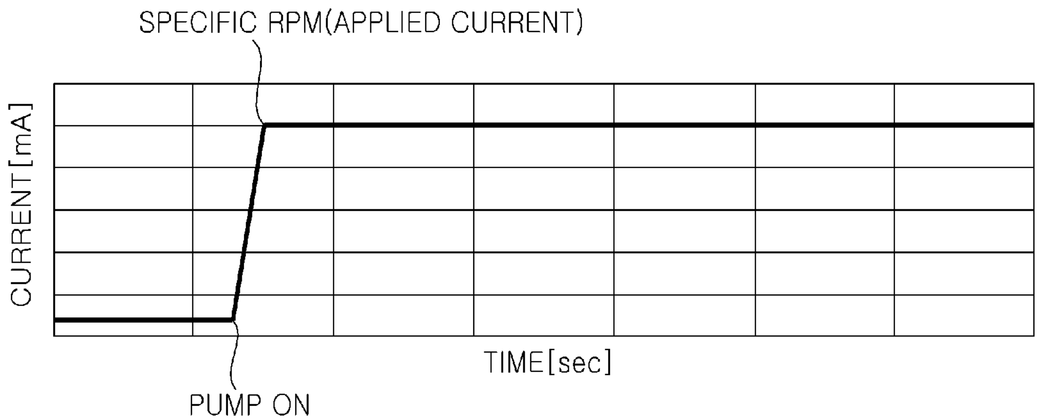

SPECIFIC RPM(APPLIED CURRENT)
CURRENT[mA]
TIME[sec]
PUMP ON

FIG. 6

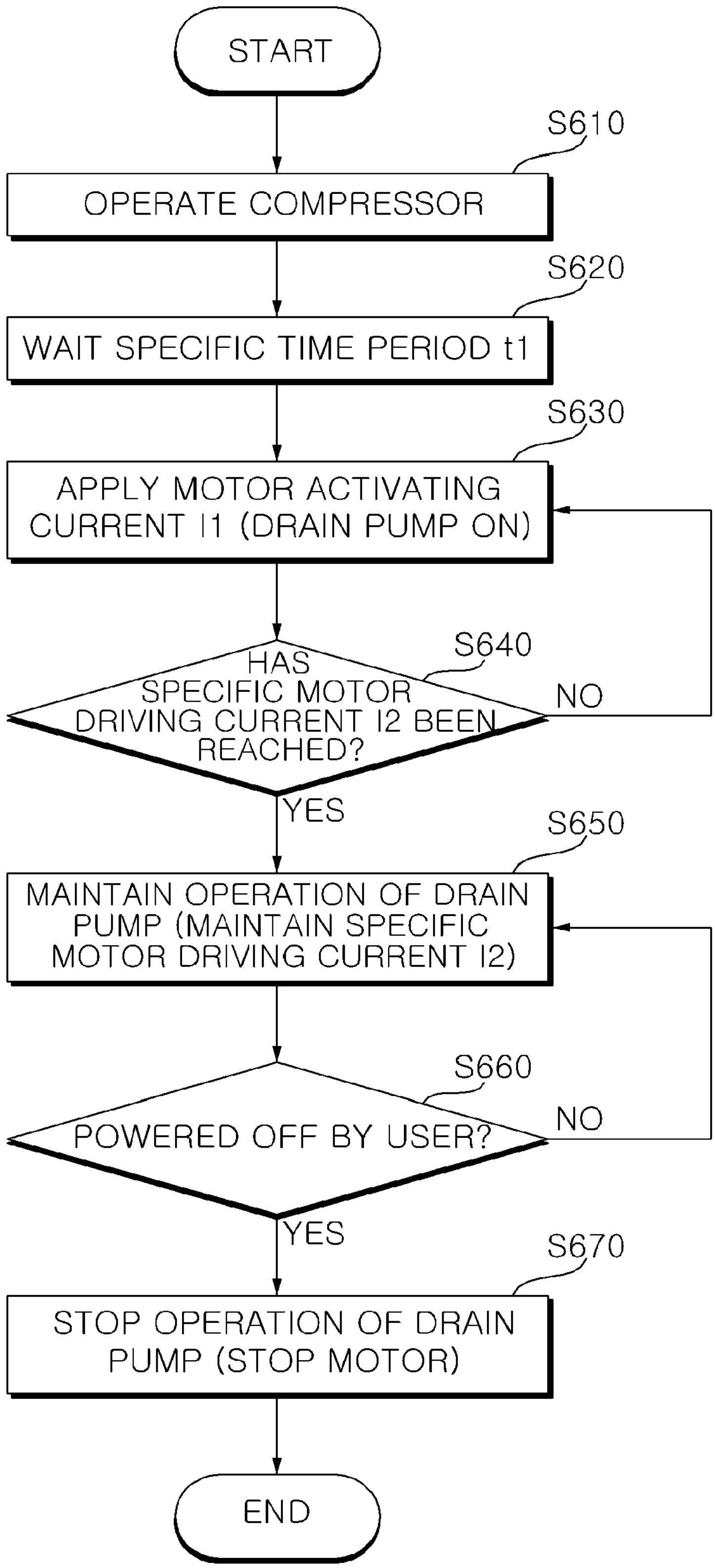

START
S610
OPERATE COMPRESSOR
S620
WAIT SPECIFIC TIME PERIOD t1
S630
APPLY MOTOR ACTIVATING CURRENT I1 (DRAIN PUMP ON)
S640
HAS SPECIFIC MOTOR DRIVING CURRENT I2 BEEN REACHED?
NO
YES
S650
MAINTAIN OPERATION OF DRAIN PUMP (MAINTAIN SPECIFIC MOTOR DRIVING CURRENT I2)
S660
POWERED OFF BY USER?
NO
YES
S670
STOP OPERATION OF DRAIN PUMP (STOP MOTOR)
END

FIG. 7

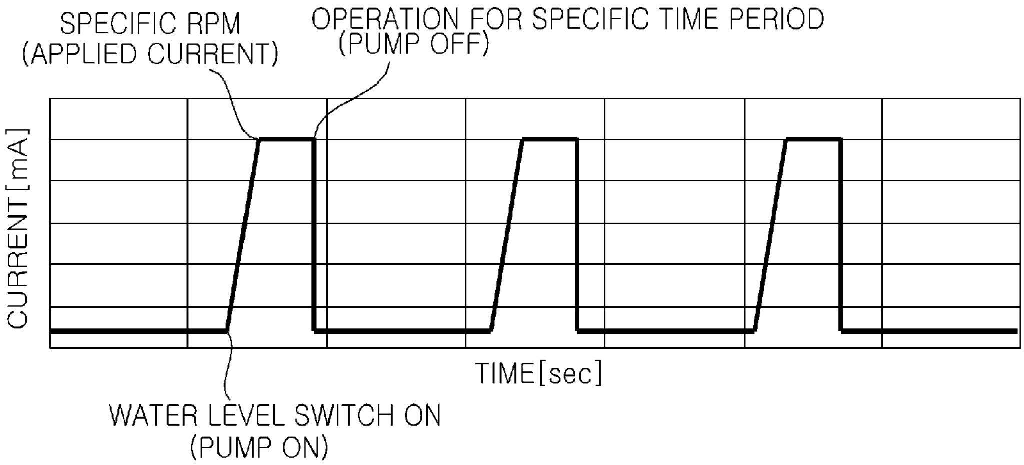

SPECIFIC RPM
(APPLIED CURRENT)
OPERATION FOR SPECIFIC TIME PERIOD
(PUMP OFF)
CURRENT[mA]
TIME[sec]
WATER LEVEL SWITCH ON
(PUMP ON)

FIG. 8

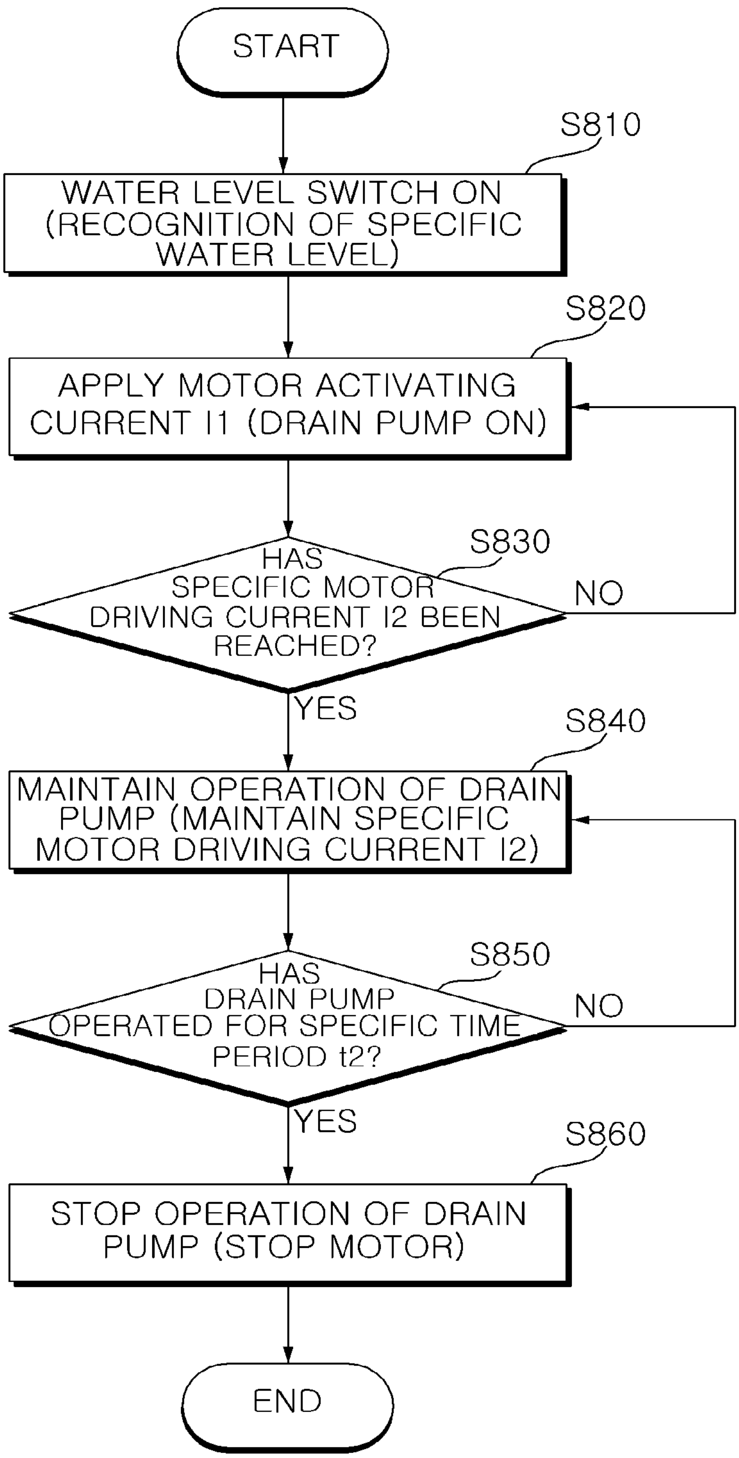

START
S810
WATER LEVEL SWITCH ON (RECOGNITION OF SPECIFIC WATER LEVEL)
S820
APPLY MOTOR ACTIVATING CURRENT I1 (DRAIN PUMP ON)
S830
HAS SPECIFIC MOTOR DRIVING CURRENT I2 BEEN REACHED?
NO
YES
S840
MAINTAIN OPERATION OF DRAIN PUMP (MAINTAIN SPECIFIC MOTOR DRIVING CURRENT I2)
S850
HAS DRAIN PUMP OPERATED FOR SPECIFIC TIME PERIOD t2?
NO
YES
S860
STOP OPERATION OF DRAIN PUMP (STOP MOTOR)
END

FIG. 9

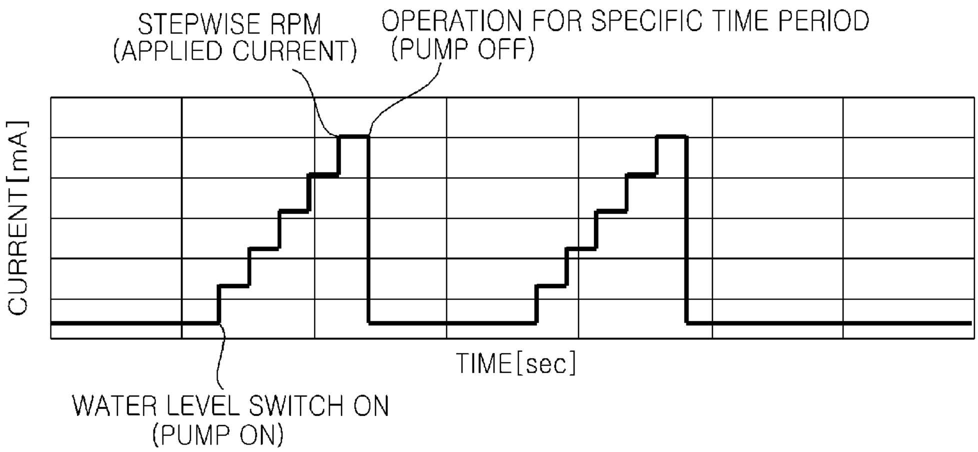

STEPWISE RPM
(APPLIED CURRENT)
OPERATION FOR SPECIFIC TIME PERIOD
(PUMP OFF)
CURRENT[mA]
TIME[sec]
WATER LEVEL SWITCH ON
(PUMP ON)

FIG. 10

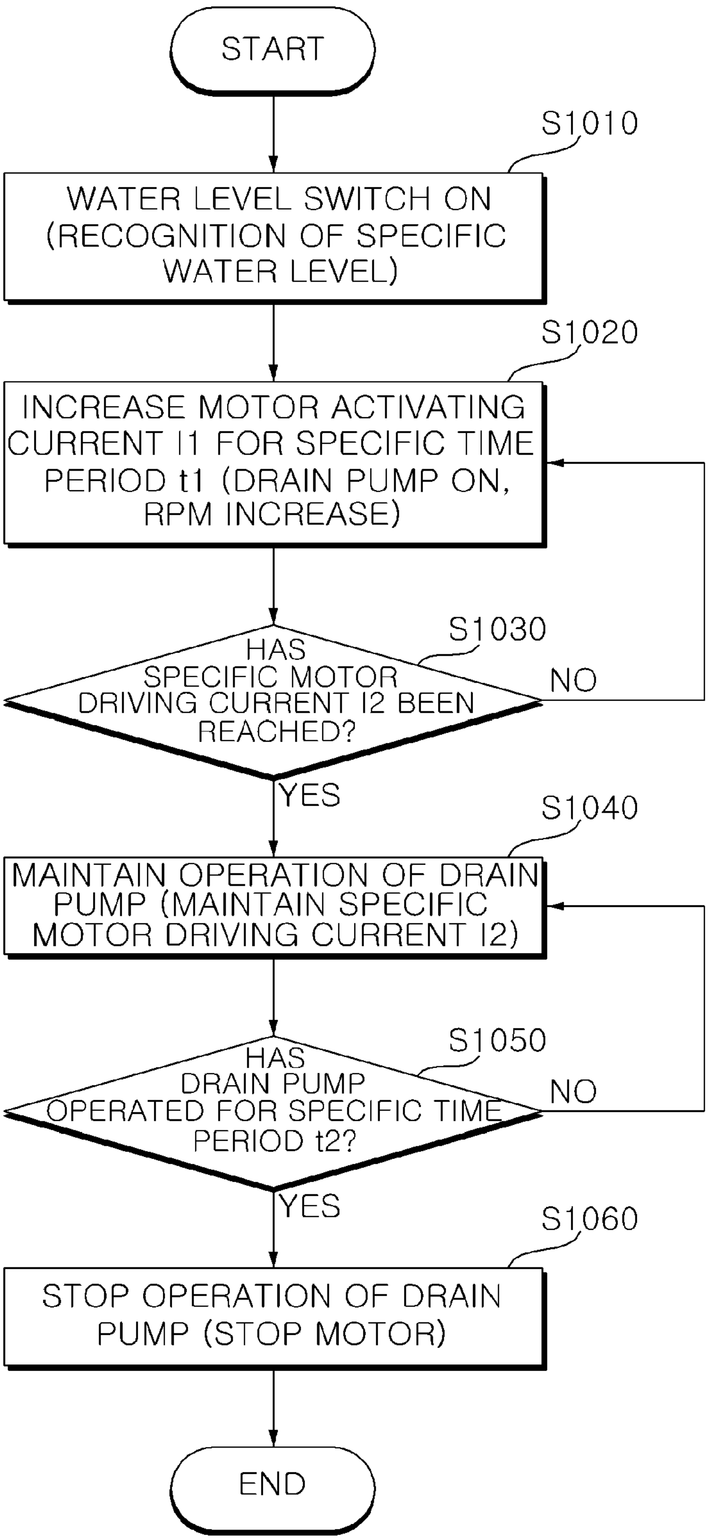

START
S1010
WATER LEVEL SWITCH ON (RECOGNITION OF SPECIFIC WATER LEVEL)
S1020
INCREASE MOTOR ACTIVATING CURRENT I1 FOR SPECIFIC TIME PERIOD t1 (DRAIN PUMP ON, RPM INCREASE)
S1030
HAS SPECIFIC MOTOR DRIVING CURRENT I2 BEEN REACHED?
NO
YES
S1040
MAINTAIN OPERATION OF DRAIN PUMP (MAINTAIN SPECIFIC MOTOR DRIVING CURRENT I2)
S1050
HAS DRAIN PUMP OPERATED FOR SPECIFIC TIME PERIOD t2?
NO
YES
S1060
STOP OPERATION OF DRAIN PUMP (STOP MOTOR)
END

FIG. 11

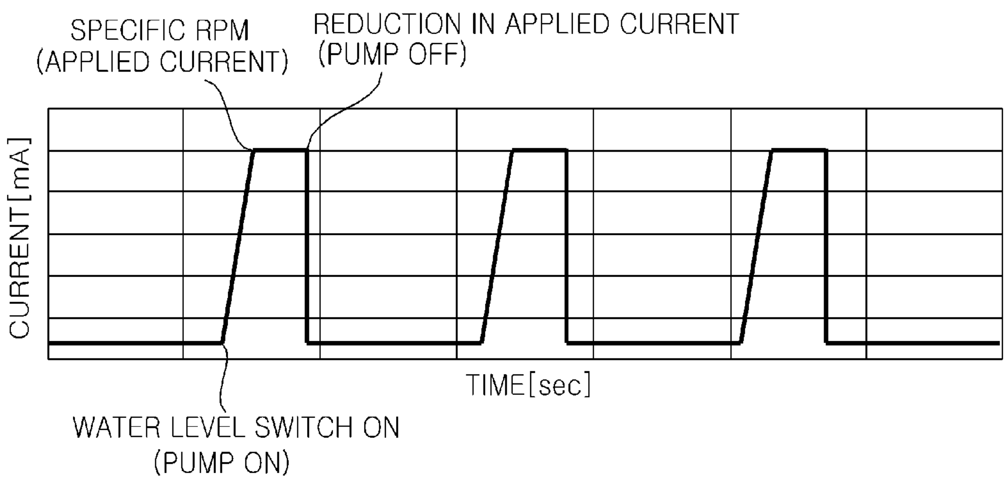

SPECIFIC RPM
(APPLIED CURRENT)
REDUCTION IN APPLIED CURRENT
(PUMP OFF)
CURRENT[mA]
TIME[sec]
WATER LEVEL SWITCH ON
(PUMP ON)

FIG. 12

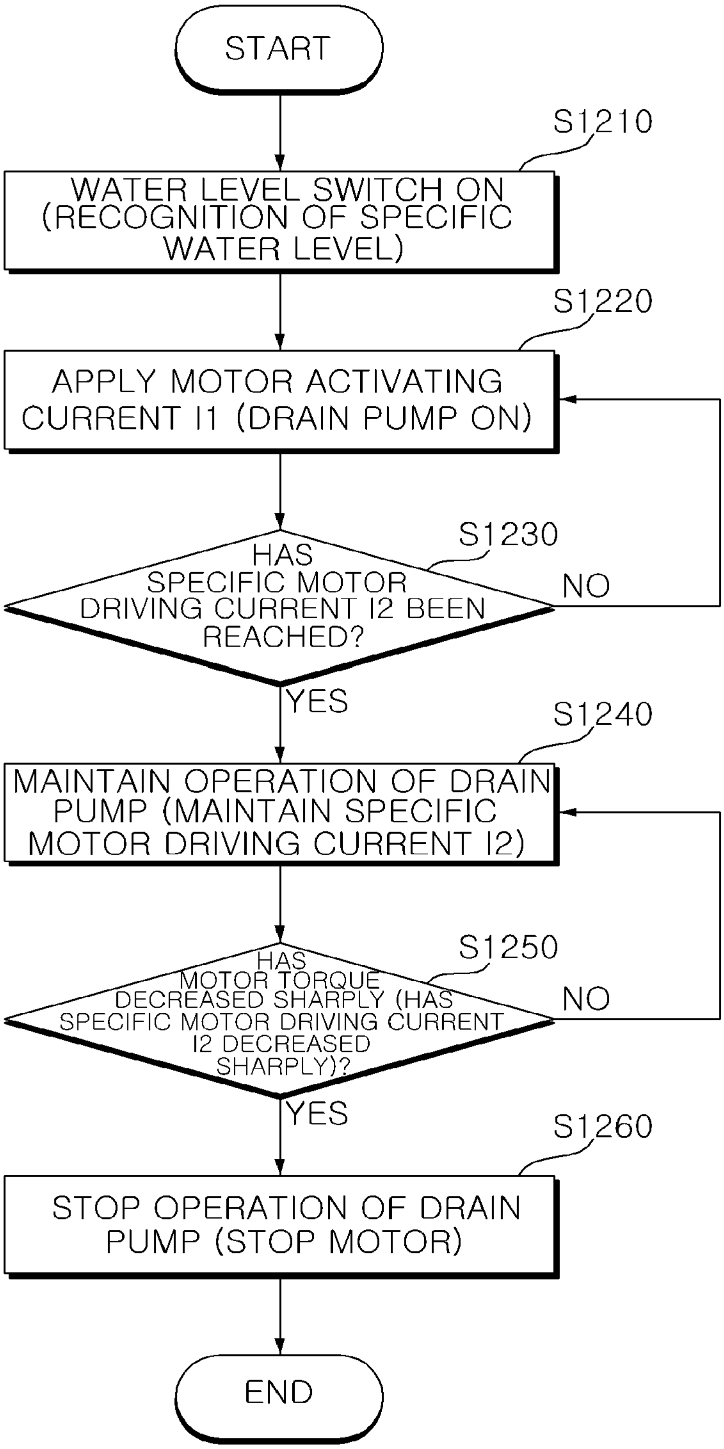

START
S1210
WATER LEVEL SWITCH ON (RECOGNITION OF SPECIFIC WATER LEVEL)
S1220
APPLY MOTOR ACTIVATING CURRENT I1 (DRAIN PUMP ON)
S1230
HAS SPECIFIC MOTOR DRIVING CURRENT I2 BEEN REACHED?
NO
YES
S1240
MAINTAIN OPERATION OF DRAIN PUMP (MAINTAIN SPECIFIC MOTOR DRIVING CURRENT I2)
S1250
HAS MOTOR TORQUE DECREASED SHARPLY (HAS SPECIFIC MOTOR DRIVING CURRENT I2 DECREASED SHARPLY)?
NO
YES
S1260
STOP OPERATION OF DRAIN PUMP (STOP MOTOR)
END

FIG. 13

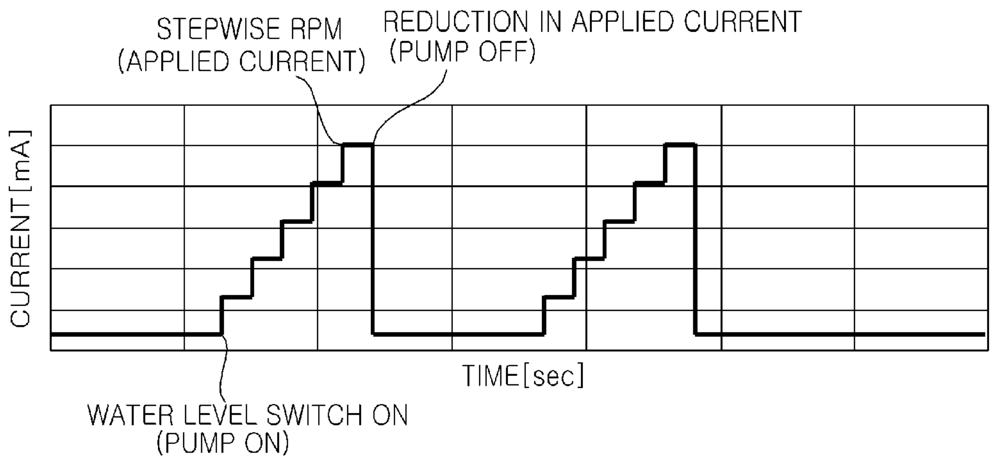

STEPWISE RPM
(APPLIED CURRENT)
REDUCTION IN APPLIED CURRENT
(PUMP OFF)
CURRENT[mA]
TIME[sec]
WATER LEVEL SWITCH ON
(PUMP ON)

FIG. 14

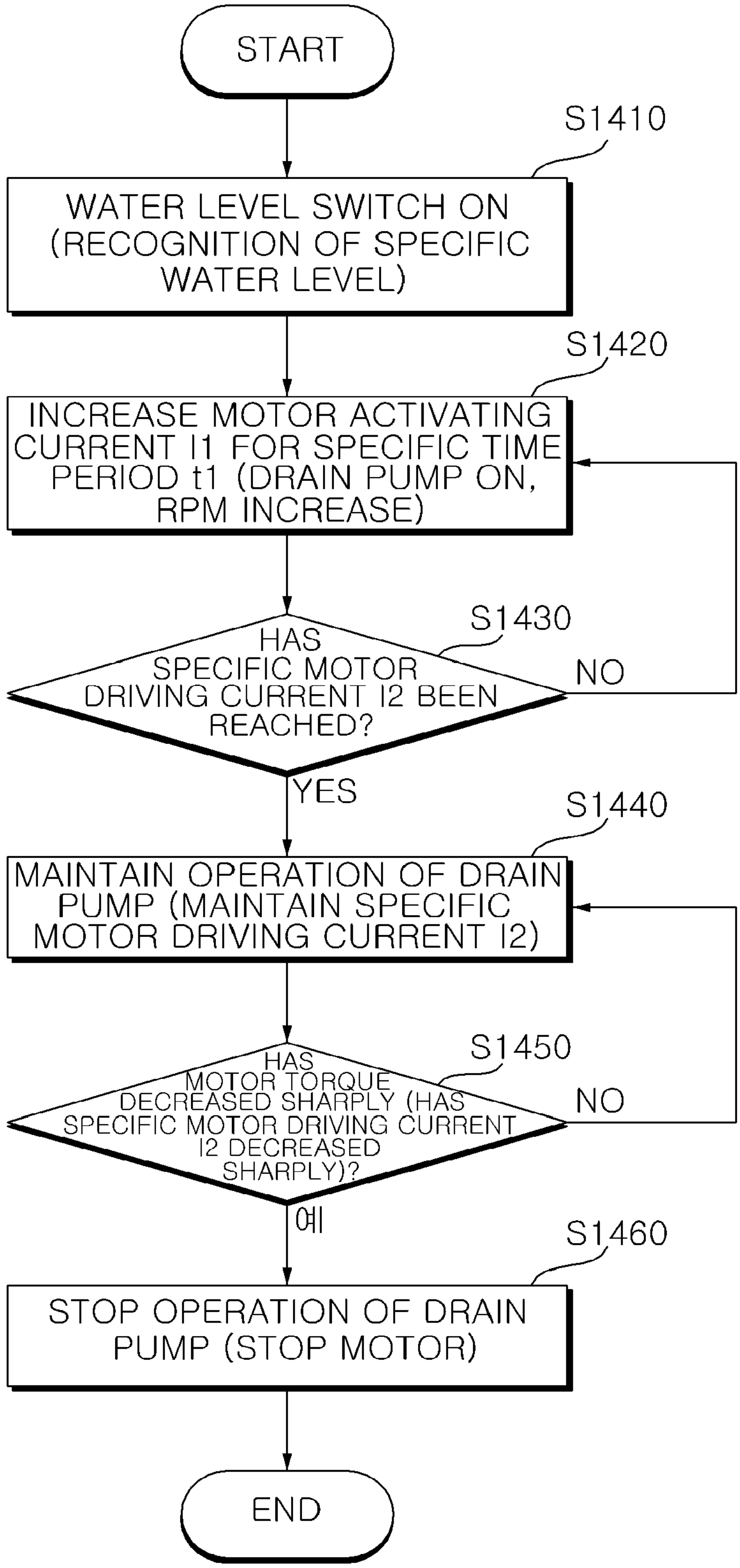

START
S1410
WATER LEVEL SWITCH ON (RECOGNITION OF SPECIFIC WATER LEVEL)
S1420
INCREASE MOTOR ACTIVATING CURRENT I1 FOR SPECIFIC TIME PERIOD t1 (DRAIN PUMP ON, RPM INCREASE)
S1430
HAS SPECIFIC MOTOR DRIVING CURRENT I2 BEEN REACHED?
NO
YES
S1440
MAINTAIN OPERATION OF DRAIN PUMP (MAINTAIN SPECIFIC MOTOR DRIVING CURRENT I2)
S1450
HAS MOTOR TORQUE DECREASED SHARPLY (HAS SPECIFIC MOTOR DRIVING CURRENT I2 DECREASED SHARPLY)?
NO
예
S1460
STOP OPERATION OF DRAIN PUMP (STOP MOTOR)
END

FIG. 15

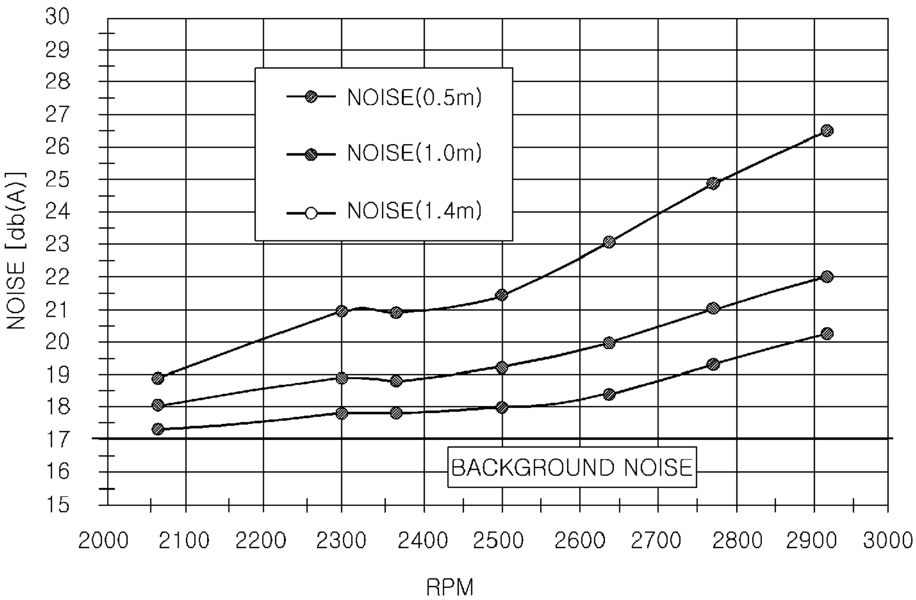
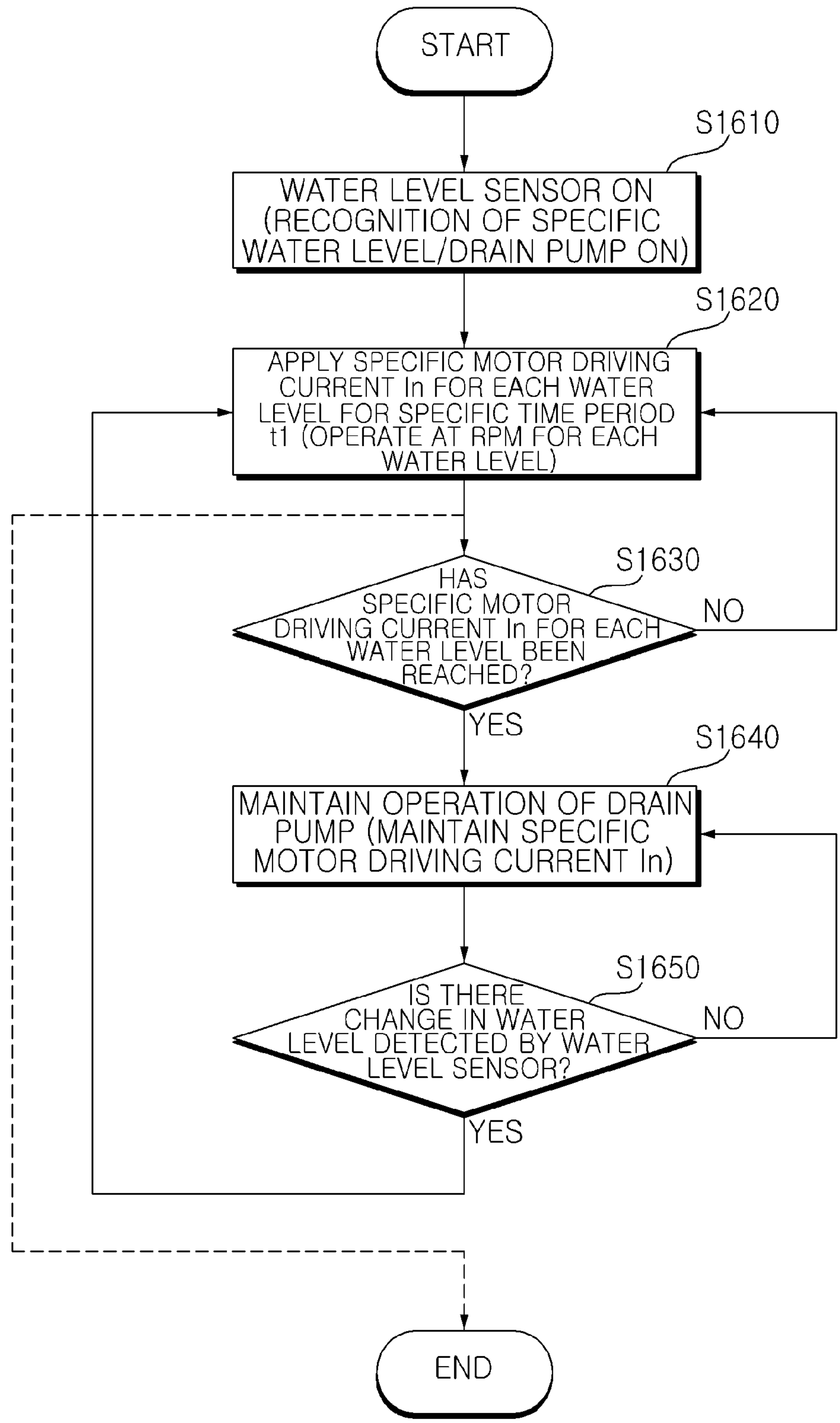

NOISE(0.5m)
NOISE(1.0m)
NOISE(1.4m)
BACKGROUND NOISE
NOISE [db(A)]
30
29
28
27
26
25
24
23
22
21
20
19
18
17
16
15
2000
2100
2200
2300
2400
2500
2600
2700
2800
2900
3000
RPM

FIG. 16


START
S1610
WATER LEVEL SENSOR ON (RECOGNITION OF SPECIFIC WATER LEVEL/DRAIN PUMP ON)
S1620
APPLY SPECIFIC MOTOR DRIVING CURRENT In FOR EACH WATER LEVEL FOR SPECIFIC TIME PERIOD t1 (OPERATE AT RPM FOR EACH WATER LEVEL)
S1630
HAS SPECIFIC MOTOR DRIVING CURRENT In FOR EACH WATER LEVEL BEEN REACHED?
NO
YES
S1640
MAINTAIN OPERATION OF DRAIN PUMP (MAINTAIN SPECIFIC MOTOR DRIVING CURRENT In)
S1650
IS THERE CHANGE IN WATER LEVEL DETECTED BY WATER LEVEL SENSOR?
NO
YES
END

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EUROPEAN SEARCH REPORT

Application Number
EP 23 21 3620

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,D	CN 1 165 716 C (SAMSUNG ELECTRONICS CO LTD [KR]) 8 September 2004 (2004-09-08) * the whole document * -----	1-13	INV. F24F13/22 F24F13/24
X	JP 2010 164205 A (FUJITSU GENERAL LTD) 29 July 2010 (2010-07-29) * paragraph [0029] * -----	1,2,9	
X	KR 2019 0083888 A (LG ELECTRONICS INC [KR]) 15 July 2019 (2019-07-15) * paragraphs [0171] - [0238]; claims 1-6; figure 9 * -----	1,2,5,9	
X	JP 2003 329283 A (MATSUSHITA ELECTRIC IND CO LTD) 19 November 2003 (2003-11-19) * paragraphs [0027], [0028]; claim 11; figure 2 * -----	1-3,9,13	
X	KR 2003 0073153 A (WINIAMANDO INC [KR]) 19 September 2003 (2003-09-19) * claim 1 * -----	1,2,9	TECHNICAL FIELDS SEARCHED (IPC)
X	CN 101 384 858 B (DAIKIN IND LTD) 29 February 2012 (2012-02-29) * claim 1 * -----	1,2,9	F24F

The present search report has been drawn up for all claims

1

Place of search	Date of completion of the search	Examiner
Munich	25 March 2024	Lienhard, Dominique

CATEGORY OF CITED DOCUMENTS

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25-03-2024

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- KR 1020020047698 **[0006]**