



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

(43) Date of publication:  
**02.08.2023 Bulletin 2023/31**

(51) International Patent Classification (IPC):  
**D06F 39/08** <sup>(2006.01)</sup> **D06F 37/04** <sup>(2006.01)</sup>  
**D06F 103/18** <sup>(2020.01)</sup>

(21) Application number: **21871157.0**

(52) Cooperative Patent Classification (CPC):  
**D06F 39/087; D06F 33/34; D06F 39/08;**  
**D06F 37/04; D06F 2103/18; D06F 2103/24**

(22) Date of filing: **19.08.2021**

(86) International application number:  
**PCT/CN2021/113473**

(87) International publication number:  
**WO 2022/062784 (31.03.2022 Gazette 2022/13)**

(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**

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(30) Priority: **27.09.2020 CN 202011032124**  
**27.09.2020 CN 202011032920**

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(54) **WASHING MACHINE AND CONTROL METHOD THEREFOR**

(57) A washing machine and a control method thereof are provided. The washing machine includes: a housing (1); an inner drum (5) arranged in the housing (1) and provided with a washing chamber individually holding washing water; a detection member (7) arranged on the inner drum (5). The position of the detection member (7) is raised/lowered as the water level is raised/lowered, and a sensing device (8) correspondingly detects a change in the position of the detection member (7). The control method includes: positioning the inner drum (5) to a position where the detection member (7) is corresponding to the sensing member (8) during feeding water in the washing machine, and obtaining the water level inside the inner drum (5) by detecting the position of the detection member (7) via the sensing member (8) by the washing machine. The control method of the washing machine enables water level detection of the holeless inner drum by controlling the positioning of the inner drum (5) during the water feeding process in conjunction with the water level detection device, the water level detection is accurate, simple, effective, and reliable.

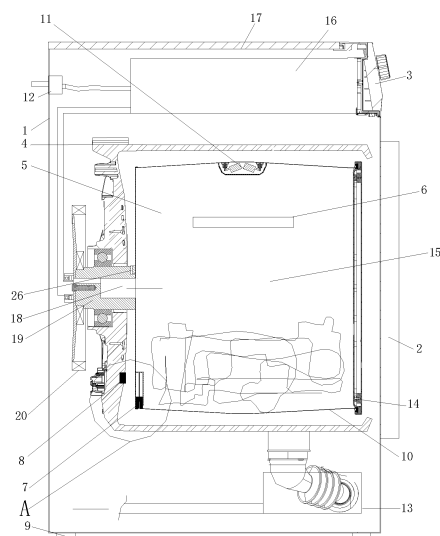


Fig. 2

## Description

### TECHNICAL FIELD

[0001] The present invention relates to the technical field of washing appliances, in particular to a washing machine and a control method thereof.

### BACKGROUND

[0002] Washing machines, which are the most widely used household appliances of people's daily life, help people free from the annoyance of laundry and give them great convenience. However, existing washing machines generally include an inner drum and an outer drum, and holes are distributed on a drum wall of the inner drum. Whereas the washing water between the inner drum and the outer drum is not utilized during the washing process, this portion of the washing water is wasted, and the dirt generated during the washing process can enter between the inner drum and the outer drum along the flow of water and be accumulated. The accumulation of dirt can affect the washing effect over prolonged use, reducing the user's use experience.

[0003] In order to solve the above problems, some patents are now also presented, such as a Chinese application number 201410215346.3 and the name of a drum washing machine. The invention discloses a drum washing machine which includes a box, an inner drum and an outer drum arranged in the box, and a door seal arranged between the outer drum and the box. The inner drum is connected to a driving device. The inner drum is a holeless inner drum, the inner drum is a conical drum with a small diameter at a bottom of the inner drum and a large diameter at an opening of the inner drum. The opening of the inner drum is folded inward in an arc shape. The door seal is provided with a water inlet pipe, one end of the water inlet pipe is connected with a washing water rapid heating device, and the other end extends into the inner drum through the door seal. The outer drum has a drain opening and a water pressure detection device. From the above-mentioned technical solution, the inner drum of the present invention without holes can be fed with water through the water inlet pipe arranged on the door seal, and water is drained during dewatering by the shape of the inner drum itself, so that water can be avoided to flow between the inner and outer drums, resulting in a substantial saving of the amount of water used for washing.

[0004] The above described invention provides a drum washing machine provided with a holeless inner drum, the washing water is contained within the inner drum and no water is present in the outer drum in the washing process, thus solving the problems of water waste and dirt accumulation between the inner and outer drums. However, the manner in which a water level sensor is arranged on the outer drum to detect the water level in the outer drum to control the water feeding process is no

longer applicable in the washing machine.

[0005] In view of this, the present invention is particularly proposed for how to solve the problem of water level detection of the washing machine with a holeless inner drum.

### SUMMARY

[0006] In order to solve the above-mentioned problems, the present invention provides a control method for detecting water level of a holeless inner drum washing machine. In particular, the following technical solutions are adopted:

According to an aspect of the present invention, there is provided a washing machine, including:

a housing;

an inner drum, arranged in the housing and provided with a washing chamber for individually holding washing water; and

a water level detection device, including a detection member and a sensing member, wherein the detection member is arranged on the inner drum, a position of the detection member is raised/lowered as the water level is raised/lowered, and the sensing member correspondingly detects a change in the position of the detection member; the water level within the inner drum is acquired by detecting the position of the detection member by the sensing device.

[0007] Further, the detection member is a magnetic float with magnetism inside the inner drum, and the sensing member is a magnetic field sensing device which acquires the water level inside the inner drum by detecting the change in height of the magnetic float.

[0008] Further, a float shell is arranged in the inner drum, the float shell and a drum wall of the inner drum forms a float chamber communicating with the inside of the inner drum, and the magnetic float is arranged in the float chamber and is capable of floating up and down as the water level varies.

[0009] Further, the float shell is mounted on a rear wall of the inner drum, the float shell and the rear wall forms a float chamber extending radially along the rear wall of the inner drum, and an end of the float shell near a peripheral side wall of the inner drum is provided with a communication port for communicating with the interior of the inner drum.

[0010] Further, a guide structure for guiding the magnetic float to float up and down is arranged in the float shell.

[0011] Preferably, the guide structure is a guide bar arranged inside the float shell. The magnetic float is provided with a through passage inside, the guide bar passes through the through passage of the magnetic float, and the magnetic float is capable of floating up and down

along the guide bar.

**[0012]** Further, the washing machine includes a main controller, wherein the magnetic field sensing device is a Hall sensor, and the Hall sensor is electrically connected to the main controller.

**[0013]** The induced current of the Hall sensor changes as the height of the magnetic float changes, and the main controller acquires the height of the water level within the inner drum from the change in the induced current of the Hall sensor.

**[0014]** Further, the washing machine includes a main controller, the magnetic field sensing device is a reed switch, and a plurality of the reed switches is provided. The path of the reed switch outside the inner drum corresponds to the floating path of the magnetic float floating up and down inside the inner drum. The reed switches are each electrically connected to a main control board. As the height of the magnetic float changes, the reed switch corresponding to the position of the magnetic float is closed, and the main controller acquires the height of the water level within the inner drum based on a closure signal of the reed switch at each position.

**[0015]** Preferably, the reed switches are respectively set according to each set height of the water level of the washing machine, and the main controller determines that water is fed to the set water level when the reed switch corresponding to the set water level is closed during water feeding of the washing machine.

**[0016]** Further, the washing machine includes an outer drum on which the magnetic field sensing device is arranged.

**[0017]** Preferably, the magnetic field sensing device is arranged on a rear wall of the outer drum.

**[0018]** Further, a positioning device is arranged on the outer drum, the positioning device is provided with a positioning rod being retractable, and a positioning hole is arranged on the inner drum for matching with the positioning rod.

**[0019]** When the positioning rod of the positioning device is extended out and matches with the positioning hole to lock the inner drum, the magnetic field sensing device corresponds to the magnetic float.

**[0020]** Further, a light emitting device is arranged in the inner drum, and the drum wall of the inner drum is provided with a light transmitting part for allowing the light emitted from the light emitting device to pass through. The detection member is a float arranged in the inner drum and is capable of floating up and down along the light transmitting part. The sensing member is a light-sensing device.

**[0021]** As the water level within the inner drum changes, the float floats along the light transmitting part to change the light emitted by the light transmitting part. The magnetic field sensing device acquires the height of the water level within the inner drum by detecting the change in light.

**[0022]** According to another aspect of the present invention, a control method of a washing machine is pro-

vided, the washing machine including: a housing; an inner drum arranged in the housing and provided with a washing chamber individually holding washing water; and a water-level detection device, being arranged on the inner drum, the position of the detection member being raised/lowered as the water level rises/lowers, and the sensing member correspondingly detecting a change in the position of the detection member; and the control method includes:

5 during feeding water in the washing machine, positioning the inner drum to a position where the detection member corresponds to the sensing member, and acquiring the water level within the inner drum by detecting the position of the detection member via the sensing member by the washing machine.

10 **[0023]** Further, the driving motor is controlled to rotate the inner drum to perform a rotation process during feeding water in the washing machine.. After the rotation process ends, the driving motor is controlled to stop in a fixed position to position the inner drum to a position where the detection member corresponds to the sensing member.

15 **[0024]** Further, in feeding water in the washing machine, the drive motor is controlled to drive the inner drum to execute the rotation process at intervals. After each rotation process ends, the drive motor is controlled to stop in a fixed position to position the inner drum to a position where the detection member corresponds to the sensing member. The washing machine acquires the water level inside the inner drum by detecting the position of the detection member by the sensing member. When the water level inside the inner drum reaches a set value, the process of feeding water ends. When the water level inside the inner drum does not reach the set value, feeding water continues and the rotation process is performed.

20 **[0025]** Further, when the value of the present water level inside the inner drum acquired by the washing machine is equal to or more than 4/5 of the set water level value, the driving motor is controlled to stop driving the inner drum to perform the rotation process, and the inner drum of the washing machine is positioned in a position where the detection member corresponds to the sensing member. The washing machine releases the positioning of the inner drum, when the water level inside the inner drum reaches the set water level.

25 **[0026]** Further, a positioning device is arranged on the outer drum of the washing machine, the positioning device is provided with a positioning rod being retractable, and the inner drum is provided with a positioning hole for matching with the positioning rod.

30 **[0027]** In feeding water in the washing machine, the inner drum is locked by controlling the positioning rod of the positioning device to extend out and match with the positioning hole, and the detection member corresponds to the sensing member.

35 **[0028]** Further, after the washing machine is started, the washing machine weighs the clothes inside the inner

drum before starting feeding water, and sets the water level for the water feeding process according to the clothes weight.

**[0029]** In one embodiment of the present invention, the detection member is a magnetic float with magnetism inside the inner drum, and the sensing member is a magnetic field sensing device. The control method includes: acquiring the water level inside the inner drum by detecting the position of the magnetic float through the magnetic field sensing device during the water feeding process of the washing machine.

**[0030]** Further, the magnetic field sensing device is a Hall sensor. The control method includes: an induced current of the Hall sensor varying as the position of the magnetic float varies in the water feeding process of the washing machine, and acquiring the water level inside the inner drum according to the change of the induced current of the Hall sensor by the washing machine.

**[0031]** Further, the magnetic field sensing device is a reed switch, a plurality of the reed switches are provided, the path of the reed switch outside the inner drum corresponds to the floating path of the magnetic float floating up and down inside the inner drum, the reed switches are each electrically connected to a main control board; and the control method includes:

in the water feeding process, the magnetic float rising as the water level rises, the reed switch corresponding to the position of the magnetic float being closed during the rising of the magnetic float, and acquiring the water level inside the inner drum based on a closure signal of the reed switch at a position by the washing machine.

**[0032]** In another embodiment of the present invention, a light emitting device is arranged in the inner drum, the drum wall of the inner drum is provided with a light-transmitting part for allowing the light emitted from the light emitting device to pass through, the detection member is a float arranged in the inner drum and capable of floating up and down along the light transmitting part, the sensing member is a light-sensing device. The control method includes: in the water feeding process of the washing machine, the float floating along the light transmitting part with a change of the water level within the inner drum to change the light emitted by the light transmitting part, and acquiring the water level within the inner drum by detecting the change in light via the magnetic field sensing device by the washing machine.

**[0033]** In the washing machine provided by the invention, there is no the washing/rinsing water between the inner drum and the outer drum, which not only avoids the possibility of dirt adhesion between the inner drum and the outer drum, but also avoids the dirt of the inner drum and the outer drum, thus improving the health and user experience of users. Moreover, the washing water consumption of the washing machine is reduced and the water consumption is saved.

**[0034]** The water level detection device of the invention is arranged with respect to the structural characteristics of the washing machine with a holeless inner drum. The

position of the detection member arranged in the inner drum can change with the change of water level, and the sensing member arranged on the outside of the inner drum correspondingly detects the change of the position of the detection member. The sensing member acquires the height of water level in the inner drum by detecting the position of the detection member, thus realizing the detection of water level in the inner drum. The water level detection device of the invention is used for detecting the water level of the holeless inner drum washing machine, has a simple structure, high detection precision and broad market prospect.

**[0035]** The control method of the washing machine realizes the water level detection of the holeless inner drum by controlling the positioning of the inner drum and cooperating with the water level detection device during the water feeding process, and the water level detection is accurate, simple, effective, stable and reliable.

## BRIEF DESCRIPTION OF THE DRAWINGS

### [0036]

Fig. 1 is a front view of a washing machine according to Embodiment 1 of the present invention;

Fig. 2 is a cross-sectional view along the plane X-X in Fig. 1;

Fig. 3 is an enlarged partial view of A in Fig. 2;

Fig. 4 is a flow chart of a control method of a washing machine according to Embodiment 2 of the present invention; and

Fig. 5 is another flow chart of a control method of a washing machine according to Embodiment 2 of the present invention.

**[0037]** Description of reference signs in the drawings: 1. housing; 2. door; 3. main controller; 4. outer drum; 5. inner drum; 6. lifting rib; 7. detection member; 8. sensing member; 9. foot; 10. conical structure; 11. centrifugal drainage mechanism; 12. water inlet valve; 13. drainage device; 14. inner drum door; 15. sealed compartment structure; 16. detergent delivery device; 17. upper deck plate; 18. hollow channel; 19. inner drum shaft; 20. driving motor; 21. peripheral side wall; 22. float shell; 23. guide bar; 24. rear wall; 25. communication port; 26. pressure equalizing channel.

## DETAILED DESCRIPTION

**[0038]** A control method of a washing machine according to the present invention is described in detail with reference to the accompanying drawings.

**[0039]** Embodiment 1As shown in Figs. 1 to 3, a washing machine of the present embodiment includes:

a housing 1;

an inner drum 5, arranged in the housing 1 and having a washing chamber for independently holding washing water; and

a water level detection device, including a detection member 7 and a sensing member 8, the detection member 7 being arranged on the inner drum 5, the position of the detection member 7 being configured to be raised/lowered as the water level is raised/lowered, and the sensing member 8 for correspondingly detecting a change in the position of the detection member 7. The water level within the inner drum 5 is obtained by sensing device 8 detecting the position of the detection member 7.

**[0040]** The washing machine provided by the invention does not need to fill the washing/rinsing water between the inner drum and the outer drum, which not only avoids the possibility of dirt adhesion between the inner drum and the outer drum, but also avoids to dirty the inner drum and the outer drum, thus improving the health and using experience of users. Moreover, the washing water consumption of the washing machine is reduced and the water consumption is saved.

**[0041]** The water level detection device of the present embodiment is directed to the structural characteristics of a washing machine with a holeless inner drum. The position of the detection member 7 inside the inner drum 5 is variable as the water level changes, and the sensing member 8 is arranged outside the inner drum 5 to correspondingly detect the position change of the detection member 7. The sensing member 8 detects the position of the detection member 7 to obtain the height of the water level in the inner drum 5, thereby realizing the detection of the water level in the inner drum.

**[0042]** The position of the detection member 7 of the present embodiment changes as the water level changes by utilizing the physical properties of water. The detection member 7 may not be powered, which solves the problem that structural members within the holeless inner drum cannot be powered. The sensing device 8 can indirectly detect the height of the water level in the inner drum by detecting the detection member 7. The sensing member 8 is arranged outside the inner drum, or arranged on a fixed member, or arranged on the outer drum or arranged in the housing, so as not to affect the supply of power to the sensing member 8 and the exchange of data and control signals between the sensing member 8 and the main controller 3 of the washing machine.

**[0043]** The inner drum 5 of the present embodiment is a holeless inner drum with an enclosed drum wall, the inner drum door 14 is arranged on the opening of the inner drum, to form an independent sealed compartment structure 15. Thereby it is avoided that clothes comes out of the inner drum 5, and clothes flows out or water splashes out of the inner drum due to pressure and falling,

and dirt adhesion between the inner and outer drums is further avoided. Thus there is no water between the inner and outer drums.

**[0044]** When the rotation speed of the inner drum reaches 1600 rpm in dewatering and if the inner drum door on the inner drum is not locked well, a safety accident will occur. The washing machine according to the present embodiment has a door lock detection device for detecting whether the inner drum door is locked at set position, such that it is ensured that the inner drum door is locked at the set position and the accuracy of locking judgment is 100%. The safety of the washing machine is greatly improved and the user experience is improved.

**[0045]** As an implementation of the present embodiment, the detection member 7 is a magnetic float with magnetism and arranged in the inner drum 5, and the sensing member 8 is a magnetic field sensing device which can detect the water level inside the inner drum by detecting the change in height of the magnetic float.

**[0046]** In the present embodiment, the water level in the holeless inner drum of the washing machine is detected by using the magnetic field sensing device to sense the magnetic float. The configuration is simple and the detection precision is high.

**[0047]** Further, in order to install the magnetic float, a float shell 22 is arranged in the inner drum 5, the float shell 22 and a drum wall of the inner drum 5 forms a float chamber for communicating with the inside of the inner drum, and the magnetic float is arranged in the float chamber and floating up and down along the change of the water level.

**[0048]** In particular, the float shell 22 is mounted on a rear wall 24 of the inner drum 5. The float shell 22 and the rear wall 24 forms the float chamber extending radially along the rear wall 24 of the inner drum 5, and an end of the float shell near a peripheral side wall 21 of the inner drum 5 is provided with a communication port 25 for communicating with the interior of the inner drum.

**[0049]** In this embodiment, the float shell 22 is arranged on the rear wall 24 of the inner drum 5, so that it does not occupy the middle space of the inner drum 5 and has no influence on washing the clothes. The float chamber extending radially along the rear wall 24 of the inner drum 5 is formed between the float shell 22 and the rear wall 24, so that the float chamber can be arranged vertically for measuring water level height by positioning the inner drum 5.

**[0050]** In this embodiment a guide structure is arranged in the float shell for guiding the magnetic float to float up and down, in order to better guide the magnetic float to slide up and down, improve the detection accuracy and ensure that the magnetic float moves within the detection range of the magnetic field detection device.

**[0051]** Preferably, the guide structure is a guide bar 23 arranged inside the float shell. The magnetic float is provided with a through passage inside, the guide bar 23 passes through the through passage of the magnetic float, and the magnetic float can float up and down along

the guide bar.

**[0052]** As an implementation of the present embodiment, the washing machine of the present embodiment includes a main controller 3. The magnetic field sensing device is a Hall sensor, and the Hall sensor is electrically connected to the main controller 3. The induced current of the Hall sensor changes with the change of the height of the magnetic float. The main controller 3 acquires the height of the water level within the inner drum from the change in the induced current of the Hall sensor.

**[0053]** As another implementation of the present embodiment, the washing machine of the present embodiment includes a main controller 3. The magnetic field sensing device is a reed switch, and a plurality of the reed switches are arranged. The paths of the reed switches outside the inner drum correspond to the floating path of the magnetic float moving up and down inside the inner drum, and each of the reed switches is electrically connected to the main controller 3. As the height of the magnetic float changes, the reed switch corresponding to the height position of the magnetic float is closed, and the main controller 3 acquires the height of the water level within the inner drum based on a closure signal of the reed switch at each position.

**[0054]** Preferably, the reed switches are respectively arranged corresponding to the set heights of the water level of the washing machine. The main controller determines that water is fed to the set water level when the reed switch corresponding to the set water level is closed during feeding water into the washing machine.

**[0055]** Further, the washing machine of the present embodiment includes an outer drum 4 on which the magnetic field sensing device is arranged. Preferably, the magnetic field sensing device is arranged on a rear wall of the outer drum 4.

**[0056]** Since the inner drum rotates during the washing process and the float chamber in which the electromagnetic float is located is required to be vertically arranged for detecting the water level within the inner drum, the inner drum needs to be positioned to the set position in detecting the water level. In order to achieve this objective, a positioning device is arranged on the outer drum 4, the positioning device is a positioning rod being retractable, and a positioning hole is arranged on the inner drum 5 for cooperating with the positioning rod. When the positioning rod of the positioning device is extended out and cooperates with the positioning hole to lock the inner drum, the magnetic field sensing device corresponds to the magnetic float, and the float chamber is vertically arranged.

**[0057]** In addition, the inner drum 5 can also be locked in the set position by the driving motor of the washing machine.

**[0058]** Another solution of detecting the water level of the holeless inner drum is also provided in the embodiment. In this embodiment, a light emitting device is arranged in the inner drum 5, and the drum wall of the inner drum 5 is provided with a light transmitting part for allow-

ing the light emitted from the light emitting device to pass through. The detection member 7 is a float arranged in the inner drum 5 and floating up and down along the light transmitting part, and the sensing member is a light-sensing device.

**[0059]** As the water level within the inner drum changes, the float floats along the light transmitting part to change the light emitted through the light transmitting part. The light-sensing device acquires the height of the water level within the inner drum by detecting the change of the light.

**[0060]** The light-emitting device in the above manner may be powered by a battery while being sealed.

**[0061]** The washing machine of the present embodiment employs a holeless inner drum. In order to drain water out of the holeless inner drum, a drain hole is arranged in the side wall of the inner drum of the present embodiment. The drain hole is provided with a centrifugal drainage mechanism 11 which is kept in a normally closed state of the drain hole to form a holeless inner drum for holding washing water independently. The inner drum is controlled to turn at high speed in draining water out. The centrifugal drainage mechanism 11 opens the drain hole under the centrifugal action at the high speed, and washing water is drained from the drain hole. Preferably, a plurality of lifting ribs 6 are arranged on the drum wall of the inner drum 5, and the centrifugal drainage mechanism 11 is arranged in an internal chamber of at least one of the lifting ribs 6.

**[0062]** In order to improve the drainage efficiency of the inner drum 5, the centrifugal drainage mechanism 11 of the present embodiment is arranged in the middle of the side wall of the inner drum, the side wall of the inner drum has a conical structure 10 with an inner diameter gradually increasing from the opening of the inner drum to the centrifugal drainage mechanism 11, and a conical structure with a gradually increasing inner diameter is formed from the rear wall of the inner drum to the centrifugal drainage mechanism 11. The inner drum having two ends with small diameter and a middle with large diameter is formed, so that water in the inner drum can be better guided to the centrifugal drainage mechanism 11 in the middle to be discharged through the conical structure in the process of high-speed centrifugal drainage.

**[0063]** The bottom of the outer drum 4 of the present embodiment is connected to a drainage device 13 for draining water out of the housing 1.

**[0064]** The washing machine of the present embodiment has a housing 1 which includes an upper deck plate 17, a front plate, a rear plate and a bottom plate. Feet 9 are mounted on the bottom plate for supporting the entire washing machine and the door 2 is mounted on the front plate. The outer drum 4 is arranged inside the housing 1, and the inner drum 5 is arranged coaxially inside the outer drum 4. The outer drum 4 is used to collect water drained out of the inner drum 5 and water drained out of the inner drum 5 in dewatering at high-speed centrifugal.

The clothes is continuously lift and fall to hit by the lifting ribs 6 set in the inner drum in rotation of the inner drum 5, so as to wash beter the clothes. The inner drum 5 is of a holeless structure, and the outer drum 4 has a central mounting hole on which a bearing is mounted and fixed. The inner barrel shaft 19, which is tightly connected with the inner drum 5, passes through the bearing and is connected with the driving motor 20.

**[0065]** In order to feed water into the holeless inner drum of the present embodiment, the driving motor 20 of the washing machine in this embodiment is fixedly connected and the inner drum 5 through the inner drum shaft 19 to drive the inner drum 5 to rotate, the inner drum shaft 19 has a hollow channel 18 communicating with the inside of the inner drum 5, and a water inlet pipeline of the washing machine is connected with the hollow channel 18 of the inner drum shaft 19. The water inlet end of the water inlet pipeline is extended out of the housing 1 of the washing machine to connect with the faucet, and the water inlet pipeline is connected with the water inlet valve 12, the detergent delivery device 16 and the hollow channel 18 of the inner drum shaft 19 in turn.

**[0066]** An air pressure balancing mechanism is arranged on the inner drum 5 of the present embodiment for communicating the inner drum 5 with the outside environment to balance the air pressure inside the inner drum.

**[0067]** In feeding water, the gas under pressure within the sealed compartment of the inner drum can escape through the equalizing mechanism to ensure air pressure equilibrium.

**[0068]** When the water is suddenly turned off, the outside atmosphere can quickly enter the sealed compartment of the inner drum and block the reverse suction to ensure air pressure equilibrium, thus avoiding the washing water from being drawn into the water supply pipe.

**[0069]** In the other cases, such as in dehydration, the air pressure balancing mechanism can also ensure air pressure balance of the inner drum.

**[0070]** As an implementation of the present embodiment, the air pressure balancing mechanism includes a pressure equalizing channel 26 arranged on the inner drum shaft 19 for connecting the inside of the inner drum 5 with the outside environment. The highest water level in the inner drum 5 is lower than the inner drum shaft, which prevents water within the inner drum 5 from flowing out of the pressure equalizing channel 26.

**[0071]** The pressure equalizing channel 26 in this embodiment includes a first channel segment and a second channel segment. The first channel segment is arranged in parallel with the hollow channel, and one end of the first channel segment is communicated with the interior of the inner drum. One end of the second channel segment is communicated with the first channel segment and the other end of the second channel segment is extended on the outer peripheral wall of the inner drum shaft and is communicated with the interior of the outer drum. Preferably, the second channel segment is ar-

ranged perpendicular to the first channel segment to form the pressure equalizing channel with an L-shape.

## Embodiment 2

**[0072]** Figs. 4 and 5 show a control method of the washing machine of the present embodiment. The washing machine includes: a housing, an inner drum arranged in the housing and provided with a washing chamber independently holding washing water, and a water level detection device. The water level detection device includes a detection member and a sensing member. The detection member is arranged the position where the detection member can move with the change of the water level, and the sensing member is arranged on the outside of the inner drum correspondingly detecting the change of the position of the detection member.

**[0073]** The control method includes: during water feeding of the washing machine, the inner drum is positioned to a position where the detection member is in a position corresponding to the sensing member; and the water level within the inner drum is acquired by detecting the position of the detection member via the sensing member of the washing machine.

**[0074]** Through the control method of the embodiment, the water level of the holeless inner drum is detected by controlling to position the inner drum and matching with the water level detection device during the water feeding process, and the water level detection is accurate, simple, effective, stable and reliable.

**[0075]** As an embodiment of the present implementation, the driving motor is controlled to drive the inner drum to rotate during the water feeding process of the washing machine. After the rotation process of the inner drum ends, the driving motor is controlled to stop in a fixed position to position the inner drum to a position where the detection member corresponds to the sensing member. The washing machine controls the rotation of the inner drum in the water feeding process, so that the clothes can be better soaked and the washing effect of the clothes can be improved. In the water feeding process, the water level detection is carried out by controlling the rotation of the inner drum and positioning the inner drum alternately, which not only ensures the wetting effect of clothes, but also the water level in the inner drum is detected, which is convenient for controlling the water feeding process.

**[0076]** In particular, in the water feeding process of the washing machine, the drive motor is controlled to drive the inner drum to execute the rotation process at intervals. After each rotation process ends, the drive motor is controlled to stop in a fixed position to position the inner drum to a position where the detection member corresponds to the sensing member, and the washing machine acquires the water level inside the inner drum by detecting the position of the detection member by the sensing member. When the water level inside the inner drum reaches a set value, the water feeding process

ends. When the water level inside the inner drum does not reach the set value, the water feeding continues and the rotation process is performed.

**[0077]** Further, when the water level inside the inner drum acquired by the washing machine is equal to or more than 4/5 of the set water level value, the driving motor is controlled to stop driving the inner drum to perform the rotation process, the inner drum of the washing machine is positioned in a position where the detection member corresponds to the sensing member. When the water level inside the inner drum reaches the set water level, the washing machine releases the positioning of the inner drum.

**[0078]** When the water level detection device detects that the water level value is about to reach the set water level, the rotation process of the inner drum is stopped. And the water level detection continues until the set water level is reached so as to avoid causing the water level to be too high.

**[0079]** As another implementation of the present embodiment, a positioning device is arranged on the outer drum of the washing machine, the positioning device is provided with a positioning rod being retractable, and the inner drum is provided with a positioning hole for cooperating with the positioning rod.

**[0080]** In the water feeding process of the washing machine, the inner drum is locked by controlling the positioning rod of the positioning device to extend out and cooperate with the positioning hole, and the detection member corresponds to the sensing member.

**[0081]** According to the control method of the washing machine, the washing machine is started, the washing machine weighs the clothes inside the inner drum before feeding water, and sets the water feeding level for the water feeding process according to the clothes weight.

**[0082]** In this embodiment, the detection member is a magnetic float with magnetism inside the inner drum, and the sensing member is a magnetic field sensing device. The control method includes: acquiring the water level inside the inner drum by detecting the position of the magnetic float through the magnetic field sensing device during the water feeding process of the washing machine.

**[0083]** In one implementation of the present embodiment, the magnetic field sensing device is a Hall sensor. The control method includes: acquiring the height of the water level inside the inner drum according to the change of the induced current of the Hall sensor since the induced current of the Hall sensor varies as the height of the magnetic float varies in the water feeding process of the washing machine.

**[0084]** A further implementation of the present embodiment, the magnetic field sensing device is a reed switch, and a plurality of the reed switches are provided, the path of the reed switch outside the inner drum corresponds to the floating path of the magnetic float moving up and down inside the inner drum, all of the reed switches are respectively electrically connected to a main control board.

**[0085]** The control method includes: acquiring the height of the water level inside the inner drum based on a closure signal of the reed switch at each position by the washing machine since the magnetic float rises as the water level rises in the water feeding process of the washing machine, and the reed switch corresponding to the position of the height of the magnetic float is closed during the rising of the magnetic float.

**[0086]** In this embodiment, a light emitting device is arranged in the inner drum, the drum wall of the inner drum is provided with a light-transmitting part for allowing the light emitted from the light emitting device to pass through, and the detection member is a float arranged in the inner drum and floating up and down along the light transmitting part. The sensing member is a light-sensing device. The control method includes: acquiring the height of the water level within the inner drum by detecting the change in light by the magnetic field sensing device by the washing machine since the float floats along the light transmitting part to change the light emitted by the light transmitting part as the water level within the inner drum changes in the water feeding process of the washing machine.

**[0087]** The above description is only a few preferred embodiments of the invention and is not intended to limit the invention in any form. Although the invention has been disclosed in better embodiments, it is not intended to limit the invention. Without departing from the scope of the technical solution of the invention, any technician familiar with the present patent can use the above-mentioned technical content to make some changes or modify it into equivalent embodiments with equivalent changes. However, any simple modifications, equivalent changes and modifications made to the above embodiments according to the technical essence of this invention are still within the scope of the technical solution of this invention.

## Claims

1. A washing machine, comprising:

a housing;  
an inner drum, arranged in the housing and provided with a washing chamber for individually holding washing water; and  
a water level detection device, comprising a detection member and a sensing member, wherein, the detection member is arranged on the inner drum, a position of the detection member is raised/lowered as a water level is raised/lowered, and the sensing member detects a change in the position of the detection member; and the water level within the inner drum is acquired by detecting the position of the detection member by the sensing device.

2. The washing machine according to claim 1, wherein,



the detection member is a magnetic float with magnetism inside the inner drum, and the sensing member is a magnetic field sensing device which acquires the water level inside the inner drum by detecting the change in position of the magnetic float.

3. The washing machine according to claim 2, wherein, a float shell is arranged in the inner drum, the float shell and a drum wall of the inner drum form a float chamber for communicating with an inside of the inner drum, and the magnetic float is arranged in the float chamber and is capable of floating up and down as the water level varies.

4. The washing machine according to claim 3, wherein, the float shell is mounted on a rear wall of the inner drum, the float shell and the rear wall form the float chamber extending radially along the rear wall of the inner drum, and an end of the float shell near a peripheral side wall of the inner drum is provided with a communication port for communicating with the interior of the inner drum.

5. The washing machine according to claim 3, wherein, a guide structure for guiding the magnetic float to float up and down is arranged in the float shell; preferably, the guide structure is a guide bar arranged inside the float shell, the magnetic float is provided with a through passage inside, the guide bar passes through the through passage of the magnetic float, and the magnetic float is capable of floating up and down along the guide bar.

6. The washing machine according to claim 2, comprising a main controller, wherein the magnetic field sensing device is a Hall sensor, and the Hall sensor is electrically connected to the main controller; and an induced current of the Hall sensor changes as the position of the magnetic float changes, and the main controller acquires the water level within the inner drum from a change in the induced current of the Hall sensor.

7. The washing machine according to claim 2, comprising a main controller, wherein the magnetic field sensing device is a reed switch, a plurality of the reed switches are provided, paths of the reed switches outside the inner drum correspond to a floating path of the magnetic float floating up and down inside the inner drum, the reed switches are each electrically connected to a main control board;

as the position of the magnetic float changes, the reed switch corresponding to the position of the magnetic float is closed, and the main controller acquires the water level within the inner drum based on a closure signal of the reed switch at each position;

preferably, the reed switches are respectively set according to the set water levels of the washing machine, and the main controller determines that water is fed to the set water level when the reed switch corresponding to the set water level is closed during water feeding of the washing machine.

8. The washing machine according to any one of claims 2 to 7, comprising an outer drum on which the magnetic field sensing device is arranged; and preferably, the magnetic field sensing device is arranged on a rear wall of the outer drum.

9. The washing machine according to claim 8, wherein, a positioning device is arranged on the outer drum, the positioning device is provided with a positioning rod being retractable, and a positioning hole is arranged on the inner drum for matching with the positioning rod; and when the positioning rod of the positioning device is extended out and matches with the positioning hole to lock the inner drum, the magnetic field sensing device is corresponding to the magnetic float.

10. The washing machine according to claim 1, wherein, a light emitting device is arranged in the inner drum, a drum wall of the inner drum is provided with a light transmitting part for allowing the light emitted from the light emitting device to pass through, the detection member is a float arranged in the inner drum and is capable of floating up and down along the light transmitting part, the sensing member is a light-sensing device; and as the water level within the inner drum changes, the float floats along the light transmitting part to change the light emitted by the light transmitting part, and the magnetic field sensing device acquires the water level within the inner drum by detecting the change in light.

11. A control method of a washing machine, comprising:

during feeding water in the washing machine, positioning an inner drum to a position where a detection member is corresponding to a sensing member, and acquiring a water level within the inner drum by detecting a position of the detection member via the sensing member by the washing machine, wherein

the washing machine comprises: a housing; the inner drum arranged in the housing and provided with a washing chamber for individually holding washing water; and a water-level detection device, wherein, the water-level detection device comprises the detection member and the sensing member, the detection member is arranged on the inner drum, the position of the detection

member is raised/lowered as the water level rises/lowers, and the sensing member correspondingly detects a change in the position of the detection member.

12. The control method of the washing machine according to claim 11, wherein, a driving motor is controlled to rotate the inner drum to perform a rotation process during feeding water in the washing machine, and after the rotation process ends, the driving motor is controlled to stop in a fixed position to position the inner drum to a position where the detection member is corresponding to the sensing member.

13. The control method of the washing machine according to claim 12, wherein, in feeding water in the washing machine, the drive motor is controlled to drive the inner drum to execute the rotation process at intervals,

after each rotation process ends, the drive motor is controlled to stop in a fixed position to position the inner drum to a position where the detection member is corresponding to the sensing member, the washing machine acquires the water level inside the inner drum by detecting the position of the detection member by the sensing member, the process of feeding water ends when the water level inside the inner drum reaches a set value, and the process of feeding water continues and the rotation process is performed when the water level inside the inner drum does not reach the set value.

14. The control method of the washing machine according to claim 13, wherein,, when a value of the present water level inside the inner drum acquired by the washing machine is equal to or greater than 4/5 of the set water level, the driving motor is controlled to stop driving the inner drum to perform the rotation process, the inner drum of the washing machine is positioned in a position where the detection member is corresponding to the sensing member, when the water level inside the inner drum reaches the set water level, and the washing machine releases the positioning of the inner drum.

15. The control method of the washing machine according to claim 12, wherein, a positioning device is arranged on an outer drum of the washing machine, the positioning device is provided with a positioning rod being retractable, and the inner drum is provided with a positioning hole for matching with the positioning rod; and in feeding water in the washing machine, the inner drum is locked by controlling the positioning rod of

the positioning device to extend out and match with the positioning hole, and the detection member is corresponding to the sensing member.

16. The control method of the washing machine according to claim 11, wherein, the washing machine is started, the washing machine weighs the clothes inside the inner drum before starting feeding water, and sets the water level for the process of feeding water according to the clothes weight.

17. The control method of the washing machine according to any one of claims 11-16, wherein, the detection member is a magnetic float with magnetism inside the inner drum, the sensing member is a magnetic field sensing device, and the control method comprises: acquiring the water level inside the inner drum by detecting the position of the magnetic float through the magnetic field sensing device during feeding water in the washing machine.

18. The control method of the washing machine according to claim 17, wherein, the magnetic field sensing device is a Hall sensor, and

the control method comprises: an induced current of the Hall sensor varying as the position of the magnetic float varies in feeding water in the washing machine, acquiring the water level inside the inner drum according to the change of the induced current of the Hall sensor by the washing machine.

19. The control method of the washing machine according to claim 17, wherein, the magnetic field sensing device is a reed switch, a plurality of the reed switches are provided, the paths of the reed switches outside the inner drum corresponds to the floating path of the magnetic float floating up and down inside the inner drum, the reed switches are each electrically connected to a main control board; and the control method comprises:

in the water feeding process, the magnetic float rising as the water level rises, the reed switch corresponding to the position of the magnetic float being closed during the rising of the magnetic float, and acquiring the water level inside the inner drum based on a closure signal of the reed switch at a position by the washing machine.

20. The control method of the washing machine according to any one of claims 11-16, wherein, a light emitting device is arranged in the inner drum, the drum wall of the inner drum is provided with a light-transmitting part for allowing the light emitted from the

light emitting device to pass through, the detection member is a float arranged in the inner drum and capable of floating up and down along the light transmitting part, the sensing member is a light-sensing device, and

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the control method comprises:

in the water feeding process of the washing machine, the float floating along the light transmitting part with a change of the water level within the inner drum to change the light emitted by the light transmitting part, and

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acquiring the water level within the inner drum by detecting the change in light via the magnetic field sensing device by the washing machine.

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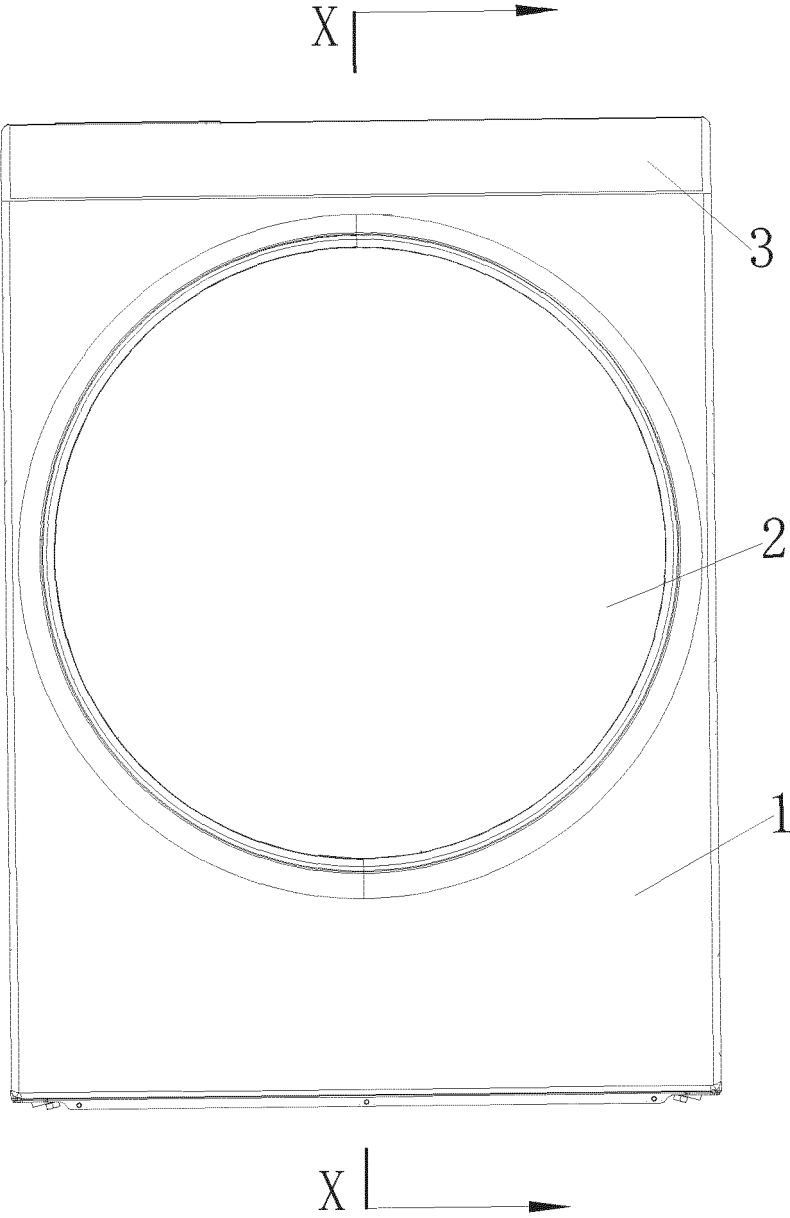


Fig. 1

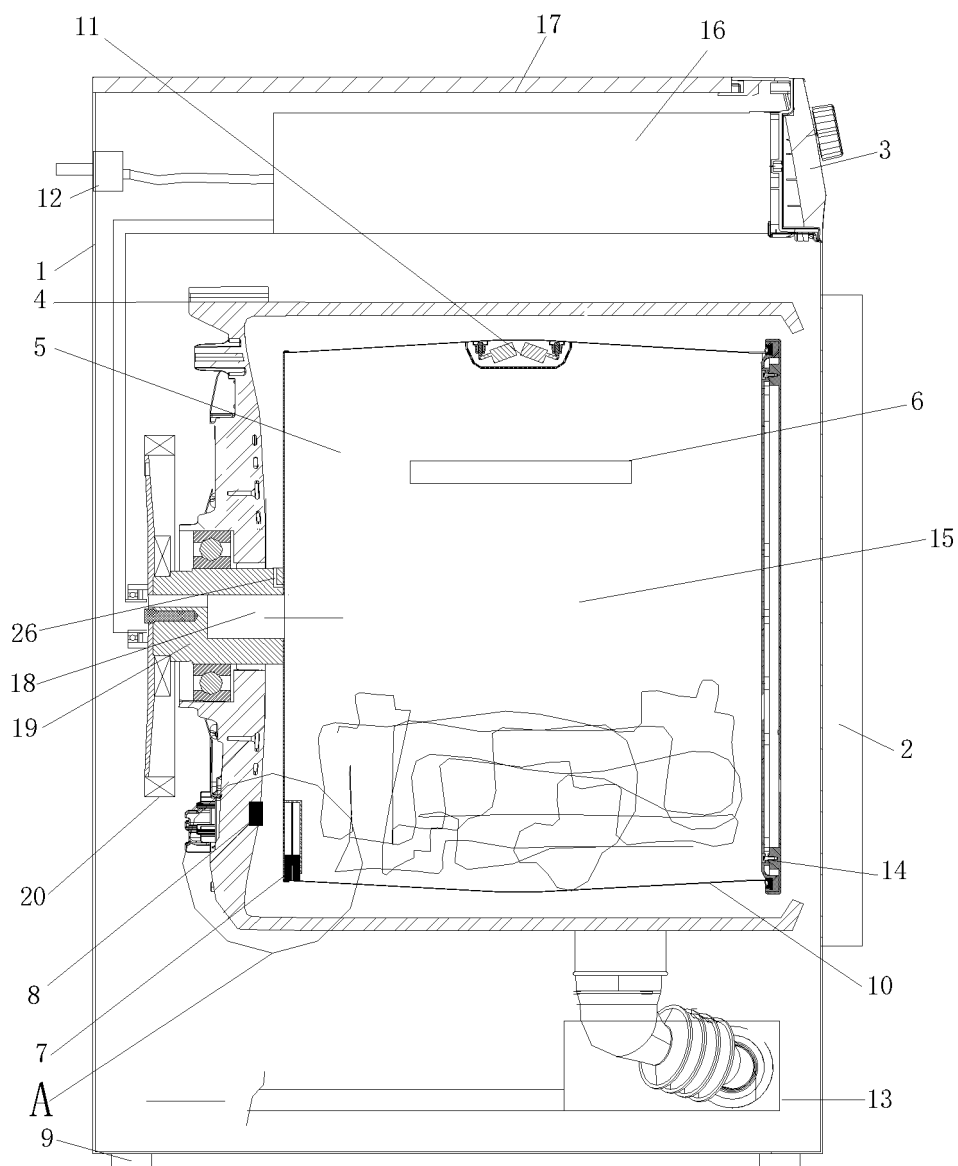


Fig. 2

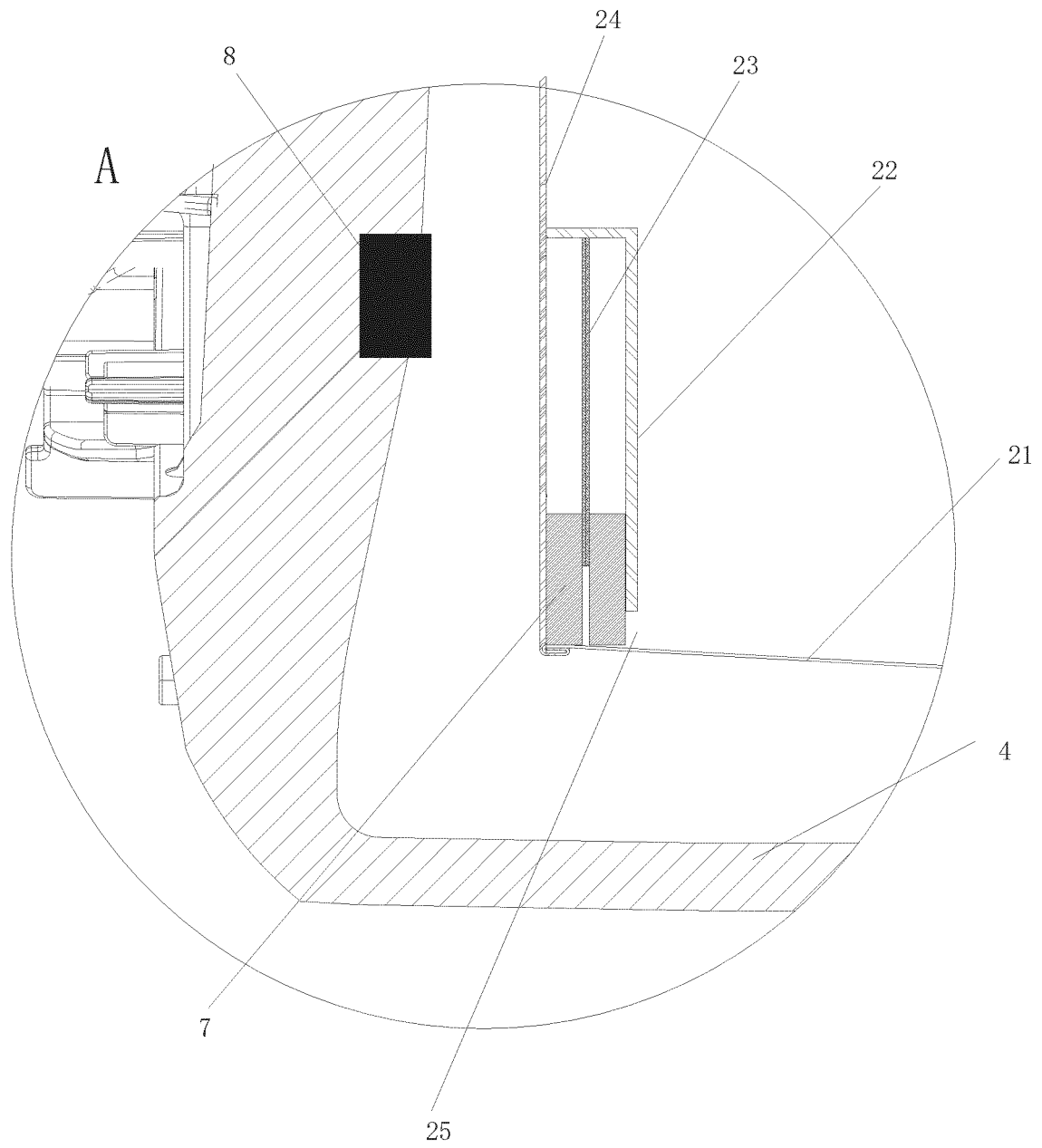


Fig. 3

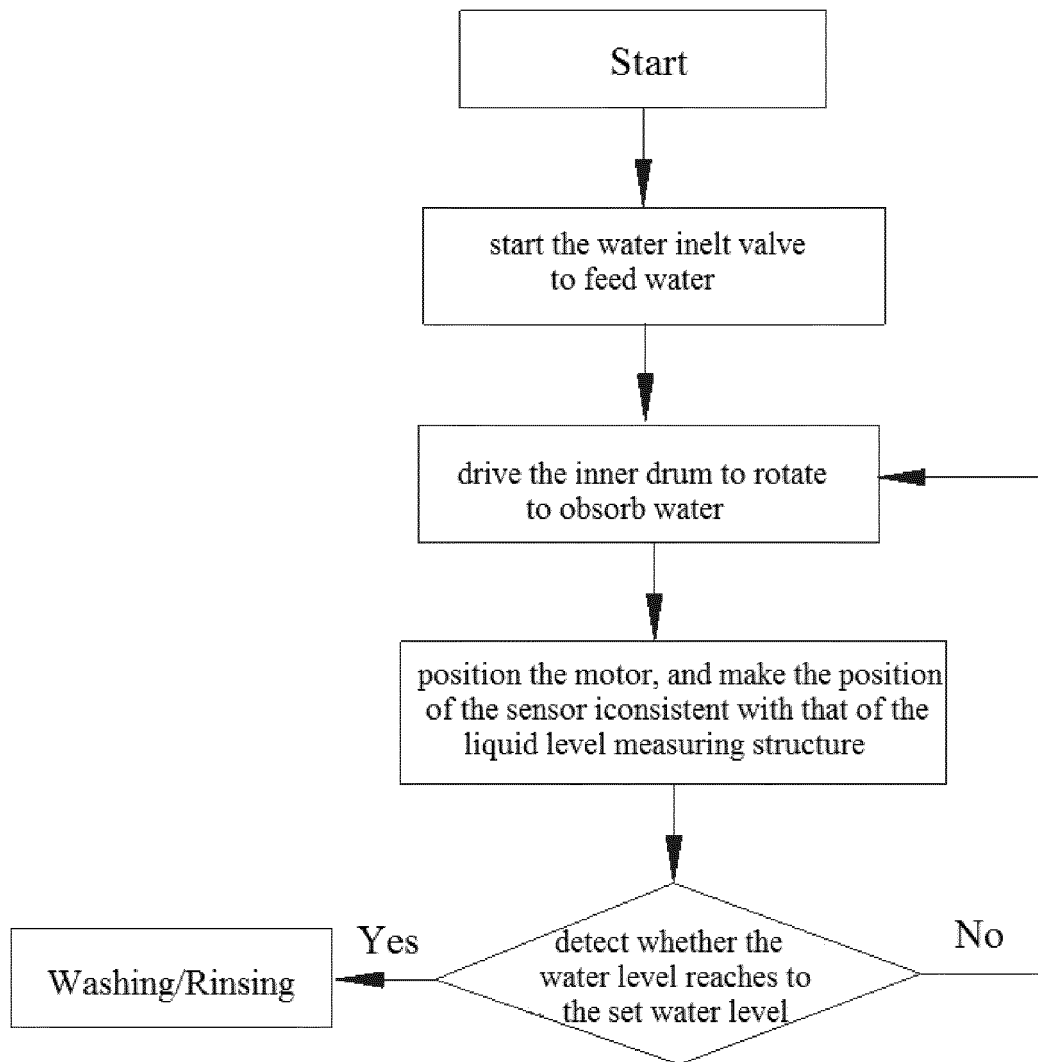


Fig. 4

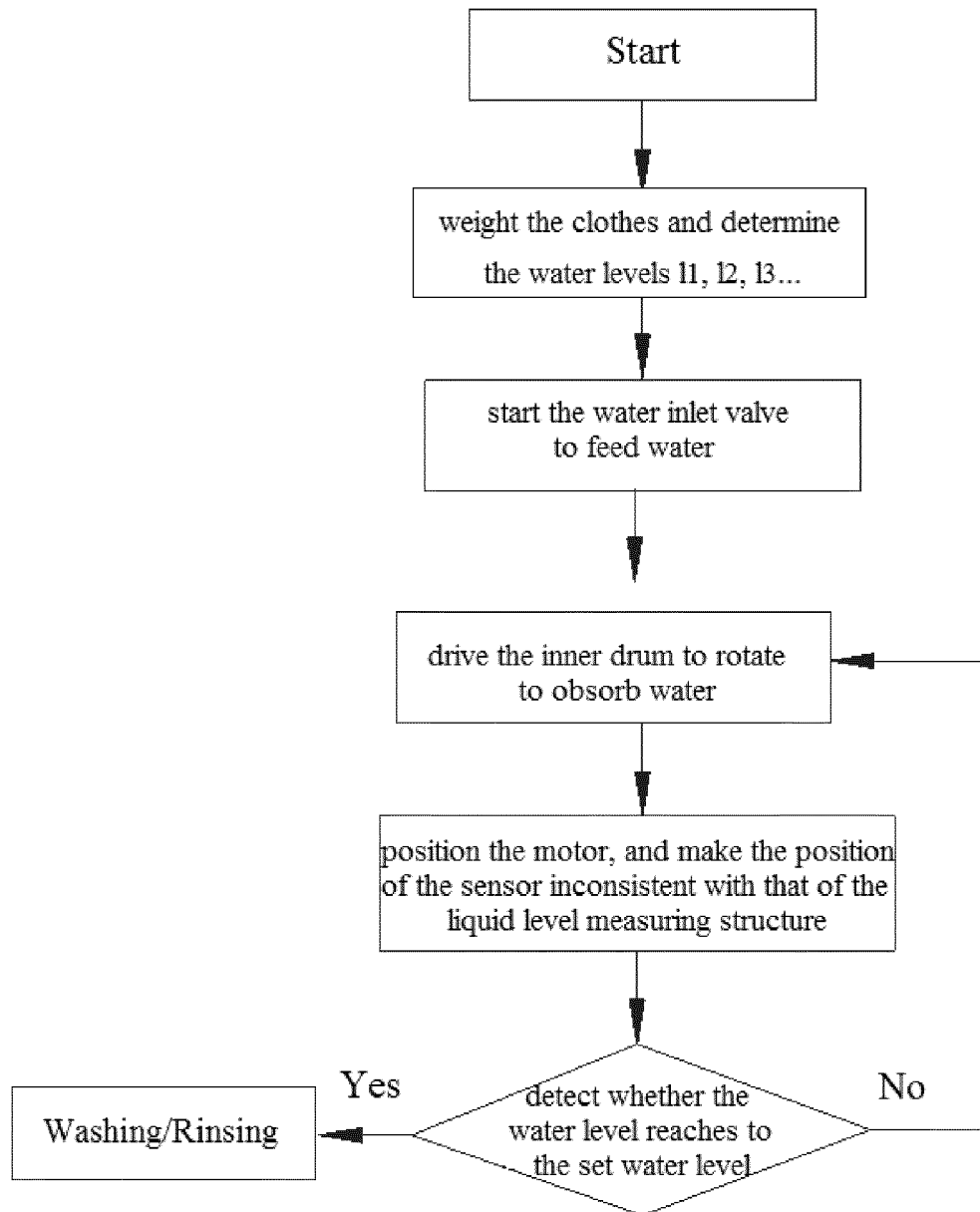


Fig.5



## INTERNATIONAL SEARCH REPORT

International application No.

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|----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 5  | <b>A. CLASSIFICATION OF SUBJECT MATTER</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|    | D06F 39/08(2006.01)i; D06F 37/04(2006.01)i; D06F 103/18(2020.01)i                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|    | According to International Patent Classification (IPC) or to both national classification and IPC                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|    | <b>B. FIELDS SEARCHED</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| 10 | Minimum documentation searched (classification system followed by classification symbols)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|    | D06F                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
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| 15 | Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|    | CNABS, CNTXT, DWPI, SIPOABS, CNKI: 测量, 检测, 浮力装置, 浮子, 浮标, 浮球, 磁力, 磁场, 磁体, 磁性, 水位, 液位, 透光, 透明, 发光, 光线, 光感, 感光, 光传感, 内筒, 内桶, 洗涤桶, 洗涤筒, 无孔, 没有孔 float+, dobber, buoy, water, liquid, level, magnet+, detect+, measur+, gleamy, luminous, transparent, photosensory, ray, light, roller, drum, hole?, aperture?, non+, without                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|    | <b>C. DOCUMENTS CONSIDERED TO BE RELEVANT</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| 20 | Category*                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Citation of document, with indication, where appropriate, of the relevant passages                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|    | Y                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | CN 111088636 (QINGDAO HAIER DRUM WASHING MACHINE CO., LTD.) 01 May 2020 (2020-05-01)<br>description, paragraph [0040], and figure 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| 25 | Y                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | CN 106264402 A (QINGDAO HAIER DISHWASHER CO., LTD.) 04 January 2017 (2017-01-04)<br>description paragraphs [0023-[0029], figures 1-2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|    | A                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | CN 111485378 A (QINGDAO HAIER WASHING MACHINE CO., LTD. et al.) 04 August 2020 (2020-08-04)<br>entire document                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| 30 | A                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | DE 10233278 A1 (WHIRLPOOL CORPORATION) 19 February 2004 (2004-02-19)<br>entire document                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| 35 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| 40 | <input type="checkbox"/> Further documents are listed in the continuation of Box C. <input checked="" type="checkbox"/> See patent family annex.                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| 45 | * Special categories of cited documents:<br>"A" document defining the general state of the art which is not considered to be of particular relevance<br>"E" earlier application or patent but published on or after the international filing date<br>"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)<br>"O" document referring to an oral disclosure, use, exhibition or other means<br>"P" document published prior to the international filing date but later than the priority date claimed | "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention<br>"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<br>"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<br>"&" document member of the same patent family |
| 50 | Date of the actual completion of the international search                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Date of mailing of the international search report                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|    | 04 November 2021                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 24 November 2021                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| 55 | Name and mailing address of the ISA/CN                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Authorized officer                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|    | China National Intellectual Property Administration (ISA/CN)<br>No. 6, Xitucheng Road, Jimenqiao, Haidian District, Beijing 100088, China                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|    | Facsimile No. (86-10)62019451                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Telephone No.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |

Form PCT/ISA/210 (second sheet) (January 2015)

**INTERNATIONAL SEARCH REPORT**  
**Information on patent family members**

International application No.  
**PCT/CN2021/113473**

|    |                                           |           |    |                                      |                         |      |                                      |    |                  |
|----|-------------------------------------------|-----------|----|--------------------------------------|-------------------------|------|--------------------------------------|----|------------------|
| 5  | Patent document<br>cited in search report |           |    | Publication date<br>(day/month/year) | Patent family member(s) |      | Publication date<br>(day/month/year) |    |                  |
|    | CN                                        | 106264402 | A  | 04 January 2017                      |                         | None |                                      |    |                  |
|    | DE                                        | 10233278  | A1 | 19 February 2004                     |                         | DE   | 10233278                             | B4 | 30 December 2004 |
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| 55 |                                           |           |    |                                      |                         |      |                                      |    |                  |

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**REFERENCES CITED IN THE DESCRIPTION**

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