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(71) Applicant: **BSH Hausgeräte GmbH**
81739 München (DE)

(72) Inventors:
- **Li, Liangdong**
  Nanjing, 210000 (CN)
- **Wang, Yukun**
  Nanjing, 210046 (CN)
- **Lu, Jin**
  Nanjing, 210046 (CN)

(54) **WASHING DEVICE**

(57) A washing device, including a control device, a washing tub, and a pump, where the pump is provided with an inlet and an outlet, and a pipeline device and a valve device connect the pump to the washing tub, an air source and a fluid receiving device, where the inlet of the pump is selectively in fluid communication with the air source or the washing tub by switching the valve device, and the outlet of the pump is selectively in fluid communication with the fluid receiving device or the washing tub by switching the valve device, where the valve device is electrically connected to the control device and controlled by the control device. In the washing device, a fluid path may be selected by opening and closing the valve device, so that a plurality of fluid driven modes can be implemented in cooperation with the pump.

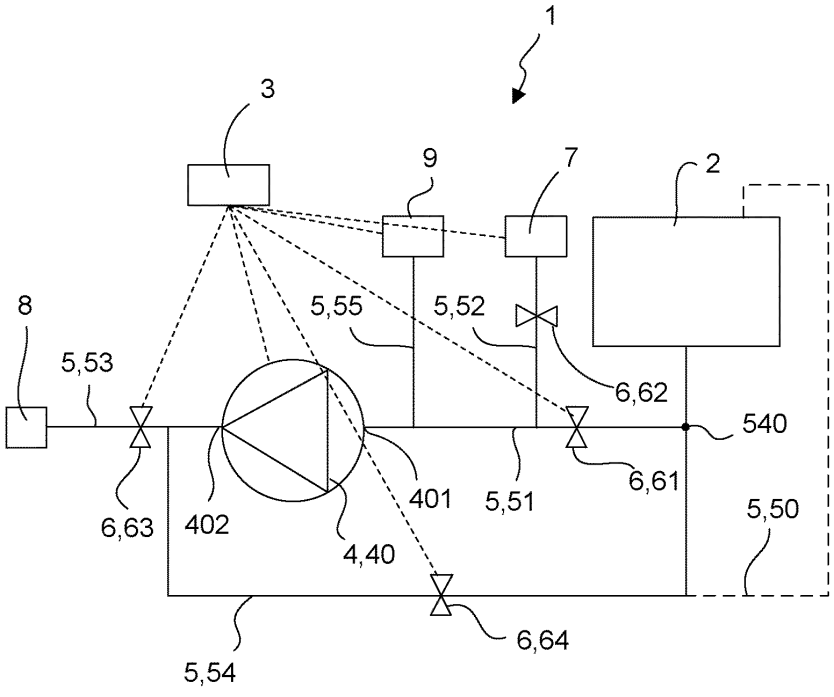

FIG. 1

EP 4 112 804 A1

Description

[0001] The present invention relates to a washing device, and in particular, to a washing device including a fluid driven device.

[0002] A washing device includes a washing tub for washing clothes. Washing liquid in the washing tub needs to be discharged during the running of the washing program or at the end of the program; washing liquid may need to be circulated in the washing process, so that the liquid in the washing tub returns to the washing tub after passing through an external passage of the washing tub; or air in the washing tub may need to be pumped, for example, to form a negative pressure in the washing tub; or air may need to be filled into the washing tub, for example, air bubbles are generated in the washing tub to improve the washing effect and the like. When there are two or more of these requirements, driving of the fluid usually becomes complex. In some cases, a plurality of fluid driven devices further need to be disposed.

[0003] An object of the present invention to provide a washing device with a streamlined fluid system.

[0004] Embodiments of the present invention include a washing device, including a control device, a washing tub, and a fluid driven device, where the fluid driven device is provided with an inlet and an outlet, and a pipeline device and a valve device connect the fluid driven device to the washing tub, an air source and a fluid receiving device, where the inlet of the fluid driven device is selectively in fluid communication with the air source or the washing tub by switching the valve device, and the outlet of the fluid driven device is selectively in fluid communication with the fluid receiving device or the washing tub by switching the valve device, where the valve device is electrically connected to the control device and controlled by the control device.

[0005] The fluid driven device may be various devices capable of driving liquid flow and/or air flow, and a proper fluid driven device is selected and disposed in the washing device according to different usage scenarios. The following specific embodiments are only one or some examples, and cannot be used as a limitation on the present invention.

[0006] In some implementations, the washing tub and the inlet of the fluid driven device are connected through a first pipeline, and the first pipeline is provided with a first valve; and the air source and the inlet of the fluid driven device are connected through a second pipeline, the second pipeline is provided with a second valve, and the control device selectively opens the first valve or the second valve to alternatively communicate the air source or the washing tub with the fluid driven device.

[0007] In some implementations, the first pipeline is connected to the bottom of the washing tub. In an optional implementation, the fluid receiving device and the outlet of the fluid driven device are connected through a third pipeline, and the third pipeline is provided with a third valve; and the washing tub and the outlet of the fluid driven device are connected through a fourth pipeline, the fourth pipeline is provided with a fourth valve, and the control device selectively opens the third valve or the fourth valve.

[0008] In an optional implementation, an end of the fourth pipeline is connected to the first pipeline. In some implementations, the air source is atmosphere, or a functional air generating device.

[0009] In an optional implementation, the fluid receiving device is atmosphere, a waste water pipeline, a water consuming device, a water storage device, or an air consuming device. In a preferable implementation, the fluid driven device is capable of driving both liquid flow and air flow.

[0010] In some implementations, the fluid driven device is a pump.

[0011] The pump includes a motor, an impeller driven to rotate by the motor, and an impeller cavity disposed around the impeller, where the impeller cavity includes a peripheral wall located on an outer side of the impeller in a radial direction, and an end wall located on an outer side of the impeller in an axial direction and opposite to the motor, the end wall is provided with the inlet and the outlet spaced apart, and an edge of the outlet is kept at a spacing distance from the peripheral wall in the radial direction.

[0012] In an optional implementation, the inlet is provided with an inlet connection port, and a cross section of the inlet connection port increases in a direction in which a fluid flows into the impeller cavity.

[0013] In an optional implementation, the outlet is provided with an outlet connection port, and a cross section of the outlet connection port decreases in a direction in which a fluid flows out of the impeller cavity.

[0014] In an optional implementation, a water supply unit is connected to an inlet of the impeller cavity through a fifth pipeline, and the control device is configured to include a process of driving air with the pump, where in the process of driving the air, the water supply unit is intermittently opened.

[0015] The foregoing embodiments may be combined in any feasible manner.

[0016] In the washing device in the embodiments of the present invention, a fluid path may be selected by opening and closing the valve device, so that a plurality of fluid driven modes can be implemented in cooperation with the fluid driven device. In addition, it is possible to implement a plurality of fluid driven modes of the washing device through one fluid driven device, which saves the cost of components and the cost of space in a machine. For example, when the inlet of the fluid driven device is in communication with the washing tub, and the outlet is in communication with the fluid receiving device, the fluid may be discharged from the washing tub to the fluid receiving device. The fluid may be liquid or air. When both the inlet and the outlet of the fluid driven device are in communication with the washing tub, a fluid circulation may be formed. When the inlet is in communication with

the air source and the outlet is in communication with the washing tub, air may be supplied into the washing tub. For example, air bubbles may be generated in the water, or air may be filled in sealed washing tub. When the inlet is in communication with the air source and the outlet is in communication with the fluid receiving device, air may be supplied into the fluid receiving device.

[0017] The fluid driven device is capable of driving both liquid flow and air flow, so that the fluid driven system has higher adaptability and flexibility.

[0018] The water supply unit may intermittently supply water to the pump, to generate intermittently changing air pressure in the pump, and the increase and release of the air pressure can better drive the air flow.

[0019] Some specific embodiments of the present invention are described below with reference to the accompanying drawings.

FIG. 1 is a schematic connection diagram of partial components of a washing device;

FIG. 2 is a partial schematic exploded view of a pump in FIG. 1;

FIG. 3A is a front view of an initial state in an impeller cavity of a pump;

FIG. 3B is a front view of a stable water ring formed in an impeller cavity; and

FIG. 3C is a schematic diagram of a transient state when an impeller cavity is filled with water in a state of FIG. 3B to form a thickened water ring.

[0020] As shown in FIG. 1, a washing device 1 includes a washing tub 2. Clothes are washed and/or undergo other treatments in the washing tub 2. The washing device 1 further includes a control device 3, which controls electrical components and electronic components in the washing device 1 and executes a clothes treatment program. A fluid driven device 4 is in fluid communication with the washing tub 2.

[0021] The fluid driven device 4 is provided with an inlet 401 and an outlet 402. A pipeline device 5 and a valve device 6 connect the fluid driven device 4, the washing tub 2, an air source 7 and a fluid receiving device 8. The inlet 401 of the fluid driven device 4 is selectively in fluid communication with the air source 7 or the washing tub 2 by switching the valve device 6, and the outlet 402 of the fluid driven device 4 is selectively in fluid communication with the fluid receiving device 8 or the washing tub 2 by switching the valve device 6, where the valve device 6 is electrically connected to the control device 3 and controlled by the control device 3.

[0022] Specifically, the washing tub 2 is connected to the inlet 401 of the fluid driven device 4 through a first pipeline 51. The first pipeline 51 is provided with a first valve 61. The air source 7 is connected to the inlet 401 of the fluid driven device 4 through a second pipeline 52.

[0023] The second pipeline 52 is provided with a second valve 62. The control device 3 selectively opens the first valve 61 or the second valve 62 to alternatively connect the air source or the washing tub 2 to the fluid driven device 4.

[0024] The fluid receiving device 8 is connected to the outlet 402 of the fluid driven device 4 through a third pipeline 53. The third pipeline is provided with a third valve 63. The washing tub 2 is connected to the outlet 402 of the fluid driven device 4 through a fourth pipeline 54. The fourth pipeline 54 is provided with a fourth valve 64. The control device 3 selectively opens the third valve 63 or the fourth valve 64.

[0025] When the first valve 61 and the third valve 63 are controlled to be opened, and the second valve 62 and the fourth valve 64 are controlled to be closed, liquid or air is discharged from the washing tub 2 to the fluid receiving device 8; when the first valve 61 and the fourth valve 64 are controlled to be opened, and the second valve 62 and the third valve 63 are controlled to be closed, fluid circulation is formed in the washing tub 2; when the second valve 62 and the third valve 63 are controlled to be opened, and the first valve 61 and the fourth valve 64 are controlled to be closed, air is supplied into the fluid receiving device 8; and when the second valve 62 and the fourth valve 64 are controlled to be opened, and the first valve 61 and the third valve 63 are controlled to be closed, air is supplied into the washing tub 2.

[0026] The air source 7 may be atmosphere, or a functional air generating device, such as an ozone generating device.

[0027] The fluid receiving device 8 is atmosphere, a waste water pipeline, a water consuming device, a water storage device, or an air consuming device. The air consuming device may be a bubble generating device or the like.

[0028] The first pipeline 51 may be implemented to be connected to the bottom of the washing tub 2. In this way, water may be pumped out through the first pipeline 51. After the water is pumped out or there is no water in the washing tub 2, the air may also be pumped out. An end 540 of the fourth pipeline 54 may be connected to the first pipeline 51. In this way, the quantities of the fluid inlets and outlets on the washing tub 2 can be reduced, to simplify the structure. In addition, for the purpose of supplying air into the washing tub 2 to generate air bubbles in the water, the first pipeline 51 may be connected to the bottom of the washing tub 2, and the end 540 of the fourth pipeline 54 is connected to the first pipeline 51. Then, air supply directly enters the washing tub 2 from the bottom of the washing tub 2, to generate the air bubbles in the water in the washing tub 2.

[0029] If it is not for the purpose of supplying air into the washing tub 2 to generate air bubbles in the water, it is also feasible that the end of the fourth pipeline 54 is directly connected to other positions in the washing tub 2, as shown by a dotted line 50 in FIG. 1.

[0030] In some embodiments, a sealed space may be formed in the washing tub 2. When the fluid driven device 4 pumps out air, a negative pressure may be formed in the washing tub 2, which is beneficial to functions or ap-

plications that require a negative pressure scenario. In addition, in some embodiments, the washing tub 2 includes a wall 21 made of a flexible material. Then, the fluid driven device 4 pumps out air to deform the wall 21 and squeeze clothes, which is beneficial for washing or dehydration. In an embodiment in which no sealed space is formed in the washing tub 2, the fluid driven device 4 still includes a small amount of water in the clothes after or near the end of discharging. In this case, continuing to keep the fluid driven device 4 open may enable the air flow to pass through the clothes, or under the action of suction, the water in the clothes may be further released under the air pressure, and then be discharged as the air flow enters the fluid driven device 4. By supplying air into the washing tub 2, the washing tub 2 deformed by the negative pressure may be opened.

[0031] Based on actual application requirements, the fluid driven device 4 may be a device that may only drive liquid flow, or a device that may only drive air flow, or a device that may drive both liquid flow and air flow.

[0032] The fluid driven device 4 may be implemented as a pump 40 that may drive both liquid flow and air flow. As shown in FIG. 2, the pump 40 includes a motor 41, an impeller 42 driven to rotate by the motor 41, and an impeller cavity 43 disposed around the impeller 42. The impeller cavity 43 includes a peripheral wall 431 located on an outer side of the impeller 42 in a radial direction, and an end wall 432 located on the outer side of the impeller 42 in an axial direction and opposite to the motor 41. The end wall 432 is provided with the inlet 401 and the outlet 402 spaced apart. An edge of the outlet 402 and the peripheral wall 431 are kept at a spacing distance D in the radial direction.

[0033] The pump 40 may be used to pump out liquid. In addition, under high-speed rotation of the impeller 42, due to the spacing distance D between the edge of the outlet 402 and the peripheral wall 431 of the impeller cavity 43, when water enters the impeller cavity 43 through the inlet 401, a water ring with a width close to D may be generated in the peripheral wall 431 of the impeller cavity 43. Then, in a subsequent process, when the water in the washing tub 2 is pumped out or only a small amount of water remains, the air may be driven through the pump 40 to be discharged from the outlet 402. The water ring reduces the air volume in the impeller cavity 43, so that the impeller 42 has a better effect of driving the air.

[0034] A specific embodiment further includes: The inlet 401 is provided with an inlet connection port 436. A cross section of the inlet connection port 436 increases in a direction in which a fluid flows into the impeller cavity 43. In this way, an impact force of the water flow on the impeller 42 can be reduced.

[0035] The outlet 402 is provided with an outlet connection port 437. A cross section of the outlet connection port 437 decreases in a direction in which fluid flows out of the impeller cavity 43. In this way, it is possible to accelerate the flow of the fluid out of the outlet 434.

[0036] The advantageous improvement further includes: A water supply unit 9 is connected to the inlet 401 of the impeller cavity 43 through a fifth pipeline 55.

[0037] The control device 3 is configured to include a process of driving air with the pump 40. In the process of driving the air, the water supply unit 9 is intermittently opened. The process of driving the air may be driving the air from the washing tub 2 or driving the air from the air source 7. Finally, a flow direction of the air may also be implemented by controlling the valve device 6 according to actual needs.

[0038] As shown in FIG. 3A to FIG. 3C, before the water supply unit 9 is opened, there may be no water in the impeller cavity 43, or there may be a small amount of accumulated water at the bottom. After the water supply unit 9 is opened, a water ring 1A is formed in the impeller cavity 43. When the water is supplied next time, the added water instantly breaks the balance of the water ring 1A, forming a water ring with a larger thickness. FIG. 3C schematically describes the process. A thickened sub-ring 1B is formed inside the water ring 1A. In fact, there is no water ring 1A and sub-ring 1B that are distinguished from each other, the water ring is still integrated, except that the thickness is temporarily increased. FIG. 3C is only for ease of understanding. In this case, an air space in the impeller cavity 43 is compressed to generate higher air pressure. In this case, a width of the water ring exceeds the edge of the outlet 402, and then a water volume with the increased width is discharged from the outlet 402 under the action of the high air pressure, while a part of the water ring remains, so that the space in the impeller cavity 43 instantly increases. During opening and closing the water supply unit 9 in each cycle, the air space in the impeller cavity 43 is continuously compressed and alternately expanded. Especially in the compression process, the impeller cavity 43 has air pressure increased in a short time, which generates a strong propulsive force for the air in the direction of the outlet 402. Therefore, the pump 40 may produce a strong air pumping or filling effect.

[0039] When the water in the washing tub 2 needs to be discharged, and the air needs to be further pumped out after discharging, the pump 40 is opened, and the first valve 61 and the third valve 63 are opened. In addition, the water supply unit 9 is intermittently opened. The foregoing description does not include a sequence relationship. A stable water ring 1A is formed in the discharging stage. When the water supply unit 9 intermittently supplies water, the same air pumping effect as described above is achieved.

[0040] In an intermittent water supply process of the water supply unit 9 after the water ring 1A is stabilized, the control device 3 needs to be configured to control the amount of water supply, so that each water supply produces a thickened water ring without filling the impeller cavity 43. When the impeller cavity is filled, an air pumping path is blocked, which breaks the continuity of air pumping, and fails in forming increased air pressure in

the impeller cavity 43. A relationship between the amount of each water supply and the impeller cavity 43 is related to the volume of the impeller cavity, the unit flow rate of the water flow, and the opening time of the water supply unit. Generally, each time the water is intermittently supplied, the water supply unit 9 only needs to be opened for a short time, for example, within 3 seconds. A specific control solution is designed according to the actual situation and based on the foregoing principles.

[0041] In some implementations, the water supply unit 9 may not be included. Compared with the embodiment including the water supply unit 9, the effect of driving the air is weakened. The various specific implementations described above and shown in the accompanying drawings are only used to illustrate the present invention. Any variation made by a person of ordinary skill in the art to the present invention within the scope of the basic technical concept of the present invention shall fall within the protection scope of the present invention.

Claims

1. A washing device, comprising a control device (3), a washing tub (2), and a fluid driven device (4, 40), wherein the fluid driven device comprises an inlet (401) and an outlet (402), **characterized in that**, a pipeline device (5, 51, 52, 53, 54) and a valve device (6, 61, 62, 63, 64) connect the fluid driven device to the washing tub, an air source (7) and a fluid receiving device (8), wherein the inlet of the fluid driven device is selectively in fluid communication with the air source or the washing tub by switching the valve device, and the outlet of the fluid driven device is selectively in fluid communication with the fluid receiving device or the washing tub by switching the valve device, wherein the valve device is electrically connected to the control device and controlled by the control device.

2. The washing device according to claim 1, **characterized in that**, the washing tub and the inlet of the fluid driven device are connected through a first pipeline (51), and the first pipeline is provided with a first valve (61); and the air source and the inlet of the fluid driven device are connected through a second pipeline (52), the second pipeline is provided with a second valve (62), and the control device selectively opens the first valve or the second valve to alternatively communicate the air source or the washing tub with the fluid driven device.

3. The washing device according to claim 2, **characterized in that**, the first pipeline is connected to the bottom of the washing tub.

4. The washing device according to claim 2, **characterized in that**, the fluid receiving device and the outlet of the fluid driven device are connected through a third pipeline (53), and the third pipeline is provided with a third valve (63); and the washing tub and the outlet of the fluid driven device are connected through a fourth pipeline (54), the fourth pipeline (64) is provided with a fourth valve; and the control device selectively opens the third valve or the fourth valve.

5. The washing device according to claim 4, **characterized in that**, an end (540) of the fourth pipeline (54) is connected to the first pipeline (51).

6. The washing device according to claim 1, **characterized in that**, the air source (7) is atmosphere, or a functional air generating device.

7. The washing device according to claim 1, **characterized in that**, the fluid receiving device (8) is atmosphere, a waste water pipeline, a water consuming device, a water storage device, or an air consuming device.

8. The washing device according to claim 1, **characterized in that**, the fluid driven device is capable of driving both liquid flow and air flow.

9. The washing device according to claim 8, **characterized in that**, the fluid driven device (4) is a pump (40).

10. The washing device according to claim 9, **characterized in that**, the pump (40) comprises a motor (41), an impeller (42) driven to rotate by the motor, and an impeller cavity (43) disposed around the impeller, wherein the impeller cavity comprises a peripheral wall (431) located on an outer side of the impeller in a radial direction, and an end wall (432) located on an outer side of the impeller in an axial direction and opposite to the motor, the end wall is provided with the inlet (401) and the outlet (402) spaced apart, and an edge of the outlet is kept at a spacing distance (D) from the peripheral wall in the radial direction.

11. The washing device according to claim 10, **characterized in that**, the inlet is provided with an inlet connection port (436), and a cross section of the inlet connection port increases in a direction in which a fluid flows into the impeller cavity.

12. The washing device according to claim 10, **characterized in that**, the outlet is provided with an outlet connection port (437), and a cross section of the outlet connection port decreases in a direction in which a fluid flows out of the impeller cavity.

13. The washing device according to claim 10, **charac-**

terized in that, a water supply unit (9) is connected to an inlet of the impeller cavity (43) through a fifth pipeline (54), and the control device is configured to include a process of driving air with the pump, wherein in the process of driving the air, the water supply unit is intermittently opened.

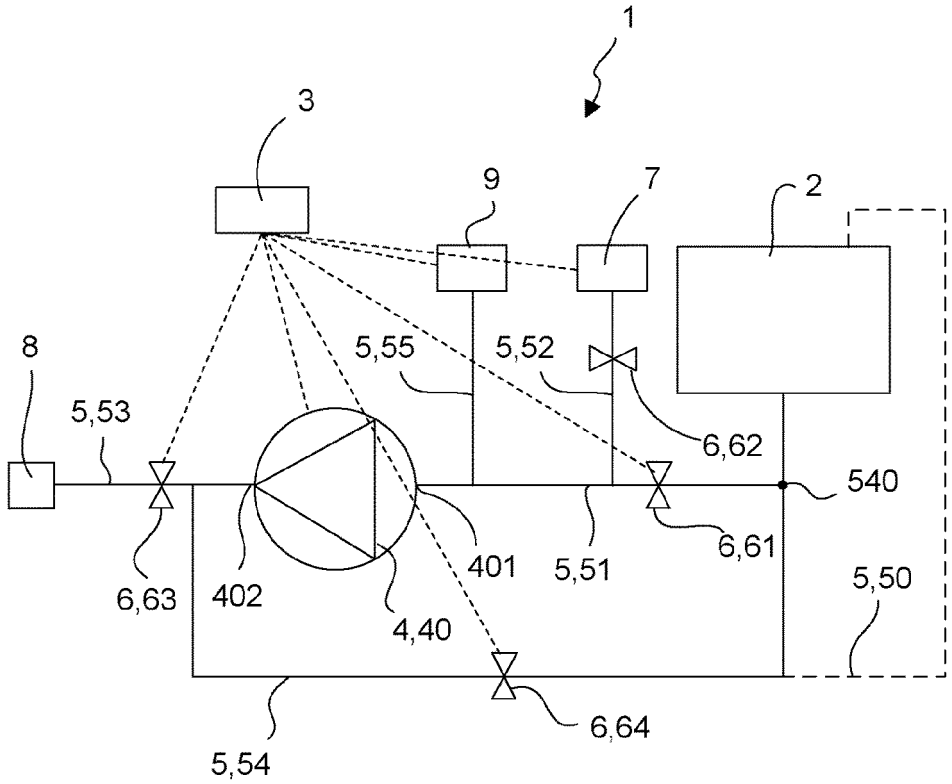
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FIG. 1

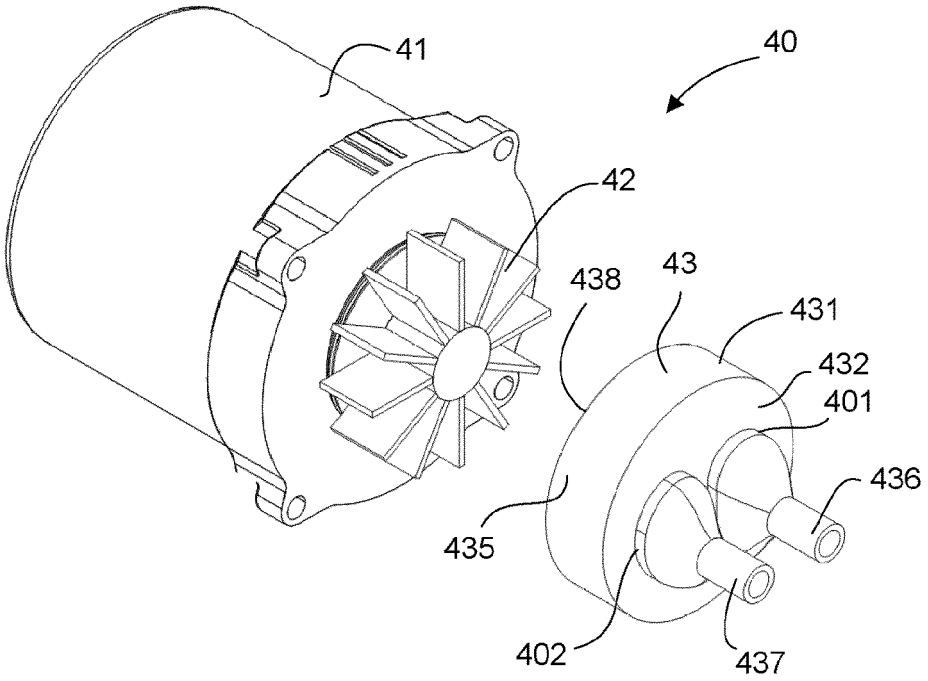
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FIG. 2

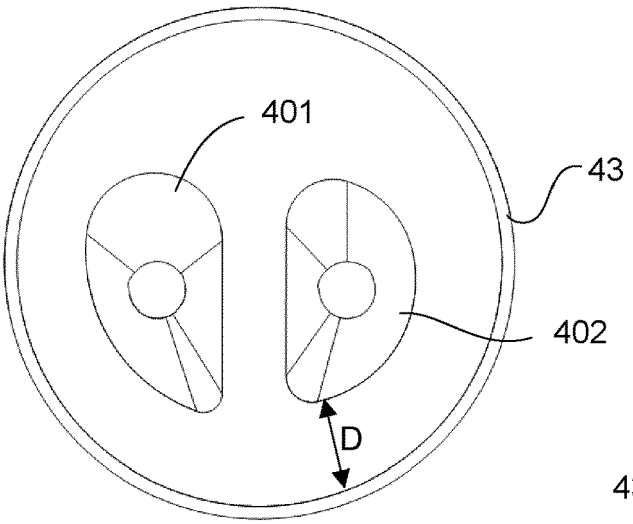

FIG. 3A

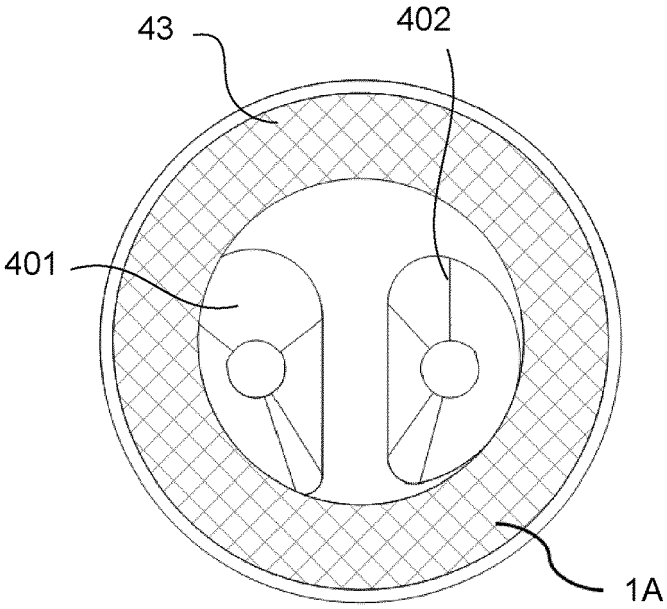

FIG. 3B

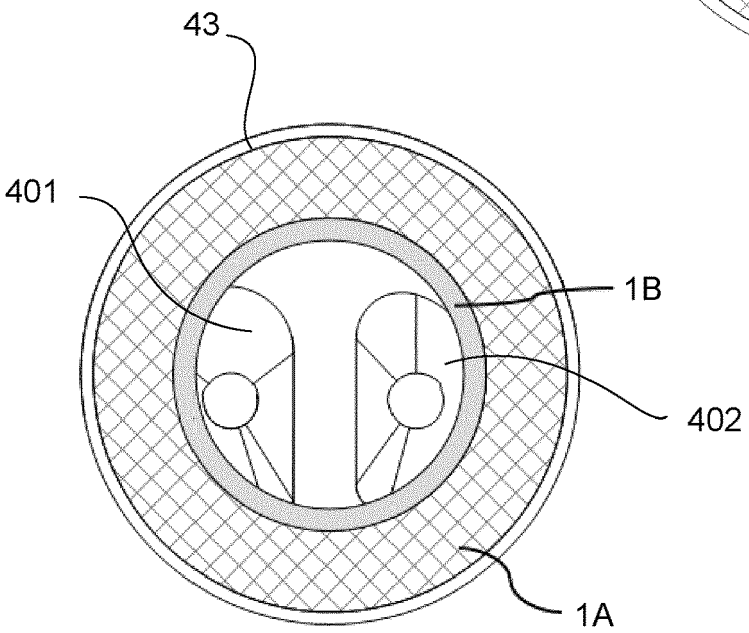

FIG. 3C

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EUROPEAN SEARCH REPORT

Application Number
EP 22 17 8620

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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A	* figures 1-3 * * column 7, line 1 - line 67 *	2-5, 10-13	
A	CN 111 074 484 A (QINGDAO HAIER DRUM WASHING MACHINE CO LTD) 28 April 2020 (2020-04-28) * figure 2 *	1-13	
A	KR 2011 0008838 A (OH SEUNG HWAN [KR]) 27 January 2011 (2011-01-27) * figure 5 *	1-13	

TECHNICAL FIELDS SEARCHED (IPC)

D06F
F04D
F04C

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	16 November 2022	Werner, Christopher

CATEGORY OF CITED DOCUMENTS

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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 22 17 8620

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16-11-2022

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