



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

(43) Date of publication:  
**16.12.2020 Bulletin 2020/51**

(51) Int Cl.:  
**F04D 29/40<sup>(2006.01)</sup> F04D 29/58<sup>(2006.01)</sup>**

(21) Application number: **17935583.9**

(86) International application number:  
**PCT/CN2017/119554**

(22) Date of filing: **28.12.2017**

(87) International publication number:  
**WO 2019/119507 (27.06.2019 Gazette 2019/26)**

(84) Designated Contracting States:  
**AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR**  
Designated Extension States:  
**BA ME**  
Designated Validation States:  
**MA MD TN**

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(30) Priority: **19.12.2017 CN 201711377633**

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(54) **HEATING PUMP AND WASHING APPLIANCE**

(57) A heating pump and a washing appliance. The heating pump includes a pump housing (1) and a pump cover assembly (2). The pump housing (1) includes an outlet and a side wall (11) extending around the outlet. The pump cover assembly (2) includes an annular support portion (21) covering the outlet and a heating element (22) thermal-conductively mounted on the support portion (21). The support portion (21) separates the heat-

ing element (22) from fluid in the heating pump, and a surface of the support portion (21) in contact with the fluid is flat. The heating pump and the washing appliance of the invention can heat the fluid while pumping, and are simply structured. The surface of the support portion in contact with the fluid is flat, thus reducing the friction between the fluid and the support portion, improving the pump efficiency and reducing the energy consumption.

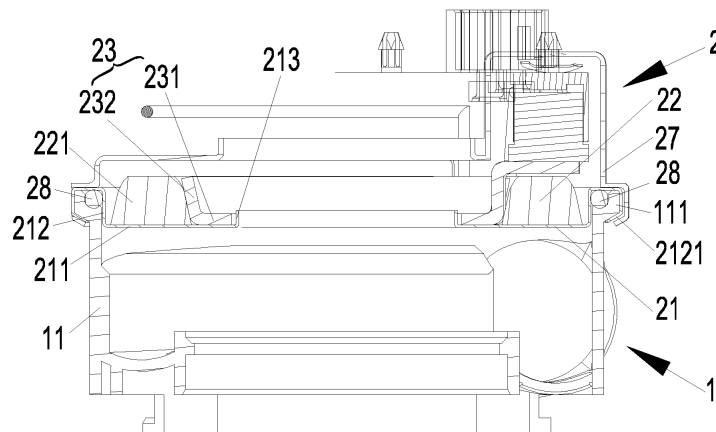


Figure 2

## Description

### FIELD OF THE INVENTION

**[0001]** The present invention relates to the field of household appliances, in particular to a heating pump and a washing appliance with the same.

### BACKGROUND OF THE INVENTION

**[0002]** In products development, such as dishwashers and washing machines, it is often required not only to heat fluid but also to pump the heated fluid. The traditional treatment method is generally to provide both a heating device and a fluid device, such that the equipment is complex, bulky, which is inconvenient for family use. In addition, in the existing integrated heating water pump, the heating device and the fluid device are integrated together, but the heating element is mounted in an outer recess formed by protruding toward the fluid side, that is, a protrusion is formed on the inner side of the pump housing. The larger friction area between the protrusion and the fluid creates a significant obstruction to the pumped fluid, resulting in lower pumping efficiency and greater energy consumption.

**[0003]** Therefore, it is desirable to design a heating pump with simple structure and high pumping efficiency, which is capable of heating and pumping simultaneously, and a washing appliance having the heating pump.

### SUMMARY OF THE INVENTION

**[0004]** An object of the present invention is to overcome the problems in prior arts that the heating and pumping structures are complicated or the pumping efficiency is low, and to provide a heating pump that can simultaneously heat and pump with a simple structure and a high pumping efficiency.

**[0005]** Another object of the present invention is to provide a washing appliance including the heating pump.

**[0006]** In order to achieve the above object, one aspect of the present invention provides a heating pump including a pump housing and a pump cover assembly. The pump housing includes an outlet and a side wall extending around the outlet. The pump cover assembly includes an annular support portion covering the outlet and a heating element thermal-conductively mounted on the support portion, the support portion separates the heating element from fluid in the heating pump, and a surface of the support portion in contact with the fluid is flat.

**[0007]** Preferably, the support portion includes a plate-shaped support ring body extending around a center line of the outlet in a plane perpendicular to the center line, a fixing ring body in connection with an outer periphery of the support ring body and configured for fixing to the top of the side wall; and a bent ring body in connection with an inner periphery of the support ring body and configured for connecting to an external pipe, where the heat-

ing element are mounted on the support ring body.

**[0008]** Preferably, the heating element includes an annular heating tube with a gap and first and second electrodes respectively disposed at both ends of the gap of the annular heating tube; the annular heating tube includes a bottom surface in contact with the support ring body and a side surface connected to the bottom surface and extending in the circumferential direction of the support ring body, and the pump cover assembly includes a thermal conductive plate in heat conduction connection with the side surface and the support ring body.

**[0009]** Preferably, the thermal conductive plate includes a first ring body and a second ring body connected to the first ring body, where the first ring body and the second ring body are in surface contact with the support ring body and the side surface of the annular heating tube, respectively; and/or the first ring body and the second ring body are respectively connected to the support ring body and the side surface of the annular heating tube by welding.

**[0010]** Preferably, the pump cover assembly includes a temperature controller connected to the first electrode, the second ring body includes a main ring body having an opening and being in contact with the annular heating tube, and a stepped portion located at the opening, both sides of the stepped portion in the circumferential direction are respectively spaced from both ends of the opening of the main ring body, the stepped portion includes a vertical portion spaced from the annular heating tube and a horizontal portion located on the annular heating tube, the temperature controller is mounted on the horizontal portion, and the temperature controller includes a first temperature-sensitive surface being in contact with the stepped portion.

**[0011]** Preferably, a distance between the horizontal portion and the annular heating tube is at least 1 mm; and/or the minimum distance between the temperature controller and the first electrodes has an arc length of 5-15 mm on the annular heating tube.

**[0012]** Preferably, the pump cover assembly includes a fuse connected to the second electrode, the fuse includes a second temperature-sensitive surface, the second temperature-sensitive surface is in contact with the annular heating tube; the annular heating tube includes a top surface and two opposite side surfaces connected between the top surface and the bottom surface, the area of the bottom surface is larger than the area of the top surface, and the fuse is supported and mounted on the top surface.

**[0013]** Preferably, the pump cover assembly includes an insulation socket, and the temperature controller, the fuse, and the insulation socket are connected in series between the first electrode and the second electrode.

**[0014]** Preferably, the pump cover assembly includes a protective cover on the top of the annular heating tube, the temperature controller, the fuse and the insulation socket; and/or, the top of the side wall is provided with a stepped flange protruding outward, the fixing ring body

is provided with a grooved flange that can be snap-fixed to an outside of the stepped flange, and the pump cover assembly includes a sealing ring disposed between the stepped flange and the grooved flange to seal the side wall and the support portion..

**[0015]** The second aspect of the present invention provides a washing appliance. The washing appliance includes the above heating pump.

**[0016]** In the above technical solutions, the heating element is thermal-conductively mounted on the support portion, the support portion separates the heating element from the fluid in the heating pump, the fluid can be heated while being pumped, the structure is simple, the volume is small, and the surface of the support portion in contact with the fluid is flat, such that the friction between the fluid and the support portion is reduced, hindering the movement of the fluid can be avoided, the pumping efficiency is significantly improved and the energy consumption can be reduced, and thus better able to meet user needs.

#### BRIEF DESCRIPTION OF THE DRAWINGS

##### **[0017]**

FIG. 1 is a partial structural schematic diagram of a heating pump in accordance with a preferred embodiment of the present invention;

FIG. 2 is a schematic diagram of a partial cross-sectional structure of a heating pump in accordance with a preferred embodiment of the present invention;

FIG. 3 is a schematic diagram of another partial structural of a heating pump in accordance with a preferred embodiment of the present invention;

FIG. 4 is a schematic structural diagram of a thermal conductive plate in accordance with a preferred embodiment of the present invention.

#### Lists of reference signs

**[0018]** 1 pump housing; 11 side wall; 111 stepped flange; 2 pump cover assembly; 21 support portion; 211 support ring body; 212 fixing ring body; 2121 grooved flange; 213 bent ring body; 22 heating element; 221 ring heating tube; 222 first electrode; 223 second electrode; 23 thermal conductive plate; 231 first ring body; 232 second ring body; 2321 main ring body; 2322 stepped portion; 24 temperature controller; 25 fuse; 26 insulation socket; 27 protective cover; 28 sealing ring; L1 short wiring; L2 long wiring.

#### DETAILED DESCRIPTION

**[0019]** The following will describe specific embodiments of the present invention in detail with the accom-

panying drawings. It should be understood that the specific embodiments described herein are merely used to illustrate and explain the present invention, and are not intended to limit the present invention.

**[0020]** In the present invention, the directional terms such as up, down, left and right generally refer to the up, down, left and right as shown in the drawings, and the term "inner" or "outer" refers to the inside or outside of the contour of each component itself, unless otherwise stated.

**[0021]** An aspect of the present invention provides a heating pump including a pump housing 1 and a pump cover assembly 2. The pump housing 1 includes an outlet and a side wall 11 extending around the outlet. The pump cover assembly 2 includes an annular support portion 21 covering the outlet and a heating element 22 thermal-conductively mounted on the support portion 21. The support portion 21 is configured to separate the heating element 22 from the fluid in the heating pump, and the surface of the support portion 21 in contact with the fluid is flat.

**[0022]** In the above technical solution, as shown in FIGS. 1-4, the heating element 22 is thermal-conductively mounted on the support portion 21. The support portion 21 separates the heating element 22 from the fluid in the heating pump. The fluid can be heated while pumping. The structure is simple and the volume is small. Moreover, the surface of the support portion 21 in contact with the fluid is flat, which can reduce the friction between the fluid and the support portion, avoid hindering the movement of the fluid, significantly improve the pumping efficiency and reduce the energy consumption, so as to better meet user needs.

**[0023]** Among them, there may be plurality of options for the structure of the support portion 21, as shown in FIG. 2, preferably, the support portion 21 includes a plate-shaped support ring body 211 extending around a center line of the outlet in a plane perpendicular to the center line, a fixing ring body 212 connected with an outer periphery of the support ring body 211 and configured to be fixed on the top of the side wall 11, and a bent ring body 213 connected with an inner periphery of the support ring body 211 and configured for connecting an external pipe, where the heating element 22 is mounted on the support ring body 211. To be specific, the support portion 21 may be stamped and formed from a stainless steel plate, and the connection portion of the support ring body 211 and the fixing ring body 212 and the bent ring body 213 may be rounded. In this way, more than 90% of the area of the support part in contact with the fluid has a plane surface, avoiding the obstruction to the fluid and significantly improving the pumping efficiency.

**[0024]** In addition, the structural composition and shape of the heating element 22 can be flexibly selected according to actual work requirements. Preferably, the heating element 22 includes an annular heating tube 221 with a gap and a first electrode 222 and a second electrode 223 respectively disposed at two ends of the gap

in the annular heating tube 221. In addition, the annular heating tube 221 may include an outer sleeve in which a resistance wire may be mounted, and a thermal-conductive insulating material may be filled between the outer sleeve and the resistance wire. Where the outer sleeve may be an aluminum tube, the thermal-conductive insulating material may be MgO. In addition, the annular heating tube 221 may include a bottom surface in thermal contact with the support ring body 211 and a side surface connected to the bottom surface and extending in a circumferential direction of the support ring body 211. The pump cover assembly 2 includes a thermal conductive plate 23 that thermal-conductively connects the side surface with the support ring body 211. In this way, the heat radiated from the side of the annular heating tube 221 can be transferred to the support ring body 211 through the thermal conductive plate 23, so that the heating efficiency of the annular heating tube 221 can be significantly improved.

**[0025]** Among them, there may be plurality of options for shape of the thermal conductive plate 23. For convenience in manufacturing, as shown in FIGS. 2 and 4, preferably, the thermal conductive plate 23 includes a first ring body 231 and a second ring body 232 connected to the first ring body 231. The first ring body 231 and the second ring body 232 are in surface contact with the support ring body 211 and the side surface of the annular heating tube 221, so that the contact area is larger which facilitates a rapid and maximum transmission of the heat dissipated from the side of the annular heating tube 221 to the support ring body 211. In addition, in order to make the structural installation reliable and stable, the first ring body 231 and the second ring body 232 are respectively connected with the support ring body 211 and the side surfaces of the annular heating tube 221 via welding. The thermal conductive plate 23 may be stamped and formed from an aluminum plate.

**[0026]** For convenience in temperature measurement of the fluid, preferably, the pump cover assembly 2 includes a temperature controller 24 connected to the first electrode 222, and to facilitate the installation of the temperature controller 24 while making the structure compact, as shown in FIGS. 3 and 4, the second ring body 232 includes a main ring body 2321 having an opening and in contact with the annular heating tube, and a stepped portion 2322 located at the opening. Both sides of the stepped portion 2322 in the circumferential direction are respectively spaced apart from both ends of the opening of the main ring body 2321. The stepped portion 2322 includes a vertical portion with an interval relative to the annular heating tube 221 and a horizontal portion located above the annular heating tube 221. The temperature controller 24 is disposed on the horizontal portion. The temperature controller 24 includes a first temperature-sensitive surface in contact with the stepped portion. Such that the influence of the annular heating tube 221 and the main ring body 2321 in contact with the annular heating tube 221 on the measurement result of

the temperature controller 24 can be minimized.

**[0027]** Moreover, preferably, a distance between the horizontal portion and the annular heating tube 221 is at least 1 mm, so that the heat transferred to the stepped portion 2322 is mostly from the fluid, and the accuracy of the measurement result of the temperature controller 24 is ensured. Further, in order to reduce the influence of the heat dissipated by the annular heating tube 221 and the first electrode 222 on the temperature controller 24, the minimum distance between the temperature controller 24 and the first electrode 222 has an arc length of 5-15mm on the annular heating tube 221. This location is generally the position with the lowest heat dissipated by the annular heating tube 221, which can further improve the accuracy of the measurement result of the temperature controller 24.

**[0028]** In order to improve the safety performance of the device, preferably, the pump cover assembly 2 includes a fuse 25 connected to the second electrode 223, and the fuse 25 includes a second temperature-sensitive surface, and the second temperature-sensitive surface is in contact with the annular heating tube 221. Moreover, to facilitate the installation of the fuse 25, the annular heating tube 221 includes a top surface and two opposite side surfaces connected between the top surface and the bottom surface, the area of the bottom surface is greater than that of the top surface. The fuse 25 is supported and mounted on the top surface. That is to say, the cross section of the annular heating tube 221 may be trapezoidal or approximately trapezoidal, for example, the aluminum heating tube may be pressed into an approximately trapezoidal shape by high pressure, and the wider bottom surface of the trapezoid is in a thermal-conductive connection with the support ring body 211 by welding. This can increase the heat transfer area on one surface (bottom surface), so that more heat can be transferred to the support ring body 211.

**[0029]** Among them, for convenience in use (connecting to a power source), preferably, the pump cover assembly 2 includes an insulation socket 26. The temperature controller 24, the fuse 25 and the insulation socket 26 are connected in series between the first electrode 222 and the second electrode 223, such that the overall structure is simple and convenient for assembly.

**[0030]** In order to further improve the safety performance of the device, preferably, the pump cover assembly 2 includes a protective cover 27 disposed on top of the annular heating tube 221, the temperature controller 24, the fuse 25 and the insulation socket 26. The structure of the protective cover 27 can be flexibly designed according to the arrangements of the temperature controller 24, the fuse 25 and the insulation socket 26, as shown in FIG. 1, when the temperature controller 24, the insulation socket 26 and the fuse 25 are sequentially arranged on the side of the annular heating tube 221, the temperature controller 24 may be connected to the first electrode 222 through a short wire L1, and the fuse 25 may be connected to the second electrode 223 through a long

wire L2. At this time, the protective cover 27 may include an inner ring disposed above the first ring body 231 of the thermal conductive plate 23, a sector portion connected to the inner ring, and at least two bent plate bodies, the sector portion is located above the other side of the annular heating tube 221. The long wiring L2 may be located above the sector portion. The two bent plate bodies may be configured to fix the temperature controller 24 and the fuse 25 respectively, and in order to facilitate installation and fixation, the sector and the edge of the bent plate body can be bent and fixed on an outside of a grooved flange 2121 to be described below. The protective cover 27 may be made of metal. In addition, in order to facilitate installation and fixation, the top of the side wall 11 is provided with a stepped flange 111 protruding outward, and the fixing ring body 212 is provided with a grooved flange 2121 capable of snapping and fixing to the outside of the stepped flange 111, that is, the outer periphery of the fixing ring body 212 can be stamped with a tongue to be riveted to the pump housing 1, and in order to improve the sealing performance between the pump cover assembly 2 and the pump housing 1, the pump cover assembly 2 includes a sealing ring 28 disposed between the stepped flange 111 and the grooved flange 2121 which seals the side wall 11 and the support portion 21.

**[0031]** A second aspect of the present invention provides a washing appliance which includes the heating pump described above. Where the washing appliance may be a dishwasher or the like.

**[0032]** The preferred embodiments of the present invention have been described in detail above with reference to the accompanying drawings, but the present invention is not limited herein. Within the scope of the spirit of the present invention, various simple modifications can be made to the technical solutions of the present invention, including the combination of each specific technical feature in any suitable manner. To avoid unnecessary repetition, the present invention does not describe various possible combinations. However, these simple modifications and combinations should also be regarded as the contents disclosed in the present invention, and should be included by the protection scope of the present invention.

## Claims

### 1. A heating pump, comprising:

a pump housing (1), comprising:

an outlet; and  
a side wall (11) extending around the outlet;  
and

a pump cover assembly (2), comprising:

an annular support portion (21) covering the outlet; and  
a heating element (22) thermal-conductively mounted to the support portion (21),

wherein the heating element (22) is separated from fluid in the heating pump by the support portion (21), and a surface of the support portion (21) in contact with the fluid is flat.

### 2. The heating pump according to claim 1, wherein the support portion (21) comprises:

a plate-shaped support ring body (211) extending around a center line of the outlet in a plane perpendicular to the center line;  
a fixing ring body (212) in connection with an outer periphery of the support ring body (211) and configured for fixing to the top of the side wall (11); and  
a bent ring body (213) in connection with an inner periphery of the support ring body (211) and configured for connecting to an external pipe, wherein the heating element (22) are mounted on the support ring body (211).

### 3. The heating pump according to claim 2, wherein:

the heating element (22) comprises an annular heating tube (221) with a gap and a first electrode (222) and a second electrode (223) disposed at two ends of the gap of the annular heating tube (221), respectively;  
the annular heating tube (221) comprises a bottom surface in thermal contact with the support ring body (211) and a side surface connected to the bottom surface and extending in the circumferential direction of the support ring body (211); and  
the pump cover assembly (2) comprises a thermal conductive plate (23) configured to thermal-conductively connect the side surface and the support ring body (211).

### 4. The heating pump according to claim 3, wherein the thermal conductive plate (23) comprises a first ring body (231) and a second ring body (232) connected to the first ring body (231), wherein:

the first ring body (231) and the second ring body (232) are in surface contact with the support ring body (211) and the side surface of the annular heating tube (221), respectively; and/or  
the first ring body (231) and the second ring body (232) are respectively configured to be connected to the support ring body (211) and the side surface of the annular heating tube (221) by welding.

5. The heating pump according to claim 4, wherein the pump cover assembly (2) comprises a temperature controller (24) in connection with the first electrode (222), wherein the second ring body (232) comprises a main ring body (2321) having an opening and being in contact with the annular heating tube (221) and a stepped portion (2322) located at the opening, both sides of the stepped portion (2322) in the circumferential direction are respectively spaced apart from both ends of the opening of the main ring body (2321), wherein the stepped portion (2322) comprises a vertical portion spaced from the annular heating tube (221) and a horizontal portion located on the annular heating tube (221), wherein temperature controller (24) is mounted on the horizontal portion, and the temperature controller (24) comprises a first temperature-sensitive surface in contact with the stepped portion (2322).
6. The heating pump according to claim 5, wherein a distance between the horizontal portion and the annular heating tube (221) is at least 1 mm; and/or the minimum distance between the temperature controller (24) and the first electrodes (222) has an arc length of 5-15 mm on the annular heating tube (221).
7. The heating pump according to claim 5 or 6, wherein the pump cover assembly (2) comprises a fuse (25) in connection with the second electrode (223), the fuse (25) comprises a second temperature-sensitive surface being in contact with the annular heating tube (221); the annular heating tube (221) comprises a top surface and the two apposite side surfaces connected between the top surface and the bottom surface, the area of the bottom surface is larger than the area of the top surface, and the fuse (25) is supported and mounted on the top surface.
8. The heating pump according to claim 7, wherein the pump cover assembly (2) comprises an insulation socket (26), wherein the temperature controller (24), the fuse (25) and the insulation socket (26) are connected in series between the first electrode (222) and the second electrode (223).
9. The heating pump according to claim 8, wherein:
- the pump cover assembly (2) comprises a protective cover (27) located on the top of the annular heating tube (221), the temperature controller (24), the fuse (25) and the insulation socket (26); and/or
- the top of the side wall (11) is provided with a stepped flange (111) protruding outward, and the fixing ring body (212) is provided with a grooved flange (2121) capable of being snap-fixed to an outside the stepped flange (111); the pump cover assembly (2) comprises a sealing ring (28) disposed between the stepped flange (111) and the grooved flange (2121) to seal the side wall (11) and the support portion (21).
10. A washing appliance comprising the heating pump according to any one of claims 1-9.

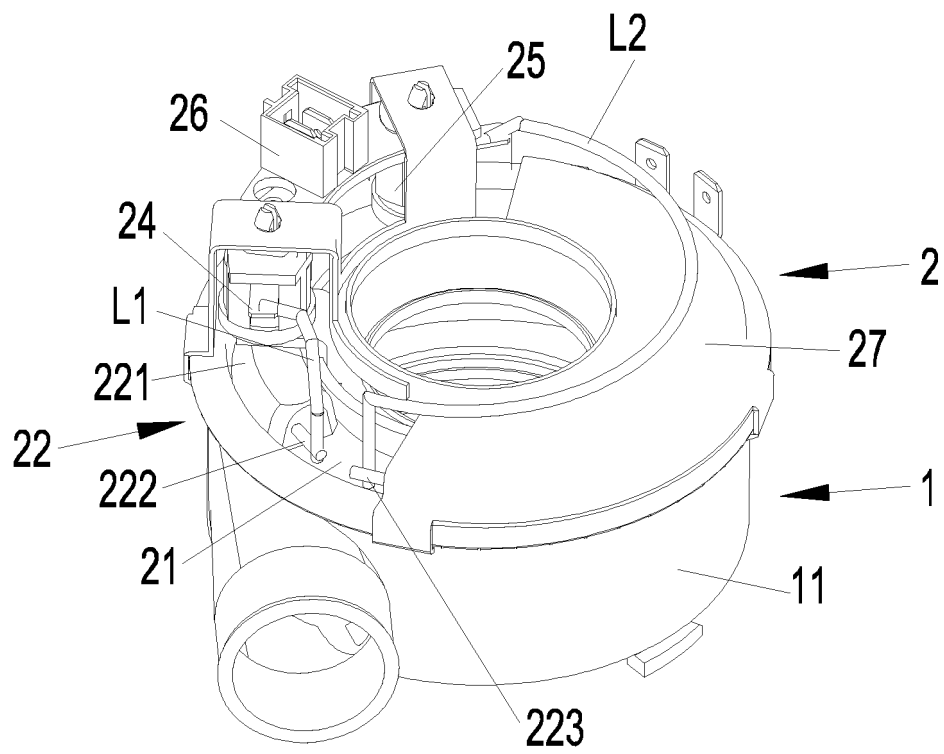


Figure 1

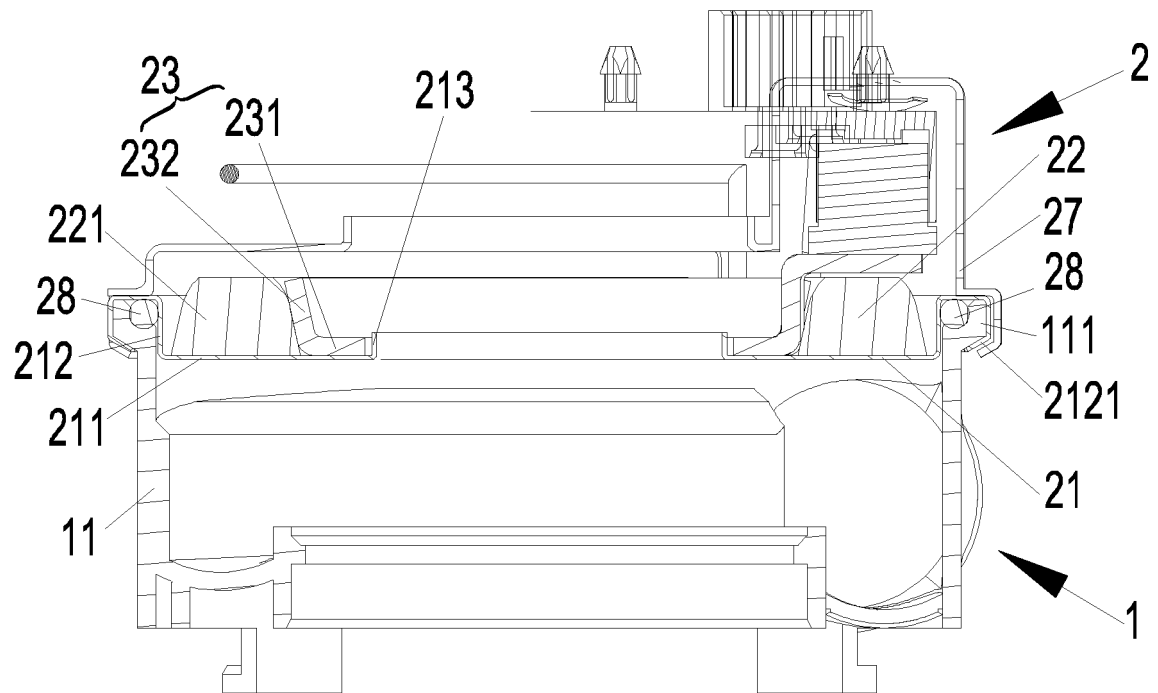


Figure 2



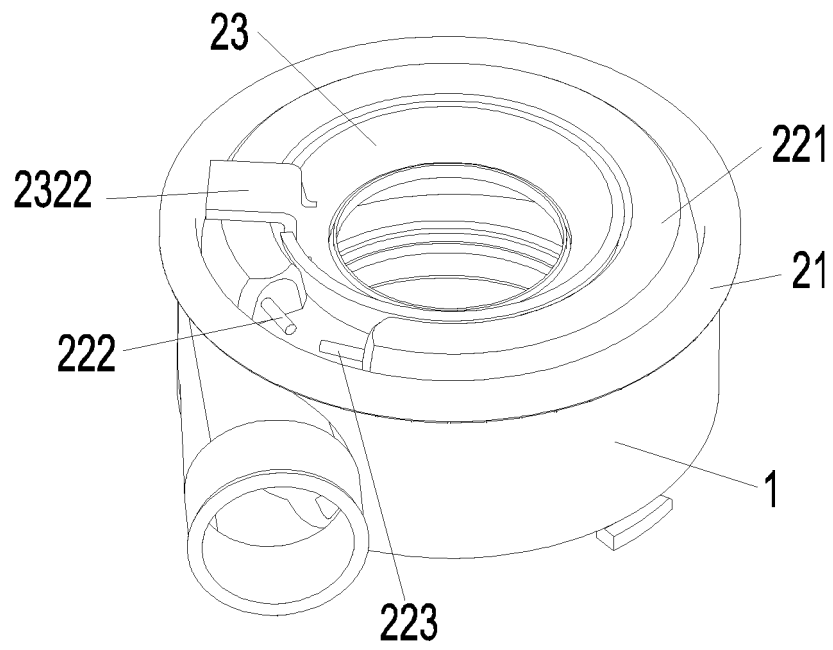


Figure 3

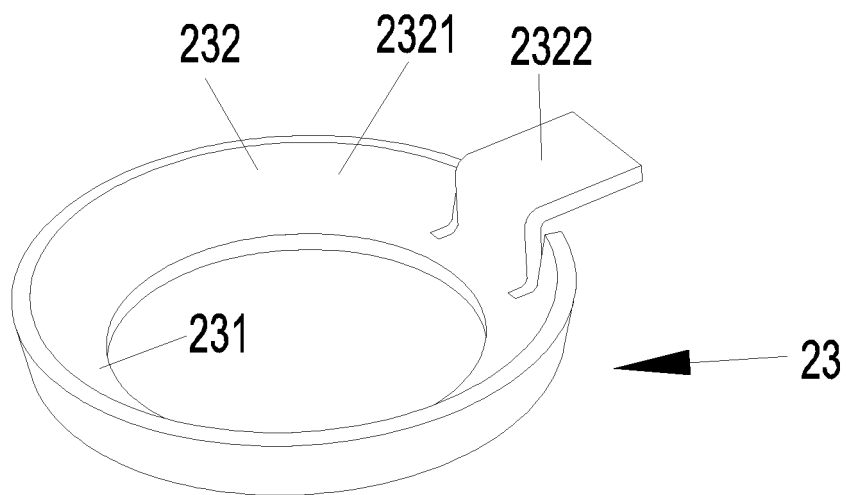


Figure 4

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2017/119554

## A. CLASSIFICATION OF SUBJECT MATTER

F04D 29/40(2006.01)i; F04D 29/58(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

F04D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

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

CNABS, VEN, CNKI: 泵, 加热, 侧壁, 支撑, 环形, pump, heat+, side, wall, sidewall, support+, ring-shaped

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	CN 103573674 A (HANGZHOU HEATWELL M & E CO., LTD.) 12 February 2014 (2014-02-12) see description, paragraphs 24-30, and figures 1-2	1-4, 10
A	US 2003071529 A1 (SIEMENS CANADA LTD.) 17 April 2003 (2003-04-17) see entire document	1-10
A	CN 107468194 A (HUANG, WENJIA) 15 December 2017 (2017-12-15) see entire document	1-10
A	CN 105370622 A (GUANGDONG WELLING MOTOR MANUFACTURING CO., LTD. ET AL.) 02 March 2016 (2016-03-02) see entire document	1-10
A	JP 2016098681 A (TOYOTA IND CORP.) 30 May 2016 (2016-05-30) see entire document	1-10
A	CN 107514818 A (XU, YINGJIE) 26 December 2017 (2017-12-26) see entire document	1-10

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

\* Special categories of cited documents:

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Date of the actual completion of the international search

03 September 2018

Date of mailing of the international search report

25 September 2018

Name and mailing address of the ISA/CN

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

International application No.

**PCT/CN2017/119554**

Patent document cited in search report	Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
CN 103573674 A	12 February 2014	CN 103573674 B	23 September 2015
US 2003071529 A1	17 April 2003	US 6552464 B1	22 April 2003
		US 6625868 B2	30 September 2003
CN 107468194 A	15 December 2017	CN 107468194 B	28 August 2018
CN 105370622 A	02 March 2016	None	
JP 2016098681 A	30 May 2016	JP 6269452 B2	31 January 2018
CN 107514818 A	26 December 2017	None	

Form PCT/ISA/210 (patent family annex) (January 2015)