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- **WU, Qihong**
Foshan
Guangdong 528311 (CN)
- **SHI, Changzhong**
Foshan
Guangdong 528311 (CN)
- **CHI, Chuang**
Foshan
Guangdong 528311 (CN)

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(71) Applicant: **Foshan Welling Washer Motor Manufacturing Co., Ltd**
Foshan, Guangdong 528311 (CN)

(74) Representative: **Lam, Alvin et al**
Maucher Jenkins
26 Caxton Street
London SW1H 0RJ (GB)

(72) Inventors:
• **GU, Wenhai**
Foshan
Guangdong 528311 (CN)

(54) **CENTRIFUGAL PUMP**

(57) A centrifugal pump (100) comprises a pump housing (1), a heating device (22), a flow guide member (3) and an impeller (4). The pump housing (1) is provided with a heating chamber (11) and a pump chamber (12) in communication with the heating chamber (11) therein. The pump housing (1) is provided with an inlet (130) in communication with the heating chamber (11) and an outlet (140) in communication with the pump chamber (12). The heating device (22) is disposed on the pump housing (1). The flow guide member (3) is disposed within the heating chamber (11). The flow guide member (3) defines spreading channels guiding fluids entering through the inlet (130) to spread outwards along a radial direction of the heating device (22) and converging channels guiding the spread fluids to converge inwards along the radial direction of the heating device (22) to the pump chamber (12) in the heating chamber (11). The impeller (4) is disposed within the pump chamber (12) and guides the fluids converged in the pump chamber (12) to the outlet (140). The centrifugal pump structure is compact and small-sized, thus having a high space utilization rate and also good hydraulic performance.

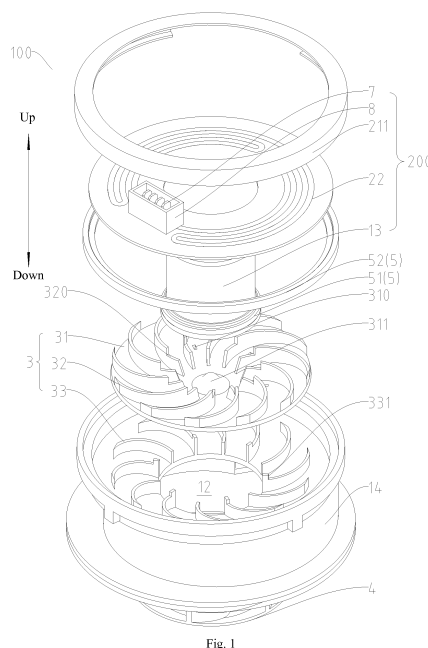


Fig. 1

Description

FIELD

[0001] The present disclosure relates to a field of pumping technology, more particularly to a centrifugal pump.

BACKGROUND

[0002] In the related art, a heating device and a pumping device are usually provided in a case of fluids to be heated and then pumped, which makes an apparatus have complex structure, large volume and low space utilization rate. Thus, an apparatus where a heating device is completely or partially buried in a pump housing to combine the heating device with a pumping device emerges, but the heater can only be machined into a regular circle, such that the pump housing cannot be designed in a spiral shape, and hydraulic performance is poor.

SUMMARY

[0003] The present disclosure seeks to solve at least one of the problems existing in the related art. For this reason, the present disclosure provides a centrifugal pump that has a simple structure, good hydraulic performance and high heating efficiency.

[0004] The centrifugal pump according to embodiments of the present disclosure includes: a pump housing, internally defining a heating chamber and a pump chamber in communication with the heating chamber, and provided with an inlet in communication with the heating chamber and an outlet in communication with the pump chamber; a heating device, provided on the pump housing; a flow guide member, provided in the heating chamber and defining a spreading channel and a converging channel in the heating chamber, the spreading channel being configured to guide fluid entering through the inlet to spread outwards along a radial direction of the heating device, and a the converging channel being configured to guide the spread fluid to converge inwards along the radial direction of the heating device to the pump chamber; and an impeller, provided within the pump chamber and configured to guide the fluid converged in the pump chamber to the outlet.

[0005] For the centrifugal pump according to embodiments of the present disclosure, the structure of the centrifugal pump is compact, and the volume thereof is small, thereby improving a space utilization rate. Meanwhile, since the heating device does not interfere with the shape design of the pump housing surrounding the impeller, the pump housing surrounding the impeller can be designed in a spiral shape, so as to achieve good hydraulic performance. Additionally, the loss due to curves of the fluid entering via the inlet is reduced, and the fluid can be sufficiently heated by the heating device, so as to improve

the heating efficiency of the fluid.

[0006] According to some embodiments of the present disclosure, the spreading channel guides the fluid entering through the inlet to spread spirally outwards along the radial direction of the heating device, and the converging channel guides the spread fluid to converge spirally inwards along the radial direction of the heating device to the pump chamber.

[0007] According to some embodiments of the present disclosure, the flow guide member includes: a separating plate; a plurality of spiral vanes provided at a side of the separating plate facing the heating device, and defining the spreading channel at the side of the separating plate facing the heating device; and a plurality of reverse spiral vanes provided at another side of the separating plate facing the pump chamber, and defining the converging channel at the another side of the separating plate facing the pump chamber.

[0008] According to some further embodiments of the present disclosure, one kind of the spiral vanes and the reverse spiral vanes is shifted clockwise from inside to outside along a radial direction of the separating plate, while the other one thereof is shifted counterclockwise from inside to outside along the radial direction of the separating plate.

[0009] According to some embodiments of the present disclosure, the plurality of reverse spiral vanes are connected to a bottom wall of the heating chamber, the plurality of spiral vanes are connected to the separating plate, and the separating plate is supported on the plurality of reverse spiral vanes.

[0010] Optionally, the plurality of reverse spiral vanes are integrally formed on the pump housing, and the plurality of spiral vanes are integrally formed on the separating plate.

[0011] Optionally, the separating plate is provided with a positioning hole, the reverse spiral vane is provided with a positioning column, and the positioning column is fitted in the positioning hole.

[0012] Preferably, a plurality of positioning columns are provided and disposed to inner ends of corresponding reverse spiral vanes, a plurality of positioning holes are provided and spaced along a circumferential direction of the separating plate, and the plurality of positioning columns are fitted in the plurality of positioning holes respectively.

[0013] In some other embodiments of the present disclosure, the plurality of reverse spiral vanes and the plurality of spiral vanes are connected to the separating plate, and the plurality of reverse spiral vanes are supported on a bottom wall of the heating chamber.

[0014] Further, the plurality of reverse spiral vanes, the plurality of spiral vanes and the separating plate are integrally formed.

[0015] In a specific embodiment of the present disclosure, the pump housing has an inlet pipe extending into the heating chamber, the inlet is provided in the inlet pipe, inner ends of the spiral vanes are provided with engaging

notches, and an end of the inlet pipe that extends into the heating chamber is fitted in the engaging notches of the plurality of spiral vanes.

[0016] In an optional embodiment of the present disclosure, a side surface of the separating plate facing the heating device is provided with a flow guide block in a center of the side surface, and the flow guide block is configured to guide the fluid entering through the inlet to the plurality of spiral vanes.

[0017] Further, the flow guide block is conical, and a vertex of the flow guide block is rounded off.

[0018] In some embodiments of the present disclosure, an outer peripheral edge of the separating plate is more adjacent to the heating device compared with that the outer peripheral edge of the separating plate is adjacent to the pump chamber, and a center of the separating plate is more adjacent to the pump chamber compared with that the center of the separating plate is adjacent to the heating device.

[0019] According to some embodiments of the present disclosure, a central axis of the inlet, a central axis of the pump housing, a central axis of the heating device, a central axis of the flow guide member, and a central axis of the impeller coincide with each other; the heating chamber and the pump chamber are communicated at the central axis of the pump housing; the outlet is provided in an outer peripheral wall of the pump housing, and a central axis of the outlet is tangent to the outer peripheral wall of the pump housing.

[0020] According to some embodiments of the present disclosure, the pump housing includes: a housing body, the heating chamber and the pump chamber being defined in the housing body, and the outlet being provided in the housing body; a casing body, detachably mounted to the housing body and pressing the heating device to an upper end of the housing body; and an inlet pipe, the inlet pipe being provided on the casing body, and the inlet being provided in the inlet pipe.

[0021] According to some embodiments of the present disclosure, the heating device is configured as an annular heating plate having a central through hole, and a position of the central through hole corresponds to a position of the inlet in a vertical direction.

[0022] According to some embodiments of the present disclosure, at least one of an upper surface and an outer peripheral surface of the heating device is provided with a resistance coating.

[0023] According to some embodiments of the present disclosure, a seal ring is provided between an inner peripheral edge of the heating device and the pump housing for sealing, and another seal ring is provided between an outer peripheral edge of the heating device and the pump housing for sealing, and a thermal insulation member is provided between the inner peripheral edge and/or the outer peripheral edge of the heating device and the corresponding seal ring.

[0024] According to some embodiments of the present disclosure, the centrifugal pump further includes: a ter-

minal box, provided on the heating device; and a wiring terminal, provided in the terminal box, electrically coupled with the heating device, and exposed out of the pump housing.

[0025] Additional aspects and advantages of embodiments of present disclosure will be given in part in the following descriptions, become apparent in part from the following descriptions, or be learned from the practice of the embodiments of the present disclosure.

BRIEF DESCRIPTION OF THE DRAWINGS

[0026]

Fig. 1 is an exploded view of a centrifugal pump according to an embodiment of the present disclosure. Fig. 2 is a perspective view of a centrifugal pump according to an embodiment of the present disclosure.

Fig. 3 is a front view of a centrifugal pump according to an embodiment of the present disclosure.

Fig. 4 is a sectional view taken along line A-A in Fig. 3. Fig. 5 is a left view of a centrifugal pump according to an embodiment of the present disclosure.

Fig. 6 is a top view of a centrifugal pump according to an embodiment of the present disclosure.

Fig. 7 is a perspective view of a separating plate and spiral vanes of a flow guide member of a centrifugal pump according to an embodiment of the present disclosure.

Fig. 8 is a front view of a separating plate and spiral vanes of a flow guide member of a centrifugal pump according to an embodiment of the present disclosure.

Fig. 9 is a top view of a separating plate and spiral vanes of a flow guide member of a centrifugal pump according to an embodiment of the present disclosure.

Fig. 10 is an exploded view of a centrifugal pump according to another embodiment of the present disclosure.

Fig. 11 is a perspective view of a flow guide member of a centrifugal pump according to another embodiment of the present disclosure.

Fig. 12 is a front view of a flow guide member of a centrifugal pump according to another embodiment of the present disclosure.

Fig. 13 is a top view of a flow guide member of a centrifugal pump according to another embodiment of the present disclosure.

Fig. 14 is a sectional view of a pump heater according to a first optional embodiment of the present disclosure.

Fig. 15 is a perspective view of a casing of the pump heater according to the first optional embodiment of the present disclosure.

Fig. 16 is a perspective view at a heating plate of the pump heater according to the first optional embodi-

ment of the present disclosure.

Fig. 17 is a perspective view of a pump heater according to a second optional embodiment of the present disclosure.

Fig. 18 is a sectional view of the pump heater according to the second optional embodiment of the present disclosure.

Reference numerals:

[0027]

centrifugal pump 100,
pump housing 1, heating chamber 11, pump chamber 12, inlet pipe 13, inlet 130, housing body 14, outlet 140,
pump heater 200, casing 21, casing body 211, heating device 22, upper space 201, lower space 202, flow guide member 3, separating plate 31, positioning hole 310, flow guide block 311, spiral vane 32, engaging notch 320, reverse spiral vane 33, positioning column 331,
impeller 4,
seal ring 5, first seal ring 51, second seal ring 52, thermal insulation member 6, first thermal insulation member 61, second thermal insulation member 62, wiring terminal 7, terminal box 8.

DETAILED DESCRIPTION

[0028] Embodiments of the present disclosure will be described in detail and examples of the embodiments will be illustrated in the drawings, where same or similar reference numerals are used to indicate same or similar members or members with same or similar functions. The embodiments described herein with reference to drawings are explanatory, and used to generally understand the present disclosure. The embodiments shall not be construed to limit the present disclosure.

[0029] A centrifugal pump 100 according to embodiments of the present disclosure will be described with reference to Figs. 1 to 13, and the centrifugal pump 100 is suitable for various applications, such as fluid transportation, cooling systems and domestic appliances, and has advantages of a compact structure, a small volume, and good hydraulic performance.

[0030] As shown in Figs. 1 to 13, the centrifugal pump 100 according to embodiments of the present disclosure includes a pump housing 1, a heating device 22, a flow guide member 3 and an impeller 4.

[0031] Specifically, the pump housing 1 internally defines a heating chamber 11 and a pump chamber 12 in communication with the heating chamber 11, and the pump housing 1 is provided with an inlet 130 in communication with the heating chamber 11 and an outlet 140 in communication with the pump chamber 12. The heating device 22 is disposed on the pump housing 1 and has at least a part located in the heating chamber 11.

For example, a lower surface of the heating device 22 is formed as a top wall of the heating chamber 11, such that fluid in the heating chamber 11 can be heated by the heating device 22. Preferably, the heating device 22 is annular and employs a thick-film resistor for heating, thereby achieving high heating efficiency. The flow guide member 3 is disposed within the heating chamber 11, and the flow guide member 3 defines a spreading channel and a converging channel in the heating chamber 11, in which the spreading channel guides the fluid entering through the inlet 130 to spread spirally outwards along a radial direction of the heating device 22, while the converging channel guides the spread fluid to converge spirally inwards along the radial direction of the heating device 22 to the pump chamber 12. The impeller 4 is disposed within the pump chamber 12 and guides the fluid converged in the pump chamber 12 to the outlet 140.

[0032] A heating and pumping process in the centrifugal pump 100 according to embodiments of the present disclosure will be described with reference to the drawings.

[0033] The fluid flows along the spreading channel after entering the heating chamber 11 via the inlet 130, and at this time, the flow of the fluid spreads from inside to outside along the radial direction of the heating device 22. Afterwards, the fluid spread by the spreading channel flows into the converging channel, and at this time, the flow of the fluid converges from outside to inside along the radial direction of the heating device 22. In such a way, resistance due to curves to the fluid flow and the resulting fluid loss due to curves are reduced; and since the fluid spreads outwards along the radial direction of the heating device 22, the fluid can flow through the lower surface of the heating device 22 and get full contact with the heating device 22, enlarging a heated area of the fluid, and finally, the heated fluid converges into the pump chamber 12 and then flows to the outlet 140 under the guidance of the impeller 4.

[0034] For the centrifugal pump 100 according to the embodiments of the present disclosure, by providing the heating device 22 within the heating chamber 11 and providing the impeller 4 within the pump chamber 12, a heating function and a pumping function are integrated, and the centrifugal pump 100 has the compact structure and the small volume, improving a space utilization rate of the centrifugal pump 100. Furthermore, the flow guide member 3 enables the heating device 22 not to interfere with a shape design of the pump housing 1 surrounding the impeller 4, that is, the pump housing 1 surrounding the impeller 4 can be designed in a spiral shape to enhance the hydraulic performance of the centrifugal pump 100. Additionally, the flow guide member 3 is employed, not only the fluid loss due to curves is reduced, but also the fluid can be heated by the heating device 22 sufficiently, so as to enhance the heating efficiency for the fluid.

[0035] In an embodiment shown in Figs. 1 and 4, the spreading channel can guide the fluid entering via the

inlet to spread spirally outwards along the radial direction of the heating device 22, and the converging channel can guide the spread fluid to converge spirally inwards along the radial direction of the heating device 22 to the pump chamber 12. In other words, the spreading channel can be formed as a spiral spreading channel, and the converging channel can be formed as a spiral converging channel, so as to further reduce the fluid loss due to curves, and make the fluid flow through the lower surface of the heating device 22 more fully, thereby further improving the heating efficiency of the centrifugal pump 100.

[0036] As shown in Fig. 1 and Figs. 10-12, according to some embodiments of the present disclosure, the flow guide member 3 can include a separating plate 31, a plurality of spiral vanes 32 and a plurality of reverse spiral vanes 33. The plurality of spiral vanes 32 are disposed at a side of the separating plate 31 facing the heating device 22 (e.g. an upper side of the separating plate 31 illustrated in the drawings), and the plurality of spiral vanes 32 define the spreading channel at the upper side of the separating plate 31. The plurality of reverse spiral vanes 33 are disposed at another side of the separating plate 31 facing the pump chamber 12 (e.g. a lower side of the separating plate 31 illustrated in the drawings), and the plurality of reverse spiral vanes 33 define the converging channel at the lower side of the separating plate 31. Thus, the entering fluid via the inlet 130 spreads spirally outwards along the radial direction of the heating device 22 under the guidance of the spreading channel, and the spread fluid flows into the converging channel individually, thereby further enhancing the heating efficiency of the fluid.

[0037] In a further embodiment of the present disclosure, one kind of the spiral vanes 32 and the reverse spiral vanes 33 can be shifted clockwise outwards from inside to outside along a radial direction of the separating plate 31, and the other one thereof can be shifted counterclockwise from inside to outside along the radial direction of the separating plate 31, such that the fluid can spread spirally from inside to outside under the guidance of the spreading channel and converge spirally from outside to inside under the guidance of the converging channel, and the spread fluid has a reduced loss due to curves at a junction of the spreading channel and the converging channel. For example, as illustrated in Fig. 1, the spiral vanes 32 can be shifted clockwise from inside to outside along the radial direction of the separating plate 31, and the reverse spiral vanes 33 can be shifted counterclockwise from inside to outside along the radial direction of the separating plate 31. Certainly, it is also possible that the spiral vanes 32 are shifted counterclockwise from inside to outside along the radial direction of the separating plate 31, and the reverse spiral vanes 33 are shifted clockwise from inside to outside along the radial direction of the separating plate 31.

[0038] As illustrated in Figs. 1, 4, 7 and 9, in some embodiments of the present disclosure, the plurality of

reverse spiral vanes 33 can be connected to a bottom wall of the heating chamber 11, the plurality of spiral vanes 32 can be connected to the separating plate 31, and the separating plate 31 is supported on the plurality of reverse spiral vanes 33, that is, the flow guide member 3 has a split structure, such that the flow guide member 3 can be mounted and positioned in the heating chamber 11.

[0039] Optionally, as illustrated in Fig. 1, the plurality of reverse spiral vanes 33 can be integrally formed on the pump housing 1, and the plurality of spiral vanes 32 are integrally formed on the separating plate 31, so as to further simplify the structure of the centrifugal pump 100 and shorten an assembly process of the flow guide member 3.

[0040] Optionally, as illustrated in Fig. 1 and Figs. 7-9, the separating plate 31 can define a positioning hole 310, the reverse spiral vane 33 can be provided with a positioning column 331, and the positioning column 331 is fitted in the positioning hole 310, such that the separating plate 31 can be firmly supported on the reverse spiral vane 33. For example, as illustrated in the drawings, the positioning column 331 can be formed in the shape of a substantially rectangular parallelepiped, while the positioning hole 310 can be formed as a substantially rectangular hole, so as to facilitate the processing. Certainly, the positioning column 331 can also be a long cylinder, and the positioning hole 310 can be formed as a circular hole, which will not be particularly defined, as long as the positioning column 331 and the positioning hole 310 can be fitted together.

[0041] As preferred, a plurality of positioning columns 331 can be provided and disposed to respective inner ends of corresponding reverse spiral vanes 33, a plurality of positioning holes 310 can be provided and spaced along a circumferential direction of the separating plate 31, and the plurality of positioning columns 331 are fitted in the plurality of positioning holes 310 respectively, so that the connection between the separating plate 31 and the reverse spiral vane 33 is firmer. For example, as illustrated in Fig. 1, only one of two adjacent reverse spiral vanes 33 is provided with the positioning column 331, that is, the two adjacent positioning columns 331 are spaced apart by one reverse spiral vane 33 without the positioning column 331. The plurality of positioning holes 310 corresponding to the plurality of positioning columns 331 are distributed and spaced along the circumferential direction of the separating plate 31, so as to facilitate the connection between the separating plate 31 and the reverse spiral vane 33.

[0042] In some other embodiments as shown in Figs. 10-13, the plurality of reverse spiral vanes 33 and the plurality of spiral vanes 32 are connected to the separating plate 31, and the plurality of reverse spiral vanes 33 are supported on the bottom wall of the heating chamber 11, that is, the flow guide member 3 is an integral piece, thereby facilitating the assembly of the flow guide member 3. Preferably, as illustrated in Fig. 11, the plurality of

reverse spiral vanes 33, the plurality of spiral vanes 32, and the separating plate 31 can be integrally formed, so as to simplify a production process of the flow guide member 3 and improve assembly efficiency of the centrifugal pump 100.

[0043] As illustrated in Figs. 1 to 6, in a specific embodiment of the present disclosure, the pump housing 1 has an inlet pipe 13 with the inlet 130 provided in the inlet pipe 13, a lower end of the inlet pipe 13 extends into the heating chamber 11, an inner end of the spiral vane 32 is provided with an engaging notch 320, and the lower end of the inlet pipe 13 is fitted in the engaging notches 320 of the plurality of spiral vanes 32. For example, as illustrated in Fig. 7, the engaging notch 320 can run through an inner end face of the spiral vane 32, such that the inlet pipe 13 can be fitted in the engaging notches 320 of the plurality of spiral vanes 32 more stably.

[0044] In optional embodiments shown in Figs. 1, 4, 7 and 10-11, a side surface of the separating plate 31 facing the heating device 22 (an upper surface of the separating plate 31 as shown in the drawings) can be provided with a flow guide block 311 in a center of the side surface, such that the fluid entering through the inlet 130 can flow to the plurality of spiral vanes 32 under the guidance of the flow guide block 311. Preferably, the flow guide block 311 can be conical, and a vertex of the flow guide block 311 is rounded off, such the fluid can be dispersed around the flow guide block 311 when falling onto the vertex of the flow guide block 311, and hence the fluid can flow into the spreading channel smoothly.

[0045] In some embodiments of the present disclosure, an outer peripheral edge of the separating plate 31 is more adjacent to the heating device 22 compared with that the outer peripheral edge of the separating plate 31 is adjacent to the pump chamber 12, and a center of the separating plate 31 is more adjacent to the pump chamber 12 compared with that the center of the separating plate 31 is adjacent to the heating device 22, that is, the separating plate 31 is funnel-shaped. For example, as illustrated in Figs. 4, 8 and 12, the separating plate 31 is recessed downwards and inwards along the radial direction, the outer peripheral edge of the separating plate 31 is located above the center of the separating plate 31, and a longitudinal section of the separating plate 31 forms a substantially tapered face, such that the fluid can be fully heated by the heating device 22, thereby further enhancing the heating efficiency of the fluid. Certainly, it could be understood that the separating plate 31 can also extend along a horizontal direction, such that the separating plate 31 has a simple structure and is easy to produce and process.

[0046] As illustrated in Fig. 4, according to some embodiments of the present disclosure, a central axis of the inlet 130, a central axis of the pump housing 1, a central axis of the heating device 22, a central axis of the flow guide member 3 and a central axis of the impeller 4 are oriented along an up-and-down direction and coincide with each other. The heating chamber 11 is located above

the pump chamber 12, and the heating chamber 11 and the pump chamber 12 are communicated at the central axis of the pump housing 1. Therefore, the structure of the centrifugal pump 100 is simplified, the volume thereof is reduced, and the hydraulic performance thereof is excellent. Referring to Fig. 6, the outlet 140 can be provided in an outer peripheral wall of the pump housing 1, a central axis of the outlet 140 is tangent to the outer peripheral wall of the pump housing 1, and in such a case the pump housing 1 surrounding the impeller 4 is designed in a spiral shape, thereby further improving the hydraulic performance of the centrifugal pump 100.

[0047] According to some embodiments of the present disclosure, the pump housing 1 can include a housing body 14, a casing body 211, and an inlet pipe 13. The heating chamber 11 and the pump chamber 12 are defined in the housing body 14, and the outlet 140 is provided in the housing body 14. The casing body 211 is detachably mounted to the housing body 14 and presses the heating device 22 to an upper end of the housing body 14. The inlet pipe 13 is provided on the casing body 211, and the inlet 130 is provided in the inlet pipe 13. In such a way, various components of the centrifugal pump 100 can be assembled and disassembled conveniently. For example, as illustrated in Figs. 1-4 and Fig. 10, the heating device 22 is located at the upper end of the housing body 14, the casing body 211 is pressed on an upper surface of the heating device 22, and the heating chamber 11 is located above the pump chamber 12, such that the fluid flows into the pump chamber 12 under the action of gravity after heated by the heating device 22. It could be understood that the casing body 211 can be structurally fitted with the housing body 14, or can be connected with the housing body 14 by means of a fastener.

[0048] The centrifugal pump 100 according to a specific embodiment of the present disclosure will be described with reference to Figs. 1-9, and it could be understood that the following description is only explanatory and is not constructed to limit the present disclosure.

[0049] As illustrated in Figs. 1-9, the centrifugal pump 100 according the embodiment of the present disclosure includes the pump housing 1, the heating device 22, the flow guide member 3 and the impeller 4.

[0050] Specifically, the pump housing 1 includes the housing body 14, the casing body 211 and the inlet pipe 13. The heating chamber 11 and the pump chamber 12 are defined within the housing body 14, the heating chamber 11 is located above the pump chamber 12, and the heating chamber 11 and the pump chamber 12 are communicated at a central axis of the housing body 14. The casing body 211 is provided with the inlet pipe 13, the inlet 130 is defined in the inlet pipe 13, and the lower end of the inlet pipe 13 extends into the heating chamber 11. An outer peripheral wall of the housing body 14 is provided with the outlet 140 in communication with the pump chamber 12, and the central axis of the outlet 140 is tangent to the outer peripheral wall of the housing body 14.

[0051] As illustrated in Fig. 4, the heating device 22 is

pressed to the upper end of the housing body 14 by the casing body 211, the lower surface of the heating device 22 is formed as the top wall of the heating chamber 11, and a seal ring 5 is provided between the heating device 22 and the housing body 14 for sealing, and another seal ring is provided between the housing body 14 and the casing body 211 for sealing. The flow guide member 3 is disposed within the heating chamber 11 and located below the heating device 22, and the flow guide member 3 includes the separating plate 31, a plurality of spiral vanes 32 and a plurality of reverse spiral vanes 33. As illustrated in Figs. 4 and 8, the separating plate 31 is recessed downwards and inwards along the radial direction, the outer peripheral edge of the separating plate 31 is located above the center of the separating plate 31, a plurality of positioning holes 310 are provided and spaced along the circumferential direction of the separating plate 31, a conical guide flow block 311 is provided at the center of the upper surface of the separating plate 31, and the vertex of the flow guide block 311 is rounded off.

[0052] As illustrated in Figs. 4 and 7, the plurality of spiral vanes 32 are provided on the upper side of the separating plate 31 and integrally formed with the separating plate 31. The spiral vanes 32 are shifted clockwise from inside to outside along the radial direction of the separating plate 31 and define the spreading channel in the upper side of the separating plate 31. The inner ends of the spiral vanes 32 are provided with the engaging notches 320, and the lower end of the inlet pipe 13 is fitted in the engaging notches 320 of the plurality of spiral vanes 32. Thus, the inlet pipe 13 is fitted with the flow guide member 3.

[0053] As illustrated in Figs. 1 and 4, the plurality of reverse spiral vanes 33 are provided to the lower side of the separating plate 31 and integrally formed with the housing body 14. The reverse spiral vanes 33 are shifted counterclockwise from inside to outside along the radial direction of the separating plate 31 and define the converging channel in the lower side of the separating plate 31. Only one of two adjacent reverse spiral vanes 33 is provided with the positioning column 331, and a plurality of positioning columns 331 are fitted in a plurality of positioning holes 310 correspondingly. Thus, the separating plate 31 is supported on the plurality of reverse spiral vanes 33, and hence the flow guide member 3 is mounted on the housing body 14.

[0054] As illustrated in Fig. 4, the impeller 4 is disposed within the pump chamber 12, the fluid converging in the pump chamber 12 flows to the outlet 140 under the guidance of the impeller 4, and the housing body 14 surrounding the impeller 4 has a spiral shape. The central axis of the inlet 130, the central axis of the housing body 14, the central axis of the heating device 22, the central axis of the flow guide member 3, and the central axis of the impeller 4 coincide with each other.

[0055] For the centrifugal pump 100 according to the embodiment of the present disclosure, by providing the heating device 22 within the heating chamber 11 and

providing the impeller 4 within the pump chamber 12, the structure of the centrifugal pump 100 is compact and the volume thereof is small, achieving an increased space utilization rate thereof. Meanwhile, the pump housing 1 surrounding the impeller 4 is designed in the spiral shape, thereby enhancing the hydraulic performance of the centrifugal pump 100. Additionally, the flow guide member 3 is used to reduce the fluid loss due to curves, and the fluid can flow through the lower surface of the heating device 22 and make sufficient contact with the heating device 22, such that an outer diameter of the heating device 22 can match an outer diameter of the pump housing 1 to improve the heating efficiency of the fluid and reduce an axial size of the centrifugal pump 100.

[0056] The centrifugal pump 100 according to another embodiment of the present disclosure will be described with reference to Figs. 2-6 and Figs. 10-13, and it could be understood that the following description is only explanatory and is not constructed to limit the present disclosure.

[0057] As illustrated in Figs. 2-6 and Figs. 10-13, the centrifugal pump 100 according to the embodiment of the present disclosure includes the pump housing 1, the heating device 22, the flow guide member 3 and the impeller 4.

[0058] Specifically, the pump housing 1 includes the housing body 14, the casing body 211 and the inlet pipe 13. The heating chamber 11 and the pump chamber 12 are defined within the housing body 14, the heating chamber 11 is located above the pump chamber 12, and the heating chamber 11 and the pump chamber 12 are communicated at the central axis of the housing body 14. The casing body 211 is provided with the inlet pipe 13, the inlet 130 is defined in the inlet pipe 13, and the lower end of the inlet pipe 13 extends into the heating chamber 11. The outer peripheral wall of the housing body 14 is provided with the outlet 140 in communication with the pump chamber 12, and the central axis of the outlet 140 is tangent to the outer peripheral wall of the housing body 14.

[0059] As illustrated in Fig. 4, the heating device 22 is pressed to the upper end of the housing body 14 by the casing body 211, the lower surface of the heating device 22 is formed as the top wall of the heating chamber 11, and the seal ring 5 is provided between the heating device 22 and the housing body 14 for sealing, and also provided between the housing body 14 and the casing body 211 for sealing. The flow guide member 3 is integrally formed and disposed within the heating chamber 11, and is located below the heating device 22. The flow guide member 3 includes the separating plate 31, a plurality of spiral vanes 32 and a plurality of reverse spiral vanes 33. As illustrated in Figs. 4 and 12, the separating plate 31 is recessed downwards and inwards along the radial direction, the outer peripheral edge of the separating plate 31 is located above the center of the separating plate 31, a plurality of positioning holes 310 are provided and spaced along the circumferential direction of the separating plate 31, a conical guide flow block 311 is provided at the center

of the upper surface of the separating plate 31, and the vertex of the flow guide block 311 is rounded off.

[0060] As illustrated in Figs. 4 and 11, the plurality of spiral vanes 32 are disposed at the upper side of the separating plate 31. The spiral vanes 32 are shifted clockwise outwards from inside to outside along the radial direction of the separating plate 31 and define the spreading channel on the upper side of the separating plate 31, and the lower end of the inlet pipe 13 is fitted in the engaging notches 320 of the plurality of spiral vanes 32. Thus, the inlet pipe 13 is fitted with the flow guide member 3.

[0061] As illustrated in Figs. 10 and 12, the plurality of reverse spiral vanes 33 are disposed at the lower side of the separating plate 31. The reverse spiral vanes 33 are shifted counterclockwise from inside to outside along the radial direction of the separating plate 31 and define the converging channel in the lower side of the separating plate 31, and the plurality of reverse spiral vanes 33 are supported on the housing body 14. Thus, the flow guide member 3 is supported on the housing body 14.

[0062] As illustrated in Figs. 4-6, the impeller 4 is disposed within the pump chamber 12, the fluid converging in the pump chamber 12 flows to the outlet 140 under the guidance of the impeller 4, and the housing body 14 surrounding the impeller 4 has a spiral shape. The central axis of the inlet 130, the central axis of the housing body 14, the central axis of the heating device 22, the central axis of the flow guide member 3, and the central axis of the impeller 4 coincide with each other, and the heating chamber 11 is communicated with the pump chamber 12 at the central axis of the housing body 14.

[0063] For the centrifugal pump 100 according to the embodiment of the present disclosure, by providing the heating device 22 within the heating chamber 11 and providing the impeller 4 within the pump chamber 12, the structure of the centrifugal pump 100 is compact and the volume thereof is small, achieving an increased space utilization rate thereof. Meanwhile, the pump housing 1 surrounding the impeller 4 is designed in the spiral shape, thereby enhancing the hydraulic performance of the centrifugal pump 100. Additionally, with the spreading channel defined by the plurality of spiral vanes 32 and the converging channel defined by the plurality of reverse spiral vanes 33, the fluid flows along a relatively large turning radius, reducing the fluid loss due to curve, and the separating plate 31 is recessed downwards and inwards along the radial direction, improving the heating efficiency for the fluid.

[0064] A pump heater 200 for the centrifugal pump 100 according to embodiments of the present disclosure will be described with reference to Figs. 1 to 18. The pump heater 200 has advantages of high space utilization rate and high heating efficiency, and will not interfere with pumping efficiency. The pump heater 200 can be applied to a pumping and heating device, such as a centrifugal pump.

[0065] As illustrated in Figs. 1-18, the pump heater 200

according to embodiments of the present disclosure includes a casing 21 and the heating device 22.

[0066] The casing 21 is provided with the inlet 130, the heating device 22 is disposed below the casing 21 and avoids the inlet 130, for example, the heating device 22 surrounds the inlet 130. The inlet 130 communicates an upper space 201 of the casing 21 with a lower space 202 of the heating device 22, and the fluid enters the casing 21 via the inlet 130 and flows to the lower space 202 of the heating device 22 to be heated by the heating device 22.

[0067] For the pump heater 200 according to embodiments of the present disclosure, by providing the heating device 22 below the casing 21 and by employing the heating device 22 to heat the fluid that flows to its lower space 202, the heated area of the fluid is enlarged, and space can be utilized sufficiently. Meanwhile, since the heating device 22 avoids the inlet 130, the heating device 22 will not produce hydraulic resistance to the fluid and avoids affecting the pumping efficiency.

[0068] In conclusion, the pump heater 200 according to embodiments of the present disclosure has high space utilization rate and high heating efficiency, and will not affect the pumping efficiency.

[0069] According to some embodiments of the present disclosure, at least one of the upper surface and an outer peripheral surface of the heating device 22 is provided with a resistance coating, i.e. at least one of surfaces of the heating device 22 not in contact with the fluid to be heated is provided with the resistance coating. For example, the upper surface of the heating device 22 is coated with the resistance coating, and heat is transferred to the lower surface of the heating device 22 and heats the fluid in the lower space 202. Certainly, the upper surface and the outer peripheral surface of the heating device 22 can be both coated with the resistance coating. Preferably, the resistance coating can be a thick-film resistor.

[0070] As illustrated in Figs. 1, 4, 10, 14, 16 and 18, in some embodiments, the heating device 22 can be an annular heating plate with a central through hole, and the position of the central through hole corresponds to that of the inlet 130 in a vertical direction. For example, a central axis of the central through hole and the central axis of the inlet 130 both extend along the vertical direction and coincide with each other, and a diameter of the central through hole is larger than or equal to a diameter of the inlet 130, such that the heating device 22 will not produce hydraulic resistance to the fluid at the inlet 130.

[0071] Optionally, as illustrated in Figs. 1, 2, 4, 6, 10, 14, and 16-18, the heating device 22 can be a ring-shaped heating plate, so as to further improve the space utilization rate and the heating efficiency.

[0072] In some embodiments shown by Figs. 14 and 18, an inner peripheral edge and an outer peripheral edge of the heating device 22 can be sealed from the casing 21 respectively to avoid fluid leakage. Specifically, the inner peripheral edge and the outer peripheral edge of the heating device 22 can be sealed from the casing 21

by means of the seal ring 5 respectively. For example, the inner peripheral edge of the heating device 22 is sealed from the casing 21 by means of a first seal ring 5, while the outer peripheral edge of the heating device 22 is sealed from the casing 21 by means of a second seal ring 5.

[0073] Preferably, a thermal insulation member 6 can be provided between the inner peripheral edge and/or the outer peripheral edge of the heating device 22 and the corresponding seal ring 5, such that the seal ring 5 is prevented from contacting the heating device 22 directly, mitigating the impact of the heat generated by the heating device 22 on the seal ring 5. The thermal insulation member 6 can be provided between the inner peripheral edge of the heating device 22 and the corresponding seal ring 5, or the thermal insulation member 6 can be provided between the outer peripheral edge of the heating device 22 and the corresponding seal ring 5. Certainly, the thermal insulation members 6 can be provided between the inner peripheral edge and the outer peripheral edge of the heating device 22 and their corresponding seal rings 5 at the same time. For example, a first thermal insulation member 61 extending along a circumferential direction of the inner peripheral edge is welded to the inner peripheral edge of the heating device 22, and a second thermal insulation member 62 extending along a circumferential direction of the outer peripheral edge is welded to the outer peripheral edge of the heating device 22. The first thermal insulation member 61 is located between the inner peripheral edge of the heating device 22 and the first seal ring 51, and the first seal ring 51 seals a gap between the first thermal insulation member 61 and the casing 21. The second thermal insulation member 62 is located between the outer peripheral edge of the heating device 22 and the second seal ring 52, and the second seal ring 52 seals a gap between the second thermal insulation member 62 and the casing 21.

[0074] As illustrated in Figs. 1, 2, 6, 10, and 14-16, in some embodiments of the present disclosure, the pump heater 200 can further include a wiring terminal 7, and the wiring terminal 7 is electrically coupled with the heating device 22 and exposed out of the casing 21 to supply power to the heating device 22. Further, as illustrated in Figs. 1-3, 5, 6, 10, and 14-16, the heating device 22 can be provided with a terminal box 8, and the wiring terminal 7 is disposed in the terminal box 8 to protect the wiring terminal 7, so as to improve electrical safety.

[0075] In some embodiments illustrated in Figs. 1-6, 10, 14, 15, 17 and 18, the casing 21 can be constituted by the casing body 211 and the inlet pipe 13 together, the heating device 22 is disposed below the casing body 211, the inlet pipe 13 is disposed on the casing body 211, and the inlet 130 is defined in the inlet pipe 13. Thus, the fluid flows to the lower space 202 of the heating device 22 under the guidance of the inlet pipe 13, with confronting little hydraulic resistance.

[0076] The pump heater 200 according to a first op-

tional embodiment of the present disclosure will be described in detail with reference to Figs. 14-16, and it could be understood that the following description is only explanatory and is not constructed to limit the present disclosure.

[0077] As illustrated in Figs. 14-16, the pump heater 200 according to the embodiment of the present disclosure includes the casing 21, the heating device 22 and the wiring terminal 7.

[0078] Specifically, the casing 21 includes the casing body 211 and the inlet pipe 13. The heating device 22 is mounted to a lower surface of the casing body 211 and is provided with the terminal box 8. The terminal box 8 is exposed out of the casing body 211, and the wiring terminal 7 is mounted in the terminal box 8 and electrically connected with the heating device 22. The inlet pipe 13 is integrally formed on the casing body 211 and has the inlet 130, and the inlet 130 communicates the upper space 201 of the casing body 211 with the lower space 202 of the heating device 22. The heating device 22 is a ring-shaped heating plate having a central through hole and applied with a thick-film resistor on its outer surface, the position of the central through hole corresponding corresponds to the position of the inlet 130 in the vertical direction.

[0079] The first thermal insulation member 61 extending along the circumferential direction of the inner peripheral edge is welded to the inner peripheral edge of the heating device 22, and the second thermal insulation member 62 extending along the circumferential direction of the outer peripheral edge is welded to the outer peripheral edge of the heating device 22. A section of the first thermal insulation member 61 in a vertical plane is substantially L-shaped, and the first thermal insulation member 61 is sealed from the casing body 211 by means of the first seal ring 51. A section of the second thermal insulation member 62 in the vertical plane is substantially Z-shaped, and the second thermal insulation member 62 is sealed from the casing body 211 by means of the second seal ring 52.

[0080] For the pump heater 200 according to the embodiment of the present disclosure, by mounting the heating device 22 below the casing body 211 and making the heating device 22 avoid the inlet 130, and coating the outer surface of the heating device 22 with the thick-film resistor, not only the space utilization rate and the heating efficiency of the pump heater 200 are enhanced, but also the pumping efficiency can be ensured.

[0081] The pump heater 200 according to a second optional embodiment of the present disclosure will be described in detail with reference to Figs. 17 and 18, and it could be understood that the following description is only explanatory and is not constructed to limit the present disclosure.

[0082] As illustrated in Figs. 17 and 18, the pump heater 200 according to the embodiment of the present disclosure includes the casing 21 and the heating device 22.

[0083] Specifically, the casing 21 includes the casing

body 211 and the inlet pipe 13. The heating device 22 is mounted to the lower surface of the casing body 211. The inlet pipe 13 is integrally formed on the casing body 211 and has the inlet 130, the inlet 130 communicates the upper space 201 of the casing body 211 with the lower space 202 of the heating device 22, and the lower end of the inlet pipe 13 extends into the lower space 202. The heating device 22 is an annular heating plate having a central through hole and coated with a thick-film resistor on its outer surface, the position of the central through hole corresponds to the position of the inlet 130 in the vertical direction. The inner peripheral edge of the heating device 22 is sealed from the casing body 211 and from the inlet pipe 13 by means of the first seal ring 51, while the outer peripheral edge of the heating device 22 is sealed from the casing body 211 by means of the second seal ring 52.

[0084] The centrifugal pump 100 according to a specific embodiment of the present disclosure will be described in detail with reference to Figs. 1-9, and the centrifugal pump 100 is suitable for various applications, such as fluid transportation, cooling systems and domestic appliances, and has advantages of the compact structure, small volume, high heating efficiency and good pumping performance. It could be understood that the following description is only explanatory and is not constructed to limit the present disclosure.

[0085] As illustrated in Figs. 1-9, the centrifugal pump 100 according to the embodiment of the present disclosure includes the housing body 14, the pump heater 200, the flow guide member 3 and the impeller 4.

[0086] Specifically, the pump heater 200 includes the casing 21, the heating device 22 and the wiring terminal 7. The casing 21 includes the casing body 211 and the inlet pipe 13. The heating device 22 is mounted to the lower surface of the casing body 211 and is provided with the terminal box 8. The terminal box 8 is exposed out of the casing body 211, and the wiring terminal 7 is mounted in the terminal box 8 and electrically connected with the heating device 22. The inlet pipe 13 is mounted on the casing body 211 and has the inlet 130. The inlet 130 communicates the upper space 201 of the casing body 211 with the lower space 202 of the heating device 22. The heating device 22 is an annular heating plate having a central through hole and coated with a thick-film resistor on its outer surface, the position of the central through hole corresponds to the position of the inlet 130 in the vertical direction.

[0087] The housing body 14, the casing body 211 and the inlet pipe 13 constitute the pump housing 1 of the centrifugal pump 100. The heating chamber 11 and the pump chamber 12 are defined in the housing body 14, the heating chamber 11 is located above the pump chamber 12, the heating chamber 11 and the pump chamber 12 are communicated at the central axis of the housing body 14, and the heating chamber 11 and the pump chamber 12 are located below the heating device 22. The heating chamber 11 is in communication with the

inlet 130, the lower end of the inlet pipe 13 extends into the heating chamber 11, the outer peripheral wall of the housing body 14 defines the outlet 140 in communication with the pump chamber 12, and the central axis of the outlet 140 is tangent to the outer peripheral wall of the housing body 14.

[0088] As illustrated in Fig. 4, the heating device 22 is pressed to the upper end of the housing body 14 by the casing body 211, and the lower surface of the heating device 22 is formed as the top wall of the heating chamber 11. The first seal ring 51 is used for sealing the inner peripheral edge of the heating device 22 from an outer peripheral surface of the inlet pipe 13 by means of the first seal ring 51, while the second seal ring 52 is used to for sealing the outer peripheral edge of the heating device 22 from the housing body 14 and sealing the housing body 14 from the casing body 211. The flow guide member 3 is disposed within the heating chamber 11 and located below the heating device 22, and the flow guide member 3 includes the separating plate 31, a plurality of spiral vanes 32 and a plurality of reverse spiral vanes 33. As illustrated in Figs. 4 and 8, the separating plate 31 is recessed downwards and inwards along the radial direction, the outer peripheral edge of the separating plate 31 is located above the center of the separating plate 31, a plurality of positioning holes 310 are provided and spaced along the circumferential direction of the separating plate 31, a conical guide flow block 311 is provided at the center of the upper surface of the separating plate 31, and the vertex of the flow guide block 311 is rounded off.

[0089] As illustrated in Figs. 4 and 7, the plurality of spiral vanes 32 are provided on the upper side of the separating plate 31 and integrally formed with the separating plate 31. The spiral vanes 32 are shifted clockwise outwards from inside to outside along the radial direction of the separating plate 31 and defines the spreading channel in the upper side of the separating plate 31. The inner ends of the spiral vanes 32 are provided with the engaging notches 320, and the lower end of the inlet pipe 13 is fitted in the engaging notches 320 of the plurality of spiral vanes 32. Thus, the inlet pipe 13 is fitted with the flow guide member 3.

[0090] As illustrated in Figs. 1 and 4, the plurality of reverse spiral vanes 33 are provided to the lower side of the separating plate 31 and integrally formed with the housing body 14. The reverse spiral vanes 33 are shifted counterclockwise from inside to outside along the radial direction of the separating plate 31 and define the converging channel in the lower side of the separating plate 31. Only one of two adjacent reverse spiral vanes 33 is provided with the positioning column 331, and a plurality of positioning columns 331 are fitted in a plurality of positioning holes 310 correspondingly. Thus, the separating plate 31 is supported on the plurality of reverse spiral vanes 33, and hence the flow guide member 3 is mounted on the housing body 14.

[0091] As illustrated in Fig. 4, the impeller 4 is disposed within the pump chamber 12, the fluid converging in the

pump chamber 12 flows to the outlet 140 under the guidance of the impeller 4, and the housing body 14 surrounding the impeller 4 has a spiral shape. The central axis of the inlet 130, the central axis of the housing body 14, the central axis of the central through hole of the heating device 22, the central axis of the flow guide member 3, and the central axis of the impeller 4 coincide with each other.

[0092] A heating and pumping process of the centrifugal pump 100 according to embodiments of the present disclosure will be described with reference to the drawings.

[0093] The fluid flows along the spreading channel after entering the heating chamber 11 via the inlet 130, and at this time, the flow of the fluid spreads from inside to outside along the radial direction of the heating device 22. Afterwards, the fluid spread by the spreading channel flows into the converging channel, and at this time, the flow of the fluid converges from outside to inside along the radial direction of the heating device 22. In such a way, resistance due to curves to the fluid flow and the resulting fluid loss due to curves are reduced; and since the fluid spreads outwards along the radial direction of the heating device 22, the fluid can flow through the lower surface of the heating device 22 and get full contact with the heating device 22, enlarging a heated area of the fluid, and finally, the heated fluid converges into the pump chamber 12 and then flows to the outlet 140 under the guidance of the impeller 4.

[0094] Since the centrifugal pump 100 according to embodiments of the present disclosure employs the above pump heater 200, the centrifugal pump 100 has the compact structure, small volume and improved space utilization rate. Meanwhile, the heating device 22 is provided in a manner of avoiding the inlet 130, so the hydraulic resistance to the fluid will not be increased, and the pump housing 1 surrounding the impeller 4 is designed in the spiral shape, thereby enhancing the pumping performance of the centrifugal pump 100. Additionally, the flow guide member 3 is employed, not only the fluid loss due to curves is reduced, but also the fluid can flow through the lower surface of the heating device 22 and contact with the heating device 22 sufficiently, such that the outer diameter of the heating device 22 can match the outer diameter of the pump housing 1 to improve the heating efficiency for the fluid and reduce the axial size of the centrifugal pump 100.

[0095] The centrifugal pump 100 according to another embodiment of the present disclosure will be described with reference to Figs. 2-6 and Figs. 10-13, and it could be understood that the following description is only explanatory and is not constructed to limit the present disclosure.

[0096] As illustrated in Figs. 2-6 and Figs. 10-13, the centrifugal pump 100 according the embodiment of the present disclosure includes the housing body 14, the pump heater 200, the flow guide member 3 and the impeller 4.

[0097] Specifically, the pump heater 200 includes the casing 21, the heating device 22 and the wiring terminal 7. The casing 21 includes the casing body 211 and the inlet pipe 13. The heating device 22 is mounted to the lower surface of the casing body 211 and is provided with the terminal box 8. The terminal box 8 is exposed out of the casing body 211, and the wiring terminal 7 is mounted in the terminal box 8 and electrically coupled with the heating device 22. The inlet pipe 13 is mounted on the casing body 211 and has the inlet 130. The inlet 130 communicates the upper space 201 of the casing body 211 with the lower space 202 of the heating device 22. The heating device 22 is an annular heating plate having a central through hole and coated with a thick-film resistor on its outer surface, the position of the central through hole corresponds to the position of the inlet 130 in the vertical direction.

[0098] The housing body 14, the casing body 211 and the inlet pipe 13 constitute the pump housing 1 of the centrifugal pump 100. The heating chamber 11 and the pump chamber 12 are defined in the housing body 14, the heating chamber 11 is located above the pump chamber 12, the heating chamber 11 and the pump chamber 12 are communicated at the central axis of the housing body 14, and the heating chamber 11 and the pump chamber 12 are located below the heating device 22. The heating chamber 11 is in communication with the inlet 130, the lower end of the inlet pipe 13 extends into the heating chamber 11, the outer peripheral wall of the housing body 14 defines the outlet 140 in communication with the pump chamber 12, and the central axis of the outlet 140 is tangent to the outer peripheral wall of the housing body 14.

[0099] As illustrated in Fig. 4, the heating device 22 is pressed to the upper end of the housing body 14 by the casing body 211, and the lower surface of the heating device 22 is formed as the top wall of the heating chamber 11. The first seal ring 51 is used for sealing the inner peripheral edge of the heating device 22 from an outer peripheral face of the inlet pipe 13, while the second seal ring 52 is used for sealing the outer peripheral edge of the heating device 22 from the housing body 14 and sealing the housing body 14 from the casing body 211. The flow guide member 3 is integrally formed and disposed within the heating chamber 11, and is located below the heating device 22. The flow guide member 3 includes the separating plate 31, a plurality of spiral vanes 32 and a plurality of reverse spiral vanes 33. As illustrated in Figs. 4 and 12, the separating plate 31 is recessed downwards and inwards along the radial direction, the outer peripheral edge of the separating plate 31 is located above the center of the separating plate 31, a plurality of positioning holes 310 are provided and spaced along the circumferential direction of the separating plate 31, a conical guide flow block 311 is provided at the center of the upper surface of the separating plate 31, and the vertex of the flow guide block 311 is rounded off.

[0100] As illustrated in Figs. 4 and 11, the plurality of

spiral vanes 32 are disposed at the upper side of the separating plate 31. The spiral vanes 32 are shifted clockwise outwards along the radial direction of the separating plate 31 and define the spreading channel in the upper side of the separating plate 31. The lower end of the inlet pipe 13 is fitted in the engaging notches 320 of the plurality of spiral vanes 32. Thus, the inlet pipe 13 is fitted with the flow guide member 3.

[0101] As illustrated in Figs. 10 and 12, the plurality of reverse spiral vanes 33 are disposed at the lower side of the separating plate 31. The reverse spiral vanes 33 are shifted counterclockwise outwards along the radial direction of the separating plate 31 and define the converging channel in the lower side of the separating plate 31. The plurality of reverse spiral vanes 33 are supported on the housing body 14. Thus, the flow guide member 3 is supported on the housing body 14.

[0102] As illustrated in Figs. 4-6, the impeller 4 is disposed within the pump chamber 12, the fluid converging in the pump chamber 12 flows to the outlet 140 under the guidance of the impeller 4, and the housing body 14 surrounding the impeller 4 has a spiral shape. The central axis of the inlet 130, the central axis of the housing body 14, the central axis of the central through hole of the heating device 22, the central axis of the flow guide member 3, and the central axis of the impeller 4 coincide with each other.

[0103] Since the centrifugal pump 100 according to embodiments of the present disclosure employs the above pump heater 200, the centrifugal pump 100 has the compact structure, small volume and improved space utilization rate. Meanwhile, the heating device 22 is provided in a manner of avoiding the inlet 130, so the hydraulic resistance to the fluid will not be increased, and the pump housing 1 surrounding the impeller 4 is designed in the spiral shape, thereby enhancing the pumping performance of the centrifugal pump 100. Additionally, with the spreading channel defined by the plurality of spiral vanes 32 and the converging channel defined by the plurality of reverse spiral vanes 33, the fluid flows along a relatively large turning radius, reducing the fluid loss, and the separating plate 31 is recessed downwards and inwards along the radial direction, improving the heating efficiency of the fluid.

[0104] In the specification, it is to be understood that terms such as "central," "upper," "lower," "horizontal," "top," "bottom," "inner," "outer," "clockwise," "counterclockwise," "axial," "radial" and "circumferential" should be construed to refer to the orientation as then described or as shown in the drawings under discussion. These relative terms are for convenience of description of the present disclosure and do not indicate or imply that the device or element referred to must have a particular orientation or must be constructed or operated in a particular orientation. Thus, these terms cannot be constructed to limit the present disclosure. In the description of the present invention, the term "a plurality of" means two or more than two, unless specified otherwise.

[0105] In the present invention, unless specified or limited otherwise, the terms "mounted," "connected," "coupled" and the like are used broadly, and may be, for example, fixed connections, detachable connections, or integral connections; may also be mechanical or electrical connections; may also be direct connections or indirect connections via intervening structures; may also be inner communications of two elements, which can be understood by those skilled in the art according to specific situations.

[0106] Reference throughout this specification to "a further embodiment," "some embodiments," "a specific embodiment," or "an optional embodiment," means that a particular feature, structure, material, or characteristic described in connection with the embodiment or example is included in at least one embodiment or example of the present disclosure. Thus, the appearances of the phrases in various places throughout this specification are not necessarily referring to the same embodiment or example of the present disclosure. Furthermore, the particular features, structures, materials, or characteristics may be combined in any suitable manner in one or more embodiments or examples.

[0107] Although embodiments of the present disclosure have been shown and illustrated, it shall be understood by those skilled in the art that various changes, modifications, alternatives and variants without departing from the principle of the present disclosure are acceptable. The scope of the present disclosure is defined by the claims or the like.

Claims

1. A centrifugal pump, comprising:

a pump housing, internally defining a heating chamber and a pump chamber in communication with the heating chamber, and provided with an inlet in communication with the heating chamber and an outlet in communication with the pump chamber;

a heating device, provided on the pump housing; a flow guide member, provided in the heating chamber and defining a spreading channel and a converging channel in the heating chamber, the spreading channel being configured to guide fluid entering through the inlet to spread outwards along a radial direction of the heating device, and the converging channel being configured to guide the spread fluid to converge inwards along the radial direction of the heating device to the pump chamber;

an impeller, provided in the pump chamber and configured to guide the fluid converged in the pump chamber to the outlet.

2. The centrifugal pump according to claim 1, wherein

the spreading channel guides the fluid entering through the inlet to spread spirally outwards along the radial direction of the heating device, and the converging channel guides the spread fluid to converge spirally inwards along the radial direction of the heating device to the pump chamber.

3. The centrifugal pump according to claim 1, wherein the flow guide member comprises:

a separating plate;

a plurality of spiral vanes provided at a side of the separating plate facing the heating device, and defining the spreading channel at the side of the separating plate facing the heating device; and

a plurality of reverse spiral vanes provided at another side of the separating plate facing the pump chamber, and defining the converging channel at the another side of the separating plate facing the pump chamber.

4. The centrifugal pump according to claim 3, wherein one kind of the spiral vanes and the reverse spiral vanes is shifted clockwise from inside to outside along a radial direction of the separating plate, while the other one thereof is shifted counterclockwise from inside to outside along the radial direction of the separating plate.

5. The centrifugal pump according to claim 3, wherein the plurality of reverse spiral vanes are connected to a bottom wall of the heating chamber, the plurality of spiral vanes are connected to the separating plate, and the separating plate is supported on the plurality of reverse spiral vanes.

6. The centrifugal pump according to claim 5, wherein the plurality of reverse spiral vanes are integrally formed on the pump housing, and the plurality of spiral vanes are integrally formed on the separating plate.

7. The centrifugal pump according to claim 5, wherein the separating plate is provided with a positioning hole, the reverse spiral vane is provided with a positioning column, and the positioning column is fitted in the positioning hole.

8. The centrifugal pump according to claim 7, wherein a plurality of positioning columns are provided and disposed to inner ends of corresponding reverse spiral vanes, a plurality of positioning holes are provided and spaced along a circumferential direction of the separating plate, and the plurality of positioning columns are fitted in the plurality of positioning holes respectively.

9. The centrifugal pump according to claim 3, wherein the plurality of reverse spiral vanes and the plurality of spiral vanes are connected to the separating plate, and the plurality of reverse spiral vanes are supported on a bottom wall of the heating chamber.

10. The centrifugal pump according to claim 9, wherein the plurality of reverse spiral vanes, the plurality of spiral vanes and the separating plate are integrally formed.

11. The centrifugal pump according to claim 3, wherein the pump housing has an inlet pipe extending into the heating chamber, the inlet is provided in the inlet pipe, inner ends of the spiral vanes are provided with engaging notches, and an end of the inlet pipe that extends into the heating chamber is fitted in the engaging notches of the plurality of spiral vanes.

12. The centrifugal pump according to claim 3, wherein a side surface of the separating plate facing the heating device is provided with a flow guide block in a center of the side surface, and the flow guide block is configured to guide the fluid entering through the inlet to the plurality of spiral vanes.

13. The centrifugal pump according to claim 12, wherein the flow guide block is conical, and a vertex of the flow guide block is rounded off.

14. The centrifugal pump according to claim 3, wherein an outer peripheral edge of the separating plate is more adjacent to the heating device compared with that the outer peripheral edge of the separating plate is adjacent to the pump chamber, and a center of the separating plate is more adjacent to the pump chamber compared with that the center of the separating plate is adjacent to the heating device.

15. The centrifugal pump according to any one of claims 1 to 14, wherein a central axis of the inlet, a central axis of the pump housing, a central axis of the heating device, a central axis of the flow guide member, and a central axis of the impeller coincide with each other; the heating chamber and the pump chamber are communicated at the central axis of the pump housing; the outlet is provided in an outer peripheral wall of the pump housing, and a central axis of the outlet is tangent to the outer peripheral wall of the pump housing.

16. The centrifugal pump according to claim 1, wherein the pump housing comprises:

a housing body, the heating chamber and the pump chamber being defined in the housing body, and the outlet being provided in the housing body;

a casing body, detachably mounted to the housing body and pressing the heating device to an upper end of the housing body; and
 an inlet pipe, the inlet pipe being provided on the casing body, and the inlet being provided in the inlet pipe. 5

17. The centrifugal pump according to claim 1, wherein the heating device is configured as an annular heating plate having a central through hole, and a position of the central through hole corresponds to a position of the inlet in a vertical direction. 10

18. The centrifugal pump according to claim 17, wherein at least one of an upper surface and an outer peripheral surface of the heating device is provided with a resistance coating. 15

19. The centrifugal pump according to claim 17, wherein a seal ring is provided between an inner peripheral edge of the heating device and the pump housing for sealing, and another seal ring is provided between an outer peripheral edge of the heating device and the pump housing for sealing, and a thermal insulation member is provided between the inner peripheral edge and/or the outer peripheral edge of the heating device and the corresponding seal ring. 20
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20. The centrifugal pump according to claim 1, further comprising: 30

a terminal box, provided on the heating device;
 and
 a wiring terminal, provided in the terminal box, electrically coupled with the heating device, and exposed out of the pump housing. 35

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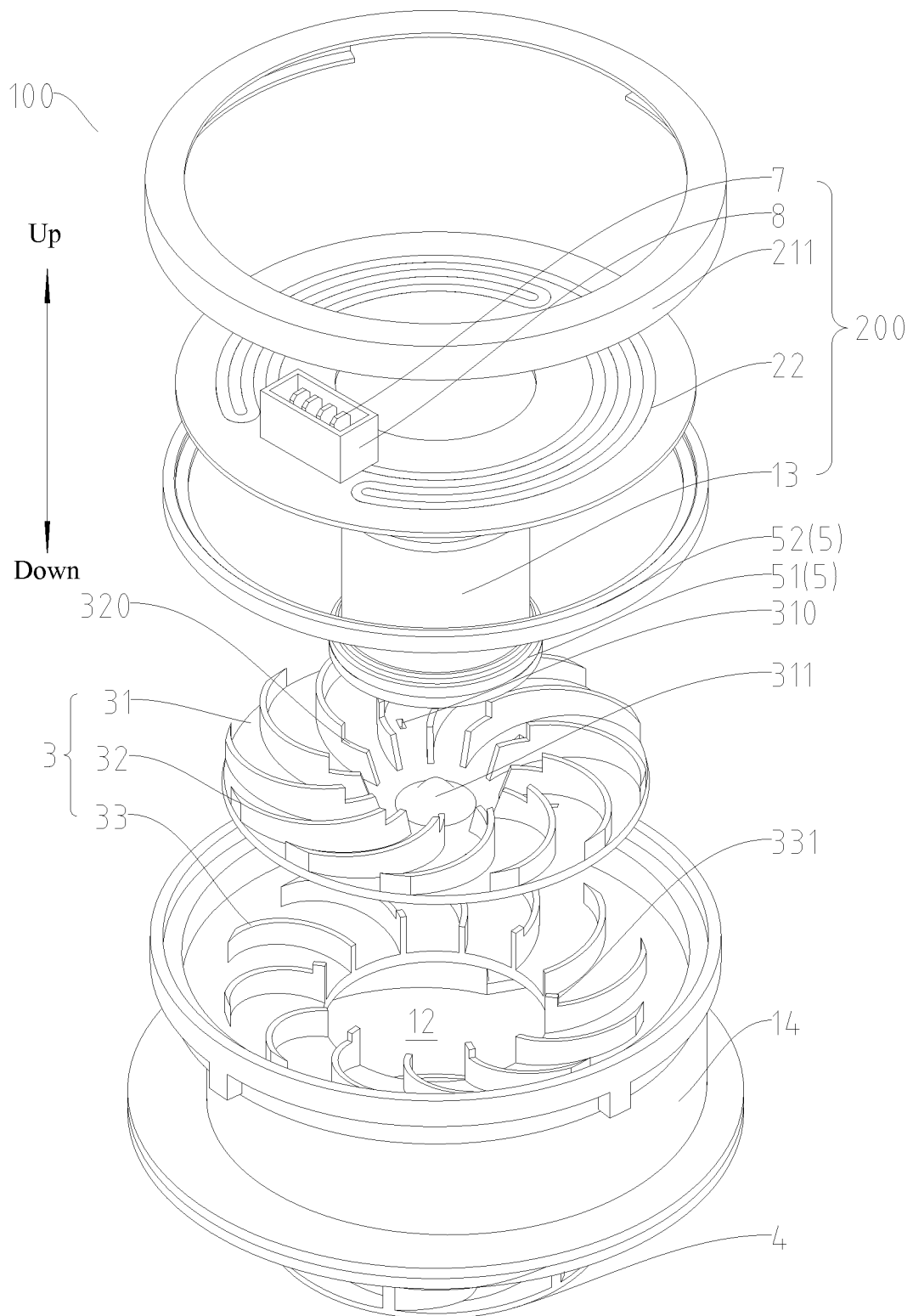


Fig. 1

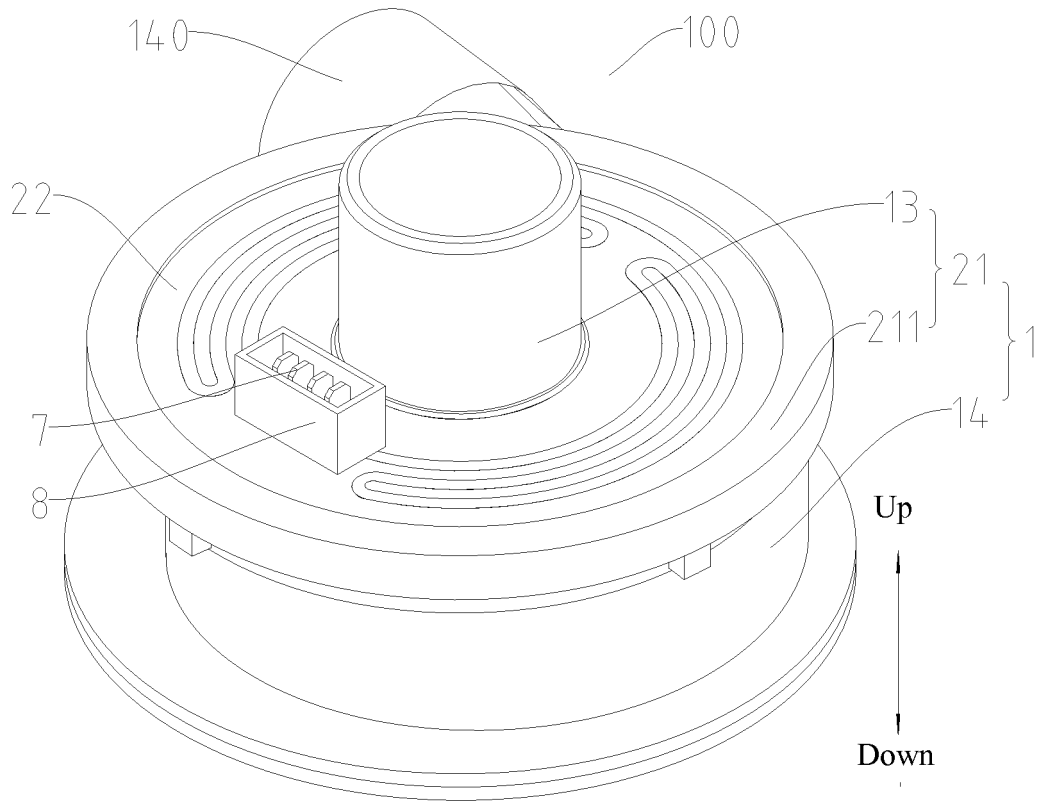


Fig. 2

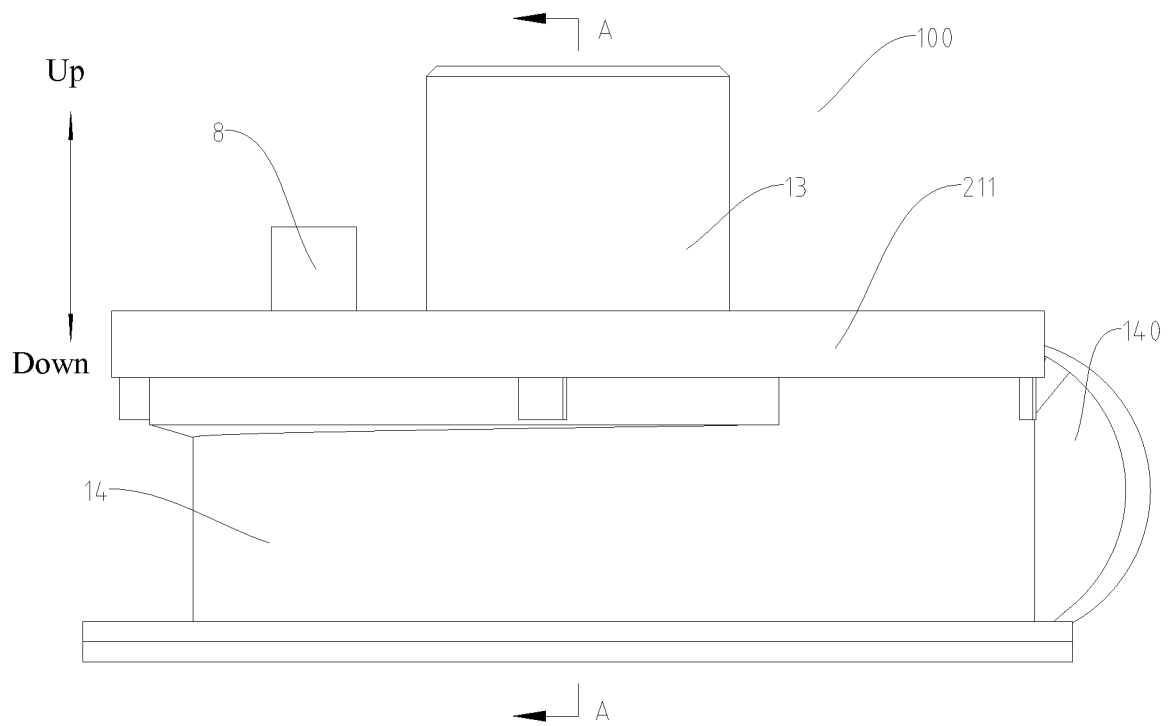


Fig. 3

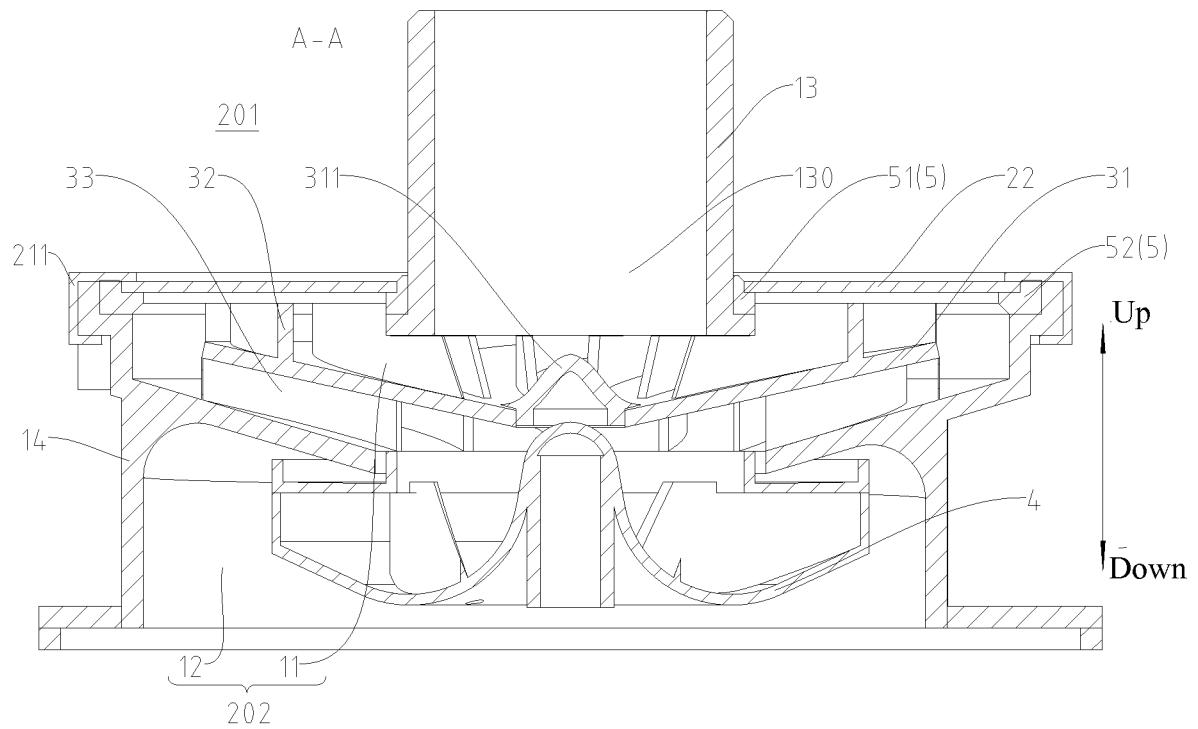


Fig. 4

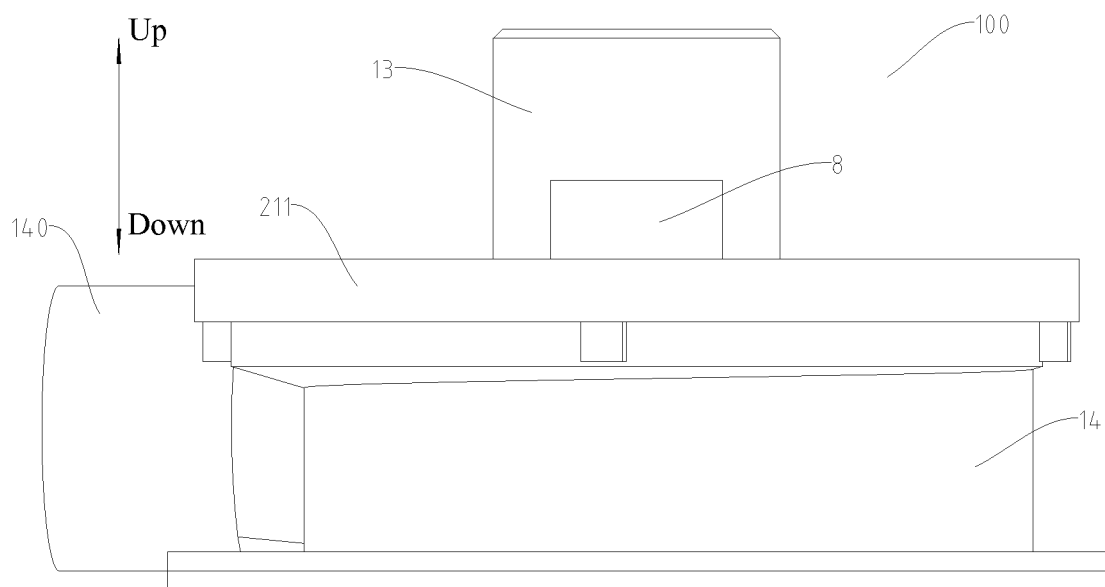


Fig. 5

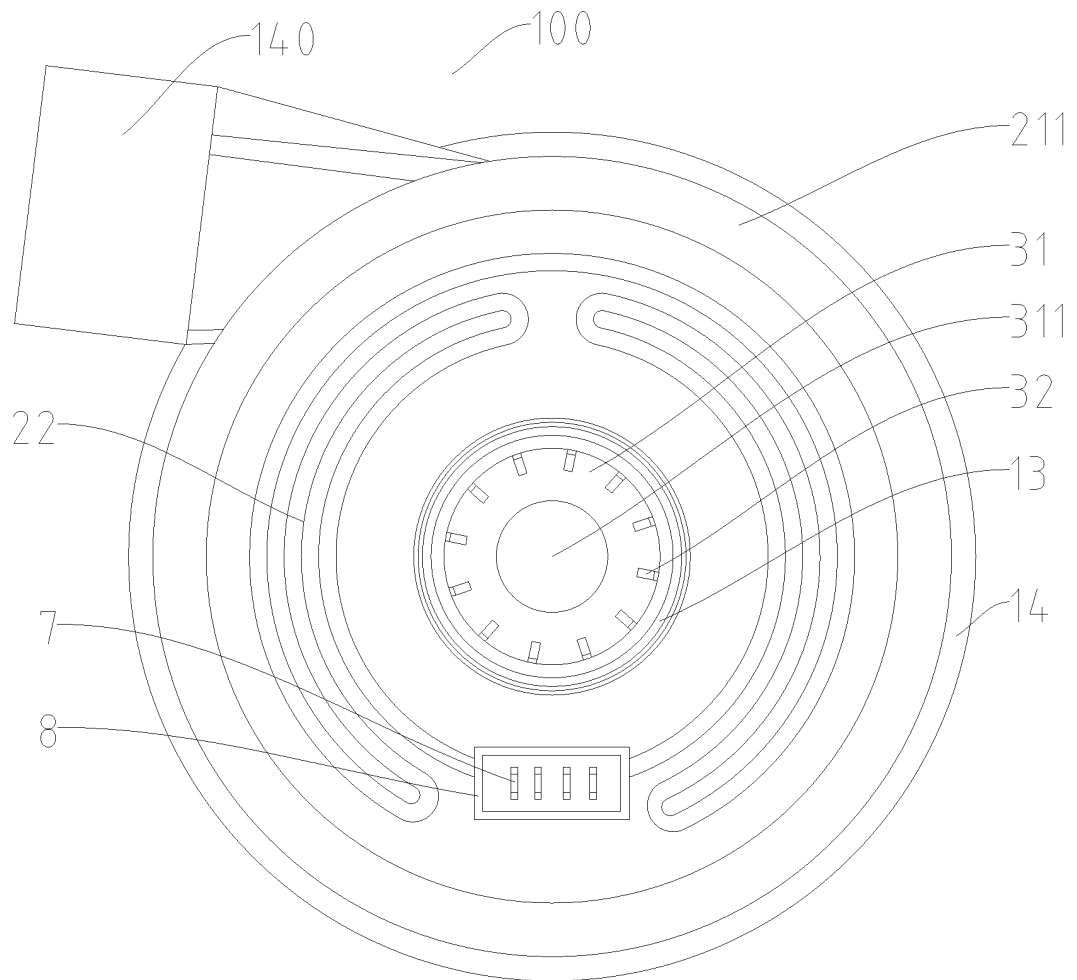


Fig. 6

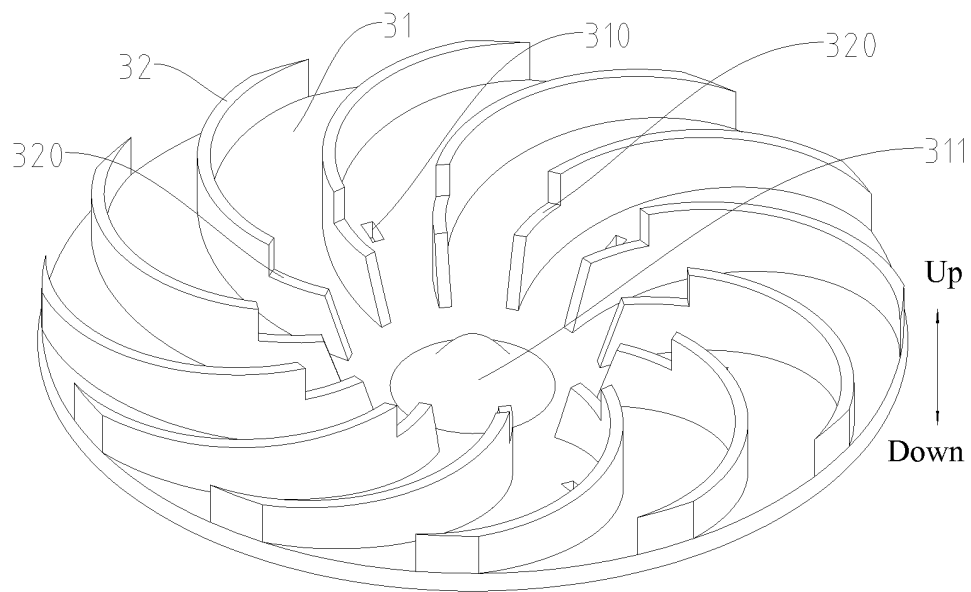


Fig. 7

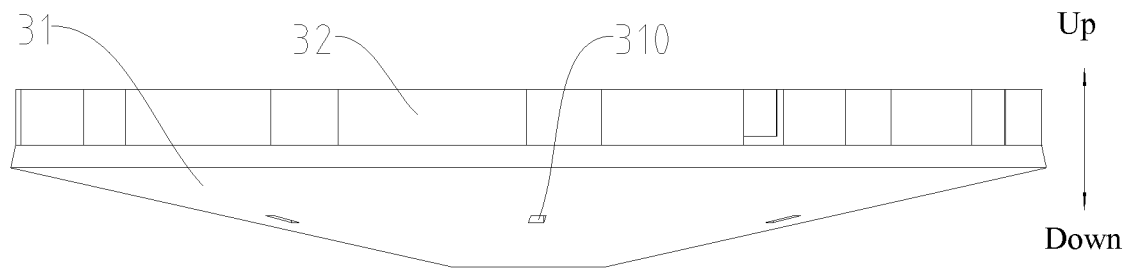


Fig. 8

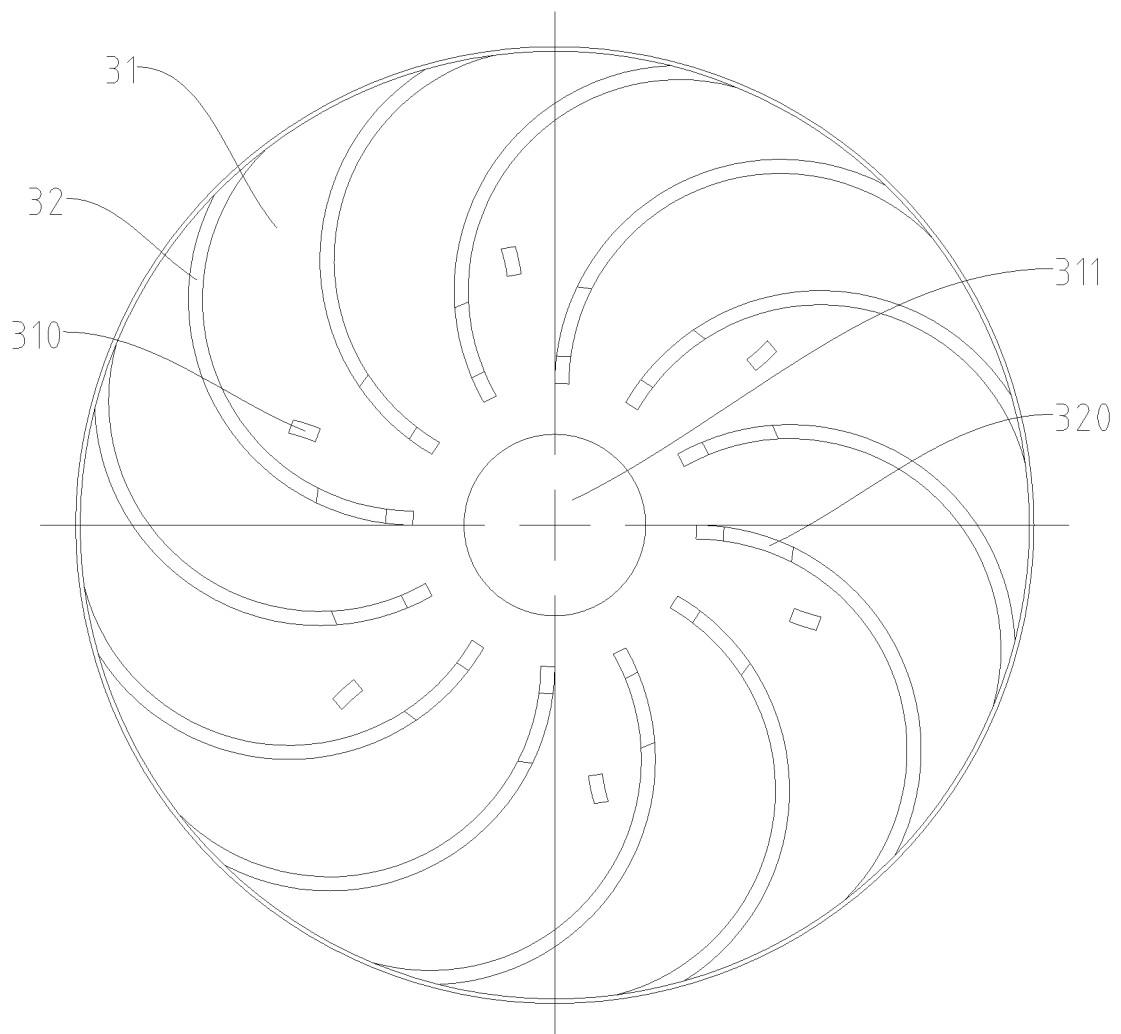


Fig. 9

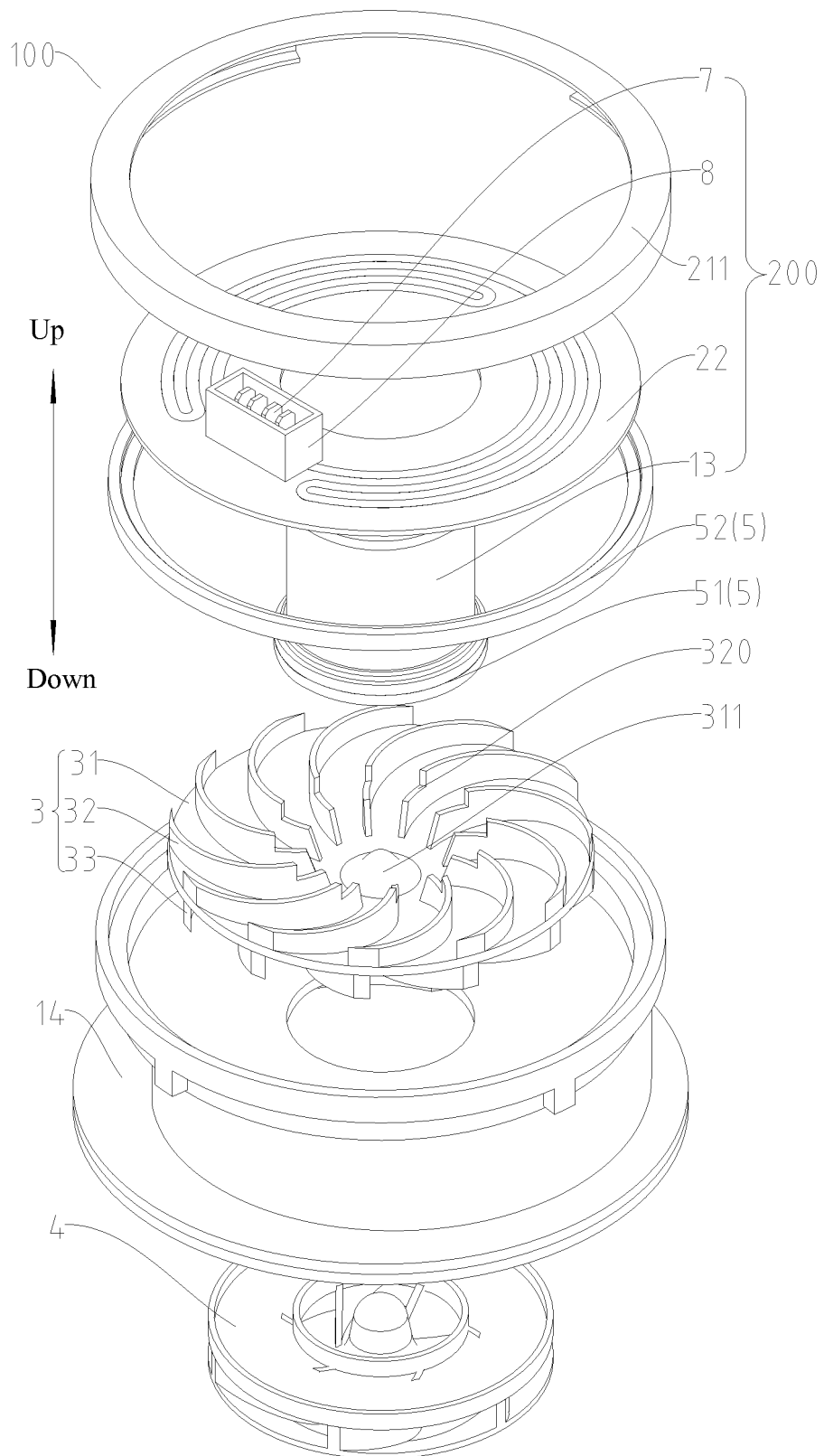


Fig. 10

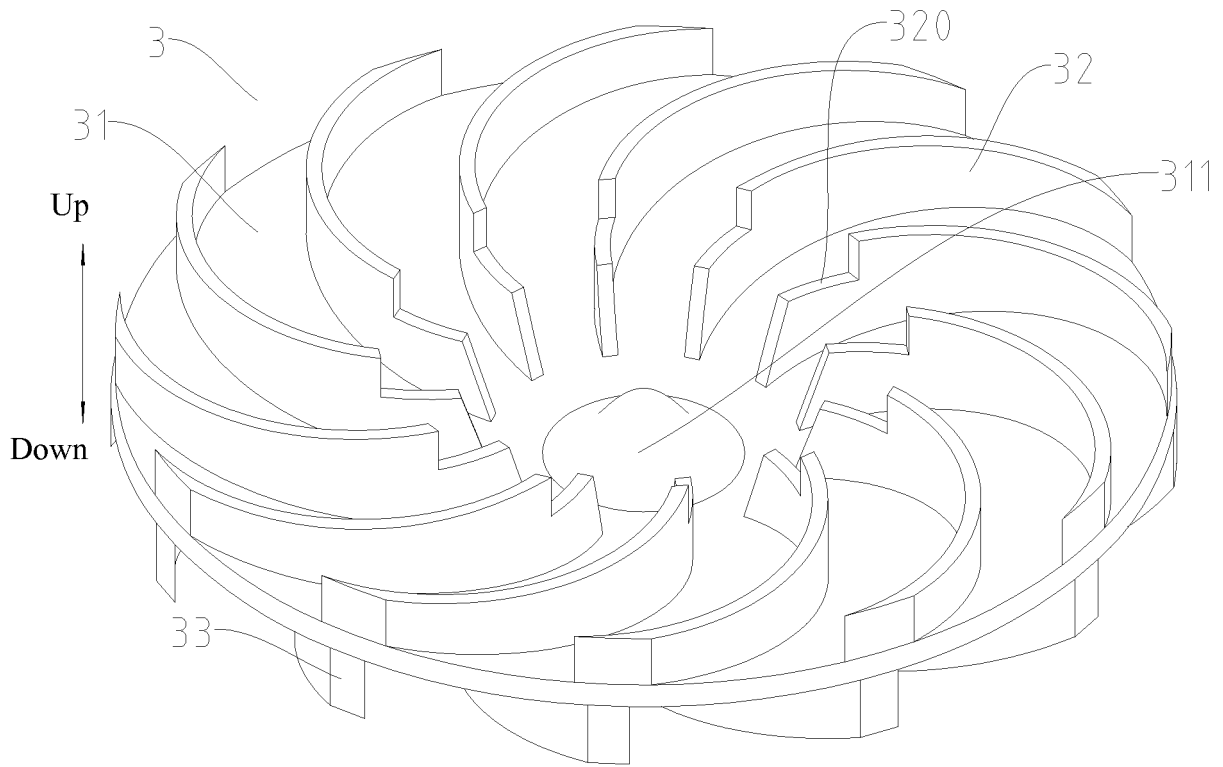


Fig. 11

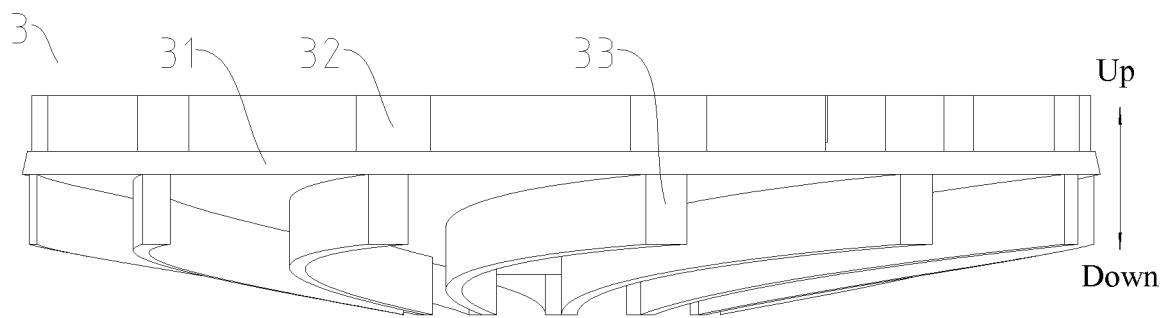


Fig. 12

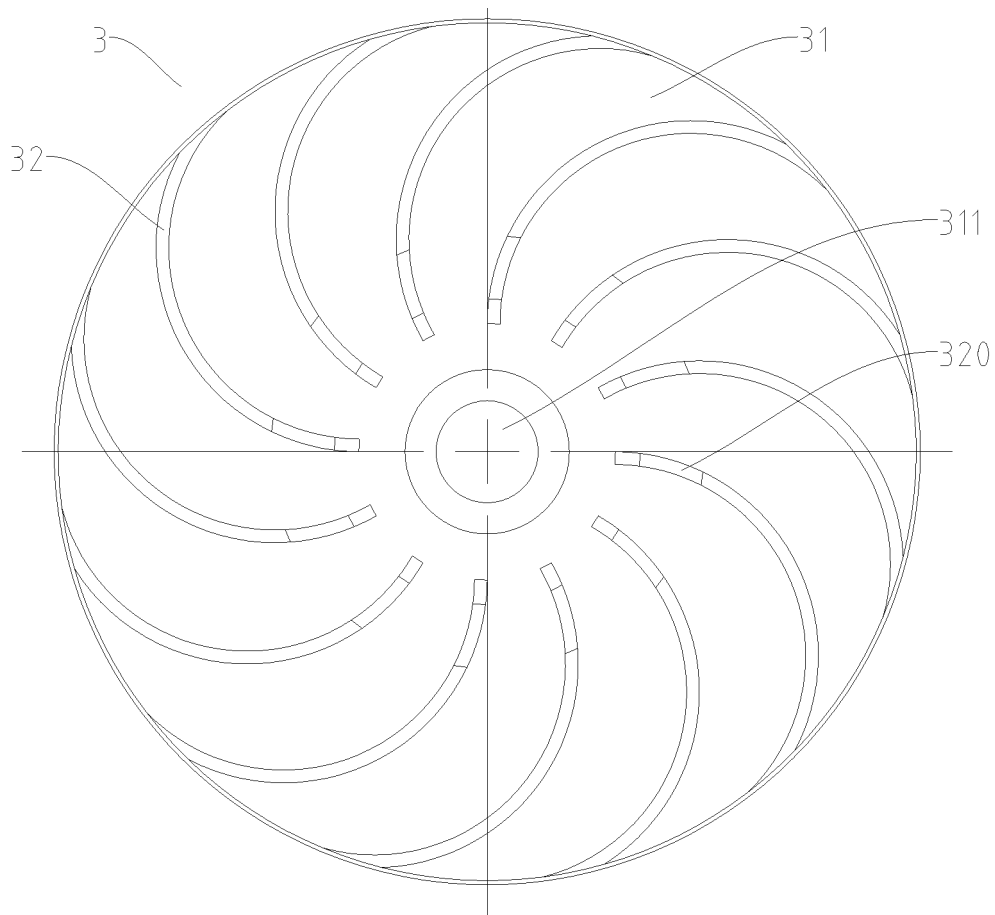


Fig. 13

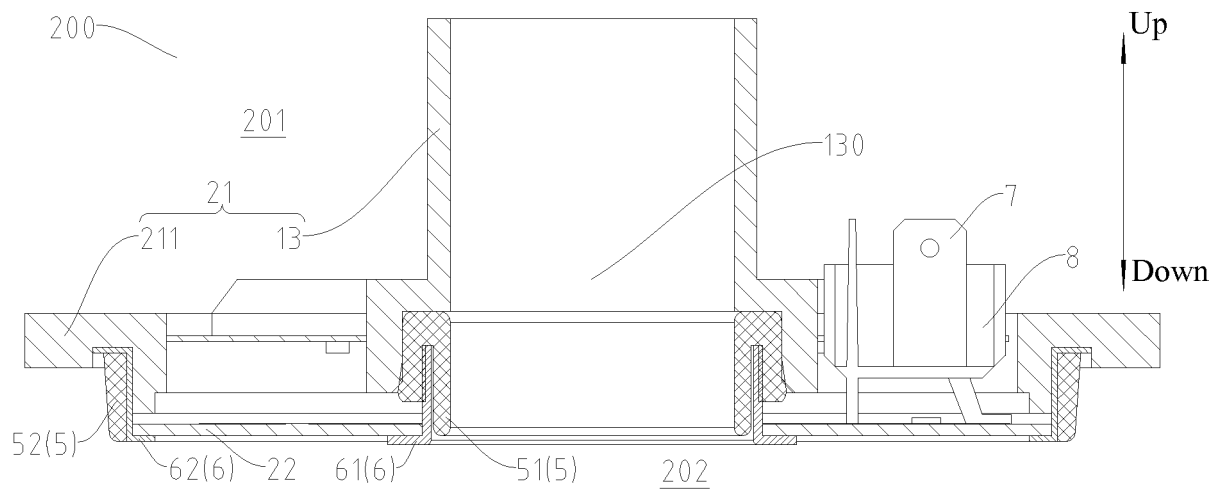


Fig. 14

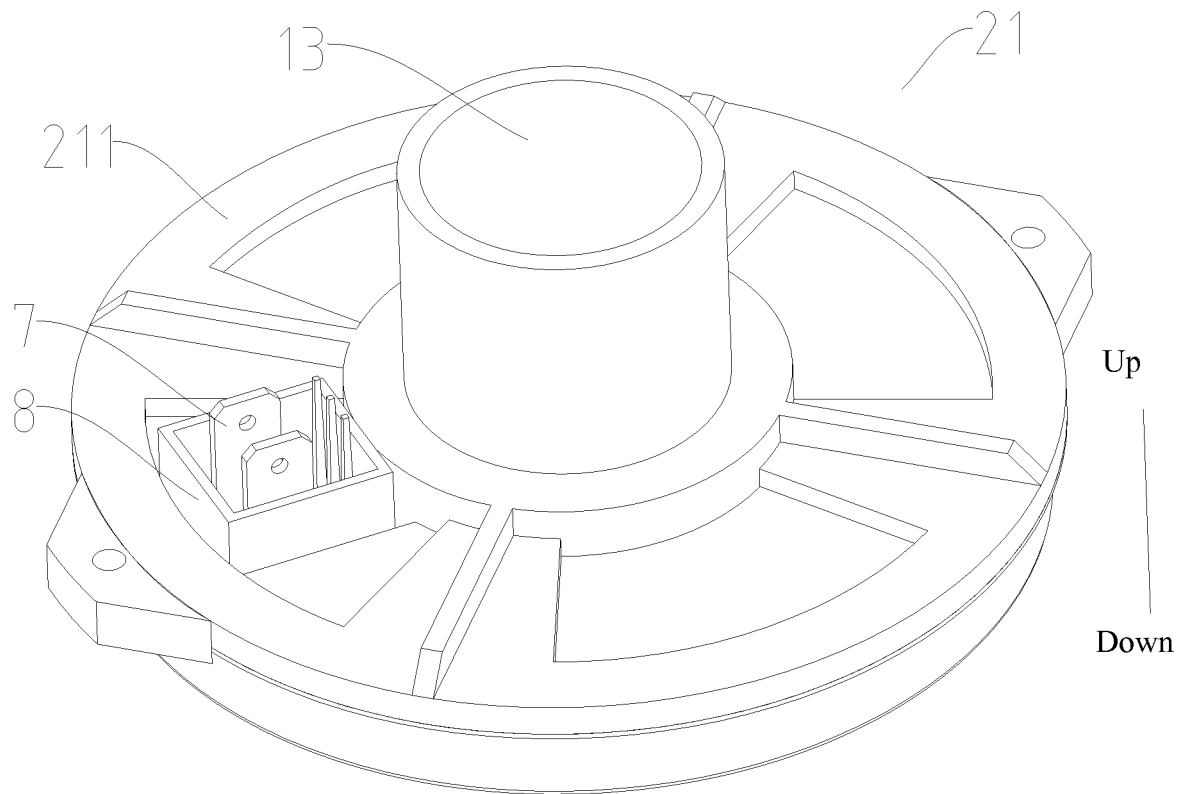


Fig. 15

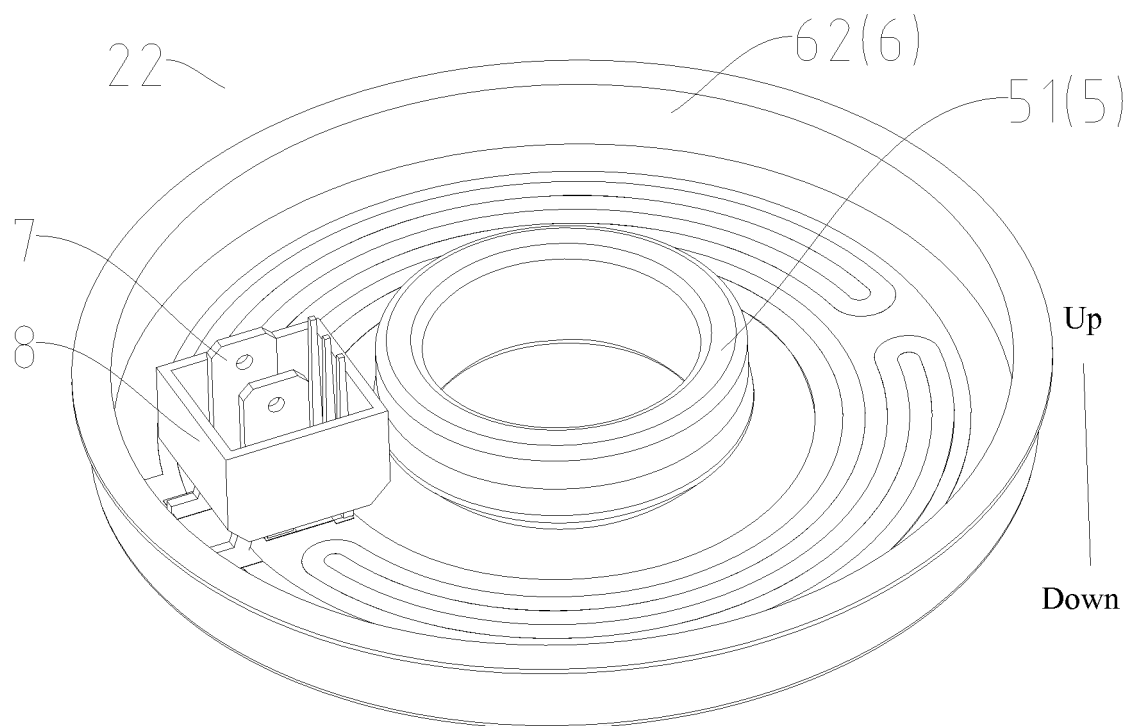


Fig. 16

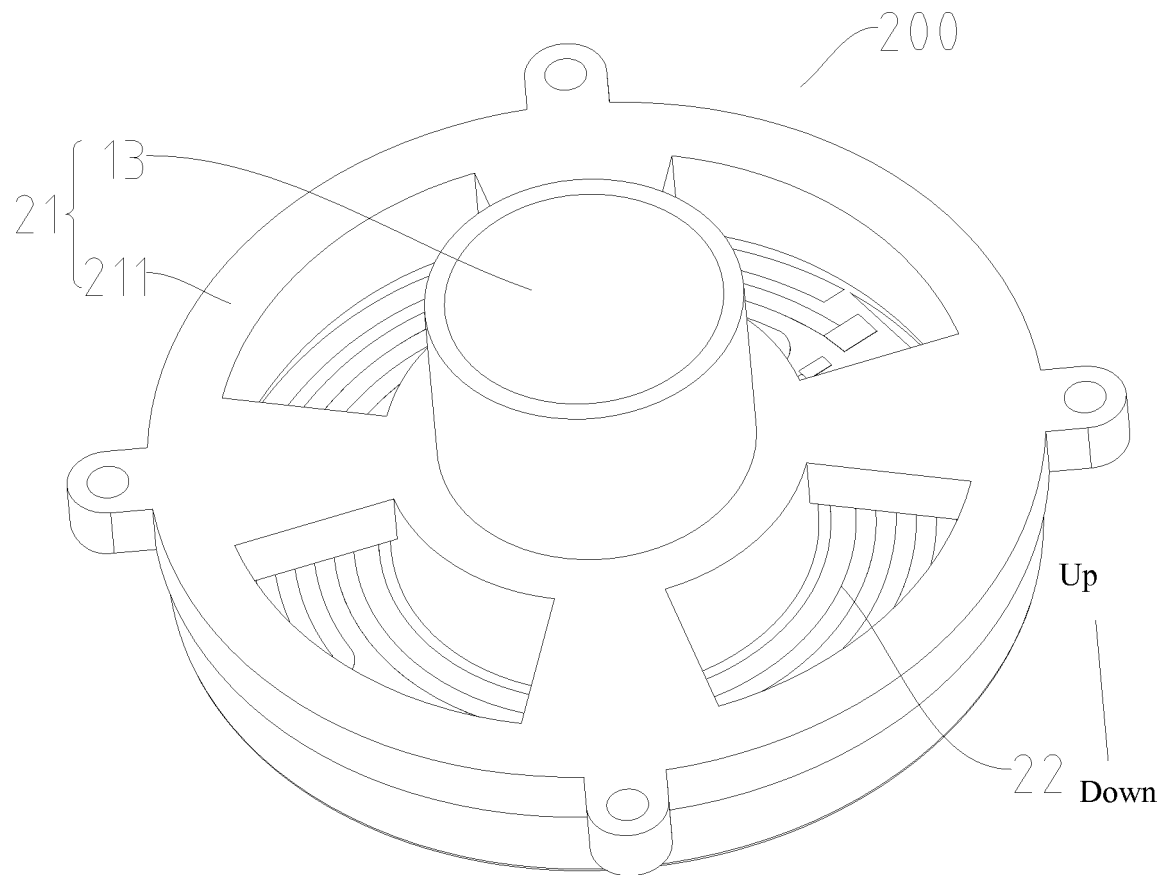


Fig. 17

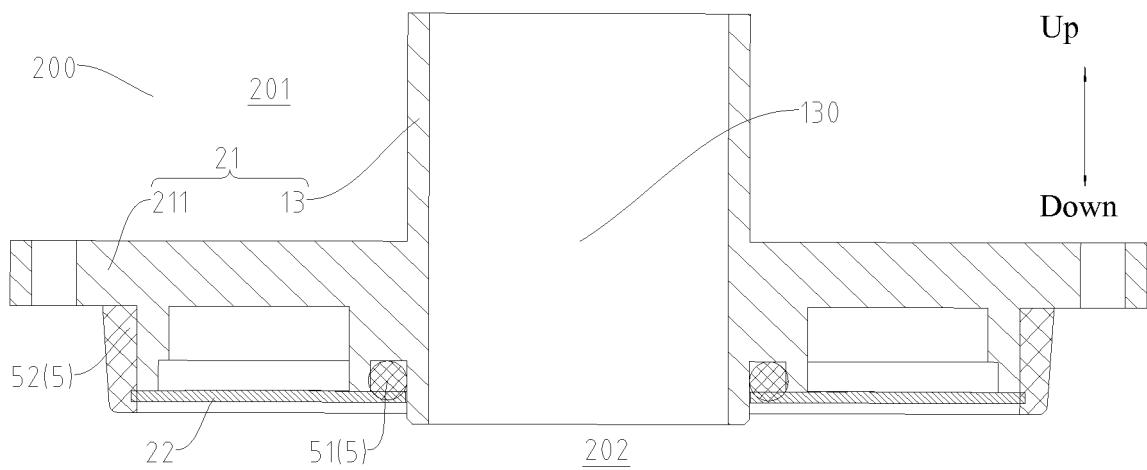


Fig. 18

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2015/096349

A. CLASSIFICATION OF SUBJECT MATTER

F04D 29/58 (2006.01) i; F04D 29/42 (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: centrifugal, pump, shell, housing, heat+, guid+, impeller

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
E	CN 105370622 A (GUANGDONG WELLING MOTOR MFG CO., LTD. et al.) 02 March 2016 (02.03.2016) see description, paragraphs [0023]-[0069], and figures 1-11	1-17, 20
E	CN 205208893 U (GUANGDONG WELLING MOTOR MFG CO., LTD. et al.) 04 May 2016 (04.05.2016) see description, paragraphs [0016]-[0082], and figures 1-9	1-20
X	CN 102748329 A (JOHNSON ELECTRIC (SHENZHEN) CO., LTD.) 24 October 2012 (24.10.2012) see description, paragraphs [0030]-[0037], and figures 1-4	1, 15-20
A	CN 104074804 A (JUNHE PUMPS CO., LTD.) 01 October 2014 (01.10.2014) see the whole document	1-20
A	US 4594500 A (WRIGHT MURRAY JOSEPH) 10 June 1986 (10.06.1986) see the whole document	1-20
A	EP 2199616 A2 (BUEHLER MOTOR GMBH) 23 June 2010 (23.06.2010) see the whole document	1-20

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

* Special categories of cited documents:	"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
"A" document defining the general state of the art which is not considered to be of particular relevance	
"E" earlier application or patent but published on or after the international filing date	"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
"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)	"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
"O" document referring to an oral disclosure, use, exhibition or other means	
"P" document published prior to the international filing date but later than the priority date claimed	"&" document member of the same patent family

Date of the actual completion of the international search 07 June 2016	Date of mailing of the international search report 05 July 2016
Name and mailing address of the ISA State Intellectual Property Office of the P. R. China No. 6, Xitucheng Road, Jimenqiao Haidian District, Beijing 100088, China Facsimile No. (86-10) 62019451	Authorized officer QIN, Baojun Telephone No. (86-10) 62084087

Form PCT/ISA/210 (second sheet) (July 2009)

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 International application No.
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