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(72) Inventors:

- HUANG, Shuiyong
Shanghai, 201812 (CN)
- WANG, Jinnian
Shanghai, 201812 (CN)
- WANG, Haijun
Shanghai, 201812 (CN)
- XU, Jiang
Shanghai, 201812 (CN)

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(74) Representative: **Meissner Bolte Partnerschaft
mbB
Patentanwälte Rechtsanwälte
Postfach 86 06 24
81633 München (DE)**

(71) Applicant: **Bestway Inflatables & Material Corp.**
Shanghai 201812 (CN)

(54) **MOTOR ROTOR FOR WATER PUMP, WATER PUMP, AND POOL CIRCULATION SYSTEM**

(57) A motor rotor for a water pump, a water pump, and a pool circulation system are provided. The motor rotor comprises a hollow rotatable shaft having a first injection-molded part, and a magnet disposed circumferentially around a portion of the first injection-molded part. The first injection-molded part extends through an entire axial length of the magnet. The motor rotor also comprises an impeller integrally formed with the first injection-molded part, the impeller being located at an axial end of the hollow rotatable shaft. The motor rotor further comprises a shaft sleeve having a tubular shape located in the hollow rotatable shaft and extending substantially the entire axial length of the hollow rotatable shaft. The water pump has a simple structure, is easy to assemble, is less prone to generating noise during operation, and has a long service life.

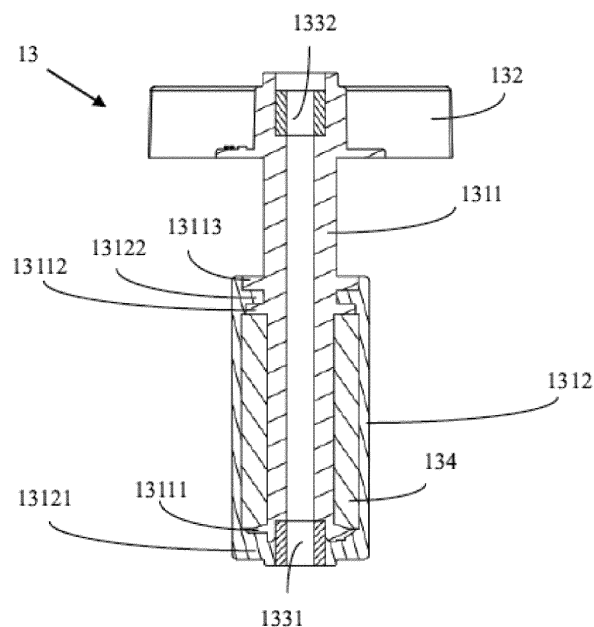


FIG. 6

Description

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This utility patent application claims the benefit of Chinese patent application CN 201822114202.5, filed December 17, 2018 and Chinese patent application CN 201921231450.6, filed August 1, 2019, the full content of both of which are herein incorporated by reference.

TECHNICAL FIELD

[0002] The present disclosure relates to the technical field of water pumps. More specifically, the present disclosure relates to a motor rotor for a water pump. The present disclosure further relates to a water pump comprising a motor rotor and a pool circulation system comprising the water pump.

BACKGROUND

[0003] Most swimming pools are equipped with a circulation system in communication with a water injection region of the pool for heating water in the pool. The circulation system typically comprises a water inlet pipeline, a water pump, a heater, and a water outlet pipeline. The circulation system can, therefore, maintain the temperature of water in the pool within a comfortable temperature range for the human body, and thus enables users to use the pool for a long time.

[0004] Conventional water pumps for pool circulation systems use a separate-type impeller. That is, the impeller and the motor rotor of the water pump are two independent components. Such separate-type impellers may become loose and disassembled after long-term use, which can result in increased noise during operation of the water pump. In addition, looseness between the impeller and the motor rotor may cause damage to components of the water pump and reduce the service life of the water pump.

SUMMARY

[0005] In accordance with various embodiments of the present disclosure, a motor rotor for a water pump comprises a hollow rotatable shaft having a first injection-molded part. The motor rotor also includes a magnet having an axial length and being disposed circumferentially around a portion of the first injection-molded part. The portion of the first injection-molded part extends through the entire axial length of the magnet. The motor rotor also includes an impeller integrally formed with the first injection-molded part, the impeller being located at an axial end of the hollow rotatable shaft.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] To understand the present disclosure, it will now

be described by way of example, with reference to the accompanying drawings in which implementations of the disclosure are illustrated and, together with the description below, serve to explain the principles of the disclosure.

Fig. 1 is a cross-sectional view of a pool circulation system, according to embodiments of the present disclosure;

Fig. 2 is an exploded view of a water pump, according to embodiments of the present disclosure;

Fig. 3 is a cross-sectional view of the water pump of Fig. 2;

Fig. 4 is a perspective view of a motor rotor of the water pump of Fig. 2, according to embodiments of the present disclosure;

Fig. 5 is a cross-sectional perspective view of the motor rotor of Fig. 4;

Fig. 6 is a cross-sectional view of the motor rotor of Fig. 4;

Fig. 7 is a perspective view of a motor rotor of the water pump of Fig. 2, according to embodiments of the present disclosure;

Fig. 8 is a cross-sectional perspective view of the motor rotor of Fig. 7;

Fig. 9 is a cross-sectional view of the motor rotor of Fig. 7;

Fig. 10 is a perspective view of a motor rotor of the water pump of Fig. 2, according to embodiments of the present disclosure;

Fig. 11 is a cross-sectional perspective view of the motor rotor of Fig. 10;

Fig. 12 is a cross-sectional view of the motor rotor of Fig. 10;

Fig. 13 is a perspective view of a motor rotor of the water pump of Fig. 2, according to embodiments of the present disclosure;

Fig. 14 is a cross-sectional perspective view of the motor rotor of Fig. 13; and

Fig. 15 is a cross-sectional view of the motor rotor of Fig. 13.

DETAILED DESCRIPTION

[0007] The present disclosure provides exemplary embodiments of a pool circulation system, and a water pump for use within such a pool circulation system. Furthermore, the present disclosure provides exemplary embodiments of a motor rotor for a water pump. The exemplary embodiments of the present disclosure are described below with reference to the drawings for illustration. It should be understood that the description about the exemplary embodiments should be considered as mere illustrations of the structures and principles of the present invention, and the present invention is not limited to the exemplary embodiments. The present invention may be incorporated in any type or form of a water pump, including, but not limited to pumping devices for pools or hot tubs, or any

other desired pumping device. The water pump, and the motor rotor of the present disclosure, includes improvements over conventional water pumps having conventional motor rotors.

[0008] Fig. 1 is a cross-sectional diagram of a pool circulation system, according to some embodiments of the present disclosure. The pool circulation system may be used to control the temperature of the pool by circulating water through a heater. As shown in Fig. 1, the pool circulation system comprises a water pump 1, a heater 2, a water inlet pipeline 3 and a water outlet pipeline 4. In some embodiments, the pool circulation system may comprise other components, such as a filter for removing impurities from the water. A filter may be arranged, for example, in the water pump 1 or between the water pump 1 and the heater 2.

[0009] The water inlet pipeline 3 comprises a water inlet end 31 and a water outlet end 32. The water inlet end 31 is in communication with a water injection region of the pool and is provided with a one-way valve so that water can only flow from the water injection region of the pool to the water inlet pipeline 3. The water outlet end 32 is in communication with a water inlet 111 of the water pump 1. When a motor of the water pump 1 is started, the water pump 1 pumps water to be heated from the water injection region of the pool via the water inlet pipeline 3 and conveys the pumped water to the heater 2. A water inlet 21 of the heater 2 is in communication with a water outlet 112 of the water pump 1. The water entering the heater 2 from the water inlet 21 is heated by a heating component 23 of the heater 2 and is then conveyed to the water injection region of the pool via the water outlet pipeline 4. The water outlet pipeline 4 comprises a water inlet end 41 and a water outlet end 42. The water inlet end 41 is in communication with the water outlet 22 of the heater 2, and the water outlet end 42 is in communication with the water injection region of the pool and is provided with a one-way valve, so that water can only flow from the water outlet pipeline 4 to the water injection region of the pool.

[0010] In some embodiments, the pool circulation system may further comprise a water flow switch provided on the water inlet pipeline 3 and/or on the water outlet pipeline 4. For example, Fig. 1 shows a water flow switch 43 provided on the water outlet pipeline 4. The water flow switch 43 may trigger an alarm signal when no water is in the pool circulation system to avoid or reduce damaging the heater 2, without water or no-load operation of the filter.

[0011] In some embodiments, and as shown on Fig. 1, the pool circulation system further comprises a temperature sensing probe 24 provided downstream of the heating component 23 of the heater 2 to sense the temperature of the heated water. In some embodiments, and as also shown on Fig. 1, the pool circulation system further comprises a temperature controller 25 provided in the heater 2. The temperature controller 25 is, for example, a manually reset temperature controller, or the tem-

perature controller 25 can be advantageously electrically connected to the temperature sensing probe 24 to control the heating temperature of the heater 2 based on the sensing result of the temperature sensing probe 24.

[0012] The specific structure of the water pump 1 of the pool circulation system, according to some embodiments, will be described with reference to Figs. 2 and 3. Fig. 2 is an exploded view of the water pump 1 of the pool circulation system of Fig. 1. Fig. 3 is a cross-sectional view of the water pump 1 of Fig. 2. As shown in Figs. 2 and 3, the water pump 1 comprises a pump cover 11, a housing 12, as well as a motor rotor 13 and a motor stator mounted in the housing 12.

[0013] As shown in Fig. 3, the housing 12 comprises a first chamber 121 provided with an opening 126 in a mounting end face 124 of the housing 12, and a second chamber 122 isolated from the first chamber 121 in a sealed manner by a pump wall 123. A fixing rod 14 is mounted in the first chamber 121. A first end 141 of the fixing rod 14 is fixed to the bottom of the first chamber 121, and a second end 142 protrudes from the opening 126 and is fixed to the pump cover 11. The fixing rod 14 may be, for example, a porcelain shaft.

[0014] The pump cover 11 comprises a body 113 and a mounting flange 114 extending around an edge of the body 113. The mounting flange 114 is adapted in shape to an outer edge of the mounting end face 124 of the housing 12, so that the mounting flange 114 can be connected to the mounting end face 124 by connecting components (e.g., screws), so that the pump cover 11 and the housing 12 are fixed to each other and confine a drainage chamber 115 through which the fixing rod 14 passes. The body 113 of the pump cover 11 is provided with a water inlet 111 in communication with the water inlet pipeline 3 and a water outlet 112 in communication with the heater 2.

[0015] The motor rotor 13 comprises a hollow rotatable shaft 131 and an impeller 132 integrally formed with the hollow rotatable shaft 131. The hollow rotatable shaft 131 is mounted in the first cavity 121 of the housing 12 by being sheathed on the fixing rod 14, and axially extends from the first chamber 121 to the drainage chamber 115 via the opening 126. The impeller 132 is integrally formed at one axial end, located in the drainage chamber 115, of the hollow rotatable shaft 131 so as to drive water to flow in the drainage chamber 115. Compared with the split designs of the hollow rotatable shaft 131 and the impeller 132 found in conventional water pumps, the integrated motor rotor 13 of the present disclosure effectively reduces the operation noise and prolongs the service life of the water pump.

[0016] The motor stator is provided in the second chamber 122, and a magnetic field generated by the motor stator passes through the pump wall 123 between the first chamber 121 and the second chamber 122 to drive the motor rotor 13 by interacting with a magnet (for example, magnetic steel) within the hollow rotatable shaft 131 of the motor rotor 13. It is noted that the second

chamber 122 should be isolated, in a sealed manner, from the first chamber 121 and the drainage chamber 115 to prevent water from entering the second chamber 122 and damaging the motor stator. In some embodiments, the motor stator comprises a winding bobbin 151 provided in the second chamber 122, a silicon steel sheet 152 provided on the winding bobbin 151, and an insulating sheet 153 provided on the silicon steel sheet 152.

[0017] When the motor stator is powered on, a magnetic field generated by the motor stator drives the motor rotor 13 to rotate around the fixing rod 14. Water from the pool is thus drawn into the drainage chamber 115 through the water inlet 111 by rotation of the impeller 132 of the motor rotor 13, and the pumped water is conveyed to the heater 2 through the water outlet 112.

[0018] In some example embodiments, as shown in Figs. 2, and in order to improve sealing performance, the mounting end face 124 of the housing 12 defines an annular groove 125 which faces the mounting flange 114 of the pump cover 11. The water pump 1 further comprises a seal ring 18 which is provided in the annular groove 125 and is attached to the mounting flange 114 to prevent water in the drainage chamber 115 from flowing between the mounting flange 114 and the mounting end face 124. At least one reinforcing rib 116 may be provided between the body 113 of the pump cover 11 and the mounting flange 114 to increase the strength of the pump cover 11.

[0019] In some example embodiments, as shown in Fig. 3, and in order to further improve sealing performance, the pump cover 11 defines a recess 117 configured to receive the second end 142 of the fixing rod 14. The water pump 1 comprises a sealing cap 16 which is disposed in the recess 117 and covers the second end 142 of the fixing rod 14. The water pump 1 may further comprise a similar or identical sealing cap 16 at the bottom of the first chamber 121 to cover the first end 141 of the fixing rod 14. The water pump 1 may further comprise a wear pad 17 which is sheathed on the fixing rod 14 and is located between the sealing cap 16 and the motor rotor 13.

[0020] Four different embodiments of the motor rotor 13 of the water pump 1, according to the present disclosure, are described in conjunction with Figs. 4 to 15. In some embodiments, the motor rotor 13 may be manufactured using secondary injection molding due to the presence of the magnet 134.

[0021] Fig. 4 is a perspective view of a first embodiment of the motor rotor 13 of the water pump, according to the present disclosure. Fig. 5 is a cross-sectional perspective view of the motor rotor 13 of Fig. 4, and Fig. 6 is a cross-sectional view of the motor rotor 13 of Fig. 4.

[0022] In the first embodiment, the hollow rotatable shaft 131 of the motor rotor 13 comprises a first injection molded part 1311 and a second injection molded part 1312. The first injection molded part 1311 has a cylindrical structure that extends circumferentially around and axially along the fixing rod 14 from the first chamber 121

of the housing 12 to the drainage chamber 115 and is integrally formed with the impeller 132. The second injection molded part 1312 extends circumferentially around the first injection molded part 1311 and over a part of an axial length of the first injection molded part 1311. The second injection molded part 1312 cooperates with the first injection molded part 1311 so that the magnet 134 is fixedly clamped between the first injection molded part 1311 and the second injection molded part 1312.

[0023] More specifically, as shown in Figs. 4 to 6, the first injection molded part 1311 is configured to extend around the fixing rod 14, substantially over the entire axial length of the hollow rotatable shaft 131. The impeller 132 extends radially outwardly from an axial end of the hollow rotatable shaft 131. The first injection molded part 1311 further comprises a first protrusion 13111, a second protrusion 13112, and a third protrusion 13113, which protrude from an outer wall of the first injection molded part 1311, the first protrusion 13111 being located at the bottom of the first injection molded part 1311, and the second protrusion 13112 and the third protrusion 13113 being located at a substantially axial central position of the first injection molded part 1311. The magnet 134 is disposed circumferentially around a portion of the first injection molded part 1311 between the first protrusion 13111 and the second protrusion 13112, with a portion of the first injection molded part 1311 extending through an entire axial length of the magnet 134.

[0024] The second injection molded part 1312 extends axially from the bottom of the motor rotor 13 to the third protrusion 13113 of the first injection molded part 1311 to cover the magnet 134. The second injection molded part 1312 further comprises a first fixing portion 13121 and a second fixing portion 13122, which protrude from an inner wall of the second injection molded part 1312, the first fixing portion 13121 forming the bottom of the motor rotor 13 to support the magnet 134 and the first injection molded part 1311, and the second fixing portion 13122 being clamped between the second protrusion 13112 and the third protrusion 13113 of the first injection molded part 1311, so that the second injection molded part 1312 cooperates with the first injection molded part 1311, so that the magnet 134 is fixedly clamped between the first injection molded part 1311 and the second injection molded part 1312.

[0025] In order to increase wear resistance, the motor rotor 13 further comprises two shaft sleeves (for example, porcelain sleeves) which are nested between the fixing rod 14 and the hollow rotatable shaft 131 at two axial ends of the hollow rotatable shaft 131. More specifically, the motor rotor 13 comprises a first shaft sleeve 1331, which is nested between the fixing rod 14 and the first protrusion 13111 of the first injection molded part 1311 and between the fixing rod 14 and the first fixing portion 13121 of the second injection molded part 1312 at the bottom of the hollow rotatable shaft 131, and a second shaft sleeve 1332 which is nested between the fixing rod

14 and the top of the first injection molded part 1311 at the top of the hollow rotatable shaft 131.

[0026] Fig. 7 is a perspective view of a second embodiment of the motor rotor 13 of the water pump, according to the present disclosure. Fig. 8 is a cross-sectional perspective view of the motor rotor 13 of Fig. 7, and Fig. 9 is a cross-sectional view of the motor rotor 13 of Fig. 7.

[0027] In the second embodiment, the structures of the hollow rotatable shaft 131 and the impeller 132 of the motor rotor 13 are similar to those in the first embodiment, which will not be described here again. Different from the first embodiment, as shown in Figs. 7 to 9, the motor rotor 13 comprises a shaft sleeve 1333 which is nested between the fixing rod 14 and the hollow rotatable shaft 131 substantially along the entire axial length of the hollow rotatable shaft 131. That is, the shaft sleeve 1333 axially extends, around the fixing rod 14, substantially from the first fixing portion 13121 of the second injection molded part 1312 and through the impeller 132 located at the top of the first injection molded part 1311.

[0028] Fig. 10 is a perspective view of a third embodiment of the motor rotor 13 of the water pump, according to the present disclosure. Fig. 11 is a cross-sectional perspective view of the motor rotor 13 of Fig. 10, and Fig. 12 is a cross-sectional view of the motor rotor 13 of Fig. 10.

[0029] In the third embodiment, the hollow rotatable shaft 131 of the motor rotor 13 comprises a first injection molded part 1311 and a second injection molded part 1312. The first injection molded part 1311 has a cylindrical structure that extends circumferentially around and axially along the fixing rod 14 in the first chamber 121 of the housing 12. The second injection molded part 1312 extends circumferentially around the first injection molded part 1311 and the fixing rod 14, from the first chamber 121 of the housing 12 to the drainage chamber 115 and is integrally formed with the impeller 132. The second injection molded part 1312 cooperates with the first injection molded part 1311, so that the magnet 134 is fixedly clamped between the first injection molded part 1311 and the second injection molded part 1312.

[0030] More specifically, as shown in Figs. 10 to 12, the first injection molded part 1311 is configured to extend around the fixing rod 14, from a position near the bottom of the motor rotor 13. The first injection molded part 1311 extends axially through an entire axial length of the magnet 134 and beyond. The first injection molded part 1311 further comprises a first protrusion 13111, a second protrusion 13112 and a third protrusion 13113, which protrude from an outer wall of the first injection molded part 1311. The first protrusion 13111 is located at the bottom of the first injection molded part 1311. The second protrusion 13112 and the third protrusion 13113 are each located at the substantially axial central position of the hollow rotatable shaft 131, with the magnet 134 extending circumferentially around the first injection molded part 1311 and being fixed axially between the first protrusion 13111 and the second protrusion 13112.

[0031] The second injection molded part 1312 extends around the first injection molded part 1311, the magnet 134 and the fixing rod 14 over the entire axial length of the hollow rotatable shaft 131 to cover the magnet 134 and the first injection molded part 1311 so as to form the illustrated "stepped" structure. The impeller 132 radially extends outward from an axial end of the second injection molded part 1312. The impeller 132 is thus located in the drainage chamber 115, so as to drive water to flow in the drainage chamber 115. The second injection molded part 1312 further comprises a first fixing portion 13121 and a second fixing portion 13122, which protrude from an inner wall of the second injection molded part 1312, the first fixing portion 13121 forming the bottom of the motor rotor 13 to support the magnet 134 and the first injection molded part 1311, and the second fixing portion 13122 being clamped between the second protrusion 13112 and the third protrusion 13113 of the first injection molded part 1311 so that the second injection molded part 1312 cooperates with the first injection molded part 1311, so that the magnet 134 is fixedly clamped between the first injection molded part 1311 and the second injection molded part 1312.

[0032] In order to increase the wear resistance, the motor rotor 13 further comprises two shaft sleeves (for example, porcelain sleeves) which are nested between the fixing rod 14 and the hollow rotatable shaft 131 at two axial ends of the hollow rotatable shaft 131. More specifically, the motor rotor 13 comprises a first shaft sleeve 1331 which is nested between the fixing rod 14 and the first protrusion 13111 of the first injection molded part 1311 and between the fixing rod 14 and the first fixing portion 13121 of the second injection molded part 1312 at the bottom of the hollow rotatable shaft 131, and a second shaft sleeve 1332 which is nested between the fixing rod 14 and the top of the second injection molded part 1312 at the top of the hollow rotatable shaft 131.

[0033] Fig. 13 is a perspective view of a fourth embodiment of the motor rotor 13 of the water pump, according to the present disclosure. Fig. 14 is a cross-sectional perspective view of the motor rotor 13 of Fig. 13, and Fig. 15 is a cross-sectional view of the motor rotor 13 of Fig. 13.

[0034] In the fourth embodiment, the structures of the hollow rotatable shaft 131 and the impeller 132 of the motor rotor 13 are similar to those in the third embodiment, which will not be described here again. Different from the third embodiment, as shown in Figs. 13 to 15, the motor rotor 13 comprises a shaft sleeve 1333 which is nested between the fixing rod 14 and the hollow rotatable shaft 131 substantially along the entire axial length of the hollow rotatable shaft 131. That is, the shaft sleeve 1333 extends around the fixing rod 14, substantially from the first fixing portion 13121 of the second injection molded part 1312 and through the impeller 132 located at the top of the second injection molded part 1312.

[0035] Although some embodiments have been described by way of examples herein, various variations

could be made to these embodiments without departing from the spirit of the present disclosure. All such variations belong to the conception of the present disclosure and fall within the scope of protection defined by the claims of the present disclosure. The specific embodiments disclosed herein are merely illustrative of the present disclosure. It would be apparent to those skilled in the art that various modifications could be made according to the teachings of the present disclosure and the present disclosure could be practiced in various equivalent ways. Thus, the particular embodiments of the present disclosure disclosed above are illustrative only, and the scope of protection of the present disclosure is not limited by the details of the structures or designs disclosed herein. Accordingly, various substitutions, combinations, or modifications could be made to the particular exemplary embodiments disclosed herein, and all variations thereof fall within the scope of the present disclosure. The pool circulation system, water pump, and motor rotors exemplarily disclosed herein may also be suitably practiced in the absence of any element not specifically disclosed herein or in the absence of any optional components disclosed herein.

Claims

1. A motor rotor (13) for a water pump, comprising:

a hollow rotatable shaft (131) having a first injection-molded part (1311);
 a magnet (134) having an axial length and being disposed circumferentially around a portion of the first injection-molded part, wherein the portion of the first injection-molded part extends through the entire axial length of the magnet; and
 an impeller (132) integrally formed with the first injection-molded part, said impeller being located at an axial end of the hollow rotatable shaft.

2. The motor rotor for a water pump of claim 1, wherein the motor rotor further comprises a shaft sleeve (1333) having a tubular shape, wherein the shaft sleeve is located in the hollow rotatable shaft at the axial end thereof.

3. The motor rotor for a water pump of claim 1, wherein the motor rotor further comprises two shaft sleeves, wherein each shaft sleeve has a tubular shape, with one of the two shaft sleeves being located in the hollow rotatable shaft at the axial end thereof and the other of the two shaft sleeves being located in the hollow rotatable shaft at an opposing axial end thereof.

4. The motor rotor for a water pump of claim 1, wherein the motor rotor further comprises a shaft sleeve

(1333) having a tubular shape, wherein the shaft sleeve is located in the hollow rotatable shaft and extends for a distance comprising at least half of the entire axial length of the hollow rotatable shaft.

5. The motor rotor for a water pump of claim 4, wherein the shaft sleeve extends substantially the entire axial length of the hollow rotatable shaft.

6. The motor rotor for a water pump of claim 1, wherein the hollow rotatable shaft further comprises: a second injection-molded part extending around the first injection-molded part and over part of an axial length of the first injection-molded part, wherein the second injection-molded part cooperates with the first injection-molded part to fixedly clamp the magnet between the first injection-molded part and the second injection-molded part.

7. The motor rotor for a water pump of claim 1, wherein the hollow rotatable shaft further comprises:

a second injection-molded part extending around the first injection-molded part and over part of an axial length of the first injection-molded part, wherein the second injection-molded part cooperates with the first injection-molded part to fixedly clamp the magnet between the first injection-molded part and the second injection-molded part, and
 the motor rotor further comprises a shaft sleeve having a tubular shape, wherein the shaft sleeve is located in the hollow rotatable shaft and extends for a distance comprising at least half of the entire axial length of the hollow rotatable shaft.

8. The motor rotor for a water pump of claim 7, wherein the shaft sleeve extends substantially the entire axial length of the hollow rotatable shaft.

9. A water pump (1), comprising a housing (12), which comprises a first chamber (121) and a second chamber (122), with a fixing rod (14) being provided in the first chamber, wherein the water pump further comprises:

the motor rotor of claim 1, wherein the hollow rotatable shaft of the motor rotor is mounted in the first chamber by being sheathed on the fixing rod;
 a pump cover (11) defining a water inlet (31), a water outlet (32), and a mounting flange (114) configured to engage a mounting end face (124) of the housing to confine a drainage chamber (115) accommodating the impeller; and
 a motor stator located in the second chamber, wherein the motor stator generates a magnetic

- field which passes through a pump wall (123) between the first chamber and the second chamber to drive the motor rotor.
10. The water pump of claim 9, wherein the pump cover has a recess (117) to receive an end, passing through the drainage chamber, of the fixing rod; and the water pump further comprises a sealing cap (16) located in the recess and covering the end of the fixing rod; preferably the water pump further comprises a wear pad which is sheathed on the fixing rod and is located between the sealing cap and the motor rotor. 5
11. The water pump of claim 9, wherein the mounting end face of the housing has an annular groove (125) which faces the mounting flange of the pump cover, and the water pump further comprises a seal ring (15) which is provided in the annular groove and is attached to the mounting flange. 10
12. The water pump of claim 9, wherein the motor stator comprises a winding bobbin (151) provided in the second chamber, a silicon steel sheet (152) provided on the winding bobbin, and an insulating sheet (152) provided on the silicon steel sheet. 15
13. A water pump (1), comprising a housing (12), which comprises a first chamber (121) and a second chamber (122), with a fixing rod (14) being provided in the first chamber, wherein the water pump further comprises: 20
- the motor rotor of claim 6, wherein the hollow rotatable shaft of the motor rotor is mounted in the first chamber by being sheathed on the fixing rod; 25
- a pump cover (11) defining a water inlet (31), a water outlet (32), and a mounting flange (114) configured to engage a mounting end face (124) of the housing to confine a drainage chamber (115) accommodating the impeller; and 30
- a motor stator located in the second chamber, wherein the motor stator generates a magnetic field which passes through a pump wall (123) between the first chamber and the second chamber to drive the motor rotor. 35
14. The water pump of claim 13, wherein the pump cover has a recess (117) to receive an end, passing through the drainage chamber, of the fixing rod; and the water pump further comprises a sealing cap (16) located in the recess and covering the end of the fixing rod; preferably 40
- the water pump further comprises a wear pad which is sheathed on the fixing rod and is located between the sealing cap and the motor rotor. 45
15. The water pump of claim 13, wherein the mounting end face of the housing has an annular groove (25) which faces the mounting flange of the pump cover, and the water pump further comprises a seal ring (8) which is provided in the annular groove and is attached to the mounting flange. 50
16. The water pump of claim 13, wherein the motor stator comprises a winding bobbin (151) provided in the second chamber, a silicon steel sheet (152) provided on the winding bobbin, and an insulating sheet (153) provided on the silicon steel sheet. 55
17. A pool circulation system, comprising:
- the water pump of claim 7;
- a water inlet pipeline (3) configured to provide fluid communication between a water injection region of a pool and the water inlet of the water pump;
- a heater (2) having a water inlet in fluid communication with the water outlet of the water pump; and
- a water outlet pipeline (4) in fluid communication between a water outlet of the heater and the water injection region of the pool.

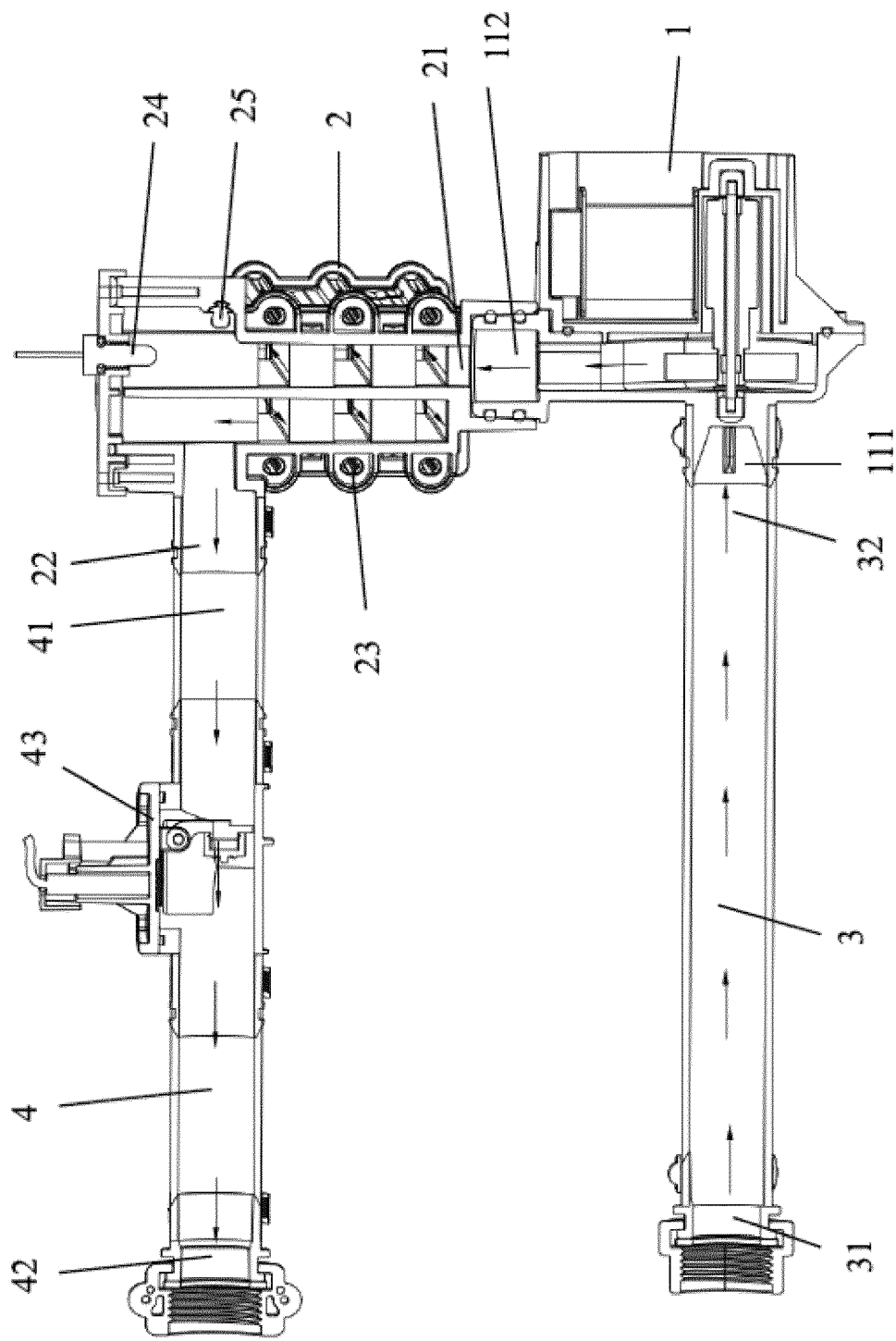


FIG. 1

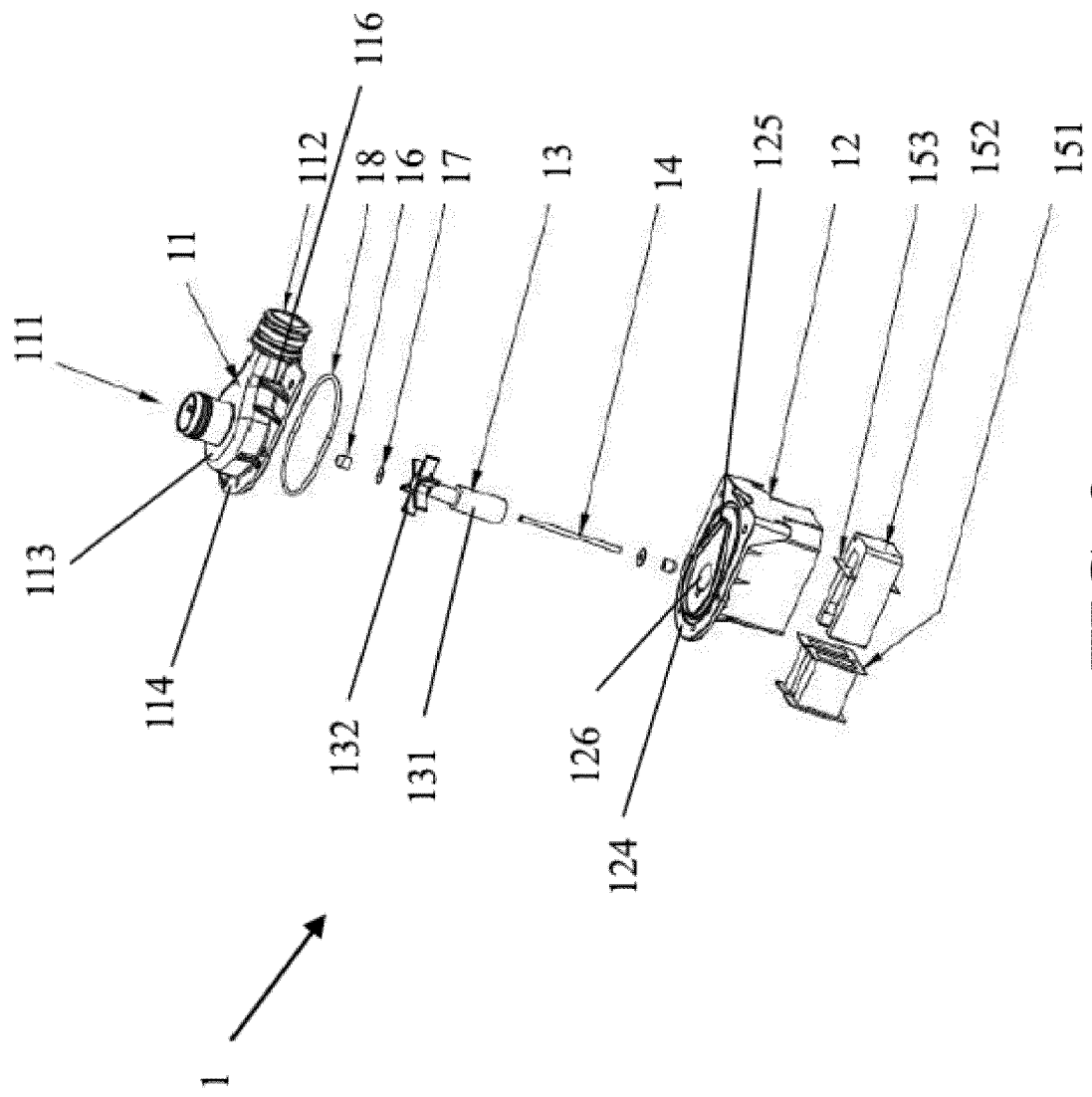


FIG. 2

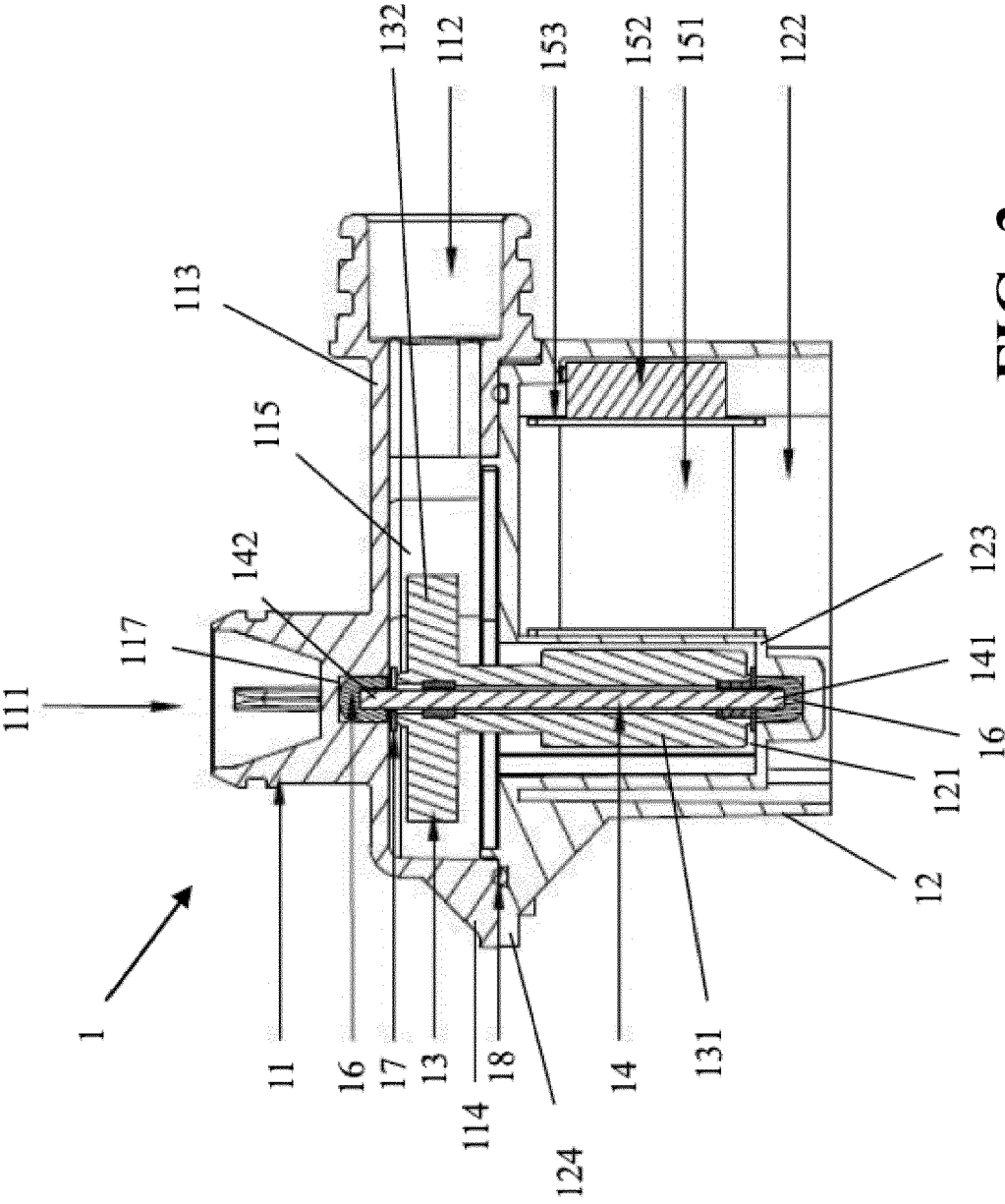


FIG. 3

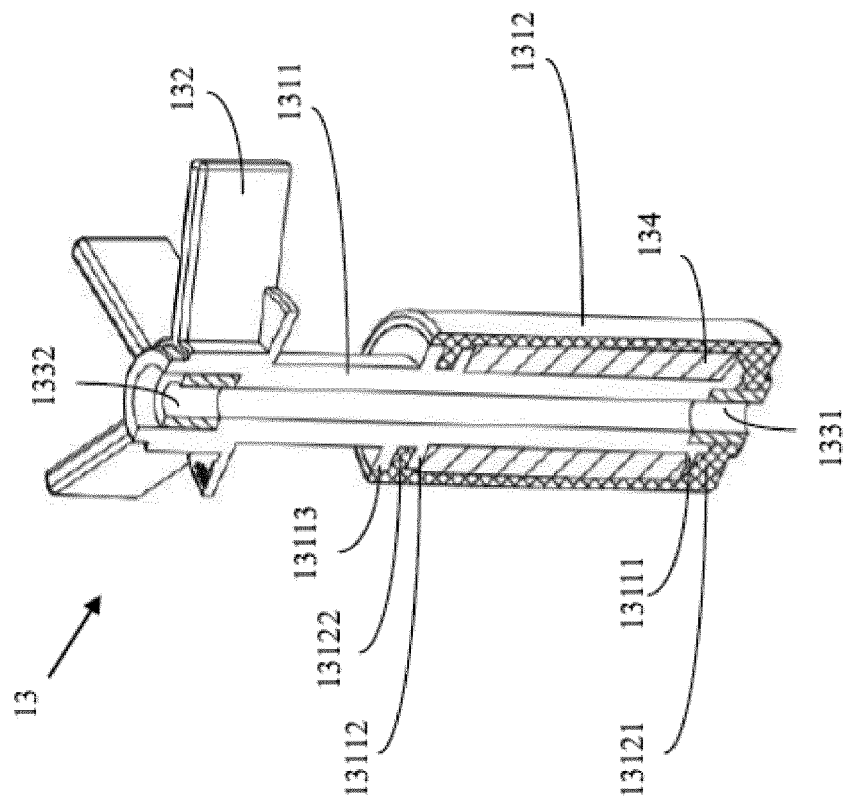


FIG. 5

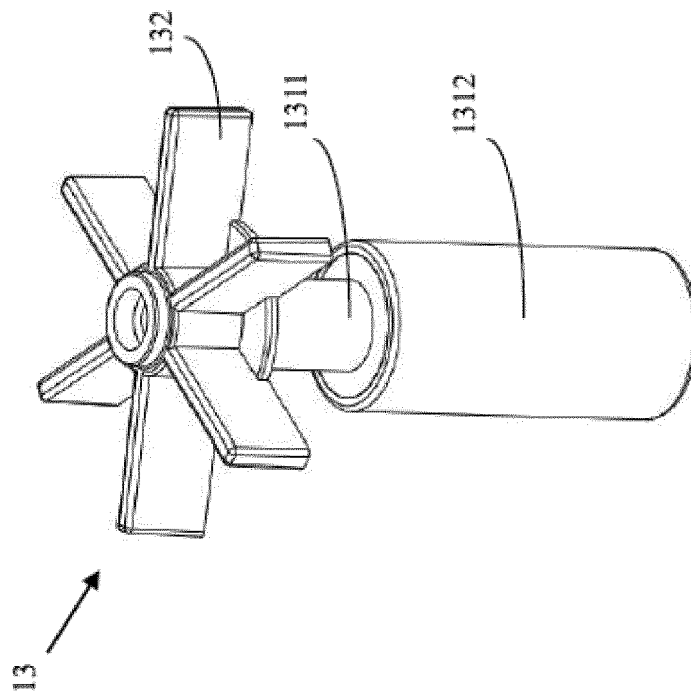


FIG. 4

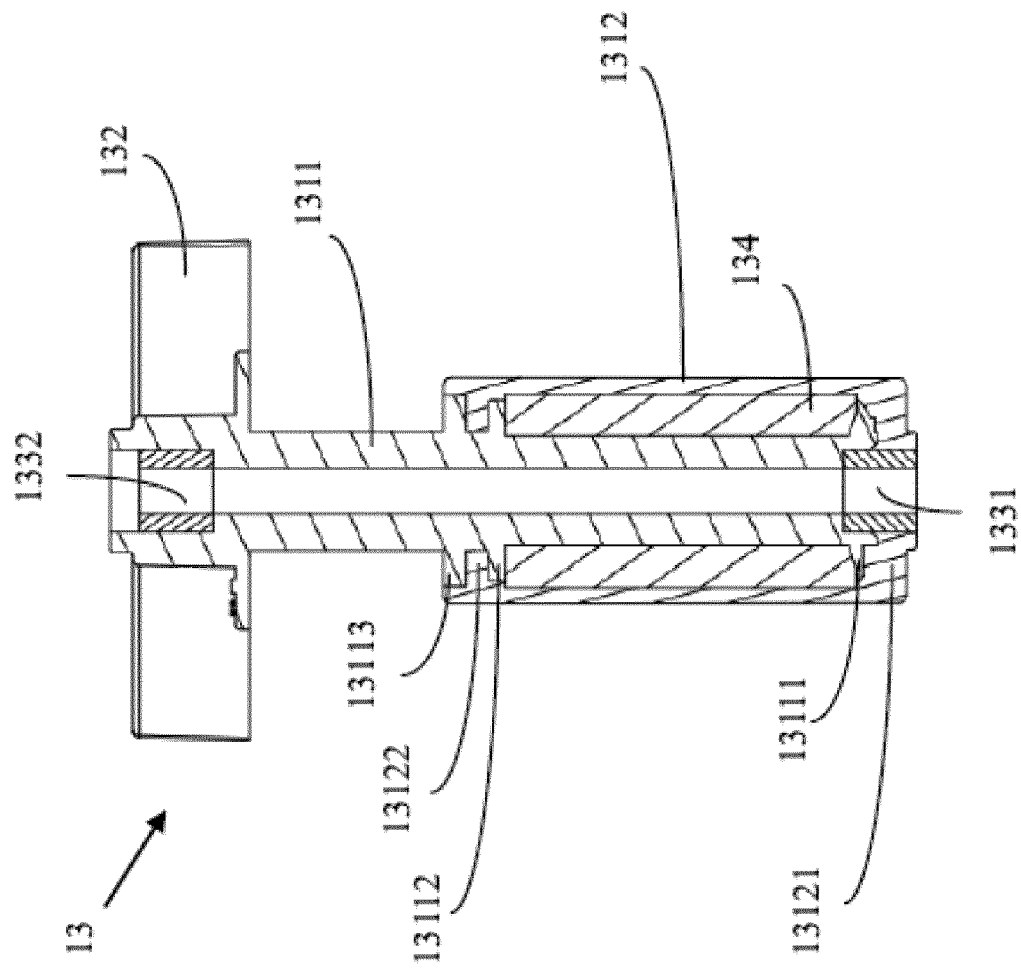


FIG. 6

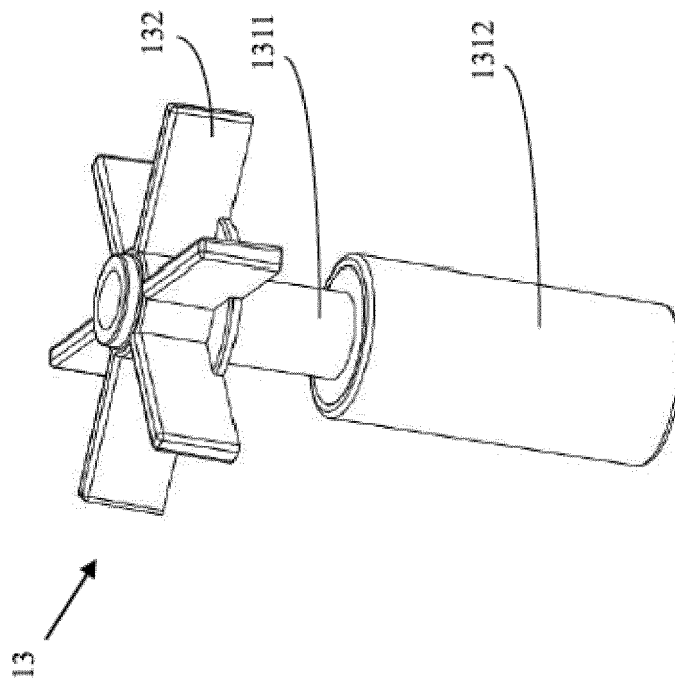


FIG. 7

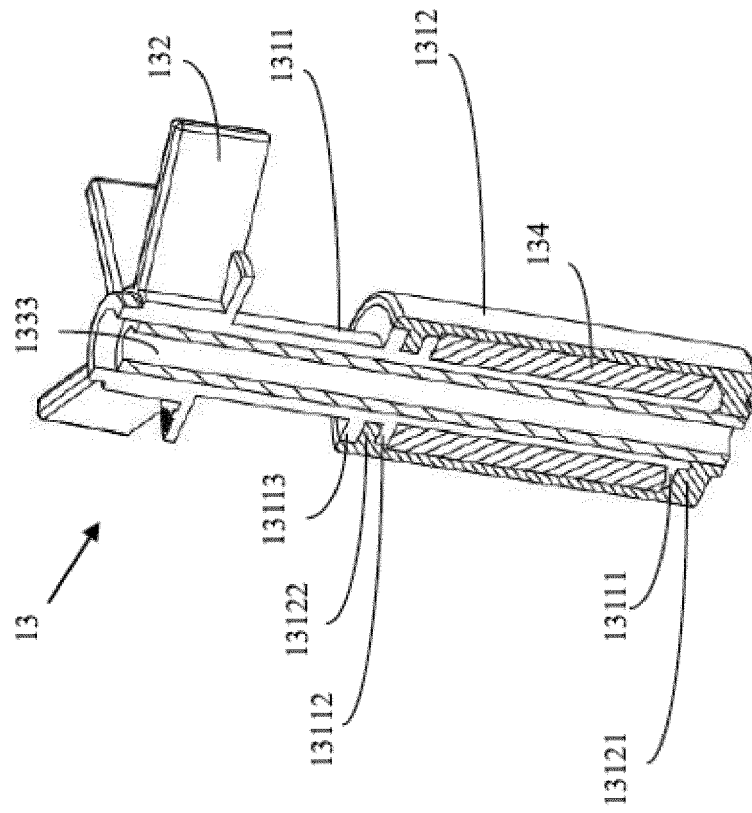


FIG. 8

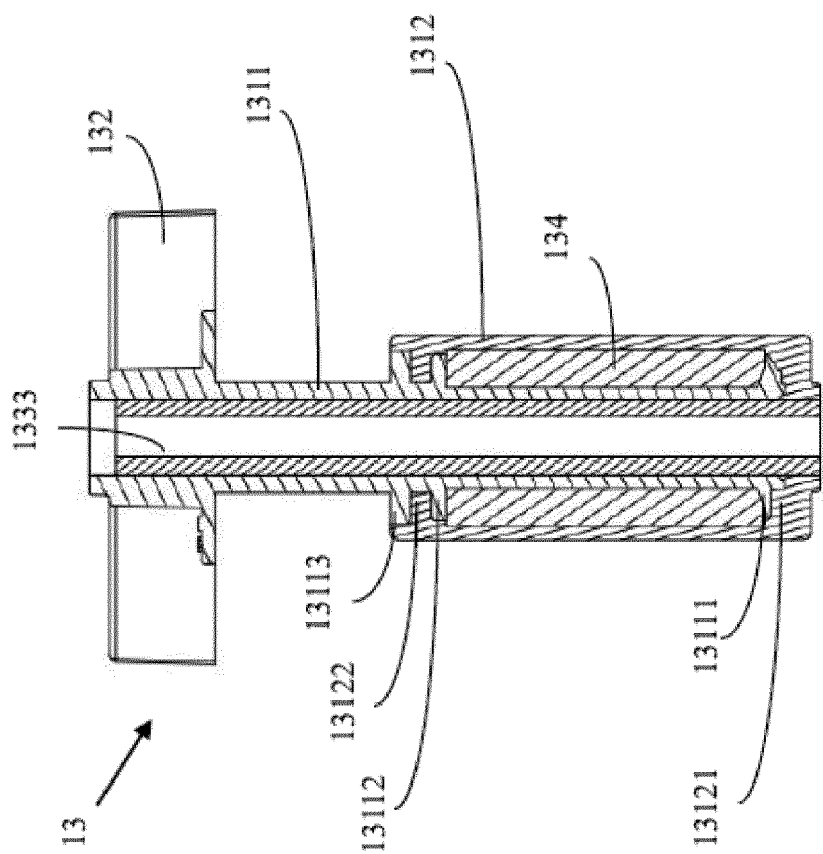


FIG. 9

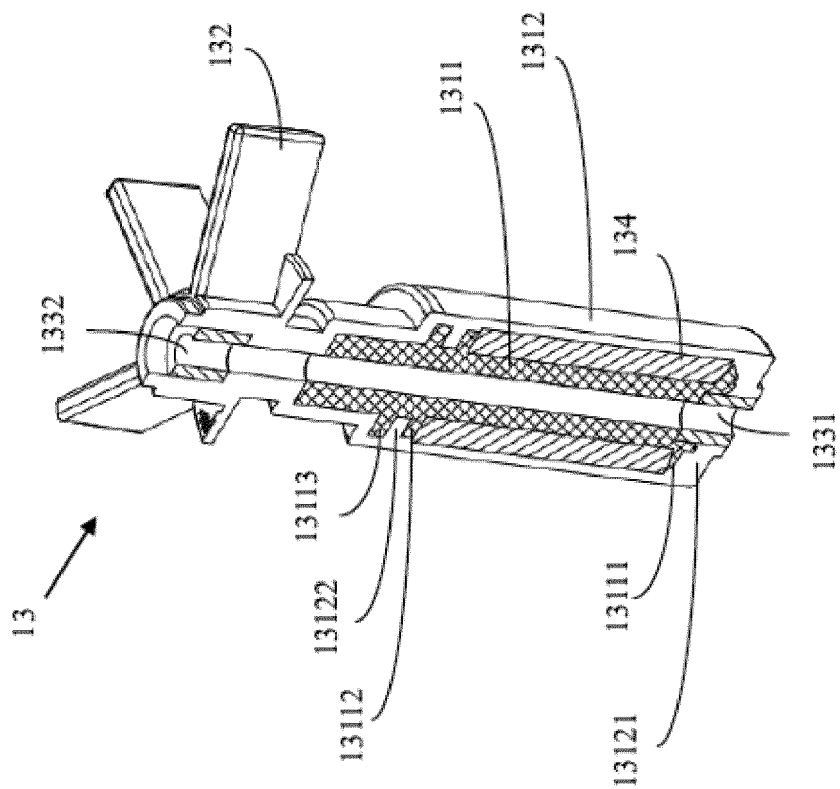


FIG. 11

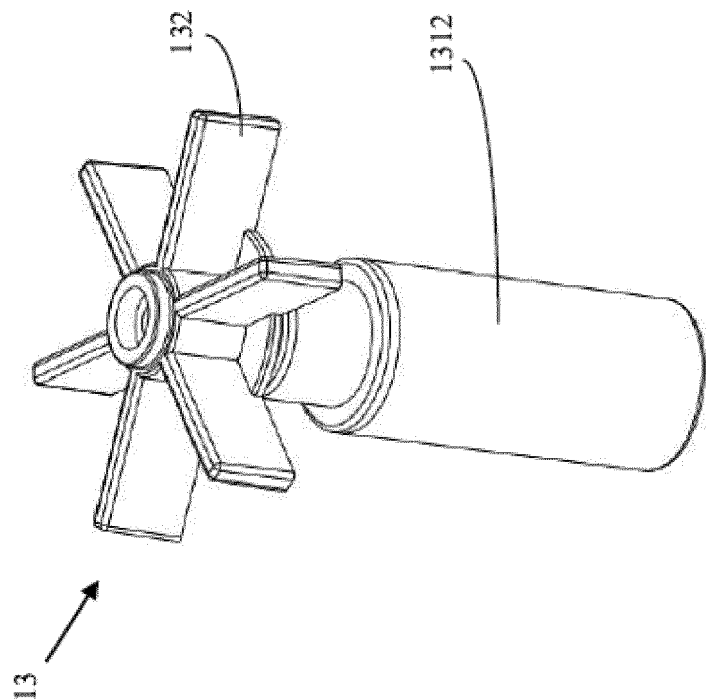


FIG. 10

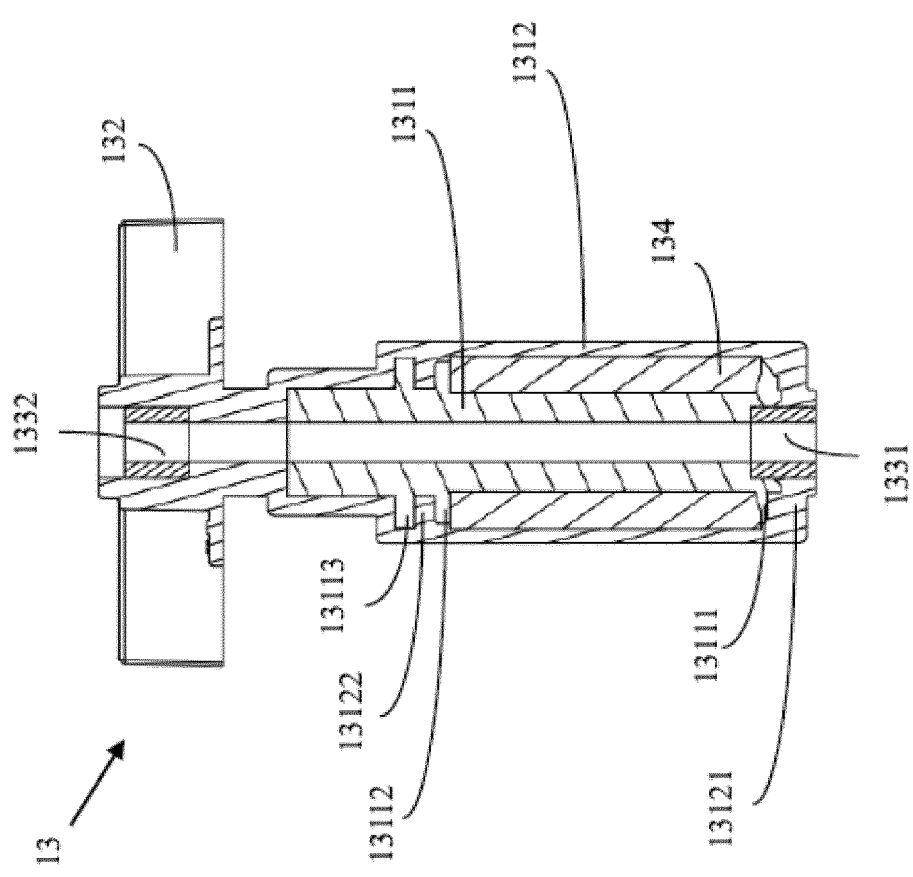


FIG. 12

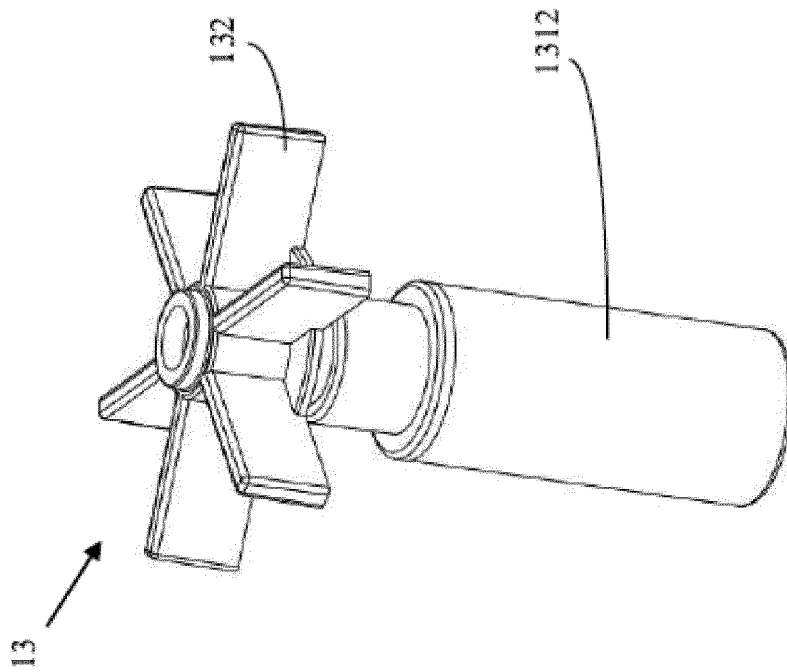


FIG. 13

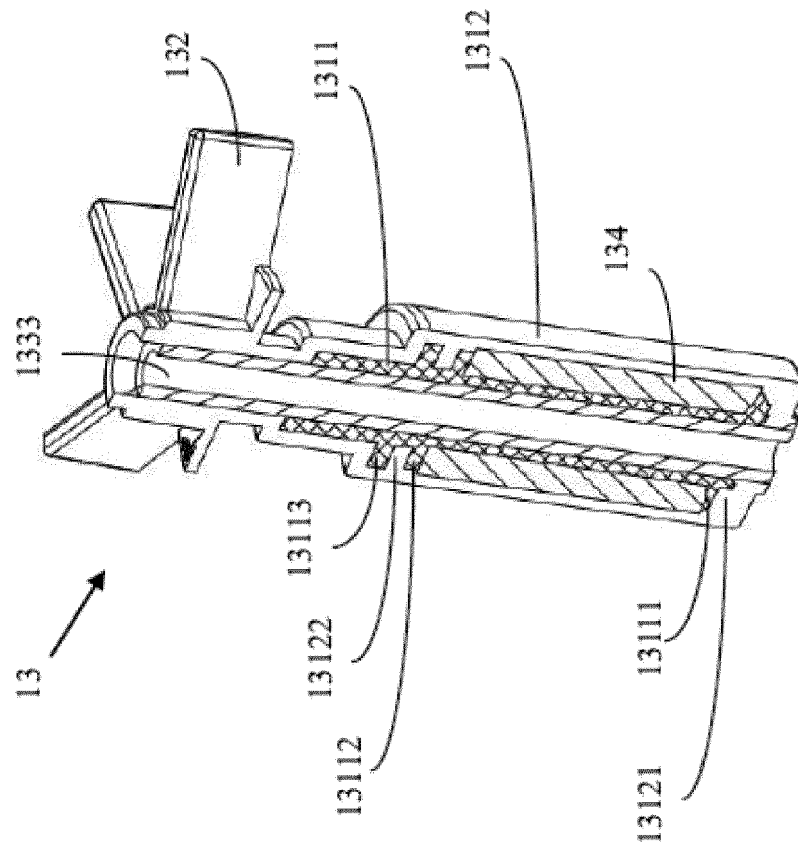


FIG. 14

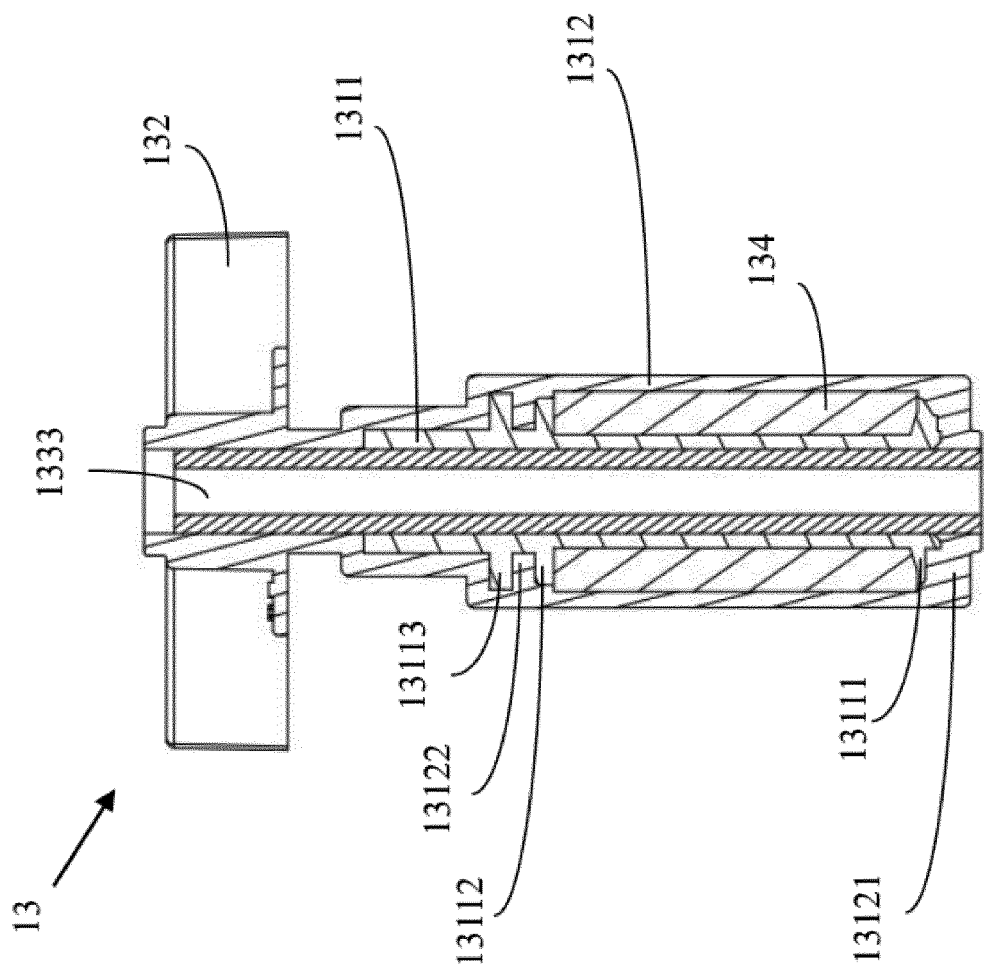


FIG. 15



EUROPEAN SEARCH REPORT

Application Number
EP 19 21 5692

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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 2016/094099 A1 (MORITZ DAVID A [CA] ET AL) 31 March 2016 (2016-03-31) * figures 11-13 * * paragraph [0060] * -----	1-3,6, 9-12	INV. F04D13/06 F04D29/043 F04D29/20
X	DE 10 2007 043600 A1 (BOSCH GMBH ROBERT [DE]) 19 March 2009 (2009-03-19) * figures 1,2,3a,3b * * paragraphs [0027] - [0033] * -----	1,4-17	
X	JP H10 108436 A (HITACHI LTD; HITACHI TAGA MOTOR KK) 24 April 1998 (1998-04-24) * figures 1,2,4 * -----	1,4-16	
X	CN 203 476 727 U (BORGWARNER SHENGLONG NINGBO CO LTD) 12 March 2014 (2014-03-12) * figure 3 * -----	1,6	
X	US 2004/061395 A1 (ABORDI MAURIZIO [IT] ET AL) 1 April 2004 (2004-04-01) * figures 1,2,3 * -----	1,6,9-16	TECHNICAL FIELDS SEARCHED (IPC)
A	US 2011/116952 A1 (YI JEAWOONG [KR] ET AL) 19 May 2011 (2011-05-19) * figure 7 * * paragraph [0054] * -----	6	F04D
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 6 April 2020	Examiner Ingelbrecht, Peter
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

EPO FORM 1503 03.82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 19 21 5692

5

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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06-04-2020

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15

20

25

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35

40

45

50

55

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2016094099 A1	31-03-2016	CN 105471143 A	06-04-2016
		EP 3001037 A1	30-03-2016
		KR 20160036507 A	04-04-2016
		US 2016094099 A1	31-03-2016
DE 102007043600 A1	19-03-2009	CN 101802411 A	11-08-2010
		DE 102007043600 A1	19-03-2009
		EP 2191138 A1	02-06-2010
		US 2011033320 A1	10-02-2011
		WO 2009037019 A1	26-03-2009
JP H10108436 A	24-04-1998	NONE	
CN 203476727 U	12-03-2014	NONE	
US 2004061395 A1	01-04-2004	AT 414342 T	15-11-2008
		AU 2394901 A	11-06-2002
		EP 1346458 A1	24-09-2003
		US 2004061395 A1	01-04-2004
		WO 0245246 A1	06-06-2002
US 2011116952 A1	19-05-2011	CN 102072164 A	25-05-2011
		DE 102010037061 A1	26-05-2011
		JP 5706642 B2	22-04-2015
		JP 2011106442 A	02-06-2011
		KR 20110055281 A	25-05-2011
		US 2011116952 A1	19-05-2011

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- CN 201822114202 [0001]
- CN 201921231450 [0001]