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Fabrication method for rotor assembly

Abstract

A rotor assembly being an injection molded piece, and comprising a first shaft sleeve and a rotor; a first injection molded body is formed by using the rotor and the first shaft sleeve as injection molding inserts to pass through injection molding; a second injection molded body is formed by at least using the first injection molded body as an injection molding insert to pass through injection molding; the second injection molded body comprises a lower cover plate and a wrapping layer, the wrapping layer wrapping around at least a portion of the outer peripheral surface of the first injection molded body; the rotor assembly further comprises blades, the blades being fixedly connected to the lower cover plate or the blades forming an integrated structure with the lower cover plate.

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Background/Summary

(1) This application is the national phase of International Patent Application No. PCT/CN2021/088602, titled "FABRICATION METHOD FOR ROTOR ASSEMBLY, ROTOR ASSEMBLY, AND ELECTRIC PUMP", filed on Apr. 21, 2021, which claims priority to Chinese Patent Application No. 202020699969.3, titled "ROTOR ASSEMBLY AND ELECTRIC PUMP", filed on Apr. 30, 2020 with the China National Intellectual Property Administration, Chinese Patent Application No. 202020845212.0, titled "ROTOR ASSEMBLY AND ELECTRIC PUMP", filed on May 19, 2020 with the China National Intellectual Property Administration, Chinese Patent Application No. 202010360293.X, titled "ROTOR ASSEMBLY AND ELECTRIC PUMP", filed on Apr. 30, 2020 with the China National Intellectual Property Administration, and Chinese Patent Application No. 202010425117.X, titled "METHOD FOR FABRICATING ROTOR ASSEMBLY", filed on May 19, 2020 with the China National Intellectual Property Administration, all of which are incorporated herein by reference in their entireties.
FIELD
(2) The present disclosure relates to a rotor assembly, a method for fabricating the rotor assembly, and an electric pump.
BACKGROUND
(3) An electric pump includes a pump shaft and a rotor assembly. The rotor assembly surrounds the pump shaft. The rotor assembly is rotatable around or with the pump shaft. The rotor assembly includes a rotor, a lower cover plate, a blade and other components. A shaft sleeve may be press-fitted in the rotor assembly in order to reduce a friction during rotation of the rotor assembly. The shaft sleeve, when being press-fitted, is subject to a pressing force, placing relatively high requirements on a material of the shaft sleeve and on strength at a joint between another component and the shaft sleeve in the rotor assembly, thereby increasing a manufacturing cost of the rotor assembly. Therefore, how to reduce the fabricating cost of the rotor assembly is a technical problem to be considered.
SUMMARY
(4) A rotor assembly, a method for fabricating the rotor assembly, and an electric pump are provided according to the present disclosure, so as to reduce a manufacturing cost of the rotor assembly.
(5) To achieve the objective, the following technical solutions are proposed in embodiments of the present disclosure.
(6) A method for fabricating a rotor assembly is provided. The rotor assembly is formed by injection molding. The rotor assembly includes a rotor and a first shaft sleeve. The method includes: S**1**, manufacturing the first shaft sleeve and the rotor; S**2**, forming a first injection-molded part by injection molding, where the rotor and the first shaft sleeve serve as an insert for the injection molding; and the method for fabricating a rotor assembly further includes one of S**3** to S**6**:

S**3**, forming a second injection-molded part by injection molding, where at least the first injection-molded part serves as an insert for the injection molding, and where the second injection-molded part includes a wrapping layer at least partially wrapping the first injection-molded part; and the second injection-molded part further includes a lower cover plate and a blade that are integrally formed by injection molding; S**4**, forming a second injection-molded part by injection molding, where at least the first injection-molded part serves as an insert for the injection molding, and where the second injection-molded part includes a wrapping layer at least partially wrapping the first injection-molded part, the second injection-molded part further includes a lower cover plate, the rotor assembly further includes a blade and an upper cover plate that are integrally formed, a lower end of the blade is fixedly connected to the lower cover plate by welding, and the blade and the upper cover plate are formed in S**1**; S**5**, forming a second injection-molded part by injection molding, where at least the first injection-molded part serves as an insert for the injection molding, and where the second injection-molded part includes a wrapping layer at least partially wrapping the first injection-molded part, the second injection-molded part further includes a lower cover plate and a blade, the rotor assembly further includes an upper cover plate, an upper end of the blade is fixedly connected to the upper cover plate by welding; and the upper cover plate is formed in S**1**; and S**6**, forming a second injection-molded part by injection molding, where at least the first injection-molded part serves as an insert for the injection molding, and where the second injection-molded part includes a wrapping layer at least partially wrapping the first injection-molded part, the second injection-molded part further includes a lower cover plate, the rotor assembly further includes a blade and an upper cover plate, an upper end of the blade is fixedly connected to the upper cover plate by welding, a lower end of the blade is fixedly connected to the lower cover by welding, and the blade and the upper cover plate are formed in S**1**.

(7) A rotor assembly is provided. The rotor assembly includes a first injection-molded part. The first injection-molded part includes a first shaft sleeve and a rotor. The rotor is arranged around the first shaft sleeve. The first injection-molded part is formed by injection molding, where at least the rotor and the first shaft sleeve serve as an insert for the injection molding. The first injection-molded part further includes a connecting portion for connecting the rotor to the first shaft sleeve. A second injection-molded part is formed by injection molding, where at least the first injection-molded part serves as an inset for the injection molding. The second injection-molded part includes a lower cover plate and a wrapping layer, and the wrapping layer at least partially wraps the first injection-molded part. The rotor assembly further includes a blade. The lower cover plate is closer to the rotor than the blade along an axis of the rotor assembly. The blade is fixedly connected to the lower cover plate, or the blade and the lower cover plate are integrally formed.

(8) An electric pump is provided. The electric pump includes a pump shaft and a rotor assembly. The rotor assembly is arranged around the pump shaft. The rotor assembly is as described above.

(9) With the method for fabricating a rotor assembly, the first shaft sleeve is fixed by injection molding, thereby reducing requirements on strength of a material of the first shaft sleeve. Therefore, the manufacturing cost of the first shaft sleeve is reduced, and thus the manufacturing cost of the rotor assembly is reduced.

(10) In the rotor assembly and the electric pump provided in the present disclosure, the rotor assembly is formed by injection molding. The rotor assembly includes the first shaft sleeve and a rotor. The first injection-molded part is formed by injection molding, with the rotor and the first shaft sleeve as an insert for the injection molding. The second injection-molded part is formed by injection molding, with at least the first injection-molded part as an insert for the injection molding. The second injection-molded part further includes a lower cover plate and a wrapping layer. The wrapping layer at least wraps partially the first injection-molded part. The rotor assembly further includes a blade. The blade is fixedly connected to the lower cover plate or the blade and the lower cover plate are integrally formed. With the above structure, the first shaft sleeve is fixed by injection molding, thereby reducing requirements on the strength of material of the first shaft

sleeve **13** and a joint for the first shaft sleeve in the rotor assembly. Therefore, material costs for the first shaft sleeve and the joint for the first shaft sleeve in the rotor assembly are reduced, thereby reducing the manufacturing cost of the rotor assembly.

Description

BRIEF DESCRIPTION OF THE DRAWINGS
(1) FIG. **1** is a schematic structural diagram showing a cross-section view of an electric pump according to an embodiment of the present disclosure;
(2) FIG. **2** is a schematic structural diagram showing a three-dimensional view of a rotor assembly in FIG. **1** according to a first embodiment;
(3) FIG. **3** is a schematic structural diagram showing a front view of the rotor assembly in FIG. **2**;
(4) FIG. **4** is a schematic structural diagram showing a cross-section view of the rotor assembly along a cutting plane line A-A in FIG. **3**;
(5) FIG. **5** is a schematic structural diagram showing a three-dimensional view of a first injection-molded part in FIG. **4** when viewed from a direction;
(6) FIG. **6***a* is a schematic structural diagram showing a three-dimensional view of a first shaft sleeve in FIG. **4** according to a first embodiment when viewed from a direction;
(7) FIG. **6***b* is a schematic structural diagram showing a three-dimensional view of the first shaft sleeve in FIG. **4** according to the first embodiment when viewed from another direction;
(8) FIG. **7** is a schematic structural diagram showing a front view of the first shaft sleeve in FIG. **6***a* or FIG. **6***b;*
(9) FIG. **8** is a schematic structural diagram showing a cross-section view of the first shaft sleeve along a cutting plane line A-A in FIG. **7**;
(10) FIG. **9** is a schematic structural diagram showing a three-dimensional view of the first shaft sleeve in FIG. **4** according to a second embodiment;
(11) FIG. **10** is a schematic structural diagram showing a three-dimensional view of a rotor in FIG. **4**;
(12) FIG. **11** is a schematic structural diagram showing a three-dimensional view of a rotor core in FIG. **10**;
(13) FIG. **12** is a schematic structural diagram showing a front view of the rotor in FIG. **10**;
(14) FIG. **13** is a schematic structural diagram showing a three-dimensional view of the first injection-molded part in FIG. **4** when viewed from another direction;
(15) FIG. **14** is a schematic structural diagram showing a cross-section view of the rotor assembly in FIG. **1** according to a second embodiment;
(16) FIG. **15** is a schematic structural diagram showing a three-dimensional view of a rotor in FIG. **14**;
(17) FIG. **16** is a schematic flow chart showing steps of a method for fabricating the rotor assembly according to the first embodiment and the second embodiment;
(18) FIG. **17** is a schematic structural diagram showing a cross-section view of the rotor assembly in FIG. **1** according to a third embodiment;
(19) FIG. **18** is a schematic flow chart showing steps of a method for fabricating the rotor assembly according to the third embodiment;
(20) FIG. **19** is a schematic structural diagram showing a cross-section view of the rotor assembly in FIG. **1** according to a fourth embodiment;
(21) FIG. **20** is a schematic flow chart showing steps of a method for fabricating the rotor assembly according to the fourth embodiment;
(22) FIG. **21** is a schematic structural diagram showing a cross-section view of the rotor assembly in FIG. **1** according to a fifth embodiment; and

(23) FIG. **22** is a schematic flow chart showing steps of a method for fabricating the rotor assembly according to the fifth embodiment.

DETAILED DESCRIPTION OF EMBODIMENTS

(24) The present disclosure is further described below in conjunction with the accompanying drawings and specific embodiments.

(25) The specific embodiments of the present disclosure are described in detail below with reference to the accompanying drawings. First of all, it should be noted that the location terms, such as upper, lower, left, right, front, rear, inside, outside, top and bottom, mentioned or possibly mentioned in this specification are relative concepts defined based on those constructs shown in the corresponding drawings, and therefore may vary with locations or states of use. Hence, these and other terms of location should not be construed as limiting.

(26) An electric pump according to the following embodiments is configured to provide flow power for a working medium of a thermal management system of an automobile. The working medium may be a 50% ethylene glycol aqueous solution, or clean water. Alternatively, the working medium may contain other substances.

(27) Referring to FIG. **1**, the electric pump **100** includes a pump housing, a rotor assembly **1**, a stator assembly **2**, a pump shaft **3**, and an isolation portion **4**. The rotor assembly **1** is sleeved on an outer periphery of the pump shaft **3**. The electric pump **100** defines a pump cavity inside. The pump cavity is separated by the isolation portion **4** into a first cavity **80** and a second cavity **90**. The first cavity **80** allows the working medium to flow through, and the second cavity **90** is not in direct contact with the working medium. The rotor assembly **1** is located in the first cavity **80**, and the stator assembly **2** is located in the second cavity **90**. Referring to FIG. **1**, the stator assembly **2** includes a stator core **21**, an insulating frame **23**, and a winding **22**. The insulating frame **23** at least partially covers the stator core **21**, and the winding **22** is wound around the insulating frame **23**, so that the winding **22** is electrically insulated from the stator core **21** because of the insulating frame **23** arranged between the winding **22** and the stator core **21**. The electric pump **100** controls, when being in operation, an excitation magnetic field generated by the stator assembly **2** by controlling a current passing through the winding **22** of the stator assembly **2**, and the rotor assembly **1** rotates around or with the pump shaft **3** under the excitation magnetic field.

(28) Reference is made to FIG. **2**, which is a schematic structural diagram showing a rotor assembly according to a first embodiment. The rotor assembly in the first embodiment is described in detail below.

(29) As shown in FIG. **2** to FIG. **5**, the rotor assembly **1** includes a first injection-molded part **11**. The first injection-molded part **11** includes a first shaft sleeve **13**, a rotor **14**, and a connecting part **16**. The rotor **14** includes a permanent magnet material. The rotor **14** surrounds the first shaft sleeve **13**. The connecting part **16** connects the rotor **14** and the first shaft sleeve **13**. The connecting part **16** is made of plastic. In this embodiment, the first injection-molded part **11** is formed by injection molding with the rotor **14** and the first shaft sleeve **13** each as an insert for the injection molding. The connecting part **16** is formed by injecting plastic. The first injection-molded part **11** is integrally formed. A second injection-molded part **12** is formed by injection molding with the first injection part **11** as an insert. As shown in FIG. **3** and FIG. **4**, the second injection-molded part **12** includes a lower cover plate **121** and a wrapping layer **122**. The wrapping layer **122** partially wraps around the first injection-molded part **11**. In this embodiment, the rotor assembly **1** further includes a blade **15**. Along an axis of the rotor assembly **1**, the lower cover plate **121** is closer to the rotor **14** than the blade **15**. In this embodiment, the blade **15** and the lower cover plate **121** are integrally formed by injection molding. Alternatively, the blade **15** is formed separately from the lower cover plate **121** as described in a fourth embodiment and a fifth embodiment of the rotor assembly, which is not described in detail here. With the above structure, the first shaft sleeve **13** is fixed by injection molding, thereby reducing requirements on the strength of material of the first shaft sleeve **13** and a joint for the first shaft sleeve **13** in the rotor assembly **1**. Therefore, material costs

for the first shaft sleeve **13** and the joint for the first shaft sleeve **13** in the rotor assembly are reduced, thereby reducing the manufacturing cost of the rotor assembly.

(30) Reference is made to FIG. **4** and FIG. **5**. In this embodiment, a connecting portion between the rotor **14** and the first shaft sleeve **13** forms a plastic part of the first injection-molded part **11**. The lower cover plate **121** and the wrapping layer **122** of the second injection-molded part **12**, and the blade **15** form a plastic part of the second injection-molded part **12**. The plastic part of the first injection-molded part **11** may be made of the same material as the plastic part of the second injection-molded part **12** or may be made of material different from the plastic part of the second injection-molded part **12**. In a case that the first injection-molded part **11** is made of material different from the plastic part of the second injection-molded part **12**, the plastic part of the second injection-molded part **12** is designed as more corrosion resistant than the plastic part of the first injection-molded part **11**. This is because that the plastic part of the second injection-molded part **12** is to be in contact with the working medium. In addition, the plastic part of the second injection-molded part **12** is subjected to a force from the working medium when being in contact with the working medium, resulting in a risk of fracture. Therefore, in a case that the first injection-molded part **11** is made of material different from the plastic part of the second injection-molded part **12**, the plastic part of the second injection-molded part **12** is designed as tougher than the plastic part of the first injection-molded part **11**.

(31) The first shaft sleeve of the rotor assembly according to the first embodiment is described in detail below.

(32) Reference is made to FIG. **6***a* to FIG. **8**, each of which is a schematic structural diagram showing the first shaft sleeve according to the first embodiment. Structure of the first shaft sleeve in the first embodiment is described in detail below.

(33) Reference is made to FIG. **4**. In this embodiment, along the axis of the rotor assembly **1**, the first shaft sleeve **13** is longer than the rotor **14**. An upper end of the first shaft sleeve **13** is higher than an upper end of the rotor **14**, and a lower end of the first shaft sleeve **13** is lower than a lower end of the rotor **14**. Reference is made to FIG. **1**. In this embodiment, along the axis of the rotor assembly **1**, a length of the first shaft sleeve **13** is greater than or equal to a half of a length of the pump shaft **3**, so that a radial support area of the pump shaft **3** on the first shaft sleeve **13** is relatively increased, thereby reducing a frictional force between the pump shaft **3** and the first shaft sleeve **13**.

(34) Reference is made to FIG. **6***a* to FIG. **8**. In this embodiment, the first shaft sleeve **13** includes a body portion **130** and at least one limiting portion **131**. The limiting portion **131** is protruded from an outer peripheral surface of the body portion **130**, and extends along an axis of the first shaft sleeve **13**. Along the axis of the first shaft sleeve **13**, the limiting portion **131** is shorter than the body portion **130**. An upper end of the limiting portion **131** is located below an upper end of the body portion **130**, and a lower end of the limiting portion **131** is located above a lower end of the body portion **130**. Therefore, during the injection molding of the first injection-molded part **11**, the connecting portion may be formed on both the upper end and the lower end of the limiting portion **131**, so as to prevent an axial movement of the first shaft sleeve **13** during use of the rotor assembly. In addition, during the injection molding of the first injection-molded part **11**, the connecting portion may be formed on an outer peripheral surface and a side surface of the limiting portion **131**, so as to prevent a circumferential movement of the first shaft sleeve **13** during the use of the rotor assembly. Referring to FIG. **7**, in this embodiment, the first shaft sleeve **13** includes six limiting portions **131** evenly arranged along the circumference of the first shaft sleeve **13**. Alternatively, the limiting portions **131** may be unevenly arranged along the circumference of the first shaft sleeve **13**. Moreover, the number of the limiting portions **131** may be two, three, or another number.

(35) Referring to FIG. **6***a* to FIG. **8**, the first shaft sleeve **13** further includes a first concave portion **132** and a first hole portion **133**. The first hole portion **133** extends along the axis of the first shaft

sleeve **13**. The pump shaft **3** in FIG. **1** is inserted inside the first hole portion **133** and is arranged in clearance fit with an inner peripheral surface of the first hole portion **133**. The first concave portion **132** is concave from the inner peripheral surface of the first hole portion **133**, and extends along an axis of the first hole portion **133**. In this embodiment, the first concave portion **132** extends through the first shaft sleeve **13** along the axis of the first hole portion **133**. Therefore, referring to FIG. **1**, the working medium is allowed to partially flow into and then stored in the first concave portion **132** during an operation of the electric pump, lubricating the pump shaft **3** in FIG. **1**, thereby reducing the friction between the pump shaft **3** and the first shaft sleeve **13**. In this embodiment, as shown in FIG. **5** and FIG. **6***a*, the first shaft sleeve **13** includes three first concave portions **132** evenly arranged along a circumference of the first shaft sleeve **13**. Alternatively, the number of the first concave portion **132** may also be one or more.
(36) Referring to FIG. **6***a* to FIG. **8**, the first shaft sleeve **13** further includes a second concave portion **134** concave inward from an upper end surface **1311** of the first shaft sleeve **13**. The second concave portion **134** is in communication with the first concave portion **132**. The second concave portion **134** is arranged close to an end of the first concave portion **132** along the axis of the first shaft sleeve **13**, directing the working medium into the first concave portion **132**. In this embodiment, the second concave portion **134** and the first concave portion **132** are equal in number. That is, the first shaft sleeve **13** includes three second concave portions **134** in communication with the three first concave portions **132**, respectively.
(37) As shown in FIG. **6***b*, the first shaft sleeve **13** further includes a third concave portion **135** concave inward from a lower end surface **1312** of the first shaft sleeve **13**. The third concave portion **135** is in communication with the first concave portion **132**. The third concave portion **135** is arranged close to the other end of the first concave portion **132** along the axis of the first shaft sleeve **13**, directing the working medium out of the first concave portion **132**. In this embodiment, the third concave portion **135** and the first concave portion **132** are equal in number. That is, the first shaft sleeve **13** includes three third concave portions **135** in communication with the three first concave portions **132**, respectively.
(38) Referring to FIG. **6***a* and FIG. **6***b*, the first shaft sleeve **13** further includes a first stepped surface **1313** and a second stepped surface **1314**. The first stepped surface **1313** is located below the upper end surface **1311** of the first shaft sleeve **13**, and the second stepped surface **1314** is located above the lower end surface **1312** of the first shaft sleeve **13**. An outer contour of the first stepped surface **1313** is farther from a central axis of the first shaft sleeve **13** than an outer contour of the upper end surface **1311** of the first shaft sleeve. An outer contour of the second stepped surface **1314** is farther from the central axis of the first shaft sleeve **13** than an outer contour of the lower end surface **1312** of the first shaft sleeve. The first stepped surface **1313** and the second stepped surface **1314** each serve as a positioning reference plane in an injection mold during the injection molding. Therefore, the upper end surface **1311** and the lower end surface **1312** of the first shaft sleeve **13** are inserted into the injection mold, and isolated from injected plastic during the injection molding, preventing the upper end surface **1311** and the lower end surface **1312** form being covered with plastic. Therefore, no plastic falls off from the upper end surface **1311** and the lower end surface **1312** of the first shaft sleeve **13** during the use of the electric pump, thereby preventing the working medium from being polluted.
(39) Reference is made to FIG. **9**, which is a schematic structural diagram showing the first shaft sleeve according to a second embodiment. The first shaft sleeve according to the second embodiment is described in detail below.
(40) Reference is made to FIG. **9**. In this embodiment, the first shaft sleeve **13′** includes at least one limiting portion **131′**. The limiting portion **131′** is concave inward from the outer peripheral surface of the first shaft sleeve **13′**, and extends along the circumference of the first shaft sleeve **13′**. In this embodiment, the limiting portion **131′** completely extends along the circumference of the rotor assembly **13′**, that is, the limiting portion **131′** is an annular groove. Alternatively, the limiting

portion **131′** may partially extend along the circumference of the first shaft sleeve **13′**. Therefore, a concave portion of the limiting portion **131′** is filled with injection molding material during the injection molding of the first injection-molded part **11**, thereby preventing the first shaft sleeve **13′** for moving along its axis during the operation of the rotor assembly. The limiting portion **131′**, partially extending along the circumference of the first shaft sleeve **13′**, is further prevented from moving circumferentially. In this embodiment, the first shaft sleeve **13′** includes two limiting portions **131′** formed at a set distance apart along the axis of the first shaft sleeve **13′**. Alternatively, the number of the limiting portion **131′** may be one or another number, depending on a length of the first shaft sleeve.

(41) Reference is made to FIG. **6***a*, FIG. **6***b* and FIG. **9**. According to the above-mentioned embodiments, the first shaft sleeve defines the limiting portion in order to prevent movement of the first shaft sleeve. Alternatively, the outer peripheral surface of the first shaft sleeve may be provided with a knurled structure, a threaded structure, or other rough structures with an uneven surface. Therefore, the uneven surface is filled with plastic in the first injection-molded part, so that a bonding force between the first shaft sleeve and the plastic in the first injection-molded part is enhanced, thereby preventing movement of the first shaft sleeve.

(42) The rotor in the rotor assembly according to the first embodiment is described in detail below.

(43) Reference is made to FIG. **10**, which is a schematic structural diagram showing the rotor in the rotor assembly according to the first embodiment. A structure of the rotor in the rotor assembly according to the first embodiment is described in detail below.

(44) Reference is made to FIG. **10** and FIG. **11**. In this embodiment, the rotor **14** includes a rotor core **141** and a permanent magnet **142**. Referring to FIG. **4** and FIG. **5**, the rotor core **141** is fixed to the first shaft sleeve **13** by injection molding, and the permanent magnet **142** is fixed to the rotor core **131** by injection molding. The wrapping layer **122** of the second injection-molded part **12** covers the permanent magnet **142**, isolating the permanent magnet **142** from the outside of the rotor assembly. Therefore, the permanent magnet **142** is shielded from corrosion by the working medium, thereby prolonging a service life of the rotor assembly.

(45) Reference is made to FIG. **10** to FIG. **12**. In this embodiment, the rotor core **141** includes silicon steel sheets that are laminated and riveted together. The rotor core **141** includes a mounting portion **1411**. The mounting portion **1411** is concave inward from the outer peripheral surface of the rotor core **141**. The permanent magnet **142** is partially disposed in the mounting portion **1411**, and the inner peripheral surface of the permanent magnet **142** is fitted with a side surface of the mounting portion **1411**, so that a position of the permanent magnet **142** is limited along the circumference of the rotor. In this embodiment, the permanent magnet **142** is of a block structure. The rotor **14** includes four permanent magnets **142**, and the rotor core **141** includes four mounting portions **1411**. The number of the mounting portions **1411** is equal to the number of the permanent magnets **142**. As shown in FIG. **10** and FIG. **12**, the inner peripheral surface of the permanent magnet **142** is concave and the outer peripheral surface of the permanent magnet **142** is convex. The rotor is cross-sectioned with a plane perpendicular to the axis of the rotor assembly **1**. A center O**2** of the outer peripheral surface of the permanent magnet **142** does not coincide with a central axis of the rotor core **141** in cross section, and a center O**1** of the inner peripheral surface of the permanent magnet **142** coincides with the central axis of the rotor core **141** in cross section. That is, the inner peripheral surface of the permanent magnet **142** centered on O**1** is nonconcentric with the outer peripheral surface of the permanent magnet centered on O**2**, so as to reduce slot ripples, thereby reducing the torque ripple. therefore, the rotor assembly operates smoothly.

(46) Referring to FIG. **13**, the connecting part **16** includes a ring portion **161** and a positioning portion **162**. The ring portion **161** surrounds an end of the first shaft sleeve **162**. An end of the positioning portion **162** is attached to an inner peripheral surface of the ring portion **161**, and another end of the positioning portion **162** is attached to an outer peripheral surface of the ring portion **161**. The positioning portion **162** is protruded from a bottom surface of the ring portion

161. The rotor assembly, after being manufactured already, is arranged into a magnetizing fixture to be magnetized. A direction along which the rotor assembly is arranged may affect a direction along which the rotor assembly is magnetized. The positioning portion **162** is to provide a reference for arranging the rotor assembly, so as to prevent misarrangement of the rotor assembly, thereby facilitating magnetization of the rotor assembly.

(47) Reference is made to FIG. **12** and FIG. **13**. In this embodiment, a part of the outer peripheral surface of the first shaft sleeve **13** serves as the inner peripheral surface of the ring portion **161**. Two positioning portions **162** are symmetrically distributed with respect to the central axis of the first shaft sleeve **13**. A central symmetry plane of the positioning portions **162** coincides with a central symmetry plane of one of the permanent magnets **142**. The "coincidence" here refers to theoretical coincidence, and there may be an error in the coincidence in practice. Any error in coincidence caused by manufacturing is within the protection scope of the present disclosure. In this embodiment, the center O**1** of the outer peripheral surface of the permanent magnet **142** coincides with the central axis of the rotor core, and the center O**2** of the inner peripheral surface of the permanent magnet **142** does not coincide with the central axis of the rotor core **142**. Therefore, in order to form the first injection-molded part **11**, the outer peripheral surface of the permanent magnet **142** serves as a positioning surface, proving a reference for placing the rotor **14** into the mold. Therefore, the central symmetry plane of the positioning portion **162** coincides with the central symmetry plane of the permanent magnet **142**, thereby matching with the direction along which the rotor assembly is magnetized.

(48) Reference is made to FIG. **14** and FIG. **15**, which are schematic structural diagrams showing the rotor assembly according to the second embodiment. The rotor assembly in the second embodiment is described in detail below.

(49) Reference is made to FIG. **14** and FIG. **15**. In this embodiment, the rotor **14′** is annular, and includes an injection-molded part formed by injection molding with a combination of plastic material and magnetic material mixed in a certain proportion. The second injection-molded part **1***a* wraps the rotor **14′**, isolating the rotor **14′** from the outside of the rotor assembly. Therefore, the rotor **14′** is insulated from the working medium during an operation of the electric pump, thereby preventing the rotor **14′** from being corroded by the working medium. Therefore, a service life of the rotor assembly is prolonged.

(50) Compared with the rotor assembly disclosed in the first embodiment, the rotor **14′** according to the second embodiment is annular, and includes the injection-molded part formed by injection molding with the combination of plastic material and magnetic material mixed in a certain proportion. The rotor **14′** is of a simpler structure than that in the first embodiment.

(51) A method for fabricating the rotor assembly described in the first embodiment and the second embodiment is described in detail below.

(52) Reference is made to FIG. **2** to FIG. **16**. The method for fabricating the rotor assembly **1** includes the following steps S**1** to S**3**.

(53) In step S**1**, a first shaft sleeve **13** and a rotor **14** are formed.

(54) In step S**2**, a first injection-molded part **11** is formed by injection molding with the rotor **14** and the first shaft sleeve **13** serving as an inset for the injection molding.

(55) In step S**3**, a second injection-molded part **12** is formed by injection molding with the first injection-molded part **11** serving as an insert for the injection molding. The second injection-molded part **12** includes a wrapping layer **122**. The wrapping layer **122** partially wraps the first injection-molded part **11**. The second injection-molded part **12** includes a lower cover plate **121** and a blade **15**. The lower cover plate **121** and the blade **15** are integrally formed by injection molding.

(56) With the above method, the first shaft sleeve is fixed by injection molding, thereby reducing requirements on strength of a material of the first shaft sleeve. Therefore, the manufacturing cost of the first shaft sleeve is reduced, and thus the manufacturing cost of the rotor assembly is reduced.

(57) The formation of the first shaft sleeve includes the following steps S**11** to S**15**.
(58) In step S**11**, at least one limiting portion **131** is formed on the first shaft sleeve **13**. The limiting portion **131** protrudes from an outer peripheral surface of a body portion **130** of the first shaft sleeve **13**. Along an axis of the first shaft sleeve **13**, the limiting portion **131** is shorter than the body portion **130** of the first shaft sleeve **13**. In this embodiment, the limiting portion **131** is convex. Alternatively, the limiting portion **131** is concave from the outer peripheral surface of the first shaft sleeve **13**, and extends along the circumference of the first shaft sleeve **13**.
(59) In step S**12**, a first hole portion **133** and at least one first concave portion **132** are formed on the first shaft sleeve **13**. The first hole portion **133** extends along the axis of the first shaft sleeve **13**, and extends through the first shaft sleeve **13**. The first concave portion **132** extends along an axis the first hole portion **133**, and is concave from an inner peripheral surface of the first hole **133** along a diameter of the first shaft sleeve **13**.
(60) In step S**13**, at least one second concave portion **134** is formed on the first shaft sleeve **13**. The second concave portion **134** is in communication with the first concave portion **132**. Along the axis of the first shaft sleeve **13**, the second concave portion **134** is concave from an upper end surface of the first shaft sleeve **13**, and is arranged close to an end of the first concave portion **132**.
(61) In step S**14**, at least one third concave portion **135** is formed on the first shaft sleeve **13**. The third concave portion **135** is in communication with the first concave portion **134**. Along the axis of the first shaft sleeve **13**, the third concave portion **135** is concave from a lower end surface of the first shaft sleeve **13**, and is arranged close to the other end of the first concave portion **132**.
(62) In step S**15**, a first stepped surface **1313** and a second stepped surface **1314** are formed on the first shaft sleeve **13**. The first stepped surface **1313** is lower than the upper end surface **1311** of the first shaft sleeve **13**, and the second stepped surface **1314** is higher than the lower end surface **1312** of the first shaft sleeve **13**. The first stepped surface **1313** is above the second stepped surface **1314**. An outer contour of the first stepped surface **1313** is farther from a central axis of the first shaft sleeve **13** than an outer contour of the upper end surface **1311** of the first shaft sleeve. An outer contour of the second stepped surface **1314** is farther from the central axis of the first shaft sleeve **13** than an outer contour of the lower end surface **1312** of the first shaft sleeve.
(63) The formation of the rotor includes the following step S**16**.
(64) In step S**16**, the rotor **14** includes a rotor core **141** and a permanent magnet **142**, and is formed by assembling the rotor core **141** and the permanent magnet **142**. In an example, the rotor core **141** is formed by riveting laminated silicon steel sheets. As shown in FIG. **16**, the rotor core **141** includes a mounting portion **1411**. The mounting portion **1411** is concave. A process of assembling the rotor core **141** and the permanent magnet **142** includes: placing the permanent magnet **142** into the mounting portion **1411** with an inner peripheral surface of the permanent magnet **142** is fitted with a side surface of the mounting portion **1411**. A position of the permanent magnet **142** is limited along the circumference of the rotor due to the mounting portion **1411**.
(65) Alternatively, the formation of the rotor **14** may include the following step S**16′**.
(66) In step S**16′**, the rotor **14′** is formed by injection molding with a combination of magnetic material and plastic material mixed in a certain proportion.
(67) It should be noted that the steps S**11** to S**16** are not necessarily performed sequentially, but may be performed simultaneously or in a different order than that is described. The method for forming the first shaft sleeve **13** in this embodiment includes the steps S**11** to S**15**. Alternatively, the method for forming the first shaft sleeve **13** may include only one or several among the steps S**11** to S**15**.
(68) Reference is made to FIG. **17**, which is a schematic structural diagram showing the rotor assembly according to a third embodiment. The rotor assembly according to the third embodiment is described in detail below.
(69) Reference is made to FIG. **17**. In this embodiment, the rotor assembly **1*b*** includes a first shaft sleeve **13*b*** and a second shaft sleeve **18*b***. The second shaft sleeve **18*b*** is arranged closer to a blade

than the first shaft sleeve **13***b*. In this embodiment, a first injection-molded part **11***b* includes a rotor **14**, the first shaft sleeve **13***b* and a connecting portion **16***b*. The connecting part **16***b* connects the first shaft sleeve **13***b* to the rotor **14**. The connecting part **16***b* is made of plastic. The first injection-molded part **11***b* is formed by injection molding with the first shaft sleeve **13***b* and the rotor **14** serving as an insert for the injection molding. In this embodiment, a second injection-molded part **12***b* is formed by injection molding with the first injection-molded part **11***b* and the second shaft sleeve **18***b* serving as an insert for the injection molding. The second injection-molded part **12***b* includes a lower cover plate **121***b* and a wrapping layer **122***b*. The wrapping layer **122***b* partially wraps the first injection-molded part **11***b*. In this embodiment, the rotor assembly **1** further includes a blade **15**. Along an axis of the rotor assembly **1**, the lower cover plate **121***b* is closer to the rotor **14** than the blade **15**. In this embodiment, the blade **15** and the lower cover plate **121***b* are integrally formed by injection molding. Alternatively, the blade **15** and the lower cover plate **121***b* may be formed separately, for which reference may be made to the rotor assembly described in the fourth and fifth embodiments, and thus details are not described here. With the above structure, the first shaft sleeve **13***b* and the second shaft sleeve **18***b* each are fixed by injection molding, which is conducive to reduction in requirements on strength of material of the first shaft sleeve **13** and a joint between the first shaft sleeve **13** and the rotor assembly in the rotor assembly **1** as well as material of the second shaft sleeve **18** and a joint between the second shaft sleeve **18** and the rotor assembly in the rotor assembly. Therefore, material costs of the first shaft sleeve **13***b*, the joint between the first shaft sleeve **13***b* and the rotor assembly in the rotor assembly **1**, the second shaft sleeve **18***b*, and the joint between the second shaft sleeve **18***b* and the rotor assembly in the rotor assembly are reduced, thereby reducing the manufacturing cost of the rotor assembly.

(70) Reference is made to FIG. **17**. The first shaft sleeve **13***b* includes a first hole portion **133***b* extending along an axis of the first shaft sleeve **13***b*. The second shaft sleeve **18***b* includes a second hole portion **181***b* extending along an axis of the second shaft sleeve **18***b*. The first hole portion **133***b* and the second hole portion **181***b* are arranged on a common central axis. The "common central axis" here refers to a common axis theoretically, and there may be an error in practice. Any error in the common axis caused by manufacturing errors is within the protection scope of the present disclosure.

(71) Reference is made to FIG. **17**. In this embodiment, the connecting part **16***b* includes a third hole portion **113***b* extending along an axis of the connecting part **16***b*. The first shaft sleeve **13***b* is arranged near one end of the third hole portion **113***b*, and the second shaft sleeve **18***b* is arranged near the other end of the third hole portion **113***b*. A diameter of the first hole portion **133***b* is less than a diameter of the third hole portion **113***b*, and a diameter of the second hole portion **181***b* is less than the diameter of the third hole portion **113***b*. In this embodiment, in a process of forming the first injection-molded part **11***b* by injection molding with the first shaft sleeve **13***b* and the rotor **14** serving as an insert, an inner peripheral surface of the first shaft sleeve **13***b* may serve as a positioning surface, and a mold mandrel is fitted with the inner peripheral surface of the first shaft sleeve **13***b*. In a process of forming the second injection-molded part **12***b* by injection molding with the first injection-molded part **11***b* and the second shaft sleeve **18***b* serving as an insert, an inner peripheral surface of the second shaft sleeve **18***b* may serve as a positioning surface, and a mold mandrel is fitted with the inner peripheral surface of the second shaft sleeve **18***b*. Therefore, compared to the rotor assembly in the first embodiment, the mold mandrel is fitted with the shaft sleeve in smaller area, which is conducive to de-molding. Further, the shaft sleeve is made of less material, thereby reducing costs. As shown in FIG. **17**, the first shaft sleeve **13***b* and the second shaft sleeve **18***b* are both greater than the third hole portion **113***b* in cross-section. In this embodiment, the first shaft sleeve **13***b* and the second shaft sleeve **18***b* each are equal to the limiting portion **131** in cross-section. In addition, structure of the rotor in the embodiment may refer to the structure of the rotor in the rotor assembly described in the first embodiment or the second embodiment, and thus is not described in detail here.

(72) A method for fabricating the rotor assembly in the third embodiment is described in detail below.

(73) Reference is made to FIG. **18**. The method for fabricating the rotor assembly **1***b* includes the following steps S**1** to S**3**.

(74) In step S**1**, the first shaft sleeve **13***b*, the second shaft sleeve **18***b*, and the rotor **14** or **14′** are formed. Here, formation of the first shaft sleeve **16***b* and the rotor **14** or **14′** may refer to that described about the rotor assembly in the first embodiment or the second embodiment, and formation of the second shaft sleeve **18***b* may refer to the formation of the first shaft sleeve **13***b*, and thus are not described in detail here.

(75) In step S**2**, the first injection-molded part **11***b* is formed by injection molding with the rotor **14** or **14′** and the first shaft sleeve **13***b* serving as an inset for the injection molding.

(76) In step S**3**, the second injection-molded part **12***b* is formed by injection molding with the first injection-molded part **11***b* and the second shaft sleeve **18***b* serving as an insert for the injection molding. The second injection-molded part **12***b* includes a wrapping layer **122***b* at least partially wrapping the first injection-molded part **11***b*. The second injection-molded part **12***b* includes a lower cover plate **121***b* and a blade **15***b*. The lower cover plate **121***b* and the blade **15***b* are formed integrally by injection molding. In this embodiment, in a process of forming the second injection-molded part, a plane defined by a first hole portion **133***b* of the first shaft sleeve **13***b* and a first hole portion **181***b* of the second shaft sleeve **18***b* serves as a positioning reference plane for a mold. The mold is inserted into the first hole portion of the first shaft sleeve **13***b* and the first hole portion **181***b* of the second shaft sleeve **18***b*, and is fitted with a side wall of the first hole portion **133***b* of the first shaft sleeve **13***b* and a side wall of the first hole portion **181***b* of the second shaft sleeve **18***b*. With the plane defined by the first hole portion **131***b* of the first shaft sleeve **13***b* and the first hole portion **181***b* of the second shaft sleeve **17***b* as the positioning reference plane for the mold, the first shaft sleeve **13***b* is accurately coaxial with the second shaft sleeve **18***b*.

(77) With the method, the first shaft sleeve **13***b* and the second shaft sleeve **18***b* each are fixed by injection molding, thereby reducing requirements on strength of material of the first shaft sleeve **13***b*, and a joint between the first shaft sleeve **13***b* and the rotor assembly in the rotor assembly, as well as material of the second shaft sleeve **18***b* and a joint between the second shaft sleeve **18***b* and the rotor assembly in the rotor assembly. Therefore, material costs of the first shaft sleeve **13***b*, the joint between the first shaft sleeve **13***b* and the rotor assembly in the rotor assembly, the second shaft sleeve **18***b*, and the joint between the second shaft sleeve **18***b* and the rotor assembly in the rotor assembly are reduced, thereby reducing the manufacturing cost of the rotor assembly.

(78) Reference is made to FIG. **19**, which is a schematic structural diagram showing a rotor assembly according to a fourth embodiment. The rotor assembly in the fourth embodiment is described in detail below.

(79) Reference is made to FIG. **19**. The rotor assembly **1***c* further includes an upper cover plate **17***c* and a blade **15***c*. The blade **15***c* is partially located between the upper cover plate **17***c* and a lower cover plate **121***c*, and the upper cover plate **17***c* is located above the lower cover plate **121***c*. In this embodiment, the upper cover plate **17***c* and the blade **15***c* are integrally formed by injection molding. Alternatively, the upper cover plate **17***c* and the blade **15***c* may be formed separately as described in the following two cases. In a first case, the upper cover plate **17***c* and the blade **15***c* are formed separately, and an upper end of the blade **15***c* is fixedly connected to the upper cover plate **17***c*, and a lower end of the blade **15***c* is fixedly connected to the lower cover plate **121***c*. In a second case, the upper cover plate **17***c* is formed independently, and the blade **15***c* and the lower cover plate **121***c* are integrally formed. Structure of the rotor **14** of the rotor assembly **1***c* in this embodiment is the same as the structure of the rotor of the rotor assembly in the first embodiment. Alternatively, the structure of the rotor **14** of the rotor assembly **1***c* in this embodiment may also refer to the structure of the rotor of the rotor assembly in the second embodiment. Other structural features of the rotor assembly in this embodiment may refer to the rotor assembly in the first

embodiment, and thus not repeated here.

(80) A method for fabricating the rotor assembly in the fourth embodiment is described in detail below.

(81) Referring to FIG. **19** and FIG. **20**, the method for fabricating the rotor assembly **1***c* includes the following steps S**1** to S**4**.

(82) In step S**1**, a first shaft sleeve **13**, a rotor **14** or **14′**, an upper cover plate **17***c*, and a blade **15***c* are formed, where the upper cover plate **17***c* and the blade **15***c* are integrally formed by injection molding. Formation of the first shaft sleeve **13** and the rotor **14** or **14′** may refer to the first embodiment or the second embodiment, and thus is not repeated here.

(83) In step S**2**, a first injection-molded part **11***c* is formed by injection molding with the rotors **14** or **14′** and the first shaft sleeve **13** serving as an insert for the injection molding.

(84) In step S**4**, a second injection-molded part **12***c* is formed by injection molding with the first injection-molded part **11***c* serving as an insert for the injection molding. The second injection-molded part **12***c* includes a wrapping layer **122***c* and a lower cover plate **121***c*. The wrapping layer **122***c* at least partially wraps the first injection-molded part **11***c*. The rotor assembly **1***c* further includes the blade **15***c* and the upper cover plate **17***c*, which are formed integrally. The lower end of the blade **15***c* is fixedly connected to the lower cover plate **121***c* by welding.

(85) Alternatively, the upper cover plate **17***c* and the blade **15***c* are formed separately. Step S**4** is performed depending on the manner in which the upper cover plate **17***c* and the blade **15***c* are formed.

(86) In a case that the blade **15***c* and the lower cover plate **121***c* are integrally formed, step S**4** is the same as step S**5** below. In step S**5**, the second injection-molded part is formed by injection molding with the first injection-molded part **11***c* serving as an insert for the injection molding. Structure of the second injection-molded part may refer to the structure of the rotor assembly in the first or second embodiment. The second injection-molded part includes the wrapping layer, and the wrapping layer at least partially wraps the first injection-molded part **11***c*. The second injection-molded part further includes the lower cover plate **121***c* and the blade **15***c*. The upper end of the blade **15***c* is fixedly connected to the upper cover plate **17***c* by welding, where the upper cover plate **17***c* is formed in step S**1**.

(87) In a case that the upper cover plate **17***c* and the blade **15***c* are separately formed, the step S**4** is the same as step S**6** below. In step S**6**, the second injection-molded part is formed by injection molding with the first injection-molded part **11***c* serving as an insert for the injection molding. The second injection-molded part includes a wrapping layer, and the wrapping layer at least partially wraps the first injection-molded part **11***c*. The second injection-molded part includes a lower cover plate **121***c*. The upper end of the blade **15***c* is fixedly connected to the upper cover plate **17***c* by welding, and the lower end of the blade **15***c* is fixedly connected to the lower cover plate **121***c* by welding. The blade **15***c* and the upper cover plate **17***c* are formed in step S**1**.

(88) With the method, the first shaft sleeve **13** is fixed by injection molding, thereby reducing requirements on the strength of material of the first shaft sleeve **13** and a joint for the first shaft sleeve **13** in the rotor assembly **1**. Therefore, material costs for the first shaft sleeve **13** and the joint for the first shaft sleeve **13** in the rotor assembly are reduced, thereby reducing the manufacturing cost of the rotor assembly.

(89) Reference is made to FIG. **21**, which is a schematic structural diagram showing a rotor assembly according to a fifth embodiment. Structure of the rotor assembly in the fifth embodiment is described in detail below.

(90) Reference is made to FIG. **21**. The rotor assembly **1***d* further includes an upper cover plate **17***d* and a blade **15***d*. The blade **15***d* is located between the upper cover plate **17***d* and a lower cover plate **121***d*, and the upper cover plate **17***d* is located above the lower cover plate **121***d*. In this embodiment, the upper cover plate **17***d* and the blade **15***d* are integrally formed by injection molding. Alternatively, the upper cover plate **17***d* and the blade **15***d* may be formed separately as

described in the following two cases. In a first case, the upper cover plate **17***d* and the blade **15***d* are formed separately, an upper end of the blade **15***d* is fixedly connected to the upper cover plate **17***d*, and a lower end of the blade **15***d* is fixedly connected to the lower cover plate **121***d*. In a second case, the upper cover plate **17***d* is formed independently, and the blade **15***d* and the lower cover **121***d* are integrally formed. Structure of the rotor in the rotor assembly in this embodiment is the same as the structure of the rotor of the rotor assembly in the first embodiment. Alternatively, the structure of the rotor of the rotor assembly in this embodiment may also refer to the structure of the rotor of the rotor assembly in the second embodiment. A main difference between the rotor assembly in this embodiment and that in the fourth embodiment is that the rotor assembly **1***d* includes a first shaft sleeve **13***d* and a second shaft sleeve **18***d*, whose structures may refer to the third embodiment, and thus are not described in detail here.
(91) A method for fabricating the rotor assembly in the fifth embodiment is described in detail below.
(92) Referring to FIG. **21** and FIG. **22**, the method for fabricating the rotor assembly **1***d* includes the following steps S**1** to S**4**.
(93) In step S**1**, a first shaft sleeve **13***d*, a second shaft sleeve **18***d*, and a rotor (**14**, **14′**) are formed. Here, formation of the first shaft sleeve **13***d* and the rotor **14** or **14′** may refer to the first embodiment and the second embodiment, and formation of the second shaft sleeve **18***d* may refer to the formation of the first shaft sleeve, and thus details are not repeated here.
(94) In step S**2**, a first injection-molded part **11***d* is formed by injection molding with the rotor (**14**, **14′**) and the first shaft sleeve **13***d* serving as an inset for the injection molding.
(95) In step S**4**, a second injection-molded part **12***d* is formed by injection molding with the first injection-molded part **11***d* and the second shaft sleeve **18***d* serving as an insert for the injection molding. The second injection-molded part **12***d* includes a wrapping layer **122***d*. The wrapping layer **122***d* at least partially wraps the first injection-molded part **11***d*. The rotor assembly **1***d* further includes a blade **15***d* and an upper cover plate **17***d*. The blade **15***d* and the upper cover plate **17***d* are integrally formed. A lower end of the blade **15***d* is fixedly connected to the lower cover plate **121***d* by welding.
(96) Alternatively, the upper cover plate **17***d* and the blade **15***d* are formed separately. Step S**4** is performed depending on the manner in which the upper cover plate **17***c* and the blade **15***c* are formed.
(97) In a case that the blade **15***d* and the lower cover plate **121***d* are integrally formed, the step S**4** is the same as step S**5** below. In step S**5**, the second injection-molded part is formed by injection molding with the first injection-molded part **11***d* serving as an insert for the injection molding. In this case, the structure of the second injection-molded part may refer to the structure of the rotor assembly in the first or second embodiment. The second injection-molded part includes the wrapping layer, and the wrapping layer at least partially wraps the first injection-molded part **11***d*. The second injection-molded part includes the lower cover plate **121***d* and the blade **15***d*. The upper end of the blade **15***d* is fixedly connected to the upper cover plate **17***d*. The upper cover plate **17***d* is formed in step S**1**.
(98) In a case that the upper cover plate **17***d* and the blade **15***d* are separately formed, the step S**4** is the same as step S**6** below. In step S**6**, the second injection-molded part is formed by injection molding with the first injection-molded part **11***d* serving as an insert for the injection molding. The second injection-molded part includes a wrapping layer, and the wrapping layer at least partially wraps the first injection-molded part **11***d*. The second injection-molded part includes a lower cover plate **121***d*. The upper end of the blade **15***d* is fixedly connected to the upper cover plate **17***d* by welding, and the lower end of the blade **15***d* is fixedly connected to the lower cover plate **121***d* by welding. The blade **15***d* and the upper cover plate **17***d* are formed in step S**1**.
(99) With the method, the first shaft sleeve **13***b* and the second shaft sleeve **18***b* each are fixed by injection molding, thereby reducing requirements on strength of material of the first shaft sleeve

13*b*, and a joint between the first shaft sleeve **13***b* and the rotor assembly in the rotor assembly, as well as material of the second shaft sleeve **18***b* and a joint between the second shaft sleeve **18***b* and the rotor assembly in the rotor assembly. Therefore, material costs of the first shaft sleeve **13***b*, the joint between the first shaft sleeve **13***b* and the rotor assembly in the rotor assembly, the second shaft sleeve **18***b*, and the joint between the second shaft sleeve **18***b* and the rotor assembly in the rotor assembly are reduced, thereby reducing the manufacturing cost of the rotor assembly.
(100) It should be noted that the above embodiments are provided to illustrate the present disclosure only, rather than limit the technical solutions described in the present disclosure. Although this specification has described the present disclosure in detail with reference to the above-mentioned embodiments, those of ordinary skill in the art should understand that modifications or equivalent replacements may be made on the present disclosure, and all technical solutions and improvements thereof that do not depart from the spirit and scope of the present disclosure shall fall within the scope of the claims in the present disclosure.

Claims

1. A method for fabricating a rotor assembly, wherein the rotor assembly comprises a rotor and a first shaft sleeve, and the method for fabricating a rotor assembly comprises: S**1**, manufacturing the first shaft sleeve and the rotor; S**2**, forming a first injection-molded part by injection molding, wherein the rotor and the first shaft sleeve serve as an insert for the injection molding; and the method for fabricating a rotor assembly further comprises one of S**3** to S**6**: S**3**, forming a second injection-molded part by injection molding, wherein at least the first injection-molded part serves as an insert for the injection molding, and wherein the second injection-molded part comprises a wrapping layer at least partially wrapping the first injection-molded part; and the second injection-molded part further comprises a lower cover plate and a blade that are integrally formed by injection molding; S**4**, forming a second injection-molded part by injection molding, wherein at least the first injection-molded part serves as an insert for the injection molding, and wherein the second injection-molded part comprises a wrapping layer at least partially wrapping the first injection-molded part, the second injection-molded part further comprises a lower cover plate, the rotor assembly further comprises a blade and an upper cover plate that are integrally formed, a lower end of the blade is fixedly connected to the lower cover plate by welding, and the blade and the upper cover plate are formed in S**1**; S**5**, forming a second injection-molded part by injection molding, wherein at least the first injection-molded part serves as an insert for the injection molding, and wherein the second injection-molded part comprises a wrapping layer at least partially wrapping the first injection-molded part, the second injection-molded part further comprises a lower cover plate and a blade, the rotor assembly further comprises an upper cover plate, an upper end of the blade is fixedly connected to the upper cover plate by welding; and the upper cover plate is formed in S**1**; and S**6**, forming a second injection-molded part by injection molding, wherein at least the first injection-molded part serves as an insert for the injection molding, and wherein the second injection-molded part comprises a wrapping layer at least partially wrapping the first injection-molded part, the second injection-molded part further comprises a lower cover plate, the rotor assembly further comprises a blade and an upper cover plate, an upper end of the blade is fixedly connected to the upper cover plate by welding, a lower end of the blade is fixedly connected to the lower cover by welding, and the blade and the upper cover plate are formed in S**1**.
2. The method according to claim 1, wherein the rotor assembly further comprises a second shaft sleeve, S**1** further comprises: manufacturing the second shaft sleeve, wherein the second injection-molded part is formed by injection molding with the second shaft sleeve and the first injection-molded part as the insert for the injection molding in S**3** to S**6**.
3. The method according to claim 2, wherein the manufacturing the first shaft sleeve comprises:

forming a hole portion of the first shaft sleeve, wherein the hole of the first shaft sleeve extends along an axis of the first shaft sleeve; the manufacturing the second shaft sleeve comprises: forming a hole portion of the second shaft sleeve, wherein the hole portion of the second shaft sleeve extends along an axis of the second shaft sleeve; and the forming a second injection-molded part by injection molding comprises: determining a plane defined by the hole portion of the first shaft sleeve and the hole portion of the second shaft sleeve, as a positioning reference plane for a mold, inserting the mold into the hole portion of the first shaft sleeve and the hole portion of the second shaft sleeve, and fitting the mold with a side wall of the hole portion of the first shaft sleeve and a side wall of the hole portion of the second shaft sleeve.

4. The method according to claim 3, wherein the manufacturing the first shaft sleeve in S**1** comprises: forming at least one limiting portion on the first shaft sleeve, wherein the limiting portion is protruded from an outer peripheral surface of the first shaft sleeve and extends along an axis of the first shaft sleeve, and the limiting portion is shorter than the first shaft sleeve; and the forming the first injection-molded part by injection molding comprises: wrapping injected plastic around the limiting portion, to limit the first shaft sleeve circumferentially and axially.

5. The method according to claim 3, wherein the manufacturing the first shaft sleeve in S**1** comprises: forming at least one limiting portion on the first shaft sleeve, wherein the limiting portion is concave along a circumference of the first shaft sleeve; and the forming a first injection-molded part by injection molding comprises: filling the limiting portion with injected plastic, to limit the first shaft sleeve axially.

6. The method according to claim 2, wherein the manufacturing the first shaft sleeve in S**1** comprises: forming at least one limiting portion on the first shaft sleeve, wherein the limiting portion is protruded from an outer peripheral surface of the first shaft sleeve and extends along an axis of the first shaft sleeve, and the limiting portion is shorter than the first shaft sleeve; and the forming the first injection-molded part by injection molding comprises: wrapping injected plastic around the limiting portion, to limit the first shaft sleeve circumferentially and axially.

7. The method according to claim 2, wherein the manufacturing the first shaft sleeve in S**1** comprises: forming at least one limiting portion on the first shaft sleeve, wherein the limiting portion is concave along a circumference of the first shaft sleeve; and the forming a first injection-molded part by injection molding comprises: filling the limiting portion with injected plastic, to limit the first shaft sleeve axially.

8. The method according to claim 1, wherein the manufacturing the first shaft sleeve in S**1** comprises: forming at least one limiting portion on the first shaft sleeve, wherein the limiting portion is protruded from an outer peripheral surface of the first shaft sleeve and extends along an axis of the first shaft sleeve, and the limiting portion is shorter than the first shaft sleeve; and the forming the first injection-molded part by injection molding comprises: wrapping injected plastic around the limiting portion, to limit the first shaft sleeve circumferentially and axially.

9. The method according to claim 8, wherein the manufacturing the first shaft sleeve in step S**1** further comprises: forming a first stepped surface and a second stepped surface on the first shaft sleeve, wherein the first stepped surface is arranged below an upper end of the first shaft sleeve, the second stepped surface is arranged above a lower end of the first shaft sleeve, and the first stepped surface is arranged above the second stepped surface, an outer contour of the first stepped surface is farther from a central axis of the first shaft sleeve than an outer contour of the upper end surface of the first shaft sleeve, and an outer contour of the second stepped surface is farther from the central axis of the first shaft sleeve than an outer contour of the lower end surface of the first shaft sleeve; and the forming the first injection-molded part by injection molding comprises: determining a plane defined by the first stepped surface and the second stepped surface as a positioning reference plane for a mold, and inserting the upper end surface of the first shaft sleeve and the lower end surface of the first shaft sleeve into a cavity of the mold to insulate the upper end surface and the lower end surface of the first shaft sleeve from the injected plastic.

10. The method according to claim 1, wherein the manufacturing the first shaft sleeve in S**1** comprises: forming at least one limiting portion on the first shaft sleeve, wherein the limiting portion is concave along a circumference of the first shaft sleeve; and the forming a first injection-molded part by injection molding comprises: filling the limiting portion with injected plastic, to limit the first shaft sleeve axially.

11. The method according to claim 10, wherein the manufacturing the first shaft sleeve in step S**1** further comprises: forming a first stepped surface and a second stepped surface on the first shaft sleeve, wherein the first stepped surface is arranged below an upper end of the first shaft sleeve, the second stepped surface is arranged above a lower end of the first shaft sleeve, and the first stepped surface is arranged above the second stepped surface, an outer contour of the first stepped surface is farther from a central axis of the first shaft sleeve than an outer contour of the upper end surface of the first shaft sleeve, and an outer contour of the second stepped surface is farther from the central axis of the first shaft sleeve than an outer contour of the lower end surface of the first shaft sleeve; and the forming the first injection-molded part by injection molding comprises: determining a plane defined by the first stepped surface and the second stepped surface as a positioning reference plane for a mold, and inserting the upper end surface of the first shaft sleeve and the lower end surface of the first shaft sleeve into a cavity of the mold to insulate the upper end surface and the lower end surface of the first shaft sleeve from the injected plastic.

12. The method according to claim 1, wherein the manufacturing the rotor in S**1** comprises: forming the rotor by injection molding with a combination of magnetic material and plastic material mixed in a certain proportion.

13. The method according to claim 1, wherein, the rotor comprises a rotor core and a permanent magnet, and the manufacturing the rotor comprises in S**1**: assembling the rotor core to the permanent magnet.

14. The method according to claim 13, wherein the rotor core is manufactured by: riveting laminated silicon steel sheets, wherein the rotor core comprises a mounting portion that is concave; wherein the assembling the rotor core to the permanent magnet comprises: arranging the permanent magnet in the mounting portion with an inner peripheral surface of the permanent magnet being fitted with a side wall of the mounting portion, wherein the permanent magnet is limited by the mounting portion along a circumference of the rotor.

15. The method according to claim 14, wherein the inner peripheral surface of the permanent magnet is concave and the outer peripheral surface of the permanent magnet is convex; a center of the outer peripheral surface of the permanent magnet does not coincide with a central axis of the rotor core in cross section, and a center of the inner peripheral surface of the permanent magnet coincides with the central axis of the rotor core in cross section; wherein the forming the first injection-molded part by injection molding comprises: determining a plane defined by the outer peripheral surface of the permanent magnet as a positioning reference plane for the mold, to provide a reference for placing the rotor into the mold.