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(54) **BEARING DEVICE FOR A HEART SUPPORT SYSTEM, AND METHOD FOR RINSING A SPACE IN A BEARING DEVICE FOR A HEART SUPPORT SYSTEM**

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See application file for complete search history.

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(57) **ABSTRACT**

The invention relates to a bearing device (**100**) for a cardiac support system. The bearing device (**100**) comprises a stand unit (**105**) and an impeller (**110**). The stand unit (**105**) is designed to support the impeller (**110**) such that it can rotate. The impeller (**110**) is designed to rotate during an operation of the cardiac support system in order to convey a pump fluid flow (**115**). The impeller (**110**) is designed to enclose at least one subsection (**120**) of the stand unit (**105**) in the assembled state of the bearing device (**100**), wherein an intermediate space (**125**) for guiding a flushing fluid flow (**130**) is provided between the subsection (**120**) and the impeller (**110**). At least one flushing outlet (**135**) is formed in the impeller (**110**). The flushing outlet (**135**) is designed to discharge the flushing fluid flow (**130**) from the interme-
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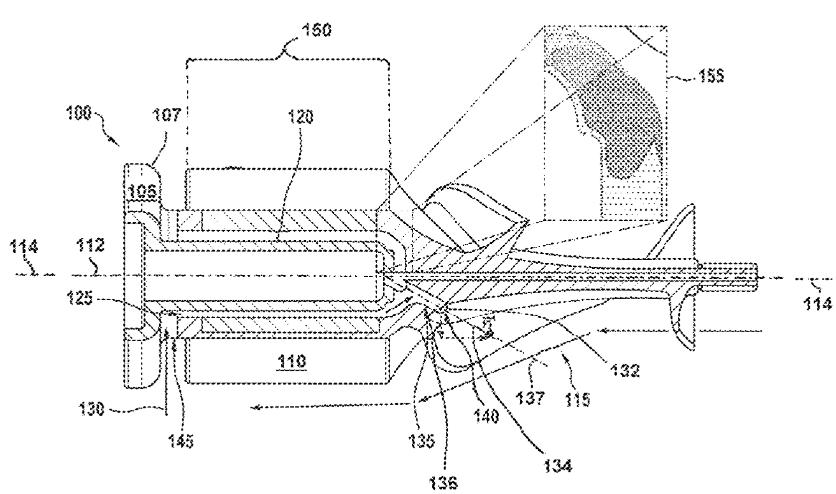

diate space (**125**) by means of centrifugal force when the cardiac support system is in operation.

20 Claims, 10 Drawing Sheets

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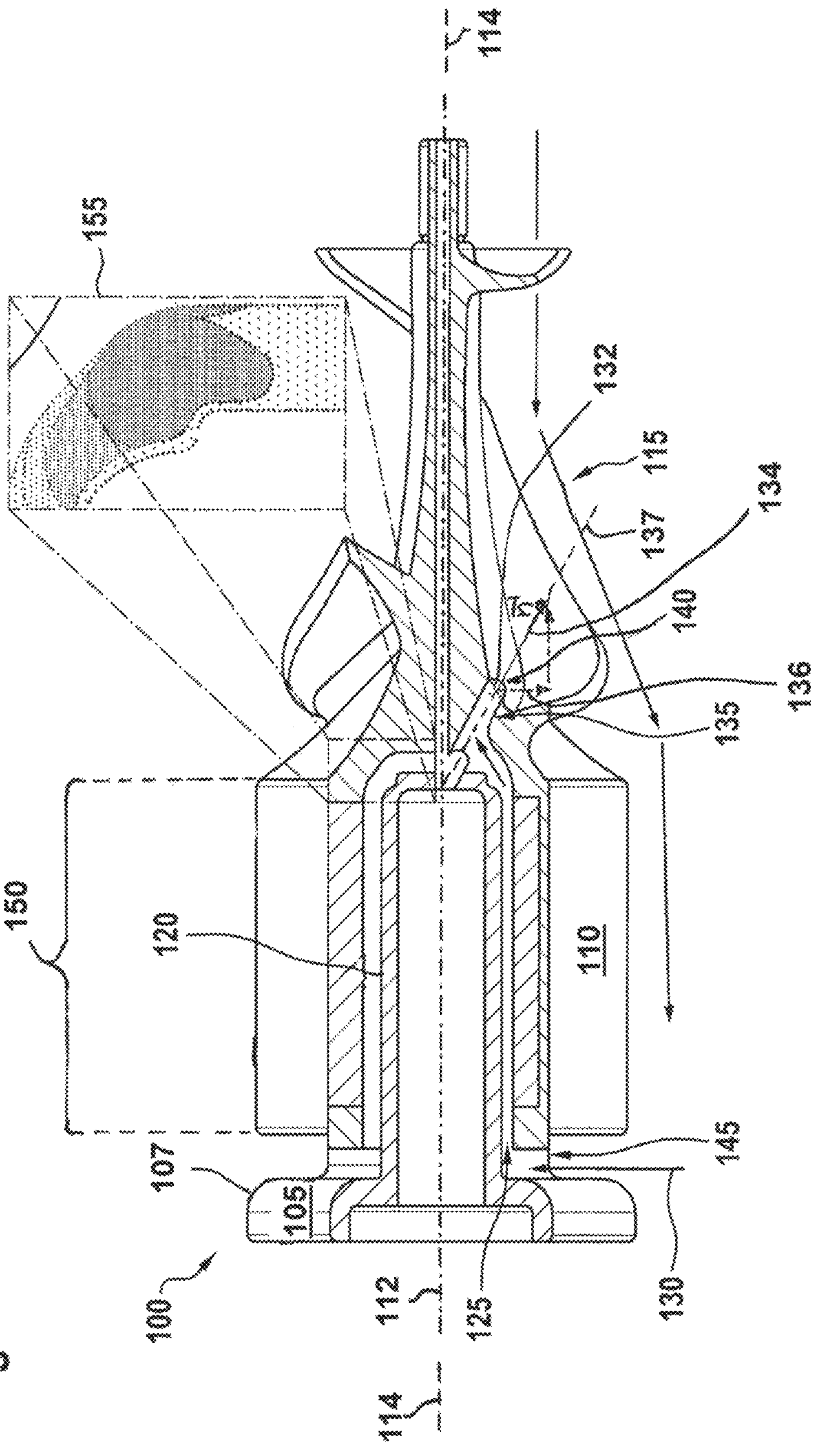
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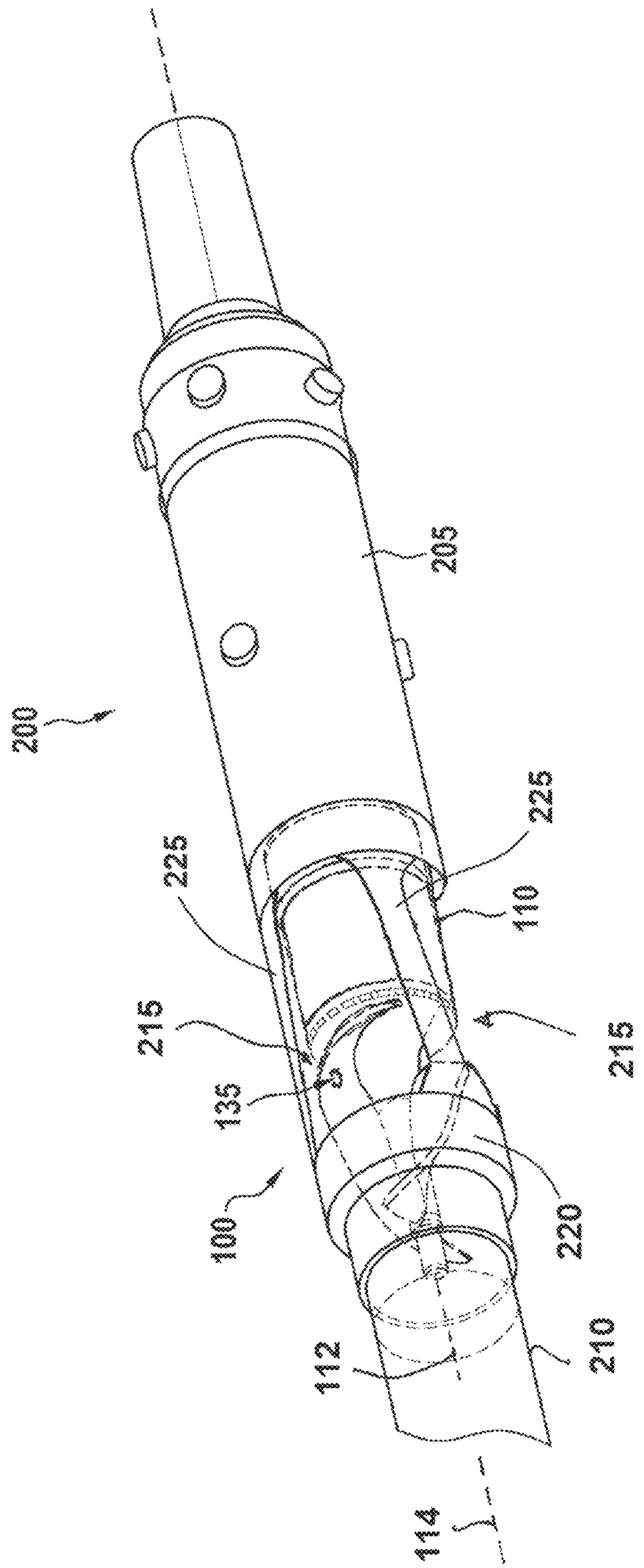
Fig. 1



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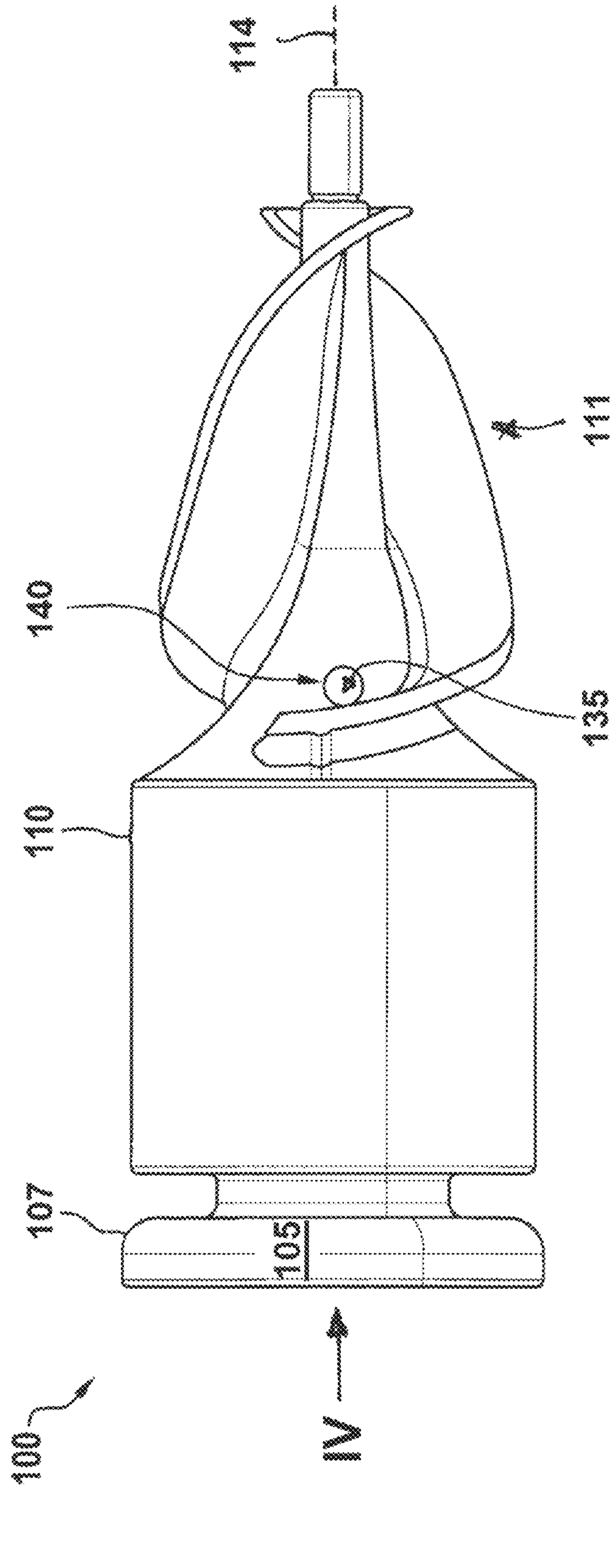
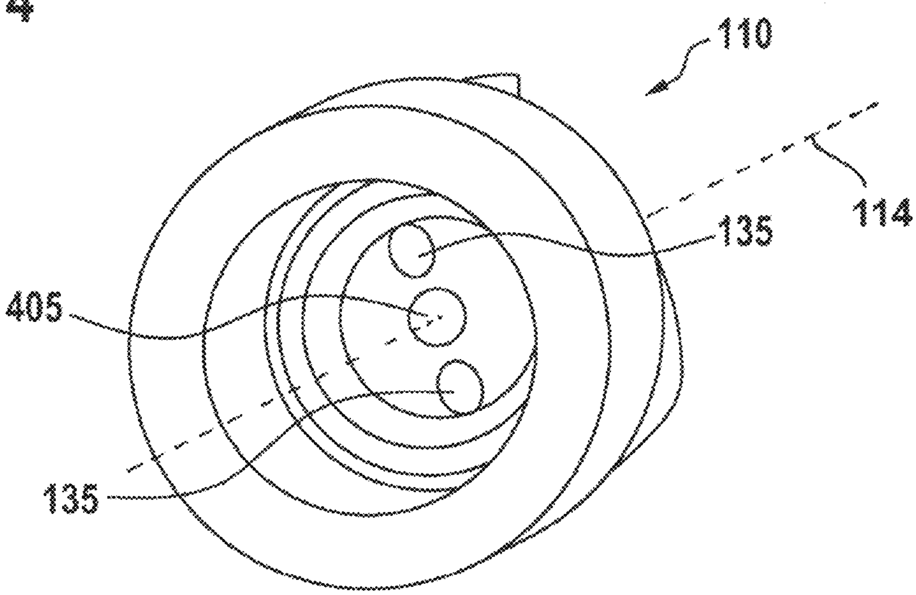


Fig. 3

Fig. 4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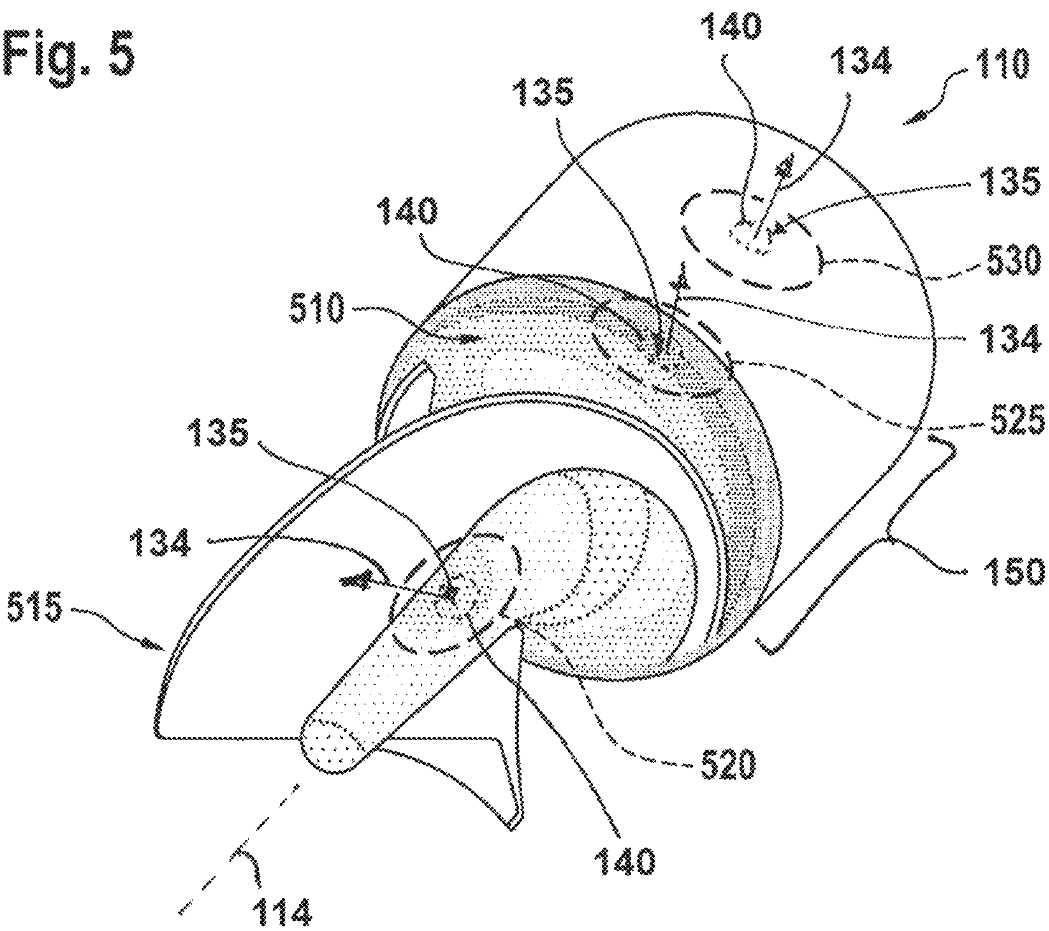
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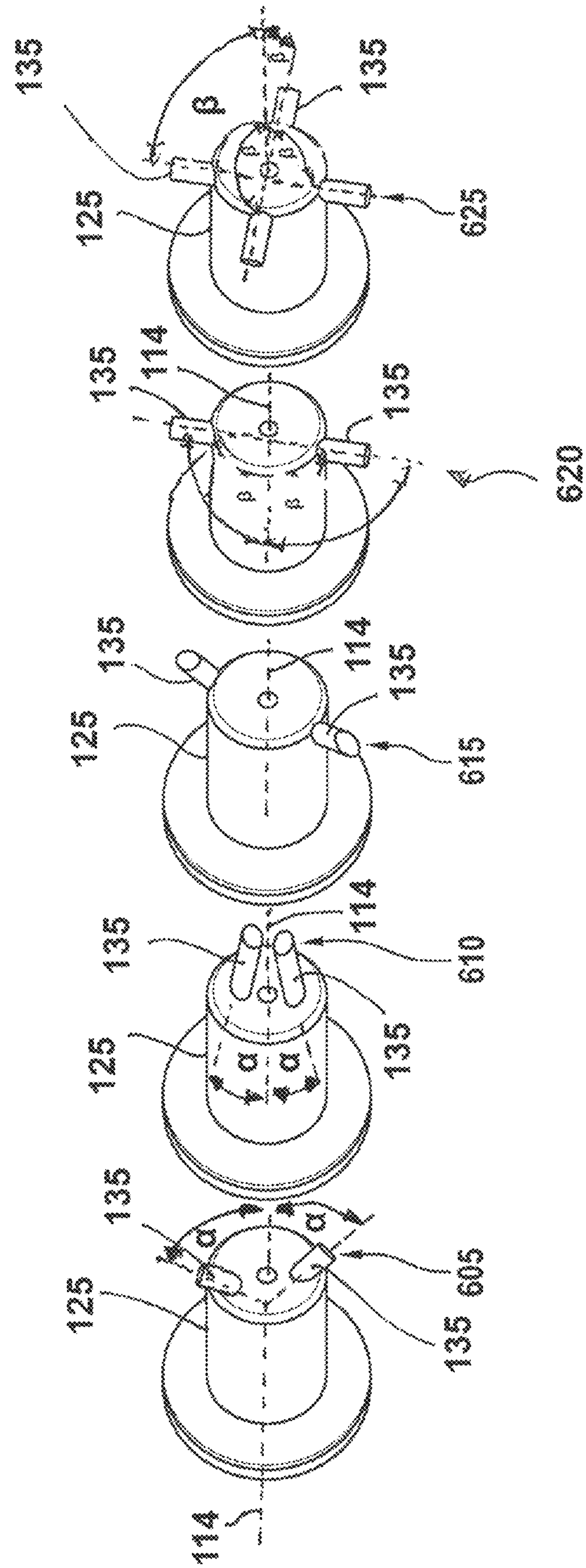
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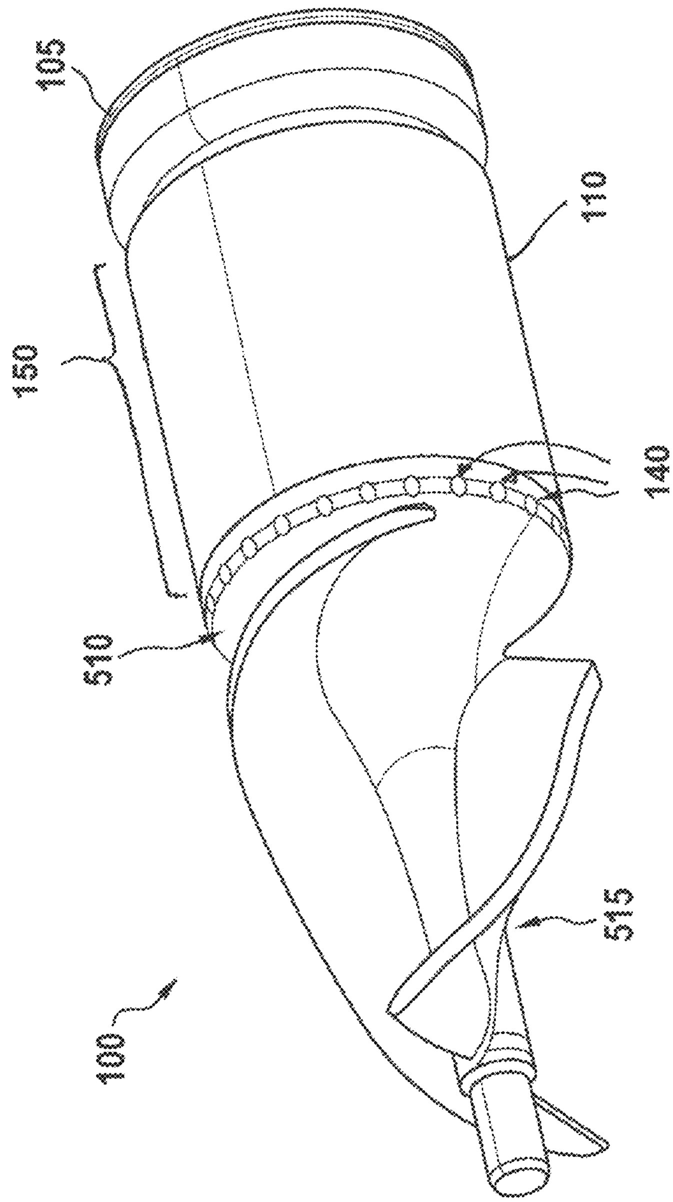


Fig. 7

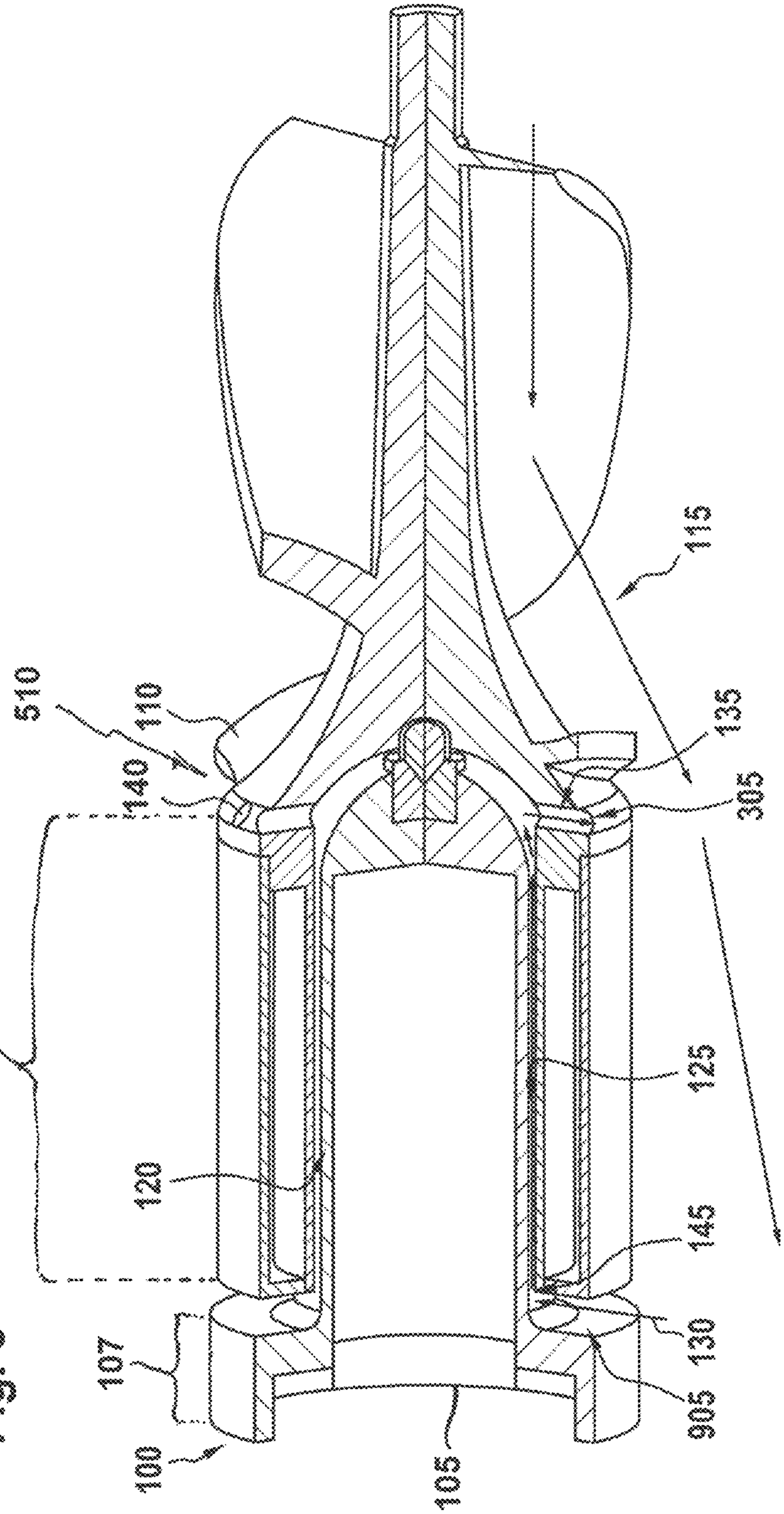
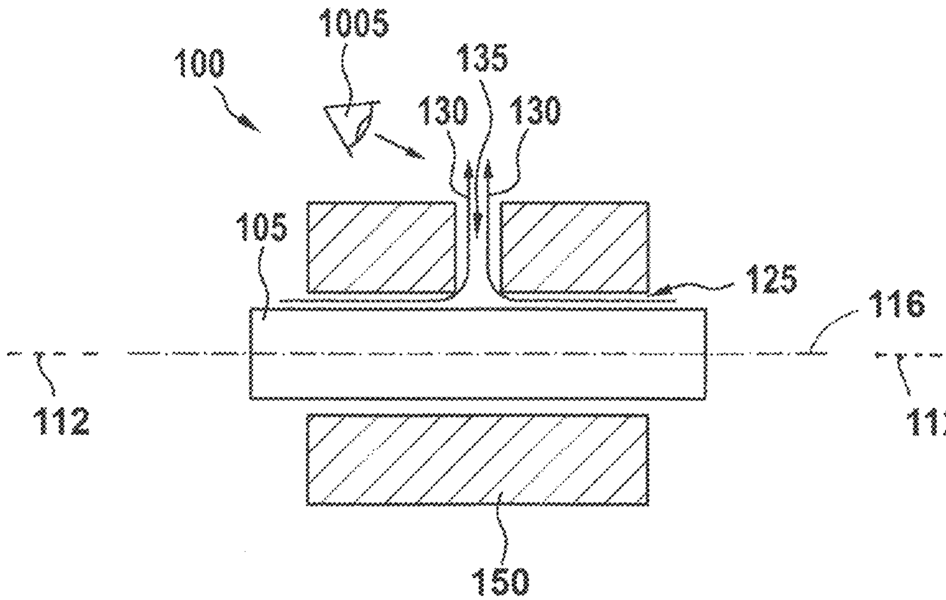


Fig. 8

Fig. 9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112
150

Fig. 10

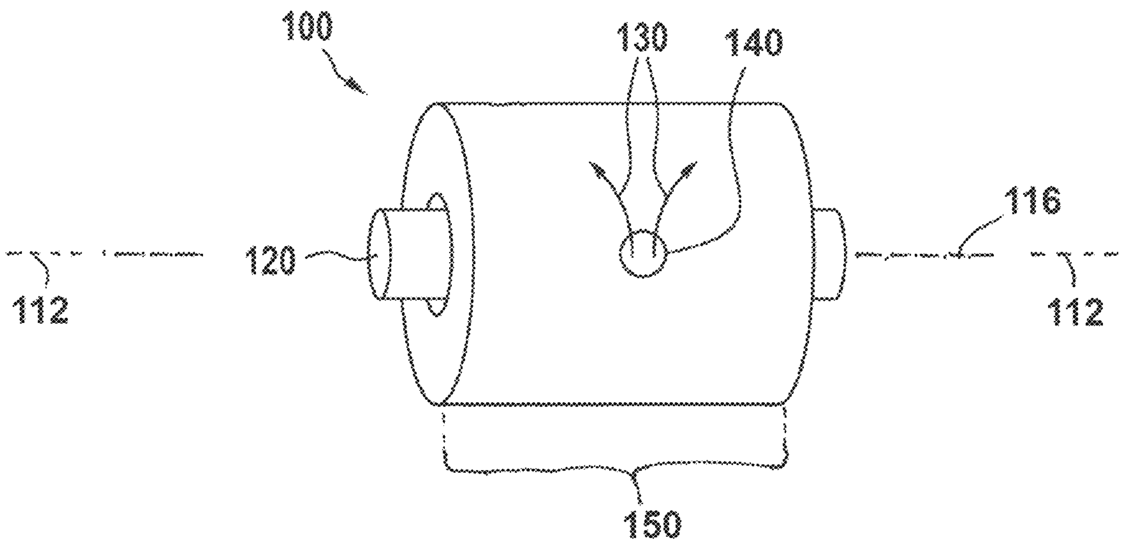
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Fig. 11

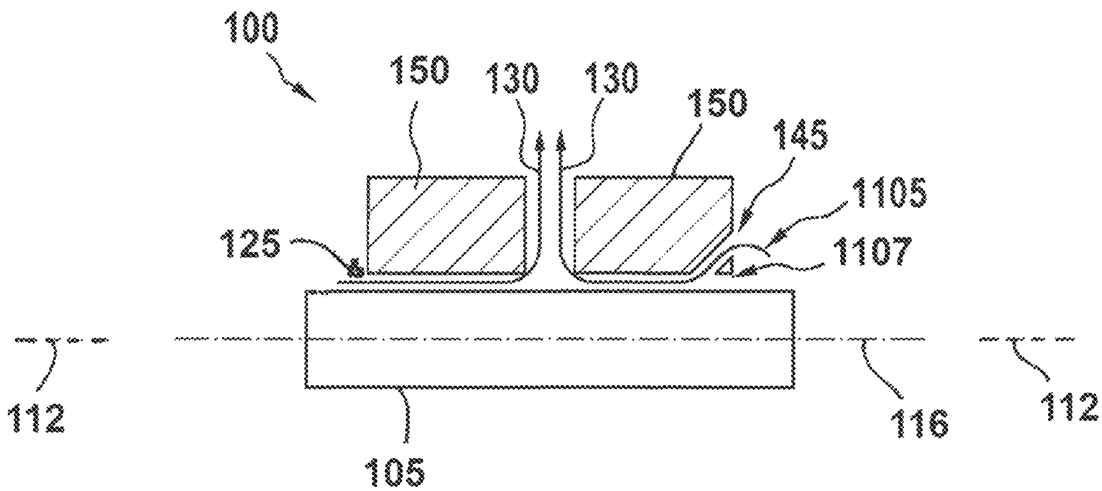
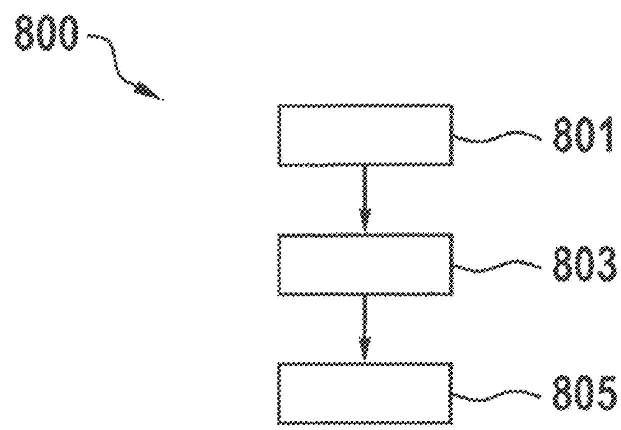


Fig. 12



BEARING DEVICE FOR A HEART SUPPORT SYSTEM, AND METHOD FOR RINSING A SPACE IN A BEARING DEVICE FOR A HEART SUPPORT SYSTEM

BACKGROUND

Field

The invention relates to a bearing device for a cardiac support system comprising a stand unit, an impeller and an intermediate space formed between the impeller and the stand unit for guiding a flushing fluid flow of a fluid, wherein the stand unit comprises a subsection which projects into the impeller and is configured to support the impeller such that it can rotate about an axis of rotation, wherein the impeller is configured to rotate about a longitudinal axis aligned with the axis of rotation when the cardiac support system is in operation to convey a pump fluid flow of the fluid in a flow direction, and wherein the impeller comprises at least one flushing inlet for introducing the flushing fluid flow into the intermediate space and at least one flushing outlet for discharging the flushing fluid flow from the intermediate space.

The invention further relates to a cardiac support system having a bearing device and a method for flushing an intermediate space for guiding a flushing fluid flow with a fluid in a bearing device for a cardiac support system and a method for producing a bearing device for a cardiac support system.

Description of the Related Art

To provide cardiovascular support for patients having heart failure, systems are used in particular that take over part or all of the heart's pumping function. These systems, which are also referred to as cardiac support systems or VADs (ventricular assist devices) for short, can be subdivided into temporary systems for short-term cardiac support and permanent systems for long-term use on or in the patient. One component of such a system is usually a blood pump, typically a centrifugal pump (turbo pump), which is driven by an integrated electric motor and produces the required blood flow by means of a rotor. The pump can be implanted in different locations. The pump can be sutured to the heart from the outside by means of an invasive sternotomy, for example, or it can be placed into the aorta or into a ventricle in a minimally invasive manner by means of a catheter. In the latter case, the maximum permissible outer diameter of the pump is generally limited to 10 mm, which is why the use of an axial pump having a rotor which receives flow axially is desirable. In the process, the blood to be conveyed is expelled through the discharge openings disposed on the circumference of a cylindrical pump housing in order to be returned to the aorta.

EP 3 127 562 A1 discloses a blood pump for a cardiac support system, which comprises a pump housing with an impeller that is rotatably mounted in the pump housing in a sliding bearing having stationary support surfaces, against which support surfaces configured on the blades of the impeller abut. The complex structure of the blades of the impeller on which the support surfaces are formed has the effect that the sliding bearing is flushed and heat is removed from it when blood is pumped in the blood pump.

SUMMARY

The object of the invention is to provide a bearing device for a cardiac support system that does not require complex blade structures and/or hoses with additional flushing pumps for flushing with a fluid, and to specify a method for flushing a bearing device for a cardiac support system that ensures that sufficient heat can be dissipated from the bearing device during operation of the cardiac support system.

This object is achieved by the bearing device specified herein and the method specified herein. Advantageous embodiments of the invention are described herein.

A bearing device according to the invention for a cardiac support system includes a stand unit and an impeller and comprises an intermediate space formed between the impeller and the stand unit for guiding a flushing fluid flow of a fluid. The stand unit comprises a subsection which projects into the impeller and is configured to support the impeller such that it can rotate about an axis of rotation. The impeller is configured to rotate about a longitudinal axis aligned with the axis of rotation when the cardiac support system is in operation to convey a pump fluid flow of the fluid in a flow direction, wherein the impeller comprises at least one flushing outlet for discharging the flushing fluid flow from the intermediate space. The at least one flushing outlet in the impeller is configured such that, due to a centrifugal force acting upon the fluid in the at least one flushing outlet, a rotation of the impeller about the axis of rotation during operation of the cardiac support system causes the fluid to be expelled from the intermediate space through the flushing outlet to at least one discharge opening, whereby the flushing fluid flow is discharged from the intermediate space. For this purpose, the at least one flushing outlet in the impeller can comprise a discharge opening for discharging the flushing fluid flow, which has an opening cross-section, in which, at at least one location, an opening cross-section normal vector has a directional component which faces away from the axis of rotation and is radial to the axis of rotation. The at least one flushing outlet in the impeller is configured such that, due to a centrifugal force acting upon the fluid in the at least one flushing outlet, a rotation of the impeller about the axis of rotation during operation of the cardiac support system causes the fluid to be expelled from the intermediate space through the flushing outlet to at least one discharge opening, whereby the flushing fluid flow is discharged from the intermediate space.

A plurality of flushing outlets can be formed in the impeller. The at least one flushing outlet preferably extends along an axis which intersects the longitudinal axis of the impeller or is disposed at an angle to said longitudinal axis. The at least one flushing outlet can in particular be configured as a tube. The at least one discharge opening of the flushing outlet can, for example, be disposed in a jacket section of the impeller enclosing the subsection of the stand unit projecting into the impeller. The at least one discharge opening of the flushing outlet can in particular be disposed in a transition section between a region of a propeller of the impeller and a jacket section of the impeller enclosing the subsection of the stand unit projecting into the impeller.

It is also possible for the impeller to comprise a plurality of flushing outlets, wherein the at least one discharge openings of the flushing outlet are disposed at least partially in a transition section between a region of a propeller of the impeller and a jacket section of the impeller enclosing the subsection of the stand unit projecting into the impeller.

It should be noted that a number of flushing outlets in the impeller can correspond to a multiple of the number of blades of the impeller. It should also be noted that the bearing device can have a flushing inlet which, in the assembled state of the sliding bearing device, opens into the intermediate space. The flushing inlet can be configured as a gap between a base of the stand unit and a jacket section of the impeller enclosing the subsection of the stand unit projecting into the impeller, for example.

It should be noted that the flushing inlet can also be configured as at least one inlet channel extending in a direction which intersects the longitudinal axis of the impeller or extends at an angle to said longitudinal axis. The bearing device can also comprise a flushing inlet having a plurality of inlet channels.

The flushing inlet can in particular be disposed downstream with respect to the flushing outlet in the flow direction of the pump fluid flow.

The impeller can be located in a housing comprising a housing section to which an inlet hose for supplying the fluid is connected.

The housing section of the bearing device preferably has at least one discharge opening for discharging the pump fluid flow. The housing section can comprise webs for connecting to a connection section for connecting an inlet hose, wherein the webs delimit at least one discharge opening of the housing section.

A bearing device according to the invention can be configured as a sliding bearing device which comprises a sliding bearing for supporting a rotating component, or as a magnetic bearing device, in which a rotating component is magnetically supported.

A sliding bearing device according to the invention comprises a stand unit and an impeller. The stand unit is designed to support the impeller such that it can rotate. The impeller is designed to rotate during an operation of the cardiac support system in order to convey a pump fluid flow. The impeller is configured to enclose at least one subsection of the stand unit in the assembled state of the sliding bearing device. An intermediate space for guiding a flushing fluid flow is provided between said subsection and the impeller. At least one flushing outlet is configured in the impeller to discharge the flushing fluid flow from the intermediate space by means of centrifugal force when the cardiac support system is in operation.

A sliding bearing device according to the invention for a cardiac support system in particular enables the sliding bearing device to be flushed by utilizing centrifugal force. For this purpose, an impeller of the sliding bearing device can comprise a flushing outlet that rotates with the impeller in order to use the centrifugal force at the rotating flushing outlet as the driving force for flushing the sliding bearing device. Flushing the sliding bearing device is beneficial during operation of the cardiac support system to dissipate heat and prevent the formation of thromboses.

Flushing that utilizes centrifugal force, as a result of which the flushing rate substantially depends only on the rotational speed of the cardiac support system and not on the static pressure difference between the flushing inlet and the flushing outlet, advantageously reduces the risk of thrombosis formation, because the flushing rate is significantly less affected by loss of pressure in the blood stream and can thus be set more robustly. It is also not necessary for an external pressure difference to be imposed via the flushing system.

The utilization of the centrifugal force via the flushing outlet in the impeller furthermore enables a compact design of the sliding bearing device, which is advantageous in particular for the use of the sliding bearing device in conjunction with the cardiac support system.

The cardiac support system can be a heart pump, for example, such as a left ventricular support system, a right ventricular support system, or a biventricular support system. The stand unit can be understood to be a non-rotating component of the sliding bearing device. The impeller can be a rotating component, such as a rotor. In the assembled state of the sliding bearing device, the impeller can enclose at least one subsection of the stand unit, whereby the sliding bearing device can be configured as a cylindrical sliding bearing, for example. In the implanted state of the cardiac support system, the impeller can be positioned in the blood. The pump fluid flow to be conveyed can, for example, be a blood flow pumped by the cardiac support system and produced by means of the cardiac support system. In the assembled state, an intermediate space in the form of a gap can emerge between the impeller and the subsection of the stand unit. The flushing outlet can be realized as a bore or another type of through-opening in the impeller. The flushing outlet can be configured to conduct the flushing fluid flow from the intermediate space through a portion of the impeller to discharge the flushing fluid flow from the intermediate space. It is also possible to configure two or more flushing outlets in the impeller.

According to one embodiment, the flushing outlet can be inclined relative to a longitudinal axis of the impeller, which in particular corresponds to an axis of rotation of the impeller. This is advantageous for utilizing the centrifugal force to effect a flushing of the sliding bearing device. The flushing outlet can have a longitudinal extension axis which is inclined relative to the longitudinal axis of the impeller. The longitudinal extension axis of the flushing outlet can also be inclined at a right angle with respect to the longitudinal axis of the impeller.

According to one embodiment, the flushing outlet can be configured as a tube having a discharge opening. The flushing outlet can thus advantageously be realized in a cost-saving manner, for example as a bore in the impeller, which also enables a compact design of the sliding bearing device.

According to one embodiment, the discharge opening can be disposed in a jacket section of the impeller enclosing the subsection of the stand unit or in a transition section between a region of a propeller of the impeller and said subsection. The transition section can be configured as a narrowing of the jacket section in the direction of the propeller, for example.

The discharge opening can alternatively also be disposed in the region of the propeller. The potential of the centrifugal force, by means of which the flushing effect for flushing the sliding bearing device can advantageously be set, can be set via the positioning of the discharge opening.

According to one embodiment, the impeller can also comprise a plurality of flushing outlets. The discharge openings of the flushing outlets can be disposed at least partially in the transition section. In the assembled state of the sliding bearing device, the flushing outlets can extend radially outward with respect to the stand unit, for example. The discharge openings can be disposed evenly spaced around the periphery of the transition section. This positioning of the flushing outlets and the discharge openings is advantageous in terms of uniform flushing of the intermediate space and in terms of presenting the largest possible cross-section of the flushing outlets.

According to one embodiment, at least one pair of flushing outlets can be configured in the impeller. The flushing outlets of the at least one pair can be disposed opposite one another with respect to a longitudinal axis of the impeller. The configuration of the oppositely disposed pair of flushing outlets is advantageous to prevent an imbalance of the rotating propeller.

A number of flushing outlets in the impeller can correspond to a multiple of the number of blades of the impeller. The flushing outlets in the form of flushing bores are disposed just as periodically as the blading of the impeller, for example. This makes it possible to prevent an imbalance. In this case, for example, two blades result in a multiple of two as the number of flushing outlets.

According to one embodiment, the sliding bearing device can also comprise a flushing inlet for introducing the flushing fluid flow. In the assembled state of the sliding bearing device, the flushing inlet can open into the intermediate space. Using the acting centrifugal force, the flushing fluid flow can flush the intermediate space and thus also the bearing of the sliding bearing device, even without the provision of a static pressure difference between the flushing inlet and the flushing outlet.

According to one embodiment, the flushing inlet can also be configured as a gap between a base of the stand unit and a jacket section of the impeller enclosing the subsection of the stand unit. Additionally or alternatively, the flushing inlet can be configured as an inlet channel in the impeller. The inlet channel can be inclined relative to an axis of rotation of the impeller. The flushing outlet can furthermore be formed in the impeller by a plurality of inlet channels with at least one inclined inlet channel. At least one side of the flushing inlet can thus be configured to be stationary and one side such that it can rotate. The flushing fluid flow can be drawn in on the stationary side of the flushing inlet, e.g., on a wall of the stand unit. If the flushing inlet is configured as an inlet channel in the impeller, the flushing inlet can be configured at least partially in the rotating body of the impeller. A portion of the flushing fluid flow that is partially enclosed in the intermediate space can be introduced through the flushing inlet and discharged again through the flushing outlet, for example to absorb and dissipate heat from the stand unit. The centrifugal pressure is advantageously increased if the flushing inlet is not or only partially located in the rotating body, the impeller.

The flushing inlet can furthermore be disposed downstream with respect to the flushing outlet in the flow direction of the pump fluid flow. By introducing the flushing fluid flow along the stand unit and along the impeller, a constant flushing of the sliding device can advantageously be set thanks to the rotation of the flushing fluid flow at the flushing outlet, even when the pressure levels at the flushing inlet and flushing outlet are the same.

The invention further presents a cardiac support system having an embodiment of the aforementioned sliding bearing device. The cardiac support system can be a left ventricular cardiac support pump, for example. For minimally invasive transfemoral or transaortic insertion, for example, the cardiac support system can furthermore have an elongated, cylindrical shape.

A method for producing a bearing device for a cardiac support system configured as a sliding bearing device or as a magnetic bearing device is presented as well. The method comprises the following steps:

- providing a stand unit, which is designed to support an impeller such that it can rotate, and the impeller, which is configured to rotate during operation of the cardiac support system to convey a pump fluid flow;
- forming at least one flushing outlet in the impeller, wherein the flushing outlet is designed to discharge a flushing fluid flow from the bearing device by means of centrifugal force when the cardiac support system is in operation; and
- assembling the impeller and the stand unit to produce the bearing device, wherein at least one subsection of the stand unit is enclosed by the impeller, and wherein an intermediate space for guiding the flushing fluid flow is disposed between the subsection and the impeller.

An embodiment of the aforementioned bearing device can advantageously be produced by carrying out the method.

The condition for the flushing to function by the action of centrifugal force is set out in the following:

The flushing is independent of the static pressure difference. Centrifugal force is used to flush the sliding bearing device; no external pump or additional geometries or structures to produce a static pressure difference are needed. This requires the mechanical energy balance due to the kinetic rotational energy at the exit, at the discharge opening of the flushing outlet, to be positive; i.e., the mechanical energy of the flow at the exit has to be greater than at the entry, at the flushing inlet. This is illustrated in the following using formulas according to Bernoulli's principle:

$$\frac{p_{exit}}{\text{density}} - \frac{v_{exit}^2}{2} < \frac{p_{entry}}{\text{density}} - \frac{v_{entry}^2}{2}$$

If v is the rotational speed and the flushing inlet is not subject to rotation, then:

$$\frac{p_{exit}}{\text{density}} - \frac{v_{exit}^2}{2} < \frac{p_{entry}}{\text{density}}$$

rearranged:

$$\frac{(p_{exit} - p_{entry})}{\text{density}} < \frac{v_{exit}^2}{2}$$

with the rotation speed $v=2\pi Rn$ and with n being the speed in revolutions/second

$$\frac{(p_{exit} - p_{entry})}{\text{density}} < 2(\pi Rn)^2$$

from which then follows:

$$\text{static pressure difference} << 2(\pi Rn)^2 * \text{density}$$

For water, the "centrifugal pressure" corresponds to a pressure difference of approx. 5 bar at a radius of 1 cm and a speed of 30,000 revolutions/minute. The described approach is therefore effective for this numerical example if the static pressure difference is only approx. 500 mbar (interpreted as "much greater" than a factor of ten).

Flushing of the sliding bearing device by means of centrifugal force requires a rotating system with system limits, the "entry" and "exit", which point outward in the direction normal to the axis of rotation. The flushing path of the flushing fluid flow extends between the rotating body, the jacket section of the impeller, and the body which is stationary relative to it, the stand unit. According to the design example shown here, the flushing fluid flow moves along the path, i.e., along the intermediate space to the flushing outlet. At the exit of the flushing outlet, the flushing fluid flow flows out of the flushing path. In order to impose the centrifugal force across the entire cross-section, the exit boundary of the flushing outlet is located inside the rotating body, inside the jacket section. The cross-section normal vector should have a component in radial direction, which is not the case on the end face of a cylindrical sliding bearing device, for example, but in radial direction, i.e., when the jacket section is drilled into.

The invention also extends to a cardiac support system in which there is a bearing device as described above.

In a method according to the invention for flushing an intermediate space for guiding a flushing fluid flow with a fluid in a bearing device for a cardiac support system, wherein the intermediate space comprises at least one flushing inlet for introducing the flushing fluid flow and at least one flushing outlet for discharging the flushing fluid flow and wherein the intermediate space is configured between an impeller which can rotate about an axis of rotation for conveying a pump fluid flow and a stand unit for rotatably supporting the impeller, in which the fluid is introduced into the intermediate space through the at least one flushing inlet, the fluid is expelled from the intermediate space through the flushing outlet to at least one discharge opening by means of a centrifugal force acting upon said fluid in the at least one flushing outlet relative to the axis of rotation.

Advantageous design examples of the invention are described in more detail in the following with reference to schematic drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

The figures show:

FIG. **1** a first sliding bearing device for a cardiac support system comprising an impeller and comprising a stand unit as a section;

FIG. **2** a portion of a cardiac support system comprising the first sliding bearing device;

FIG. **3** a side view of the first sliding bearing device;

FIG. **4** a rear view of the impeller in the direction of the arrow IV of FIG. **3**;

FIG. **5** other possible designs of an impeller in a sliding bearing device for a cardiac support system;

FIG. **6** an intermediate space having various flushing fluid volumes in different sliding bearing devices for a cardiac support system with different configurations of flushing outlets;

FIG. **7** a further sliding bearing device comprising an impeller and comprising a stand unit;

FIG. **8** the further sliding bearing device comprising an impeller and comprising a stand unit as a section;

FIG. **9** a detail of a further sliding bearing device for a cardiac support system in a sectional view;

FIG. **10** the detail of the further sliding bearing device for a cardiac support system of FIG. **9** in a plan view;

FIG. **11** a detail of a further sliding bearing device for a cardiac support system in a sectional view; and

FIG. **12** a flow diagram of a method for producing a sliding bearing device.

DETAILED DESCRIPTION

In the following description of favorable design examples of the present invention, the same reference signs are used for the elements shown in the various figures, which are the same or have a similar effect, whereby a repeated description of these elements is omitted.

FIG. **1** shows a schematic illustration of a bearing device **100** for a cardiac support system which is configured as a sliding bearing device according to one design example. The bearing device **100** comprises a stand unit **105** and an impeller **110**. The stand unit **105** is configured to support the impeller **110** such that it can rotate about an axis of rotation **112** which is coaxial with the longitudinal axis **114** of the impeller **110**. The impeller **110** is designed to rotate about the axis of rotation **112** when the cardiac support system is in operation in order to convey a pump fluid flow **115**. In the assembled state of the sliding bearing device shown here, the impeller **110** encloses at least one subsection **120** of the stand unit **105**. An intermediate space **125** for guiding a flushing fluid flow **130** is provided between the subsection **120** and the impeller **110**. At least one flushing outlet **135** is formed in the impeller **110**. The flushing outlet **135** is designed to discharge the flushing fluid flow **130** from the intermediate space **125** by means of centrifugal force when the cardiac support system is in operation.

The flushing outlet **135** comprises a discharge opening **140** for discharging the flushing fluid flow **130**, which has an opening cross-section **132**, in which, at at least one location, an opening cross-section normal vector **134** has a directional component **136** which faces away from the axis of rotation **112** and is radial to the axis of rotation **112**.

According to the design example shown here, the flushing outlet **135** is inclined relative to the longitudinal axis **114** of the impeller **110** which is coaxial with the axis of rotation **112**. The flushing outlet **135** comprises an axis **137** along which said flushing outlet **135** extends and which is thus a longitudinal extension axis of the flushing outlet **135**, which is inclined relative to the longitudinal axis **114** of the impeller **110** and forms an acute angle α with it. It should be noted that this axis **137** can also be inclined relative to the longitudinal axis **114** of the impeller **110**.

Furthermore, according to the design example shown here, the flushing outlet **135** is configured as a tube with a discharge opening **140**. The discharge opening **140** is disposed at an end of the tube facing away from the intermediate space **125**.

According to the design example shown here, the sliding bearing device **100** also comprises a flushing inlet **145** for introducing the flushing fluid flow **130**. In the assembled state of the bearing device **100** shown here, the flushing inlet **145** opens into the intermediate space **125**.

According to the design example shown here, the flushing inlet **145** is configured as a gap between a base **107** of the stand unit **105** and a jacket section **150** of the impeller **110** enclosing the subsection **120** of the stand unit **105**. It should be noted that the flushing inlet can in principle also be configured as an inlet channel in the impeller **110**.

In the sliding bearing device shown in FIG. **1**, the flushing inlet **145** is disposed downstream with respect to the flushing outlet **135** in the flow direction of the pump fluid flow **115** as in the design example shown here. FIG. **1** shows a flushing fluid flow **130** with a flushing path for flushing the bearing device **100** which extends from the flushing inlet **145** through the intermediate space **125** to the flushing outlet **135** with the discharge opening **140**.

FIG. **2** shows a perspective view of a portion of a cardiac support system **200** with the sliding bearing device **100** in the form of a left ventricular cardiac support pump (LVAD heart pump). FIG. **3** is a side view of the bearing device **100**.

The bearing device **100** and its function in a cardiac support system are described in more detail in the following:

The impeller **110** is a rotor that forms a rotating component in the bearing device **100** of the cardiac support system **200**, which is supported magnetically or by means of sliding bearings, wherein the rotating component is positioned over a fluid to dissipate heat or reduce friction. When the impeller **110** is positioned directly in the blood during operation of the cardiac support system, as is the case, for example, with the left ventricular cardiac support pump (LVAD heart pump) shown in FIG. **2** in the implanted state of the cardiac support system, it is beneficial to flush the bearing device **100** to dissipate heat and prevent the formation of thromboses ("blood clotting"). To enable robust flushing of the sliding bearing device **100**, a constant flow is necessary. Flushing the sliding bearing device **100** prevents the formation of thromboses. A pump design (such as baffles) that converts mechanical energy into hydrodynamic energy can be used for this purpose. With the sliding bearing device **100** shown in FIG. **1** and FIG. **2**, it is possible to utilize the centrifugal force on the flushing outlet **135** rotating with the impeller **110** using only a bore in the form of the flushing outlet **135**. The centrifugal force represents the driving force for the flushing. Such a structure is inexpensive to produce.

A plurality of flushing outlets **135** can alternatively also be provided at different locations on the impeller **110** to utilize the centrifugal force, as shown in the following figures.

Using a design example of the bearing device **100** shown here, introduction can be realized by suctioning out the flushing fluid flow **130** with the aid of the centrifugal force at the flushing outlet **135**. Structurally, this is achieved by configuring the flushing outlet **135** such that the flushing outlet **135** is enclosed by the rotating component, the impeller **110**, e.g., by having a bore as the flushing outlet **135**, while the inlet side in the form of flushing inlet **145** is not or only partially, e.g., only on one side, subject to the rotation. This is achieved by configuring the flushing inlet **145** with at least one section of the stand unit **105** as a wall section. In this case, the statistical pressure difference has practically no effect on the flushing flow of the flushing fluid flow **130**, which is why the flushing effect of the bearing device **100** is substantially determined by the centrifugal force and the rotational speed of the pump of the cardiac support system. The flushing effect of the bearing device **100** is thus largely independent of other potential influencing variables, such as the magnitude of the mass flow or the level of the pressure build-up through or over the cardiac support system. Consequently, there is no need for a static pressure difference to flush the bearing device **100**. The positioning of the flushing outlet **135** in the impeller **110**, which is trumpet-shaped here as an example, with widely varying diameters relative to a longitudinal extension axis **114** of said impeller **110**, can therefore be realized in different ways, whereby a positioning of the flushing outlet **135** far upstream of the longitudinal extension of the impeller **110** can be omitted. Complex structures, such as a pump wheel, or the application of a pressure difference in or around the sliding bearing device **100** are not necessary to effect the flushing of the sliding bearing device **100** either. Because of the independence from the pump flow, the pump flow of the pump fluid flow **115** shown here, the flushing of the bearing device **100** is possible without an absence of flushing as long as the impeller **110** is rotating.

In the design example discussed here, the bearing device **100** comprises the impeller **110** as a rotating part which, together with the stand unit **105** as a stationary part, forms a cylindrical sliding bearing. The flushing effect of the bearing device **100** is based on the centrifugal force that results from a rotation at the flushing outlet **135**. The prerequisite for this is that, as shown here, at least one side at the flushing inlet **145** is stationary; in this case the inner side in the form of the stand unit **105**. As a result, even if the pressure levels at the flushing inlet **145** and the flushing outlet **135** are comparable or the same, a constant flushing of the sliding bearing device **100** can be set due to the rotation of both sides of the flushing outlet **135** formed in the rotating impeller **110** or the fluid volume of the flushing outlet **135**. The design example of the bearing device **100** shown here also makes it possible to flush a partially enclosed volume, which is shown here in block **155** which, as an example, is disposed around the fixed bearing of the stand unit **105**, by combining a rotating and a stationary side. The reason for this is that the flushing fluid flow **130** is accelerated on the rotating side of the impeller as a result of the molecular adhesion conditions. The flushing fluid flow **130** is accelerated along the wall of the intermediate space **125** toward a larger diameter due to the centrifugal force, as a result of which the flushing fluid flow **130** is drawn in on the stationary side of the intermediate space **125** in the form of a wall of the stand unit **105**. This causes the partially enclosed fluid of the flushing fluid flow **130** to be flushed, which allows heat at the fixed bearing of the stand unit **105**, for example, to be absorbed and dissipated.

The cardiac support system **200** shown in FIG. **2** comprises a housing section **205**. The impeller **110** of the bearing device **100** is located in the housing section **205** of the cardiac support system **200**. In the cardiac support system **200**, the impeller **110** is disposed in a housing section **205** on which an inlet hose **210** for supplying the fluid is provided. In the housing section **205** of the housing of the cardiac support system, there are discharge openings **215** for discharging the pump fluid flow **115**. For connecting the inlet hose **210**, the cardiac support system **200** comprises a connection section **220** which is connected to webs **225** of the housing section **205** that delimit two discharge openings **215** for discharging fluid conveyed by a rotation of the impeller **110** in the cardiac support system **200** from the housing section **205**.

The housing section **205** of the cardiac support system **200** has a cylindrical, elongated structure with a substantially constant outer diameter for easy placement in a blood vessel, such as the aorta, by means of a catheter. The elongated axial design shown here allows transfemoral implantation of the cardiac support system **200**. The sliding bearing device **100** is accordingly disposed in a window opening in the housing section **205** such that, in the implanted state of the cardiac support system **200**, the rotating rotor component, the impeller **110**, is positioned in the blood. Due to the axial design of the cardiac support system **200**, the flow received by the impeller **110** is axial relative to the longitudinal axis **114** of the impeller **110**, which corresponds to a longitudinal axis of the cardiac support system **200**. The flushing outlet **135** in the impeller **110** is disposed in the region **111** of a propeller of the impeller **110**, whereby the flushing outlet **135** is realized by a drilled hole or a through-bore or another type of through-hole in the impeller **110**.

FIG. **3** shows the sliding bearing device **100** with the stand unit **105** and the impeller **110** in the assembled state, whereby the stand unit **105** forms the non-rotating counterpart to the rotating impeller **110**. The stand unit **105** has a section which narrows in the direction of the impeller **110**. The narrowed section of the stand unit **105** is mostly enclosed by the impeller **110**. The stand unit **105** is connected to the impeller **110** and supports the impeller **110** such that it can rotate. The flushing outlet **135** having a discharge opening **140** is configured in the impeller **105**. As an example, the discharge opening **140** of the flushing outlet here is disposed in the region of the propeller of the impeller **110**.

FIG. **4** shows a perspective rear view of the impeller in the direction of the arrow IV of FIG. **3**. The side of the impeller **110** facing away from the propeller of the impeller **110**, which can be coupled to the stand unit **105** of the bearing device, is shown as the rear side of the impeller **110**. To connect the impeller **110** to the stand unit **105**, the impeller **110** here comprises a ball bearing **405** for supporting the impeller **110**. The flushing outlets **135** of the impeller **110**, which, as an example, are configured here as discharge bores and which communicate with the intermediate space **125** shown in FIG. **1**, can be seen as well.

According to the design example shown here, at least one pair of flushing outlets **135** is configured in the impeller **110**. The flushing outlets **135** of the at least one pair are disposed opposite one another with respect to a longitudinal axis **114** of the impeller **110**. As an example, the flushing outlets **135** of the pair are evenly spaced with respect to the axis of rotation **112** of the impeller **110**, i.e., they extend symmetrically relative to a longitudinal axis **114** of the impeller **110** coaxial with the axis of rotation **112**.

FIG. **5** shows further possible designs of an impeller **110** in a bearing device for a cardiac support system, which can be configured as a sliding bearing device or as a magnetic bearing device. The figure shows a perspective view of the impeller **110**, wherein different example positionings of a discharge opening **140** of the flushing outlet **135** in the impeller **110** as well as a respective opening cross-section normal vector **134** and the longitudinal axis **114** of the impeller **110** are identified.

According to one design example, the discharge opening **140** of the flushing outlet **135** is disposed in a jacket section **150** of the impeller **110** enclosing the subsection of the stand unit. Alternatively, the discharge opening of the flushing outlet is disposed in a transition section **510** between a region of a propeller **515** of the impeller **110** and the jacket section **505**.

This figure shows a potential estimate for the design example, where the strongest suction force occurs, and thus where a suitable location for positioning the flushing outlet and the discharge opening of the flushing outlet is. Three regions **520**, **525** and **530** for disposing the discharge opening of the flushing outlet in the impeller **110** are shown as examples. The region **520** is located in the region of the propeller **515**. The region **525**, for example, identifies a position of the discharge opening of the flushing outlet **135** in the transition section **510**. The region **530**, for example, identifies a positioning of the discharge opening of the flushing outlet in the jacket section **150**. According to the potential estimate shown here, when the flushing outlet **135** and the discharge opening **140** are positioned in the region **530**, a beneficial flushing effect is achieved in a bearing device having such an impeller **110** and a stand unit **105** because the centrifugal force between the flushing inlet and the flushing outlet is sufficient to drive the flushing.

FIG. **6** shows the intermediate space **125** with different flushing fluid volumes in different bearing devices for a cardiac support system designed as a sliding bearing device or as a magnetic bearing device having different configurations of flushing outlets, wherein the flushing outlets **135** are configured differently. The flushing outlet **135**, through which the flushing fluid flow passes, has different configurations **605**, **610**, **615**, **620**, **625** here. At least one pair of flushing outlets **135** is configured in the impeller of these sliding bearing devices, whereby the flushing outlets **135** of the at least one pair in a bearing device are disposed opposite one another with respect to the longitudinal axis **114** of the impeller **110** aligned with the axis of rotation **112**. The respective configurations **605**, **610**, **615**, **620**, **625** of the flushing outlets shown here show examples of the pair of flushing outlets. In a first configuration **605**, the flushing outlets of the pair extend radially from the longitudinal axis **114** of the impeller inclined at an obtuse angle α with respect to said longitudinal axis **114** of the impeller, whereby a starting point of the flushing outlets **135** is formed in close proximity to the longitudinal axis **114**. In a second configuration **610**, the flushing outlets **135** of the pair extend inclined at an acute angle α with respect to the longitudinal axis **114** of the impeller; the flushing outlets **135** of the pair are accordingly angled toward one another. A third configuration **615** corresponds to the first configuration **605** with the exception of the starting point of the flushing outlets **135**, which are disposed further apart than the starting points of the flushing outlets of the first configuration **605**. In a fourth configuration **620**, the flushing outlets **135** of the pair extend at a right angle β to the longitudinal axis **114** of the impeller. A fifth configuration **625** shows an example of two pairs of flushing outlets **135**, which are disposed opposite one another with respect to the longitudinal axis **114** of the impeller and are disposed evenly spaced apart from one another. Like the pair shown in the fourth configuration **620**, the two pairs of flushing outlets **135** extend at a right angle β to the longitudinal axis **114** of the impeller.

FIG. **7** shows a further sliding bearing device **100** for a cardiac support system. The figure shows a perspective view of the sliding bearing device **100** in the assembled state, in which the impeller partly encloses the stand unit **105**. FIG. **8** shows this sliding bearing device **100** as a section. The sliding bearing device **100** shown here is similar to the sliding bearing device described with reference to the preceding figures. According to the design example shown here, the impeller **110** comprises a plurality of flushing outlets **135**. The discharge openings **140** of the flushing outlets are disposed at least partially in the transition section **510** between the propeller **515** and the jacket section **505**. As an example, the discharge openings **140** are disposed evenly spaced around the periphery of the transition section **510**. FIG. **7** shows a utilization of the flushing position of the plurality of flushing outlets having the suction force determined to be the strongest.

FIG. **8** shows a further sliding bearing device **100** for a cardiac support system. The figure shows a sectional view of a side view of the sliding bearing device **100**. The stand unit **105** is partially enclosed by the jacket section **150** of the impeller **110**. The plurality of discharge openings **140** of flushing outlets **135** is disposed in the transition region or transition section **510** between the propeller of the impeller **110** and the jacket section **150**. The figure shows the flow direction of the pump fluid flow **115** and the flow path of the flushing fluid flow **130**. The flushing fluid flow **130** is introduced through the flushing inlet **145** which, according to the design example shown here, is configured as a gap **905** between the base **107** of the stand unit **105** and the jacket section **505** of the impeller **110** enclosing the subsection **120** of the stand unit **105**. The flushing fluid flow **130** is then conducted through the intermediate space **125** to one of the discharge openings **140** of the plurality of flushing outlets **135** by means of centrifugal force in order to flush the sliding bearing device **100**.

FIG. **9** shows a schematic illustration of a detail of a sliding bearing device **100** for a cardiac support system according to one design example. The figure shows a cross-section of a part of the sliding bearing device **100** with the subsection of the stand unit **105** enclosed by the jacket section **150** of the impeller. The configuration of the flushing outlet **135** here is intended to show that the flushing outlets can also be disposed in a non-mirror-symmetrical manner.

The figure shows a portion of the flushing path of the flushing fluid flow **130** that flows through the intermediate space **125** to the flushing outlet **135** and is discharged from the discharge opening of the flushing outlet **135**. The outflow of the flushing fluid flow is shown in the following FIG. **10** with the aid of a plan view from the direction identified here with the arrow **1005**.

FIG. **10** shows a schematic illustration of a detail of a sliding bearing device **100** for a cardiac support system according to one design example. The figure shows a plan view onto the detail of the sliding bearing device **100** identified in the preceding FIG. **9**. The flushing outlet **135** is disposed in the jacket section **150** radially to a longitudinal extension axis **116** of the subsection of the stand unit **105** enclosed by the jacket section **505** which is aligned with the axis of rotation **112** in the bearing device. The flushing fluid flow **130** exits the jacket section **150** at the discharge opening **140** of the flushing outlet.

FIG. **11** shows a schematic illustration of a detail of a sliding bearing device **100** for a cardiac support system according to one design example. According to the design example shown here, the flushing inlet **145** is realized in the intermediate space **125** by a plurality of inlet channels, namely by the channel **1105** and the channel **1107**. This is also intended to demonstrate that the inlet direction does not necessarily only have to be oriented in the direction of the longitudinal extension axis **116** of the bearing device **100** aligned with the axis of rotation **112** of the bearing device **100**, but can also be inclined relative to said longitudinal extension axis. If the flushing inlet **145** is configured such that there is no acting centrifugal force there, for example such that the boundary of the flushing inlet **145** is not or only partially in the rotating body as in the design example of the flushing inlet **145** shown here as an inlet channel **1105** which is partially configured in the jacket section **150**, the centrifugal pressure is advantageously increased.

FIG. **12** shows a flow diagram of a method **800** for producing a bearing device for a cardiac support system configured as a sliding bearing device or as a magnetic bearing device according to one design example. The method **800** comprises a step **801** of providing, a step **803** of forming, and a step **805** of assembling. In step **801** of providing, a stand unit is provided, which is configured to support an impeller such that it can rotate. Also provided in step **801** is the impeller, which is designed to rotate during an operation of the cardiac support system in order to convey a pump fluid flow. In step **803** of forming, at least one flushing outlet is formed in the impeller, which is designed to discharge a flushing fluid flow from the sliding bearing device by means of centrifugal force when the cardiac support system is in operation. In step **805** of assembling, the impeller and the stand unit are assembled to produce the sliding bearing device. At least one subsection of the stand unit is enclosed by the impeller. An intermediate space for guiding the flushing fluid flow is furthermore provided between said subsection and the impeller. During the operation of the cardiac support system, the flushing fluid flow is conducted from the intermediate space into the flushing outlet by means of centrifugal force and from there is discharged from the bearing device in order to flush the bearing device.

In summary, in particular the following should be noted: The invention relates to a bearing device **100** for a cardiac support system. The bearing device **100** comprises a stand unit **105** and an impeller **110**. The stand unit **105** is designed to support the impeller **110** such that it can rotate. The impeller **110** is designed to rotate when the cardiac support system is in operation in order to convey a pump fluid flow **115**. The impeller **110** is designed to enclose at least one subsection **120** of the stand unit **105** in the assembled state of the bearing device **100**, wherein an intermediate space **125** for guiding a flushing fluid flow **130** is provided between the subsection **120** and the impeller **110**. At least one flushing outlet **135** is formed in the impeller **110**. The flushing outlet **135** is designed to discharge the flushing fluid flow **130** from the intermediate space **125** by means of centrifugal force when the cardiac support system is in operation.

The invention relates, in particular, to the aspects specified in the following clauses:

1. Sliding bearing device (**100**) for a cardiac support system (**200**), wherein the sliding bearing device (**100**) has the following features:
   a stand unit (**105**) is designed to support an impeller (**110**) such that it can rotate; and
   the impeller (**110**), which is configured to rotate when the cardiac support system (**200**) is in operation to convey a pump fluid flow (**115**), wherein the impeller (**110**) is designed to enclose at least one subsection (**120**) of the stand unit (**105**) in the assembled state of the sliding bearing device (**100**), wherein an intermediate space (**125**) for guiding a flushing fluid flow (**130**) is provided between the subsection (**120**) and the impeller (**110**), wherein at least one flushing outlet (**135**) is formed in the impeller (**110**), wherein the flushing outlet (**135**) is designed to discharge the flushing fluid flow (**130**) from the intermediate space (**125**) by means of centrifugal force when the cardiac support system (**200**) is in operation.
2. Sliding bearing device (**100**) according to clause 1, wherein a plurality of flushing outlets (**135**) are formed in the impeller (**110**).
3. Sliding bearing device (**100**) according to any one of the preceding clauses, wherein the at least one flushing outlet (**135**) is inclined relative to a longitudinal axis of the impeller (**110**).
4. Sliding bearing device (**100**) according to any one of the preceding clauses, wherein the flushing outlet (**135**) is configured as a tube having a discharge opening (**140**).
5. Sliding bearing device (**100**) according to clause 4, wherein the discharge opening (**140**) is disposed in a jacket section (**505**) of the impeller (**110**) enclosing the subsection (**120**) of the stand unit (**105**) or in a transition section (**510**) between a region of a propeller (**515**) of the impeller (**110**) and the jacket section (**150**).
6. Sliding bearing device (**100**) according to clause 5, wherein the impeller (**110**) comprises a plurality of flushing outlets (**135**), wherein the discharge openings (**140**) of the flushing outlets (**135**) are at least partially disposed in the transition section (**510**).
7. Sliding bearing device (**100**) according to any one of the preceding clauses, wherein a number of the flushing outlets (**135**) in the impeller (**110**) corresponds to a multiple of the number of blades of the impeller (**110**).
8. Sliding bearing device (**100**) according to any one of the preceding clauses, comprising a flushing inlet (**145**) for introducing the flushing fluid flow (**130**), wherein, in the

assembled state of the sliding bearing device (**100**), the flushing inlet (**145**) opens into the intermediate space (**125**).

9. Sliding bearing device (**100**) according to clause 8, wherein the flushing inlet (**145**) is formed as a gap (**905**) between a base of the stand unit (**105**) and a jacket section (**150**) of the impeller (**110**) enclosing the subsection (**120**) of the stand unit (**105**), and/or wherein the flushing inlet (**145**) is formed in the impeller (**110**) as an inclined inlet channel (**1105**) or by a plurality of inlet channels having at least one inclined inlet channel (**1105**).

10. Sliding bearing device (**100**) according to any one of clauses 8 to 9, wherein the flushing inlet (**145**) is disposed downstream with respect to the flushing outlet (**135**) in the flow direction of the pump fluid flow (**115**).

11. Cardiac support system (**200**) comprising a sliding bearing device (**100**) according to any one of the preceding clauses 1 to 10.

12. Method (**800**) for producing a sliding bearing device (**100**) for a cardiac support system (**200**), wherein the method (**800**) comprises the following steps:

providing (**801**) a stand unit (**105**), which is designed to support an impeller (**110**) such that it can rotate, and the impeller (**110**), which is configured to rotate during operation of the cardiac support system (**200**) to convey a pump fluid flow (**115**);

forming (**803**) at least one flushing outlet (**135**) in the impeller (**110**), wherein the flushing outlet (**135**) is designed to discharge a flushing fluid flow (**130**) from the sliding bearing device (**100**) by means of centrifugal force when the cardiac support system (**200**) is in operation; and

assembling (**805**) the impeller (**110**) and the stand unit (**105**) to produce the sliding bearing device (**100**), wherein at least one subsection (**120**) of the stand unit (**105**) is enclosed by the impeller (**110**), and wherein an intermediate space (**125**) for guiding the flushing fluid flow (**130**) is disposed between the subsection (**120**) and the impeller (**110**).

LIST OF REFERENCE SIGNS

100 Sliding bearing device
105 Stand unit
107 Base
110 Impeller
111 Region of a propeller of the impeller
112 Axis of rotation
114 Longitudinal axis
115 Pump fluid flow
116 Longitudinal extension axis
120 Subsection of the stand unit
125 Intermediate space
130 Flushing fluid flow
132 Opening cross-section
134 Opening cross-section normal vector
135 Flushing outlet
136 Directional component
137 Axis
140 Discharge opening
145 Flushing inlet
150 Jacket section
155 Block
200 Cardiac support system
205 Housing section
210 Inlet hose
215 Discharge opening
220 Connection section
225 Web
405 Ball bearing
505 Jacket section
510 Transition section
515 Propeller
520, **525**, **530** Region
605, **610**, **615**, **620**, **625** Configuration
800 Method
801 Step of providing
803 Step of forming
805 Step of assembling
905 Gap
1005 Arrow
1105, **1107** Inlet channel

The invention claimed is:

1. A heart pump having a bearing device, the bearing device comprising:

a stand unit;

an impeller; and

an intermediate space formed between the impeller and the stand unit for conducting a flushing fluid flow from a fluid;

wherein the stand unit comprises a subsection enclosed by the impeller and configured to align the impeller about an axis of rotation,

wherein the impeller is configured to rotate about a longitudinal axis aligned with the axis of rotation when the heart pump is in operation to convey a pump fluid flow of the fluid in a flow direction,

wherein the impeller comprises at least one flushing outlet for discharging the flushing fluid flow from the intermediate space,

wherein the at least one flushing outlet comprises a first discharge opening for discharging the flushing fluid flow, which has an opening cross-section in which, an opening cross-section normal vector faces away from the axis of rotation and is radial to the axis of rotation,

wherein the impeller is disposed in a housing section comprising at least two second discharge openings for discharging the pump fluid flow and connected to an inlet hose for supplying the fluid, and

wherein the opening cross-section normal vector intersects with one of the at least two second discharge openings of the housing section at a time and is perpendicular to the axis of rotation.

2. The heart pump according to claim **1**, wherein the at least one flushing outlet comprises a plurality of flushing outlets formed in the impeller.

3. The heart pump according to claim **1**, wherein the at least one flushing outlet is tubular.

4. The heart pump according to claim **1**, wherein the first discharge opening of the at least one flushing outlet is disposed in a jacket section of the impeller enclosing the subsection of the stand unit.

5. The heart pump according to claim **1**, wherein the first discharge opening of the at least one flushing outlet is disposed in a transition section between a region of a propeller of the impeller and a jacket section of the impeller surrounding the subsection of the stand unit.

6. The heart pump according to claim **1**, wherein the at least one flushing outlet comprises a plurality of flushing outlets formed in the impeller, the first discharge openings of the plurality of flushing outlets disposed at least partially in a transition section between a region of a propeller of the impeller and a jacket section of the impeller enclosing the subsection of the stand unit.

7. The heart pump according to claim 1, wherein a number of the flushing outlets formed in the impeller correspond to a multiple of a number of blades of the impeller.

8. The heart pump according to claim 1, wherein the housing section comprises webs, wherein the webs delimit the at least two second discharge openings for discharging the pump fluid flow.

9. The heart pump according to claim 1, wherein the bearing device is configured as a sliding bearing device comprising a sliding bearing for supporting a rotating component in the form of the impeller, or as a magnetic bearing device in which a rotating component in the form of the impeller is magnetically supported.

10. The heart pump according to claim 1, wherein a flushing inlet opens into the intermediate space in an assembled state of the bearing device.

11. The heart pump according to claim 10, wherein the flushing inlet is configured as a gap between a base of the stand unit and a jacket section of the impeller enclosing the subsection of the stand unit.

12. The heart pump according to claim 10, wherein the flushing inlet is configured as at least one inlet channel extending in a direction which intersects the longitudinal axis of the impeller or extends at an angle to the longitudinal axis of the impeller.

13. The heart pump according to claim 10, wherein the flushing inlet comprises a plurality of inlet channels.

14. The heart pump according to claim 10, wherein the flushing inlet is disposed downstream with respect to the at least one flushing outlet in the flow direction of the pump fluid flow.

15. The heart pump according to claim 1, wherein the impeller comprises a jacket section, the jacket section comprising an inner surface comprising a first constant radius from a longitudinal axis; wherein a flushing inlet is positioned at a first end of the jacket section and the at least one flushing outlet is positioned at a second end of the jacket section opposite the first end, wherein the intermediate space is parallel to the longitudinal axis between the flushing inlet and the at least one flushing outlet.

16. A method for flushing an intermediate space for guiding a flushing fluid flow with a fluid in a bearing device of a heart pump, the method comprising:

providing the intermediate space, the intermediate space comprising at least one flushing inlet for introducing the flushing fluid flow and at least one flushing outlet for discharging the flushing fluid flow, wherein the intermediate space is configured between an impeller which can rotate about an axis of rotation for conveying a pump fluid flow and a stand unit configured to align the impeller about the axis of rotation;

introducing the fluid into the intermediate space through the at least one flushing inlet;

expelling the fluid from the intermediate space through the at least one flushing outlet to at least one first discharge opening by means of a centrifugal force acting upon the fluid in the at least one flushing outlet relative to the axis of rotation, wherein the at least one flushing outlet comprises the at least one first discharge opening for an exit of the flushing fluid flow, wherein the at least one first discharge opening has an opening cross-section in which an opening cross-section normal vector faces away from the axis of rotation and is radial to the axis of rotation, wherein the impeller is disposed in a housing section connected to an inlet hose for supplying the fluid, wherein the housing section comprises at least two second discharge openings for discharging the pump fluid flow, and wherein the opening cross-section normal vector intersects with at the least two second discharge openings of the housing section and is perpendicular to the axis of rotation.

17. A heart pump configured to be delivered to the heart via catheter for pumping blood, the heart pump comprising:

a conduit having a discharge opening and configured to convey blood through the discharge opening into a blood vessel;

an impeller comprising a first magnet and configured to rotate about an axis to convey the blood; and

a support comprising a second magnet and configured to magnetically communicate with the first magnet to rotate the impeller, wherein the impeller and support define an intermediate space therebetween, the intermediate space configured to convey from a flushing inlet to a flushing outlet a portion of the blood conveyed through the conduit, the flushing inlet disposed downstream of the flushing outlet with respect to a direction of flow of the blood conveyed in the conduit, and the flushing outlet extending perpendicular to the axis;

wherein the flushing outlet extends in a direction that intersects the discharge opening of the conduit.

18. The heart pump according to claim 17, wherein the conduit comprises a tubular inlet hose connected to a tubular housing section.

19. The heart pump according to claim 17, wherein the flushing inlet defines a disc-like gap configured to receive blood from a plurality of angular locations about the axis.

20. The heart pump according to claim 17, further comprising a plurality of the flushing outlets defining elongated channels extending through the impeller.

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