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Specification

1. Title of invention

Blood Pump

2. Claims

1. A blood pump that has a periphery of a diaphragm attached to a housing inner circumferential surface so as to divide a blood pump housing into a blood chamber and an air chamber, and circulates blood by pumping the diaphragm in pulses to cause the blood to once flow into the blood chamber and then flow out from the blood chamber,

characterized in that the diaphragm is configured to have a thick peripheral portion and become gradually thinner towards a center portion.

2. The blood pump of claim 1, characterized in that the film thickness of the peripheral portion is 0.2 to 2.0 mm, and the thickness of the center portion is 50 to 90% of the film thickness of the peripheral portion.

3. Detailed Description of Invention

(Industrial Applicability)

[0001]

The present invention relates to a diaphragm type blood pump used in the field of cardiac surgeries.

(Background Art)

[0002]

In recent years, in the field of cardiac surgeries, a circulation assisting method that assists blood circulation during surgery and the like is being employed, and for example, an application of an intra-aortic balloon pumping method or a veno-arterial bypassing method on seriously ill heart disease patients may save the lives of such patients. However, for patients of heart failures who had gone into a serious condition by acute myocardial infarction or during open heart surgeries, problems are present in that the aforementioned intra-aortic balloon pumping method would not be effective due to the limit cast on its circulation

assisting performance, and with the veno-arterial bypassing method, a large amount of anticoagulant must be used, which results in the presence of bleeding tendency, and occurrences of dysfunctions in other organs, or the like.

[0003]

As a substitute to the intra-aortic balloon pumping method and the veno-arterial bypassing method having such problems, a method of using an auxiliary artificial heart is recently being employed. A blood pump of the auxiliary artificial heart has the ability to take over partial or entire cardiac function of a patient who has gone into even a more serious condition of heart failure due to acute myocardial infarction or post-operational cardiogenic shock after the open heart surgery.

[0004]

A conventional blood pump for the auxiliary artificial heart has a diaphragm with a uniform thickness that divides an inside of an oval-spherical blood pump main body into two chambers, namely a blood chamber and an air chamber, where the blood chamber is provided therein with a blood inflow tube that allows the body blood to flow into the blood chamber and a blood outflow tube that allows the blood in the blood chamber to circulate in the body. A contraflow-preventing valve for preventing the blood in the blood chamber from adversely flowing into the blood inflow tube is installed between the blood inflow tube and the blood chamber being the housing, and a contraflow-preventing valve for preventing the blood in the blood outflow tube from adversely flowing into the blood chamber is installed between the blood outflow tube and the blood chamber.

[0005]

In such a conventional blood pump, the blood chamber first is inflated by sucking the diaphragm into the air chamber by discharging the air in the air chamber, and introducing the blood into the blood chamber via the blood inflow tube from within the body. Then, air is supplied to the air chamber to press the diaphragm into the blood chamber, whereby the blood chamber contracts to guide the blood in the blood chamber into the blood outflow tube. Accordingly, the air supply to the air chamber and the air discharge from the air chamber are repeated to pump the diaphragm in pulses to circulate the blood.

(Problem Aimed to be Solved by Invention)

[0006]

In the conventional blood pump, the pulsing diaphragm has the unique film thickness. Due to this, a large negative pressure must be applied to the diaphragm for sucking a center portion of the diaphragm having the same thickness as its peripheral portion toward an air chamber side upon inflating the blood chamber to introduce blood flow into the blood chamber. With such an increased negative pressure, there is a risk that the blood might flow into the blood chamber in a surge, as a result of which blood emissary speed may become large, and hemolysis may occur. With a unique film thickness for the diaphragm, stress applied to the diaphragm accumulates locally upon pulsing the diaphragm, and the diaphragm is pumped in pulses in a state of being undulated. As a result of this, the portions where the stress in the diaphragm is accumulated has lower durability, and breakage may occur from that portion. Further, when the diaphragm is rippled, there is also a risk that a part of the blood stagnates in the blood chamber. With such stagnation of blood in the blood chamber, anti-coagulant performance would be lost, and there would be higher chances of blood clots.

[0007]

The present invention solves the above conventional problems, and aims to provide a blood pump with high durability, and that can pump its diaphragm in pulses by a relatively small driving force, as a result achieving less risk for undulation of the diaphragm upon being pulsed, thus maintaining its anti-coagulant performance, and that has no risk of hemolysis.

(Means for Solving Problem)

[0008]

The present invention is a blood pump that has a periphery of a diaphragm attached to a housing inner circumferential surface so as to divide a blood pump housing into a blood chamber and an air chamber, and circulates blood by pumping the diaphragm in pulses to cause the blood to once flow into the blood chamber and then flow out from the blood chamber, characterized in that the diaphragm is configured to have a thick peripheral portion and become gradually thinner towards a center portion, by which the above aims are fulfilled.

(Embodiment)

[0009]

Hereinbelow the present invention will be described with reference to drawings.

As shown in FIG. 1 and FIG. 2, the blood pump of the present invention includes an oval-spherical housing 10, and a semispherical diaphragm 20 that divides the inside of a blood pump main body.

[0010]

The housing 10 is provided with a blood inflow tube part 11a (shown only in FIG. 1) and a blood outflow tube part 11b (shown only in FIG. 2) projecting therefrom, and includes a semispherical main body part 11 that configures an outer shell of a blood chamber 14, and a back plate part 12 that configures an outer shell of an air chamber 15 by being joined with a peripheral portion of the main body 11 in an airtight manner.

At least an inner circumferential surface of the main body part 11 of the housing 10 is formed of an anti-coagulant polymer material. Thus, an entirety of the main body 11 is formed for example of the anti-coagulant polymer material, or is formed of plastic and have its inner circumferential surface covered by the anti-coagulant polymer material.

[0011]

An outer peripheral edge of a diaphragm 20 formed in a semispherical shape by the anti-coagulant polymer material is attached airtight to the inner circumferential surface on the peripheral part of the main body part 11 of the housing 10, and it is formed integral with the anti-coagulant polymer material of the inner circumferential surface of the main body part 11. The diaphragm 20 divides the inside of the housing 10 into the blood chamber 14 and the air chamber 15.

[0012]

As shown in FIG. 1, the blood inflow tube part 11a provided projecting from the main body part 11 of the housing 10 has a blood inflow tube 31 connected thereto. The blood inflow tube part 11a is provided with a contraflow-preventing valve 11c that is opened only when blood flows into the blood chamber 14 of the housing 10 from the blood inflow tube 31, and prevents the blood from flowing out into the blood inflow tube 31 from the

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