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SUPPLEMENTARY EUROPEAN SEARCH REPORT

Application number:
EP 18 80 96 22

Classification of the application (IPC):
A61M 1/10, ***A61M 1/12***, ***A61N 1/362***, ***F04D 13/16***, ***F04D 13/06***, ***F04D 29/043***, ***F04D 29/048***, ***F04D 29/22***

Technical fields searched (IPC):
A61M

DOCUMENTS CONSIDERED TO BE RELEVANT		
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim
	No further relevant documents disclosed	

The supplementary search report has been based on the last set of claims valid and available at the start of the search.

Place of search	Date of completion of the search	Examiner
The Hague	17 December 2020	Martin Amezaga, J

CATEGORY OF CITED DOCUMENTS

X: particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
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LACK OF UNITIY OF INVENTION

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

1. claims: 1-8
A mechanical circulatory support for assisting the heart, the support comprising: a casing comprising a main body, an inlet configured to introduce blood flow from an upstream portion of a human aorta into the main body, and an outlet configured to return the blood flow from the main body to a downstream portion of the human aorta; an impeller positioned within an internal volume of the main body of the casing so as to receive blood flow from the inlet, the direction of the received blood flow defining a longitudinal axis, wherein the impeller comprises a plurality of blades for pumping blood, the blades being arranged around the longitudinal axis so as to define an outer circumference, and wherein the impeller is configured to rotate around the longitudinal axis to pump the blood in a centrifugal manner toward the outer circumference; and a diffuser integral with or joined to the casing, the diffuser configured to receive blood outflow from the impeller and direct the blood flow to the outlet, wherein the diffuser is at least partially open the internal volume of the main body of the casing along at least a portion of the outer circumference of the impeller.

1.1. claims: 1-3
A mechanical circulatory support for assisting the heart, the support comprising: a casing comprising a main body, an inlet configured to introduce blood flow from an upstream portion of a human aorta into the main body, and an outlet configured to return the blood flow from the main body to a downstream portion of the human aorta; an impeller positioned within an internal volume of the main body of the casing so as to receive blood flow from the inlet, the direction of the received blood flow defining a longitudinal axis, wherein the impeller comprises a plurality of blades for pumping blood, the blades being arranged around the longitudinal axis so as to define an outer circumference, and wherein the impeller is configured to rotate around the longitudinal axis to pump the blood in a centrifugal manner toward the outer circumference; and a diffuser integral with or joined to the casing, the diffuser configured to receive blood outflow from the impeller and direct the blood flow to the outlet, wherein the diffuser is at least partially open the internal volume of the main body of the casing along at least a portion of the outer circumference of the impeller, wherein the impeller is a shrouded impeller comprising: an blade passage chamber; an upper portion forming a ceiling to the blade passage chamber, the upper portion having an upper channel extending along the longitudinal axis from a top of the impeller to the blade passage chamber; and a lower portion forming a floor to the blade passage chamber, the lower portion having a lower channel extending along the longitudinal axis from the bottom of the impeller to the blade passage chamber, wherein the blades extend from an inner circumference around the longitudinal axis to the outer circumference, the blades extending axially between the floor and the ceiling of the blade passage chamber to join the upper portion and the lower portion together.

1.2. claims: 4-7
A mechanical circulatory support for assisting the heart, the support comprising: a casing comprising a main body, an inlet configured to introduce blood flow from an upstream portion of a human aorta into the main body, and an outlet configured to return the blood flow from the main body to a downstream portion of the human aorta; an impeller positioned within an internal volume of the main body of the casing so as to receive blood flow from the inlet, the direction of the received blood flow defining a longitudinal axis, wherein the impeller comprises a plurality of blades for pumping blood, the blades being arranged around the longitudinal axis so as to define an outer circumference, and wherein the impeller is configured to rotate around the longitudinal axis to pump the blood in a centrifugal manner toward the outer circumference; and a diffuser integral with or joined to the casing, the diffuser configured to receive blood outflow from the impeller and direct the blood flow to the outlet, wherein the diffuser is at least partially open the internal volume of the main

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body of the casing along at least a portion of the outer circumference of the impeller, wherein the impeller is magnetically suspended in an axial direction within the casing by a combination of axial-suspension permanent magnets coupled to a top half and a bottom half of the casing and permanent magnets positioned coupled to a top half and a bottom half of the impeller, the axial-suspension permanent magnets coupled to the top half of the casing being axially spaced apart from the permanent magnets coupled to the top half of the impeller and the axial-suspension permanent magnets coupled to the bottom half of the casing being axially spaced apart from the permanent magnets coupled to the bottom half of the impeller, and wherein the impeller is magnetically suspended in a radial direction within the casing by a radial-suspension permanent magnet coupled to the casing near the permanent magnet in the top half of the impeller and by a radial-suspension permanent magnet coupled to the casing near the permanent magnet in the bottom half of the impeller.

1.3. claim: 8
A mechanical circulatory support for assisting the heart, the support comprising: a casing comprising a main body, an inlet configured to introduce blood flow from an upstream portion of a human aorta into the main body, and an outlet configured to return the blood flow from the main body to a downstream portion of the human aorta; an impeller positioned within an internal volume of the main body of the casing so as to receive blood flow from the inlet, the direction of the received blood flow defining a longitudinal axis, wherein the impeller comprises a plurality of blades for pumping blood, the blades being arranged around the longitudinal axis so as to define an outer circumference, and wherein the impeller is configured to rotate around the longitudinal axis to pump the blood in a centrifugal manner toward the outer circumference; and a diffuser integral with or joined to the casing, the diffuser configured to receive blood outflow from the impeller and direct the blood flow to the outlet, wherein the diffuser is at least partially open the internal volume of the main body of the casing along at least a portion of the outer circumference of the impeller, wherein the support further comprises a motor for electromagnetically rotating the impeller around the axial direction, the motor comprising a stator within the casing comprising a plurality of electromagnets; and a rotor within the impeller comprising a plurality of permanent drive magnets, the rotor configured to be positioned concentrically within the stator.

2. claims: 9-14
A mechanical circulatory support for assisting the heart, the support comprising: a casing comprising a main body, an inlet configured to introduce blood flow from an upstream portion of a human aorta into the main body, and an outlet configured to return the blood flow from the main body to a downstream portion of the human aorta; an impeller positioned within an internal volume of the main body of the casing so as to receive blood flow from the inlet, the direction of the received blood flow defining a longitudinal axis, wherein the impeller comprises a plurality of blades for pumping blood, the blades being arranged around the longitudinal axis so as to define an outer circumference, and wherein the impeller is configured to rotate around the longitudinal axis to pump the blood in a centrifugal manner toward the outer circumference; and a diffuser integral with or joined to the casing, the diffuser configured to receive blood outflow from the impeller and direct the blood flow to the outlet, wherein the diffuser is at least partially open the internal volume of the main body of the casing along at least a portion of the outer circumference of the impeller, wherein the blood flow is redirected toward an axial direction prior to reaching the outlet, such that the outlet is substantially collinear with the inlet.

3. claim: 15
A mechanical circulatory support for assisting the heart, the support comprising: a casing comprising a main body, an inlet configured to introduce blood flow from an upstream portion of a human aorta into the main body, and an outlet configured to return the blood flow from the main body to a downstream portion of the human aorta; an impeller positioned within an internal volume of the main body of the casing so as to receive

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blood flow from the inlet, the direction of the received blood flow defining a longitudinal axis, wherein the impeller comprises a plurality of blades for pumping blood, the blades being arranged around the longitudinal axis so as to define an outer circumference, and wherein the impeller is configured to rotate around the longitudinal axis to pump the blood in a centrifugal manner toward the outer circumference; and a diffuser integral with or joined to the casing, the diffuser configured to receive blood outflow from the impeller and direct the blood flow to the outlet, wherein the diffuser is at least partially open the internal volume of the main body of the casing along at least a portion of the outer circumference of the impeller, wherein a portion of a surface of the internal volume of the main body of the casing and/or a portion of an outer surface of the impeller comprises spiraling grooves configured to facilitate secondary flow paths of blood between the impeller and the casing.

Please note that all inventions mentioned under item 1, although not necessarily linked by a common inventive concept, could be searched without effort justifying an additional fee.

None of the further search fees have been paid within the fixed time limit. The present (supplementary) European search report has been drawn up for those parts of the European patent application which relate to the first mentioned in the claims, namely claims: 1-8

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