

We Claim:

1. A heart pump assembly comprising:
 - an elongate catheter having a proximal portion and a distal portion;
 - a rotor disposed at the distal portion of the elongate catheter, the rotor having
5 an impeller blade, wherein the impeller blade is shaped to induce fluid flow in a first axial direction when the rotor is rotated in a first rotational direction;
 - a drive shaft coupled to the rotor, the drive shaft including a pump element formed on a surface of the drive shaft at the distal portion of the elongate catheter; and
 - a bearing disposed at the distal portion of the elongate catheter and having a
10 bore into which the drive shaft extends;
 - wherein, when the distal portion of the elongate catheter is inserted into a patient and the rotor is rotated in the first rotational direction, the pump element is shaped to induce fluid flow through the bore and into the patient in a second axial direction.
- 15 2. The heart pump assembly of claim 1, wherein the second axial direction is opposite to the first axial direction.
3. The heart pump assembly of claim 1, wherein the second axial direction is
20 substantially the same as the first axial direction.
4. The heart pump assembly of any of the preceding claims, wherein a fluid supply line is in fluid communication with the bore, and wherein the pump element is configured to draw fluid from the fluid supply line through the bore.
- 25 5. The heart pump assembly of any of the preceding claims, wherein the bearing is a sleeve bearing, and the pump element is disposed in a bearing gap between the drive shaft and the bearing.
- 30 6. The heart pump assembly of claim 5, wherein the bearing gap between the drive shaft and the bearing is in a range of 5-15 microns.
7. The heart pump assembly of any of the preceding claims, wherein the pump element is shaped as a groove on the surface of the drive shaft.

8. The heart pump assembly of claim 7, wherein the groove on the surface of the drive shaft is angled with respect to a longitudinal axis of the drive shaft.
- 5 9. The heart pump assembly of claims 1-6, wherein the pump element is shaped as a protrusion on the surface of the drive shaft.
- 10 10. The heart pump assembly of any of the preceding claims, wherein the heart pump assembly is configured such that a ratio of a flow rate of the fluid flow in the second axial direction to a flow rate of the fluid flow in the first axial direction is about 0.002% or less.
- 15 11. The heart pump assembly of any of the preceding claims, wherein the heart pump assembly is configured such that a flow rate of the fluid flow in the first axial direction is 2-5 liters per minute (lpm).
- 20 12. The heart pump assembly of any of the preceding claims, wherein the heart pump assembly is configured such that a flow rate of the fluid flow in the second axial direction is 2-30 cc/hr.
- 25 13. The heart pump assembly of any of the preceding claims, wherein the drive shaft is coupled to a motor.
14. The heart pump assembly of any of the preceding claims, further comprising a pump housing enclosing the rotor and bearing.
- 30 15. The heart pump assembly of claim 14, wherein the pump assembly is sized for percutaneous insertion.
16. The heart pump assembly of claim 15, further comprising:
a blood outlet positioned proximal to a proximal end of the pump housing;
and
a blood inlet positioned at a distal end portion of a cannula of the pump assembly.

17. The heart pump assembly of claim 15, further comprising:

a blood outlet positioned at a distal end portion of a cannula of the pump assembly;

and

5 a blood inlet positioned proximal to a proximal end of the pump housing.