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**Gourlay**

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(54) **INTEGRATED PERFUSION DEVICE**

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See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,306,018 A \* 12/1981 Kirkpatrick ..... 435/2  
4,490,331 A 12/1984 Steg, Jr.

(Continued)

FOREIGN PATENT DOCUMENTS

EP 1464350 A1 10/2004  
EP 1624912 A2 2/2006

(Continued)

OTHER PUBLICATIONS

Japan Patent Office, Office Action Summary for Application No. 2013-521207, 1 page, Apr. 21, 2015, Japan.

(Continued)

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(57) **ABSTRACT**

An integrated perfusion apparatus or device for use in e.g. extracorporeal membrane oxygenation, cardiopulmonary bypass, or isolated organ or limb perfusion, comprises a blood pump for circulating blood through the device; a blood oxygenator for oxygenating blood, and at least one heat control unit capable of controlling and/or regulating blood temperature within the device, wherein the at least one heat control unit comprises at least one solid state heating and/or cooling source, such as at least one Peltier device. The invention also relates to a method of performing perfusion on a patient, limb or organ, comprising using the perfusion device.

**15 Claims, 26 Drawing Sheets**

