(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
4 November 2010 (04.11.2010)

PCT

(10) International Publication Number
WO 2010/125017 A1

(51) International Patent Classification:
F28D 1/047 (2006.01) *F28F 1/02* (2006.01)
F28D 7/02 (2006.01) *F24H 1/43* (2006.01)

(21) International Application Number:
PCT/EP2010/055512

(22) International Filing Date:
26 April 2010 (26.04.2010)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
PD2009A000111 27 April 2009 (27.04.2009) IT

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(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Declarations under Rule 4.17:

— *of inventorship (Rule 4.17(iv))*

[Continued on next page]

(54) Title: MICROCHANNEL EXCHANGER

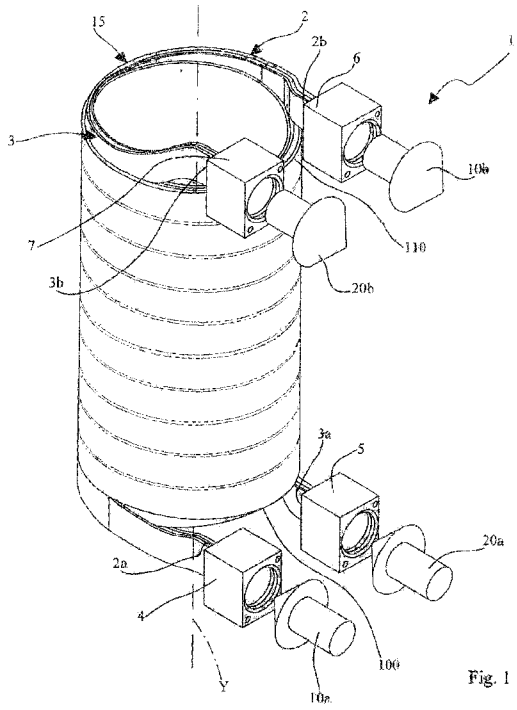

Fig. 1

(57) Abstract: A microchannel exchanger comprises a first and a second plurality of microchannels, each one connected by a respective inlet manifold and a respective outlet manifold; the microchannels are wound in respective helixes about a winding axis and, in a plan view perpendicular to the winding axis, the first plurality of microchannels extends from the respective inlet manifold to the respective outlet manifold in a clockwise direction about said winding axis and the second plurality of microchannels extends from the respective inlet manifold to the respective outlet manifold in an anticlockwise direction about said winding axis.

WO 2010/125017 A1

Published:

— *with international search report (Art. 21(3))*

MICROCHANNEL EXCHANGER

Technical field

The subject of the present invention is a microchannel exchanger of the type including the features mentioned in the preamble of the main claim.

The present invention lends itself particularly, although not exclusively, to application in exchangers with reduced power, of less than 5 kW.

Technological background

In the field of heat exchangers it is known to provide thermal exchange elements having a high thermal efficiency which comprise two or more pluralities of rectilinear passages of the microchannel type, parallel to one another, and traversed by two or more fluids in thermal contact with one another.

In addition, since low-powered exchangers typically serve thermal machines or installations of reduced dimensions, it is required that the exchangers also have reduced overall dimensions and compact shapes, unlike typical microchannel implementations, which are characterized by a predominant overall dimension in a predominant longitudinal direction.

Description of the invention

The principal aim of the present invention is to provide a microchannel exchanger which is structurally and functionally designed to remedy the drawbacks mentioned with reference to the prior art cited, in such a manner as to be effectively usable for applications which require compact geometries and reduced overall dimensions.

This aim and others which will become clear hereinafter are confronted and achieved by the invention by means of a microchannel exchanger produced

in accordance with the following claims.

Brief description of the drawings

The features and advantages of the invention will become clearer from the detailed description of a preferred exemplary embodiment thereof, illustrated by way of non-limiting example with reference to the appended drawings, in which:

- Figure 1 is an axonometric view of a microchannel exchanger produced according to the invention;
- Figure 2 is a plan view from above of the exchanger of Figure 1,
- Figure 3 is an axonometric view of a detail of the exchanger of Figure 1.

Preferred embodiments of the invention

With reference to the above-mentioned drawings, a microchannel exchanger is indicated as a whole by 1.

The exchanger 1 comprises a first plurality of microchannels 2, parallel to one another, and a second plurality of microchannels 3, parallel to one another. Each of the pluralities of microchannels 2, 3 is provided with respective longitudinal ends for inlet 2a, 3a and outlet 2b, 3b and is respectively traversable by a first and a second heat exchange fluid, which are shown schematically in Figure 1 by the arrows 10a, 10b and 20a, 20b, respectively. The arrows 10a, 10b respectively represent the inlet and the outlet of the first heat exchange fluid in the exchanger 1, while the arrows 20a, 20b respectively represent the inlet and the outlet of the second heat exchange fluid in the exchanger 1.

The longitudinal inlet ends 2a, 3a of the plurality of channels 2, 3 are

connected to a respective inlet manifold 4, 5. The longitudinal outlet ends 2b, 3b are connected to a respective outlet manifold 6, 7. The inlet and outlet manifolds 4, 5, 6 and 7 are of conventional type in shape and dimensions, commonly available on the market.

The first heat exchange fluid traverses the first plurality of microchannels 2 from the inlet manifold 4 to the outlet manifold 6; the second heat exchange fluid traverses the second plurality of microchannels 3 from the inlet manifold 5 to the outlet manifold 7.

The two pluralities of microchannels 2, 3 are wound in respective helixes about a winding axis Y in such a manner that, in a plan view (Figure 2) perpendicular to the winding axis Y, the first plurality of microchannels 2 extends from the inlet manifold 4 to the outlet manifold 6 in a clockwise direction about the axis Y and the second plurality of microchannels extends from the inlet manifold 5 to the outlet manifold 7 in an anticlockwise direction about the same axis Y.

Each of the two pluralities of channels 2, 3 comprises two multiport tubes 11a,b, 12a,b, respectively. Each of the multiport tubes 11a,11b and 12a,12b has a cross-section flattened along a respective flattening axis X which is orientated in the exchanger 1 so as to be approximately parallel to the winding axis Y.

The tubes of each pair of multiport tubes 11a, 11b and 12a, 12b are parallel to each other and disposed so that, in the plan view of Figure 2, they are interposed between the tubes of the other pair.

In other alternative embodiments of the invention (not shown) each plurality of microchannels comprises three or more multiport tubes

interposed between the multiport tubes of the other plurality of microchannels.

The exchanger 1 is thus formed of helixes of multiport tubes, wound coaxially about the axis Y and with turns that are alongside one another so as to form a cylindrical wall 15, having a longitudinal axis coinciding with the axis Y. The exchanger 1 comprises a first and a second axial end 100, 110, opposed to each other and placed respectively at the opposed bases of the cylindrical wall 15.

The cylindrical wall 15 comprises a plurality of adjacent layers (four layers 15a,b,c,d in the example in the drawings), each corresponding to a respective multiport tube. In the example in the appended drawings, the first, outer layer 15a is formed by the helical winding of the multiport tube 11a, the second layer 15b is formed by the helical winding of the multiport tube 12a, the third layer 15c is formed by the helical winding of the multiport tube 11b and the fourth, inner layer 15d, facing towards the axis Y, is formed by the helical winding of the multiport tube 12b.

The microchannels 2, 3 are wound about the axis Y in such a manner that the inlet manifolds 4, 5 are placed at the first axial end 100 of the exchanger 1 and the outlet manifolds 6, 7 are placed at the second axial end 110 of the exchanger 1.

In an alternative version of the invention (not shown) the microchannels 2, 3 are wound about the axis Y in such a manner that the inlet manifold 4 and the outlet manifold 7 are placed at the first axial end 100 of the exchanger 1 and the inlet manifold 5 and the outlet manifold 6 are placed at the second axial end 110 of the exchanger 1.

In both the cases described above, at each of the axial ends 100, 110, two inlet and/or outlet manifolds are placed in positions spaced apart along the edge of the respective base of the wall 15. This configuration, made possible by the fact that the two pluralities of microchannels 2, 3 are wound about the axis Y in opposite winding directions, makes it possible to use standard type manifolds commonly available on the market, and to avoid the use of dedicated manifolds.

A method of manufacturing the exchanger 1 comprises the following successive steps of:

a. arranging the multiport tubes 11a, 11b and 12a, 12b of flattened cross-section along the flattening axis X, so as to obtain the respective pluralities of microchannels 2 and 3,

b. winding the multiport tube 12b in a helix about the winding axis Y, from the end 100 to the end 110 of the exchanger 1, with the turns of the helix alongside one another so as to form the layer 15d of the cylindrical wall 15. The multiport tube 12b is disposed so that the axes X and Y are parallel to each other. In the plan view in Figure 2 the multiport tube 12b is wound in an anticlockwise direction about the axis Y,

c. winding the multiport tube 11b in a helix about the winding axis Y from the end 100 to the end 110 of the exchanger 1, so that the axes X and Y are parallel to each other and the turns of the helix are alongside one another, so as to form the layer 15c adjacent to the layer 15d. In the plan view in Figure 2, the multiport tube 11b is wound in a clockwise direction about the axis Y. At the ends 100,

110 of the exchanger 1, the ends of the multiport tubes 11b and 12b are disposed so as to be spaced apart from each other,

d. winding the multiport tube 12a in a helix about the winding axis Y so that the axes X and Y are parallel to each other and the turns of the helix are alongside one another, so as to form the layer 15b of the cylindrical wall 15, adjacent to the layer 15c. The tubes 12a, 12b are wound in such a manner as to be parallel to each other. In the plan view in Figure 2 the multiport tube 12a is wound in an anticlockwise direction about the axis Y,

e. winding the multiport tube 11a in a helix about the winding axis Y so that the axes X and Y are parallel to each other and the turns of the helix are alongside one another, so as to form the outermost layer 15a of the cylindrical wall 15, adjacent to the layer 15b. The tubes 11a, 11b are wound in such a manner as to be parallel to each other. In the plan view in Figure 2 the multiport tube 11a is wound in a clockwise direction about the axis Y,

f. connecting the inlet manifold 4 to the inlet end 2a of the multiport tubes 11a, 11b and the outlet manifold 5 to the outlet end 2b of the multiport tubes 11a, 11b,

g. connecting the inlet manifold 5 to the inlet end 3a of the multiport tubes 12a, 12b and the outlet manifold 7 to the outlet end 3b of the multiport tubes 12a, 12b.

The invention thus solves the problem mentioned with reference to the prior art cited, making it possible to obtain low-powered microchannel exchangers of compact dimensions and simple construction while at the

same time allowing the production costs to be contained.

Moreover, the fact that, at each of the axial ends 100, 110 of the exchanger, the inlet and outlet manifolds are spaced apart from one another, facilitates the connection of the exchanger to the installation into which it is being inserted.

The exchanger lends itself particularly, although not exclusively, to heat exchange between gases and/or compressed gases, for example compressed air, or to exchange between a working fluid and a cooling gas (evaporator or condenser).

An example of use for the exchanger described above is that of a pre-exchange circuit in an air dehumidifier, in which the first heat exchange fluid is hot moist air and the second heat exchange fluid is dry cool air.

C L A I M S

1. Microchannel exchanger comprising a first and a second plurality of microchannels, each of said pluralities being connected to a respective inlet manifold and a respective outlet manifold, characterized in that said microchannels are wound in respective helixes about a winding axis and that, in a plan view perpendicular to said winding axis, one of said first and said second plurality of microchannels extends from the respective inlet manifold to the respective outlet manifold in a clockwise direction about said winding axis, and the other of said first and said second plurality of microchannels extends from the respective inlet manifold to the respective outlet manifold in an anticlockwise direction about said winding axis.

2. Exchanger according to claim 1, wherein the microchannels of each of said pluralities are parallel to one another.

3. Exchanger according to claim 1 or 2, wherein at least one of said pluralities comprises a multiport tube.

4. Exchanger according to claim 3, wherein each of said pluralities of microchannels comprises two or more multiport tubes with cross-section flattened along a flattening axis which is orientated approximately parallel to said winding axis.

5. Exchanger according to claim 4 wherein, in said plan view perpendicular to the winding axis, the multiport tubes comprised in each plurality of microchannels are interposed with the multiport tubes comprised in the other plurality of microchannels.

6. Exchanger according to any one of the preceding claims, wherein the

inlet manifolds of said first and said second plurality are placed at a first axial end of said exchanger, and the outlet manifolds of said first and said second plurality are placed at a second axial end of said exchanger which is opposed to said first axial end.

7. Exchanger according to any one of claims 1 to 5, wherein the inlet manifold of said first plurality and outlet manifold of said second plurality are placed at a first axial end of said exchanger, and the inlet manifold of said second plurality and outlet manifold of said first plurality are placed at a second axial end of said exchanger which is opposed to said first axial end.

8. Exchanger according to one or more of the preceding claims, wherein at each of the axial ends of said exchanger two inlet and/or outlet manifolds are placed in positions spaced apart from each other.

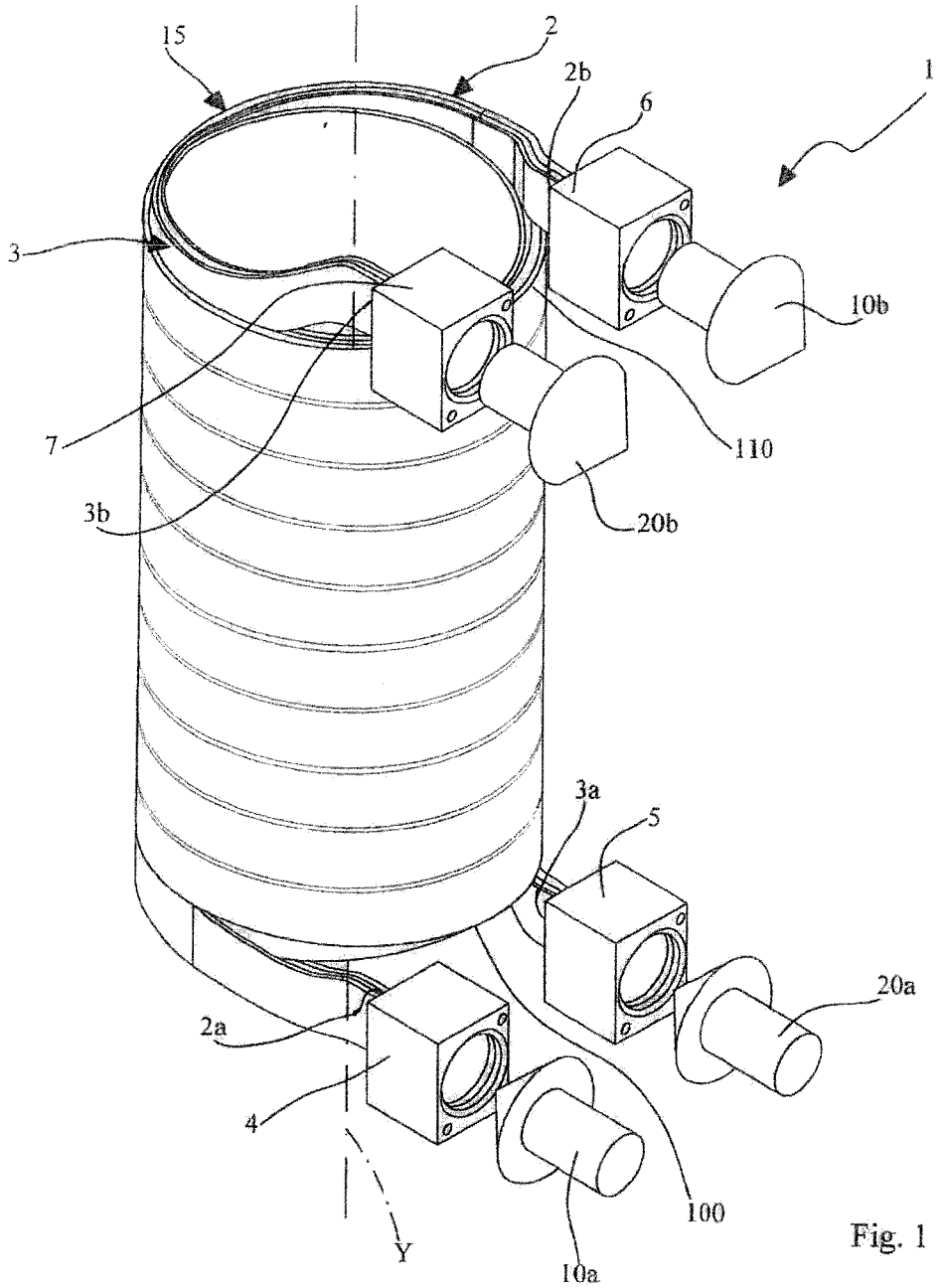

Fig. 1

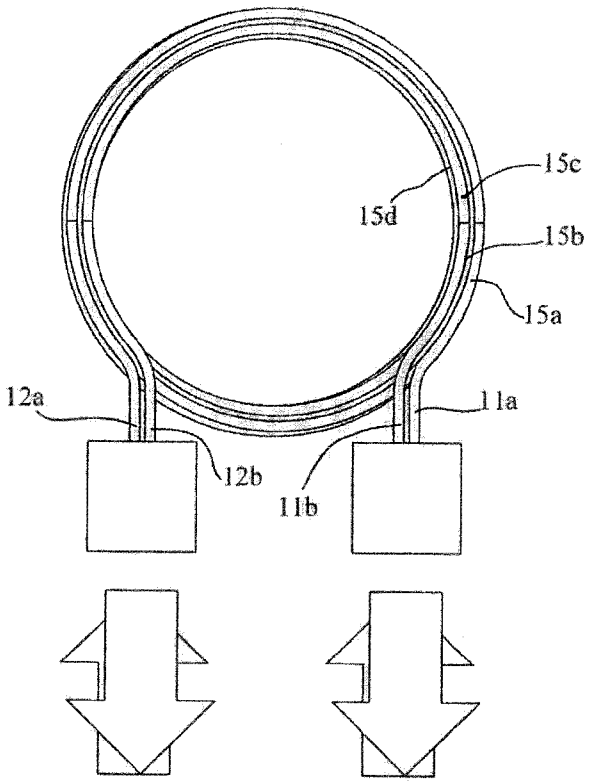

Fig. 2

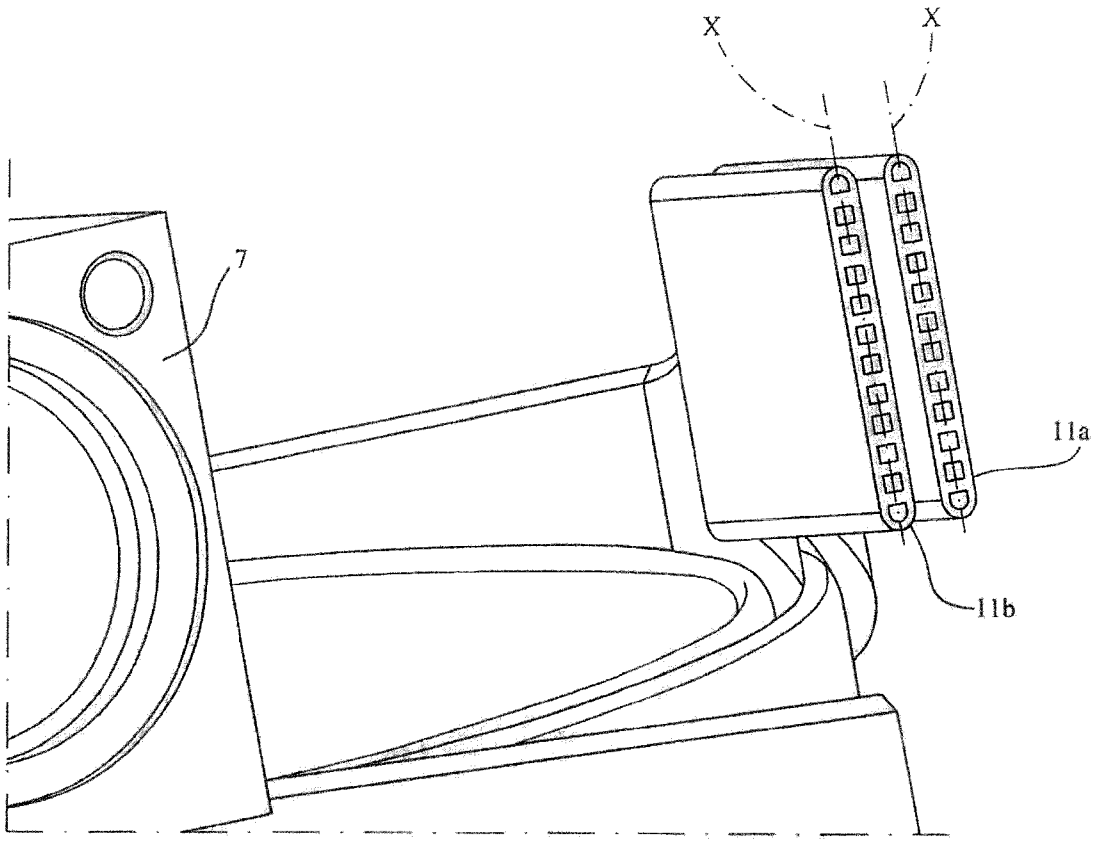

Fig. 3

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2010/055512

A. CLASSIFICATION OF SUBJECT MATTER
INV. F28D1/047 F28D7/02 F28F1/02 F24H1/43
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
F28D F28F F24H

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	JP 2003 254684 A (ATAGO SEISAKUSHO) 10 September 2003 (2003-09-10) paragraph [0008] - paragraph [0009]; figures 5-7	1-5,7,8 6
Y	US 2004/154312 A1 (ABRAS ALEXEI D [US]) 12 August 2004 (2004-08-12) figure 1	6
A	DE 87 12 814 U (VIA GESELLSCHAFT FÜR VERFAHRENSTECHNIK MBH) 19 January 1989 (1989-01-19) figure 2	1
A	DE 10 2007 023672 A1 (INST LUFT UND KAELTETECHNIK GG [DE]) 27 November 2008 (2008-11-27) figures 1-3	1

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[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
7 July 2010	27/07/2010

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Vassoille, Bruno

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INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2010/055512

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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Form PCT/ISA/210 (continuation of second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
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