

(19) World Intellectual Property Organization  
International Bureau



(43) International Publication Date  
29 January 2009 (29.01.2009)

(10) International Publication Number  
**WO 2009/013179 A3**

(51) International Patent Classification:

F28D 7/16 (2006.01) F28D 1/04 (2006.01)  
F28F 9/22 (2006.01) F28F 1/02 (2006.01)  
F28D 7/00 (2006.01)

(21) International Application Number:

PCT/EP2008/059235

(22) International Filing Date:

15 July 2008 (15.07.2008)

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data:

PD 2007 A 000250 23 July 2007 (23.07.2007) IT  
08150852.5 30 January 2008 (30.01.2008) EP

(71) Applicant (for all designated States except US): **M.T.A. S.P.A.** [IT/IT]; Via dell'Artigianato, 2, I-35026 Conselve (PD) (IT).

(72) Inventors; and

(75) Inventors/Applicants (for US only): **BERNARDINELLO, Stefano** [IT/IT]; Via Monte Bianco, 27, I-35021 Villatora di Saonara (PD) (IT). **BOTTAZZO, Andrea**

[IT/IT]; Via Magenta, 12, I-35020 Ponte San Nicolò (PD) (IT).

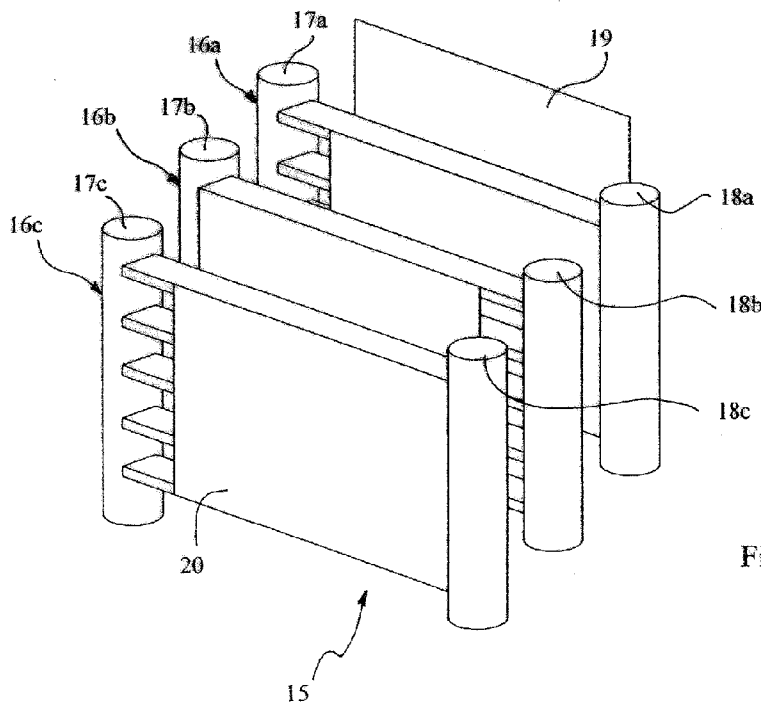
(74) Agents: **CANTALUPPI, Stefano** et al.; Cantaluppi & Partners s.r.l., Via Matteotti, 26, I-35137 Padova (IT).

(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, 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, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, 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, 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, MT, NL, NO, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

[Continued on next page]

(54) Title: HEAT EXCHANGER WITH MINI- AND/OR MICRO-CHANNELS AND METHOD FOR ITS CONSTRUCTION



(57) Abstract: A heat exchanger (1), with mini- and/or micro-channels, comprises a plurality of multiport tubes (2), extending between respective manifolds (3, 4) with a substantially longitudinal distribution, mutually spaced by respective interspaces (7), and blocking means between said multiport tubes (2), arranged to delimit in the respective interspaces (7) longitudinal channels (8) intended to be traversed longitudinally by a thermal exchange fluid.

Fig. 3

**Published:**

**(88) Date of publication of the international search report:**  
5 November 2009

- *with international search report (Art. 21(3))*
- *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))*

## INTERNATIONAL SEARCH REPORT

International application No

PCT/EP2008/059235

## A. CLASSIFICATION OF SUBJECT MATTER

INV. F28D7/16 F28F9/22 F28D7/00 F28D1/04 F28F1/02

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)  
F28F F28D B23P

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	JP 2003 314927 A (MATSUSHITA ELECTRIC IND CO LTD) 6 November 2003 (2003-11-06) figures 2-5	1,2
X	JP 2007 017132 A (DENSO CORP) 25 January 2007 (2007-01-25) figures 5-11	1,3
Y		4,8
X	US 2003/178188 A1 (COLEMAN JOHN W [US]) 25 September 2003 (2003-09-25) figures 4b,5	1,3
Y	GB 1 001 095 A (RAMENS PATENTER AB) 11 August 1965 (1965-08-11) figure 1	4,8
	----- -/--	

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

## \* Special categories of cited documents:

\*A\* document defining the general state of the art which is not considered to be of particular relevance

\*E\* earlier document but published on or after the international filing date

\*L\* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

\*O\* document referring to an oral disclosure, use, exhibition or other means

\*P\* document published prior to the international filing date but later than the priority date claimed

\*T\* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

\*X\* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

\*Y\* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

\*Z\* document member of the same patent family

Date of the actual completion of the international search

21 July 2009

Date of mailing of the international search report

16/09/2009

Name and mailing address of the ISA/

European Patent Office, P.B. 5818 Patentlaan 2  
NL - 2280 HV Rijswijk  
Tel. (+31-70) 340-2040,  
Fax: (+31-70) 340-3016

Authorized officer

Martínez Rico, Celia

## INTERNATIONAL SEARCH REPORT

International application No

PCT/EP2008/059235

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2005/038375 A (BEHR GMBH & CO KG [DE]; DEMUTH WALTER [DE]; KOHL MICHAEL [DE]; KOTSCH) 28 April 2005 (2005-04-28)	1-4, 9, 16
Y	page 9, line 23 - page 10, line 9; figures 1, 1a, 1b, 1c, 4	17
X	JP. 2006 200864 A (T RAD CO LTD) 3 August 2006 (2006-08-03) figures 1-10	1, 9
A	WO 2007/037670 A (SEASONAIR M SDN BHD [MY]; LIOW SENG ONG [MY]) 5 April 2007 (2007-04-05) figures 1, 3-12	1, 9
X	JP 2006 200862 A (T RAD CO LTD) 3 August 2006 (2006-08-03) figures 1, 2	1, 10
X	DE 201 18 511 U1 (AUTOKUEHLER GMBH & CO KG [DE]) 14 February 2002 (2002-02-14) abstract; figure 5	1, 10
A	EP 1 203 923 A (AKG THERMOTECHNIK GMBH & CO KG [DE]) 8 May 2002 (2002-05-08) abstract	11-15
A	US 5 709 028 A (KREUTZER JOSEF [DE] ET AL) 20 January 1998 (1998-01-20) figures 1-5	11-15
Y	JP 10 267585 A (DENSO CORP) 9 October 1998 (1998-10-09) figure 8	17
Y	JP 2000 346584 A (DENSO CORP) 15 December 2000 (2000-12-15) figure 4	17
A	US 4 942 654 A (WRIGHT WILLIAM D [US] ET AL) 24 July 1990 (1990-07-24) the whole document	23-29

# INTERNATIONAL SEARCH REPORT

International application No.  
PCT/EP2008/059235

## Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1.  Claims Nos.:  
because they relate to subject matter not required to be searched by this Authority, namely:
  
2.  Claims Nos.:  
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
  
3.  Claims Nos.:  
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

## Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1.  As all required additional search fees were timely paid by the applicant, this international search report covers allsearchable claims.
  
2.  As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.
  
3.  As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:  
  
1-17, 20-29
  
4.  No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

### Remark on Protest

- The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- No protest accompanied the payment of additional search fees.

## FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-8,20-22

These claims relate to a heat exchanger comprising tubes disposed in a plurality of groups side by side, each group comprising a row of multiport tubes extending between an inlet manifold and an outlet manifold. Blocking plates are provided between each row, these blocking plates having apertures to connect each row. Due to the apertures in the blocking plates the fluid circulating in the interspace outside the tubes can reverse the direction of flow (see figures 3 and 4).

---

2. claims: 1-4,9

These claims relate to a heat exchanger divided into a plurality of sections comprising transfer manifolds for transfer between sections (see figures 5 and 7). Due to the transfer manifolds, the fluid circulating outside the tube can pass from one section to the other. This is an alternative solution to the one provided by the invention mentioned above relating to claims 1 to 8.

---

3. claims: 1-4,10-15

These claims relate to a heat exchanger having deformable longitudinal channels (see figures 14-17). By means of these features, the walls of the longitudinal channels are capable of flexing as a result of the pressure of the fluid to be cooled (see page 11, lines 23 to 25 of the description).

---

4. claims: 1-4,9,16-17,23-29

These claims relate to a heat exchanger comprising one insert in which the longitudinal channels are produced in one piece (see figures 6 to 17). These claims also relate to a method of manufacture of a heat exchanger comprising an insert in which the longitudinal channels are produced. Please note that although in the embodiment of figures 14 to 17 the inserts are made of deformable material, according to the structure of the dependent claims and to the other embodiments, the insert does not have to be of deformable material. By means of the insert, several longitudinal channels can be provided in just one piece.

---

5. claims: 1,18,19,30,31

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

These claims relate to a heat exchanger having tubes disposed in a tube bundle and to a method to produce it. The blocking means in such a heat exchanger are provided by the shell itself. It is noted that the combination of claims 1 and 18 seems already to be known from the available prior art.

---

## INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2008/059235

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
JP 2003314927	A	06-11-2003	NONE	
JP 2007017132	A	25-01-2007	NONE	
US 2003178188	A1	25-09-2003	AU 2003225747 A1 WO 03083395 A1	13-10-2003 09-10-2003
GB 1001095	A	11-08-1965	NONE	
WO 2005038375	A	28-04-2005	AT 427468 T DE 10349150 A1 EP 1682840 A1 JP 2007508519 T KR 20060113897 A US 2007056720 A1	15-04-2009 19-05-2005 26-07-2006 05-04-2007 03-11-2006 15-03-2007
JP 2006200864	A	03-08-2006	NONE	
WO 2007037670	A	05-04-2007	CN 201173710 Y RU 79990 U1	31-12-2008 20-01-2009
JP 2006200862	A	03-08-2006	NONE	
DE 20118511	U1	14-02-2002	NONE	
EP 1203923	A	08-05-2002	AT 334373 T	15-08-2006
US 5709028	A	20-01-1998	DE 4446754 A1 FR 2728492 A1	27-06-1996 28-06-1996
JP 10267585	A	09-10-1998	NONE	
JP 2000346584	A	15-12-2000	NONE	
US 4942654	A	24-07-1990	NONE	