



EUROPEAN PATENT APPLICATION

(43) Date of publication:
30.12.2020 Bulletin 2020/53

(51) Int Cl.:
F28F 9/02 (2006.01)

(21) Application number: **19461548.0**

(22) Date of filing: **26.06.2019**

(84) Designated Contracting States:
**AL AT BE BG CH CY CZ DE DK EE ES FI FR GB
GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO
PL PT RO RS SE SI SK SM TR**
Designated Extension States:
BA ME
Designated Validation States:
KH MA MD TN

- **POKRYWINSKI, Karol**
32 050 SKAWINA (PL)
- **SZOSTEK, Dawid**
32 050 SKAWINA (PL)
- **BENOUALI, Jugurtha**
78322 LE MESNIL SAINT-DENIS CEDEX (FR)

(71) Applicant: **Valeo Autosystemy SP. Z.O.O.**
32-050 Skawina (PL)

(74) Representative: **Bialkowski, Adam**
Valeo Systèmes Thermiques
Industrial Property Department
ZA L'Agiot
8 rue Louis Lormand
CS 80517 LA VERRIERE
78322 Le Mesnil Saint Denis Cedex (FR)

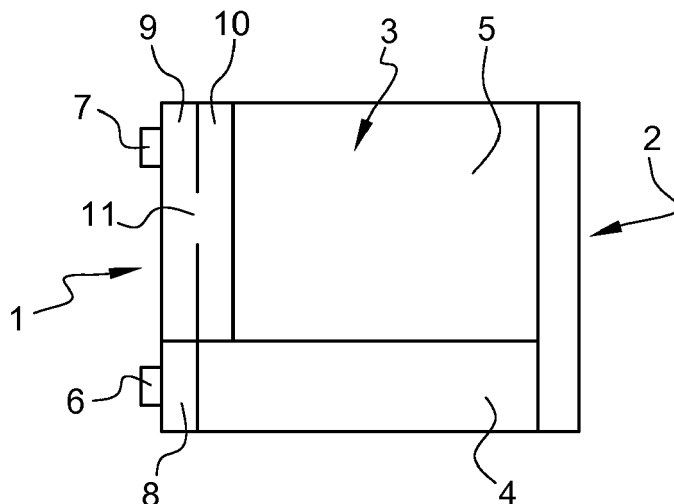
(72) Inventors:
• **BELZOWSKI, Michal**
32 050 SKAWINA (PL)

(54) **HEAT EXCHANGER**

(57) A heat exchanger comprising a first manifold and a second manifold connected by tubes, configured to provide at least two passes for a heat exchange fluid between an inlet port and an outlet port located on either of the manifolds, characterised in that for at least one of the passes, at least one of the manifolds comprises a first section adapted to receive the heat exchange fluid

directly from the tubes, and a second section which is adapted to receive the heat exchange fluid from the tubes through a third section, the third section being adapted to receive the heat exchange fluid directly from the tubes and being arranged in fluid communication with the second section.

Fig. 1



Description

FIELD OF THE INVENTION

[0001] The invention relates to heat exchangers. In particular, it relates to heat exchangers with heat exchange tubes and connection blocks.

BACKGROUND OF THE INVENTION

[0002] Heat exchangers commonly used in the industry usually comprise connection blocks, into which the connecting pipe of the heat exchange system can be connected so that the heat exchange fluid can be supplied to or received from said heat exchanger. Often-times, the placement of the connection blocks on the heat exchanger are predetermined. This may be problematic, as in some cases, the placement of the exit or entry for the heat exchange fluid greatly influences the performance of the heat exchanger. For example, in case of heat exchangers with two manifolds connected by heat exchange tubes, a so-called "dead zones" can occur, wherein the flow of the heat exchange fluid is limited. This can occur especially when the connection block is not placed centrally with respect to given plurality of tubes. Examples of such heat exchangers are a condenser, an evaporator, or an evaporator-condenser, which may function in both heating mode and cooling mode.

[0003] One of the known solutions to this problem is utilization of additional tubing, which receives the heat exchange fluid from the manifold at a place optimal in terms of performance and then directs it to the connection block located elsewhere. However, such additional tubing negatively influences the external dimensioning of the heat exchanger. This may lead to reduction of active area of the core and creation of areas, which cannot be effectively used for heat exchange. Additionally, in some applications it becomes necessary to introduce additional sealing to prevent by-passing of the core by air in those areas.

[0004] It would be desirable to provide a heat exchanger which would allow for optimal performance and at the same time for an unrestricted placement of the inlet/outlet connection block.

SUMMARY OF THE INVENTION

[0005] The object of the invention is, among others, a heat exchanger comprising a first manifold and a second manifold connected by tubes, configured to provide at least two passes for a heat exchange fluid between an inlet port and an outlet port located on either of the manifolds. The heat exchanger is characterised in that for at least one of the passes at least one of the manifolds comprises a first section adapted to receive the heat exchange fluid directly from the tubes, and a second section which is adapted to receive the heat exchange fluid from the tubes through a third section, the third section being

adapted to receive the heat exchange fluid directly from the tubes and being arranged in fluid communication with the second section.

[0006] Preferably, the third section is arranged in parallel to the second section.

[0007] Preferably, the third section is connected fluidically with the second section through a first opening and a second opening.

[0008] Preferably, the first pass is associated with the inlet port, the second pass is associated with the outlet port, and the first opening is located closer to the outlet port than the second opening.

[0009] Preferably, the first opening has a smaller hydraulic diameter than the second opening.

[0010] Preferably, it comprises a third pass between the first pass and the second pass.

[0011] Preferably, the third section receives all the tubes of the second pass.

[0012] Preferably, the third section receives a part of the tubes of the second pass.

[0013] Preferably, the third section receives bottom part of the tubes.

[0014] Preferably, the outlet port is associated with the lower half of the second pass.

[0015] Preferably, the outlet port is associated with the top half of the second pass.

[0016] Preferably, an air-conditioning loop comprises a heat exchanger according to the subject of an invention.

BRIEF DESCRIPTION OF DRAWINGS

[0017] Examples of the invention will be apparent from and described in detail with reference to the accompanying drawings, in which:

Fig. 1 shows a heat exchanger according to the invention in a first example;

Fig. 2 shows a heat exchanger according to the invention in a second example;

Fig. 3 shows a heat exchanger according to the invention in a third example;

Fig. 4 shows a heat exchanger according to the invention in a fourth example;

Fig. 5 shows a heat exchanger according to the invention in a fifth example;

Fig. 6 shows a heat exchanger according to the invention in a sixth example;

Figs. 7a-7b show a plurality of examples of a heat exchanger in a cross-section through a manifold, with openings visible between the second and the third section.

DETAILED DESCRIPTION OF EMBODIMENTS

[0018] Fig. 1 shows a heat exchanger according to the invention in a first example. The heat exchanger comprises a first manifold 1 and a second manifold 2. Manifolds 1, 2 are connected by tubes 3. The heat exchanger further comprises an inlet port 6 and an outlet port 7 located on either of the manifolds 1, 2. In this case, both the inlet port 6 and the outlet port 7 are located on the first manifold 1 - one below the other. The heat exchanger is configured to provide at least two passes 4, 5 for a heat exchange fluid between the inlet port 6 and the outlet port 7. By the term "pass" it is understood a group of tubes 3 located one next to the other, in which the heat exchange fluid flows in the same direction. The heat exchanger further comprises the third section 10 next to the second section 9, preferably in parallel to the second section 9. The third section 10 receives the heat exchange fluid from the tubes 3 comprised in the second pass 5. Further, the third section 10 is in fluid communication with the second section 9 at least through a first opening 11.

[0019] In the embodiment presented in Fig. 2 the second section 9 and the third section 10 are in a fluid communication through the first opening 11 and a second opening 12.

[0020] As shown in Figs 1-6, the first pass 4 is associated with the inlet port 6. Analogically, the second pass 5 is associated with the outlet port 7. The outlet port 7 may be associated either with the lower part of the second pass 5 or with the top half of the second pass 5. In principle, it could also be associated with the middle of the pass 5. The type of association affects how the heat exchange fluid travels across the part of the heat exchanger delimited by the second pass 5.

[0021] In Fig. 2 and 4 the first opening 11 is located closer to the outlet port 7 than the second opening 12. The outlet port 7 is located near the outermost end of the second section 9. However, in some applications, as presented in the Fig. 5, moving the outlet port 7 to the bottom of the second section 9 may be needed. For example, such need may occur when the packaging constrains or deployment of other devices in the engine bay do not allow the outlet port 7 to be located on the outermost end of the second section 9.

[0022] The openings between the second section 9 and the third section 10 may have different hydraulic diameter. This may allow to control the flow between the sections 9 and 10. Preferably, the opening closer to the outlet port 7 has a smaller hydraulic diameter, to promote a more uniform flow of the fluid between the sections.

[0023] For example, in case of the example shown in Fig. 2, the first opening 11 may have a smaller hydraulic diameter than the second opening 12.

[0024] The third section 10 receives all the tubes 3 of the second pass 5, as presented in the Figs 1 and 2. Alternatively, as shown in Fig. 3, the third section 10 re-

ceives only a part of the tubes 3 of the second pass 5. The amount of the tubes 3 received by the third section 10 depends on the desired heat exchanger properties, flow regime, etc. In case when the third section 10 receives the part of the tubes 3 of the second pass 5, the remaining part of the tubes is received by the second section 9.

[0025] The example shown in Fig. 4 differs from the example of Fig. 3 in that there are two openings between the second section 9 and the third section 10. This may promote a more uniform flow of the fluid through the heat exchanger.

[0026] In another example, as presented in the Fig. 5, the third section 10 receives bottom part of the tubes 3. Consequently, the remaining upper part of the tubes 3 is longer than the bottom part of the tubes 3 and they are received by the second section 9.

[0027] In an embodiment presented in the Fig. 6 the heat exchanger comprises a third pass 13 between the first pass 4 and the second pass 5. In this case, the fluid flows first through the first pass 4, then through the third pass 13 and finally through the second pass 3. The third pass 13 is suitable for applications in which the outlet port 7 is desired to be deployed on the opposite side of the heat exchanger. Even in such case, the flow through the second pass 3 is more uniform than if the third section 10 was not applied.

[0028] Figs. 7a-7e show a plurality of examples of a heat exchanger in a cross-section through a manifold, with openings visible between the second section 9 and the third section 10.

[0029] Fig. 7a shows an example, in which the first opening 11 is the only opening providing a fluidal communication of the third section 10 with the second section 9.

[0030] Fig. 7b shows an example, in which there are two openings - the first opening 11 and the second opening 12 providing a fluidal communication of the third section 10 with the second section 9. In this case, they are of the same hydraulic diameter.

[0031] Fig. 7c shows an example, in which there are two openings - the first opening 11 and the second opening 12 providing a fluidal communication of the third section 10 with the second section 9. In this case, the first opening 11 is of a smaller hydraulic diameter than the second opening 12.

[0032] Fig. 7d shows an example, in which besides the first opening 11, the second opening 12 there is a further plurality of openings between the second section 9 and the third section 10. In this case, all of the openings are of the same hydraulic diameter.

[0033] Fig. 7e shows an example, in which besides the first opening 11, the second opening 12 there is a further plurality of openings between the second section 9 and the third section 10. In this case, the hydraulic diameter is progressively increasing from the first opening to the last.

[0034] Compared to classic jumper-line design, the in-

vention allows to eliminate additional components, and the whole assembly is lighter.

[0035] In general, the invention allows mitigating the occurrence of the "dead-zones" within the pass associated with the outlet block, especially when the block is not placed near the center of the pass.

[0036] It should be mentioned that the invention provides analogous benefits when the flow through the inlet/outlets, manifolds and tubes is reversed, i.e. it works in cooling mode. The outlet then becomes an inlet, and the inlet becomes an outlet.

[0037] Other variations to the disclosed embodiments can be understood and effected by those skilled in the art in practicing the claimed invention, from a study of drawings, the disclosure, and the appended claims. The mere fact that certain measures are recited in mutually different dependent claims does not indicate that a combination of these measures cannot be used to the advantage.

Claims

1. A heat exchanger comprising a first manifold 1 and a second manifold 2 connected by tubes 3, configured to provide at least two passes 4, 5 for a heat exchange fluid between an inlet port 6 and an outlet port 7 located on either of the manifolds 1, 2, **characterised in that** for at least one of the passes 4, 5, at least one of the manifolds 1, 2 comprises a first section 8 adapted to receive the heat exchange fluid directly from the tubes 3, and a second section 9 which is adapted to receive the heat exchange fluid from the tubes 3 through a third section 10, the third section 10 being adapted to receive the heat exchange fluid directly from the tubes 3 and being arranged in fluid communication with the second section 9.
2. A heat exchanger according to claim 1, wherein the third section 10 is arranged in parallel to the second section 9.
3. A heat exchanger according to any preceding claim, wherein the third section 10 is connected fluidically with the second section 9 through a first opening 11 and a second opening 12.
4. A heat exchanger according to claim 3, wherein the first pass 4 is associated with the inlet port 6, the second pass 5 is associated with the outlet port 7, and the first opening 11 is located closer to the outlet port 7 than the second opening 12.
5. A heat exchanger according to claim 3 or 4, wherein the first opening 11 has a smaller hydraulic diameter than the second opening 12.
6. A heat exchanger according to any preceding claim, wherein it comprises a third pass 13 between the first pass 4 and the second pass 5.
7. A heat exchanger according to any preceding claim, wherein the third section 10 receives all the tubes 3 of the second pass 5.
8. A heat exchanger according to any of claims 1-6, wherein the third section 10 receives a part of the tubes 3 of the second pass 5.
9. A heat exchanger according to claim 8, wherein the third section 10 receives bottom part of the tubes 3.
10. A heat exchanger according to any preceding claim, wherein the outlet port 7 is associated with the lower half of the second pass 5.
11. A heat exchanger according to any preceding claim, wherein the outlet port 7 is associated with the top half of the second pass 5.
12. An air-conditioning loop comprising a heat exchanger according to any preceding claim.

Fig. 4

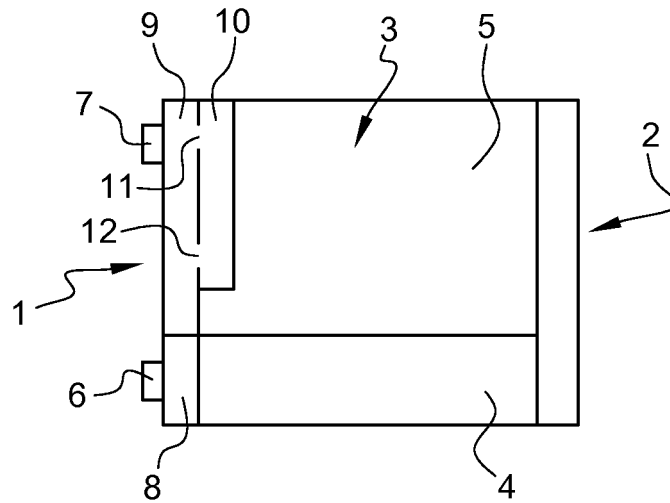


Fig. 5

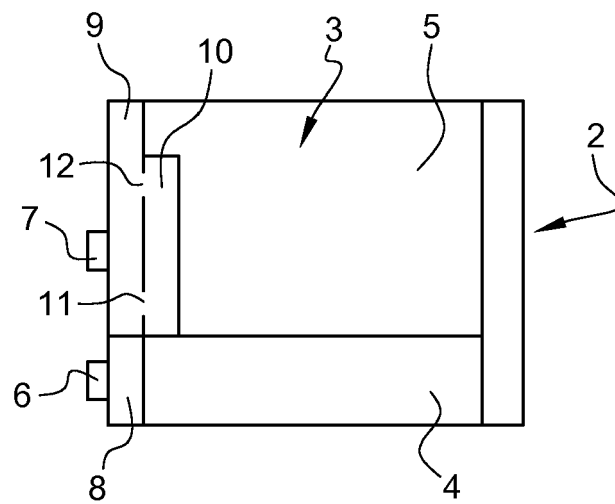


Fig. 6

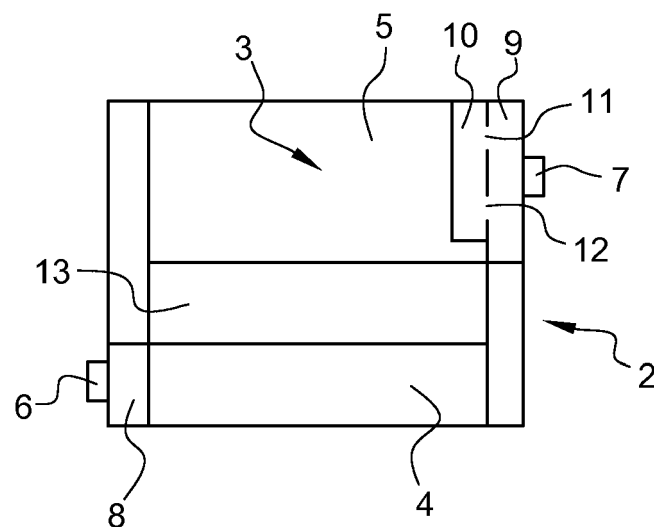


Fig. 4

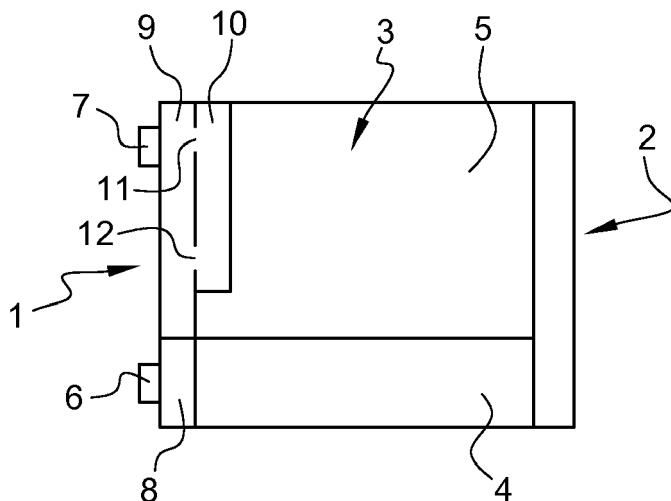


Fig. 5

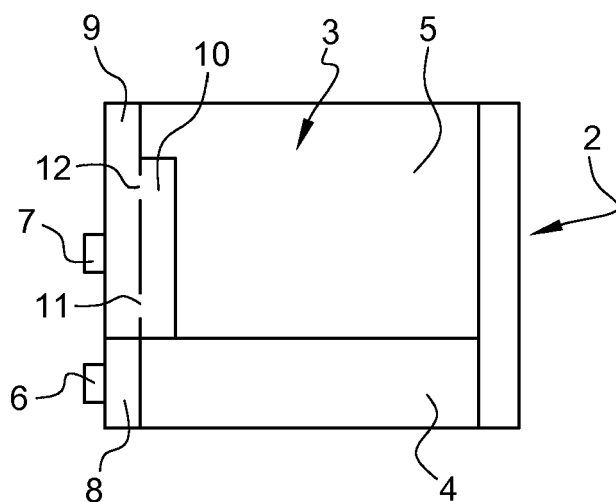
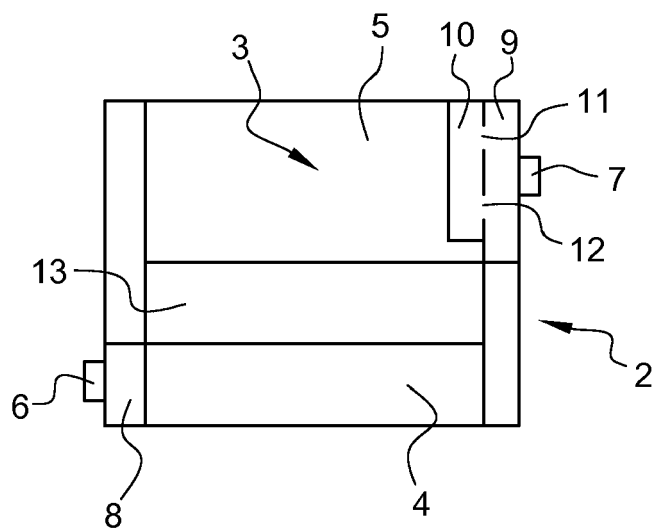


Fig. 6



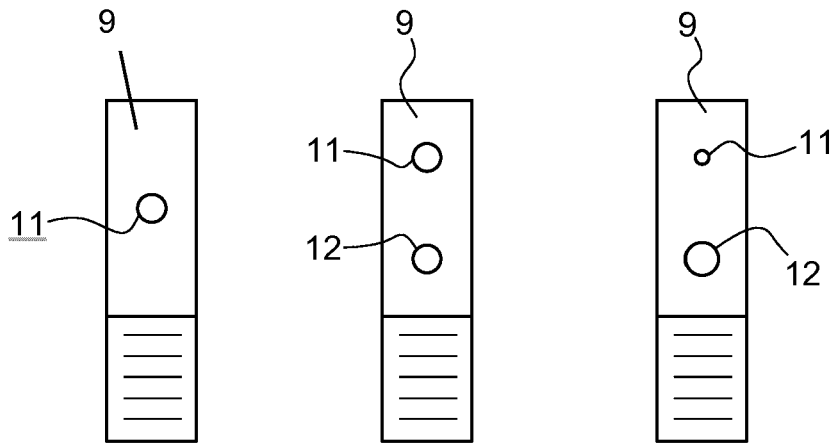


Fig. 7a

Fig. 7b

Fig. 7c

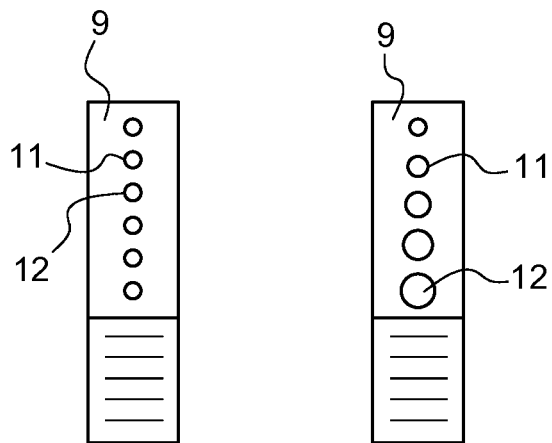


Fig. 7d

Fig. 7e



EUROPEAN SEARCH REPORT

Application Number
EP 19 46 1548

5

10

15

20

25

30

35

40

45

50

55

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	JP 2003 075024 A (SHOWA DENKO KK) 12 March 2003 (2003-03-12)	1-7,9,12	INV. F28F9/02
Y	* figures 9-16 *	8	
X	EP 1 300 646 A2 (BEHR GMBH & CO [DE]) 9 April 2003 (2003-04-09) * figure 5 *	1,10,11	
X	WO 2008/048505 A2 (CARRIER CORP [US]; MACRI SALVATORE [IT] ET AL.) 24 April 2008 (2008-04-24) * figure 1 *	1	
Y	DE 35 11 952 A1 (SUEDEDEUTSCHE KUEHLER BEHR [DE]) 9 October 1986 (1986-10-09) * figure 7 *	8	
The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (IPC)
			F28F
Place of search		Date of completion of the search	Examiner
Munich		2 December 2019	Bain, David
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

EPO FORM 1503 03/02 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.

EP 19 46 1548

5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

02-12-2019

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
JP 2003075024 A	12-03-2003	JP 4554144 B2	29-09-2010
		JP 2003075024 A	12-03-2003
EP 1300646 A2	09-04-2003	DE 10149507 A1	10-04-2003
		EP 1300646 A2	09-04-2003
		US 2003150603 A1	14-08-2003
		US 2006070729 A1	06-04-2006
WO 2008048505 A2	24-04-2008	AT 556283 T	15-05-2012
		CN 101558277 A	14-10-2009
		DK 2079973 T3	13-08-2012
		EP 2079973 A2	22-07-2009
		ES 2387134 T3	14-09-2012
		HK 1138362 A1	30-08-2013
		US 2010089095 A1	15-04-2010
		WO 2008048505 A2	24-04-2008
DE 3511952 A1	09-10-1986	NONE	