



(51) International Patent Classification:
F28F 9/02 (2006.01)

(21) International Application Number:
PCT/EP2020/055115

(22) International Filing Date:
27 February 2020 (27.02.2020)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
1902118 28 February 2019 (28.02.2019) FR

(71) Applicant: **VALEO SYSTEMES THERMIQUES**
[FR/FR]; 8 rue Louis Lormand, La Verrière, 78320 LE
MESNIL SAINT-DENIS (FR).

(72) Inventors: **MAQUIN, Olivier**; C/o Valeo Systèmes Ther-
miques, 9 rue du Colonel Charbonneaux, CS 60044, 51721
REIMS (FR). **MOUGNIER, Jérôme**; C/o Valeo Systèmes
Thermiques, ZA l'Agiot, 8 rue Louis Lormand, CS 80517
La Verrière, 78322 LE MESNIL SAINT-DENIS CEDEX
(FR). **PICHENOT, Yann**; C/o Valeo Systèmes Thermiques,
ZA l'Agiot, 8 rue Louis Lormand, 78320 LE MESNIL
SAINT-DENIS CEDEX (FR).

(74) Agent: **BIALKOWSKI, Adam**; ZA l'Agiot, 8 rue Louis
Lormand, CS 80517 LA VERRIERE, 78322 LE MESNIL
SAINT DENIS CEDEX (FR).

(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, BN, BR, BW, BY, BZ,
CA, CH, CL, CN, CO, CR, CU, CZ, DE, DJ, DK, DM, DO,
DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN,
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MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ,
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SC, SD, SE, SG, SK, SL, ST, SV, SY, TH, TJ, TM, TN, TR,
TT, TZ, UA, UG, US, UZ, VC, VN, WS, 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, RW, SD, SL, ST, SZ, TZ,
UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ,
TM), European (AL, 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, RS, SE, SI, SK, SM,
TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW,
KM, ML, MR, NE, SN, TD, TG).

(54) Title: ASSEMBLY METHOD FOR A COLLECTOR BOX FOR A HEAT EXCHANGER

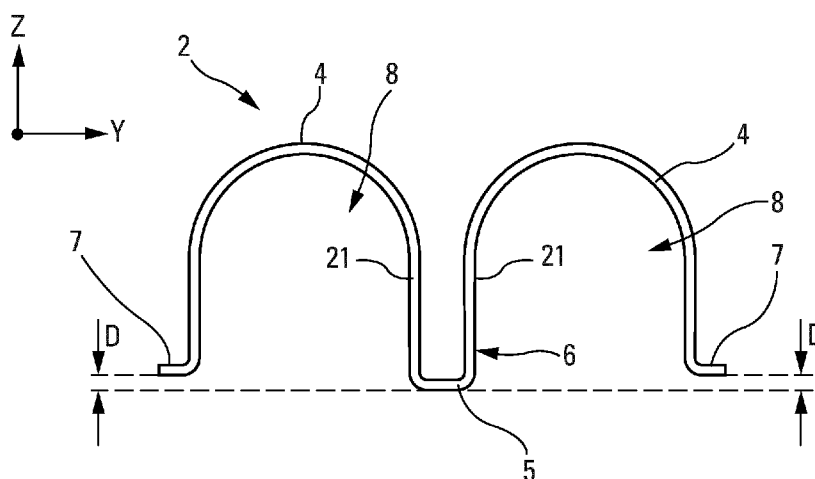


Fig. 1

(57) Abstract: Cover (2) for a collector box of a heat exchanger, the cover (2) being in the form of a profile comprising two lobes (4) that are joined together by a substantially flat central portion (5), the lobes (4) also having a lateral edge (7) opposite the central portion (5), the lateral edges (7) being offset by a gap (D) from the central portion (5) in a direction of a transverse axis perpendicular to an axis of extension of said central portion (5).

Published:

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

Description

Title of the invention: ASSEMBLY METHOD FOR A COLLECTOR BOX FOR A HEAT EXCHANGER

- [1] The invention relates to the automobile domain and more specifically to heat exchangers for air conditioning systems in motor vehicles.
- [2] Motor vehicles are usually fitted with an air conditioning system, of which the primary objective is to deliver cold or hot air to the passenger compartment.
- [3] In a simplified form, air conditioning systems in motor vehicles comprise an air conditioning circuit including a compressor that compresses and moves a refrigerant through the circuit, an expansion valve to lower the pressure of the refrigerant, and two heat exchangers, respectively a condenser and an evaporator.
- [4] Evaporators in the form of several bundles that are superposed on one another and through which the refrigerant flows are known. In order to move the refrigerant uniformly through the bundles of the heat exchanger, the heat exchanger has one or more collector boxes connected to the bundles.
- [5] Collector boxes that include a collector plate and a cover mounted on the collector plate, in which said cover and said collector plate define at least two compartments, are known.
- [6] Before brazing, which involves heating the elements of the exchanger to be fastened together in a kiln at a predetermined melting temperature of the brazing material, said elements are pre-assembled together.
- [7] Pre-assembly of the cover on the collector plate can be carried out using various techniques. According to one of these techniques, the collector plate and the cover together define at least two compartments, as mentioned above. The two compartments are separated by a central foot acting as a partition between the compartments. The seal between the two compartments is of crucial importance, since an imperfect seal would significantly reduce the performance of the heat exchanger, or even make the heat exchanger unusable. During brazing, the central foot is fastened to the collector plate, thereby partitioning the compartments. In order to guarantee effective brazing, i.e. a sealed central foot, several slots are formed in the collector plate, these slots receiving a pin that projects beyond the cover. The pins thus inserted in the slots enhance the contact between the central foot of the cover and the collector plate, thereby improving the brazing and the seal.
- [8] Although this technique works, it has some drawbacks. Firstly, the collector plate has to be cut according to precise dimensions over its entire length, and secondly the pins of the cover have to be precisely arranged to enable said cover to be inserted into said collector plate. In practice, the pins are often not inserted into the holes in the collector plate. Another

drawback is that assembly is more difficult to carry out. Another risk is that the brazing material does not correctly fill the holes, thereby potentially compromising the seal.

- [9] Therefore, a cover is firstly proposed for a collector box of a heat exchanger, the cover being in the form of a profile comprising two lobes that are joined together by a substantially flat central portion, the lobes also having a lateral edge opposite the central portion, the lateral edges being offset by a gap from the central portion in a direction of a transverse axis perpendicular to an axis of extension of said central portion.
- [10] Such a cover helps to better secure the compartments of the collector box, notably on account of the central foot acting as a sealed partition. Indeed, the gap between the central portion and the lateral edges enables a pre-assembly of the collector box with a reliable contact between the central portion and the collector plate. More specifically, the gap encourages contact between the central portion and the collector plate rather than contact between the lateral edges and the collector plate. This is notably possible because the contact between the collector plate and the lateral edges can be made by means of a pre-assembly operation of the cover and the collector plate, notably by crimping. The elasticity of the cover then enables the central portion of the cover, which is slightly compressed, to be held in contact with the collector plate. In particular, such a cover obviates the need to use holes in the collector plate and pins on the cover, which are liable to cause sealing faults following brazing, *inter alia*.
- [11] Various additional features may be implemented, individually or in combination:
- [12] the gap between the central portion and the lateral edges is between 0.2 and 0.5 mm, measured along the transverse axis,
- [13] the gap between the central portion and the lateral edges is approximately 0.3 mm, measured along the transverse axis,
- [14] the central portion and an inner portion of each lobe together define a central foot, said central foot being deformable,
- [15] the central portion is designed to be fastened to a collector plate of a collector box,
- [16] the central portion is designed to be deformed mechanically to be fastened to the collector plate of a collector box,
- [17] the lateral edges are designed to be fastened to the collector plate,
- [18] the lateral edges are designed to be fastened to the collector plate by crimping.
- [19] Secondly, an assembly method is proposed for a collector box including a cover as described above and a collector plate, in which said collector plate has a central zone and lateral zones, said method including the following successive steps:
- [20] a first step in which the cover is attached to the collector plate such that the central portion is in contact with the central zone,

- [21] a second step in which the lobes are deformed such that the lateral edges are brought into contact with the lateral zones,
- [22] a third step in which the lateral edges are fastened to the lateral zones.
- [23] Various additional features may be implemented, individually or in combination:
- [24] between the first and second steps, the method includes an intermediate step in which the central portion is fastened to the collector plate, notably by clinching,
- [25] clinching is performed using an external tool comprising a plurality of clinching supports forming a die and a plurality of punches, each punch being positioned to face one of the clinching supports, the punches having a diameter of approximately 2 mm and/or the clinching supports having a diameter of approximately 3 mm,
- [26] clinching is performed along the central portion at a plurality of different points,
- [27] the collector plate has deformable tabs arranged about the periphery of the lateral zones, the method involving the lateral edges of the cover being fastened to the lateral zones by crimping by folding the deformable tabs such that said deformable tabs come into contact with said lateral edges.
- [28] Thirdly, a collector box manufactured using a method such as the one described above or including a cover such as the one described above is proposed.
- [29] Finally, a heat exchanger including a collector box such as the one described above is proposed.
- [30] Other details and advantages of the invention are set out in the description below provided with reference to the attached drawings, which are provided as non-limiting examples:
- [31] [Figure 1] Figure 1 is a two-dimensional front view of a cover according to the invention,
- [32] [Figure 2] Figure 2 is a perspective view of a collector box during assembly,
- [33] [Figure 3] Figure 3 is another perspective view of Figure 2,
- [34] [Figure 4] Figure 4 is a schematic view of a method according to the invention,
- [35] [Figure 5] Figure 5 is a perspective view of a heat exchanger including a collector box according to the invention.
- [36] Figure 1 shows a cover 2 of a collector box 1 of a heat exchanger 22. In the embodiment shown in the figures, the heat exchanger 22 is an evaporator. The heat exchanger 22 has two heat exchange bundles 23 through which a refrigerant is designed to flow. The bundles 23 are positioned one behind the other such as to be traversed successively by an air flow. The bundles 23 have tubes arranged in parallel to one another. To improve the thermal

exchange, the bundles have inserts (not shown) arranged between and in contact with two adjacent tubes in a given bundle.

[37] The collector box 1 has a cover 2 and a collector plate 3.

[38] In the remainder of the description, by convention and without limitation, the longitudinal, vertical and transverse orientations are referenced using the X, Y, Z system shown in the figures, in which the axis Y is perpendicular to the axis X and the axis Z is perpendicular to the axes X and Y. The axes X, Y and Z define the planes XY, XZ and YZ.

[39] The cover 2 is a profile that extends along an axis of extension X and has two lobes 4. The lobes 4 are linked by a central portion 5. The central portion 5 is substantially flat. The central portion 5 and the inner portion 21 of the lobes together define a central foot 6. Each lobe 4 has a lateral edge 7, that is notably flat and continuous, at one of the ends thereof opposite the central portion 5. The collector box 1 therefore has two compartments 8 separated from one another by the central foot 6.

[40] Said profile is open at each of the longitudinal ends thereof. Partitions close the profile at each of the longitudinal ends.

[41] The collector plate 3 has a plurality of openings 9. The openings 9 are designed to receive the ends of the tubes (not shown) of the heat exchanger.

[42] Preferably, the bundles and the collector boxes are made of aluminium or aluminium alloy components brazed together. The heat exchanger 22 is for example designed to enable the refrigerant to flow in series in the two bundles 23. In each of the bundles 23, the refrigerant can flow in a single pass, i.e. in the same direction in each of the tubes of the same bundle. In a variant, the collector box can be designed, for example using partitions placed in the compartments, such that the refrigerant flows in several passes in one or each of the bundles. The refrigerant flows in two opposing directions between two adjacent passes of the same bundle. The heat exchanger is designed so that the refrigerant passes into one of the compartments then into the other in the flow direction thereof.

[43] The collector plate has a central zone 10 positioned between two rows of openings 9. The collector plate 3 has lateral zones 11 on each side of the openings 9, opposite the central zone 10.

[44] The central zone 10 of the collector plate 3 is designed to come into contact with the central portion 5 of the cover 2, and the lateral zones 11 are designed to come into contact with the lateral edges 7 of said cover 2.

[45] According to the invention, the lateral edges are offset in relation to the central portion. As shown in Figure 1, the lateral edges are offset in relation to the central portion by a distance D measured along the axis Z. The distance D is measured between a point located on the central portion designed to come into contact with the central zone and a point located on the lateral edge and designed to come into contact with one of the lateral zones of the collector plate.

- [46] The distance D is advantageously between 0.2 and 0.5 mm. The distance is preferably approximately 0.3 mm. On the one hand this distance D advantageously makes it possible to ensure an effective seal of the central foot between the compartments, while on the other hand preventing any significant deformation of a cover during assembly.
- [47] An assembly method of the collector box 1 is described below. More specifically, this is an assembly method for assembling the cover 2 of the collector box 1 on the collector plate 3.
- [48] The method comprises the following successive steps.
- [49] In a first step 12, the cover 2 is attached to the collector plate 3. The central portion 5 of the cover 2 is brought into contact with the central zone 10 of the collector plate 3. The contact is made along the entire length of the cover 2 and of the collector plate 3, which preferably have identical longitudinal dimensions.
- [50] In an optional intermediate step 13, the central portion 5 is fastened to the central zone 10. The cover 2 is for example fastened to the collector plate 3 by clinching. Clinching is a fastening technique that involves locally deforming the material.
- [51] Clinching is in this case performed along the central portion 5 at a plurality of different points. The central portion is therefore mechanically deformable. The figures show that the clinching is performed at four different points. The number of points can however vary as a function of the length of the collector plate 3 and of the cover 2.
- [52] Clinching is performed using an external tool 14. This external tool 14 has clinching supports 15 forming a die and punches 16. A die is an inverted impression of the end of the punch 16. Each punch 16 is positioned to face a clinching support 15. The clinching operation is performed by positioning the central zone 10 of the collector plate 3 and the central portion 5 of the cover 2 between the punches 16 and the clinching supports 15.
- [53] Advantageously, the punches 16 have a diameter of approximately 2 mm. This enables solid pre-fastening of the cover 2 to the collector plate 3, while minimizing the width of the central foot 6.
- [54] The central foot 6 is deformable. This enables the cover 2 to be deformed during assembly. This point is described in greater detail below.
- [55] The clinching supports 15 have a diameter of approximately 3 mm. This enables solid pre-fastening of the cover 2 to the collector plate 3, while enabling the clinching support 15 to be inserted into the width of the central zone 10, i.e. without obstructing the openings 9.
- [56] In a third step 17, the lobes 4 are deformed such that the lateral edges are brought into contact with the lateral zones.
- [57] In a fourth step, the lateral edges 7 are fastened to the lateral zones 11.

- [58] As shown in the figures, the collector plate 3 is provided with deformable tabs 19, in this case crimping teeth, arranged about the periphery of the lateral zones 11 and projecting beyond the collector plate 3. During the fourth step, the cover 2 is crimped to the collector plate 3. In this fourth step, the deformable tabs 19 are folded towards the cover 2 so that said deformable tabs 19 come into contact with the lateral edges 7 of said cover 2.
- [59] On completion of the fourth step, the cover 2 and the collector plate 3 are rigidly connected to one another and are ready to be assembled with the rest of the exchanger for brazing.

Claims

1. Cover (2) for a collector box (1) of a heat exchanger (22), the cover (2) being in the form of a profile comprising two lobes (4) that are joined together by a substantially flat central portion (5), the lobes (4) also having a lateral edge (7) opposite the central portion (5), the lateral edges (7) being offset by a gap (D) from the central portion (5) in a direction of a transverse axis perpendicular to an axis of extension of said central portion (5).
2. Cover (2) according to Claim 1, in which the gap (D) between the central portion (5) and the lateral edges (7) is between 0.2 and 0.5 mm, measured along the transverse axis.
3. Cover (2) according to Claim 1 or 2, in which the gap (D) between the central portion (5) and the lateral edges (7) is approximately 0.3 mm, measured along the transverse axis.
4. Cover (2) according to one of the preceding claims, in which the central portion (5) and an inner portion (21) of each lobe (4) together define a central foot (6), said central foot (6) being deformable.
5. Cover (2) according to one of the preceding claims, in which the central portion (5) is designed to be fastened to a collector plate (3) of a collector box (1).
6. Cover (2) according to Claim 5, in which the central portion (5) is designed to be deformed mechanically to be fastened to the collector plate (3) of a collector box (1).
7. Cover (2) according to Claim 5 or 6, in which the lateral edges (7) are designed to be fastened to the collector plate (3).
8. Cover (2) according to Claim 7, in which the lateral edges (7) are designed to be fastened to the collector plate (3) by crimping.
9. Assembly method for a collector box including a cover (2) according to one of the preceding claims and a collector plate (3), in which said collector plate (3) has a central zone (10) and lateral zones (11), said method including the following successive steps:
 - a first step (12) in which the cover (2) is attached to the collector plate (3) such that the central portion (5) is in contact with the central zone (10),
 - a second step (17) in which the lobes (4) are deformed such that the lateral edges (7) are brought into contact with the lateral zones (11),
 - a third step (24) in which the lateral edges (7) are fastened to the lateral zones (11).
10. Assembly method according to Claim 9, in which, between the first and second steps, the method includes an intermediate step (13) in which the central portion (5) is fastened to the collector plate (3), notably by clinching.
11. Assembly method according to Claim 10, in which clinching is performed using an external tool (14) comprising a plurality of clinching supports (15) forming a die and a plurality of punches (16), each punch (16) being positioned to face one of the clinching supports (15), the punches (16) having a diameter of approximately 2 mm and/or the clinching supports (15) having a diameter of approximately 3 mm.
12. Assembly method according to Claim 11, in which clinching is performed along the central portion (5) at a plurality of different points.
13. Assembly method according to Claim 12, in which the collector plate (3) has deformable tabs (19) arranged about the periphery of the lateral zones (11), the method involving the

lateral edges (7) of the cover (2) being fastened to the lateral zones (11) by crimping by folding the deformable tabs (19) such that said deformable tabs (19) come into contact with said lateral edges (7).

14. Collector box (1) manufactured using a method according to one of Claims 9 to 13 or including a cover (2) according to one of Claims 1 to 8.
15. Heat exchanger (22) including a collector box (1) according to Claim 14.

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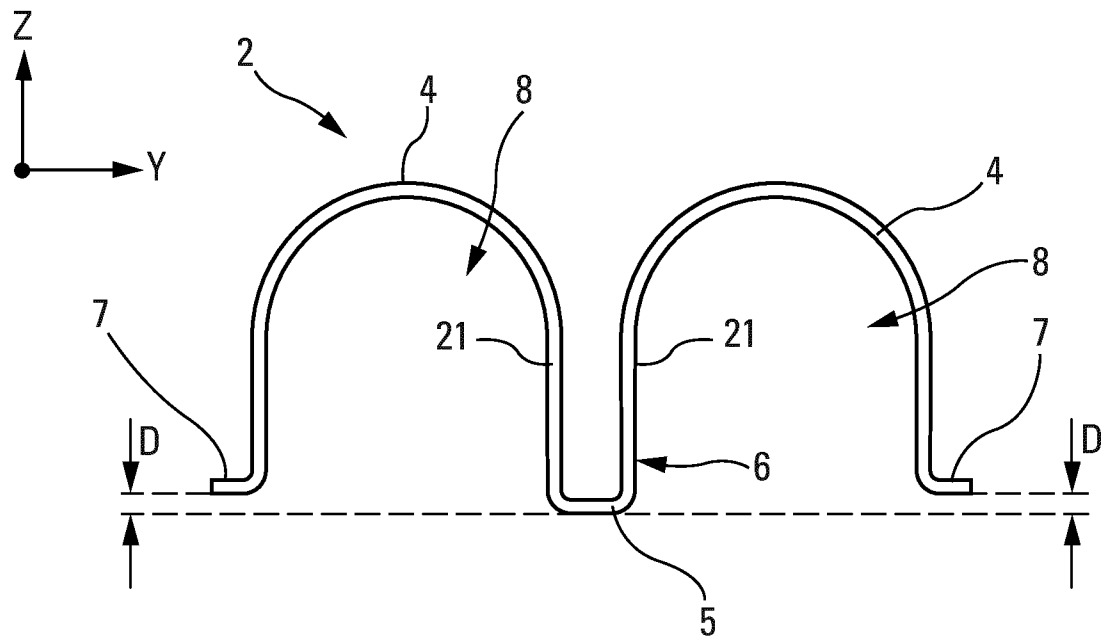


Fig. 1

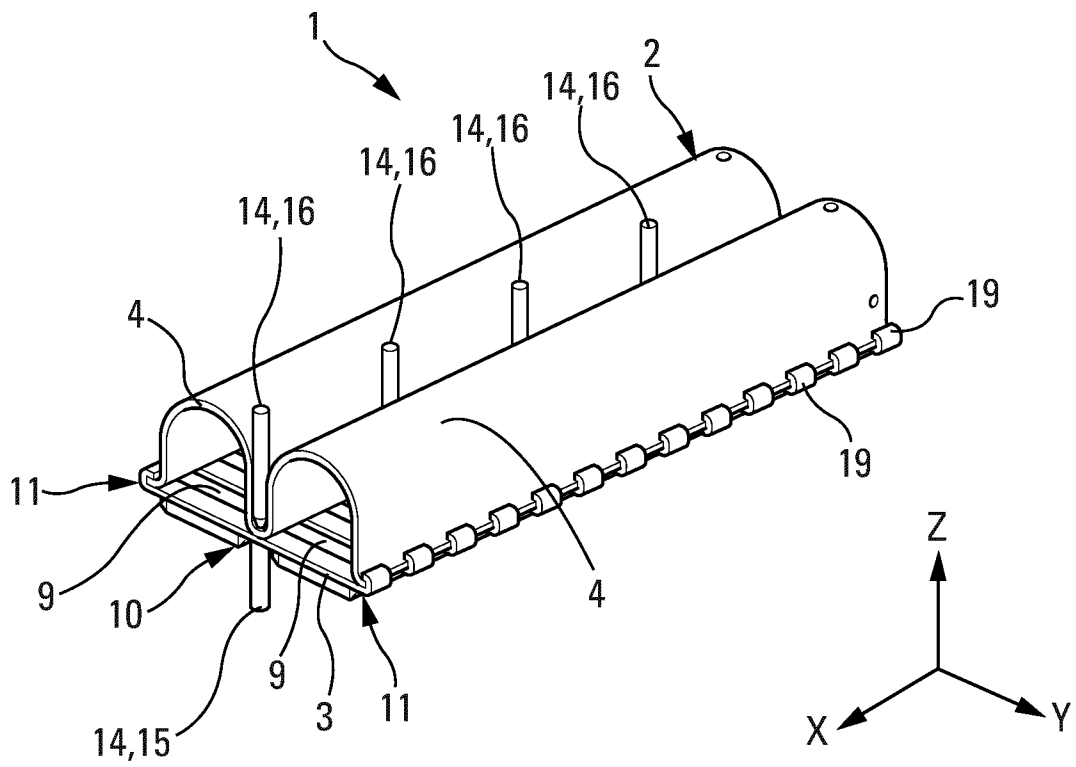


Fig. 2

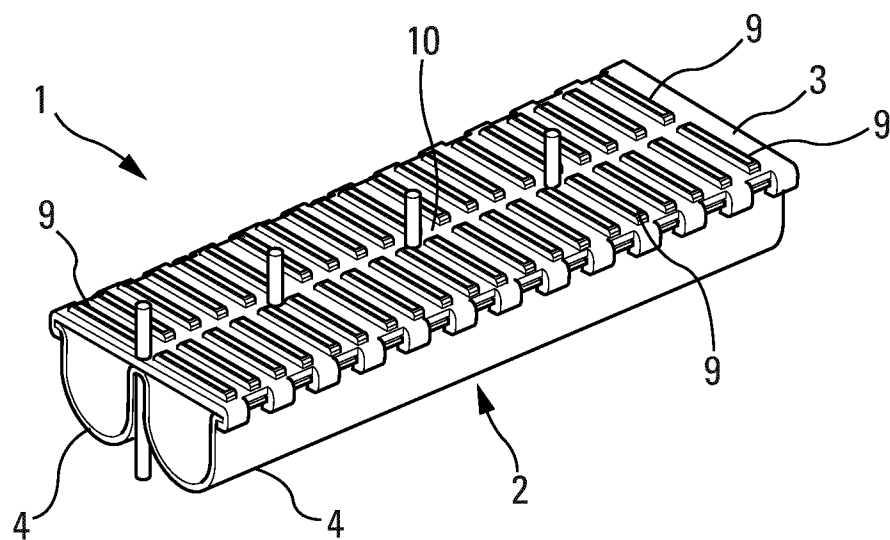


Fig. 3

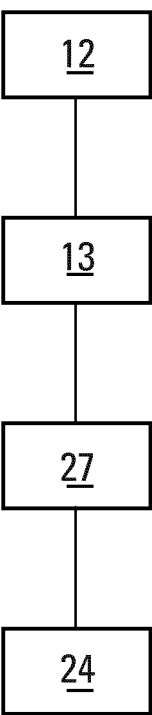


Fig. 4

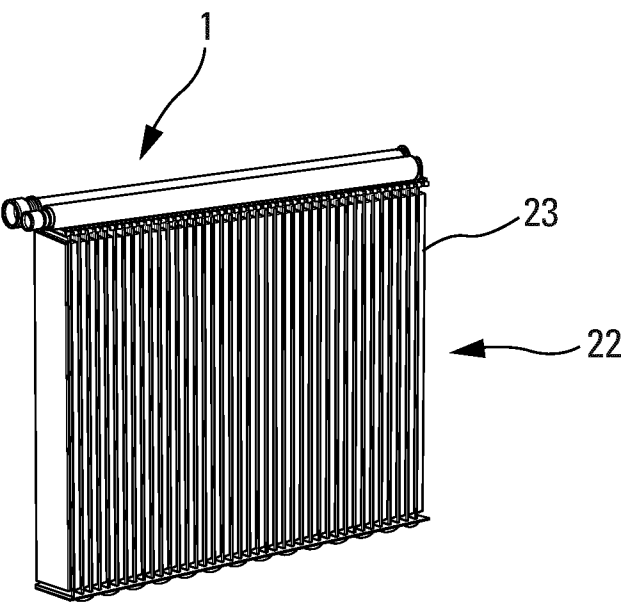


Fig. 5

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2020/055115

A. CLASSIFICATION OF SUBJECT MATTER
INV. F28F9/02
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)
F28F

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 practicable, search terms used)

EPO-Internal, WPI Data

C. 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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X	US 4 576 223 A (HUMPOLIK BOHUMIL [DE] ET AL) 18 March 1986 (1986-03-18) figure 1	1,4-8
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	----- -/-	



Further documents are listed in the continuation of Box C.



See patent family annex.

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Date of the actual completion of the international search

30 April 2020

Date of mailing of the international search report

15/05/2020

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/EP2020/055115

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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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

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