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(54) HEAT EXCHANGE PLATE USED FOR PLATE-TYPE HEAT EXCHANGER AND PLATE-TYPE HEAT EXCHANGER PROVIDED WITH THE HEAT EXCHANGE PLATE

(57) A heat exchange plate used for a plate-type heat exchanger. The heat exchange plate comprises: a heat exchange part (10); multiples protrusions (14) that protrude from a plate plane (12) to at least one side of the plate plane (12) in the heat exchange part (10), the multiple protrusions (14) being aligned along multiple lines; and a transition part (16) that is between adjacent protrudes (14) aligned along a line and that protrudes to at least one side of the plate plane (12), the size of the top of each protrusion (14) in a direction perpendicular to the line being larger than the size of the top of the transition part (16). Strength of the heat exchange plate of the plate-type heat exchanger is improved by increasing the size of a welding part or a bearing part.

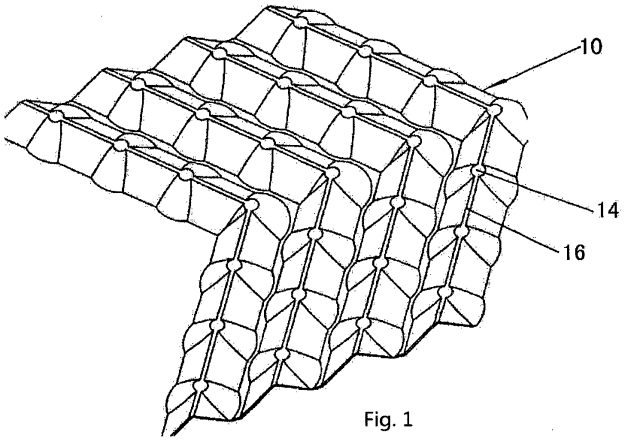

Fig. 1

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Description

[0001] *This application claims the priority of Chinese patent application no.* 201410081940.8 *with invention title "Heat exchange plate for plate-type heat exchanger and plate-type heat exchanger provided with the heat exchange plate", submitted on March 7, 2014, the entire contents of which are incorporated herein by reference.*

Technical field

[0002] The present invention relates to a heat exchanger, in particular a heat exchange plate for a plate-type heat exchanger and a plate-type heat exchanger provided with the heat exchange plate.

Background art

[0003] In the prior art, plate-type heat exchangers have low strength because the tops of elongated ridges on the heat exchange plates thereof are narrow and the welding point structure leads to concentration of stress.

Content of the invention

[0004] An object of the present invention is to provide a heat exchange plate for a plate-type heat exchanger, and a plate-type heat exchanger having the heat exchange plate, and to increase the strength of the heat exchange plate of the plate-type heat exchanger by increasing the size of welding parts or connecting parts.

[0005] Another object of the present invention is to provide a heat exchange plate for a plate-type heat exchanger, and a plate-type heat exchanger having the heat exchange plate, and to thereby improve the transverse distribution of fluid while increasing the strength of the heat exchange plate of the plate-type heat exchanger.

[0006] According to one aspect of the present invention, the present invention provides a heat exchange plate for a plate-type heat exchanger, the heat exchange plate comprising: a heat exchange part; multiple protrusions which project at the heat exchange part from a plate plane to at least one side of the plate plane, the multiple protrusions being arranged along multiple lines; and transitional parts which are located between adjacent protrusions arranged along one of the lines and project to the at least one side of the plate plane; in a direction perpendicular to the line, the size of the top of each protrusion is greater than the size of the top of the transitional part.

[0007] According to one aspect of the present invention, the distance from the top of the protrusion to the plate plane is greater than or equal to the distance from the top of the transitional part to the plate plane.

[0008] According to one aspect of the present invention, the top of the protrusion is substantially flat.

[0009] According to one aspect of the present invention, when viewed in a direction perpendicular to the line, the transitional part has a step between the top of the transitional part and the plate plane.

[0010] According to one aspect of the present invention, when viewed in a direction facing the plate plane, the multiple lines are arranged substantially in a V-shaped, W-shaped or wave-shaped pattern.

[0011] According to one aspect of the present invention, the distance from the top of the protrusion to the plate plane is greater than the distance from the top of the transitional part to the plate plane, and the distance from the top of the protrusion to the top of the transitional part is less than or equal to the distance from the top of the transitional part to the plate plane.

[0012] According to one aspect of the present invention, amongst protrusions and transitional parts arranged along one of the lines, the protrusions are connected via corresponding transitional parts, and together with the transitional parts form an entire ridge.

[0013] According to one aspect of the present invention, the top of the protrusion is substantially round.

[0014] According to one aspect of the present invention, amongst protrusions and transitional parts arranged along one of the lines, the protrusions are connected via corresponding transitional parts, and together with the transitional parts form an entire ridge; ridges projecting to one side of the plate plane are arranged alternately with ridges projecting to another side, which is opposite to said side, of the plate plane.

[0015] According to one aspect of the present invention, protrusions in a ridge projecting to one side of the plate plane are staggered in the longitudinal direction of the ridge with respect to protrusions in an adjacent ridge projecting to the other side of the plate plane.

[0016] According to another aspect of the present invention, the present invention provides a plate-type heat exchanger, comprising the heat exchange plate for a plate-type heat exchanger as described above.

[0017] By increasing the size of welding parts or connecting parts, the strength of the heat exchange plate of the plate-type heat exchanger is increased.

[0018] In addition, compared with heat exchangers with an inverted-V-shaped pattern, the present invention increases the welding area, and at the same time alters the transition between welding points and the bottom surface, to achieve the object of increasing strength. Furthermore, compared with dimple plates, the present invention has a transitional groove between two rows of welding points, to promote transverse fluid distribution. According to the technical solution of the present invention, with regard to the transitional part between two welding points, the distance between the top of the protrusion to the plate plane is greater than the distance from the top of the transitional part to the plate plane, and the pressure drop can be suitably reduced by suitably lowering the height of the transitional part.

[0019] In addition, according to the technical solution of the present invention, the welding parts or connecting parts are round, and two plates can be fully welded or connected, whereas the welding parts or connecting

parts of an inverted-V-shaped pattern are diamond-shaped, which is not conducive to distribution of stress.

Description of the accompanying drawings

[0020]

Fig. 1 is a partial enlarged schematic perspective view of a heat exchange plate for a plate-type heat exchanger according to a first embodiment of the present invention;

Fig. 2 is a partial enlarged schematic top view of a heat exchange plate for a plate-type heat exchanger according to a first embodiment of the present invention;

Fig. 3 is a partial enlarged schematic sectional view along line AA in Fig. 2 of a heat exchange plate for a plate-type heat exchanger according to a first embodiment of the present invention;

Fig. 4 is a partial enlarged schematic sectional view along line BB in Fig. 2 of a heat exchange plate for a plate-type heat exchanger according to a first embodiment of the present invention;

Fig. 5 is a partial enlarged schematic perspective view of a heat exchange plate for a plate-type heat exchanger according to a second embodiment of the present invention;

Fig. 6 is a partial enlarged schematic top view of a heat exchange plate for a plate-type heat exchanger according to a second embodiment of the present invention;

Fig. 7 is a partial enlarged schematic sectional view along line AA in Fig. 6 of a heat exchange plate for a plate-type heat exchanger according to a second embodiment of the present invention;

Fig. 8 is a partial enlarged schematic sectional view along line BB in Fig. 6 of a heat exchange plate for a plate-type heat exchanger according to a second embodiment of the present invention;

Fig. 9 is a partial enlarged schematic perspective view of a heat exchange plate for a plate-type heat exchanger according to a third embodiment of the present invention;

Fig. 10 is a partial enlarged schematic top view of a heat exchange plate for a plate-type heat exchanger according to a third embodiment of the present invention;

Fig. 11 is a partial enlarged schematic sectional view along line AA in Fig. 10 of a heat exchange plate for a plate-type heat exchanger according to a third embodiment of the present invention;

Fig. 12 is a partial enlarged schematic sectional view along line BB in Fig. 10 of a heat exchange plate for a plate-type heat exchanger according to a third embodiment of the present invention; and

Fig. 13 is a partial enlarged schematic perspective view of a heat exchange plate for a plate-type heat exchanger according to a fourth embodiment of the present invention.

Particular embodiments

[0021] The present invention is explained further below in conjunction with the accompanying drawings and particular embodiments.

[0022] A plate-type heat exchanger according to an embodiment of the present invention comprises: end plates and heat exchange plates which form first fluid heat exchange channels and second fluid heat exchange channels. The end plates are disposed on outer sides of the heat exchange plates. The plate-type heat exchanger also comprises: a fluid inlet and a fluid outlet. The heat exchange plates are stacked together, thus first fluid heat exchange channels and second fluid heat exchange channels are formed alternately in a stacking direction. Only one heat exchange plate is provided between at least two adjacent fluid heat exchange channels. The plate-type heat exchanger may be any known plate-type heat exchanger.

[0023] Heat exchange plates according to the embodiments of the present invention are described in detail below.

Embodiment 1

[0024] As Figs. 1 to 4 show, a heat exchange plate for a plate-type heat exchanger according to an embodiment of the present invention comprises a heat exchange part 10 which forms a heat exchange part of a fluid of the plate-type heat exchanger. The heat exchange plate also comprises multiple protrusions 14 which project at the heat exchange part 10 from a plate plane 12 to one side of the plate plane 12; the multiple protrusions 14 are arranged along multiple lines, and a portion of the multiple protrusions 14 can serve as welding parts or connecting parts for welding or connection of the heat exchange plate to an adjacent heat exchange plate. When viewed in a direction facing the plate plane, the multiple lines are arranged substantially in a V-shaped, W-shaped or wave-shaped pattern, or are arranged in another suitable pattern. The plate plane 12 is a plane in which the heat exchange plate lies before being stamped.

[0025] As Figs. 1 to 4 show, the heat exchange plate also comprises transitional parts 16 which are located

between adjacent protrusions 14 and arranged along one of the lines and project to said side of the plate plane 12; in a direction perpendicular to the line, the size of the top of each protrusion 14 is greater than the size of the top of the transitional part 16. Amongst protrusions 14 and transitional parts 16 arranged along one of the lines, the protrusions 14 are connected via corresponding transitional parts 16, and together with the transitional parts form an entire ridge. Protrusions in one ridge can be staggered in the longitudinal direction of the ridge with respect to protrusions in an adjacent ridge. By increasing the size of the welding parts or connecting parts, the strength of the heat exchange plate of the plate-type heat exchanger is increased.

[0026] As Fig. 4 shows, the distance E from the top of the protrusion 14 to the plate plane 12 is greater than or equal to the distance e from the top of the transitional part 16 to the plate plane 12. The top of the protrusion 14 may be substantially flat. It may for example be round.

[0027] As Fig. 4 shows, according to an embodiment of the present invention, the distance E from the top of the protrusion 14 to the plate plane 12 is greater than the distance e from the top of the transitional part 16 to the plate plane 12, and the distance E-e from the top of the protrusion 14 to the top of the transitional part 16 is less than or equal to the distance E from the top of the transitional part to the plate plane 12.

Embodiment 2

[0028] Embodiment 2 according to the present invention differs from the embodiment above in that the transitional part 16 is provided with a step part.

[0029] As Figs. 5 to 8 show, when viewed in a direction perpendicular to the line, the transitional part 16 has steps 18 between the top of the transitional part and the plate plane 12. The steps 18 are disposed on two sides of a plane of symmetry of the transitional part 16, such that the cross-section of the transitional part 16 is substantially "⊓"-shaped.

[0030] As Fig. 7 shows, the distance E from the top of the protrusion 14 to the plate plane 12 is greater than or equal to the distance e2 from the top of the transitional part 16 to the plate plane 12. The distance e1 from the top of the step 18 to the plate plane 12 is less than the distance e2 from the top of the transitional part 16 to the plate plane 12 and the distance E from the top of the protrusion 14 to the plate plane 12.

[0031] The use of steps 18 enables a further improvement in heat exchange performance.

Embodiment 3

[0032] Embodiment 3 according to the present invention differs from embodiment 2 above in that the top of the transitional part and the top of the protrusion 14 are substantially in the same plane.

[0033] As Figs. 9 to 12 show, the distance E from the top of the protrusion 14 to the plate plane 12 is equal to the distance e2 from the top of the transitional part 16 to the plate plane 12. The distance e1 from the top of the step 18 to the plate plane 12 is less than the distance e2 from the top of the transitional part 16 to the plate plane 12 and the distance E from the top of the protrusion 14 to the plate plane 12.

Embodiment 4

[0034] Embodiment 4 according to the present invention differs from the embodiments above in that: amongst protrusions 14 and transitional parts 16 arranged along one of the lines, the protrusions 14 are connected via corresponding transitional parts 16, and together with the transitional parts 16 form an entire ridge; ridges projecting to one side of the plate plane are arranged alternately with ridges projecting to another side, which is opposite to said side, of the plate plane. Ridges projecting to one side of the plate plane are arranged alternately with ridges projecting to another side, which is opposite to said side, of the plate plane. Protrusions 14 in a ridge projecting to one side of the plate plane may be staggered in the longitudinal direction of the ridge with respect to protrusions 14 in an adjacent ridge projecting to the other side of the plate plane.

[0035] It must be explained that the technical features and solutions in embodiments 1 - 3 above may be applied to embodiment 4.

[0036] Thus, the present invention provides a heat exchange plate for a plate-type heat exchanger, the heat exchange plate comprising: a heat exchange part; multiple protrusions which project at the heat exchange part from a plate plane to at least one side (e.g. one side or two opposite sides) of the plate plane, the multiple protrusions being arranged along multiple lines; and transitional parts which are located between adjacent protrusions arranged along one of the lines and project to the at least one side of the plate plane; in a direction perpendicular to the line, the size of the top of each protrusion is greater than the size of the top of the transitional part.

[0037] In the present invention, a V-shaped, W-shaped or wave-shaped pattern is employed, the distance from the top of the protrusion to the plate plane is greater than or equal to the distance from the top of the transitional part to the plate plane, and the distance from the top of the protrusion to the top of the transitional part is less than or equal to the distance from the top of the transitional part to the plate plane. Thus the strength of the heat exchange plate is increased and the fluid diffusion capability is improved, thereby saving material costs and improving the heat exchange performance.

[0038] In addition, by employing larger welding parts or connecting parts, the strength of the heat exchange plate is increased.

Claims

1. A heat exchange plate for a plate-type heat exchanger, the heat exchange plate comprising:

   a heat exchange part;
   multiple protrusions which project at the heat exchange part from a plate plane to at least one side of the plate plane, the multiple protrusions being arranged along multiple lines; and
   transitional parts which are located between adjacent protrusions arranged along one of the lines and project to the at least one side of the plate plane; in a direction perpendicular to the line, the size of the top of each protrusion is greater than the size of the top of the transitional part.

2. The heat exchange plate for a plate-type heat exchanger as claimed in claim 1, wherein
   the distance from the top of the protrusion to the plate plane is greater than or equal to the distance from the top of the transitional part to the plate plane.

3. The heat exchange plate for a plate-type heat exchanger as claimed in claim 1 or 2, wherein
   the top of the protrusion is substantially flat.

4. The heat exchange plate for a plate-type heat exchanger as claimed in claim 1 or 2, wherein
   when viewed in a direction perpendicular to the line, the transitional part has a step between the top of the transitional part and the plate plane.

5. The heat exchange plate for a plate-type heat exchanger as claimed in claim 1 or 2, wherein
   when viewed in a direction facing the plate plane, the multiple lines are arranged substantially in a V-shaped, W-shaped or wave-shaped pattern.

6. The heat exchange plate for a plate-type heat exchanger as claimed in claim 1, wherein
   the distance from the top of the protrusion to the plate plane is greater than the distance from the top of the transitional part to the plate plane, and the distance from the top of the protrusion to the top of the transitional part is less than or equal to the distance from the top of the transitional part to the plate plane.

7. The heat exchange plate for a plate-type heat exchanger as claimed in claim 1, wherein
   amongst protrusions and transitional parts arranged along one of the lines, the protrusions are connected via corresponding transitional parts, and together with the transitional parts form an entire ridge.

8. The heat exchange plate for a plate-type heat exchanger as claimed in claim 3, wherein
   the top of the protrusion is substantially round.

9. The heat exchange plate for a plate-type heat exchanger as claimed in claim 1 or 2, wherein
   amongst protrusions and transitional parts arranged along one of the lines, the protrusions are connected via corresponding transitional parts, and together with the transitional parts form an entire ridge;
   ridges projecting to one side of the plate plane are arranged alternately with ridges projecting to another side, which is opposite to said side, of the plate plane.

10. The heat exchange plate for a plate-type heat exchanger as claimed in claim 9, wherein
    protrusions in a ridge projecting to one side of the plate plane are staggered in the longitudinal direction of the ridge with respect to protrusions in an adjacent ridge projecting to the other side of the plate plane.

11. A plate-type heat exchanger, comprising:

    the heat exchange plate for a plate-type heat exchanger as claimed in claim 1.

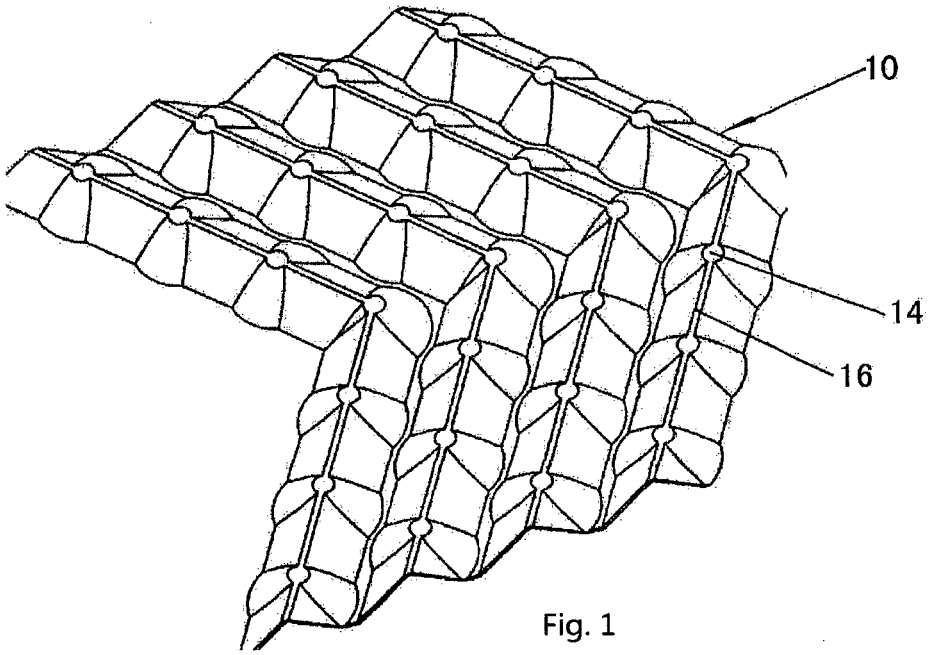

Fig. 1

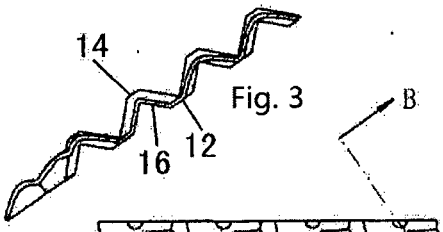

Fig. 3

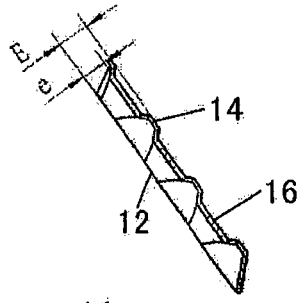

Fig. 4

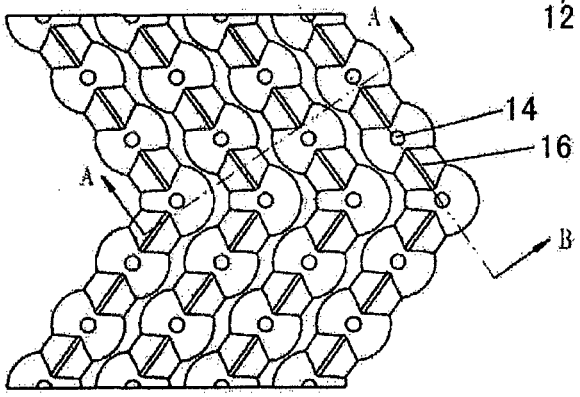

Fig. 2

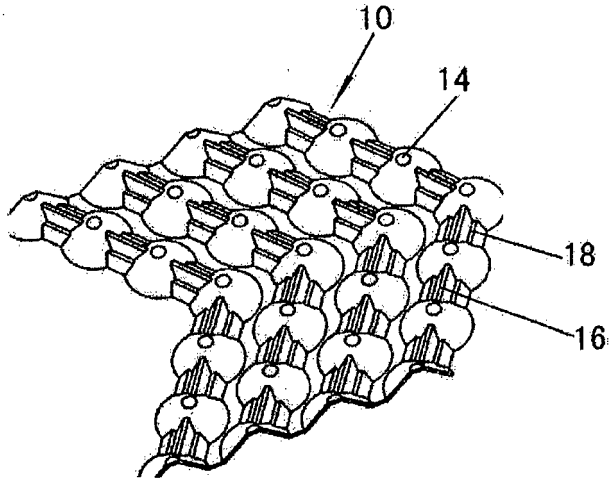

Fig. 5

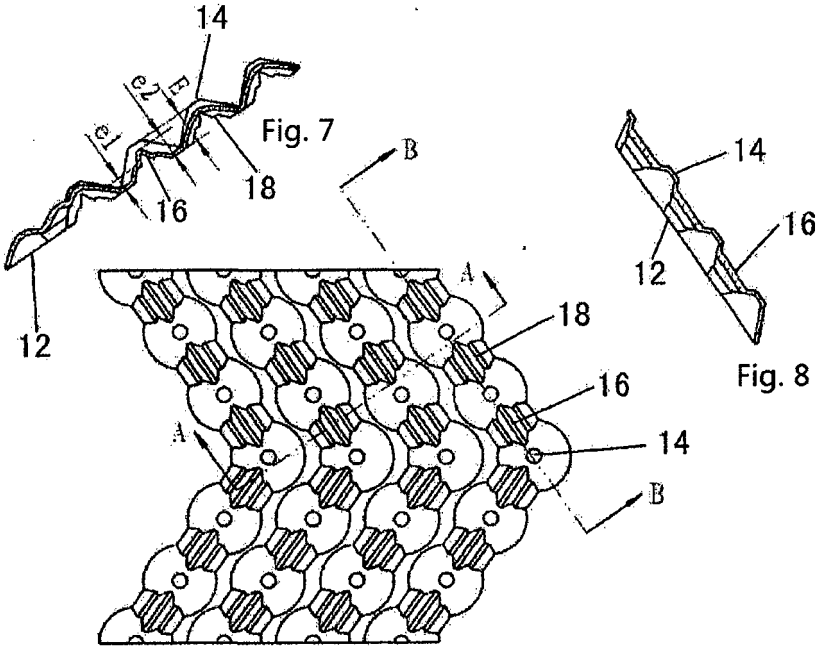

Fig. 6

Fig. 7

Fig. 8

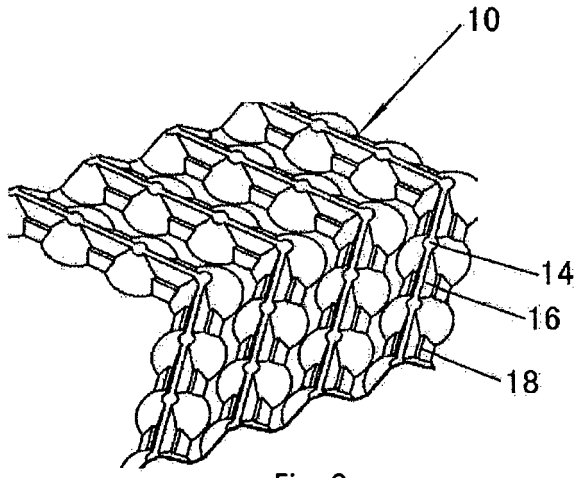

Fig. 9

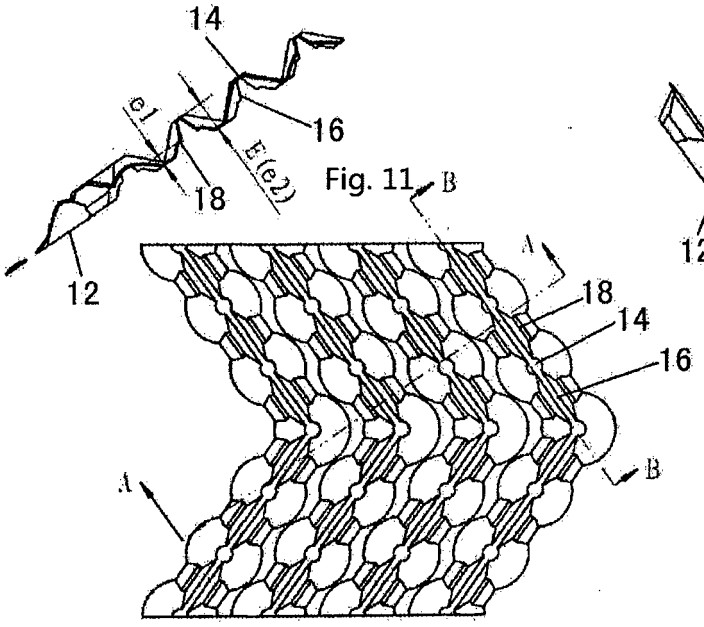

Fig. 10

Fig. 11

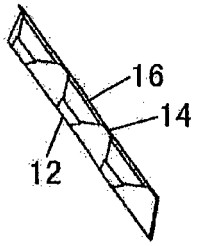

Fig. 12

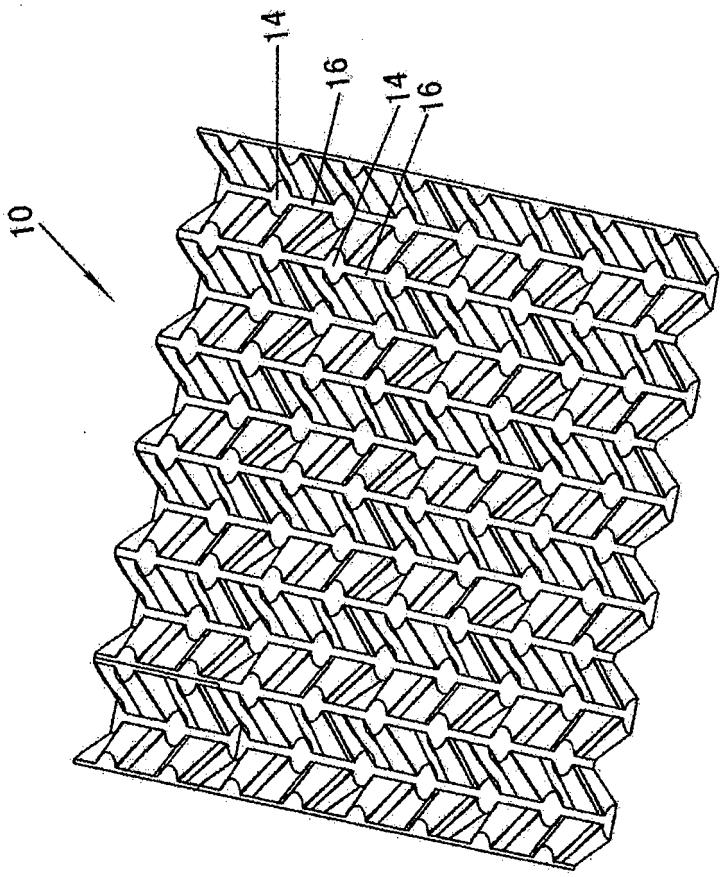

Fig. 13

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2015/073007

A. CLASSIFICATION OF SUBJECT MATTER

F28F 3/04 (2006.01) i

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 3; F28D

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)

VEN, CNABS, CNKI: heat exchange, plate, panel, protrude, extrude, project, convex, heave, size

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
PX	CN 103791758 A (DANFOSS MICROCHANNEL HEAT EXCHANGER JIAX) 14 May 2014 (14.05.2014) claims 1 to 11	1-11
X	CN 101158561 A (BEIJING JINGHAI HEAT EXCHANGER PRODN CO) 09 April 2008 (09.04.2008) description, page 3, lines 5 to 25, and figures 1 to 8	1-3, 5, 8, 11
A	CN 101178293 A (SATOMI SANGYO KK) 14 May 2008 (14.05.2008) the whole document	1-11

☒ 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

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

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"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

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
20 April 2015	12 May 2015

Name and mailing address of the ISA	Authorized officer
State Intellectual Property Office of the P. R. China No. 6, Xitucheng Road, Jimenqiao Haidian District, Beijing 100088, China Facsimile No. (86-10) 62019451	YANG, Yi Telephone No. (86-10) 62084859

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2015/073007

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	CN 1811322 A (SATOMI SANGYO KK) 02 August 2006 (02.08.2006) the whole document	1-11
A	US 2007006998 A1 (BROST VIKTOR) 11 January 2007 (11.01.2007) the whole document	1-11

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2015/073007

Patent Documents referred in the Report	Publication Date	Patent Family	Publication Date
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		TW 200632271 A	16 September 2006
US 2007006998 A1	11 January 2007	None	

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REFERENCES CITED IN THE DESCRIPTION

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- CN 201410081940 **[0001]**