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(54) **BOARD-TYPE HEAT EXCHANGER**

(57) The present invention relates to a plate type heat exchanger, comprising multiple heat exchange plates which are stacked together, each heat exchange plate comprising a fluid inlet and a fluid outlet located at two opposite ends respectively in a longitudinal direction of the heat exchange plate, and where a separating part is

provided on a top surface and/or a bottom surface of each heat exchange plate, such that a fluid coming from the fluid inlet is split into different flows at the fluid inlet, then flows into mutually independent fluid channel regions separated by the separating part and converges at the fluid outlet, and finally flows out of the fluid outlet.

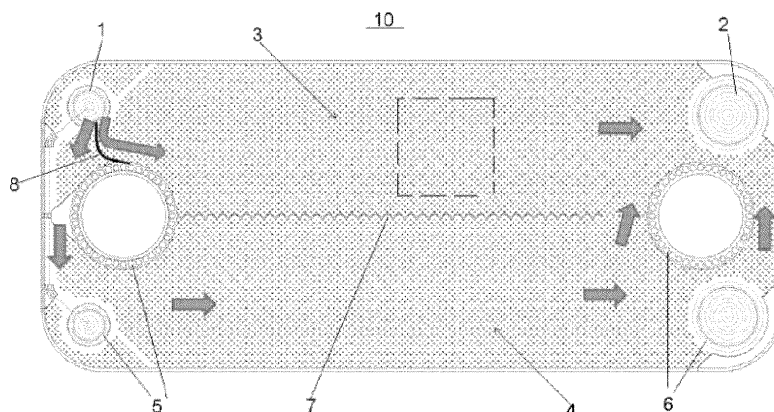


Fig. 1

Description

[0001] *This application claims the priority of Chinese patent application no. 201410042349.1 with invention title "Plate-type heat exchanger", submitted on January 28, 2014, the entire contents of which are incorporated herein by reference.*

Technical field

[0002] The present invention relates to the fields of heating, ventilation and air conditioning, motor vehicles, cooling and transportation, and in particular relates to a plate type heat exchanger.

Background art

[0003] With regard to heat exchangers (evaporators) with parallel channels, in particular plate type heat exchangers and microchannel heat exchangers, the non-uniform distribution (mal-distribution) of coolant is a global technical difficulty. In general, coolant entering a heat exchanger exists in a two-phase form, and due to application conditions and the complexity of two-phase flow, uniform distribution of coolant is very difficult to achieve. In many cases, an excessive amount of liquid coolant flows into some channels, while an excessive amount of gaseous coolant flows into other channels, and this has a major impact on the overall performance of the evaporator.

[0004] However, if a heat exchange plate is too wide, such a large heat exchange plate will fail to achieve good fluid distribution, e.g. in the longitudinal direction of the heat exchange plate. Thus, there is definitely a need to provide a novel plate type heat exchanger capable of at least partially solving the problem above.

Content of the invention

[0005] The object of the present invention is to solve at least one aspect of the abovementioned problems and shortcomings in the prior art.

[0006] According to one aspect of the present invention, a plate type heat exchanger is provided. The plate type heat exchanger comprises multiple heat exchange plates which are stacked together, each heat exchange plate comprising a fluid inlet and a fluid outlet located at two opposite ends respectively in a longitudinal direction of the heat exchange plate, a separating part is provided on a top surface and/or a bottom surface of each heat exchange plate, such that a fluid coming from the fluid inlet is split into different flows at the fluid inlet, then flows into mutually independent fluid channel regions separated by the separating part and converges at the fluid outlet, and finally flows out of the fluid outlet.

[0007] In one embodiment, the separating part comprises a separating strip, which splits fluid into different

flows at the fluid inlet, and a longitudinal piece connected thereto.

[0008] Specifically, the longitudinal piece is arranged in one of the following three ways:

substantially parallel to the longitudinal direction of the heat exchange plate;

inclined relative to the longitudinal direction of the heat exchange plate;

having a bent or meandering shape in the longitudinal direction of the heat exchange plate.

[0009] In another embodiment, the separating part comprises at least one separating strip extending from the fluid inlet to the vicinity of the fluid outlet.

[0010] Specifically, the separating strip is arranged in one of the following three ways:

substantially parallel to the longitudinal direction of the heat exchange plate;

inclined relative to the longitudinal direction of the heat exchange plate;

having a bent or meandering shape in the longitudinal direction of the heat exchange plate.

[0011] Specifically, at the fluid inlet, the separating strip is arranged to be in the angular range of -45° to 45° relative to a direction perpendicular to the longitudinal direction of the heat exchange plate, wherein the separating strip is in the shape of a straight line or bent.

[0012] Specifically, the fluid inlet is at a top side at a left end of the top surface and/or bottom surface of the heat exchange plate, and the fluid outlet is at a top side or bottom side at a right end of the surface of the heat exchange plate.

[0013] Specifically, a fluid distributor is provided at the fluid inlet, the fluid distributor having a middle cavity for receiving a fluid from the fluid inlet, and at least two guide parts which pass through the fluid distributor and guide fluid out of the middle cavity.

[0014] Specifically, the at least two guide parts comprise any one of a through-hole, a duct and a channel passing through a main body of the fluid distributor, or any combination thereof.

[0015] Specifically, the ducts comprise tubes and/or capillary tubes which introduce fluid into different fluid channel regions respectively.

[0016] Specifically, the channel is formed on the heat exchange plate integrally or separately.

[0017] Specifically, the fluid distributor comprises an annular main body which the guide parts pass through from the outside.

[0018] Specifically, the plate type heat exchanger also comprises end plates which are disposed on outer sides

of the heat exchange plates and used for fixing the heat exchange plates in place.

[0019] Specifically, a structural pattern for distributing fluid is provided on the surface of the heat exchange plate.

[0020] Specifically, multiple regularly arranged recesses or protrusions are provided on the surface.

[0021] Specifically, multiple alternately arranged channels and ridges in an inverted-V-shape are provided on the surface.

[0022] The main concept of the present invention is mainly based on the following aspects:

1) dividing a large heat exchange plate into multiple sections or channel regions which extend substantially parallel to each other;

2) with regard to fluid distribution in a plate type heat exchanger, the narrower the heat exchange plate after being divided, the better the fluid distribution;

3) fluid can enter at a port of the plate type heat exchanger and be guided to the required region by means of the fluid distributor according to the present invention.

[0023] At least some of the above aspects of the present invention achieve the following technical effects:

1) good fluid distribution is achieved without limiting or restricting the width of the heat exchange plate;

2) recessing technology is used without the loss of strength; this is more competitive in terms of reducing costs;

3) the specially designed fluid distributor according to the present invention can provide a consistent and stable process and performance.

Description of the accompanying drawings

[0024] These and/or other aspects and advantages of the present invention will become obvious and easy to understand through the following description of preferred embodiments in conjunction with the accompanying drawings, wherein:

Fig. 1 is a view of an example of a heat exchange plate in a plate type heat exchanger according to the present invention;

Fig. 2 is a view of another example of a heat exchange plate in a plate type heat exchanger according to the present invention;

Fig. 3 is a view of a heat exchange plate, adjacent to the heat exchange plate shown in Fig. 1 or 2, in a

plate type heat exchanger according to the present invention;

Fig. 4 is an enlarged view of the rectangular frame shown in Fig. 1;

Fig. 5 is a view of another example of a heat exchange plate in a plate type heat exchanger according to the present invention;

Fig. 6 is a view of another example of a heat exchange plate in a plate type heat exchanger according to the present invention;

Fig. 7 is a view of another example of a heat exchange plate in a plate type heat exchanger according to the present invention;

Figs. 8a - 8d are views of multiple examples of a fluid distributor used in a heat exchange plate in a plate type heat exchanger according to the present invention;

Figs. 9a - 9b respectively show views of two examples of a heat exchange plate using a fluid distributor; and

Fig. 10a shows a view of part of a heat exchange plate according to the present invention; Fig. 10b is an enlarged view of part of Fig. 10a.

Particular embodiments

[0025] The technical solution of the present invention is explained in further detail below by means of embodiments in conjunction with Figs. 1 - 10b. In this description, identical or similar drawing labels indicate identical or similar components. The following explanation of embodiments of the present invention with reference to the accompanying drawings is intended to explain the overall inventive concept of the present invention, and should not be interpreted as being a limitation of the present invention.

[0026] Reference is made to Fig. 1, which shows a front view of a heat exchange plate 10 in a plate type heat exchanger according to an embodiment of the present invention. As is known by all those skilled in the art, a plate type heat exchanger comprises multiple heat exchange plates 10 which are stacked together, and end plates (not shown) disposed on outer sides of the plate type heat exchanger, for fixing the heat exchange plates 10 in place. In other words, the multiple heat exchange plates 10 which are stacked together are assembled by means of two end plates, e.g. by screw fastening, screw-thread connection or welded connection. Generally, two adjacent heat exchange plates 10 are alternately stacked together, to form a fluid channel or a single fluid channel region for the passage of fluid. Clearly, the manner of

installation described above is just one example, and any known method in the prior art could be used to fix the heat exchange plates of the present invention in place.

[0027] In view of the fact that the main improvement brought about by the present invention is in the heat exchange plates in the heat exchanger, structures such as the end plates and the manner of fixing are not described in detail. Those skilled in the art can set these as required in accordance with the prior art.

[0028] The heat exchange plate 10 comprises a fluid inlet 1 and a fluid outlet 2 located at two opposite ends in the longitudinal direction thereof (e.g. the top-left corner and top-right corner shown in the figure). To achieve better fluid distribution, a separating part is disposed on a top surface (i.e. the surface shown in the figure) of the heat exchange plate 10 in this example; the separating part divides the surface of the heat exchange plate 10 into two independent fluid channel regions 3 and 4. The separating part comprises a separating strip 8 which splits fluid flow at the fluid inlet 1, and a longitudinal piece 7 connected thereto. Thus, fluid (e.g. coolant, as shown by the arrows in the figure) from the fluid inlet 1 is first split into different flows by the separating strip 8, then flows into the two fluid channel regions 3 and 4 respectively and converges at the fluid outlet 2, finally flowing out of the fluid outlet 2. It must be explained here that the fluid channel regions 3 and 4 are independent of each other; in other words, once the fluid has been split into different flows by the separating strip 8, the respective flows in the fluid channel regions 3 and 4 do not mix with each other; they only mix in the vicinity of the fluid outlet 2, and finally flow out of the fluid outlet 2.

[0029] It must be explained that the separating strip 8 is not necessarily in the shape of a straight line, and can be chosen to be in the angular range of -45° to 45° relative to a vertical direction of the heat exchange plate 10 (i.e. the up-down direction in the figure, perpendicular to the longitudinal direction of the heat exchange plate 10). To encourage fluid distribution, the separating strip 8 can be arranged to be bent or inclined slightly to the left as shown in the figure.

[0030] The fluid inlet 1 is disposed at a top side at the left end (e.g. the top-left corner) of the heat exchange plate 10; the fluid outlet 2 is disposed at a top side at the right end (e.g. the top-right corner) of the heat exchange plate 10. Those skilled in the art should understand that ports 5 and 6 are also disposed on the heat exchange plate 10, in order to mate with an adjacent heat exchange plate; however, ports 5 and 6 play no role in or are not associated with fluid distribution on the top surface, shown in the figure, of the heat exchange plate 10, so are not described in detail below.

[0031] In order to ensure that the flow paths in the fluid channel regions 3 and 4 are independent of each other or that no mixing of fluid occurs midway after it has been split into different flows at the fluid inlet 1, the separating strip 8 is generally connected to the longitudinal piece 7 in a sealed manner.

[0032] It can be seen from Fig. 1 that fluid is split into two branches at the fluid inlet 1. The two branches are first of all inclined downwards slightly overall. Then one branch is guided rightwards through the fluid channel region 3; the other branch of fluid is guided towards the bottom left side from the fluid inlet 1 (e.g. through a region between the port 5 and a left side edge of the heat exchange plate 10), and is then guided rightwards to the fluid channel region 4. The two branches converge at the fluid outlet 2, and flow out of the fluid outlet 2.

[0033] Although Fig. 1 shows the longitudinal piece 7 as being substantially parallel to the longitudinal direction of the heat exchange plate 10 (i.e. the left-right direction shown in Fig. 1), those skilled in the art could, as required, arrange it to be inclined by a predetermined angle relative to the longitudinal direction of the heat exchange plate 10 (e.g. within the angular range of -45° to 45° relative to a direction perpendicular to the longitudinal direction of the heat exchange plate, e.g. 30°), or to have a bent or meandering shape in the longitudinal direction of the heat exchange plate 10.

[0034] It can be understood that such a separating part could be likewise disposed on another surface of the heat exchange plate 10 (opposite the top surface described above, i.e. the bottom surface); the number of separating parts can be specifically set as required on the heat exchange plate 10, and is not limited to the scenario shown in the figure; the separating part may also be formed in another way, and is not limited to the structure shown in the figure.

[0035] As Fig. 2 shows, the fluid inlet 1 is disposed at the top left corner of the heat exchange plate 10, while the fluid outlet 2 is disposed at a bottom side at the right end (e.g. the bottom right corner) of the heat exchange plate 10. The position of the fluid outlet 2 is different from the scenario shown in Fig. 1, therefore except for the direction of fluid flow (as shown by the arrow in Fig. 2) which is different from that shown in Fig. 1, everything else is the same as the structure shown in Fig. 1, and is not described in detail here.

[0036] In Figs. 1 and 2, there is no direct sealed connection between the separating strip 8 and the longitudinal piece 7; instead, separation of fluid is accomplished by means of a sealed edge of the port 5. Of course, if no port 5 is provided or in another case, the separating strip 8 and longitudinal piece 7 may be connected in a sealed manner directly.

[0037] Fig. 3 shows another heat exchange plate 20 which is mated with or adjacent to the heat exchange plate 10 described above. It can be understood that in order to mate with the heat exchange plate 10, corresponding ports 25, 26 are disposed at the four corners respectively of the heat exchange plate 20; the ports 25, 26 are arranged such that fluid cannot be made to flow therethrough. In order to guide fluid (e.g. water) on the heat exchange plate 20, a fluid inlet 21 and a fluid outlet 22 are disposed in a middle position at two ends (left and right) thereof, respectively. As the figure shows, fluid from

the second fluid inlet 21 is guided directly to the second fluid outlet 22 over the surface of the heat exchange plate 20; no separating part as described above is provided thereon. Of course, those skilled in the art could provide a similar separating part on the heat exchange plate 20 as required, in accordance with the content disclosed above.

[0038] Reference is made to Fig. 4, which shows an enlarged view of part of the heat exchange plate 10 shown in Fig. 1. As can be seen in the figure, most of the top surface of the heat exchange plate 10 is provided with a recessed structural pattern as shown in the figure, for helping to distribute fluid. It can be understood that when the pattern structure of substantially hemispherical recesses described above is provided on a surface (e.g. the top surface) of the heat exchange plate 10, a structure of protrusions corresponding to the substantially hemispherical recesses described above will be correspondingly provided on the other surface (e.g. the bottom surface) of the heat exchange plate 10. The form of the recessed pattern structure described above, as well as the distance between adjacent recesses and the size thereof, may be arranged as required. Of course, if possible, the pattern structure of recesses 11 and protrusions described above could also be replaced with an inverted-V-shaped pattern of grooves and ridges, which is already known in the prior art. Of course, the present invention could also be applied to a heat exchange plate with a dimpled pattern.

[0039] Fig. 5 shows another example of the heat exchange plate of the present invention. Clearly, the heat exchange plate 30 shown in Fig. 5 differs from the heat exchange plate 10 described above in that the heat exchange plate 30 is divided into three fluid channel regions 331, 332 and 333, starting from a fluid inlet 31, by means of separating strips 37 and 38 (i.e. two separating parts). The separating strip 37 extends from the fluid inlet 31 at the top left corner to a region close to a fluid outlet 32 at the top right corner. The other separating strip 38 passes the left side of a port 35 in a middle position at the left side from a fluid inlet 31, passes a port 35' at the bottom left corner, and then extends to a region between a port 36 in a middle position at the right side and a fluid outlet 33 at the bottom right corner. As shown by the arrows in the figure, fluid from the fluid inlet 31 is divided into three parts, which flow in the three fluid channel regions 331, 332 and 333. Of course, multiple separating parts could also be disposed based on the same principle, to divide the heat exchange plate 30 into 4, 5 or an even greater number of fluid channel regions. As stated above, the separating strips 37 and 38 may be arranged to be substantially parallel to the longitudinal direction of the heat exchange plate 30 (i.e. be in the form of straight lines), to be inclined relative to the longitudinal direction of the heat exchange plate 30, or to have a bent or meandering shape in the longitudinal direction of the heat exchange plate 30. In addition, the number of fluid outlets 32 and 33 may be set to be 2 or 1 as required.

[0040] Fig. 6 shows another example of the heat exchange plate 40 of the present invention. A separating strip 47 extends from a fluid inlet 41 at the top left corner of the heat exchange plate 40 to a region between a fluid outlet 42 at the top right corner and a port 46 at the bottom right corner. Thus, as shown by the arrows in the figure, fluid is split by a bent part 471 of the separating strip into two parts, which respectively flow along the arrows shown in the figure in two fluid channel regions 43 and 44 separated by the separating strip 47, finally converge and then flow out of the fluid outlet 42. Likewise, ports 45 and 46 for mating with an adjacent heat exchange plate are also provided.

[0041] Fig. 7 shows another example of the heat exchange plate 50 of the present invention. Two separating strips 57 respectively extend from a fluid inlet 51 at the top left corner of the heat exchange plate 50 to a region between a fluid outlet 52 at the top right corner and a port 56 at the bottom right corner, but the two separating strips 57 are arranged to be separated by a predetermined distance. Thus, as shown by the arrows in the figure, fluid is split into three parts, which respectively flow in three fluid channel regions 53, 54 and 59 so formed, and finally flow out of the fluid outlet 52. Likewise, ports 55 and 56 for mating with an adjacent heat exchange plate are also provided.

[0042] It is clear from the above that the heat exchange plate is arranged to have at least two independent fluid channel regions whether by means of separating strips or longitudinal pieces, to improve the fluid distribution effect.

[0043] Figs. 1 - 7 all show the surface of the heat exchange plate to be provided with recesses or protrusions, the details of which will not be described again.

[0044] Although no fluid distributor has been provided on the heat exchange plates shown in Figs. 1 - 7, it is clear that in the case where it is necessary to distribute fluid better, or fluid cannot be guided to the required heat transfer region without a fluid distributing device, the following forms of fluid distributor may be employed. In other words, preferably, the separating part described above is used in combination with a fluid distributor in the present invention.

[0045] Figs. 8a - 8d each show an example of a fluid distributor 60 according to the present invention. The fluid distributor 60 has a main body 61 and a middle cavity 62 located inside the main body 61, for receiving fluid. In addition, the fluid distributor 60 also has at least two guide parts 63 and 64 which pass through the fluid distributor 60 and guide fluid out of the middle cavity 62. As the figure shows, the main body 61 is substantially annular or circularly annular, but could also be set to have various feasible shapes such as square, rectangular or elliptical. The guide parts may be set to take the form of a through-hole 63 or a duct 64 which passes through the main body 61 from the outside to the middle cavity 62. The duct 64 may be a tube or a capillary tube, and is used to guide fluid into different fluid channel regions. Fig. 8a shows

guide parts in the form of one through-hole 63 and one duct 64. Fig. 8b shows guide parts in the form of one through-hole 63 and three ducts 64. Fig. 8c shows guide parts in the form of one through-hole 63 and five ducts 64. Fig. 8d shows guide parts in the form of three through-holes 63. It can be understood that the specific form of the guide parts can be selected as required, e.g. through-holes, ducts and channels, or any combination thereof.

[0046] Figs. 9a and 9b each show an enlarged view of part of a heat exchange plate, wherein different examples of the guide parts are shown. Fig. 9a shows an example of fluid from a fluid inlet 71 being guided to different fluid channel regions by means of two guide parts, such as ducts 72 and 73. It is clear from Figs. 9a and 9b that both guide parts are arranged to extend substantially downwards or towards a bottom left side, in order to distribute fluid better.

[0047] Fig. 9b shows an example of fluid from a fluid inlet 81 being guided to different fluid channel regions by means of two guide parts, such as channels 82 and 83, wherein the channels 82 and 83 are integrally formed on the heat exchange plate. It can be understood that although Figs. 9a and 9b only show scenarios in which there are two guide parts, those skilled in the art would be able to understand scenarios in which multiple similar guide parts are provided.

[0048] Figs. 10a and 10b show a partial view and an enlarged view respectively of part of a heat exchange plate according to the present invention. Fig. 10a shows an example of a fluid distributor with guide parts in the form of one through-hole 63 and one duct 64 being used in a heat exchange plate of the present invention. As shown by the arrows in the figure, the heat exchange plate is divided into two fluid channel regions 105 and 106 by means of a separating part 107. As can be clearly seen in the enlarged view of Fig. 10b, fluid guided through the through-hole 63 (i.e. the fluid on the left side in the figure) returns upon encountering a left-side boundary of the separating part 107, and then flows upwards until it flows to a fluid outlet. Fluid is guided to the fluid channel region 106 at the right side of the separating part 107 by means of a long tube or capillary tube 64 (i.e. the fluid on the right side in the figure), and returns upon encountering a right-side boundary of the separating part 107, and then flows upwards until it flows to a fluid outlet. It must be explained that upon encountering a boundary of the heat exchange plate, fluid will similarly return and flow towards the fluid outlet. As Fig. 10a shows, it is also possible to provide separating strips 108 and 109 close to the bottom on left and right sides of the heat exchange plate, to further enhance the fluid distribution effect. The separating part 107 comprises a longitudinal piece or separating strip 104.

[0049] Although multiple structural features of the heat exchange plate of the present invention are shown in the multiple embodiments above, it should be understood that those skilled in the art could combine the multiple structural features in different embodiments to form new

embodiments, and this should be understood as being included in the scope of protection of the present invention.

[0050] The above are merely some embodiments of the present invention. Those skilled in the art will understand that changes may be made to these embodiments without departing from the principles and spirit of the overall inventive concept. The scope of the present invention shall be defined by the claims and their equivalents.

Claims

1. A plate type heat exchanger, comprising multiple heat exchange plates which are stacked together, each heat exchange plate comprising a fluid inlet and a fluid outlet located at two opposite ends respectively in a longitudinal direction of the heat exchange plate,

characterized in that

a separating part is provided on a top surface and/or a bottom surface of each heat exchange plate, such that a fluid coming from the fluid inlet is split into different flows at the fluid inlet, then flows into mutually independent fluid channel regions separated by the separating part and converges at the fluid outlet, and finally flows out of the fluid outlet.

2. The plate type heat exchanger as claimed in claim 1, **characterized in that** the separating part comprises a separating strip, which splits fluid into different flows at the fluid inlet, and a longitudinal piece connected thereto.

3. The plate type heat exchanger as claimed in claim 2, **characterized in that** the longitudinal piece is arranged in one of the following three ways:

substantially parallel to the longitudinal direction of the heat exchange plate;
inclined relative to the longitudinal direction of the heat exchange plate;
having a bent or meandering shape in the longitudinal direction of the heat exchange plate.

4. The plate type heat exchanger as claimed in claim 1, **characterized in that** the separating part comprises at least one separating strip extending from the fluid inlet to the vicinity of the fluid outlet.

5. The plate type heat exchanger as claimed in claim 4, **characterized in that** the separating strip is arranged in one of the following three ways:

- substantially parallel to the longitudinal direction of the heat exchange plate;
inclined relative to the longitudinal direction of the heat exchange plate;
having a bent or meandering shape in the longitudinal direction of the heat exchange plate.
6. The plate type heat exchanger as claimed in claim 2 or 4, **characterized in that** at the fluid inlet, the separating strip is arranged to be in the angular range of -45° to 45° relative to a direction perpendicular to the longitudinal direction of the heat exchange plate, wherein the separating strip is in the shape of a straight line or bent.
7. The plate type heat exchanger as claimed in any one of claims 1 - 6, **characterized in that** the fluid inlet is at a top side at a left end of the top surface and/or bottom surface of the heat exchange plate, and the fluid outlet is at a top side or bottom side at a right end of the surface of the heat exchange plate.
8. The plate type heat exchanger as claimed in any one of claims 1 - 7, **characterized in that** a fluid distributor is provided at the fluid inlet, the fluid distributor having a middle cavity for receiving a fluid from the fluid inlet, and at least two guide parts which pass through the fluid distributor and guide fluid out of the middle cavity.
9. The plate type heat exchanger as claimed in claim 8, **characterized in that** the at least two guide parts comprise any one of a through-hole, a duct and a channel passing through a main body of the fluid distributor, or any combination thereof.
10. The plate type heat exchanger as claimed in claim 9, **characterized in that** the ducts comprise tubes and/or capillary tubes which introduce fluid into different fluid channel regions respectively.
11. The plate type heat exchanger as claimed in claim 9, **characterized in that** the channel is formed on the heat exchange plate integrally or separately.
12. The plate type heat exchanger as claimed in claim 9, **characterized in that** the fluid distributor comprises an annular main body which the guide parts pass through from the outside.
13. The plate type heat exchanger as claimed in any one of claims 1 - 12, **characterized by** also comprising end plates which are disposed on outer sides of the heat exchange plates and used for fixing the heat exchange plates in place.
14. The plate type heat exchanger as claimed in any one of claims 1 - 13, **characterized in that** a structural pattern for distributing fluid is provided on the surface of the heat exchange plate.
15. The plate type heat exchanger as claimed in claim 14, **characterized in that** multiple regularly arranged recesses or protrusions are provided on the surface.
16. The plate type heat exchanger as claimed in claim 14, **characterized in that** multiple alternately arranged channels and ridges in an inverted-V-shape are provided on the surface.

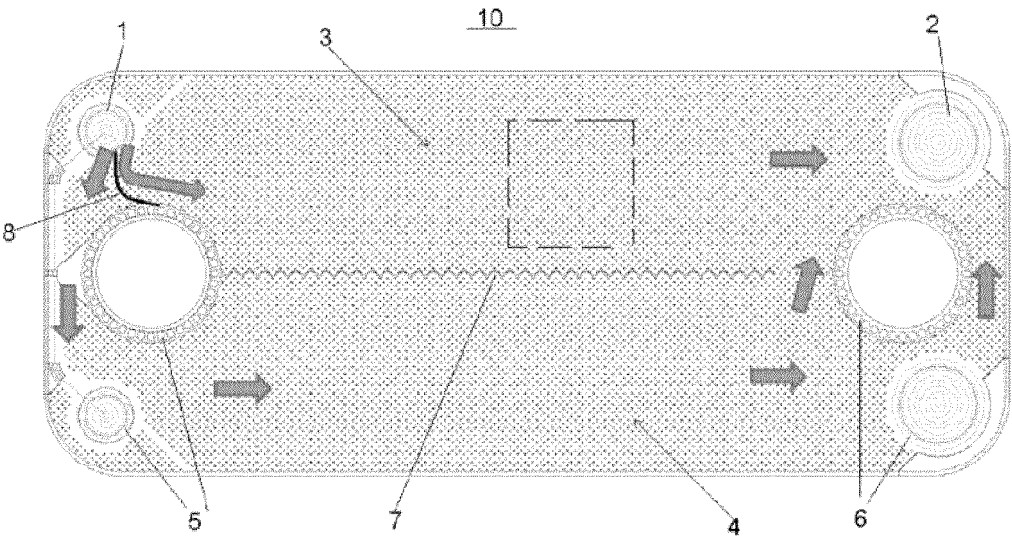


Fig. 1

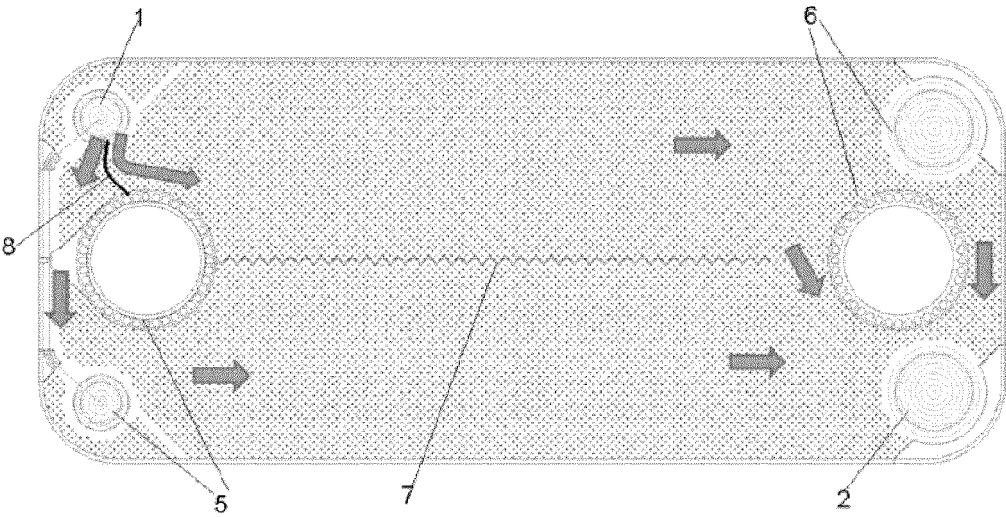


Fig. 2

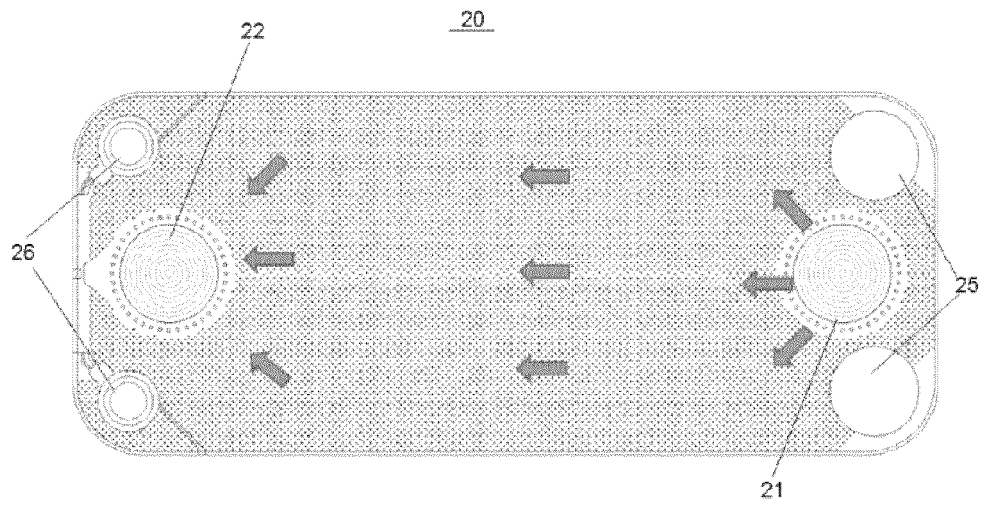


Fig. 3

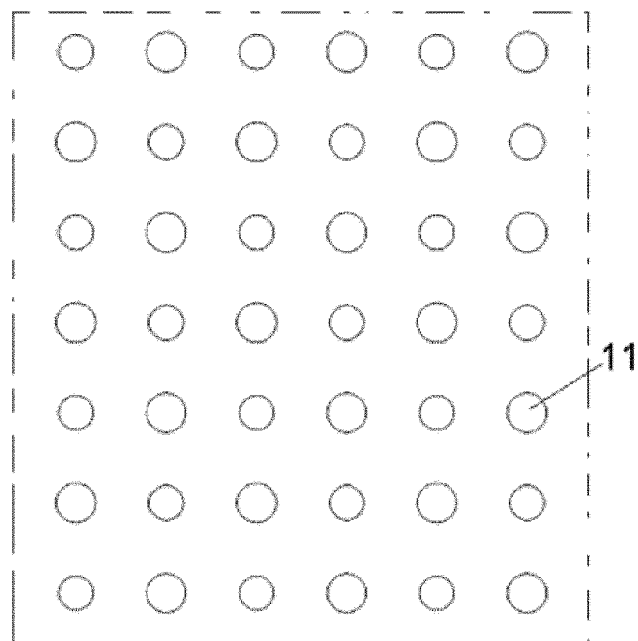


Fig. 4

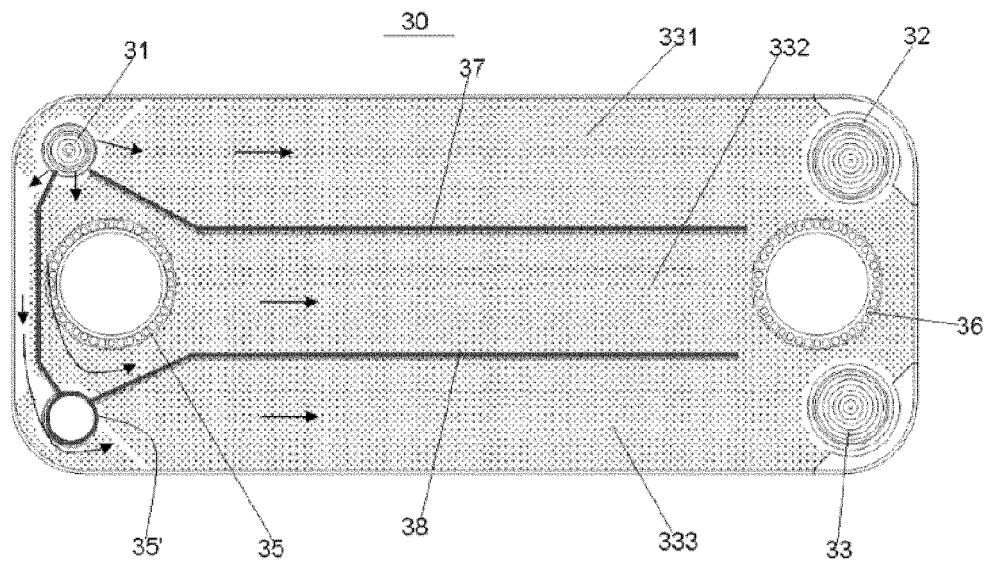


Fig. 5

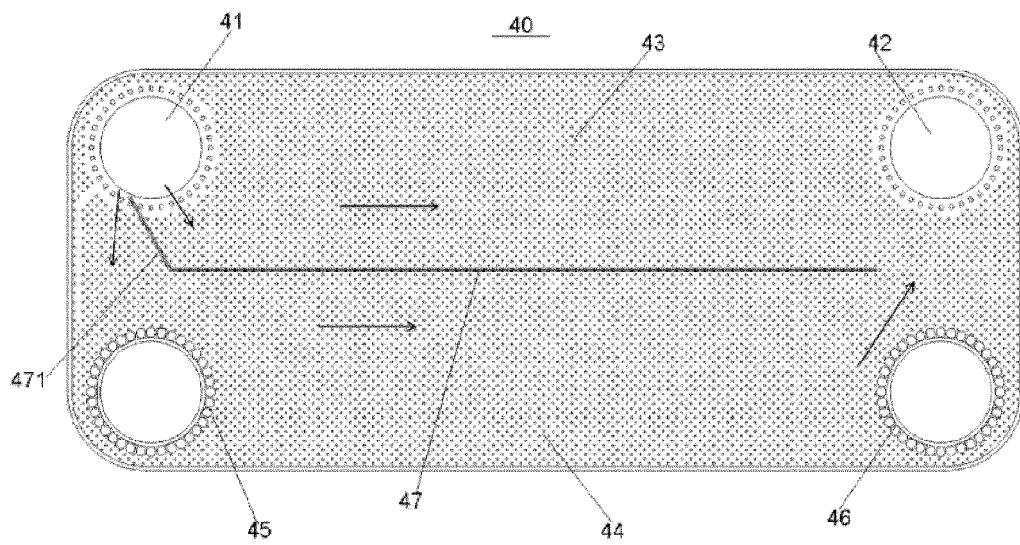


Fig. 6

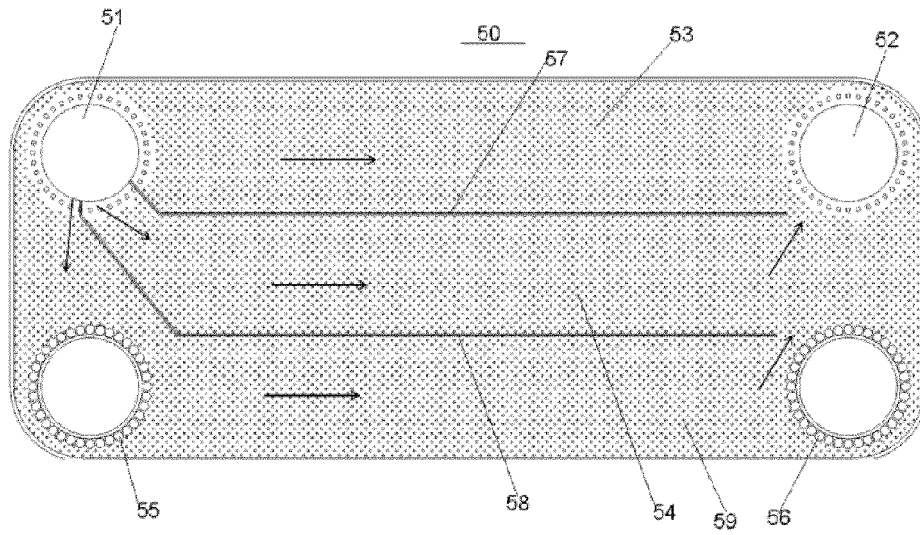


Fig. 7

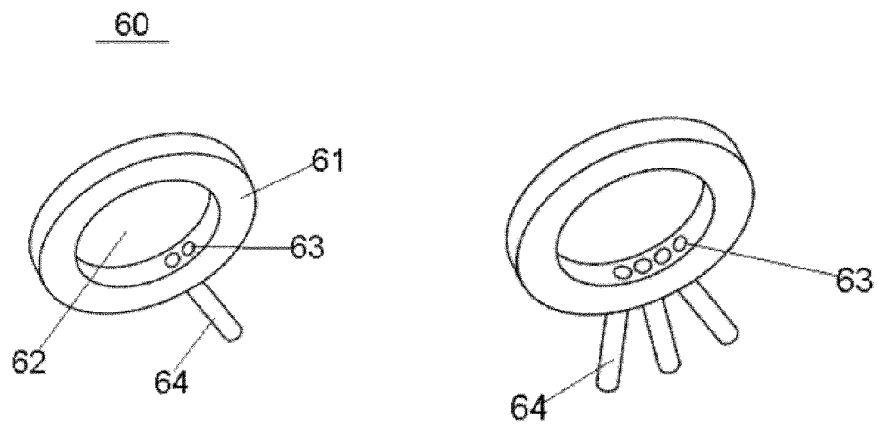


Fig. 8a

Fig. 8b

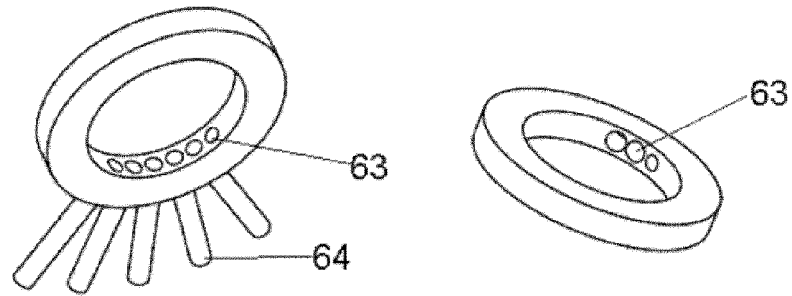


Fig. 8c

Fig. 8d

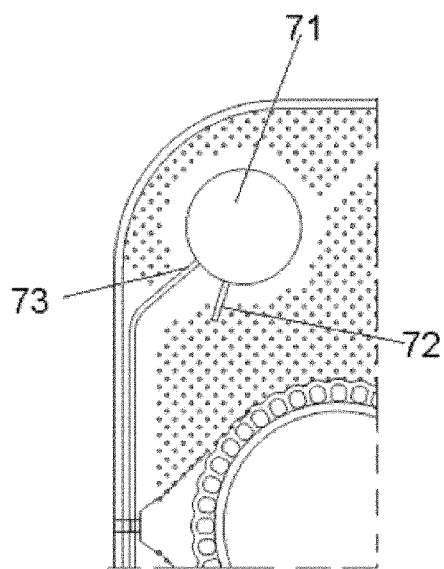


Fig. 9a

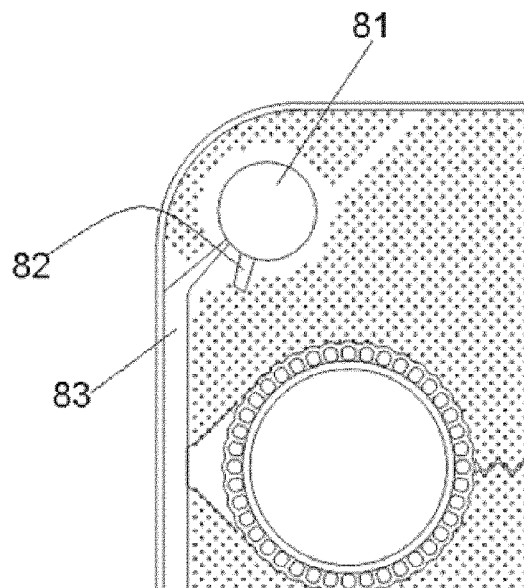


Fig. 9b

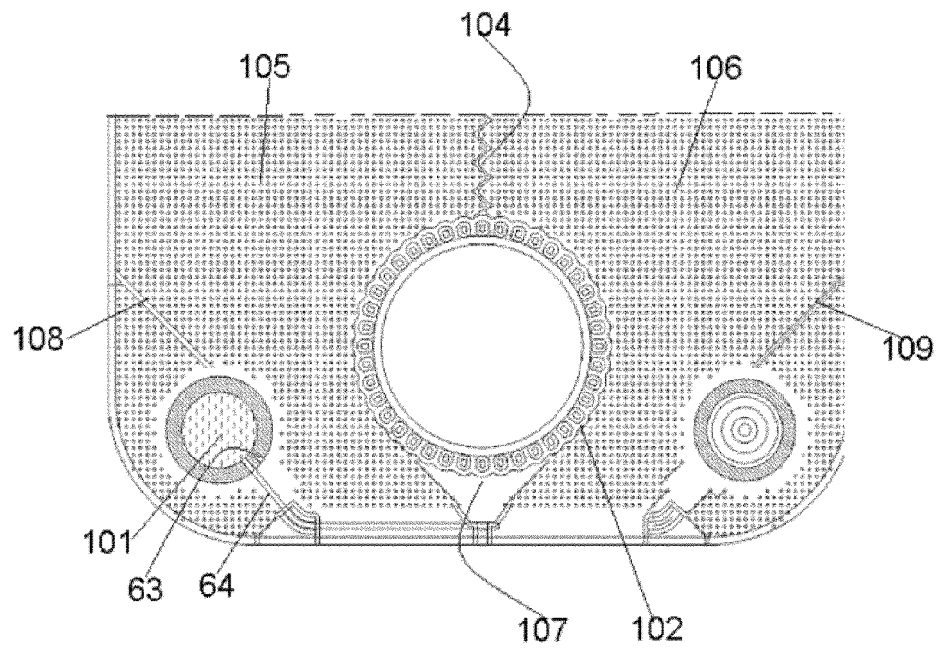


Fig. 10a

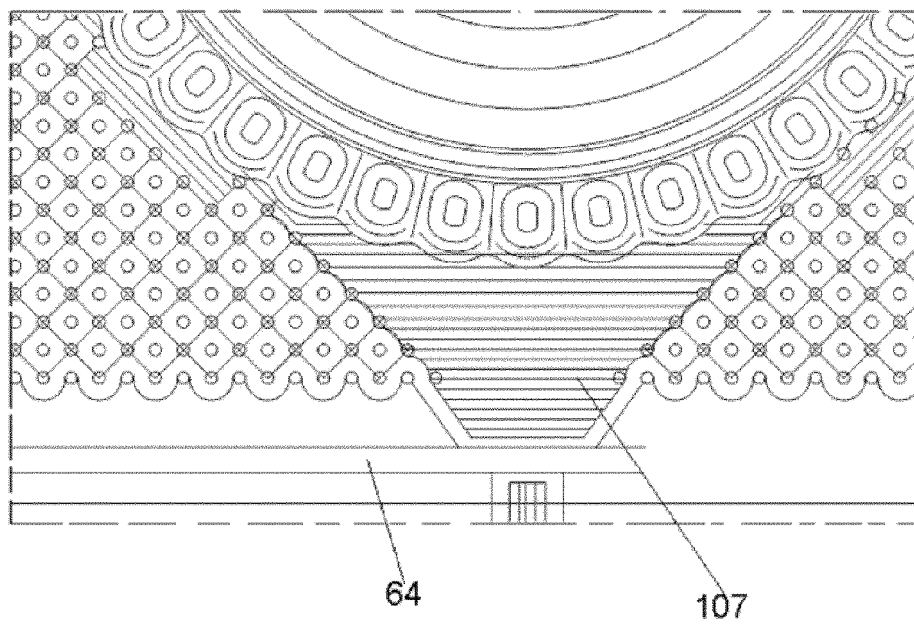


Fig. 10b

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2015/071724

A. CLASSIFICATION OF SUBJECT MATTER

F28F 3/08 (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)

IPC: F28F; F25B

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)

CNTXT, CNKI, VEN: heat exchanger, plate type, divid+, distribut+, dispens+, shar+, slot, groove

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	WO 2012176336 A1 (MITSUBISHI ELECTRIC CORP et al.) 27 December 2012 (27.12.2012) description, paragraphs [0028]-[0032], and figures 8 and 9	1, 7-16
Y	CN 101629792 A (LINDE AG) 20 January 2010 (20.01.2010) description, page 4, line 12 to page 5, line 24, and figures 1-3	1, 7-16
PX	CN 103759474 A (DANFOSS MICRO CHANNEL HEAT EXCHANGER JIAXING CO., LTD.) 30 April 2014 (30.04.2014) claims 1-16	1-16
A	CN 103424024 A (HANGZHOU SANHUA INST CO., LTD.) 04 December 2013 (04.12.2013) the whole document	1-16

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

* Special categories of cited documents:

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“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

“&” document member of the same patent family

Date of the actual completion of the international search
07 April 2015

Date of mailing of the international search report
06 May 2015

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2015/071724

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2010261662 A (HISAKA WORKS LTD.) 18 November 2010 (18.11.2010) the whole document	1-16

Form PCT/ISA /210 (continuation of second sheet) (July 2009)

INTERNATIONAL SEARCH REPORT
 Information on patent family members

 International application No.
 PCT/CN2015/071724

Patent Documents referred in the Report	Publication Date	Patent Family	Publication Date
WO 2012176336 A1	27 December 2012	CN 103649668 A	19 March 2014
		US 2014123697 A1	08 May 2014
		JPWO 2012176336 A1	23 February 2015
		JP 5665983 B2	04 February 2015
		GB 2505829 A	12 March 2014
CN 101629792 A	20 January 2010	US 2010025026 A1	04 February 2010
		DE 102008033302 A1	21 January 2010
CN 103759474 A	30 April 2014	None	
CN 103424024 A	04 December 2013	None	
JP 2010261662 A	18 November 2010	JP 5174739 B2	03 April 2013

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- CN 201410042349 [0001]