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(54) **Refrigerant distributor for heat exchanger and heat exchanger**

(57) A refrigerant distributor for a heat exchanger is disclosed. The distributor comprises: a pipe having an inlet disposed generally at one end of the pipe, refrigerant flowing into the pipe through the inlet. A cross-section of a flow passage within the pipe gradually decreases from

the one end to the other end of the pipe. With the above configuration, the refrigerant can be distributed relatively uniformly.

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Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to a refrigerant distributor for a heat exchanger and a heat exchanger having the refrigerant distributor.

2. Description of the Related Art

[0002] A conventional micro-channel heat exchanger 2' generally comprises micro-channels or flat tubes 5, fins 4 disposed between the adjacent micro-channels or flat tubes 5, an inlet manifold 3 and an outlet manifold (not shown) disposed at ends of the micro-channels or flat tubes 5 respectively, and a refrigerant distributor 1' disposed in the inlet manifold 3 as shown in Figs. 1-2. The refrigerant distributor 1' is disposed at a side of the heat exchanger 2' to distribute refrigerant. The distributor 1' may have a portion extending out of the inlet manifold 3 as shown in Fig. 1 or may have no portion extending out of the inlet manifold 3.

[0003] In the conventional micro-channel heat exchanger 2', and especially in a micro-channel evaporator, since refrigerant is two-phase refrigerant containing gas and liquid, if an inappropriate refrigerant distributor is employed, the refrigerant can not be uniformly distributed to the micro-channels or flat tubes 5.

[0004] The distributor 1' is composed of a cylindrical pipe that is inserted into the inlet manifold 3, and a plurality of outlets 8 with the same size are arranged in the cylindrical pipe at the same intervals in a longitudinal direction of the pipe as shown in Figs. 1-2. Refrigerant flows from the outlets 8 of the distributor 1' near the inlet 7 at a high flow rate so that more refrigerant is distributed, but refrigerant flows from the outlets 8 of the distributor 1' far from the inlet 7 at a low flow rate so that less refrigerant is distributed.

[0005] The above distributor is disadvantageous in that since the flow rate gradually decreases in a refrigerant flow direction R in which refrigerant flows in the distributor 1', if a diameter (i.e., a cross-section area) of the pipe is uniform along its length, a volume flow rate of the refrigerant Q is expressed as $Q=VA$, where V represents a flow speed, and A represents a cross-section area of a distributor.

[0006] Therefore, the flow speed of the refrigerant gradually reduces in the refrigerant flow direction R and thus the flow rate of the refrigerant flowing from the outlets with the same size is decreased. More refrigerant is distributed from the outlets near the inlet, and less refrigerant is distributed from the outlets far from the inlet. Furthermore, after the flow speed reduces, the gas and liquid tend to be separated from each other to cause non-uniform distribution of the refrigerant.

SUMMARY OF THE INVENTION

[0007] It is an object of the present invention to provide a refrigerant distributor for a heat exchanger and a heat exchanger having the refrigerant distributor which can relatively uniformly distribute refrigerant.

[0008] In accordance with an aspect of the present application, there is provided a refrigerant distributor for a heat exchanger. The distributor comprises: a pipe having an inlet disposed generally at one end of the pipe, refrigerant flowing into the pipe through the inlet, wherein a cross-section of a flow passage within the pipe gradually decreases from the one end to the other end of the pipe.

[0009] In accordance with another aspect of the present application, there is provided a heat exchanger. The heat exchanger comprises a refrigerant distributor disposed at a side of the heat exchanger to distribute refrigerant, wherein the refrigerant distributor is one of the distributors mentioned above.

[0010] With the above configuration, refrigerant can be distributed relatively uniformly.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] These and/or other aspects and advantages of the present invention will become apparent and more readily appreciated from the following description of the embodiments, taken in conjunction with the accompanying drawing.

Fig. 1 is a conventional micro-channel heat exchanger.

Fig. 2 is a sectional view taken along line A-A of Fig. 1.

Fig. 3 is a schematic view showing a micro-channel heat exchanger according to a first embodiment of the present application.

Fig. 4 is a schematic view showing a refrigerant distributor for a micro-channel heat exchanger according to the first embodiment of the present application.

Fig. 5 is a schematic view showing a refrigerant distributor for a micro-channel heat exchanger according to a second embodiment of the present application.

Fig. 6 is a schematic view showing a micro-channel heat exchanger according to a third embodiment of the present application.

Fig. 7 is a schematic view showing a refrigerant distributor for a micro-channel heat exchanger according to the third embodiment of the present application.

Fig. 8 is a schematic view showing a micro-channel heat exchanger according to the third embodiment of the present application.

DETAILED DESCRIPTION OF THE EMBODIMENTS

[0012] The embodiments are described below in order

to explain the present invention, but do not pose a limitation on the scope of the invention.

Embodiment 1

[0013] A micro-channel heat exchanger 2 according to the first embodiment of the present application comprises micro-channels or flat tubes 5, fins 4 disposed between the adjacent micro-channels or flat tubes 5, an inlet manifold 3 and an outlet manifold (not shown) disposed at ends of the micro-channels or flat tubes 5 respectively, and a refrigerant distributor 1 disposed in the inlet manifold 3 as shown in Figs. 3-4. The refrigerant distributor 1 is disposed at a side of the heat exchanger 2 to distribute refrigerant.

[0014] The refrigerant distributor 1 for the heat exchanger 1 comprises: a pipe 9 having an inlet 7 disposed generally at one end of the pipe. Refrigerant flows into the pipe through the inlet in use. A cross-section of a flow passage within the pipe 9 gradually decreases from the one end to the other end of the pipe.

[0015] The pipe 9 comprises a plurality of segments 91, and a cross-section area of one of the plurality of segments 91 is less than that of the preceding one of the plurality of segments 91 from the one end to the other end of the pipe.

[0016] As shown in Fig. 4, the distributor 1 or pipe 9 may comprise a plurality of cylindrical pipes 91 having different diameters and connected with each other by welding. The respective diameters of the plurality of cylindrical pipes 91 gradually decrease in a refrigerant flow direction R in which the refrigerant flows in the pipe 9. The pipe 9 shown in Fig. 4 does not contain the portion extending out of the heat exchanger as shown in Fig. 3.

[0017] With the above distributor, the flow rate of the refrigerant gradually decreases in the refrigerant flow direction R, but a cross-section area of the pipe also reduces in the refrigerant flow direction R. It can be known from the formula $Q=VA$ that a flow speed of refrigerant is substantially uniform along the entire length of the distributor and generally uniform amount of refrigerant is distributed from the outlets with the same size. Therefore, the distributor can ensure that amounts of refrigerant passing through the respective outlets are uniform.

Embodiment 2

[0018] A heat exchanger according to the second embodiment of the present invention is the same as that of the first embodiment except a distributor 1. Only the distributor 1 is described below in detail.

[0019] The distributor 1 according to the second embodiment comprises a pipe 9. The pipe 9 is configured in such a manner that a cylindrical pipe is divided into a plurality of segments 91 and is at least partially pressed so that a cross-section of one of the plurality of segments 91 is narrower than that of the preceding one of the plurality of segments from the one end to the other end of

the pipe. In other words, the cylindrical pipe is pressed to be more flat gradually in the refrigerant flow direction R. The cross-sections of the pipe have the same perimeter, but the cross-section area of the pipe gradually reduces in the refrigerant flow direction R as shown in Fig. 5.

[0020] With the above configuration of the distributor, the flow rate of the refrigerant gradually decreases in the refrigerant flow direction R, but the cross-section area of the pipe also reduces in the refrigerant flow direction R. It can be known from the formula $Q=VA$ that a flow speed of refrigerant is substantially uniform along the entire length of the distributor and generally uniform amount of refrigerant is distributed from the outlets with the same size. Therefore, the distributor can ensure that amounts of refrigerant passing through the respective outlets are uniform.

Embodiment 3

[0021] A micro-channel heat exchanger 2 according to the third embodiment of the present application comprises micro-channels or flat tubes 5, fins 4 disposed between the adjacent micro-channels or flat tubes 5, an inlet manifold 3 and an outlet manifold (not shown) disposed at ends of the micro-channels or flat tubes 5 respectively, and a refrigerant distributor 1 disposed in the inlet manifold 3 as shown in Figs. 6 and 8. The refrigerant distributor 1 is disposed at a side of the heat exchanger 2 to distribute refrigerant.

[0022] The distributor 1 comprises a plurality of distributing pipes 9 (three pipes 9 are shown in Figs. 6-8) having the same diameter and inserted into the inlet manifold 3 as shown in Figs. 6-8. The plurality of distributing pipes 9 have different lengths. The first one of the plurality of distributing pipes 9 is shortest and is used for distributing the refrigerant in a range from the inlet 7 to an end 11 of the first pipe away from the inlet 7. The lengths of the remaining pipes 9 are increased successively from the second one to the last one, and each of the remaining pipes is used for distributing the refrigerant in a range from an end 11 of the preceding pipe 9 away from the inlet 7 to its end 11 away from the inlet 7, as shown in Fig. 7.

[0023] Each of the plurality of distributing pipes 9 is responsible for distributing refrigerant to the same number of the micro-channels or flat tubes 5. In Fig. 7, reference numerals 8' indicate refrigerant flows distributed by the plurality of pipes 9. The pipes 9 shown in Fig. 7 do not contain the portions extending out of the heat exchanger 2 as shown in Fig. 6.

[0024] With the above configuration of the distributor, since each distributor pipe is responsible for distributing refrigerant to fewer flat tubes, a number of the distributing outlets is decreased. Therefore, the flow speed of the refrigerant within the distributor is relative uniform.

[0025] Alternatively, a plurality of distributing pipes 9 are inserted into the inlet manifold as shown in Fig. 8, but each of the plurality of distributing pipes 9 may be

used to distribute refrigerant to different numbers of flat tubes 5 according to the different conditions as required, respectively. The flow rate of refrigerant can be distributed by adjusting the cross-section area of each of the pipes 9 and/or size and number of the outlets in each of the distributing pipes 9, or different combinations thereof. When the heat exchanger having the distributor is used for domestic, commercial and other applications, only the combination of the distributing pipes is adjusted to improve the distribution of refrigerant conveniently.

[0026] In addition, the distributing pipe 9 may comprise any other number of pipes such as two, four, and five pipes. The plurality of pipes 9 can be arranged horizontally (as shown in Fig. 8), vertically (as shown in Fig. 6) or at any appropriate angle or diagonally.

[0027] Although the above embodiments have been described, but other configuration may be used to enable fluid to flow at a uniform flow speed within the distributing pipe. For example, a cone-shape pipe can be used for the distributor.

[0028] In addition, in the above embodiments, the distributing pipe 9 and the inlet manifold 3 are made of a cylindrical pipe, but they can be made of pipe having any appropriate cross-section shape such as a pipe having elliptical cross-section.

[0029] Furthermore, in the above embodiment, the micro-channel heat exchanger is described and shown in a state that the micro-channel heat exchanger stands vertically only for the purpose of convenient description and illustration. The present invention is not limited to the examples shown in the figures. In addition, the outlet manifold located on the above side of the micro-channel exchanger is omitted in the figures. The distributing pipe 9 and the inlet manifold may be disposed on the above side of the micro-channel exchanger shown in the drawings.

[0030] In addition, although the micro-channel heat exchanger is described in order to explain the present invention, the principle and concept of the present invention can be applied to any other appropriate heat exchangers.

[0031] Furthermore, the micro-channel heat exchanger or the heat exchanger according to the embodiments of the present application can be used as an evaporator and the like.

[0032] Moreover, in the above embodiments, the distributing pipe 9 is inserted from one end of the inlet manifold, but with regard to the distributing pipe 9 shown in Figs. 4-5, two distributing pipes 9 may be employed and inserted into the inlet manifold from both ends of the inlet manifold respectively, and as for the distributor shown in Fig. 7, two distributors may be employed and inserted into the inlet manifold from both ends of the inlet manifold, respectively.

Claims

1. A refrigerant distributor for a heat exchanger, comprising:

a pipe having an inlet disposed generally at one end of the pipe, refrigerant flowing into the pipe through the inlet, wherein a cross-section of a flow passage within the pipe gradually decreases from the one end to the other end of the pipe.

2. The refrigerant distributor for a heat exchanger according to claim 1, wherein the pipe is configured in such a manner that a cylindrical pipe is divided into a plurality of segments and is at least partially pressed so that a cross-section of one of the plurality of segments is narrower than that of the preceding one of the plurality of segments from the one end to the other end of the pipe.

3. The refrigerant distributor for a heat exchanger according to claim 1, wherein the pipe comprises a plurality of segments, and a cross-section area of one of the plurality of segments is less than that of the preceding one of the plurality of segments from the one end to the other end of the pipe.

4. The refrigerant distributor for a heat exchanger according to claim 1, wherein the pipe comprises a plurality of pipes having different lengths, the first one of the plurality of pipes is shortest and is used for distributing refrigerant in a range from the inlet to an end of the first pipe away from the inlet, the lengths of the remaining pipes are increased successively from the second one to the last one, and each of the remaining pipes is used for distributing refrigerant in a range from an end of the preceding pipe away from the inlet to its end away from the inlet.

5. The refrigerant distributor for a heat exchanger according to claim 4, wherein the pipe comprises three pipes.

6. The refrigerant distributor for a heat exchanger according to claim 1, wherein the pipe is a taper pipe.

7. A heat exchanger, comprising:

a refrigerant distributor disposed at a side of the heat exchanger to distribute refrigerant, wherein the refrigerant distributor is the distributor according to any one of claims 1-6.

8. The heat exchanger according to claim 7, wherein the heat exchanger is a micro-channel heat exchanger.

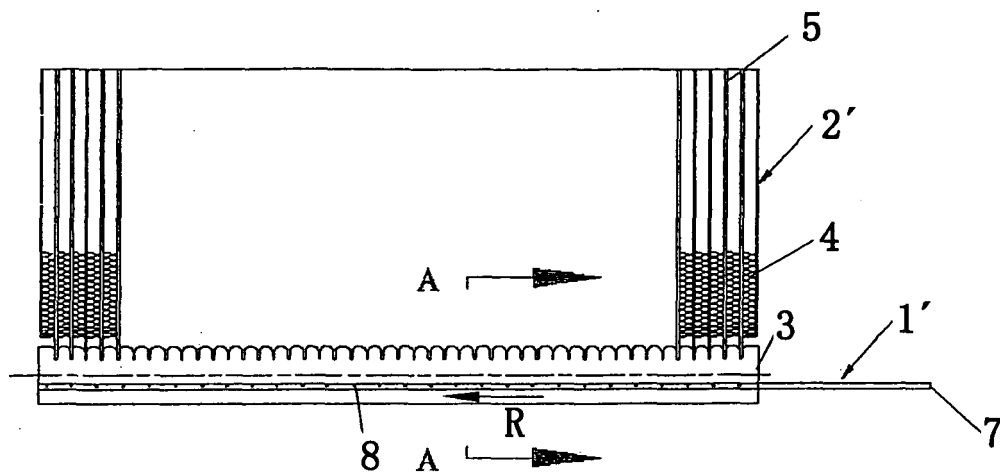


Fig. 1

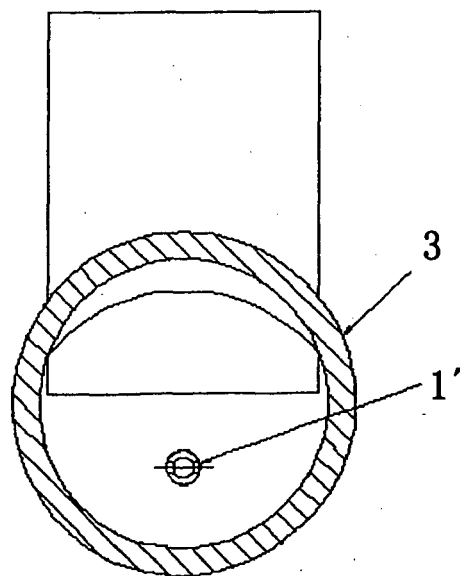


Fig. 2

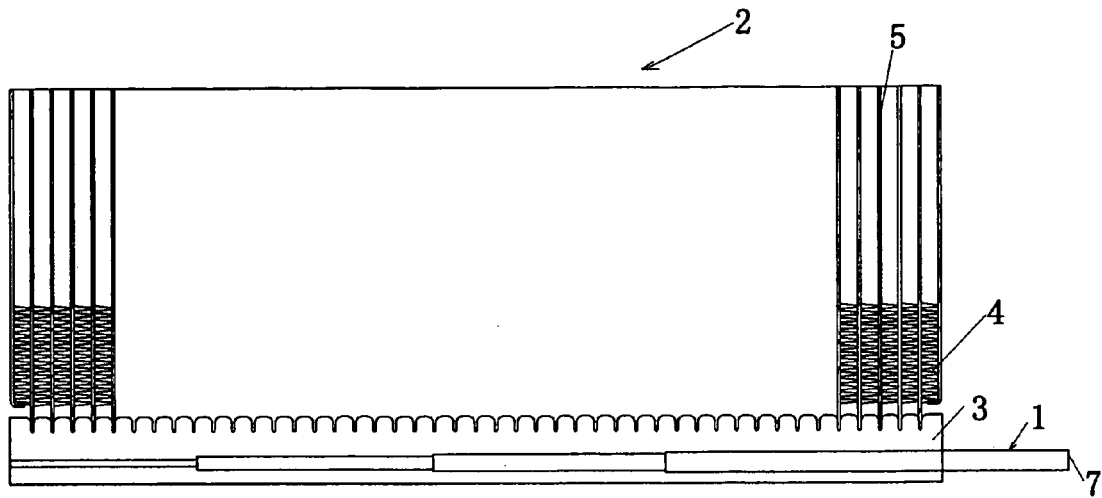


Fig. 3

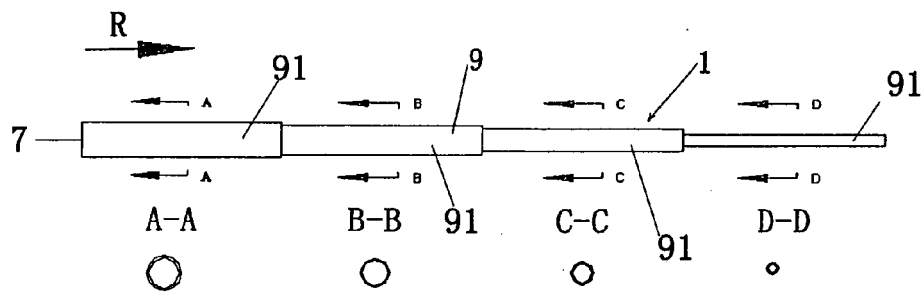


Fig. 4

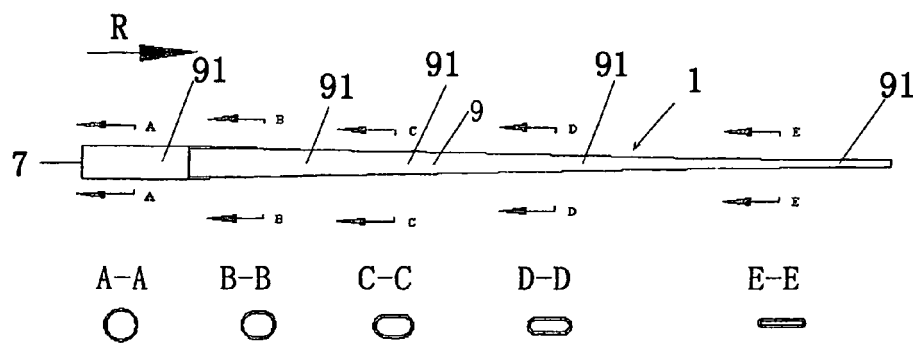


Fig. 5

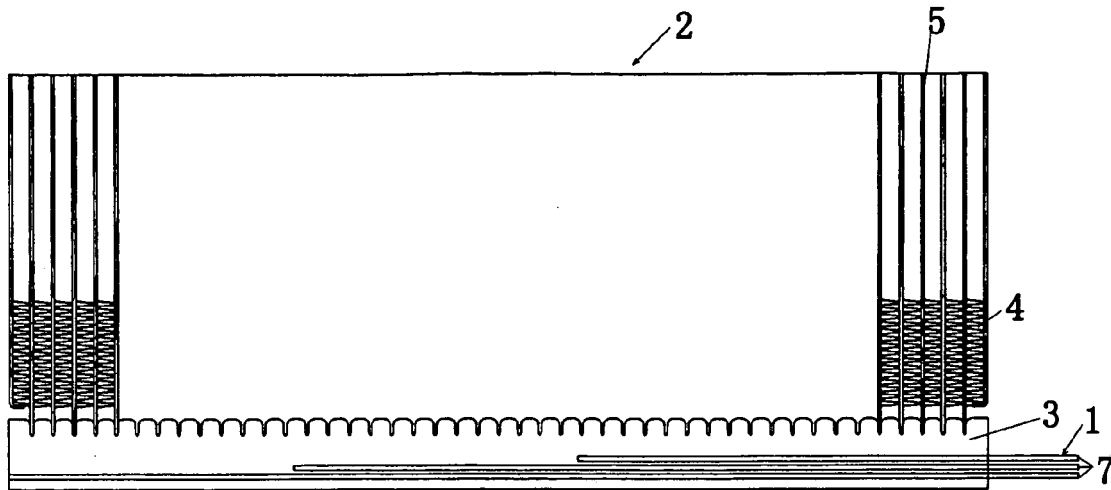


Fig. 6

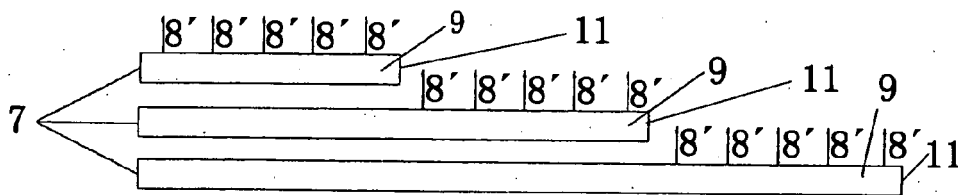


Fig. 7

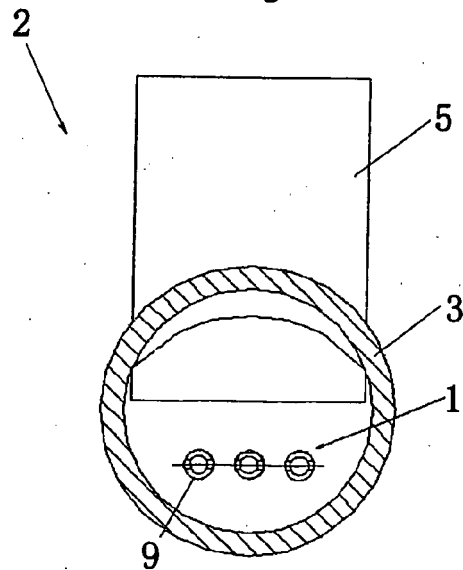


Fig. 8