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(54) **FIN SOLUTION RELATED TO MICRO CHANNEL BASED HEAT EXCHANGER**

RIPPENLÖSUNG IM ZUSAMMENHANG MIT AUF MIKROKANAL BASIERENDEM
WÄRMETAUSCHER

SOLUTION D'AILETTE ASSOCIÉE À UN ÉCHANGEUR DE CHALEUR À BASE DE MICROCANAU

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Description

[0001] The present invention relates to micro channel (multi-port) based heat exchangers for heat exchange or heat recovery in systems such as refrigeration or heat pump systems, in particular a condenser or evaporator in such systems.

[0002] Micro channel type heat exchangers based on Multi Port Extruded profiles of aluminium (MPE) are known where serpentine fins, also of aluminium, are provided in the longitudinal direction of and between the extruded tubes or channels.

[0003] The fins are commonly brazed to the profiles at their elbow outer faces (as can be seen in the attached Fig. 1).

[0004] Heat exchangers of such type are for instance known from JP laid open publication No. 3-13794 JP S59 104094 A discloses a micro channel or multiport based heat exchangers according to the preamble of claim 1. A limitation with these known heat exchangers is the poor drainage of water condensed on the outer faces of the heat exchanger. With the present invention is provided an improved heat exchanger fin arrangement and design which:

- Utilize the benefit of MPE production technology.
- More tubes in one extrusion.
- Fewer parts in heat exchanger assembly.
- Allows better surface balance (optimization) between the refrigerant and air side of the heat exchanger.
- Can utilize the continuous fin concept.
- Improves condensed water drainage from the MPE type heat exchanger.
- More robust fins on heat exchanger air inlet and outlet.
- More rational heat exchanger assembly process
- Can be utilized with a novel web-MPE design (see later definition) The invention is characterized by the features as defined in the attached independent claim 1 .

[0005] The present invention provides;

A Micro channel or multiport based heat exchangers of aluminium for heat exchange or heat recovery in systems such as refrigeration or heat pump, in particular a condenser or evaporator in such systems, including in addition to the micro channel or multiport extrusions, serpentine fins (9) attached to the extrusions (7,8) and inlet an outlet manifolds collectors/distributors (15) attached to the extrusions, wherein that the serpentine fins (9) are provided transversally in relation to the extrusions (7, 8) and laying with their side edges (10, 11) perpendicular to the extrusions (7, 8) where the extrusion (30) is of the web-MPE design, characterized in that part of the material of the flanges or webs (14) between the micro port or tubes are removed to enhance drainage of condensed water and/or reduce and control heat transfer in the trans-

versal direction of the micro ports or tubes.

Preferred embodiments of the invention are further defined in the independent claims 2-8.

[0006] The invention will be further described in detail in the following by means of examples and with reference to the attached drawings, where:

Fig. 1 shows in perspective view part of a commonly known MPE based heat exchanger with serpentine fin assembly,

Fig. 2 shows a perspective view part of a MPE based heat exchanger with a serpentine fin assembly according to the invention,

Fig. 3 shows examples of extruded profiles that may suitably be used in connection with the present invention,

Fig. 4 shows an expanded view of an assembly of a part of a web-MPE based heat exchanger with a serpentine fin assembly according to the invention,

Fig. 5 shows an embodiment of the extrusion and fin design according to the invention where the crests or bends of the fins are partly removed, Fig. 6 shows a cross section of the assembly shown in Fig. 5 and how the fins are adopted to and brazed to the extrusions,

Fig. 7 shows an alternative embodiment of the invention where the fins are provided with a "louvre" design.

Fig. 8 is an illustration of different louver and airflow designs,

Fig. 9 shows alternative serpentine fin enhancement designs shows a further serpentine fin design with optimized reduction of heat transfer in the air flow direction, shows an embodiment of a web-MPE design with optimized braze flanges, shows still another alternative web-MPE design where part of the web material between the ports or tubes of the extrusion is removed. a) is a perspective view and b) is a cross section of part of fin and tube embodiment showing a modification with improved bonding/brazing properties.

[0007] As stated above, Fig. 1 shows in perspective view part of a commonly known MPE based heat exchanger 1 with serpentine fin assembly. As can be seen from the figure, the serpentine fin 2 of the heat exchanger is provided in the longitudinal direction standing between the multi tube extrusions 3, 4 and is attached to the extrusions at their crests or bends 5 outer faces by means of the brazing 6. A heat exchanger of this type is normally composed of a number of such extrusions 3 with "layers"

of fins 2 and extrusions 3, 4 (one above the other), depending on the size and heat exchange capacity of the heat exchanger.

[0008] Fig. 2 shows part of a heat exchanger according to the invention where the serpentine fins 9 are provided transversally in relation to the extrusions 7, 8 and laying with their sharp edges 10, 11 perpendicular to the extrusions 7, 8. As with the known horizontal, standing version shown in Fig. 1, the heat exchanger according to the invention as shown in Fig. 2 may be composed of one, a few, or number of extrusions 3, 4 (see corresponding Fig. 1) side by side, with "layers" of fins 9 depending on the size and heat exchange capacity of the heat exchanger. As can be seen from the figure (see also later figures) the bends of the fins 9 may stretch beyond the side edges of the extrusions 7, 8. Fig. 3 shows examples of extruded profiles that may suitably be used in connection with the present invention, i.e. the ordinary multi-port (or channel) extrusion, so-called MPE 5, 7, 8 as mentioned above and shown in figures 1 and 2 and a web type extrusion with "individual" tubes or micro channels 13 interlinked with a thinner flanges or webs 14 in the following referred to as web-MPE..

[0009] Fig. 4 shows an expanded view of an assembly of a part of a web-MPE 12 based heat exchanger with a serpentine fin assembly according to the invention including a manifold 15. Heat exchangers of this type is commonly provided with two manifolds, an inlet manifold and outlet manifold and this is therefore just an illustration showing only one manifold 15. Fig. 4 also shows by means of arrows the direction of the refrigerant flowing in the web-MPE micro ports or tubes 17, respectively the direction of the air flowing on the outside of the heat-exchanger in the transversal direction of the web-MPE 12 but alongside the serpentine fins 9.

[0010] Fig. 5 further shows an embodiment of the extrusion 12 and fin design according to the invention where the crests or bends of the fins are cut and partly removed, at 19, respectively 20. This is done to enhance and improve the air flow through the fins. Fig. 6 still further shows a cross section of a similar assembly as shown in Fig. 5. As can be seen in this figure, part of the material of the fins 9 are removed and thereby adapted to the flanges or web sections 14 of the profiles 12 such that the fins 9 may be connected to the profiles basically along the total outer surface (web 14 including tubes 17) by brazing 21. This will improve the connection between the fins and extrusions and enhance heat transfer between the profile and fin. However, an alternative may be to connect the fins to the tubes only as is indicated in Fig 5.

[0011] Fig. 7 shows an alternative embodiment of the invention where the serpentine fins 9 are provided with a "louver" 23 design to enhance convection of heat from the fins to the air or vice versa (depending on application). The fins 9 are provided with vertical slits where the metal along the slits is pressed inwards or outwards creating transversal louvers 23 which are designed to pick up air directing it through the created openings in the fin. This

is further illustrated in Fig. 8 which shows different louver and air flow designs. The crests or bends of the serpentine fins may be open or closed as stated in the figure.

[0012] With the present invention other fin designs may also be possible as shown in Fig. 9 where the fins are provided with lengthwise 25 or crosswise 24 wave designs. Other designs may also be possible such as herringbone pattern.

[0013] Fig. 10 shows a design where one or more heat transfer separation zones 31 can be punched in the fin. Similar design is used in the deeper F&T heat exchanger design to suppress heat transfer in the air flow direction. Fig. 11 shows an alternative web-MPE design where the ports or tubes of the extrusions 26 are provided with outwardly protruding flanges 27 improving the brazing connection between the fins and extrusions as well as the heat transfer between the fins and aid extrusions. Fig. 12 shows an extrusion web design where part of the material of webs 29 is removed to enable drainage between the tubes and when needed to reduce heat transfer in transversal direction of the tubes. If more of the web material is removed, the heat transfer is correspondingly also reduced. This design may be used to optimise heat transfer.

[0014] Further Fig. 13 a) shows a perspective view and b) is a cross section of part of fin 30 and tube 31 embodiment where the lower part 32 of the fin 30 is buckled outwards to improve the bonding or brazing (attachment) of the fin to the tubes. The invention as defined in the claims is not delimited to the example as described above and shown in the figures. Thus, the heat exchanger can be used, not only as condenser or evaporator in a refrigeration system, but in any system where heat is exchanged or recovered. Further, the expression multi tube as defined in the claim may include single or multi tube extruded profiles of aluminium.

Claims

1. Micro channel or multiport based heat exchangers of aluminium for heat exchange or heat recovery in systems such as refrigeration or heat pump, in particular a condenser or evaporator in such systems, including in addition to the micro channel or multiport extrusions, serpentine fins (9) attached to the extrusions (7,8) and inlet an outlet manifolds collectors/distributors (15) attached to the extrusions, wherein the serpentine fins (9) are provided transversally in relation to the extrusions (7, 8) and laying with their side edges (10, 11) perpendicular to the extrusions (7, 8) and where the extrusion (30) is of the web multiport extrusion (web-MPE) design, **characterized in that** part of the material of the flanges or webs (14) between the micro port or tubes are removed to enhance drainage of condensed water and/or reduce and control heat transfer in the transversal direction of the micro ports or tubes.

2. Heat exchanger according to claim 1, **characterized in that** the crests or bends of the serpentine fins (9) are cut and partly removed, (at 19, respectively 20) to enhance air flow through the fins.
3. Heat exchanger according to claims 1-2, **characterized in that** the serpentine fins (9) are provided with a "louver" design to enhance convection of heat from the fins to the air or vice versa, depending on application whereby the fins (9) are provided with vertical slits where the metal along the slits is pressed inwards or outwards creating transversal louvers (23) which are designed to pick up air directing it through the readily created openings in the fin.
4. Heat exchanger according to claims 1-3, **characterized in that** the fins are provided with lengthwise (25) or crosswise (24) wave designs.
5. Heat exchanger according to claims 1-4, **characterized in that** the fins are attached to the extrusions by means of brazing.
6. Heat exchanger according to claims 1-5, **characterized in that** the fins are attached to the extrusions by means of bonding.

Patentansprüche

1. Mikrokanal- oder multiöffnungsbasierte Wärmetauscher aus Aluminium zum Wärmeaustausch oder Wärmerückgewinnung in Systemen, wie beispielsweise eine Kälte- oder Wärmepumpe, insbesondere ein Kondensator oder Verdampfer in solchen Systemen, umfassend, zusätzlich zu den Mikrokanal- oder Multiöffnungsextrusionen, schlangenförmige Rippen (9), die an den Extrusionen (7,8) befestigt sind, und Einlass- und Auslassverzweigungsrohre Sammler/Verteiler (15), die an den Extrusionen befestigt sind, wobei die schlangenförmigen Rippen (9) quer zu den Extrusionen (7, 8) bereitgestellt sind und mit ihren Seitenkanten (10, 11) senkrecht zu den Extrusionen (7, 8) liegen, und wobei die Extrusion (30) eine Stegmultiöffnungsextrusion (web-MPE) -gestaltung hat, **dadurch gekennzeichnet, dass** ein Teil des Materials der Flanschen oder Stege (14) zwischen den Mikroöffnungen oder -röhren entfernt werden, um die Entwässerung von Kondenswasser zu verbessern und/oder Wärmeübertragung in die Querrichtung der Mikroöffnungen oder -röhren zu verringern und steuern.
2. Wärmetauscher nach Anspruch 1, **dadurch gekennzeichnet, dass** die Gipfel oder Biegungen der schlangenförmigen Rippen (9) zugeschnitten und teilweise entfernt sind (an 19 bzw. 20), um die Luftströmung durch die Rippen zu verbessern.

3. Wärmetauscher nach Anspruch 1-2, **dadurch gekennzeichnet, dass** die schlangenförmigen Rippen (9) eine "Schlitz"-Gestaltung hat, um Wärmekonvektion von den Rippen zur Luft oder umgekehrt abhängig von der Anwendung zu verbessern, wobei die Rippen (9) mit vertikalen Spalten versehen sind, wobei das Metall entlang den Spalten nach innen oder nach außen gepresst ist, wodurch querlaufende Schlitze (23) hergestellt werden, die dafür ausgestaltet sind, Luft aufzufangen und sie durch die leicht hergestellten Öffnungen in der Rippe zu leiten.
4. Wärmetauscher nach Anspruch 1-3, **dadurch gekennzeichnet, dass** die Rippen längslaufende (25) oder querlaufende (24) Wellenformen aufweisen.
5. Wärmetauscher nach Anspruch 1-4, **dadurch gekennzeichnet, dass** die Rippen mittels Löten an den Extrusionen befestigt sind.
6. Wärmetauscher nach Anspruch 1-5, **dadurch gekennzeichnet, dass** die Rippen mittels Bindung an den Extrusionen befestigt sind.

Revendications

1. Échangeurs de chaleur à micro-canaux ou multiport d'aluminium pour l'échange de chaleur ou la récupération de chaleur dans des systèmes tels que la pompe à réfrigération ou à chaleur, en particulier un condenseur ou évaporateur dans ces systèmes, y compris au-delà des extrusions à micro-canaux ou multiport, des ailettes serpentes (9) attachées aux extrusions (7,8) et des collecteurs / distributeurs d'entrée et de sortie (15) fixés aux extrusions, les ailettes serpentes (9) étant prévues transversalement par rapport aux extrusions (7, 8) et posées avec leurs bords latéraux (10, 11) perpendiculaires aux extrusions (7, 8) et les extrusions (30) étant de la conception d'extrusion multiport bande, (web-MPE), **caractérisés en ce qu'une** partie du matériau des brides ou des bandes (14) entre le micro-orifice ou les tubes est retirée pour améliorer le drainage de l'eau condensé et / ou réduire et contrôler le transfert de chaleur dans le sens transversal des micro-orifices ou des tubes.
2. Echangeur de chaleur selon les revendications 1, **caractérisé en ce que** les crêtes ou les coudes des ailettes serpentes (9) sont découpées et partiellement enlevées (en 19, respectivement 20) pour améliorer le flux d'air à travers les ailettes.
3. Echangeur de chaleur selon les revendications 1-2, **caractérisé en ce que** les ailettes serpentes (9) sont munies d'une conception "à persiennes" pour

améliorer la convection de chaleur des ailettes à l'air ou vice versa, en fonction de l'application, les ailettes (9) étant munies de fentes verticales où le métal le long des fentes est pressé vers l'intérieur ou vers l'extérieur en créant des persiennes transversales (23) conçues pour capter l'air et le diriger à travers les ouvertures facilement créées dans l'ailette. 5

4. Echangeur de chaleur selon les revendications 1-3, **caractérisé en ce que** les ailettes sont munies de conceptions d'ondulations longitudinales (25) ou transversales (24). 10

5. Echangeur de chaleur selon les revendications 1-4, **caractérisé en ce que** les ailettes sont fixées aux extrusions au moyen d'un brasage. 15

6. Echangeur de chaleur selon les revendications 1-5, **caractérisé en ce que** les ailettes sont fixées aux extrusions au moyen d'une liaison. 20

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Fig. 1

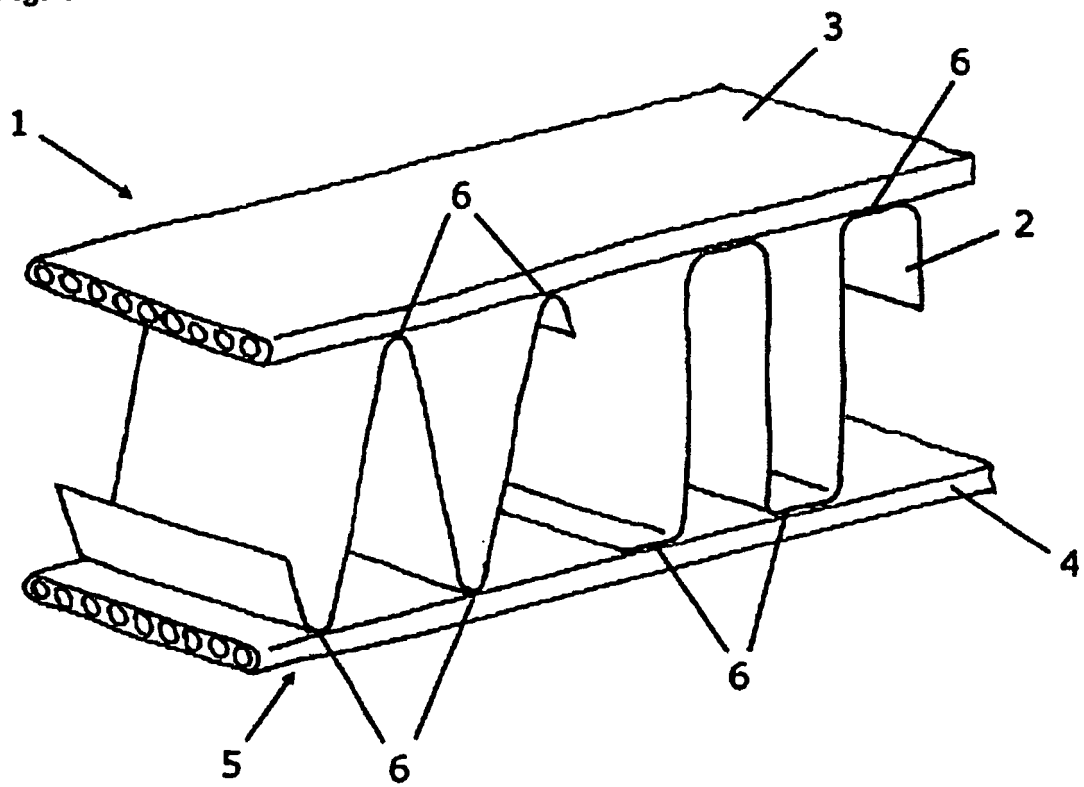


Fig. 2

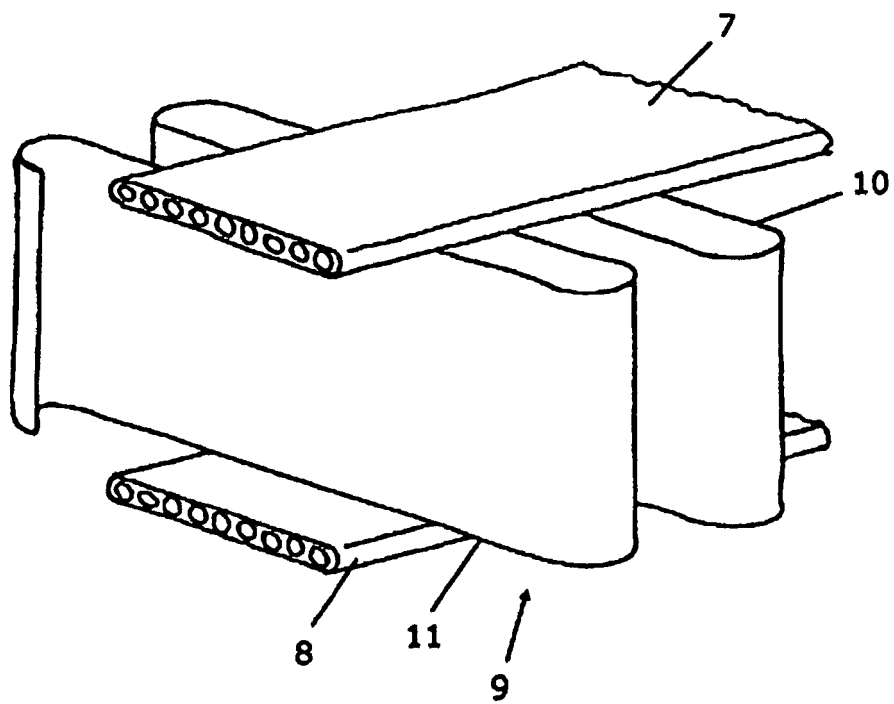


Fig. 3

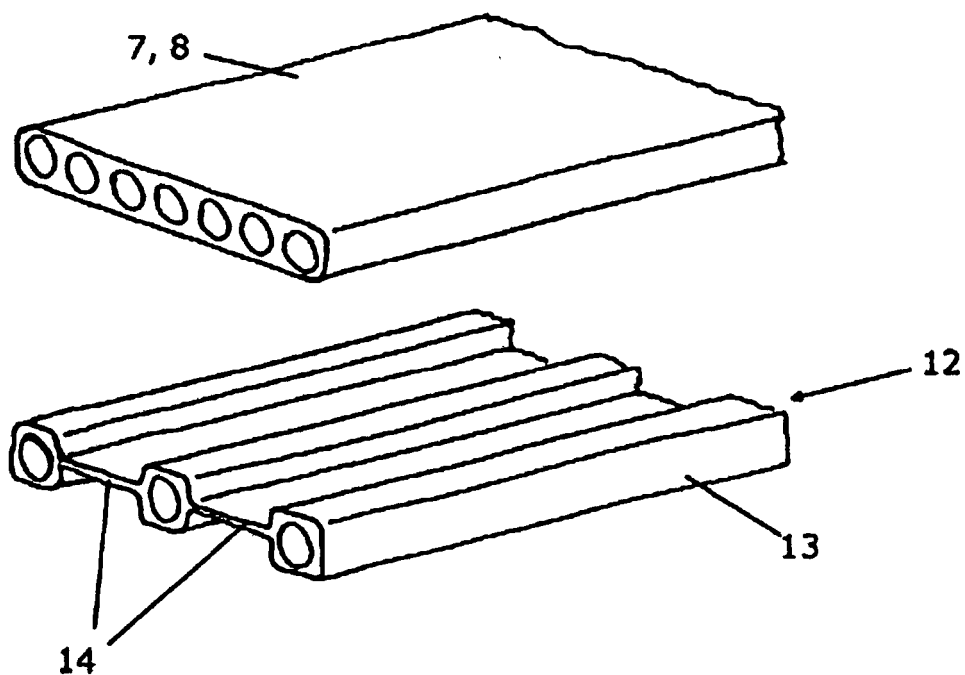


Fig. 4

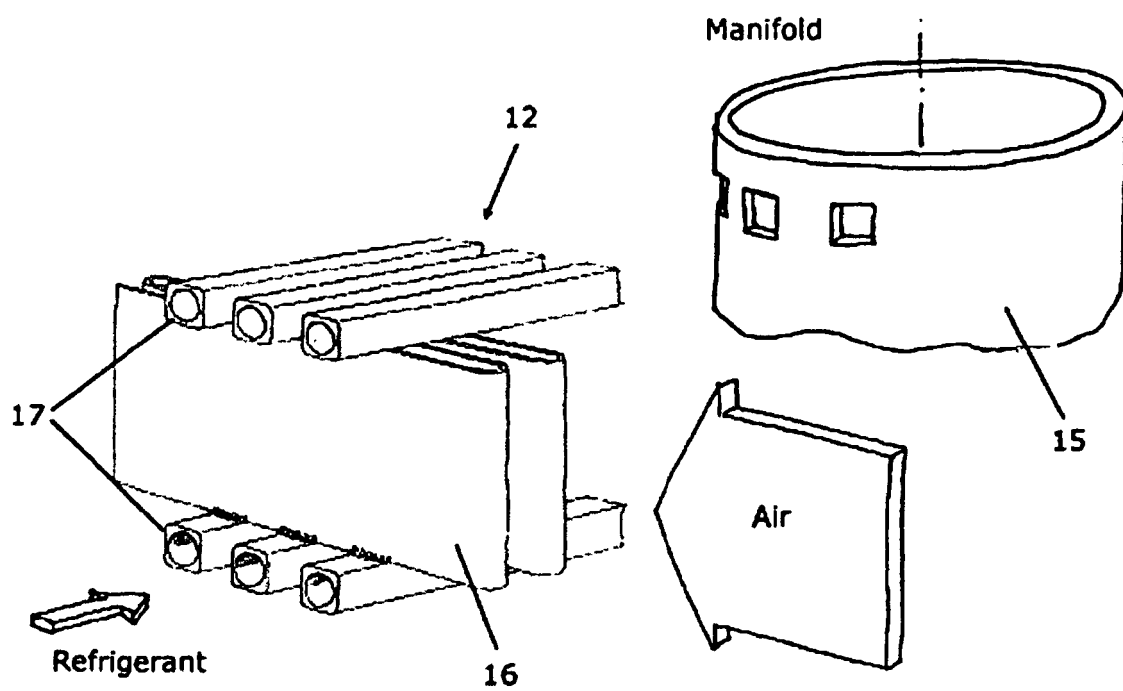


Fig. 5

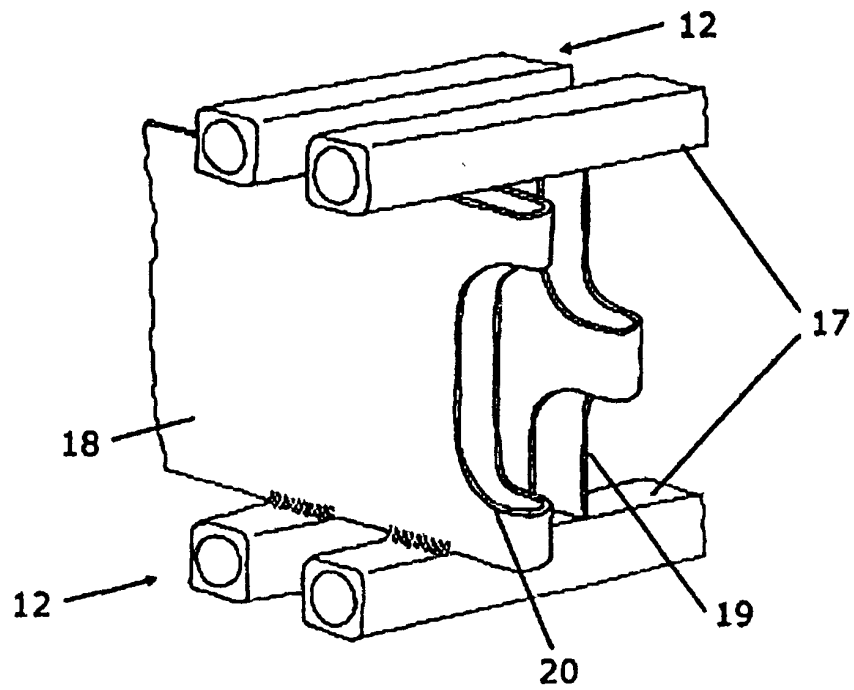


Fig. 6

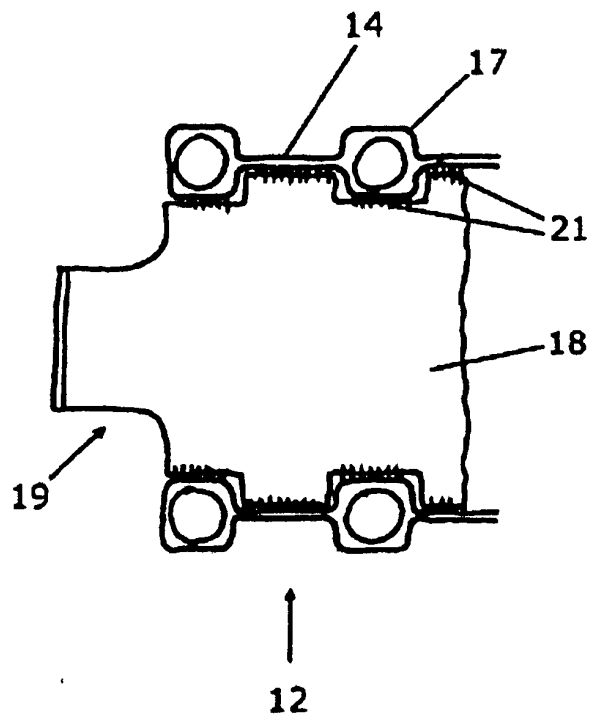


Fig. 7

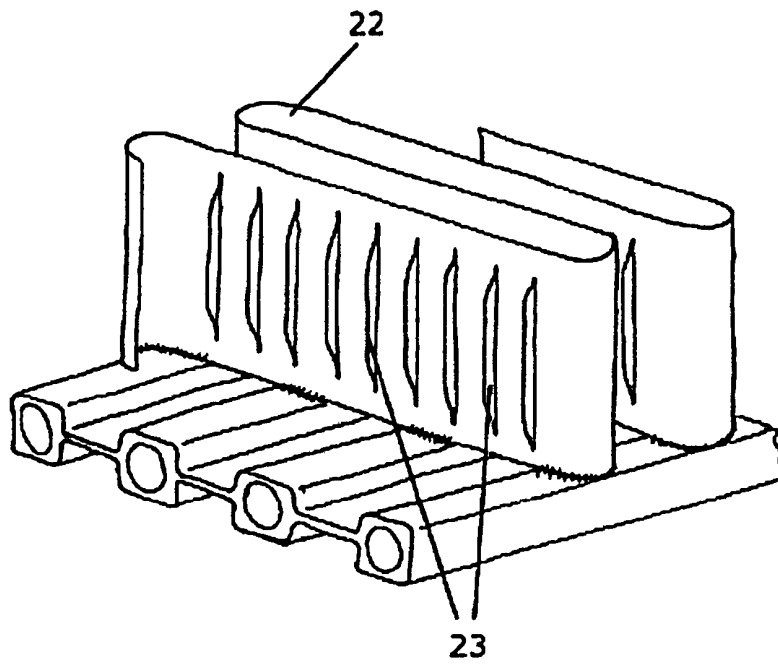


Fig. 8

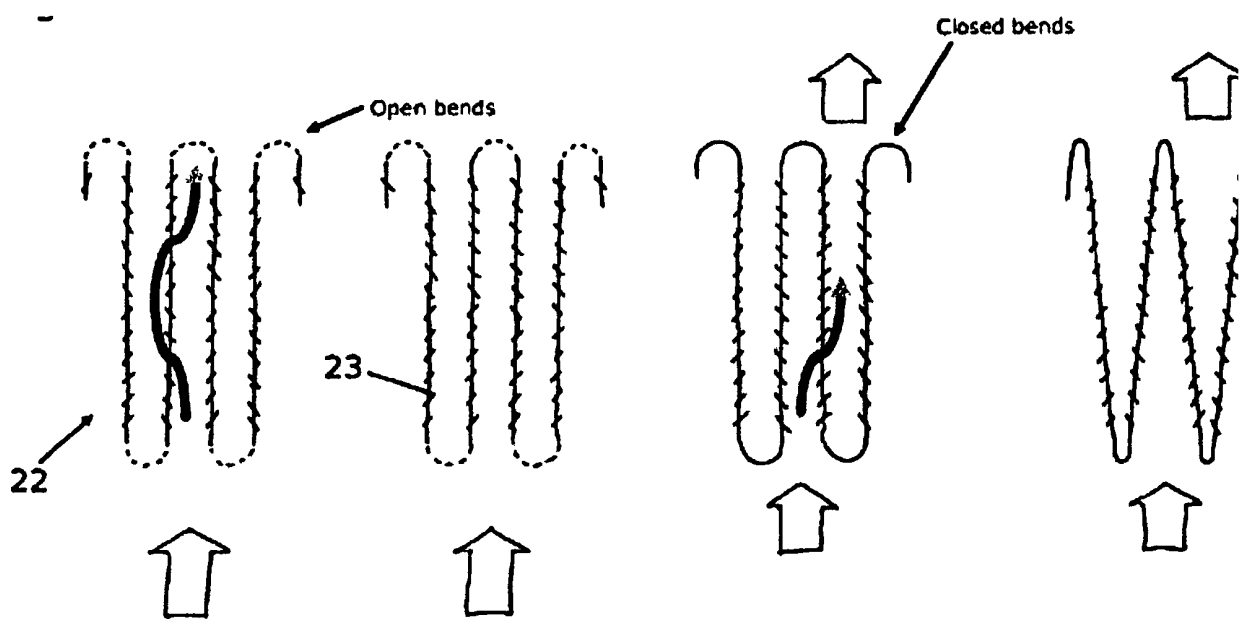


Fig. 9

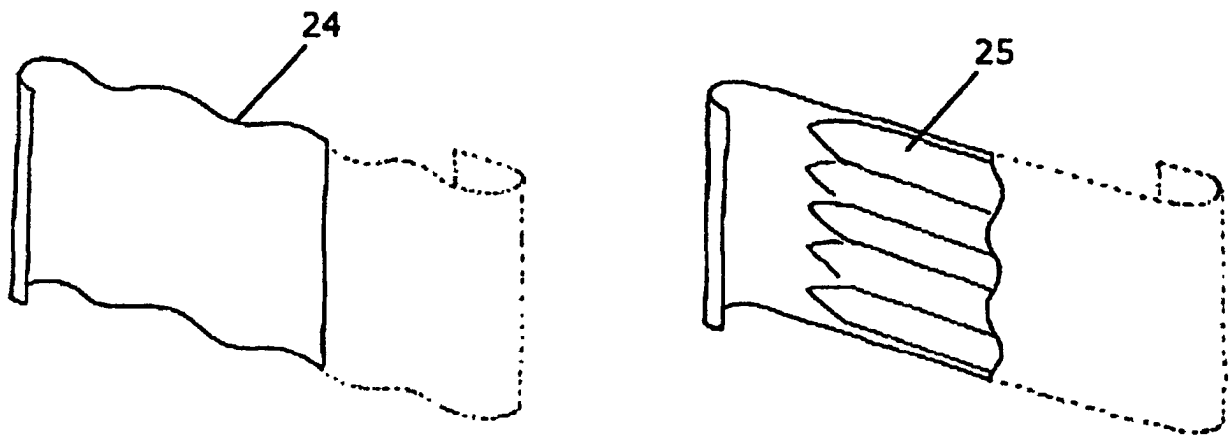


Fig. 10

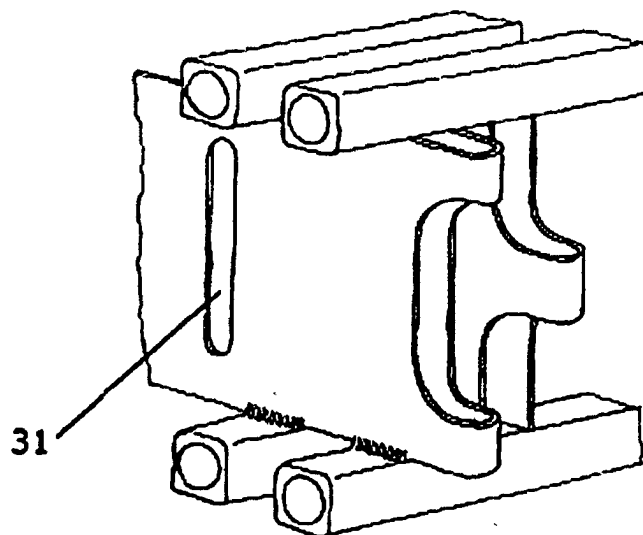


Fig. 11

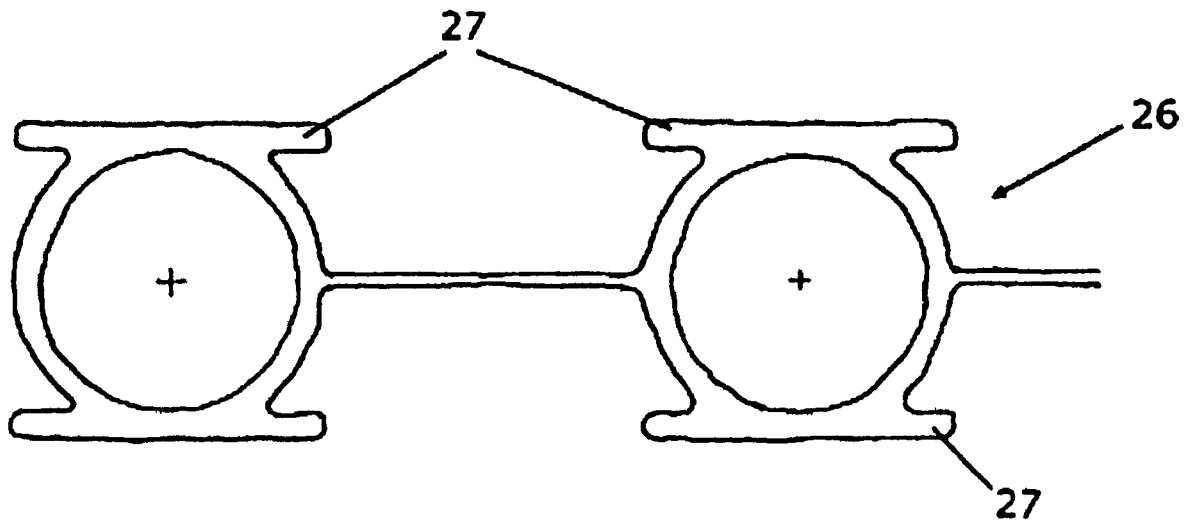


Fig 12

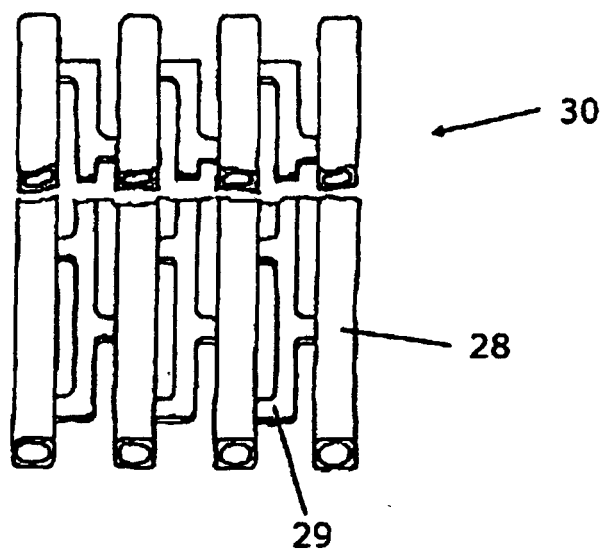
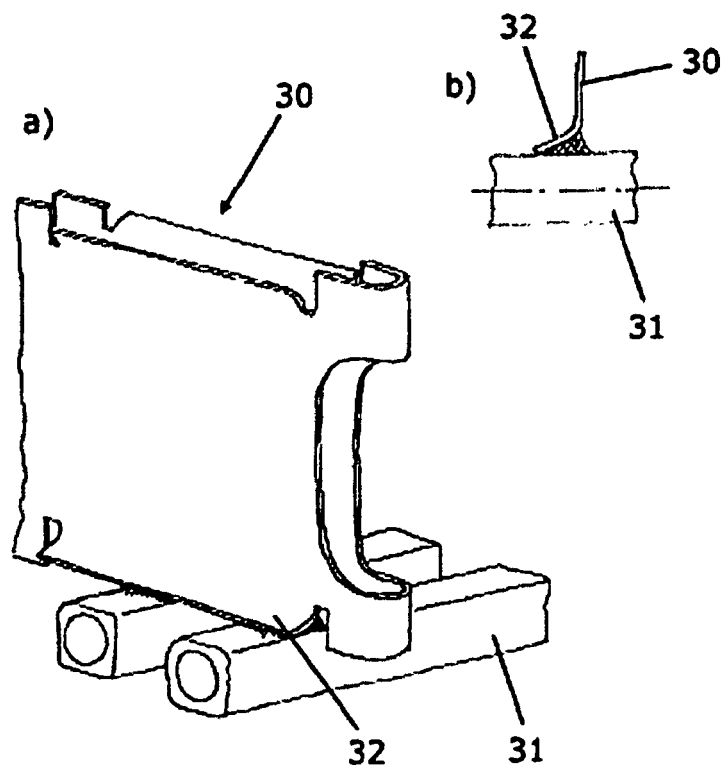


Fig. 13



REFERENCES CITED IN THE DESCRIPTION

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