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(54) HEAT EXCHANGER COMPRISING A TUBULAR ELEMENT AND A HEAT TRANSFER ELEMENT

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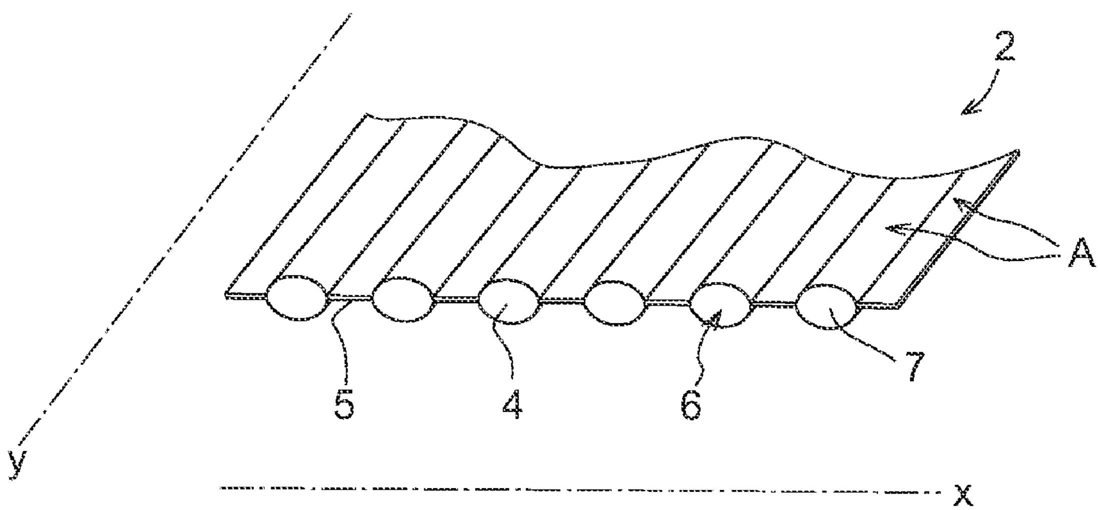
(57) ABSTRACT

The present invention relates to a heat exchanger (**1**) comprising a first flow passage (**6**) comprising a tubular element (**2**) comprising at least two tubular flow channels (**4**) separated by region (**5**) extending along a longitudinal Y-axis, for passage of a first medium, and a second flow passage (**8**) for passage of a second medium between tubular element and a heat transfer element (**3**). The tubular element comprises a first surface (A) comprising at least region and two bulging sections (**7**). The heat transfer element comprises a second surface (B) comprising at least region **5'** and two indentation, cavity or nest sections (**17**). The first surface and the second surface are adapted to contact each other and have a complementary shape such that the bulging sections of the first surface are in continuous contact with the indentation, cavity or nest sections of the second surface.



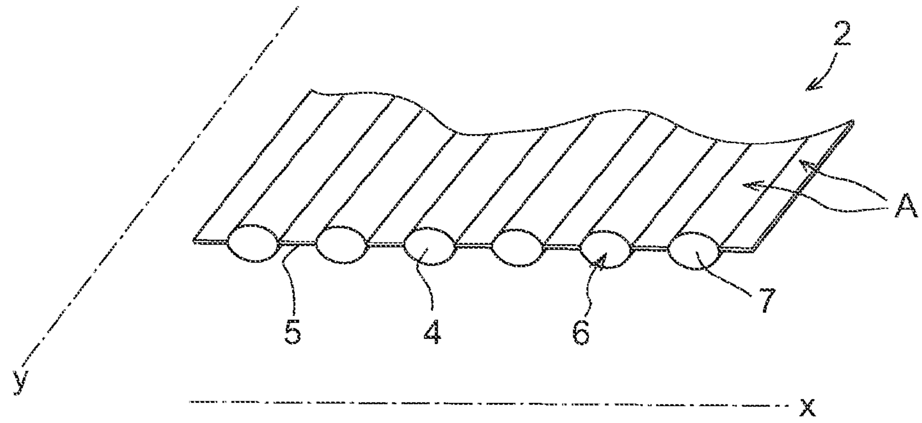


Fig. 1

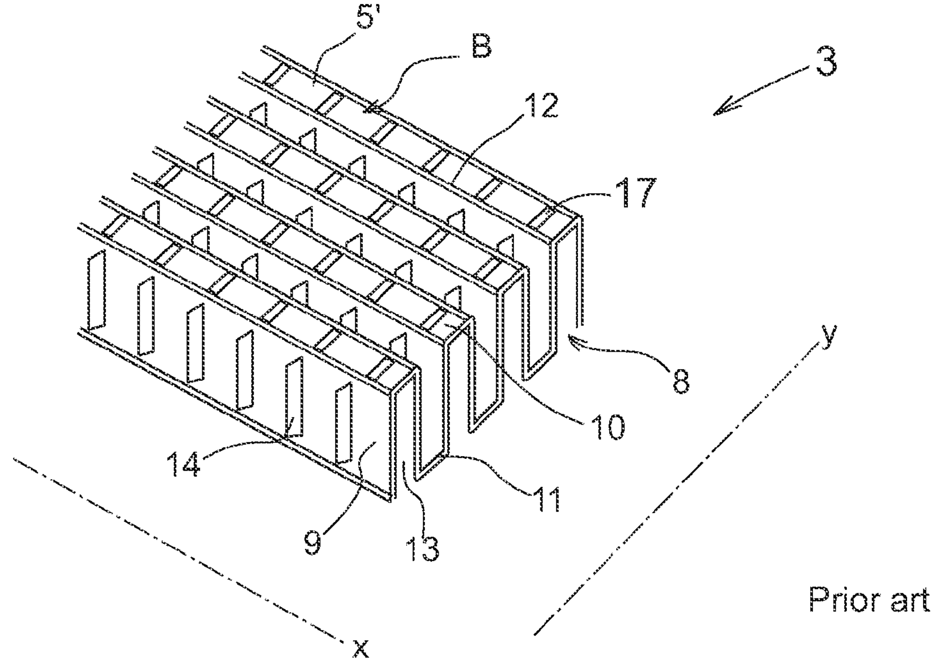


Fig. 2

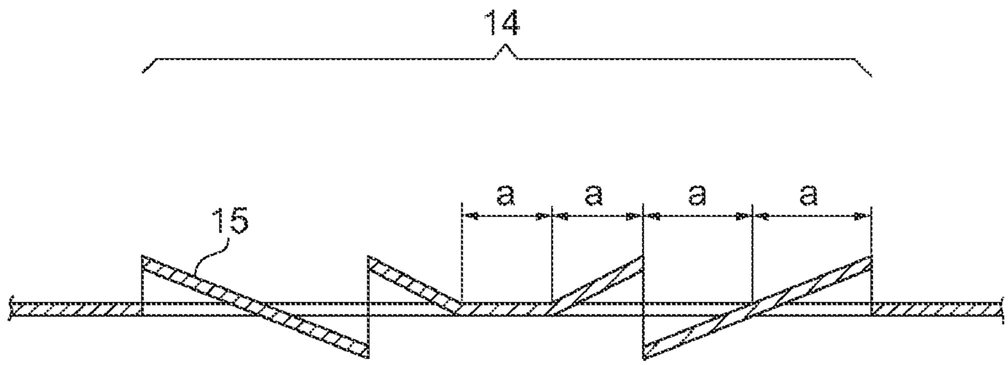


Fig. 3

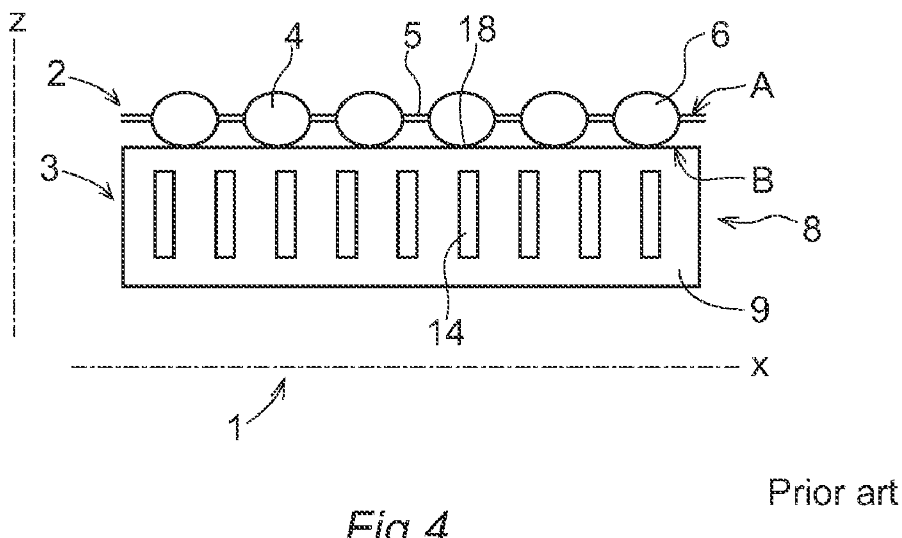


Fig.4

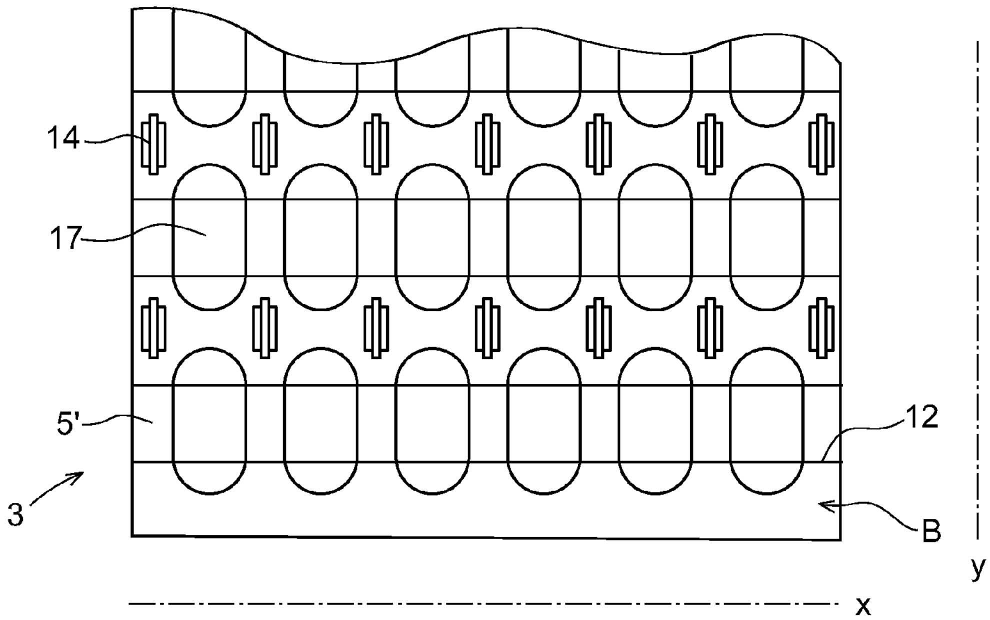


Fig. 5a

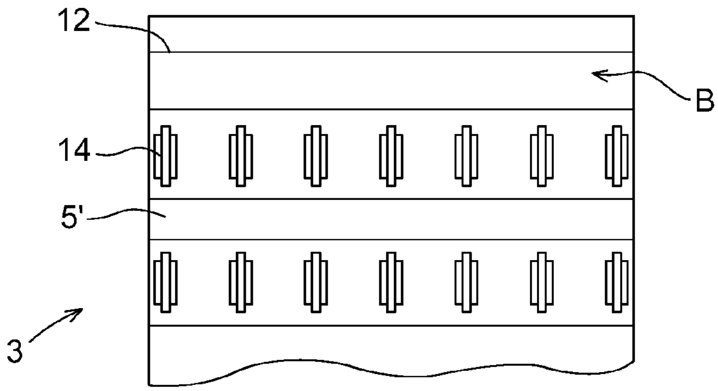


Fig. 5b

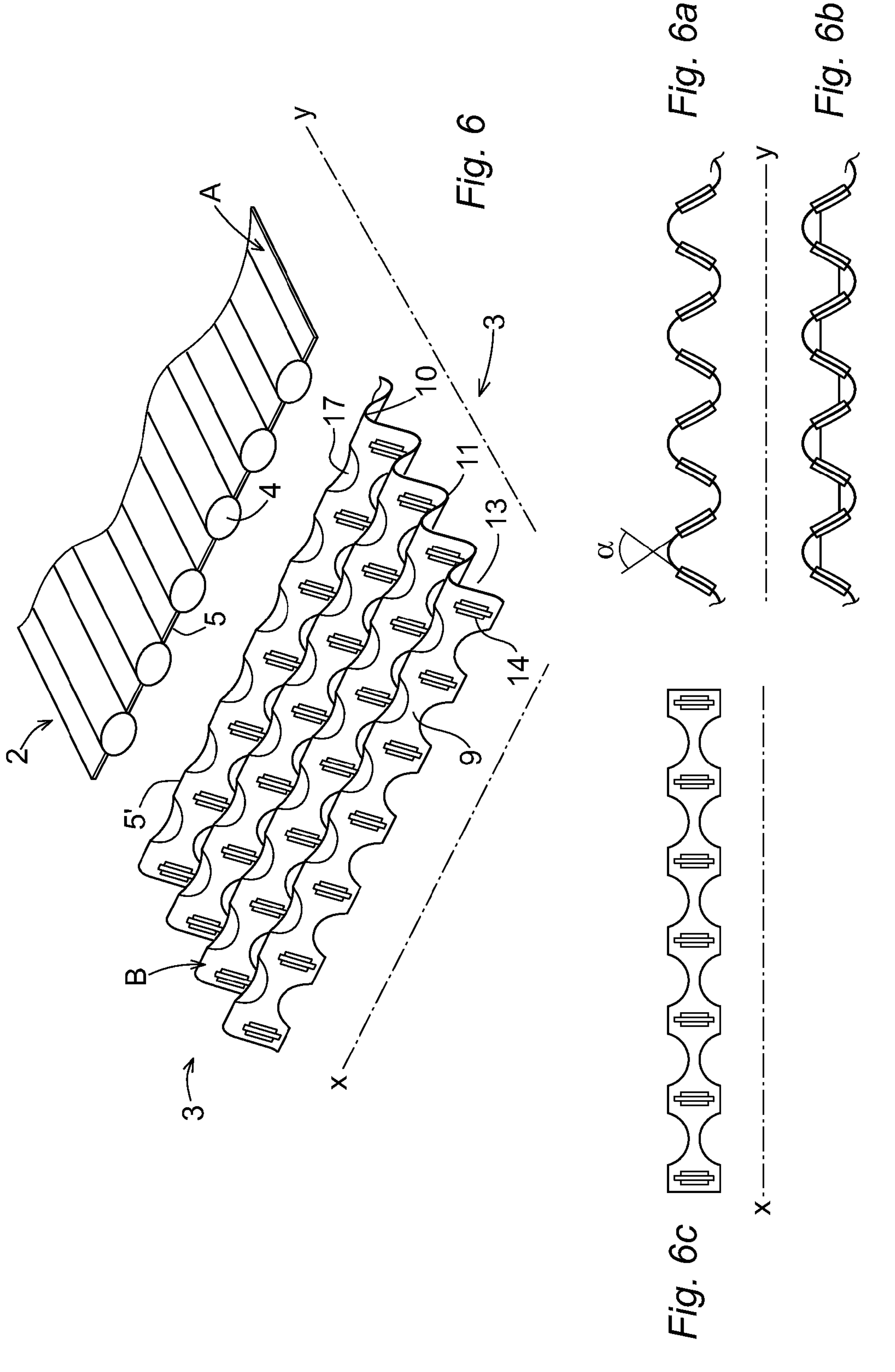


Fig. 6

Fig. 6a

Fig. 6b

Fig. 6c

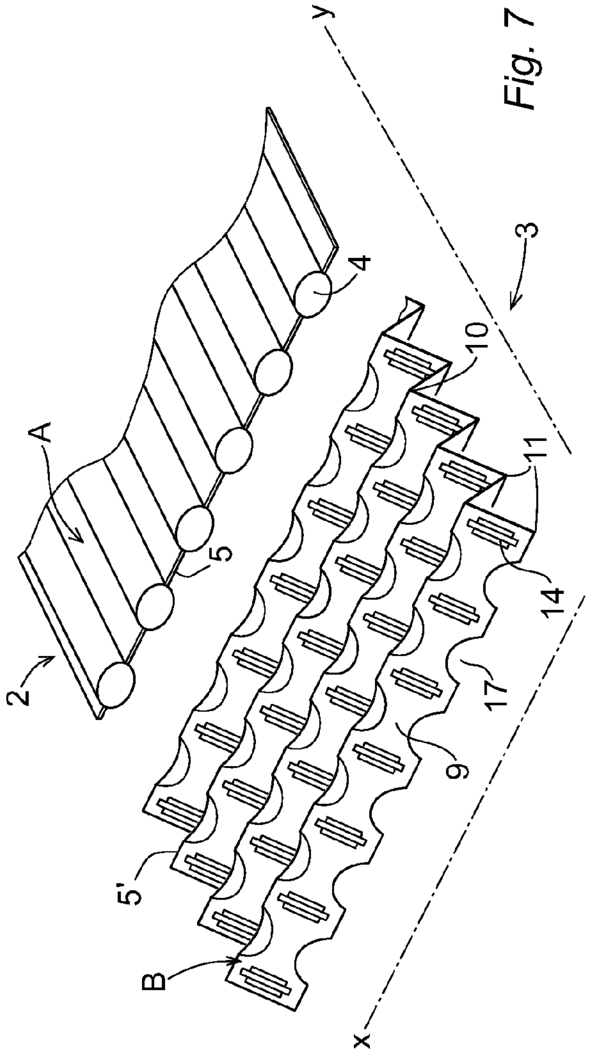


Fig. 7

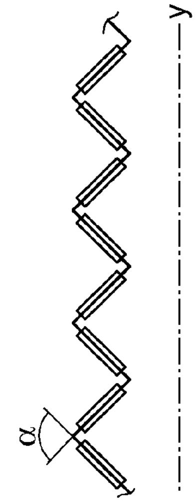


Fig. 7a

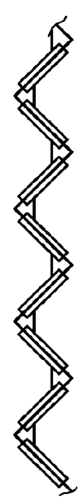


Fig. 7b

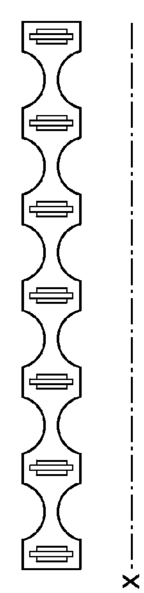


Fig. 7c

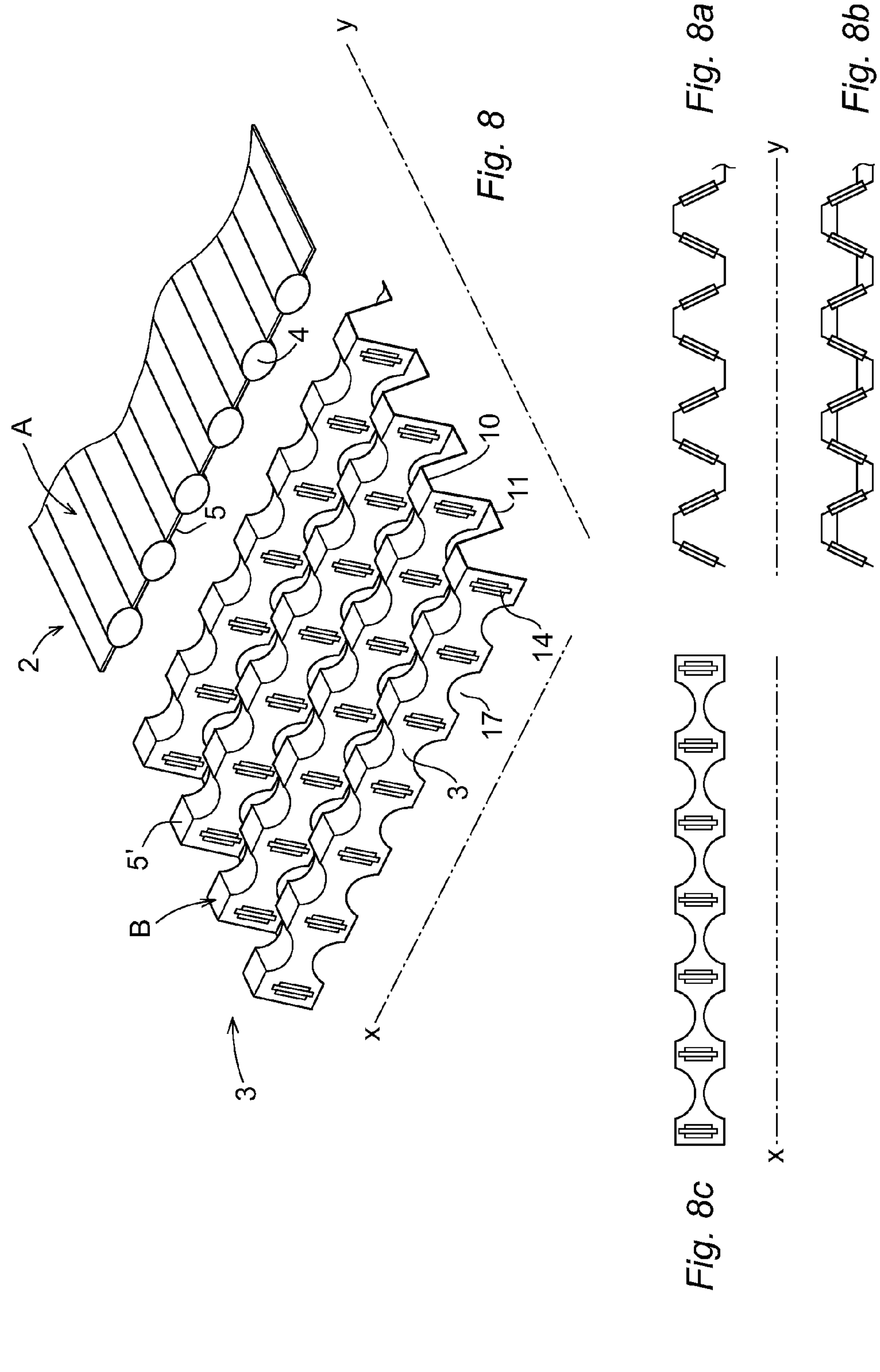


Fig. 8

Fig. 8a

Fig. 8b

Fig. 8c

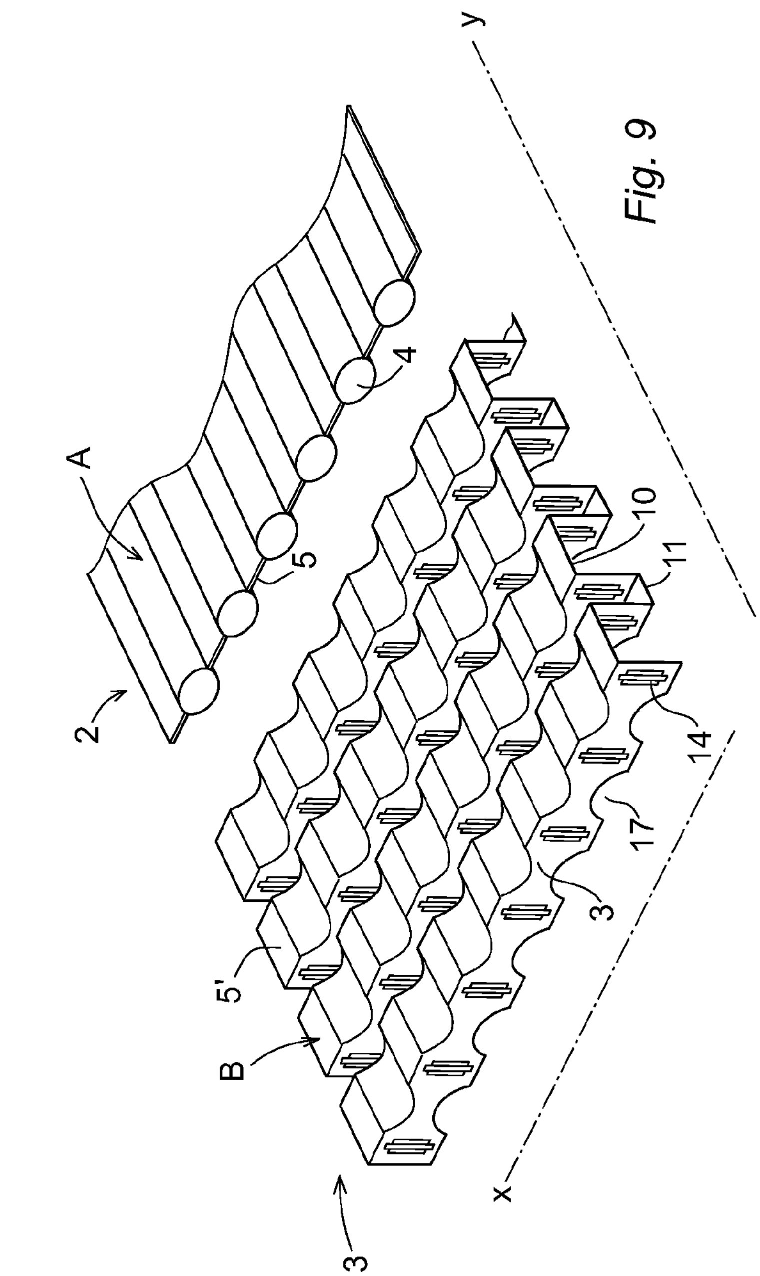


Fig. 9

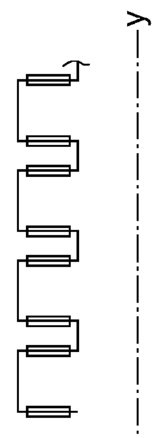


Fig. 9a

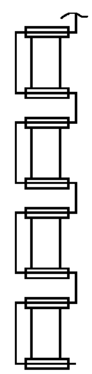


Fig. 9b

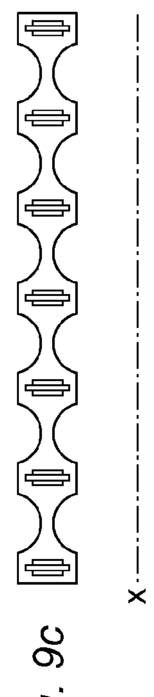


Fig. 9c

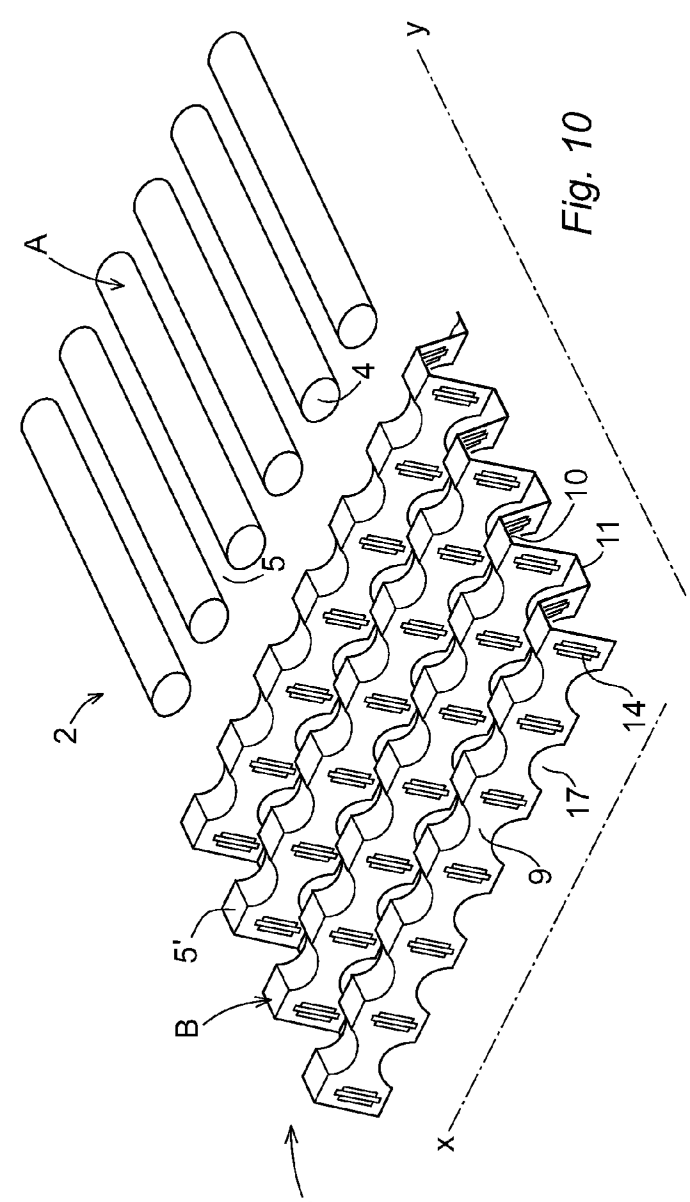


Fig. 10

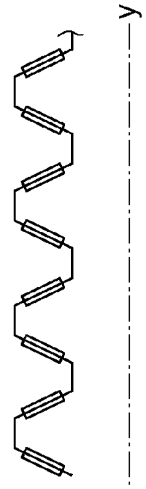


Fig. 10a

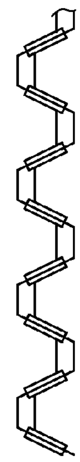


Fig. 10b

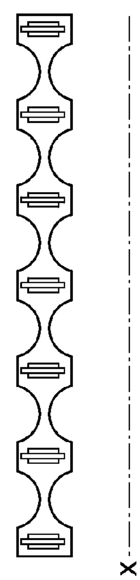


Fig. 10c

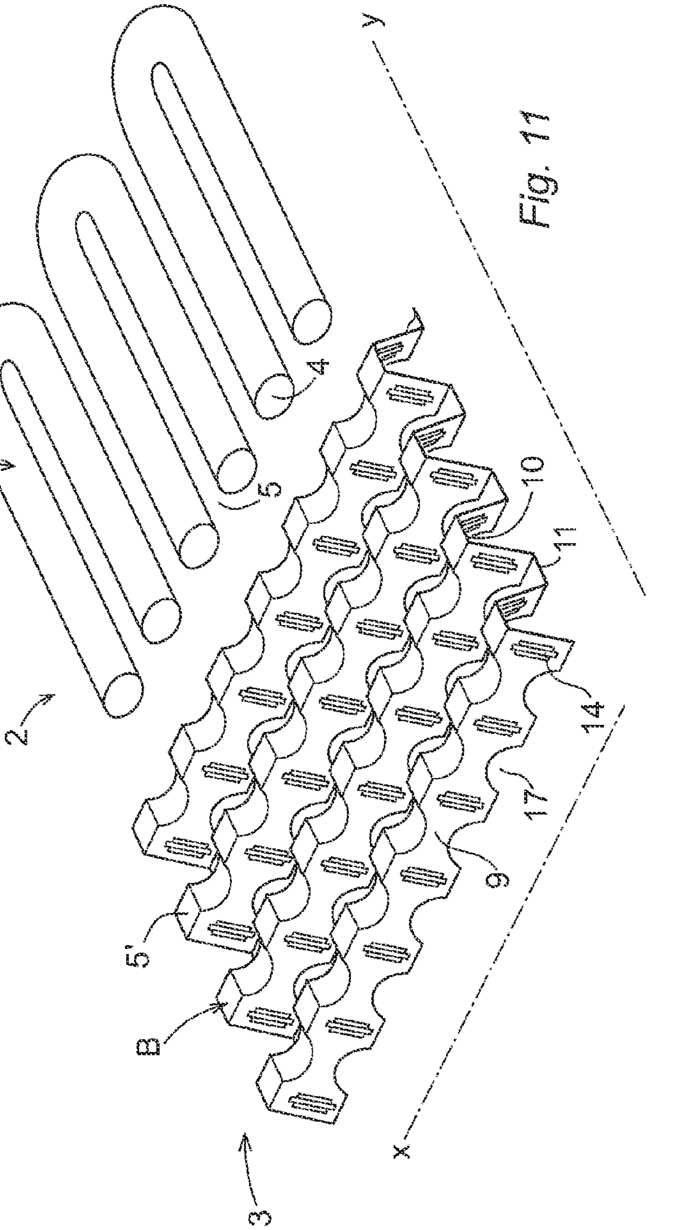


Fig. 11

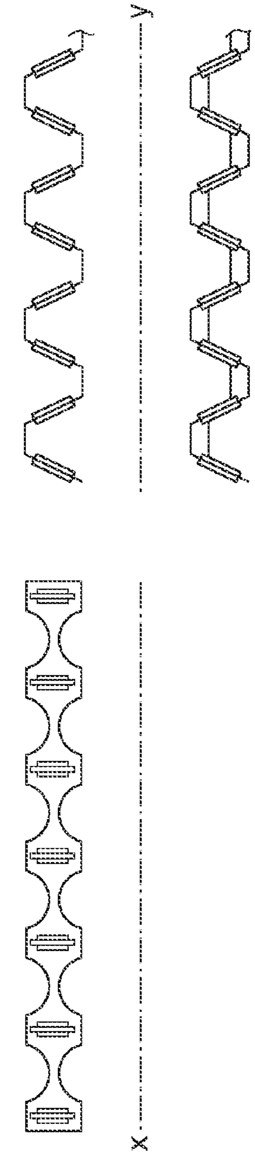


Fig. 11a

Fig. 11b

Fig. 11c

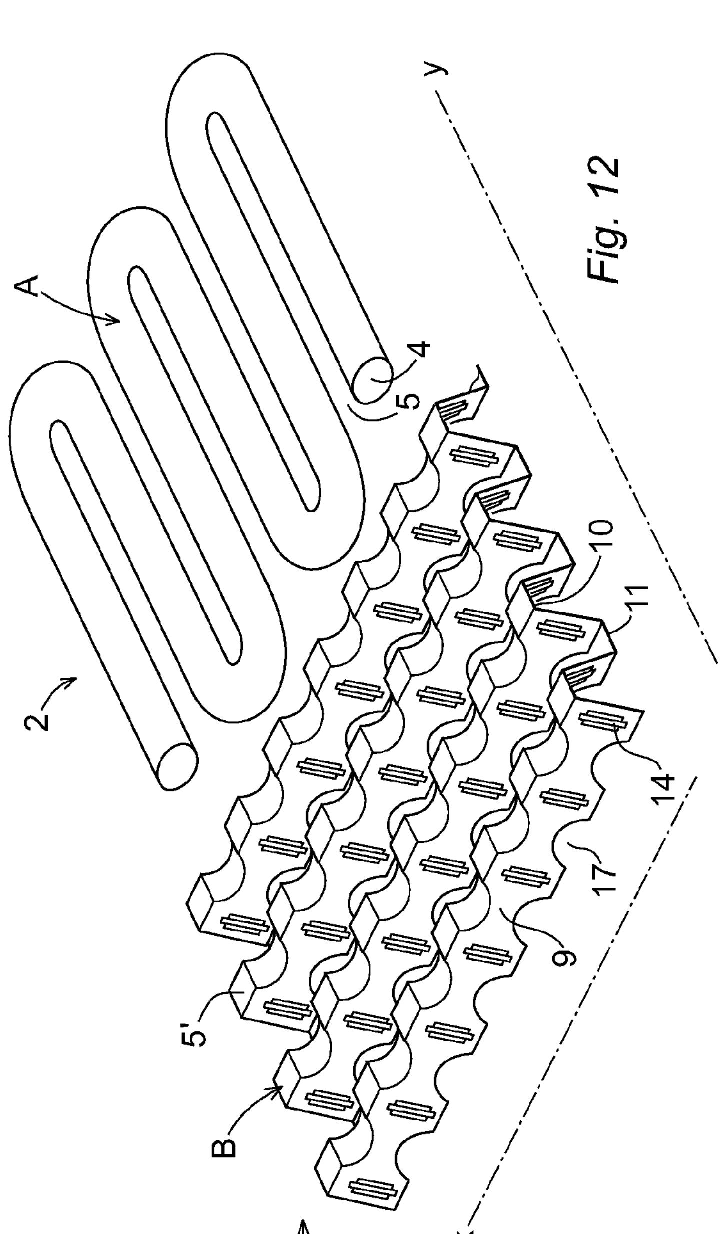


Fig. 12

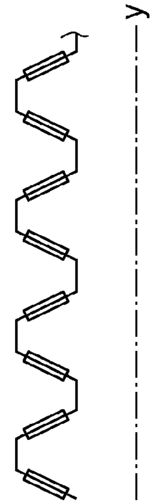


Fig. 12a

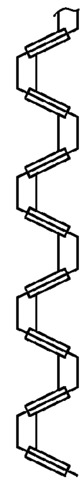


Fig. 12b

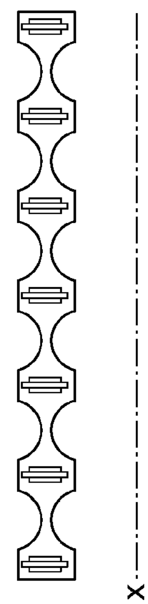


Fig. 12c

HEAT EXCHANGER COMPRISING A TUBULAR ELEMENT AND A HEAT TRANSFER ELEMENT

FIELD OF THE INVENTION

[0001] The present invention refers to a heat exchanger according to the characterized portion of claim **1** and a use of the heat exchanger in apparatus such as heating, ventilating, and air conditioning in buildings, heat radiators in engines, computers, heat absorbers and/or industrial coolers such as equipment for cooling transformers and power generators.

BACKGROUND OF THE INVENTION AND RELATED ART

[0002] Heat exchangers are utilized in a broad range of applications where it is necessary to transfer heat to or from a particular item or equipment, such as an air condition unit, booster or engine.

[0003] A heat exchanger generally comprises an arrangement of channels forming a first flow passage and a first surface. A heat exchanger is further pro-vided with a plurality of heat transfer elements such as corrugated fins along and extending traverse to the length of the channels forming a second flow passage, whereby the fins provide a second surface. When the heat exchanger is used for cooling, a hot medium from a room or engine is passed through the fins whilst a cooler medium is passed through the channels to extract heat. The fins assist in cooling the hot medium by providing a large heat transfer area. The first surface of the channels and the second surface of the heat transfer elements are preferably made of a metal with high thermal conductivity.

[0004] AU2010233051 describes a heat exchanger tube assembly comprising a tube having a plurality of fins mounted traversaly on the side of the longitudinal tube. In order to optimize the contact between the tube and the fins a thermally conductive medium is used for bonding the tube with the sides of the corrugated fins.

[0005] US2007/0012430 describes a heat exchanger with heat transfer elements in the form of corrugated fins. (See FIG. **2**). The corrugated fins comprise of a plurality of side walls interconnected to a plurality of top walls and bottom walls. Each side wall extends between an adjacent top wall and an adjacent bottom wall and joint to said top and bottom wall by a bend extending along an horizontal X-axis parallel to the side wall such that spaces are defined between adjacent pairs of side walls. The side walls comprise groups of louvers, comprising a plurality of parallel slits formed in the side wall and extending substantially between the top wall and bottom wall. The top and bottom walls have substantially flat second surfaces to ensure maximum contact with the flat plates of the first surface. The flat top and bottom walls may have indentation sections or depressions in the second surface. These indentation sections may have different shapes and forms. The function of the indentation sections is to re-direct the fluid flow away from the second surface, i.e. the top and bottom walls and into contact with the louvers, thereby minimizing duct flow through the corrugated fins and improving heat transfer.

[0006] A problem with the existing heat transfer elements is that the shape of the top and bottom walls is flat. When the arrangement of channels of the first surface comprises of tubular channels with tubular bulging sections of the first surface, the contact between the tubular channels and the flat heat transfer elements are points due to the flat surfaces of the top and bottom walls of the second surface (FIG. **4**). This significantly restricts energy transfer between the channels and the heat transfer elements and thus decreases the efficiency of the heat exchanger. The lack of sufficient contact between the first surface of the tubular element and second surface of the heat transfer element makes it economically unattractive to use the heat exchanger in heating, ventilating, and air conditioning (HVAC-heat exchanger).

SUMMARY OF THE INVENTION

[0007] An objective of the present invention is to provide a heat exchanger comprising tubular elements and heat transfer elements with improved contact between the tubular elements and the heat transfer elements.

[0008] A further objective is to develop a heat exchanger that can be used as heat exchanger in heating, ventilating, and air conditioning (HVAC-heat exchanger).

[0009] The objectives are achieved by the heat exchanger initially defined, which is characterized in that the first and second surfaces have a complementary shape such that the bulging sections of the first surface are in continuous contact with the indentation, cavity or nest sections of the second surface.

[0010] In one embodiment, the shape of the bulging sections of the first surface and the shape of the indentation, cavity or nest sections of the second surface are defined by the shape of the internal tubular flow channels of the tubular element.

[0011] In another embodiment, the distance between the bulging sections of the first surface and the distance between the indentation, cavity or nest sections of the second surface is the same and defined by the region.

[0012] One advantage of the present invention is that the first surface of the tubular element is in line contact with the second surface of the heat transfer element because the contours of the second surface nest right on the internal tubular flow channels of the first surface. This continuous contact between the surfaces increases the total heat transfer area and thus improves the overall efficiency of the heat exchanger. A further advantage is that no thermally conductive medium needs to be used for bonding the two surfaces together.

[0013] The metal of the second surface at the location of the indentation sections may also be open or even removed by punching or cutting the metal. These openings in the top and bottom walls of the heat transfer element further improve the heat transfer between the tubular elements and the heat transfer elements. In one embodiment, the heat exchanger is characterised in that a portion of the second surface of the heat transfer element is open. In another embodiment, the heat exchanger is characterised in that the second surface has an opening at least one of the indentation sections.

[0014] In one embodiment, the heat exchanger is characterised in that the at least two internal tubular flow channels are connected by a flat region, or the channels are not connected to each other, or the channels are connected in a hairpin structure or in a serpentine structure. Another advantage of the new heat exchanger is that the design of the tubular element can be varied and adapted for different applications. These differences in designs have no adverse effects on the functioning of the heat exchanger.

[0015] In one embodiment, the flow direction of the second medium is substantially perpendicular to the longitudinal

Y-axis. An arrangement of flow directions whereby the flow direction of the first medium is perpendicular to the flow direction of the second medium increases the heat transfer area and thus the efficiency of the heat exchanger.

[0016] The amount of heat transfer can be improved by further increasing the contact area between the first and second surfaces. This can for example be achieved by increasing the length of the tubular elements and heat transfer elements in a longitudinal direction along the longitudinal Y-axis. Alternatively, the amount of internal tubular flow channels per tubular element may be increased. Also, several tubular elements may be sandwiches between heat transfer elements along a vertical Z-axis. In a further embodiment, the heat exchanger comprises a plurality of parallel tubular elements separated by spaces along a vertical Z-axis, and a plurality of heat transfer elements provided in the spaces.

[0017] In yet a further embodiment, the heat transfer element comprises corrugated fins comprising

[0018] a plurality of side walls interconnected to a plurality of top walls and bottom walls, whereby each side wall extends between an adjacent top wall and an adjacent bottom wall and joint to said top and bottom wall by a bend extending along a horizontal X-axis parallel to the side wall such that spaces are defined between adjacent pairs of side walls, and whereby

[0019] the side wall comprises at least one group of louvers, comprising a plurality of parallel slits formed in the side wall and extending substantially between the top wall and bottom wall.

[0020] The arrangement of the corrugated fins advantageously increases the heat transfer area while at the same time minimizing the flow through the second flow passage defined by the corrugated fins. Thereby, heat transfer between the first and second medium is increased and the overall efficiency of the heat exchanger improved. The function of the louvers is to create turbulence in the second medium as it passes through the second flow passage. This turbulence minimizes the duct flow of the second medium through the second flow passage and thus improves the heat transfer between the second and first medium. This further improves the efficiency of the heat exchanger.

[0021] In yet another embodiment, the top and bottom walls of the corrugated fins comprise at least two indentation, cavity or nest sections separated by a region, whereby the indentation, cavity or nest sections have a complementary shape to the internal tubular flow channels of the tubular element.

[0022] One advantage of these indentation, cavity or nest sections is an improved contact between the tubular element and the heat transfer element. Another advantage of the indentation, cavity or nest sections is that these indentation, cavity or nest sections also minimize the duct flow through the second flow passage by re-directing the flow away from the top and bottom walls and into contact with the louvers located in the side walls of the corrugated fins. When the indentation, cavity or nest section is an opening, as shown in FIG. **6***a*, the flow medium in the second flow passage impinges to a portion of the tubular element. This results in turbulences in the second flow medium. This way, the heat transfer coefficient is significantly improved.

[0023] The heat exchanger comprises preferably a material with high thermal conductivity such as copper, aluminium or alloys thereof. By means of using a metal with high thermal conductivity, the heat conduction rate between the internal tubular flow channels and the regions is increased, which improves the heat transfer efficiency. In one embodiment, the tubular element comprises copper or alloys thereof. In another embodiment, the heat transfer element comprises aluminium, copper, brass, stainless steel, steel inocnel, hastoloy, titanium, or mixtures or alloys thereof. A further advantage of using copper or copper alloys is that copper has an anti-bacterial effect. The risk for spreading bacteria and the like through a ventilation system or air conditioning system can thus be decreased by using copper as a metal in the heat exchanger.

[0024] In a further embodiment, the tubular element and/or the heat transfer element are coated or partly coated with a tin-based solder material. Especially the areas where the tubular element is attached to the heat transfer element may be coated with the solder material.

[0025] In yet another embodiment, the tubular element and the heat transfer element are joined together by welding, bracing, rolling or Cuprobrazing®.

[0026] In yet a further embodiment, the first medium is liquid or gas. In one embodiment, the second medium is gas.

[0027] One embodiment refers to a process for the manufacture of the heat exchanger characterised in that a shape of the heat transfer element is formed by pressing and high speed folding the metal of the second surface into the shape, whereby the second surface comprises at least a region and at least two indentation, cavity or nest sections.

[0028] The metal of the second surface at the location of the indentation, cavity or nest sections may also be opened to further improve the heat exchange between the tubular elements and the heat transfer elements. Another embodiment refers to a process for the manufacture of the heat exchanger characterised in that the shape of the heat transfer element is formed by punching through at least a portion of the metal of the second surface, whereby the second surface comprises at least a region and at least one open sections.

[0029] The objective of the invention is also achieved by a use of the heat exchanger as described herein, for heating, ventilating, and air conditioning, heat radiators in engines, computers, heat absorbers and/or industrial coolers. One advantage of the new heat exchanger is improved efficiency. This improved efficiency will save energy and costs for the user. Consequently, the heat exchanger is more environmentally friendly compared to the known heat exchangers.

BRIEF DESCRIPTION OF THE DRAWINGS

[0030] The invention will now be explained more closely by means of a description of various embodiments and with reference to the drawings attached hereto.

[0031] FIG. **1**. A schematic view of a tubular element.

[0032] FIG. **2**. A schematic view of a heat transfer element from the prior art in the form of corrugated fins.

[0033] FIG. **3**. A top view of the side wall of the corrugated fin showing a group of louvers with slits.

[0034] FIG. **4**. A schematic view of a heat exchanger from the prior art having a tubular element in (point) contact with a heat transfer element.

[0035] FIG. **5***a*. A flat view of the new heat transfer element with kidney shaped holes.

[0036] FIG. **5***b*. A flat view of the new heat transfer element without kidney shaped holes.

[0037] FIGS. **6**-**9**. A perspective view of the new heat transfer element whereby the heat transfer element has a wave-like, triangular, trapezoidal and rectangular shape.

[0038] FIGS. **6***a*-**12***a*. A side view along the longitudinal Y-axis of the new heat transfer element, manufactured using punching and high speed continuous folding process.

[0039] FIGS. **6***b*-**12***b*. A side view along the longitudinal Y-axis of the new heat transfer element, manufactured using pressing and high speed folding process.

[0040] FIGS. **6***c*-**12***c*. A front view along the horizontal X-axis of the new heat transfer element.

[0041] FIG. **10**. A schematic view of the new heat exchanger having a tubular element comprising separated flow channels such as round tubes.

[0042] FIG. **11**. A schematic view of the new heat exchanger having a tubular element comprising flow channels in a hairpin structure.

[0043] FIG. **12**. A schematic view of the new heat exchanger having a tubular element comprising flow channels in a serpentine structure.

DETAILED DESCRIPTION OF VARIOUS EMBODIMENTS OF THE INVENTION

[0044] A heat exchanger **1** according to the present invention comprises of two parts, a tubular element **2** and a heat transfer element **3**. FIG. **1** shows a schematic overview of the tubular element **2**. The tubular element **2** comprises of at least two internal tubular flow channels **4** extending along a longitudinal Y-axis

[0045] The internal tubular flow channels **4** are separated from one another by a region **5**. The distance between the flow channels **4**, i.e. the breadth of the region **5**, is preferably the same between each flow channel **4**.

[0046] The flow channels **4** together with region **5** between them form a first surface A of the heat exchanger **1**. This first surface A has at least region **5** and at least two regular bulging sections **7**. The region **5** may comprise of flat metal connecting the internal tubular flow channels **4** as shown in FIG. **1**. Alternatively, the region **5** may be an opening between the internal tubular flow channels **4**. The internal tubular flow channels **4** may not be connected as shown in FIG. **10**. The internal tubular flow channels **4** may be connected in a hairpin HP structure as shown in FIG. **11** or in a serpentine SP structure as shown in FIG. **12**.

[0047] The amount of flow channels **4** may vary depending on the application. In FIG. **1** six internal tubular flow channels **4** are shown. The internal tubular flow channels **4** have a substantially round cylindrical shape. This shape may be oval, non-circular, or circular cylindrical.

[0048] The internal tubular flow channel **4** forms a first flow passage **6** for the passage of a first medium through the flow channels **4**. This medium may be fluid, gas or a mixture of fluid and gas. This first medium may for example be cooling fluid.

[0049] FIG. **2** shows a schematic view of a heat transfer element **3** from the prior art. The heat transfer element **3** forms a second surface B of the heat exchanger **1** and defines a second flow passage **8** for passage of a second medium. This second medium may be fluid, gas or a mixture of fluid and gas. The second medium may for example be air. The flow direction of the second medium is preferably perpendicular to the longitudinal Y-axis, i.e. perpendicular to the flow direction of the first medium in the internal tubular flow channels **4**.

[0050] The heat transfer element **3** may comprise of corrugated fins as shown in FIGS. **2** and **6** to **12**. The corrugated fins may comprise a plurality of side walls **9** interconnected to a plurality of top walls **10** and bottom walls **11**. Each side wall **9** extends between an adjacent top wall **10** and an adjacent bottom wall **11**. The top and bottom walls **10**, **11** are joint to the side walls **9** by a bend **12** extending along the horizontal X-axis parallel to the side wall **9** such that spaces **13** are defined between adjacent pairs of side walls **9**.

[0051] In FIG. **3** is shown that the side wall **9** may comprise at least one group of louvers **14**, comprising a plurality of parallel slits **15** formed in the side wall **9** and extending substantially between the top wall **10** and bottom wall **11**. The slits **15** are spaced from one another by distance a and may have the form shown in FIG. **3**. The slits **15** may be substantially perpendicular to the horizontal X-axis. The slits **15** may have any other form and the present invention is not limited to any particular form of the slits **15**. Each side wall **9** may comprise one, two or more groups of louvers **14**.

[0052] FIG. **4** shows a heat exchanger **1** from the prior art, with contact points **16** where the first surface A of the tubular element **2** is in contact with the second surface B of the heat transfer element **3**.

[0053] In order to improve the contact between the first and the second surface, the top wall **10** and bottom wall **11** of the heat transfer element **3** comprise at least two indentation, cavity or nest sections **17** separated by a region **5'**. The corrugated fin shown in FIG. **6** may be manufactured by folding the flat piece as shown in FIGS. **5***a* and **5***b* along the folding lines **12**. This way, the kidney shape holes will form nests for the tubular elements A. To make indentation or sockets shown in FIG. **6***a*, pressing is be employed to stretch the material to form the right shape.

[0054] The amount of indentation, cavity or nest sections **17** may vary and depend on the application. In FIGS. **5***a*, **5***b* and **6** to **12** heat transfer element **3** is shown with six indentation, cavity or nest sections **17**. The indentation, cavity or nest sections **17** have a complementary shape to the internal tubular flow channels **4** of the tubular element **2**. The second surface B has at least a region **5'** and at least two indentation, cavity or nest sections **17**. The distance between the indentation, cavity or nest sections **17** in the top and bottom wall **10**, **11**, i.e. the breadth of the region **5'**, is preferably the same between each indentation, cavity or nest section **17**.

[0055] The shape of the bulging sections **7** of the first surface A and the shape of the indentation, cavity or nest sections **17** of the second surface B are defined by the shape of the internal tubular flow channels **4** of the tubular element **2**. When the shapes of the bulging sections **7** and the indentation, cavity or nest sections **17** are the same, the first and second surfaces A, B can be in continuous contact with each other. I.e. the contact between the bulging sections **7** of the first surface A and the indentation, cavity or nest sections **17** of the second surface B is maximised.

[0056] Alternatively, a portion of the second surface B may be opened by cutting or punching a portion of the second surface B. For example, the metal at every or at every second indentation section **17** may be opened from the top or from bottom wall as shown in FIGS. **6***b* to **12***b*. The metal may be removed or not.

[0057] The heat transfer element **3** may have different shapes as shown in FIGS. **6** to **9**. The shapes may be rectangular, wave like such as a sinus wave, triangular or trapezoidal or any other suitable shape.

[0058] The heat exchanger **1** may comprise a plurality of tubular elements **2** separated by heat transfer elements **3** stacked on top of each other alternating along a vertical Z-axis. For example the heat exchanger **1** may comprise of five tubular elements **2** and six heat transfer elements **3**, whereby the tubular elements **2** are sandwiched between the heat transfer elements **3** along the vertical Z-axis. The tubular elements **2** may comprise six internal tubular flow channels **4** and the heat transfer element **3** may comprise six indentation, cavity or nest sections **17**. The tubular elements **2** may further be connected to a reservoir or external channel system (not shown) configured to conduct the first medium.

[0059] The tubular elements **2** may be manufactured in different way. The tubular elements **2** must have a material thickness that provides sufficient strength to maintain a certain pressure of the medium within the internal tubular flow channels **4**. The flat regions **5** between the flow channels **4**, if present, must have a thickness that provides a sufficient heat conduction rate to or from the flow channels **4**. In most situations the desired pressure of the medium within the internal tubular flow channels **4** requires a higher material thickness than the necessary material thickness of the flat regions **5**. A tubular element **2** configured with higher material thickness of the internal tubular flow channels **4** than the material thickness of the flat regions **5** provides a reduced material consumption for the tubular element **2** with negligible reduction in performance when used in a heat exchanger **1**. Furthermore, such a tubular element **2** has a reduced weight. Accordingly, the tubular element **2** may be manufactured using extrusion or clad-rolling. In order to facilitate the manufacturing of tubular element **2** of various types of metals, a first metal profile and a second metal profile may be used. A method for producing a tubular elements **2**, may comprise the steps: a) arranging a first metal profile towards a second metal profile, said first and second metal profile comprise elongated tubular portions **4'** mutually separated by flat portions **5***, b) joining the first metal profile to the second metal profile so that internal tubular flow channels **4** between these profiles are defined, which channels **4** extend according to said tubular portions **4'**, said flow channels **4** being separated by flat regions **5**, and characterized by using in step a) as at least one of said profiles a profile comprising an incipient cut to be located in at least one said flat portion **5***, and by comprising a further step c) carried out after step b) of removing material from said at least one flat portion **5*** by means of said incipient cut, so that the thickness of at least a part of said at least one flat region **5** becomes less than the sum of the thicknesses of the first metal profile and the second metal profile which form the flow channel **4**.

[0060] The metal profiles may be joined together by various joining methods, such as welding, bracing, rolling or Cuprobrazing®, etcetera.

[0061] The heat transfer element **3** may be manufactured in different ways. Flat pieces of metal (FIG. **5***a*, **5***b*) may first be folded along the folding line **12**. In one process the heat transfer element **3** is manufactured by pressing the metal of the second surface B into the desired shape, whereby the second surface B comprises at least a region **5'** and at least two indentation, cavity or nest sections **17**. The form or shape of the sections **17** may vary and may for example be round or kidney shaped.

[0062] It may be desired to open a portion of the surface of the second surface. This opening may be done in various ways such as cutting or punching. This punching or cutting through at least a portion of the metal of the second surface B may be done before or after folding of the flat pieces. The portion to be opened is preferably in the indentation, cavity or nest section **17**.

[0063] The tubular element **2** and the heat transfer element **3** may be made of any metal with a high thermal conductivity. Examples of such metals may be copper, aluminum, brass, stainless steel, steel inocnel, hastoloy, titanium or mixtures or alloys thereof. The heat transfer element **3** may even be made of screen metal or wire mesh. The anti-bacterial effect of copper makes it advantageous to choose copper as the metal for the tubular element **2** and/or the heat transfer element **3**.

[0064] The tubular element **2** and the heat transfer element **3** may be joined to each other in different ways. The two parts may for example be welded together. The tubular element **2** and/or the heat transfer element **3** may therefore be coated or partly coated with a tin-based solder material. Alternatively, the coating may only be applied to the areas of the tubular element **2** and/or heat transfer element **3** that will be welded. Preferably, the solder material is free of lead.

[0065] The heat exchanger **1** described above may be used in any application where heat needs to be transferred from one medium to another medium. Examples of some suitable applications are heating, ventilating, and air conditioning in buildings, heat radiators in engines, computers, heat absorbers and/or industrial coolers such as equipment for cooling transformers and power generators.

[0066] The present invention is not limited to the embodiments disclosed but may be varied and modified within the scope of the following claims.

What is claimed is:

1. A heat exchanger (**1**) configured to exchange heat between a first and a second medium, comprising:

a first flow passage (**6**) comprising a tubular element (**2**) comprising at least two internal tubular flow channels (**4**) separated by a region (**5**) and extending along a longitudinal Y-axis, for the passage of a first medium through the internal flow channels (**4**), and

a second flow passage (**8**) for the passage of a second medium between the tubular element (**2**) and a heat transfer element (**3**),

wherein the tubular element (**2**) comprises a first surface (A) comprising at least a region (**5**) and at least two bulging sections (**7**), and the heat transfer element (**3**) comprises a second surface (B) comprising at least a region (**5'**) and at least two indentation, cavity or nest sections (**17**), wherein the first surface (A) and the second surface (B) are adapted to contact each other,

characterised in that the first and second surfaces (A, B) have a complementary shape such that the bulging sections (**7**) of the first surface (A) are in continuous contact with the indentation, cavity or nest sections (**17**) of the second surface (B).

2. The heat exchanger (**1**) according to claim **1**, characterised in that the shape of the bulging sections (**7**) of the first surface (A) and the shape of the indentation, cavity or nest sections (**17**) of the second surface (B) are defined by the shape of the internal tubular flow channels (**4**) of the tubular element (**2**).

3. The heat exchanger (**1**) according to claim **1**, characterised in that the distance between the bulging sections (**7**) of the first surface (A) and the distance between the indentation, cavity or nest sections (**17**) of the second surface (B) is the same and defined by the regions (**5**, **5'**).

4. The heat exchanger (**1**) according to claim **1**, characterised in that a portion of the second surface (B) of the heat transfer element (**3**) is open.

5. The heat exchanger (**1**) according to claim **1**, characterised in that the second surface (B) has an opening at least one of the indentation, cavity or nest sections (**17**).

6. The heat exchanger (**1**) according to claim **1**, characterised in that at least two internal tubular flow channels (**4**) are connected by a region (**5**), or the channels (**4**) are not connected to each other, or the channels (**4**) are connected in a hairpin structure (HP) or in a serpentine (SP) structure.

7. The heat exchanger (**1**) according to claim **1**, characterised in that the flow direction of the second medium is substantially perpendicular to the longitudinal Y-axis.

8. The heat exchanger (**1**) according to claim **1**, characterised in that the heat exchanger (**1**) comprises a plurality of parallel tubular elements (**2**) separated by a space along a vertical Z-axis, and a plurality of heat transfer elements (**3**) provided in the spaces.

9. The heat exchanger (**1**) according to claim **1**, characterised in that the heat exchange element (**3**) comprises corrugated fins comprising:

a plurality of side walls (**9**) interconnected to a plurality of top walls (**10**) and bottom walls (**11**), whereby each side wall (**9**) extends between an adjacent top wall (**10**) and an adjacent bottom wall (**11**) and joint to said top and bottom wall (**10**, **11**) by a bend (**12**) extending along a horizontal X-axis parallel to the side wall (**9**) such that spaces (**13**) are defined between adjacent pairs of side walls (**9**), and whereby,

the side wall (**9**) comprises at least one group of louvers (**14**), comprising a plurality of parallel slits (**15**) formed in the side wall (**9**) and extending substantially between the top wall (**10**) and bottom wall (**11**).

10. The heat exchanger (**1**) according to claim **9**, characterised in that the top and bottom walls (**10**, **11**) of the corrugated fins comprise at least two indentation, cavity or nest sections (**17**) separated by a region (**5'**), whereby the indentation, cavity or nest sections (**17**) have a complementary shape to the tubular flow channels (**4**) of said tubular element (**2**).

11. The heat exchanger (**1**) according to claim **1**, characterised in that the tubular element (**2**) comprises copper, or alloys thereof.

12. The heat exchanger (**1**) according to claim **1**, characterised in that the heat transfer element (**3**) comprises aluminium, copper. brass, stainless steel, steel inocnel, hastoloy, titanium, or mixtures or alloys thereof.

13. The heat exchanger (**1**) according to claim **1**, characterised in that the tubular element (**2**) and/or the heat transfer element (**3**) are coated or partly coated with a tin-based solder material.

14. The heat exchanger (**1**) according to claim **1**, characterised in that the tubular element (**2**) and the heat transfer element (**3**) are joined together by welding, bracing, rolling or Cuprobrazing®.

15. The heat exchanger (**1**) according to claim **1**, characterised in that the first medium is liquid or gas.

16. The heat exchanger (**1**) according to claim **1**, characterised in that the second medium is gas.

17. A process for the manufacture of a heat exchanger (**1**) configured to exchange heat between a first and a second medium, comprising:

a first flow passage (**6**) comprising a tubular element (**2**) comprising at least two internal tubular flow channels (**4**) separated by a region (**5**) and extending along a longitudinal Y-axis, for the passage of a first medium through the internal flow channels (**4**), and

a second flow passage (**8**) for the passage of a second medium between the tubular element (**2**) and a heat transfer element (**3**),

wherein the tubular element (**2**) comprises a first surface (A) comprising at least a region (**5**) and at least two bulging sections (**7**), and the heat transfer element (**3**) comprises a second surface (B) comprising at least a region (**5'**) and at least two indentation, cavity or nest sections (**17**), wherein the first surface (A) and the second surface (B) are adapted to contact each other, and characterised in that the first and second surfaces (A, B) have a complementary shape such that the bulging sections (**7**) of the first surface (A) are in continuous contact with the indentation, cavity or nest sections (**17**) of the second surface (B), whereby the process is, characterised in that a shape of the heat transfer element (**3**) is formed by pressing and high speed folding the metal of the second surface (B) into the shape, whereby the second surface (B) comprises at least a region (**5'**) and at least two indentation, cavity or nest sections (**17**).

18. A process for the manufacture of a heat exchanger (**1**) configured to exchange heat between a first and a second medium, comprising:

a first flow passage (**6**) comprising a tubular element (**2**) comprising at least two internal tubular flow channels (**4**) separated by a region (**5**) and extending along a longitudinal Y-axis, for the passage of a first medium through the internal flow channels (**4**), and

a second flow passage (**8**) for the passage of a second medium between the tubular element (**2**) and a heat transfer element (**3**),

wherein the tubular element (**2**) comprises a first surface (A) comprising at least a region (**5**) and at least two bulging sections (**7**), and the heat transfer element (**3**) comprises a second surface (B) comprising at least a region (**5'**) and at least two indentation, cavity or nest sections (**17**), wherein the first surface (A) and the second surface (B) are adapted to contact each other, and characterised in that the first and second surfaces (A, B) have a complementary shape such that the bulging sections (**7**) of the first surface (A) are in continuous contact with the indentation, cavity or nest sections (**17**) of the second surface (B), whereby the process is, characterised in that a shape of the heat transfer element (**3**) is formed by punching through at least a portion of the metal of the second surface (B), whereby the second surface (B) comprises at least a region (**5'**) and at least one open sections (**17**).

19. A method for using a heat exchanger (**1**) configured to exchange heat between a first and a second medium, comprising:

a first flow passage (**6**) comprising a tubular element (**2**) comprising at least two internal tubular flow channels (**4**) separated by a region (**5**) and extending along a longitudinal Y-axis, for the passage of a first medium through the internal flow channels (**4**), and

a second flow passage (**8**) for the passage of a second medium between the tubular element (**2**) and a heat transfer element (**3**), wherein the tubular element (**2**) comprises a first surface (A) comprising at least a region (**5**) and at least two bulging sections (**7**), and the heat transfer element (**3**) comprises a second surface (B) comprising at least a region (**5'**) and at least two indentation, cavity or nest sections (**17**), wherein the first surface (A) and the second surface (B) are adapted to contact each other, and characterised in that the first and second surfaces (A, B) have a complementary shape such that the bulging sections (**7**) of the first surface (A) are in continuous contact with the indentation, cavity or nest sections (**17**) of the second surface (B), for heating, ventilating, and air conditioning in buildings, heat radiators in engines, computers, heat absorbers and/or industrial coolers.

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