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(54) **HEAT EXCHANGER**

WÄRMETAUSCHER

ÉCHANGEUR DE CHALEUR

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Description

Technical field

[0001] The present invention relates to a heat exchanger.

Background

[0002] In general, a heat exchanger such as a micro-channel heat exchanger comprises two manifolds disposed on two sides of the heat exchanger, heat exchange tubes such as flat tubes connected between the two manifolds, and fins disposed between the heat exchange tubes.

[0003] Heat exchangers comprising two manifolds arranged on the same side are disclosed in CN-A-103245132, JP-A-2010169289 and EP-A-1762808. EP-A-1762808 discloses a heat exchanger according to the preamble of claim 1.

Summary

[0004] An object of an embodiment of the present invention is to provide a heat exchanger, such that manifolds are arranged on the same side, to save connecting pipelines.

[0005] An embodiment of the present invention provides a heat exchanger according to claim 1.

[0006] Advantageous embodiments of the invention are defined in claims 2-17.

[0007] According to an embodiment of the present invention, the second end deviates from a center line of the second heat exchange part by curving, and the first end and the second end deviate in opposite directions.

[0008] According to an embodiment of the present invention, the first heat exchange part and the second heat exchange part are arranged in a first direction, and extend in a second direction which is substantially perpendicular to the first direction, and the first end deviates from the center line of the first heat exchange part in a third direction which is substantially perpendicular to the first direction and the second direction.

[0009] According to an embodiment of the present invention, the first heat exchange part and the second heat exchange part are arranged in a first direction, and extend in a second direction which is substantially perpendicular to the first direction, the first end deviates from the center line of the first heat exchange part in a third direction which is substantially perpendicular to the first direction and the second direction, and the second end deviates from the center line of the second heat exchange part in a third direction which is substantially perpendicular to the first direction and the second direction.

[0010] According to an embodiment of the present invention, each heat exchange tube also has a plurality of third heat exchange parts disposed between the first heat exchange part and the second heat exchange part, and

the first heat exchange part, the second heat exchange part and the third heat exchange parts are substantially parallel.

[0011] According to an embodiment of the present invention, each heat exchange tube also has a plurality of connecting parts connecting adjacent heat exchange parts amongst the first heat exchange part, the third heat exchange parts and the second heat exchange part, with at least one of the connecting parts being formed by bending, or being a U-shaped tube.

[0012] According to an embodiment of the present invention, the heat exchanger further comprises: a fin, disposed between the first heat exchange part and the second heat exchange part.

[0013] According to an embodiment of the present invention, the heat exchanger further comprises: a fin, disposed between adjacent heat exchange parts amongst the first heat exchange part, the third heat exchange parts and the second heat exchange part.

[0014] According to an embodiment of the present invention, the first end of each heat exchange tube is inclined relative to the first heat exchange part.

[0015] According to an embodiment of the present invention, the first end of each heat exchange tube is inclined relative to the first heat exchange part, and the second end of each heat exchange tube is inclined relative to the second heat exchange part.

[0016] According to an embodiment of the present invention, the first end deviates from the center line of the first heat exchange part by curving substantially in a plane defined by the second direction and the third direction.

[0017] According to an embodiment of the present invention, the first end deviates from the center line of the first heat exchange part by curving substantially in a plane defined by the second direction and the third direction, and the second end deviates from the center line of the second heat exchange part by curving substantially in the plane defined by the second direction and the third direction.

[0018] According to an embodiment of the present invention, the first end and the first heat exchange part of each heat exchange tube lie substantially in a plane defined by the second direction and the third direction.

[0019] According to an embodiment of the present invention, the first end and the first heat exchange part of each heat exchange tube lie substantially in a plane defined by the second direction and the third direction, and the second end and the second heat exchange part of each heat exchange tube lie substantially in the plane defined by the second direction and the third direction.

[0020] According to an embodiment of the present invention, the first manifold and the second manifold are manifolds with D-shaped cross sections, and substantially flat surfaces of the manifolds with the D-shaped cross sections face each other.

[0021] According to an embodiment of the present invention, the heat exchanger further comprises: a heat insulating element disposed between the first manifold

and the second manifold.

[0022] According to an embodiment of the present invention, each of the heat exchange tubes is an integral whole.

[0023] In the heat exchanger according to an embodiment of the present invention, the manifolds are arranged on the same side, so connecting pipelines are saved, and costs are lower.

Brief Description of the Drawings

[0024]

Fig. 1 is a schematic diagram of a heat exchange tube of a heat exchanger according to a first embodiment of the present invention;

fig. 2 is a three-dimensional schematic diagram of the heat exchanger according to the first embodiment of the present invention;

fig. 3 is a view of the heat exchanger according to the first embodiment of the present invention from the right;

fig. 4 is a main view of the heat exchanger according to the first embodiment of the present invention;

fig. 5 is a schematic diagram of a heat exchange tube of a heat exchanger according to a second embodiment of the present invention;

fig. 6 is a three-dimensional schematic diagram of the heat exchanger according to the second embodiment of the present invention;

fig. 7 is a view of the heat exchanger according to the second embodiment of the present invention from the right;

fig. 8 is a main view of the heat exchanger according to the second embodiment of the present invention;

fig. 9 is a schematic diagram of a heat exchange tube of a heat exchanger according to a third embodiment of the present invention;

fig. 10 is a three-dimensional schematic diagram of the heat exchanger according to the third embodiment of the present invention;

fig. 11 is a view of the heat exchanger according to the third embodiment of the present invention from the right;

fig. 12 is a main view of the heat exchanger according to the third embodiment of the present invention;

fig. 13 is a schematic diagram of a heat exchange tube of a heat exchanger according to a fourth embodiment of the present invention;

fig. 14 is a three-dimensional schematic diagram of the heat exchanger according to the fourth embodiment of the present invention;

fig. 15 is a view of the heat exchanger according to the fourth embodiment of the present invention from the right; and

fig. 16 is a main view of the heat exchanger according to the fourth embodiment of the present invention.

Detailed Description

[0025] Figs. 1, 5, 9 and 13 show heat exchange tubes according to embodiments of the present invention; figs. 2 to 4, 6 to 8, 10 to 12 and 14 to 16 show heat exchangers according to embodiments of the present invention, wherein an end cap for an end of a manifold of the heat exchanger has been omitted, hence that end of the heat exchange tube which is inserted into the manifold can be seen.

[0026] As shown in figs. 1 to 16, a heat exchanger 100, such as a micro-channel heat exchanger according to an embodiment of the present invention comprises: a first manifold 11 and a second manifold 12 disposed on the same side of the heat exchanger 100 (e.g. a first manifold 11 and a second manifold 12 disposed substantially in parallel, at an angle or side by side, or a first manifold 11 and a second manifold 12 formed from one tube by means of a longitudinal partition plate); and a plurality of heat exchange tubes 20 such as flat tubes, each heat exchange tube 20 having: a first heat exchange part 21 and a second heat exchange part 22 which are substantially parallel; and a first end 24 and a second end 25 connected to the first heat exchange part 21 and the second heat exchange part 22 respectively, with the first end 24 deviating from a center line (i.e. an axis, axial center line or longitudinal center line of a tube section forming the heat exchange part) of the first heat exchange part 21 by curving, such that the first end 24 and the second end 25 are connected to, and in fluid communication with, the first manifold 11 and the second manifold 12 respectively. Each heat exchange tube 20 also has a connecting part 23 connecting the first heat exchange part 21 and the second heat exchange part 22. At least one heat exchange tube 20 is an integral whole, and the connecting part 23 of the at least one heat exchange tube 20 may be formed by bending. Optionally, each heat exchange tube 20 also has a connecting part 23 connecting the first heat exchange part 21 and the second heat exchange part 22, with at least one of the connecting parts 23 being a U-shaped tube, e.g. a single U-shaped tube is connected to the first heat exchange part 21 and the second heat exchange part 22 by welding. According to one example of the present invention, each of the heat exchange tubes 21 is an integral whole.

[0027] A refrigerant can flow into the heat exchanger through the first manifold 11 and flow out of the heat exchanger through the second manifold 12. In the embodiment shown in the figure, the first end 24 and the second end 25 are opposite the connecting part 23. The heat exchanger 100 also comprises: fins 30, disposed between the first heat exchange part 21 and the second heat exchange part 22. In the embodiment shown in figs. 1 to 4, the first end 24 deviates from the center line of the first heat exchange part 21 by bending twice, and each heat exchange tube 20 comprises two heat exchange parts.

[0028] Referring to figs. 1 to 16, according to some

embodiments of the present invention, each heat exchange tube 20 also has a plurality of third heat exchange parts disposed between the first heat exchange part 21 and the second heat exchange part 22, and the first heat exchange part 21, the second heat exchange part 22 and the third heat exchange parts are substantially parallel. Each heat exchange tube 20 also has a plurality of connecting parts 23 connecting adjacent heat exchange parts amongst the first heat exchange part 21, the third heat exchange parts and the second heat exchange part 22, with at least one of the connecting parts 23 being formed by bending, or being a U-shaped tube. The heat exchanger 100 also comprises: fins 30, disposed between adjacent heat exchange parts amongst the first heat exchange part 21, the third heat exchange parts and the second heat exchange part 22. By forming a plurality of connecting parts 23, each heat exchange tube 20 may comprise four or more heat exchange parts.

[0029] Referring to figs. 2 to 4, 6 to 8 and 10 to 12, the first heat exchange part 21 and the second heat exchange part 22 are arranged in a first direction D1, and extend in a second direction D2 which is substantially perpendicular to the first direction D1, and said same side of the heat exchanger 100 is the same side in the second direction D2, in a plane defined by the first direction D1 and the second direction D2.

[0030] As shown in figs. 5 to 12, the second end 25 deviates from a center line (i.e. an axis, axial center line or longitudinal center line of a tube section forming the heat exchange part) of the second heat exchange part 22 by curving, and the first end 24 and the second end 25 deviate in opposite directions.

[0031] In the embodiment shown in figs. 5 to 8, the first end 24 and the second end 25 deviate from the center line of the first heat exchange part 21 and the center line of the second heat exchange part 22 respectively by bending twice, and each heat exchange tube 20 comprises two heat exchange parts; by forming a plurality of connecting parts 23, each heat exchange tube 20 may comprise four or more heat exchange parts.

[0032] As shown in figs. 2 to 4, the first heat exchange part 21 and the second heat exchange part 22 are arranged in the first direction D1 (i.e. an axial direction of the first manifold 11 and the second manifold 12), and extend in the second direction D2 which is substantially perpendicular to the first direction D1; and the first end 24 deviates from the center line of the first heat exchange part 21 in a third direction D3 which is substantially perpendicular to the first direction D1 and the second direction D2. The first manifold 11 and the second manifold 12 are disposed in the third direction D3. For example, the first end 24 deviates from the center line of the first heat exchange part 21 by curving substantially in a plane defined by the second direction D2 and the third direction D3. According to some embodiments of the present invention, the first end 24 and the first heat exchange part 21 of each heat exchange tube 20 may lie substantially in the plane defined by the second direction D2 and the

third direction D3.

[0033] As shown in figs. 6 to 8 and 10 to 12, the first heat exchange part 21 and the second heat exchange part 22 are arranged in the first direction D1 (i.e. the axial direction of the first manifold 11 and the second manifold 12), and extend in the second direction D2 which is substantially perpendicular to the first direction D1; the first end 24 deviates from the center line of the first heat exchange part 21 in the third direction D3 which is substantially perpendicular to the first direction D1 and the second direction D2, and the second end 25 deviates from the center line of the second heat exchange part 22 in the third direction D3 which is substantially perpendicular to the first direction D1 and the second direction D2. For example, the first end 24 deviates from the center line of the first heat exchange part 21 by curving substantially in the plane defined by the second direction D2 and the third direction D3, and the second end 25 deviates from the center line of the second heat exchange part 22 by curving substantially in the plane defined by the second direction D2 and the third direction D3. According to some embodiments of the present invention, the first end 24 and the first heat exchange part 21 of each heat exchange tube 20 lie substantially in the plane defined by the second direction D2 and the third direction D3, and the second end 25 and the second heat exchange part 22 of each heat exchange tube 20 lie substantially in the plane defined by the second direction D2 and the third direction D3.

[0034] In the embodiment shown in figs. 1 to 4, a direction of extension of a part 241, connected to the first manifold 11, of the first end 24 of each heat exchange tube 20 is substantially the same as the direction of extension of the first heat exchange part 21. For example, the part 241, connected to the first manifold 11, of the first end 24 of each heat exchange tube 20 extends substantially in the second direction D2.

[0035] In the embodiment shown in figs. 5 to 8, the direction of extension of the part 241, connected to the first manifold 11, of the first end 24 of each heat exchange tube 20 is substantially the same as the direction of extension of the first heat exchange part 21, and a direction of extension of a part 251, connected to the second manifold 12, of the second end 25 of each heat exchange tube 20 is substantially the same as the direction of extension of the second heat exchange part 22. For example, the part 241, connected to the first manifold 11, of the first end 24 of each heat exchange tube 20 extends substantially in the second direction D2, and the part 251, connected to the second manifold 12, of the second end 25 of each heat exchange tube 20 extends substantially in the second direction D2.

[0036] Referring to figs. 9 to 12, the first end 24 (e.g. a center line of the first end 24 (i.e. an axis, axial center line or longitudinal center line of a tube section forming the end)) of each heat exchange tube 20 is inclined relative to the first heat exchange part 21 (e.g. the center line of the first heat exchange part 21 (i.e. the axis, axial

center line or longitudinal center line of the tube section forming the first heat exchange part 21)). In the embodiment shown in figs. 9 to 12, the first end 24 and the second end 25 deviate from the center line of the first heat exchange part 21 and the center line of the second heat exchange part 22 respectively by bending once, and each heat exchange tube 20 comprises two heat exchange parts; by forming a plurality of connecting parts 23, each heat exchange tube 20 may comprise four or more heat exchange parts.

[0037] In the embodiment shown in figs. 9 to 12, the first end 24 of each heat exchange tube 20 is inclined relative to the first heat exchange part 21, and the second end 25 (e.g. a center line of the second end 25 (i.e. an axis, axial center line or longitudinal center line of a tube section forming the end)) of each heat exchange tube 20 is inclined relative to the second heat exchange part 22 (e.g. the center line of the second heat exchange part 22 (i.e. the axis, axial center line or longitudinal center line of the tube section forming the second heat exchange part 22)).

[0038] A heat insulating space 40 or heat insulating element may be disposed between the first manifold 11 and the second manifold 12, and may prevent heat exchange between the two manifolds and the formation of a heat bridge, which would affect the heat exchange effect of the heat exchanger. The first manifold 11 and the second manifold 12 may be two separate manifolds, but could also be a first manifold 11 and a second manifold 12 formed from one tube by means of a longitudinal partition plate. The longitudinal partition plate may be two partition plates; the two partition plates may be integral with pipe walls of the pipes, but could also be separate.

[0039] As shown in figs. 14 to 16, the first manifold 11 and the second manifold 12 are manifolds with D-shaped cross sections, and substantially flat surfaces of the two manifolds with the D-shaped cross sections face each other. A gap is provided between the first manifold 11 and the second manifold 12. The heat insulating element may be disposed in the gap.

[0040] The heat exchanger according to an embodiment of the present invention may be used in the fields of heating, ventilating and air conditioning, motor vehicles, refrigeration and transport, and may be a micro-channel heat exchanger or a parallel-flow heat exchanger, etc. The heat exchanger according to an embodiment of the present invention can reduce costs, increase the wind field uniformity and output wind temperature uniformity of a micro-channel heat pump evaporator, and increase the utilization rate of the heat exchange area.

[0041] Moreover, in the heat exchanger according to the present invention, a partition plate may be disposed in the manifold, so as to form different circuits. In addition, in the heat exchanger according to the present invention, the circuit length may be adjusted as required (with the heat exchange tube being bent a number of times). When the heat exchanger is used in an evaporator, the difference between the condensate water produced by the top

portion and condensate water of the bottom-half portion is not large, the wind field of the heat exchanger is more uniform, and the output wind temperatures of various parts of the heat exchanger are more uniform.

[0042] Furthermore, in the heat exchanger according to the present invention, the manifolds are arranged at a single side, so connecting pipelines and manifolds are saved, and costs are lower. In addition, a single row of flat tubes may be employed, so that wind resistance is low.

Claims

1. A heat exchanger (100), comprising:

a first manifold (11) and a second manifold (12) disposed on the same side of the heat exchanger (100); and
a plurality of flat heat exchange tubes (20), each heat exchange tube (20) having:

a first heat exchange part (21) and a second heat exchange part (22) which are substantially parallel; and

a first end (24) and a second end (25) connected to the first heat exchange part (21) and the second heat exchange part (22) respectively, the first end (24) deviates from a center line of the first heat exchange part (21) by curving, such that the first end (24) and the second end (25) are connected to, and in fluid communication with, the first manifold (11) and the second manifold (12) respectively, the first heat exchange part (21) and the second heat exchange part (22) are arranged in a first direction (D1), and extend in a second direction (D2) which is substantially perpendicular to the first direction (D1), and

said same side of the heat exchanger (100) is the same side in the second direction (D2), in a plane defined by the first direction (D1) and the second direction (D2), **characterised in that** each heat exchange tube (20) further has a connecting part (23) connecting the first heat exchange part (21) and the second heat exchange part (22); at least one of the connecting parts (23) is a U-shaped tube, or at least one heat exchange tube (20) is an integral whole and the connecting part (23) of the at least one heat exchange tube (20) is formed by bending, fins (30) are disposed between the first heat exchange part (21) and the second heat exchange part (22).

2. The heat exchanger as claimed in claim 1, **charac-**

terized in that:

the second end (25) deviates from a center line of the second heat exchange part (22) by curving, and the first end (24) and the second end (25) deviate in opposite directions.

3. The heat exchanger as claimed in claim 1, **characterized in that:**

the first heat exchange part (21) and the second heat exchange part (22) are arranged in a first direction (D1), and extend in a second direction (D2) which is substantially perpendicular to the first direction (D1), and

the first end (24) deviates from the center line of the first heat exchange part (21) in a third direction (D3) which is substantially perpendicular to the first direction (D1) and the second direction (D2).

4. The heat exchanger as claimed in claim 2, **characterized in that:**

the first heat exchange part (21) and the second heat exchange part (22) are arranged in a first direction (D1), and extend in a second direction (D2) which is substantially perpendicular to the first direction (D1),

the first end deviates (24) from the center line of the first heat exchange part (21) in a third direction (D3) which is substantially perpendicular to the first direction (D1) and the second direction (D2), and

the second end (25) deviates from the center line of the second heat exchange part (22) in a third direction (D3) which is substantially perpendicular to the first direction (D1) and the second direction (D2).

5. The heat exchanger as claimed in claim 1, **characterized in that:**

each heat exchange tube (20) further has a plurality of third heat exchange parts disposed between the first heat exchange part (21) and the second heat exchange part (22), and the first heat exchange part (21), the second heat exchange part (22) and the third heat exchange parts are substantially parallel.

6. The heat exchanger as claimed in claim 5, **characterized in that:**

each heat exchange tube (20) further has a plurality of connecting parts (23) connecting adjacent heat exchange parts amongst the first heat exchange part (21), the third heat exchange parts and the second heat exchange part (22), with at least one of the connecting parts (23) being formed by bending, or being a U-shaped tube.

7. The heat exchanger as claimed in claim 1, further **characterized by:**

a fin (30), disposed between the first heat exchange part (21) and the second heat exchange part (22).

8. The heat exchanger as claimed in claim 5, further **characterized by:**

a fin (30), disposed between adjacent heat exchange parts amongst the first heat exchange part (21), the third heat exchange parts and the second heat exchange part (22).

9. The heat exchanger as claimed in claim 1, **characterized in that:**

the first end (24) of each heat exchange tube (20) is inclined relative to the first heat exchange part (21).

10. The heat exchanger as claimed in claim 2, **characterized in that:**

the first end (24) of each heat exchange tube is inclined relative to the first heat exchange part (21), and

the second end (25) of each heat exchange tube (20) is inclined relative to the second heat exchange part (22).

11. The heat exchanger as claimed in claim 3, **characterized in that:**

the first end (24) deviates from the center line of the first heat exchange part (21) by curving substantially in a plane defined by the second direction (D2) and the third direction (D3).

12. The heat exchanger as claimed in claim 4, **characterized in that:**

the first end (24) deviates from the center line of the first heat exchange part (21) by curving substantially in a plane defined by the second direction (D2) and the third direction (D3), and the second end (25) deviates from the center line of the second heat exchange part (22) by curving substantially in the plane defined by the second direction (D2) and the third direction (D3).

13. The heat exchanger as claimed in claim 3, **characterized in that:**

the first end (24) and the first heat exchange part (21) of each heat exchange tube (20) lie substantially in a plane defined by the second direction (D2) and the third direction (D3).

14. The heat exchanger as claimed in claim 4, **characterized in that:**

the first end (24) and the first heat exchange part

(21) of each heat exchange tube (20) lie substantially in a plane defined by the second direction (D2) and the third direction (D3), and the second end (25) and the second heat exchange part (22) of each heat exchange tube (20) lie substantially in the plane defined by the second direction (D2) and the third direction (D3).

15. The heat exchanger as claimed in claim 1, **characterized in that:** the first manifold (11) and the second manifold (12) are manifolds (11, 12) with D-shaped cross sections, and substantially flat surfaces of the manifolds (11, 12) with the D-shaped cross sections face each other.
16. The heat exchanger as claimed in claim 1 or 15, further **characterized by:** a heat insulating element (40) disposed between the first manifold (11) and the second manifold (12).
17. The heat exchanger as claimed in claim 1, **characterized in that:** each of the heat exchange tubes (20) is an integral whole.

Patentansprüche

1. Wärmetauscher (100), der aufweist:

einen ersten Verteiler (11) und einen zweiten Verteiler (12), die auf der gleichen Seite des Wärmetauschers (100) angeordnet sind; und eine Vielzahl von flachen Wärmetauscherrohren (20), wobei jedes Wärmetauscherrohr (20) aufweist:

einen ersten Wärmetauscherteil (21) und einen zweiten Wärmetauscherteil (22), die im Wesentlichen parallel sind; und ein erstes Ende (24) und ein zweites Ende (25), die mit dem ersten Wärmetauscherteil (21) bzw. dem zweiten Wärmetauscherteil (22) verbunden sind, wobei das erste Ende (24) durch Krümmung von einer Mittellinie des ersten Wärmetauscherteils (21) abweicht, so dass das erste Ende (24) und das zweite Ende (25) mit dem ersten Verteiler (11) bzw. dem zweiten Verteiler (12) verbunden sind und in Fluidverbindung mit diesen stehen,

der erste Wärmetauscherteil (21) und der zweite Wärmetauscherteil (22) in einer ersten Richtung (D1) angeordnet sind und sich in einer zweiten Richtung (D2) erstrecken, die im Wesentlichen

senkrecht zu der ersten Richtung (D1) ist, und die gleiche Seite des Wärmetauschers (100) in einer Ebene, die durch die erste Richtung (D1) und die zweite Richtung (D2) definiert ist, die gleiche Seite in der zweiten Richtung (D2) ist, **dadurch gekennzeichnet, dass** jedes Wärmetauscherrohr (20) weiterhin einen Verbindungsteil (23) aufweist, der den ersten Wärmetauscherteil (21) und den zweiten Wärmetauscherteil (22) verbindet; wobei mindestens einer der Verbindungsteile (23) ein U-förmiges Rohr ist oder mindestens ein Wärmetauscherrohr (20) ein integrales Ganzes ist und der Verbindungsteil (23) des mindestens einen Wärmetauscherrohrs (20) durch Biegen gebildet ist, wobei Rippen (30) zwischen dem ersten Wärmetauscherteil (21) und dem zweiten Wärmetauscherteil (22) angeordnet sind.

2. Wärmetauscher nach Anspruch 1, **dadurch gekennzeichnet, dass:** das zweite Ende (25) von einer Mittellinie des zweiten Wärmetauscherteils (22) durch Krümmung abweicht und das erste Ende (24) und das zweite Ende (25) in entgegengesetzte Richtungen abweichen.
3. Wärmetauscher nach Anspruch 1, **dadurch gekennzeichnet, dass** der erste Wärmetauscherteil (21) und der zweite Wärmetauscherteil (22) in einer ersten Richtung (D1) angeordnet sind und sich in einer zweiten Richtung (D2) erstrecken, die im Wesentlichen senkrecht zur ersten Richtung (D1) ist, und das erste Ende (24) von der Mittellinie des ersten Wärmetauscherteils (21) in einer dritten Richtung (D3) abweicht, die im Wesentlichen senkrecht zu der ersten Richtung (D1) und der zweiten Richtung (D2) ist.
4. Wärmetauscher nach Anspruch 2, **dadurch gekennzeichnet, dass** der erste Wärmetauscherteil (21) und der zweite Wärmetauscherteil (22) in einer ersten Richtung (D1) angeordnet sind und sich in einer zweiten Richtung (D2) erstrecken, die im Wesentlichen senkrecht zu der ersten Richtung (D1) ist, wobei das erste Ende von der Mittellinie des ersten Wärmetauscherteils (21) in eine dritte Richtung (D3) abweicht, die im Wesentlichen senkrecht zu der ersten Richtung (D1) und der zweiten Richtung (D2) ist, und das zweite Ende (25) von der Mittellinie des zweiten Wärmetauscherteils (22) in eine dritte Richtung (D3) abweicht, die im Wesentlichen senkrecht zu der ersten Richtung (D1) und der zweiten Richtung (D2) ist.
5. Wärmetauscher nach Anspruch 1, **dadurch gekennzeichnet, dass** jedes Wärmetauscherrohr (20) weiterhin eine Vielzahl von dritten Wärmetauscherrohren aufweist, die zwischen dem ersten Wärmetau-

- scherteil (21) und dem zweiten Wärmetauscherteil (22) angeordnet sind, und das erste Wärmetauscherteil (21), das zweite Wärmetauscherteil (22) und das dritte Wärmetauscherteil im Wesentlichen parallel sind.
6. Wärmetauscher nach Anspruch 5, **dadurch gekennzeichnet, dass** jedes Wärmetauscherrohr (20) weiterhin eine Vielzahl von Verbindungsteilen (23) aufweist, die benachbarte Wärmetauscherteile zwischen dem ersten Wärmetauscherteil (21), dem dritten Wärmetauscherteil und dem zweiten Wärmetauscherteil (22) verbinden, wobei mindestens eines der Verbindungsteile (23) durch Biegen gebildet ist oder ein U-förmiges Rohr ist.
7. Wärmetauscher nach Anspruch 1, weiter **gekennzeichnet durch** eine Rippe (30), die zwischen dem ersten Wärmetauscherteil (21) und dem zweiten Wärmetauscherteil (22) angeordnet ist.
8. Wärmetauscher nach Anspruch 5, weiter **gekennzeichnet durch** eine Rippe (30), die zwischen benachbarten Wärmetauscherteilen unter dem ersten Wärmetauscherteil (21), den dritten Wärmetauscherteilen und dem zweiten Wärmetauscherteil (22) angeordnet ist.
9. Wärmetauscher nach Anspruch 1, **dadurch gekennzeichnet, dass** das erste Ende (24) jedes Wärmetauscherrohrs (20) relativ zum ersten Wärmetauscherteil (21) geneigt ist.
10. Wärmetauscher nach Anspruch 2, **dadurch gekennzeichnet, dass** das erste Ende (24) jedes Wärmetauscherrohrs relativ zu dem ersten Wärmetauscherteil (21) geneigt ist und das zweite Ende (25) jedes Wärmetauscherrohrs relativ zu dem zweiten Wärmetauscherteil (22) geneigt ist.
11. Wärmetauscher nach Anspruch 3, **dadurch gekennzeichnet, dass** das erste Ende (24) von der Mittellinie des ersten Wärmetauscherteils (21) abweicht durch Krümmung im Wesentlichen in einer Ebene, die durch die zweite Richtung (D2) und die dritte Richtung (D3) definiert ist.
12. Wärmetauscher nach Anspruch 4, **dadurch gekennzeichnet, dass** das erste Ende (24) von der Mittellinie des ersten Wärmetauscherteils (21) abweicht durch Krümmung im Wesentlichen in einer Ebene, die durch die zweite Richtung (D2) und die dritte Richtung (D3) definiert ist, und das zweite Ende (25) von der Mittellinie des zweiten Wärmetauschers (22) abweicht durch Krümmung im Wesentlichen in der Ebene, die durch die zweite Richtung (D2) und die dritte Richtung (D3) definiert ist.
13. Wärmetauscher nach Anspruch 3, **dadurch gekennzeichnet, dass** das erste Ende (24) und der erste Wärmetauscherteil (21) jedes Wärmetauscherrohrs (20) im Wesentlichen in einer Ebene liegen, die durch die zweite Richtung (D2) und die dritte Richtung (D3) definiert ist.
14. Wärmetauscher nach Anspruch 4, **dadurch gekennzeichnet, dass** das erste Ende (24) und der erste Wärmetauscherteil (21) jedes Wärmetauscherrohrs (20) im Wesentlichen in einer Ebene liegen, die durch die zweite Richtung (D2) und die dritte Richtung (D3) definiert ist, und das zweite Ende (25) und der zweite Wärmetauscherteil (22) jedes Wärmetauscherrohrs (20) im Wesentlichen in der Ebene liegen, die durch die zweite Richtung (D2) und die dritte Richtung (D3) definiert ist.
15. Wärmetauscher nach Anspruch 1, **dadurch gekennzeichnet, dass** der erste Verteiler (11) und der zweite Verteiler (12) Verteiler (11, 12) mit D-förmigen Querschnitten sind, und die im Wesentlichen flachen Oberflächen der Verteiler (11, 12) mit D-förmigen Querschnitten einander zugewandt sind.
16. Wärmetauscher nach Anspruch 1 oder 15, weiter **gekennzeichnet durch** ein wärmeisolierendes Element (40), das zwischen dem ersten Verteiler (11) und dem zweiten Verteiler (12) angeordnet ist.
17. Wärmetauscher nach Anspruch 1, **dadurch gekennzeichnet, dass** jedes der Wärmetauscherrohre (20) ein integrales Ganzes ist.

Revendications

1. Échangeur de chaleur (100), comprenant :

un premier collecteur (11) et un second collecteur (12) disposée sur la même face de l'échangeur de chaleur (100) ; et
une pluralité de tubes d'échange de chaleur plats (20), chaque tube d'échange de chaleur (20) comportant :

une première pièce d'échange de chaleur (21) et une deuxième pièce d'échange de chaleur (22) qui sont substantiellement parallèles ; et
une première extrémité (24) et une seconde extrémité (25) connectées à la première pièce d'échange de chaleur (21) et à la deuxième pièce d'échange de chaleur (22) respectivement, la première extrémité (24) déviant d'une ligne centrale de la première pièce d'échange de chaleur (21) par cintrage, de sorte que la première extrémité (24)

et la seconde extrémité (25) sont connectées à, et en communication fluide avec, le premier collecteur (11) et le second collecteur (12) respectivement,

la première pièce d'échange de chaleur (21) et la deuxième pièce d'échange de chaleur (22) étant disposées dans un premier sens (D1), et s'étendant dans un deuxième sens (D2) qui est substantiellement perpendiculaire au premier sens (D1), et

ladite même face de l'échangeur de chaleur (100) étant la même face dans le deuxième sens (D2), dans un plan défini par le premier sens (D1) et le deuxième sens (D2), **caractérisé en ce que**

chaque tube d'échange de chaleur (20) comporte en outre une pièce de connexion (23) connectant la première pièce d'échange de chaleur (21) et la deuxième pièce d'échange de chaleur (22) ; qu'au moins une des pièces de connexion (23) est un tube en forme de U, ou qu'au moins un tube d'échange de chaleur (20) est un ensemble intégral et que la pièce de connexion (23) de l'au moins un tube d'échange de chaleur (20) est formée par cintrage, des ailettes (30) étant disposées entre la première pièce d'échange de chaleur (21) et la deuxième pièce d'échange de chaleur (22).

2. Échangeur de chaleur selon la revendication 1, caractérisé en ce que :

la seconde extrémité (25) dévie d'une ligne centrale de la deuxième pièce d'échange de chaleur (22) par cintrage, et que la première extrémité (24) et la seconde extrémité (25) dévient dans des sens opposés.

3. Échangeur de chaleur selon la revendication 1, caractérisé en ce que :

la première pièce d'échange de chaleur (21) et la deuxième pièce d'échange de chaleur (22) sont disposées dans un premier sens (D1), et s'étendent dans un deuxième sens (D2) qui est substantiellement perpendiculaire au premier sens (D1), et que la première extrémité (24) dévie de la ligne centrale de la première pièce d'échange de chaleur (21) dans un troisième sens (D3) qui est substantiellement perpendiculaire au premier sens (D1) et au deuxième sens (D2).

4. Échangeur de chaleur selon la revendication 2, caractérisé en ce que :

la première pièce d'échange de chaleur (21) et la deuxième pièce d'échange de chaleur (22)

sont disposées dans un premier sens (D1), et s'étendent dans un deuxième sens (D2) qui est substantiellement perpendiculaire au premier sens (D1), et

la première extrémité dévie (24) de la ligne centrale de la première pièce d'échange de chaleur (21) dans un troisième sens (D3) qui est substantiellement perpendiculaire au premier sens (D1) et au deuxième sens (D2), et

la seconde extrémité (25) dévie de la ligne centrale de la deuxième pièce d'échange de chaleur (22) dans un troisième sens (D3) qui est substantiellement perpendiculaire au premier sens (D1) et au deuxième sens (D2).

5. Échangeur de chaleur selon la revendication 1, caractérisé en ce que :

chaque tube d'échange de chaleur (20) comporte en outre une pluralité de troisièmes pièces d'échange de chaleur disposées entre la première pièce d'échange de chaleur (21) et la deuxième pièce d'échange de chaleur (22), et que la première pièce d'échange de chaleur (21), la deuxième pièce d'échange de chaleur (22) et les troisièmes pièces d'échange de chaleur sont substantiellement parallèles.

6. Échangeur de chaleur selon la revendication 5, caractérisé en ce que :

chaque tube d'échange de chaleur (20) comporte en outre une pluralité de pièces de connexion (23) connectant les pièces d'échange de chaleur adjacentes parmi la première pièce d'échange de chaleur (21), les troisièmes pièces d'échange de chaleur et la deuxième pièce d'échange de chaleur (22), au moins une des pièces de connexion (23) étant formée par cintrage, ou étant un tube en forme de U.

7. Échangeur de chaleur selon la revendication 1, caractérisé en outre par :

une ailette (30) disposée entre la première pièce d'échange de chaleur (21) et la deuxième pièce d'échange de chaleur (22).

8. Échangeur de chaleur selon la revendication 5, caractérisé en ce que :

une ailette (30) disposée entre des pièces d'échange de chaleur adjacentes parmi la première pièce d'échange de chaleur (21), les troisièmes pièces d'échange de chaleur et la deuxième pièce d'échange de chaleur (22).

9. Échangeur de chaleur selon la revendication 1, caractérisé en ce que :

la première extrémité (24) de chaque tube d'échange de chaleur (20) est inclinée par rapport à la première pièce d'échange de chaleur (21).

10. Échangeur de chaleur selon la revendication 2, **caractérisé en ce que** :

la première extrémité (24) de chaque tube d'échange de chaleur est inclinée par rapport à la première pièce d'échange de chaleur (21), et la seconde extrémité (25) de chaque tube d'échange de chaleur (20) est inclinée par rapport à la deuxième pièce d'échange de chaleur (22).

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11. Échangeur de chaleur selon la revendication 3, **caractérisé en ce que** :

la première extrémité (24) dévie de la ligne centrale de la première pièce d'échange de chaleur (21) par cintrage substantiellement dans un plan défini par le deuxième sens (D2) et le troisième sens (D3).

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12. Échangeur de chaleur selon la revendication 4, **caractérisé en ce que** :

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la première extrémité (24) dévie de la ligne centrale de la première pièce d'échange de chaleur (21) par cintrage substantiellement dans un plan défini par le deuxième sens (D2) et le troisième sens (D3), et

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la seconde extrémité (25) dévie de la ligne centrale de la deuxième pièce d'échange de chaleur (22) par cintrage substantiellement dans le plan défini par le deuxième sens (D2) et le troisième sens (D3).

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13. Échangeur de chaleur selon la revendication 3, **caractérisé en ce que** :

la première extrémité (24) et la première pièce d'échange de chaleur (21) de chaque tube d'échange de chaleur (20) se situent substantiellement dans un plan défini par le deuxième sens (D2) et le troisième sens (D3) .

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14. Échangeur de chaleur selon la revendication 4, **caractérisé en ce que** :

la première extrémité (24) et la première pièce d'échange de chaleur (21) de chaque tube d'échange de chaleur (20) se situent substantiellement dans un plan défini par le deuxième sens (D2) et le troisième sens (D3), et la seconde extrémité (25) et la deuxième pièce d'échange de chaleur (22) de chaque tube d'échange de chaleur (20) se situent substantiellement dans un plan défini par le deuxième sens (D2) et le troisième sens (D3).

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15. Échangeur de chaleur selon la revendication 1, **caractérisé en ce que** :

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le premier collecteur (11) et le second collecteur (12) sont des collecteurs (11,12) ayant des sections

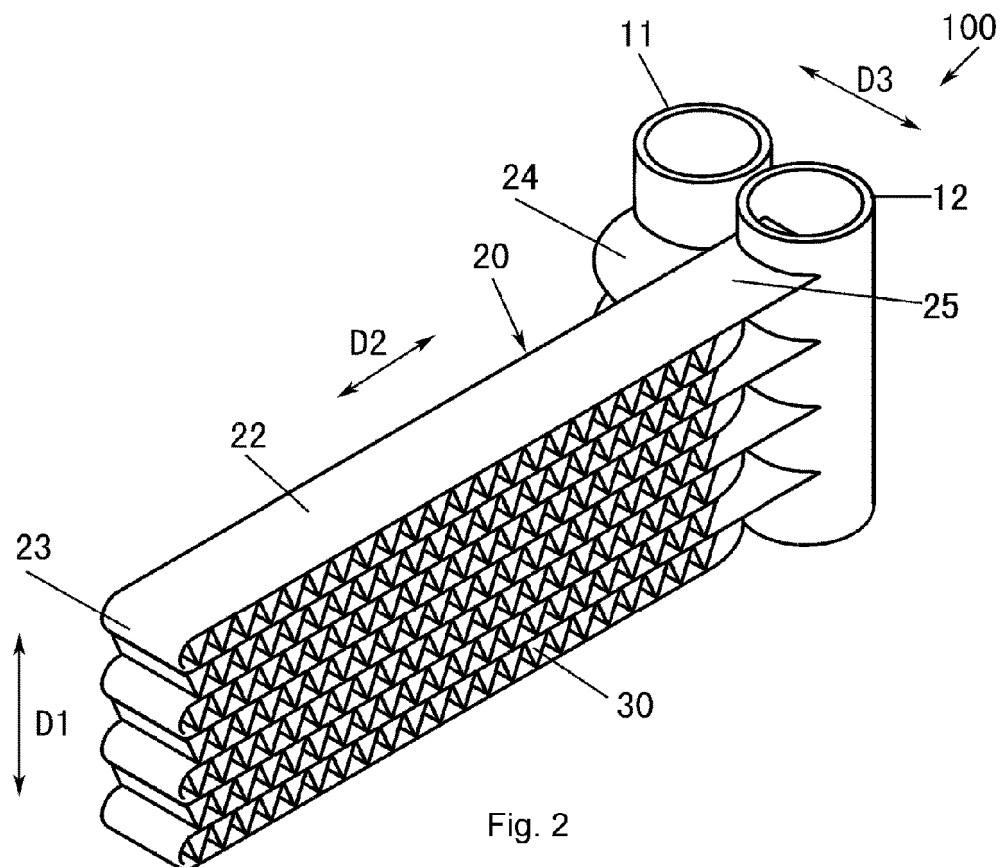
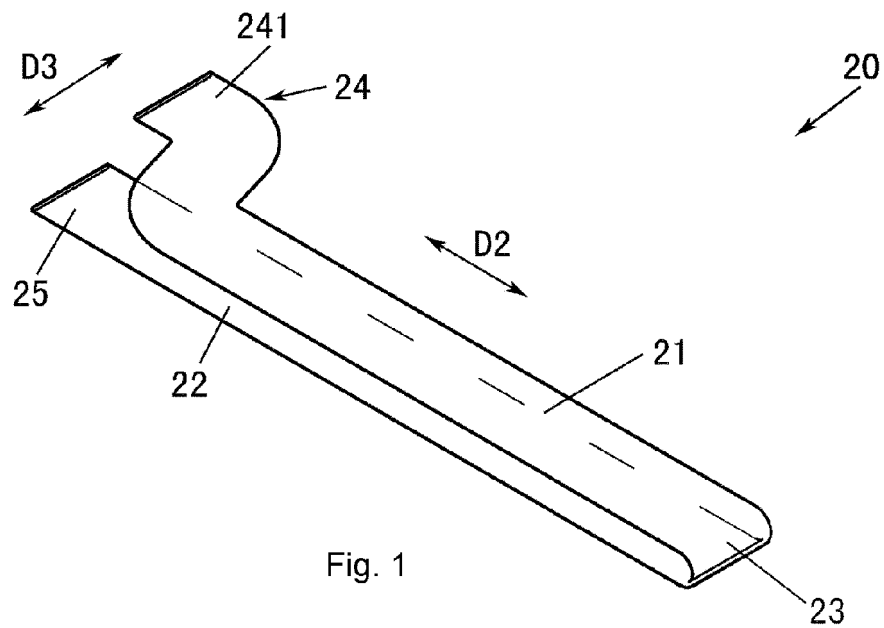
transversales en forme de D, et que les surfaces substantiellement plates des collecteurs (11,12) ayant les sections transversales en forme de D sont face à face.

16. Échangeur de chaleur selon la revendication 1 ou 15, **caractérisé en outre par** :

un élément isolant thermique (40) disposé entre le premier collecteur (11) et le second collecteur (12).

17. Échangeur de chaleur selon la revendication 1, **caractérisé en ce que** :

chacun des tubes d'échange de chaleur (20) est un ensemble intégral.



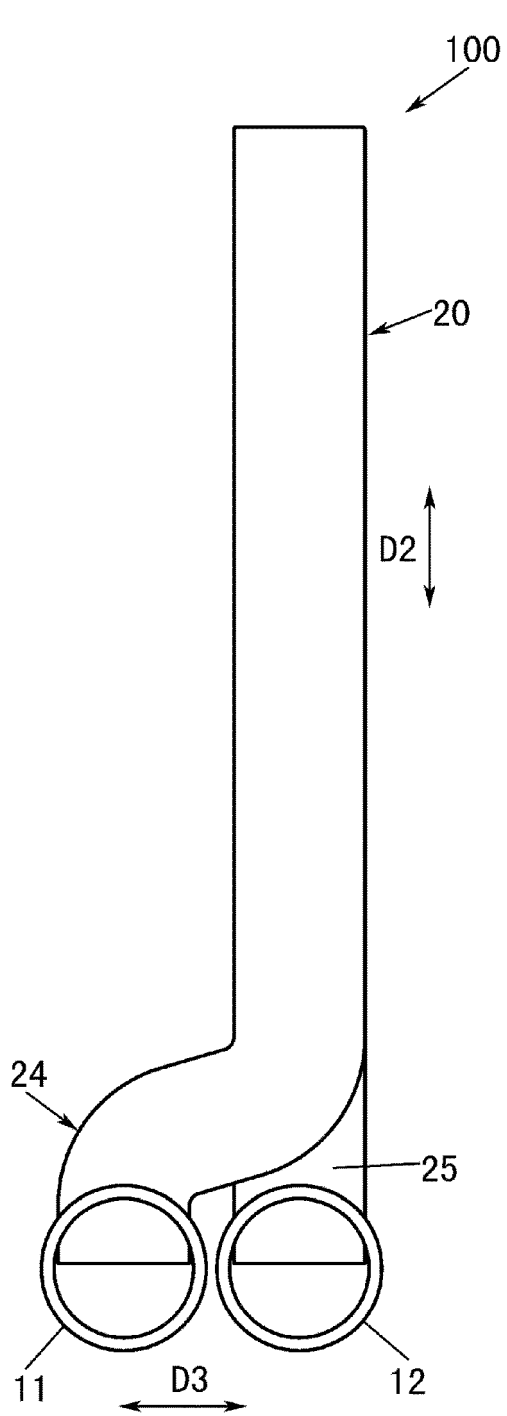


Fig. 3

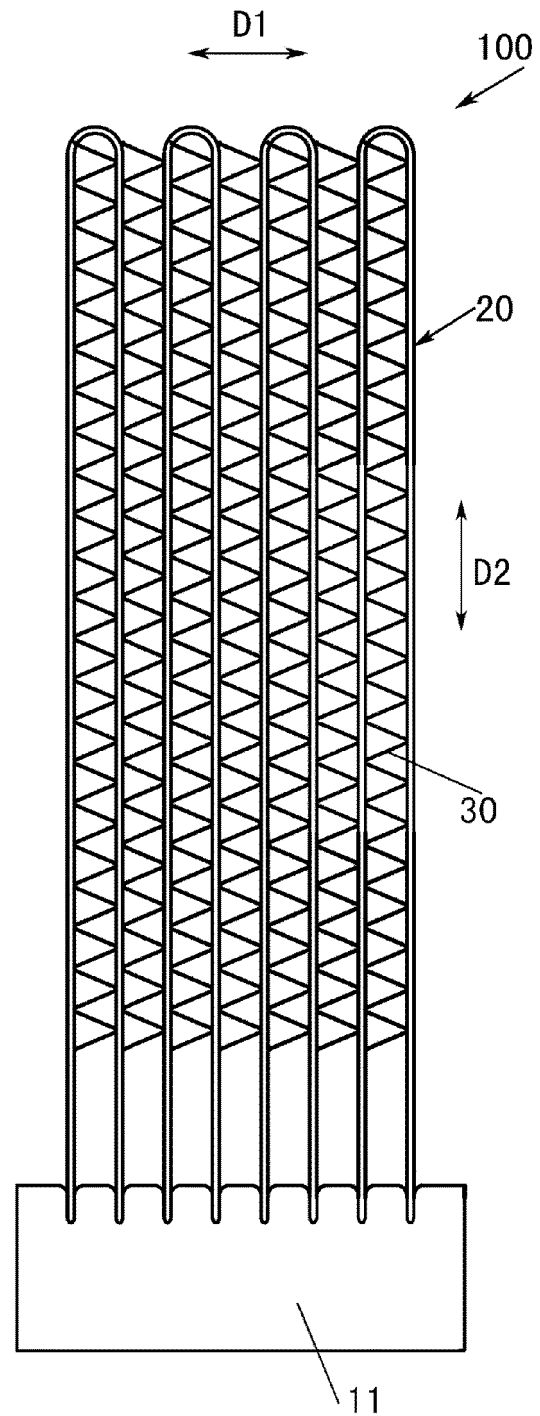


Fig. 4

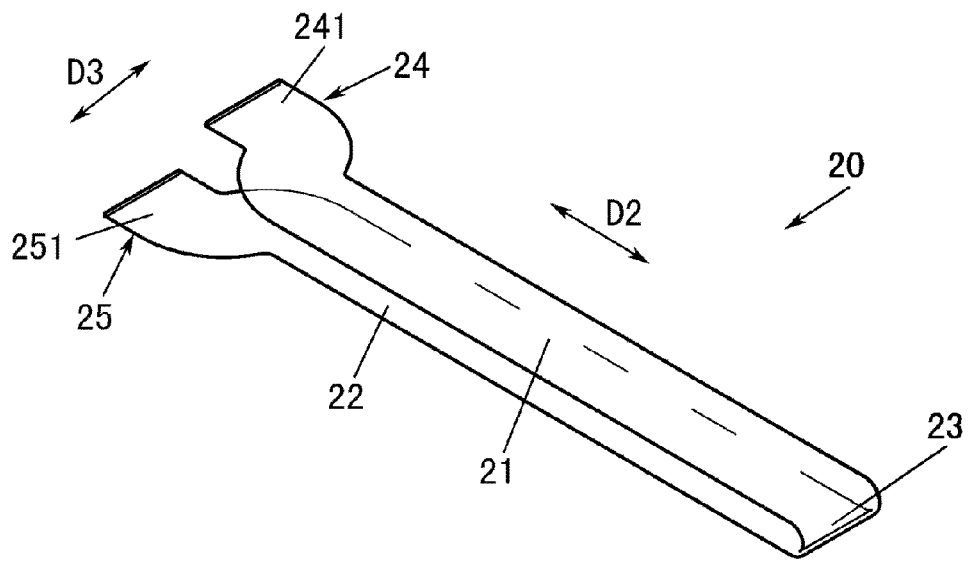


Fig. 5

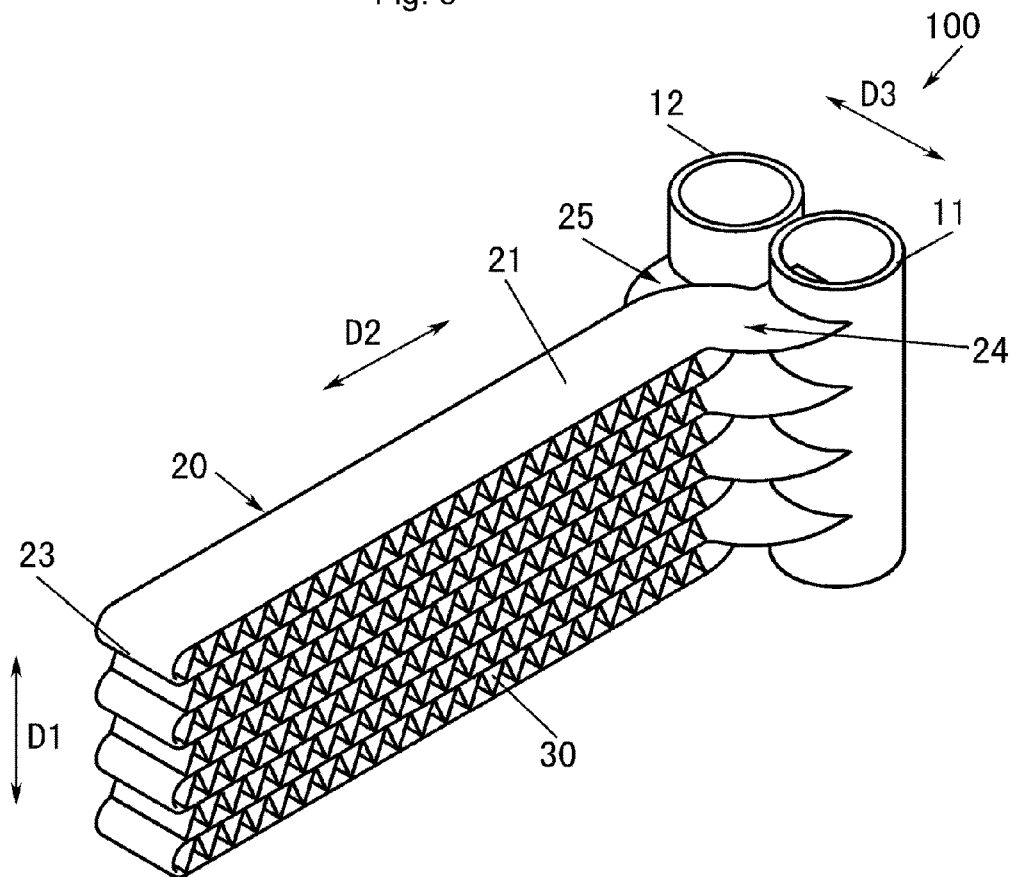


Fig. 6

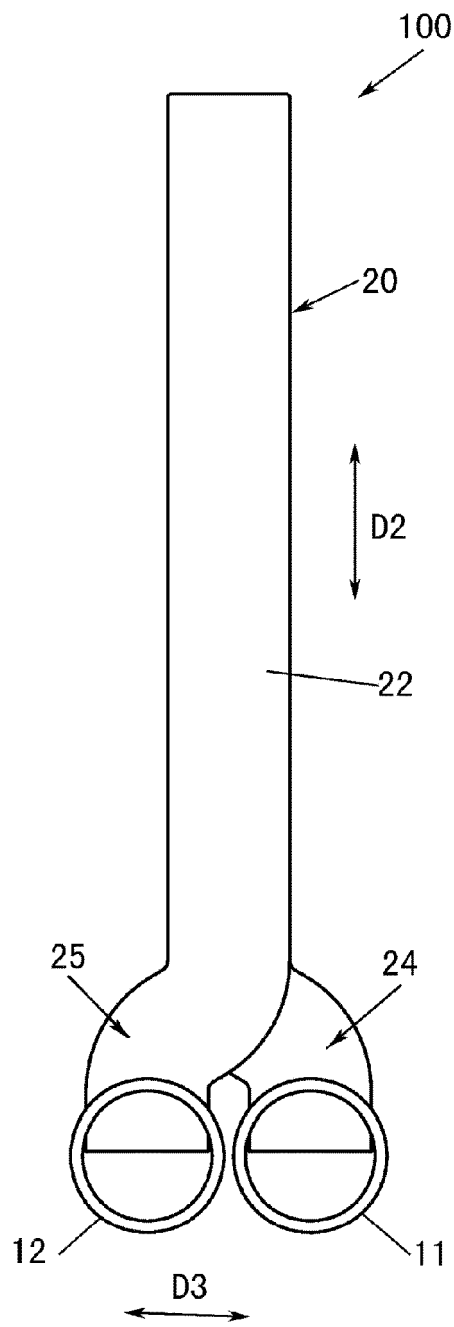


Fig. 7

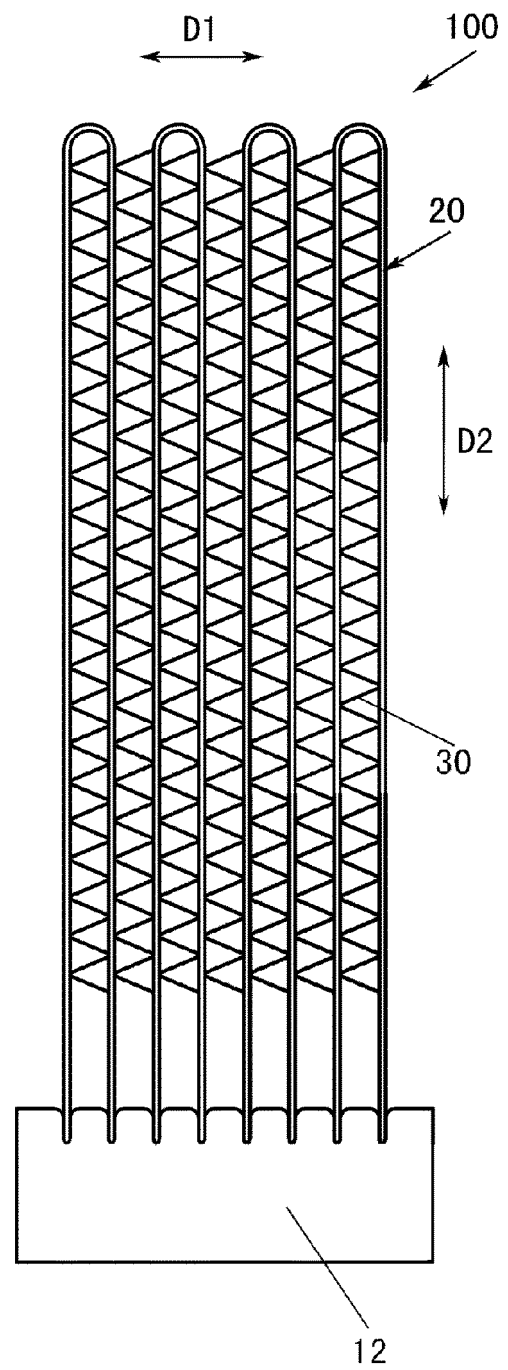


Fig. 8

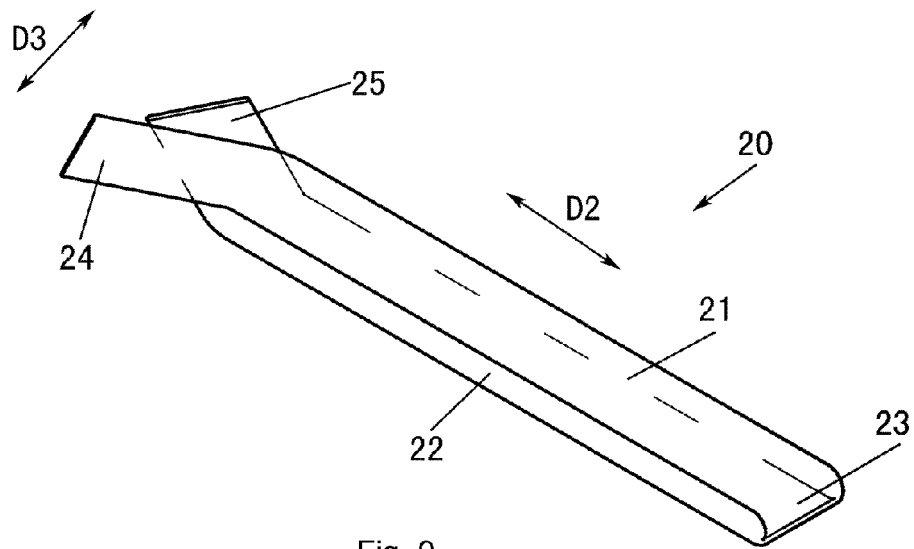


Fig. 9

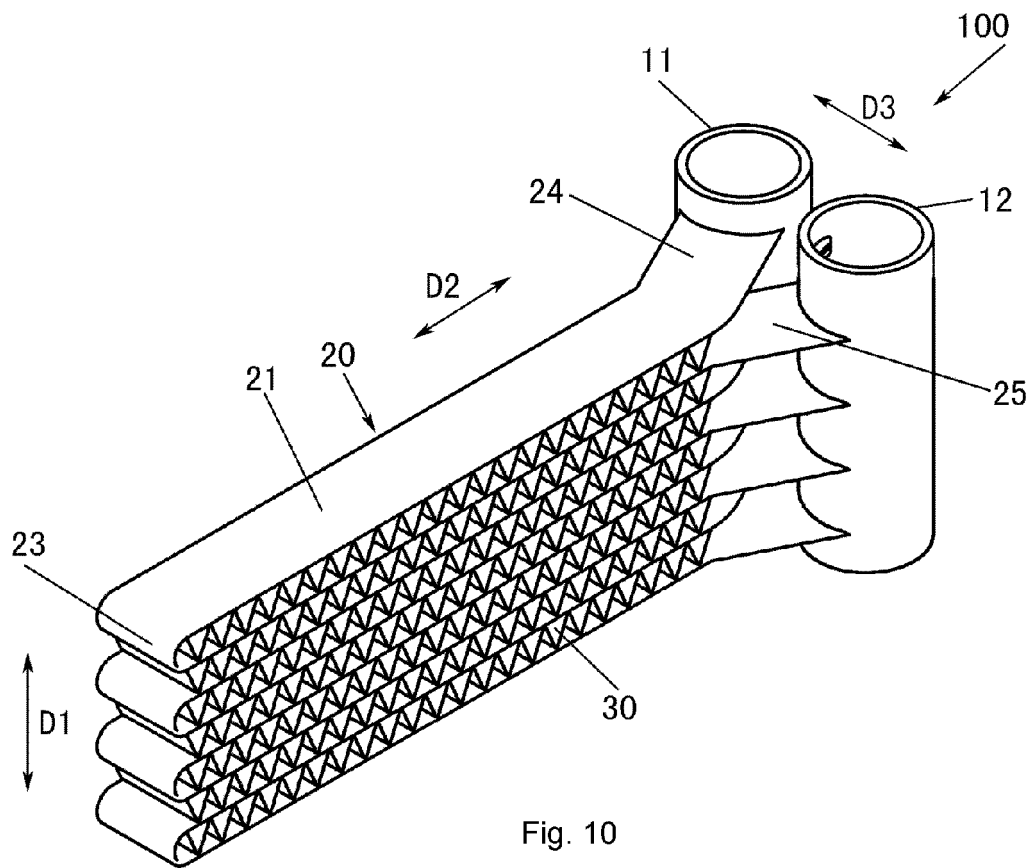


Fig. 10

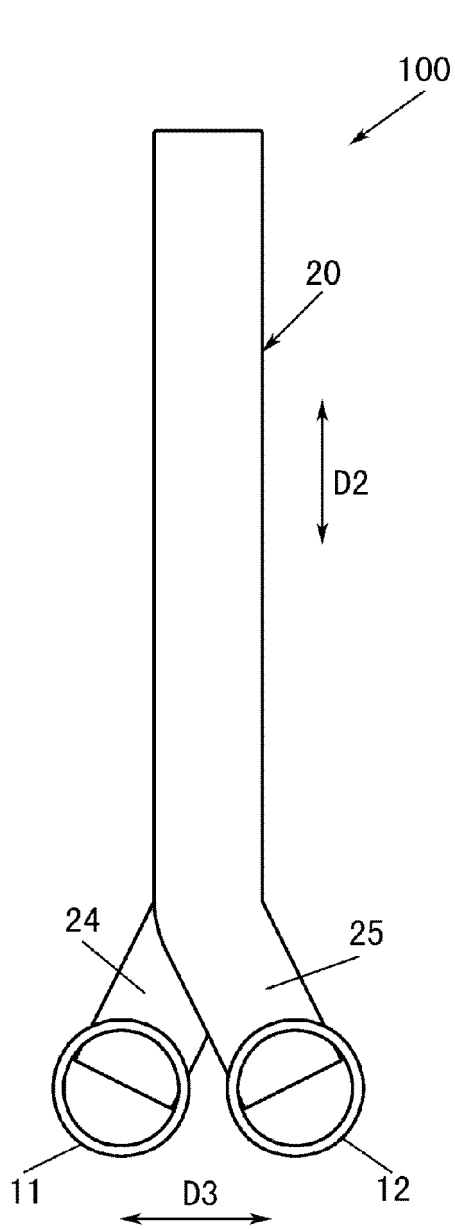


Fig. 11

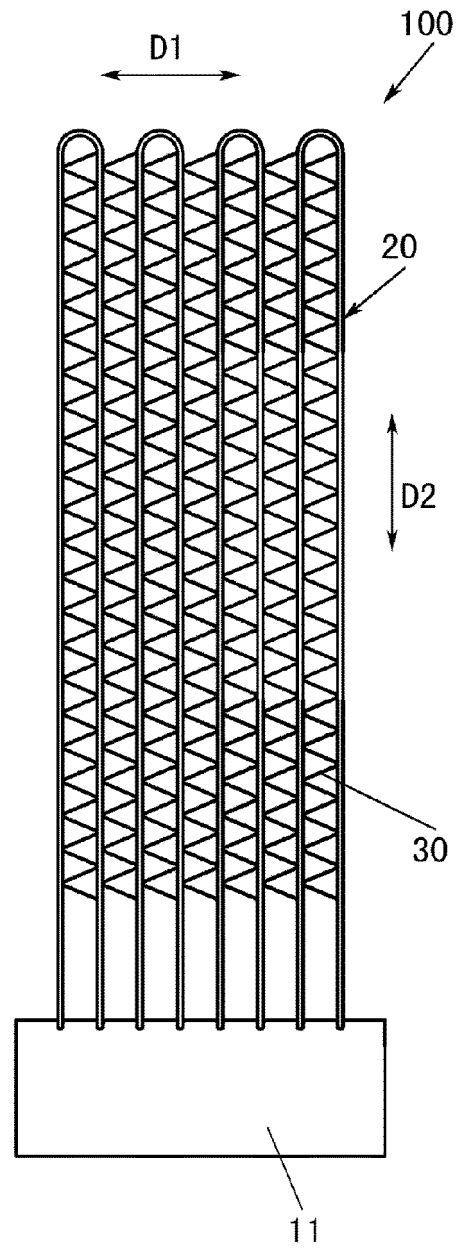


Fig. 12

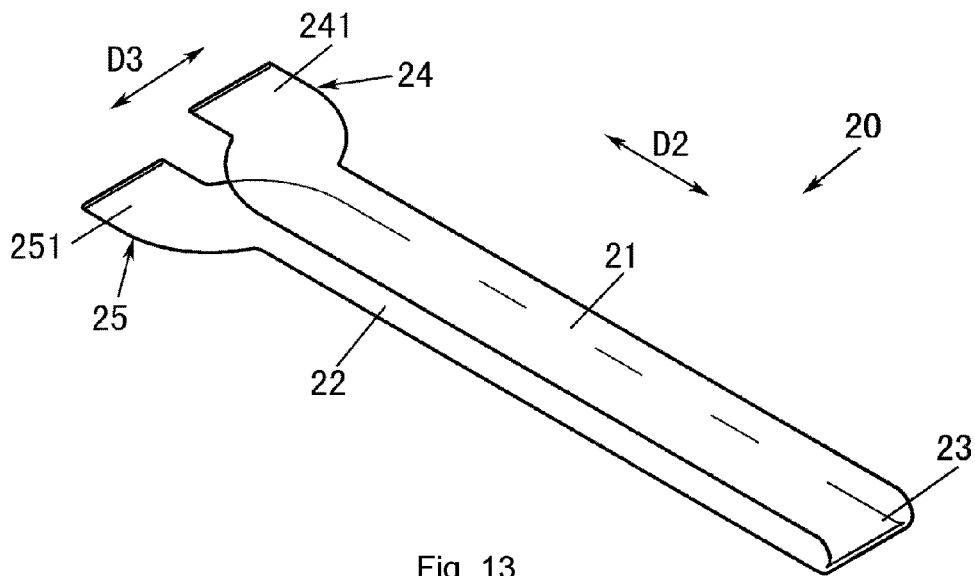


Fig. 13

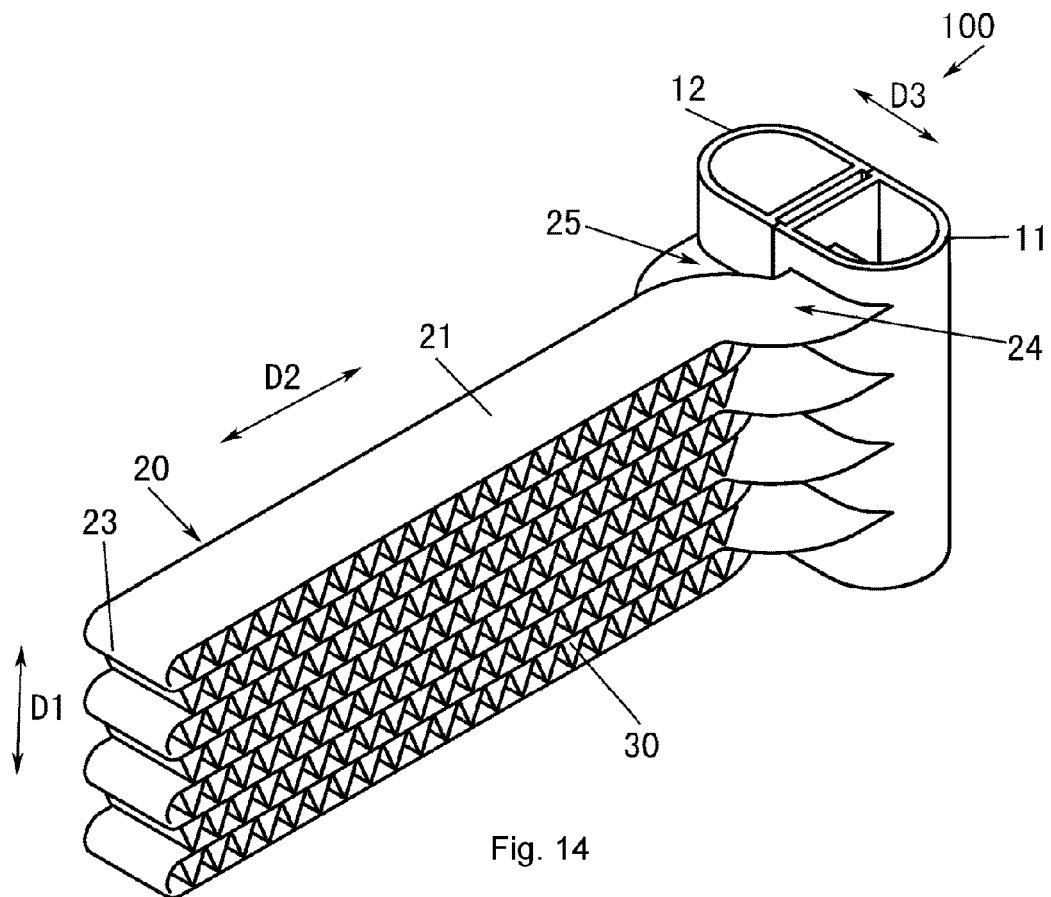


Fig. 14

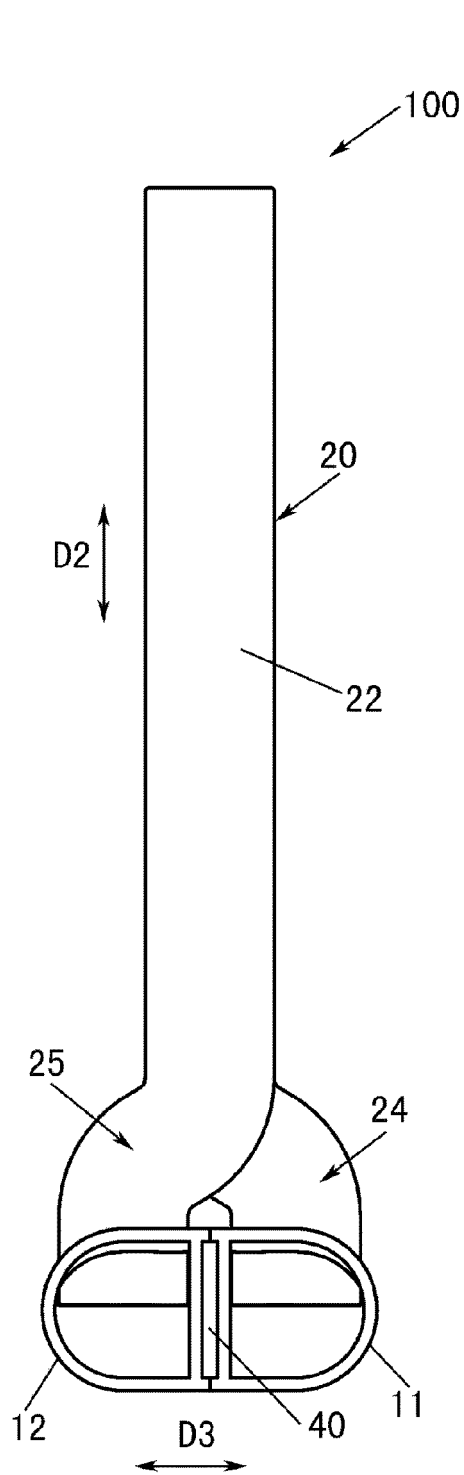


Fig. 15

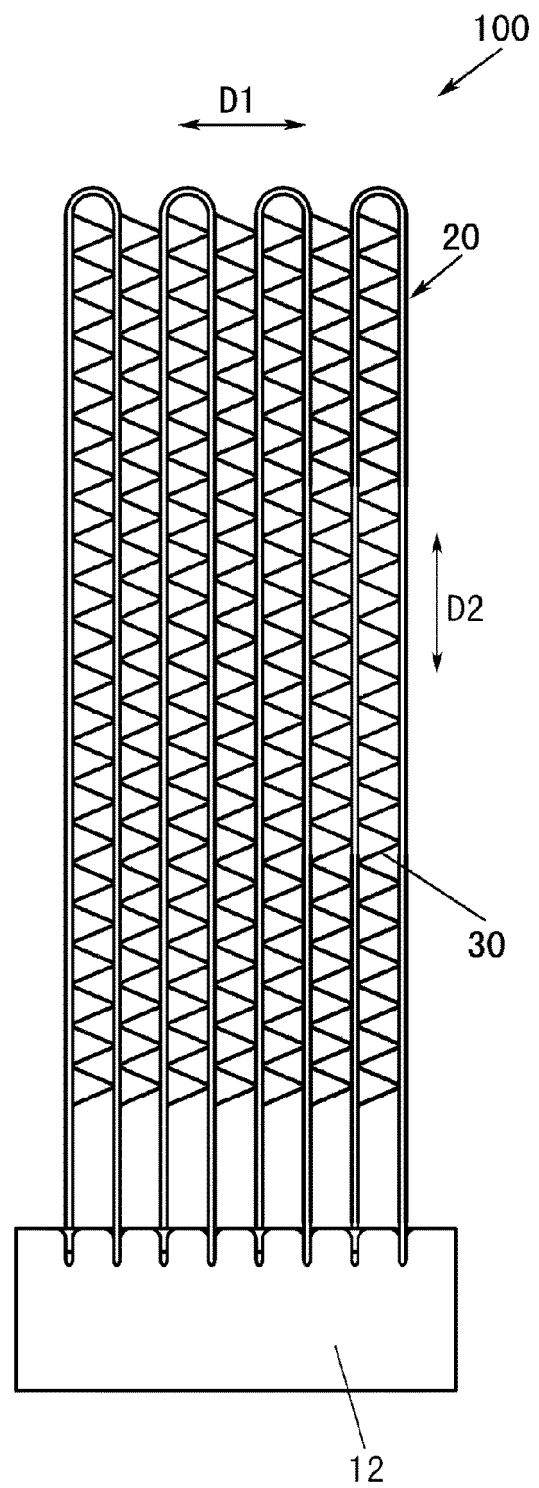


Fig. 16

REFERENCES CITED IN THE DESCRIPTION

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