



(11) **EP 4 343 257 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
27.03.2024 Bulletin 2024/13

(51) International Patent Classification (IPC):
F28D 9/00 (2006.01) **F28F 3/02** (2006.01)
F28F 3/04 (2006.01) **F28F 9/02** (2006.01)

(21) Application number: **22196564.3**

(52) Cooperative Patent Classification (CPC):
F28F 9/0268; F28D 9/005; F28F 3/025; F28F 3/046

(22) Date of filing: **20.09.2022**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
KH MA MD TN

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(54) **A PLATE HEAT EXCHANGER**

(57) The disclosure relates to a plate heat exchanger (1) comprising: a package of heat exchanger plates (2), each having a peripheral portion (4) and several port portions (6a,6b) with through flow ports (8a,8b) communicating with flow passages (12) between adjacent heat exchanger plates (2). First guiding ribs (50) are arranged in the port portions (6a,6b), which first guiding ribs (50) in every other flow passage (12) between the heat exchanger plates (2) are configured to guide and distribute the first heat exchange medium (18) from a first inlet channel (16a) to a heat exchange portion (14) and from the heat exchange portion (14) to a first outlet channel (16b), and in that second guiding ribs (52) are arranged in the port portions (6a,6b), which second guiding ribs (52) in the remaining flow passages (12) between the heat exchanger plates (2) are configured to guide and distribute a second heat exchange medium (22) from a second inlet channel (20a) to the heat exchange portion (14) and from the heat exchange portion (14) to a second outlet channel (20b).

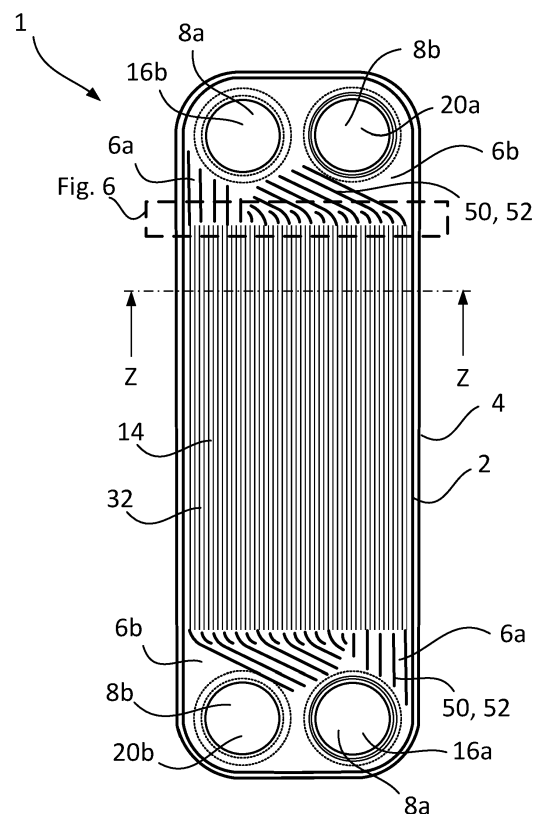


Fig. 5

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Description

Technical field

[0001] The present disclosure relates to a plate heat exchanger. More specifically, the disclosure relates to a plate heat exchanger as defined in the introductory parts of the independent claims.

Background art

[0002] Plate heat exchangers, which are permanently joined to each other, do not require separate sealings between the plates and no external frame to hold the plates together. Instead of an external frame, the plates can be permanently joined by brazing, soldering, welding or gluing. The joints between the plates have a pressure bearing function and can thus resist pressures from the heat exchange medium in the plate heat exchangers. Joints may be formed by a joining method in which the plates are subjected to a heat lower than the melting point of the plates. Such joining methods may be one of brazing with an added brazing material in the form of a foil, a paste, or a powder comprising e.g., copper or nickel, or joining by means of the material of the plates by application of a melting depressant composition applied to the plates prior to being heated e.g., as discussed in document WO2013144211A1.

[0003] The inlet and outlet channels in the port portions of the plates have large projected areas and are provided with connecting joints between the heat exchanger plates. In order to enable a large volume flow of the heat exchange medium through the plate heat exchanger, the diameter of the inlet and outlet channels is increased, so that the exposed area of the channels in direction of flow passages in the heat exchanger increases. Further, the flow of the heat exchange medium between the plates in the heat exchanger is more evenly distributed when the diameter of the inlet and outlet channels is increased. Also, the distance between the inlet and outlet channels may influence on the distribution of the heat exchange medium between the plates.

[0004] Document KR1020180028704 A discloses a plate heat exchanger comprising heat exchanger plates, which are provided with distribution channels pressed directly in the heat exchanger plate. The distribution channels are shaped from grooves pressed in the heat exchanger plate. Heat exchange medium introduced through a fluid inlet is divided into several branches, which are constituted by the distribution channels. The heat exchange medium is distributed to a fin insert. After the heat exchange medium has passed the fin insert, the heat exchange medium is guided through another set of distribution channels for gathering the heat exchange medium to a fluid outlet.

Summary

[0005] Distribution of the heat exchange medium from the inlet channel to the fins may in different situations be critical, since the distribution of the heat exchange medium, in the heat transfer portion in which the fin insert is situated, affects the heat transfer performance of the plate heat exchanger. An uneven distribution of the heat exchange medium in the heat transfer portion may decrease the heat transfer performance. The uneven distribution of heat exchange medium may depend on how the distribution channels in the heat exchanger plate mesh with the heat transfer portion. Further, any differences or irregularities such as bypass channels in the shape or outfit of the heat exchange portion may affect the heat transfer performance due to uneven distribution of the heat exchange medium in the heat transfer portion. Further, when increasing the overall dimensions of the plate heat exchanger, the flow of the heat exchange medium between the plates in the heat exchanger may be subjected to turbulence affecting the heat transfer performance of the plate heat exchanger.

[0006] Despite known solutions in the field, it would be desirable to develop a plate heat exchanger, which overcome or alleviate at least some of the issues connected to the prior art plate heat exchangers.

[0007] It is an object of the present disclosure to mitigate, alleviate or eliminate one or more of the above-identified issues of the prior art and solve at least the above-mentioned difficulties.

[0008] Further, it is an object of the present invention is to provide a plate heat exchanger with increased heat exchange performance.

[0009] These objectives are achieved with the above-mentioned plate heat exchanger according to the appended claims.

[0010] According to a first aspect there is provided a plate heat exchanger comprising: a package of heat exchanger plates, each having a peripheral portion and several port portions with through flow ports; wherein the heat exchanger plates are permanently joined to adjacent heat exchanger plates of the package along their peripheral portions in such manner that they leave flow passages in a heat exchange portion between adjacent heat exchanger plates; wherein the through flow ports of the heat exchanger plates are aligned and form first inlet and outlet channels through the package for a first heat exchange medium, which communicate with every other flow passage between the heat exchanger plates, and second inlet and outlet channels through the package for a second heat exchange medium, which communicate with remaining flow passages between the heat exchanger plates; and wherein along each of the inlet and outlet channels, the port portions of adjacent heat exchanger plates, which form a flow passage separated from the inlet and outlet channel, respectively, are permanently joined around the inlet and outlet channel, respectively, between an outer line and an inner line, which inner line

is located closer to the Inlet and outlet channel, respectively, characterised in that first guiding ribs are arranged in the port portions, which first guiding ribs in every other flow passage between the heat exchanger plates are configured to guide and distribute the first heat exchange medium from the first inlet channel to the heat exchange portion and from the heat exchange portion to the first outlet channel, and in that second guiding ribs are arranged in the port portions, which second guiding ribs in the remaining flow passages between the heat exchanger plates are configured to guide and distribute the second heat exchange medium from the second inlet channel to the heat exchange portion and from the heat exchange portion to the second outlet channel. The plate heat exchanger may comprise a number of heat exchanger plates, which are arranged above each other between an upper, outer cover plate and a lower, outer cover plate. The ports of the heat exchanger plates are aligned, so that they form an inlet channel and an outlet channel, which at the bottom are limited by the non-penetrated port portions of the lower, outer cover plate and which at the top communicate with the inlet pipe and the outlet pipe, respectively. The heat exchanger may have one inlet channel and one outlet channel for each of the two heat exchange media, which Inlet and outlet channels are located in the end portions of the heat exchanger plates. The heat exchanger can alternatively be provided with several inlet or outlet channels. The shape of the channels and the location can be chosen freely. The flow of the first and second heat exchange medium may be in parallel in the heat exchange portion of the heat exchanger. However, the first inlet and outlet channels may be diagonally arranged in relation to the parallel flow in the heat exchange portion. Further, the second inlet and outlet channels may be diagonally arranged in relation to the parallel flow in heat exchange portion. Alternatively, the first inlet and outlet channels may be aligned in relation to the parallel flow in heat exchange portion. Further, the second inlet and outlet channels may be aligned in relation to the parallel flow in heat exchange portion. The number of heat exchanger plates of the heat exchanger form together a package of heat exchanger plates. The heat exchanger plates may have a rectangular form, but other forms could be possible, such as round heat exchanger plates. The number of heat exchanger plates of the heat exchanger is depending on desired capacity. For the joining of the heat exchanger a suitable amount of plates are piled on each other, whereupon adjacent plates are joined together by brazing, soldering, welding or gluing. Adjacent heat exchanger plates are permanently joined to each other. Therefore, no separate gaskets are required between the plates and neither any outer frame to hold the plates together. The expression permanently joined refers mainly to brazing, but also for example soldering, welding or gluing. Joints may be formed by a joining method in which the plates are subjected to a heat lower than the melting point of the plates. Such joining methods may be one of

brazing with an added brazing material in the form of a foil, a paste, or a powder comprising e.g., copper or nickel, or joining by means of the material of the plates by application of a melting depressant composition applied to the plates prior to being heated. The peripheral portion of the heat exchanger plates may be provided with a flank and a brim. The flank of one heat exchanger plates may be joined to the flank of one adjacent heat exchanger plate. The joined flanks will ensure a fluid tight connection along the peripheral portion of the heat exchanger plates. The brim increases the stiffness and overall strength of the plate heat exchanger. The brim may however be excluded from the heat exchanger plate. The port portions surround an inlet or outlet channel, which communicating with the flow passages formed by the plates. The port portions may be placed in the two end planes of the plates, located furthest from each other. The at least one connection part within the above said inner line in each port portion, also avoids that the ports of the plate become oval during manufacturing of the plates. The connection parts may be formed as integral parts of respective heat exchanger plate. Alternatively, the connection parts may be formed of loose elements arranged between the heat exchanger plates. Flow passages are configured between adjacent plates. In the flow passages the heat exchange medium flows through the plate heat exchanger. Adjacent heat exchanger plates are connected and bounded together at several positions on their surfaces. Between these bonding positions, the flow passages are left. The heat exchange portion is arranged between adjacent plates and between the end portions of the heat exchanger. In the heat exchange portion heat is transferred from one of the heat exchange medium to the other heat exchange medium. Stacking the individual heat exchanger plates on each other will align the through flow ports of the plates. The aligned through flow ports form inlet and outlet channels through the package of plates. The first inlet and outlet channels communicate with every other flow passage between the heat exchanger plates. The second inlet and outlet channels communicate with the remaining flow passages between the heat exchanger plates. There is only heat exchange between every other flow passage and the remaining flow passages but no fluid communication between these separated passages. The inner line is located closer to the Inlet and outlet channel, respectively, than the outer line. Plate interspaces are located in an area around the inlet and outlet channel, respectively, located between the outer line and the inlet or outlet channel itself. The at least one connection part is arranged in the plate interspace along each of the inlet and outlet channels. The first and second guiding ribs may be configured as separate parts or as integral parts of the heat exchanger plate. The first and second guiding ribs are arranged at the port portions of the plates. The first and second guiding ribs may extend between the area of the throw flow ports and the area of the heat exchange portion. The first and second guiding ribs may be configured to guide the first and sec-

ond heat exchange medium in both directions along and between the ribs. When the heat exchange medium flows in the direction from the ports to the heat exchange portion, the heat exchange medium will be spread out at a larger area than the area at the port. When the heat exchange medium flows in the direction from the heat exchange portion to the ports, the heat exchange medium will be concentrated to a smaller area than the area at the heat exchange portion. The first and second guiding ribs may also be configured to guide and positioning the heat exchange portion within the heat exchanger plate. In this case the heat exchange portion may be a separate part from the heat exchanger plate, which may be positioned between the port portions, which are provided with the first and second guiding ribs. During manufacturing of the plate heat exchanger, the heat exchange portion may first be positioned between the port portions and guided to a correct position by the first and second guiding ribs, where after the heat exchange portion is firmly connected to the heat exchanger plate by for example brazing, soldering, welding or gluing. The plate heat exchanger provided with the above-mentioned guiding ribs will increase the heat exchange performance of the plate heat exchanger.

[0011] The first and second guiding ribs may constitute an integral part of a heat exchanger plate. The first and second guiding ribs may be manufactured simultaneously with the heat exchanger plate. The first and second guiding ribs may be permanently joined to the heat exchanger plate. When the first and second guiding ribs constitutes an integral part of a heat exchanger plate, the position of the first and second guiding ribs are fixed in relation to the heat exchanger portion on the heat exchanger plate.

[0012] The heat exchanger plates may be made of thin material and be provided with the first and second guiding ribs shaped on one side, each first and second guiding rib being shaped in the port portion of a heat exchanger plate. The first and second guiding ribs may be shaped in the surface of the heat exchanger plate during manufacturing of the plate. The manufacturing of the ribs may be shaped in a second step after the plate has been has been manufactured in a first step.

[0013] The first and second guiding ribs may be arranged in a separate sheet element, and wherein such sheet elements are arranged in the respective port portion. The separate sheet may be made of thin material. The first and second guiding ribs may be shaped in a surface of the separate sheet element. The separate sheet elements may be connected to the respective port portion and permanently joined to the heat exchanger plate by brazed, soldered, welded or glued joints.

[0014] The height of the first and second guiding ribs may correspond to the distance between two adjacent heat exchanger plates in the port portions, respective. The first and second guiding ribs may extend between two adjacent heat exchanger plates. The space between the ribs leave flow passages, which define guide passag-

es for the heat exchange media. The first and second guiding ribs may be brazed, soldered, welded or glued to the surfaces of adjacent plates. However, a part of the ribs along the length of the ribs may have a reduced height.

[0015] Fins may be arranged in the heat exchange portion of the flow passages between the adjacent heat exchanger plates, which fins may create a number of parallel guide channels for each of the first and second heat exchange medium, respective. The fins may guide the flow of the first and second heat exchange medium in parallel through the heat exchange portion. The fins may be made of thermally conductive material, such as steel or an aluminum alloy. A number of individual fins may be arranged in parallel in the heat exchange portion, extending in a longitudinal direction of the heat exchanger, and creating guide channels between the individual fins. Alternatively, the individual fins may be connected to each other.

[0016] Each parallel guide channel may be delimited by walls of the fins and a heat exchanger plate. Each fin may extend between two adjacent heat exchanger plates. The surfaces of the two adjacent plates and the surfaces of two adjacent fins may define one guide channel. The fins may be brazed, soldered, welded or glued to the surfaces of two adjacent plates. The distance between the fins and the distance between the plates affects the shape and size of the cross-sectional area of the individual guide channel. The distance between the fins may also decide the number of fins and channels in the heat exchange portion. The shape and the size of the cross-sectional area of the individual guide channel may have an impact on the volume flow of the heat exchange medium in the guide channel.

[0017] The fins may be created by a corrugated sheet metal, which has wave peaks and wave troughs. The fins may be created by a pleated sheet of thermally conductive material. The fins may have a wave shape. The parallel guide channels may be created between wave peaks and between wave troughs of the wave shaped fins. The wave peaks may be configured to be rigidly connected to a heat exchanger plate, and the wave troughs may be configured to be rigidly connected to an adjacent heat exchanger plate in the heat exchange portion between the adjacent heat exchanger plates. The wave peaks and the wave troughs may be brazed, soldered, welded or glued to the surfaces of two adjacent plates. The distance between the wave peaks, the distance between the wave troughs and the distance between the plates affects the shape and size of the cross-sectional area of the individual guide channel. The distance between the wave peaks and the distance between the wave troughs may also decide the number of fins and channels in the heat exchange portion. The shape and the size of the cross-sectional area of the individual guide channel may have an impact on the volume flow of the heat exchange medium in the guide channel.

[0018] The wave height of the fins of the corrugated

sheet metal may corresponds to the distance between two adjacent heat exchanger plates in the heat exchange portion. The wave height of the fins of the corrugated sheet metal may correspond to the distance between two adjacent heat exchanger plates in the heat exchange portion. The wave peaks and the wave troughs of the fins may extend between two adjacent heat exchanger plates. The surface of one of the two adjacent plates and the surfaces of two adjacent fins having a common wave peak define one guide channel. The wave peaks and the wave troughs of the fins of the corrugated sheets may be brazed, soldered, welded or glued to the surfaces of two adjacent plates. A distance between walls of two adjacent fins at middle point of height of the fins are in the range of 0,25 - 10 mm, preferably in the range of 0,35 - 3 mm and most preferably in the range of 0,5 - 1 mm. Such configuration of the distance between walls of two adjacent fins at middle point of height of the fins may result in a shape and size of the cross-sectional area of the individual guide channel may have a low impact on the volume flow of the heat exchange medium in the guide channel. Further, the pressure fall over the heat exchange portion may be low when the distance between walls of two adjacent fins at middle point of height of the fins is in within this ranges.

[0019] A number of the first and second guiding ribs may extend to a position at a distance from a respective end portion of the fins, which distance between the respective end portion of the fins and the first and second guiding ribs may be configured as a mixing zone for mixing and equalize the volume flow of the first heat exchange medium before entering the parallel guide channels created by the fins, and for mixing and equalize the volume flow of the second heat exchange medium before entering the parallel guide channels created by the fins. The number of guiding ribs may be different from the number of fins. The number of fins may be larger than the number of guiding ribs. The space between the ribs leave flow passages, which define guide passages for the heat exchanging media, which guide passages may be wider and larger than the guide channels between the fins. Arranging the end portion of the guiding ribs at a distance from the end portion of the fins avoid the end portion of the guiding ribs to block the guiding channels created by the fins. Further, this design creates the mixing zone between the ribs and fins, such that the fluid can be redistributed evenly over the fin channels.

[0020] A number of the first and second guiding ribs may extend into the mixing zone and abut against the respective end portion of the fins for positioning and guidance of the corrugated sheet metal of fins in the heat exchange portion of the flow passages. The end portion of a number of guiding ribs may abut against the respective end portion of the fins for positioning and guidance of the corrugated sheet metal of fins. The guiding ribs may thus be configured to guide and positioning the corrugated sheet metal of fins within the heat exchanger plate. In this case the corrugated sheet metal of fins may

be a separate part from the heat exchanger plate, which may be positioned between the port portions, which are provided with the guiding ribs. During manufacturing of the plate heat exchanger, the corrugated sheet metal of fins may first be positioned between the port portions and guided to a correct position by the end portions of the guiding ribs, which extend into the mixing zone. Thereafter the corrugated sheet metal of fins is firmly connected to the heat exchanger plate by for example brazing, soldering, welding or gluing. The plate heat exchanger provided with the above-mentioned guiding ribs, which extend into the mixing zone and abut against the respective end portion of the fins will positioning the corrugated sheet metal of fins correctly and thus increase the heat exchange performance of the plate heat exchanger. The guiding ribs, which abut against the respective end portion of the fins, may block some of the guiding channels created by the fins. However, the majority of the guiding channels may not be blocked by guiding ribs. Instead, the volume flow of the heat exchange media may be mixed and equalized in the mixing zone before entering the parallel guide channels created by the fins. A part of the ribs, along the length of the ribs, which extend into the mixing zone and abut the fins may have a reduced height. The reduced height may connect the mixing zones, so that the heat exchange medium can flow over and pass the ribs with reduced height. This configuration of the end portion of the ribs, may not block some of the guiding channels created by the fins.

[0021] The outermost guiding ribs of the first and second guiding ribs may extend into the mixing zone and abut against the respective end portion of the fins, for preventing the first and second heat exchange medium, respective, to flow in a bypass channel formed between the peripheral portion of the heat exchanger plate and the outermost fins in the heat exchange portion. Since the corrugated sheet metal of fins in the heat exchange portion may have a smaller width, than the width of the heat exchanger plate, bypass channels without fins may occur between the outermost fins and the peripheral side portion of the heat exchanger plate. An uneven distribution of the heat exchange medium in the heat transfer portion may decrease the heat transfer performance of the plate heat exchanger. The uneven distribution of heat exchange medium may depend on how the ribs and guiding channels of the fins mesh with the heat transfer portion. Further, any differences or irregularities such as a bypass channel in the heat exchange portion may affect the heat transfer performance due to uneven distribution of the heat exchange medium in the heat transfer portion. The outermost guiding ribs abutting against the respective end portion of the outermost fins prevents the heat exchange medium to flow in the bypass channel. This will equalize the volume flow of the heat exchange medium entering the parallel guide channels created by the fins.

[0022] Additional objectives, advantages and novel features of the invention will be apparent to one skilled

in the art from the following details, and through exercising the invention. While the invention is described below, it should be apparent that the invention may not be limited to the specifically described details. One skilled in the art, having access to the teachings herein, will recognize additional applications, modifications and incorporations in other areas, which are within the scope of the invention.

Brief descriptions of the drawings

[0023] The above objects, as well as additional objects, features and advantages of the present disclosure, will be more fully appreciated by reference to the following illustrative and non-limiting detailed description of example embodiments of the present disclosure, when taken in conjunction with the accompanying drawings.

Fig. 1 schematically illustrates a plate heat exchanger in a perspective view according to an example;

Fig. 2 schematically illustrates the plate heat exchanger in a section view along line X - X in fig. 1 according to an example;

Fig. 3 schematically illustrates the plate heat exchanger in a section view along line V - V in fig. 1 according to an example;

Fig. 4 schematically illustrates the plate heat exchanger in a section view along line V - V in fig. 1 according to an example;

Fig. 5 schematically illustrates a heat exchanger plate in a view from above according to an example;

Fig. 6 schematically illustrates in a view from above of a mixing zone indicated in fig. 5;

Figures 7 - 9 schematically illustrate examples of a part of the plate heat exchanger in a section view along line Z - Z in fig. 5.

Detailed description

[0024] The present disclosure will now be described with reference to the accompanying drawings, in which preferred example embodiments of the disclosure are shown. The disclosure may, however, be embodied in other forms and should not be construed as limited to the herein disclosed embodiments. The disclosed embodiments are provided to fully convey the scope of the disclosure to the skilled person.

[0025] Figure 1 schematically illustrates a plate heat exchanger 1 in a perspective view according to an example. The plate heat exchanger 1 comprising a package of heat exchanger plates 2, each having a peripheral portion 4 and several port portions 6a,6b with through flow ports 8a,8b. The heat exchanger plates 2 are permanent-

ly joined to adjacent heat exchanger plates 2 of the package along their peripheral portions 4 in such manner that they leave flow passages 12 (fig. 2) in a heat exchange portion 14 between adjacent heat exchanger plates 2. The through flow ports 8a,8b of the heat exchanger plates 2 are aligned and form first inlet and outlet channels 16a,16b through the package for a first heat exchange medium 18, which communicate with every other flow passage 12 between the heat exchanger plates 2, and second inlet and outlet channels 20a,20b through the package for a second heat exchange medium 22, which communicate with remaining flow passages 12 between the heat exchanger plates 2. The port portions 6a,6b of two adjacent heat exchanger plates 2, which port portions 6a,6b surround an inlet or outlet channel 16a,16b; 20a,20b communicating with the flow passage 12 formed by the heat exchanger plates 2, are placed at the end planes 42 of the heat exchanger plates 2 located furthest from each other.

[0026] Fig. 2 schematically illustrates a part of the plate heat exchanger 1 in a section view along line X - X in fig. 1 according to an example. The heat exchanger plates 2 are permanently joined to adjacent heat exchanger plates 2 of the package along their peripheral portions 4 in such manner that they leave flow passages 12 in a heat exchange portion 14 between adjacent heat exchanger plates 2. Fins 32 are arranged in the heat exchange portion 14 of the flow passages 12 between the adjacent heat exchanger plates 2, which fins 32 creates a number of parallel guide channels 34 for each of the first and second heat exchange medium 18,22, respectively. The peripheral portion of the heat exchange plates are provided with a flank 23 and a brim 25.

[0027] Fig. 3 schematically illustrates the plate heat exchanger 1 in a section view along line V - V in fig. 1 according to an example. Each connection part 28 creates according to this example a solid line around the outlet or inlet channel 16b, 20a, respectively. The second inlet channel 20a communicate with every other flow passage between the heat exchanger plates 2. The first outlet channel 16b communicate with the remaining flow passages between the heat exchanger plates 2. Fins 32 are arranged between the adjacent heat exchanger plates 2, which fins 32 creates a number of parallel guide channels 34.

[0028] Fig. 4 schematically illustrates the plate heat exchanger 1 in a section view along line V - V in fig. 1 according to an example. Along each of the inlet and outlet channels 6b, 20a the heat exchanger plates 2 are permanently joined by connection parts 28. The connection parts 28 are arranged to keep the port portions 6a,6b of adjacent heat exchanger plates 2 together along the inlet and outlet channels 16b, 20a. At least one connection part 28, along each of the inlet and outlet channels 16b, 20a is arranged in the plate interspaces 30, which communicate with the inlet and outlet channels 16b, 20a, respectively, and is permanently connected in each such plate interspace 30 to both of the adjacent heat exchang-

er plates 2. Fins 32 are arranged between the adjacent heat exchanger plates 2, which fins 32 creates a number of parallel guide channels 34.

[0029] Fig. 5 schematically illustrates a heat exchanger plate 2 in a view from above according to an example. The peripheral portion 4 encircle the entire plate 2. Through flow ports 8a,8b are arranged in the heat exchanger plate 2, which together with through flow ports 8a,8b of other plates 2 are configured to form inlet and outlet channels 16a,16b; 20a,20b through a package of plates 2 (fig. 1). First guiding ribs 50 are arranged in the port portions 6a,6b, which first guiding ribs 50 in every other flow passage 12 between the heat exchanger plates 2 are configured to guide and distribute the first heat exchange medium 18 (fig. 1) from the first inlet channel 16a to the heat exchange portion 14 and from the heat exchange portion 14 to the first outlet channel 16b, and in that second guiding ribs 52 are arranged in the port portions 6a,6b, which second guiding ribs 52 in the remaining flow passages 12 between the heat exchanger plates 2 are configured to guide and distribute the second heat exchange medium 22 (fig. 1) from the second inlet channel 20a to the heat exchange portion 14 and from the heat exchange portion 14 to the second outlet channel 20b. The first and second guiding ribs 50,52 constitute an integral part of a heat exchanger plate 2. The first and second guiding ribs 50,52 may however be arranged in a separate sheet element 54, and the separate sheet element 54 may be arranged in the respective port portion 6a,6b. The heat exchanger plates 2 are made of thin material and be provided with the first and second guiding ribs 50,52 shaped on one side, each first and second guiding rib 50,52 being shaped in the port portion 6a,6b of a heat exchanger plate 2.

[0030] Fig. 6 schematically illustrates in a view from above of a mixing zone 58 indicated in fig. 5. A number of the first and second guiding ribs 50,52 extend to a position at a distance from a respective end portion 56 of the fins 32, which distance between the respective end portion 56 of the fins 32 and the first and second guiding ribs 50,52 is configured as a mixing zone 58 for mixing and equalize the volume flow of the first heat exchange medium 18 (fig. 1) before entering the parallel guide channels 34 created by the fins 32, and for mixing and equalize the volume flow of the second heat exchange medium 22 before entering the parallel guide channels 34 created by the fins 32. A number of the first and second guiding ribs 50,52 extend into the mixing zone and abuts against the respective end portion 56 of the fins 32 for positioning and guidance of the corrugated sheet metal 38 of fins 32 in the heat exchange portion 14 of the flow passages 12. The outermost guiding ribs 50a,52a of the first and second guiding ribs 50,52 extend into the mixing zone 58 and abuts against the respective end portion 56 of the fins 32, for preventing the first and second heat exchange medium 18,22 (fig. 1), respectively, to flow in a bypass channel 60 formed between the peripheral portion 4 of the heat exchanger plate 2 and the outermost

fins 32a in the heat exchange portion 14, which is also shown in fig. 7.

[0031] Figures 7 - 9 schematically illustrate examples of a part of the plate heat exchanger 1 in a section view along line Z - Z in fig. 5. The height rh_1 of the first and second guiding ribs 50,52 corresponds to the distance d between two adjacent heat exchanger plates 2 in the port portions 6a,6b (fig. 5), respectively. However, the ribs 50,52 which extend into the mixing zone 58 and abut the fins 32 may have a reduced height rh_2 . The reduced height rh_2 may connect the mixing zones 58, so that the heat exchange medium 18,22 can flow over and pass the ribs 50,52 with reduced height rh_2 . Fins 32 are arranged in the heat exchange portion 14 of the flow passages 12 between the adjacent heat exchanger plates 2, which fins 32 creates a number of parallel guide channels 34 for each of the first and second heat exchange medium 18,22, respectively. Each parallel guide channel 32 is delimited by walls 36 of the fins 32 and a heat exchanger plate 2. The fins 32 are created by a corrugated sheet metal 38, which has wave peaks p_1, p_2 and wave troughs t_1, t_2 . The wave height wh of the fins 32 of the corrugated sheet metal 38 corresponds to the distance d between two adjacent heat exchanger plates 2 in the heat exchange portion 14. In fig. 7 the first and second guiding ribs 50,52 are arranged in a separate sheet element 54, which is arranged between the plates 2. In figures 8 and 9, the first and second guiding ribs 50,52 are shaped from the heat exchange plate 2 by a suitable manufacturing method. In figures 8 and 9 the fins 32 have a different shape comparing to the shape of the fins 32 in fig. 7. As shown in the figures 8 and 9, the width w_r of a rib is larger than the width w_d between the walls 36 of two fins 32 at a middle point of height MH of a wave height wh of the fins 32. In fig. 9, the outermost guiding ribs 50a,52a of the first and second guiding ribs 50,52 extend into the mixing zone 58 and abuts against the respective end portion 56 of the fins 32, for preventing the first and second heat exchange medium 18,22, respectively, to flow in a bypass channel 60 formed between the peripheral portion 4 of the heat exchanger plate 2 and the outermost fins 32a in the heat exchange portion 14. The outermost guiding ribs 50a,52a are shaped in the plate 2 and in a part of the flank 23 of the plate 2.

[0032] The foregoing description of the embodiments has been furnished for illustrative and descriptive purposes. It is not intended to be exhaustive, or to limit the embodiments to the variations described. Many modifications and variations will obviously be apparent to one skilled in the art. The embodiments have been chosen and described in order to best explicate principles and practical applications, and to thereby enable one skilled in the art to understand the invention in terms of its various embodiments and with the various modifications that are applicable to its intended use. The components and features specified above may, within the framework of the disclosure, be combined between different embodiments specified.

Claims

1. A plate heat exchanger (1) comprising:

a package of heat exchanger plates (2), each having a peripheral portion (4) and several port portions (6a,6b) with through flow ports (8a,8b); wherein the heat exchanger plates (2) are permanently joined to adjacent heat exchanger plates (2) of the package along their peripheral portions (4) in such manner that they leave flow passages (12) in a heat exchange portion (14) between adjacent heat exchanger plates (2); wherein the through flow ports (8a,8b) of the heat exchanger plates (2) are aligned and form first inlet and outlet channels (16a,16b) through the package for a first heat exchange medium (18), which communicate with every other flow passage (12) between the heat exchanger plates (2); and second inlet and outlet channels (20a,20b) through the package for a second heat exchange medium (22), which communicate with remaining flow passages (12) between the heat exchanger plates (2); and wherein along each of the inlet and outlet channels (16a,16b; 20a,20b), the port portions (6a,6b) of adjacent heat exchanger plates (2), which form a flow passage (12) separated from the inlet and outlet channel (16a,16b; 20a,20b), respectively, are permanently joined around the inlet and outlet channel (16a,16b; 20a,20b), respectively, between an outer line (24) and an inner line (26), which inner line (26) is located closer to the Inlet and outlet channel, respectively, **characterised in that** first guiding ribs (50) are arranged in the port portions (6a,6b), which first guiding ribs (50) in every other flow passage (12) between the heat exchanger plates (2) are configured to guide and distribute the first heat exchange medium (18) from the first inlet channel (16a) to the heat exchange portion (14) and from the heat exchange portion (14) to the first outlet channel (16b), and **in that** second guiding ribs (52) are arranged in the port portions (6a,6b), which second guiding ribs (52) in the remaining flow passages (12) between the heat exchanger plates (2) are configured to guide and distribute the second heat exchange medium (22) from the second inlet channel (20a) to the heat exchange portion (14) and from the heat exchange portion (14) to the second outlet channel (20b).

2. The heat exchanger (1) according to claim 1, wherein the first and second guiding ribs (50,52) constitute an integral part of a heat exchanger plate (2).

3. The heat exchanger (1) according to any one of

claims 1 and 2, wherein the heat exchanger plates (2) are made of thin material and be provided with the first and second guiding ribs (50,52) shaped on one side, each first and second guiding rib (50,52) being shaped in the port portion (6a,6b) of a heat exchanger plate (2).

4. The heat exchanger (1) according to claim 1, wherein the first and second guiding ribs (50,52) are arranged in a separate sheet element (54), and wherein such sheet elements (54) are arranged in the respective port portion (6a,6b).

5. The heat exchanger (1) according to any one of the preceding claims, wherein the height (rh) of the first and second guiding ribs (50,52) corresponds to the distance (d) between two adjacent heat exchanger plates (2) in the port portions (6a,6b), respective.

6. The heat exchanger (1) according to any one of the preceding claims, wherein fins (32) are arranged in the heat exchange portion (14) of the flow passages (12) between the adjacent heat exchanger plates (2), which fins (32) creates a number of parallel guide channels (34) for each of the first and second heat exchange medium (18,22), respective.

7. The heat exchanger (1) according to claim 6, wherein each parallel guide channel (32) is delimited by walls (36) of the fins (32) and a heat exchanger plate (2).

8. The heat exchanger (1) according to any one of claims 6 and 7, wherein the fins (32) are created by a corrugated sheet metal (38), which has wave peaks (p1,p2) and wave troughs (t1,t2).

9. The heat exchanger (1) according to claim 8, wherein the wave height (wh) of the fins (32) of the corrugated sheet metal (38) corresponds to the distance (d) between two adjacent heat exchanger plates (2) in the heat exchange portion (14).

10. The heat exchanger (1) according to any one of claims 6 - 8, wherein a number of the first and second guiding ribs (50,52) extend to a position at a distance from a respective end portion (56) of the fins (32), which distance between the respective end portion (56) of the fins (32) and the first and second guiding ribs (50,52) is configured as a mixing zone (58) for mixing and equalize the volume flow of the first heat exchange medium (18) before entering the parallel guide channels (34) created by the fins (32), and for mixing and equalize the volume flow of the second heat exchange medium (22) before entering the parallel guide channels (34) created by the fins (32).

11. The heat exchanger (1) according to claims 8 and 10, wherein a number of the first and second guiding

ribs (50,52) extend into the mixing zone and abut against the respective end portion (56) of the fins (32) for positioning and guidance of the corrugated sheet metal (38) of fins (32) in the heat exchange portion (14) of the flow passages (12).

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- 12.** The heat exchanger (1) according to any one of the claims 10 and 11, wherein the outermost guiding ribs (50a,52a) of the first and second guiding ribs (50,52) extend into the mixing zone (58) and abut against the respective end portion (56) of the fins (32), for preventing the first and second heat exchange medium (18,22), respective, to flow in a bypass channel (60) formed between the peripheral portion (4) of the heat exchanger plate (2) and the outermost fins (32a) in the heat exchange portion (14).

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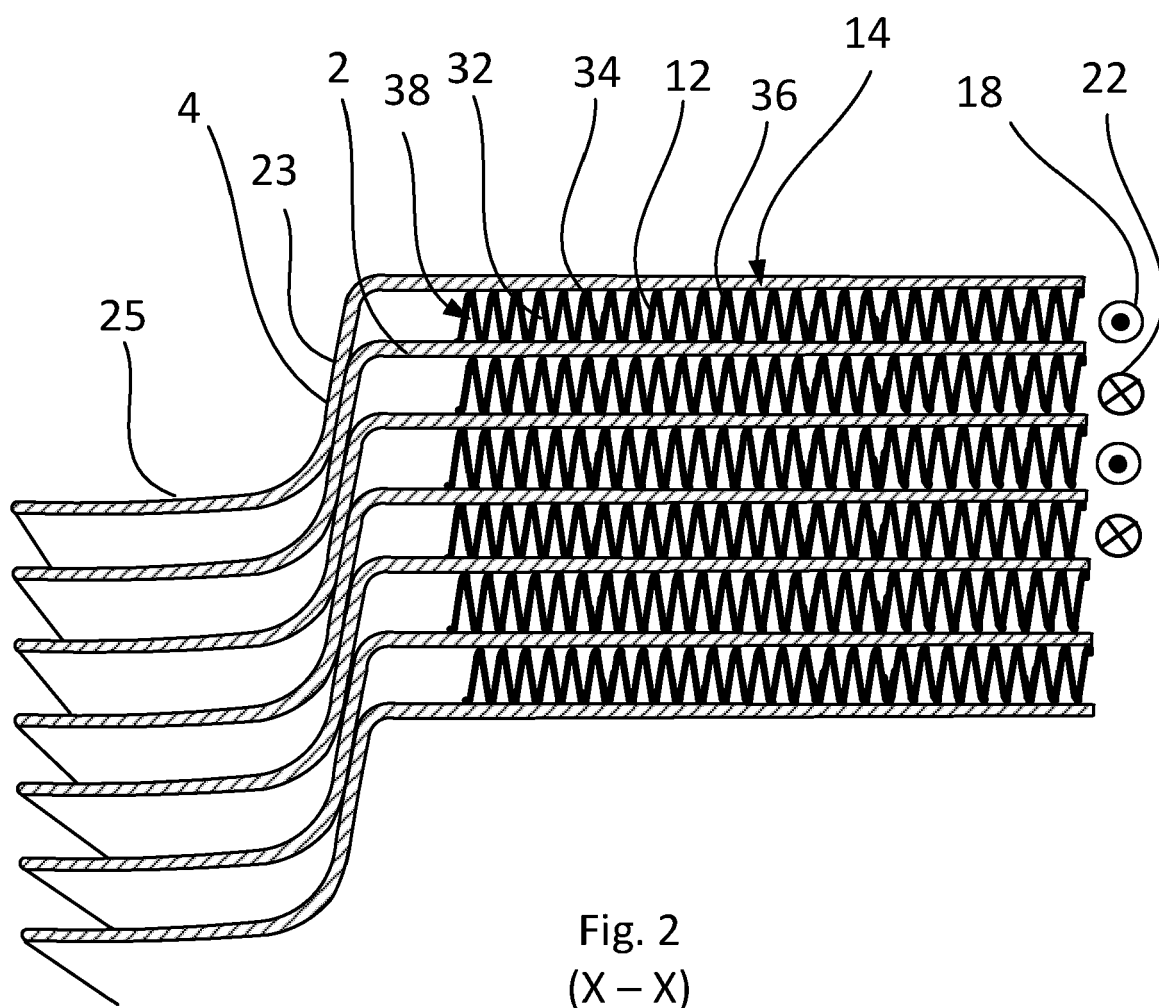
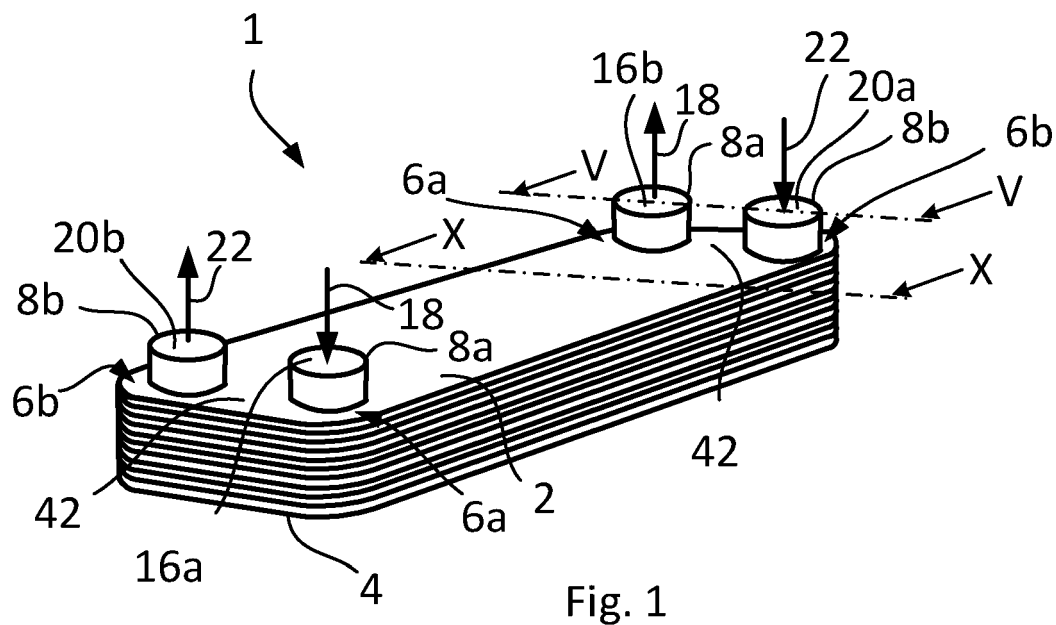
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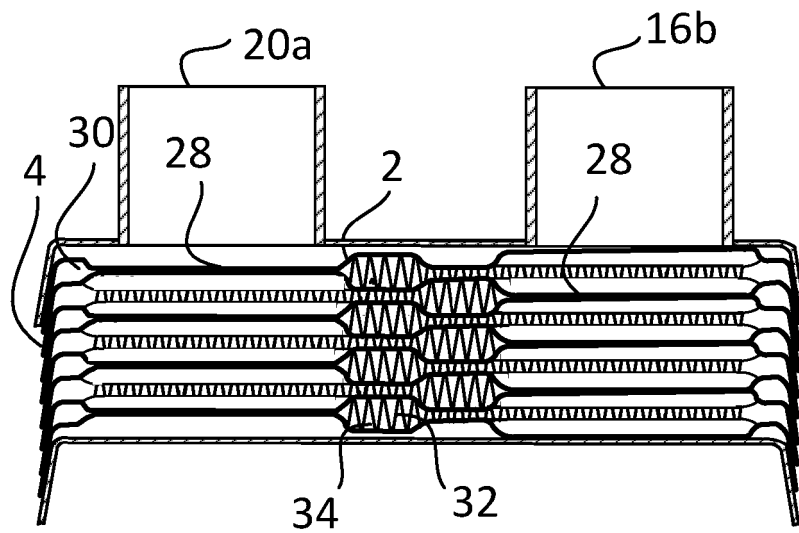


Fig. 3
(V - V)

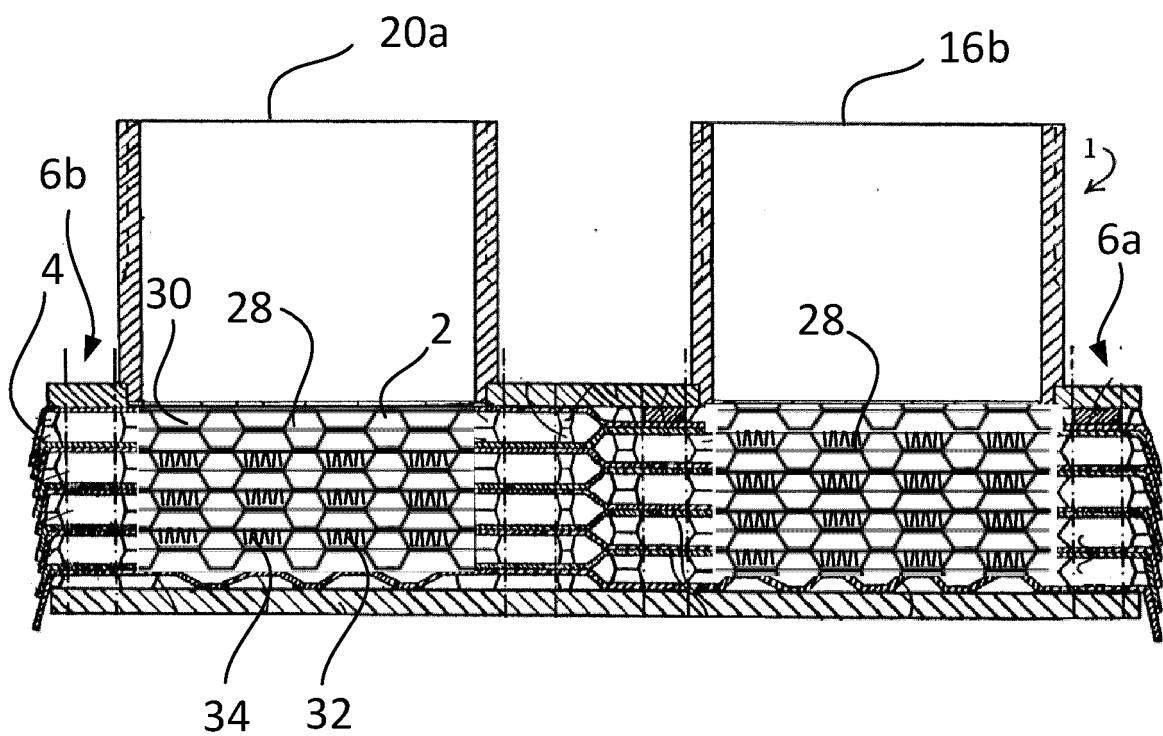


Fig. 4
(V - V)

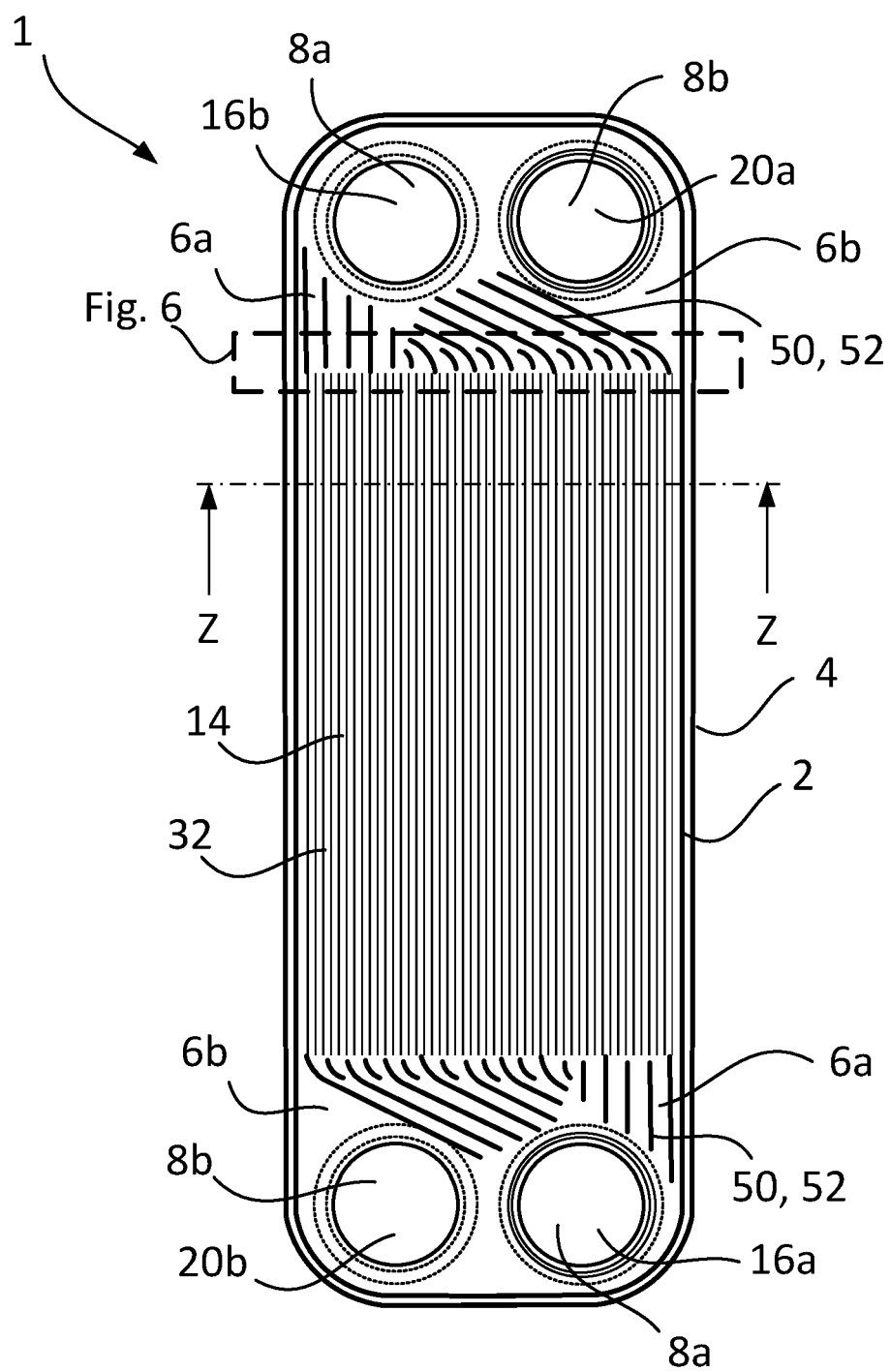
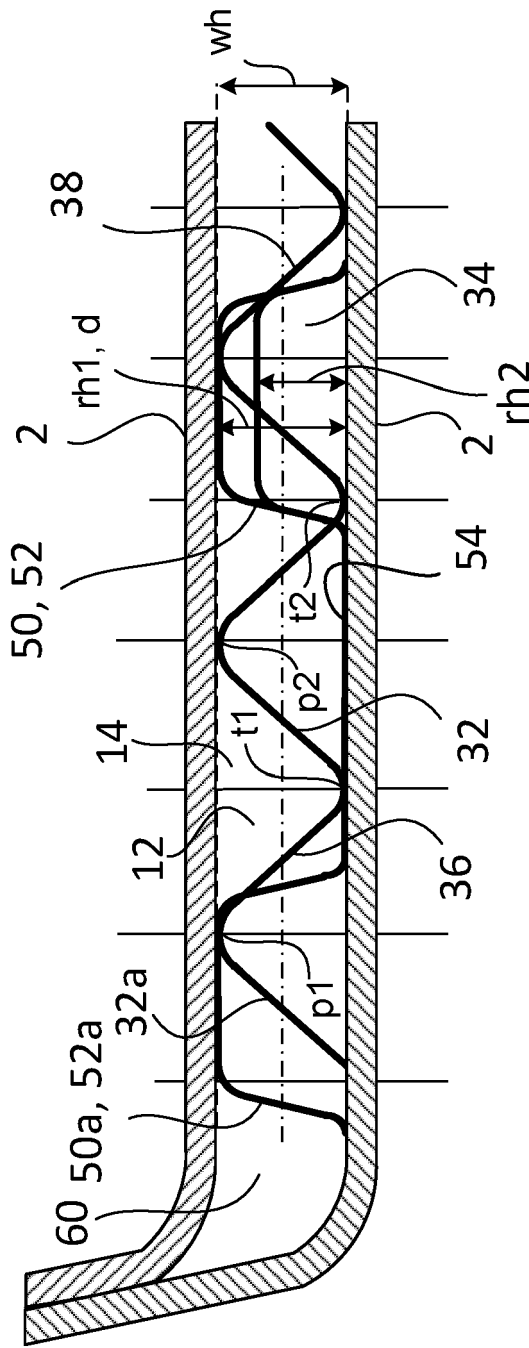
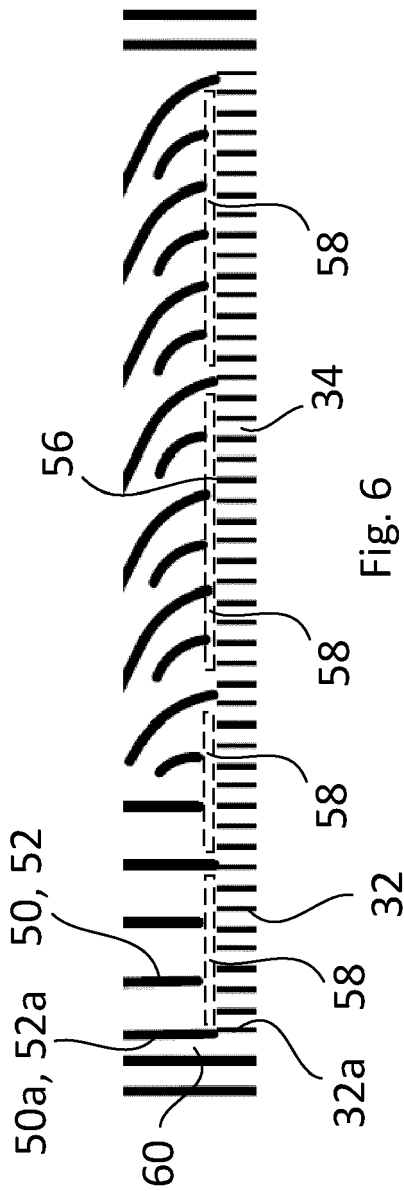
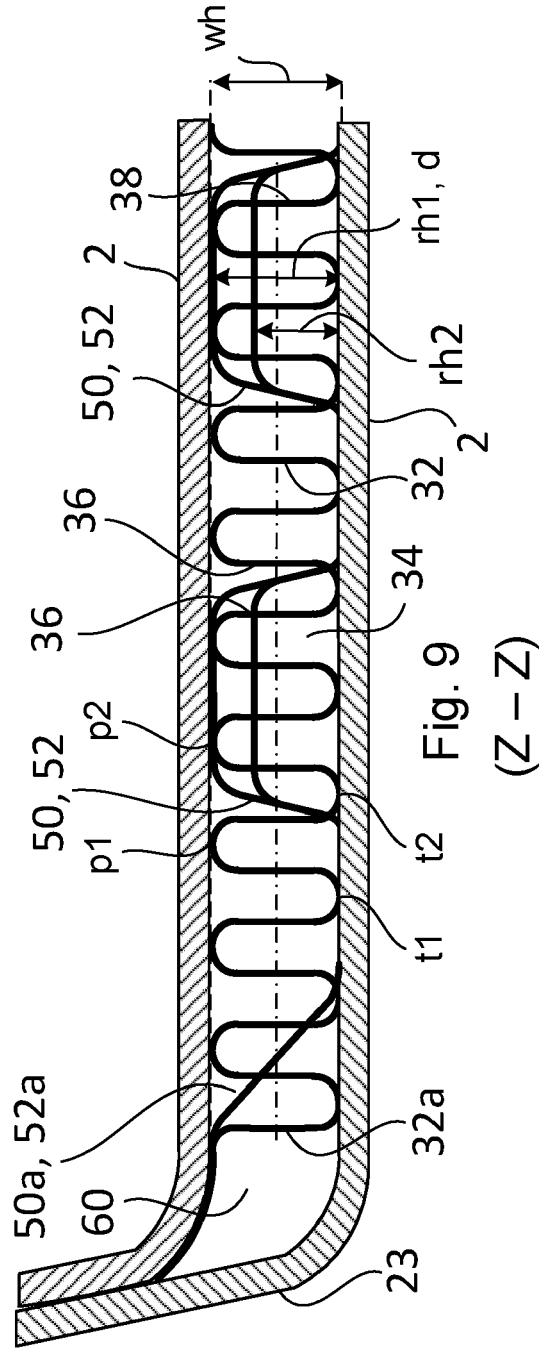
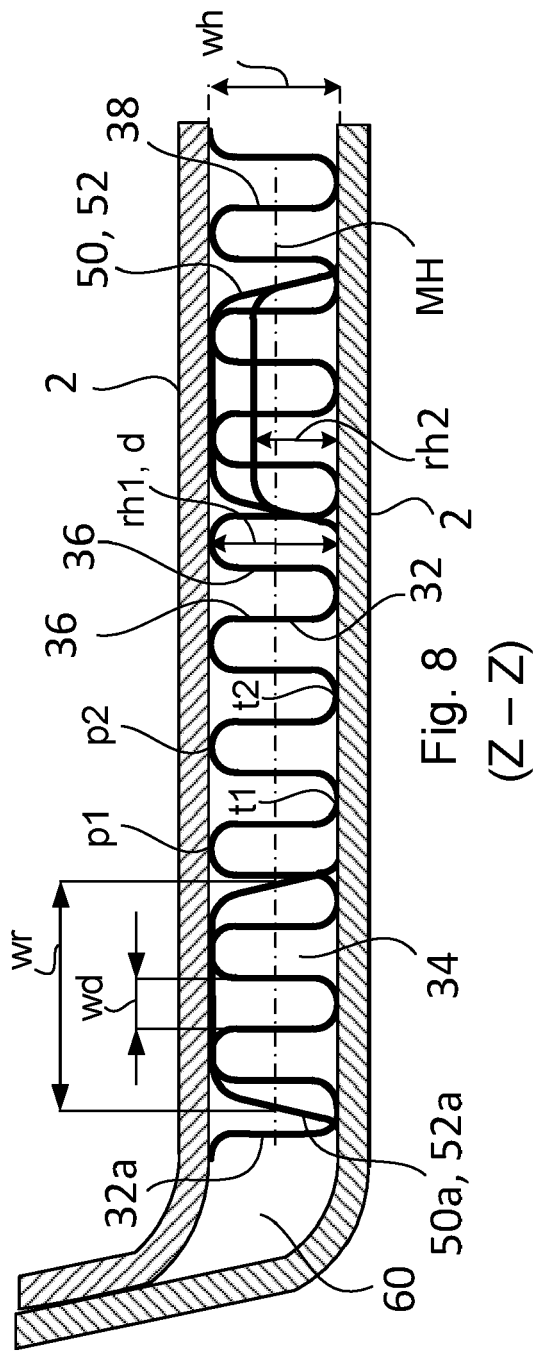


Fig. 5







EUROPEAN SEARCH REPORT

Application Number

EP 22 19 6564

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Place of search

Munich

Date of completion of the search

20 February 2023

Examiner

Leclaire, Thomas

CATEGORY OF CITED DOCUMENTS

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