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(54) **Exchange tube support and securing assembly for tube exchanger**

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Support de tube d'échange et ensemble de fixation pour échangeur de tube

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Description

TECHNICAL FIELD OF THE INVENTION

[0001] The present invention relates to the field of the heat exchangers that are used to exchange heat energy from one fluid to another without mixing them. The invention relates more particularly to the large size exchangers of tube type comprising supports making it possible to support a tube bundle intended to convey a fluid. The field of the invention relates more specifically to that of the supports, such as rings, comprising elements making it possible to secure tubes of the tube exchangers.

PRIOR ART

[0002] There are various types of exchangers used in industry which each address particular needs depending on the desired heat transfer mode or the use of specific fluids. There are plate, coil, block, fin and even tube exchangers. Other exchangers exist in the prior art.

[0003] The tube exchangers are particularly appreciated for their resistance to high pressures, the adaptation to different powers and to wide temperature deviations. They offer the advantage of being economical and compact. They are used most often for heat transfers between two volumes of water or more generally between a volume of liquid or of gas and another volume of liquid or of gas.

[0004] Some tube exchangers comprise supports which make it possible to limit the head losses of the fluids circulating in a calender and can also make it possible to better withstand the mechanical stresses due to the vibrations of the structure, these vibrations being mainly due to the arrival of the fluid in the calender which strikes the bundle, generally at right angles.

[0005] Their design relies on an assembly of rods fastened to rings making it possible to secure exchange tubes in which a fluid circulates. Generally, the ring is produced from a template.

[0006] EP 0 224 668 discuss an example of a tube support grid for a steam generator comprising grid, which is formed from intersecting grid rods arranged in more than one plane and is surrounded by a frame. The inside of the frame has circumferential grooves for accepting the grid rods. Various designs of spacers for fixing the spacing of the grid rods are discussed including the use of space at the end of the rod.

[0007] An exemplary exchanger is represented in figure 1, similar to that which is described in the patent US2009/0200004, in which circular baffle plates 8 also make it possible to secure the exchange tubes 9 along the exchanger by the presence of a plurality of holes allowing for the passage of the tubes 9.

[0008] The plates 6, 7 are spaced apart in a calender 10 forming the shell of the exchanger 1 so as to secure, at the ends of the calender, the exchange tubes 9 all along the exchanger 1. The tubes 9 are parallel and pass

through the volume of the calender. The baffle plates make it possible to circulate a fluid along a route 11 in the exchanger 1 from an inlet nozzle 4 to an outlet nozzle 5.

[0009] An inlet 2 makes it possible to circulate a first fluid in the exchange tubes 9. The first fluid leaves through an outlet 3 at the other end of the exchanger 1.

[0010] An inlet 4 makes it possible to circulate a second fluid in the calender. The second fluid leaves the exchanger through an outlet 5 at the other end of the exchanger 1.

[0011] The two fluids exchange heat by contact between the second fluid and the exchange tubes.

[0012] One drawback with this structure is that it absorbs shocks and vibrations very little, the gap between the tubes and the baffle plates used to secure them being very small. Such a structure is likely to break under high stresses unless more of the holed plates to support the tubes are provided, these plates here being the baffle plates providing the support function. However, this solution would make the production of the overall structure heavier by an increase in the number of parts, and would not make it possible to observe the thermal dimensioning of the exchanger, the spacing between the baffle plates being determined to be suited to the desired heat exchange.

[0013] Moreover, another drawback is that many head losses occur because of the course of the fluid in the calender 10 imposed by the baffle plates 8.

[0014] Figure 2 represents another exemplary exchanger 20 of the prior art. The exchanger type is tubular.

[0015] Rings 25 are spaced apart in a calender 21 forming the shell of the exchanger 20 so as to secure the tubes all along the exchanger 20.

[0016] Nozzles 22, 24 make it possible to inject or recover a fluid circulating in the calender.

[0017] A grid forms the interior of each ring making it possible to support a portion of the effort used to secure the tubes and to minimize the lateral movements of the exchange tubes. The term "interior" should be understood to mean the space delimited by the dimensions of the ring, or its diameter and its thickness. The grid allows for an easy passage of fluid in the calender because, on each ring, there is only one row of tubes in every two which is secured with the rods. This leaves many sections of passage for the fluid, which makes it possible to have low head losses. Figure 2 represents a support plate 23 securing the tubes in a holed plate. The rings then positioned allow for a recovery of effort to maintain a stable position for the tubes while making it possible to absorb vibrations. In another possible configuration (tubular exchanger with straight tubes) there are two support plates which secure the tubes in a holed plate at the ends. The rings positioned between the two plates allow for a recovery of effort to maintain a stable position for the tubes while making it possible to absorb vibrations.

[0018] There are a number of possible manufacturing methods, but the most commonplace consists in securing

each rod of the ring in openings provided for this purpose using a template specifically designed and manufactured to facilitate the assembly of a ring.

[0019] To ensure correct support of the tubes, rings very close together are required; at least four rings, or three intervals, are required to secure a tube in all the directions at right angles to its axis.

[0020] Figure 2 represents an embodiment of this design in which the rings are spaced apart by 158.5 mm from one another. Consequently, the number of rings per apparatus is significant.

[0021] Moreover, devices according to the prior art generally incur a significant manufacturing cost due to the fitting of numerous rings to secure the exchange tubes and lead to head losses in the guiding of the fluid in the calender.

EXPLANATION OF THE INVENTION

[0022] The support of the invention makes it possible to overcome all or part of the abovementioned drawbacks.

[0023] In particular, the support of the invention makes it possible to reduce the head losses of the fluids as they are being guided in the calender, to reduce the weight of an exchanger and to augment the securing of the exchange tubes.

[0024] To do this, there is proposed, according to a first aspect of the invention, a support for an exchange tube bundle forming, in a cutting plane, a mesh, said support comprising a ring, wherein the ring comprises fastening means making it possible to fasten, respectively, on either side of the cutting plane of the ring, a first set of rods and a second set of rods, said rods each having a form which constitutes a median plane, the median planes of the first set being parallel to one another and the median planes of the second set being parallel to one another, the orientation of the median planes of the first set and of the median planes of the second set forming a first angle greater than zero.

[0025] Such a device makes it possible to address all or part of the drawbacks of the prior art, notably because it allows for an exchanger design having at least two times fewer rings. This also makes it possible to reduce the head losses inside such an exchanger provided with such supports.

[0026] According to the invention, the form of the rods is a "U" form, that is to say a form having a central segment and two lateral segments forming the "U". Advantageously, the first angle and the number of rods of each set are chosen so as to form a frame exhibiting patterns corresponding to the mesh of the bundle.

[0027] Such a support makes it possible to improve the securing of the exchange tubes while absorbing any vibrations. Such a support also makes it possible to increase the stability of the exchanger and reduce the weight thereof.

[0028] Advantageously, the first angle is substantially

equal to 90° or substantially equal to 60°. These orientations make it possible to transversely immobilize, in an optimum manner, the exchange tubes when they are arranged in the mesh formed by the set of rods.

[0029] According to another particular feature, the section of the ring is square and/or its lateral faces are substantially planar. This notably allows for easy adaptation of the rods on either side of the ring.

[0030] According to an advantageous feature, the rods are fastened to the ring by shrink-fitting into holes preformed on each of the lateral faces of the ring thus forming the fastening means. Preferably, the shrink-fitting of the rods can be complemented by a step of welding on each of the lateral faces of the ring.

[0031] Moreover, the rods can be welded without necessarily being shrink-fitted. In this case, the weld forms the fastening means.

[0032] According to another technical aspect, the rods are:

- bent so as to obtain a U form, that is to say a form having a central segment and two lateral segments forming the "U"; and/or
- formed by an assembly of several sections of rods so as to obtain rods having a U form, that is to say a form having a central segment and two lateral segments forming the U, and preferably three rod segments, one for the central segment and one for each of the lateral segments.

[0033] In the latter case, the lateral segments are preferably machined, either by turning before bending, or by grinding or milling before or after bending. It should be noted that, in the general case, whatever the structure of the rod, the latter can be machined. For example, a rod of single-piece structure formed by bending can be machined on these lateral segments. This is particularly advantageous to reduce their thicknesses (or their diameter) in order to adapt their flexibility if necessary, the machining of the rods taking place before their bending.

[0034] Such features relating to the rods notably make it possible to be able to design said rods in such a way that they exhibit a flexibility suited to best damping the vibrations but above all to reduce the play of the tubes in relation to the mesh to zero to have a firm contact.

[0035] Advantageously, the central section of the rods is more rigid than the lateral sections of said rods. This makes it possible notably to guarantee that the flexibility seen by the tubes at the center of the bundle is the same as the flexibility seen by the tubes on the edges of the bundle.

[0036] Moreover, the invention also relates to a securing assembly comprising at least two supports as described, the supports are spaced apart by a first distance and oriented relative to one another by the first angle.

[0037] According to an advantageous feature the supports of the securing assembly are mounted in series.

This makes it possible notably to have an optimal rod mesh in order to arrange the exchange tubes therein.

[0038] Moreover, the invention also relates to a heat exchanger comprising a calender which encloses at least one bundle of exchange tubes and at least three exchange tube bundle supports forming, in a cutting plane, a mesh, said support comprising a ring, wherein the ring comprises fastening means making it possible to fasten, respectively, on either side of the cutting plane of the ring, a first set of rods and a second set of rods, said rods each forming a "U", each constituting a median plane, the median planes of the first set being parallel to one another and the median planes of the second set being parallel to one another, the orientation of the median planes of the first set and of the median planes of the second set forming a first angle greater than zero.

[0039] Such an exchanger makes it possible to address all or part of the drawbacks of the prior art notably because it requires at least two times fewer rings than what is proposed by the prior art. This also makes it possible to reduce the head losses inside such an exchanger provided with such supports.

BRIEF DESCRIPTION OF THE FIGURES

[0040] Other features and advantages of the invention will be presented in a detailed description illustrated by the following figures, with the help of the following description, given in light of the appended drawings which represent:

- figure 1: a first tube exchanger of the prior art;
- figure 2: a second tubular exchanger with tubes of the prior art;
- figures 3A, 3B, 3C and 3D: rods having different "U" forms of the invention;
- figure 4: a 3D view of a ring according to the invention forming a support for fastening the securing rods for the passage of exchange tubes;
- figures 5A and 5B: side and front views of a support according to an embodiment and comprising a ring on to which are fastened securing rods for the passage of exchange tubes.

DETAILED DESCRIPTION OF AN EMBODIMENT

Definitions

[0041] The term "ring" should be understood to mean an element having a closed contour having a certain thickness and delimiting an interior space that is open on either side of the closed contour. Generally, the closed contour has a substantially circular profile but it may have a different profile, for example oval, oblong, etc.

[0042] The term "calender" should be understood to mean the shell of the exchanger into which a fluid is injected for its cooling or its heating and which comprises rings such as those defined in the present invention. Generally, a calender is cylindrical.

[0043] The expression "exchanger of calender tube type" should be understood to mean an exchanger in which at least two fluids exchange heat, one fluid circulating in the calender and a second fluid circulating in the tubes. The surface of the tubes serving as support for the heat exchange between the two fluids.

[0044] The expression "rod in "U" form" should be understood to mean a rod assembled or folded or bent which forms three branches, each branch having a join with another branch forming an angle less than 180°. Figures 3A, 3B, 3C and 3D represent examples of rods which can be used in the support of the invention.

[0045] The term "baffle plate" should be understood, notably for a good understanding of the prior art, to mean a device making it possible to modify the direction of a fluid. In the field of heat exchangers, the term "baffle" is often used. The prior art discloses baffle plates that are used also to secure the tubes.

25 Description

[0046] A support for exchange tubes of the invention makes it possible to reduce the number of rings of an exchanger while making it possible to offer enhanced flexibility in the installation of an exchanger. Furthermore, the support of the invention makes it possible to improve the securing of the exchange tubes while absorbing any vibrations. The support of the invention makes it possible to increase the stability of the exchanger and reduce the weight thereof.

[0047] Figure 4 represents a support 400 of the invention, suitable for a so-called "calender tube" exchanger of circular form, comprising a ring 40 having a circular profile, a first set 41 of rods 410 and a second set 42 of rods 420. The rods 410, 420 of the two sets 41, 42 are fastened to the ring 40 on either side on the flanges of the ring 40 which respectively represent first and second lateral surfaces 401, 402 of the ring 40 delimiting a thickness of the ring.

[0048] For the legibility of the figure, all the rods 410, 420 of each set are not represented.

[0049] According to the embodiments, the ring 40 can have a parallelepipedal section such as a rectangle or a square or can even have a circular section.

[0050] Hereinafter in the description, a preferred embodiment is based on a ring 40 with square section on which the first and second lateral surfaces 401, 402 of the ring 40 are substantially coplanar and spaced apart from one another by a distance equal to the thickness of the ring 40.

[0051] For production convenience and to maximize the cylindrical surface of the exchanger with respect to the number of tubes forming the bundle to be supported,

each rod 410, 420 having a form which constitutes a median plane, the form of the rods here being substantially a "U" form.

[0052] The "U" form can be obtained by bending, folding or by assembling three rod branches. Moreover, the "U" form can be described as comprising a central segment provided with two ends and two lateral segments provided with two ends, each of the lateral segments being attached by one of their ends to an end of the lateral segment.

[0053] In the embodiment of figure 4, the first set 41 of rods 410 has a plurality of rods 410 parallel with one another, each rod 410 forming a "U" of which each end is fastened to the first lateral face 401 of the ring 40, the ends of the rods in "U" form corresponding to two ends of the lateral segments.

[0054] The second set 42 of rods 420 has the same properties as the first, except that the rods 420 are fastened to the second lateral face 402 of the ring 30. Furthermore, the median planes of the first set 41 are parallel with one another and the median planes of the second set 42 are parallel with one another, the orientation of the median planes of the first set 41 and of the median planes of the second set 42 forming a first angle α greater than zero.

[0055] In this embodiment, the first and second sets 41, 42 of rods 410, 420 are oriented relative to one another by a first angle equal to 90° in the example of figure 4.

[0056] In this figure, the axis (O, x) corresponds to the axis according to which the tubes of the exchange tube bundle will be positioned so that they are colinear to said axis (O, x).

[0057] Let (O, y, z) be a cutting plane normal to the axis (O, x) having for origin the center of the ring so that the ring is substantially coaxial to the axis (O, x), the coordinate system (O, x, y, z) also forming an orthogonal trihedron.

[0058] Let (O', y', z') be a first orthogonal coordinate system defining a first plane normal to the axis (O, x) comprising substantially the central segments of each rod 410 of the first set 41 of rods 410, said first plane being at a distance from the cutting plane by a length equal to the length of the segment [O, O'], O' having the coordinates (x1, 0, 0) in the coordinate system (O, x, y, z).

[0059] The median planes of the first set 41 are parallel with one another, parallel to the plane (O', x, z') and orthogonal to the cutting plane (O, y, z).

[0060] Let (O'', y'', z'') be a second orthogonal coordinate system defining a second plane normal to the axis (O, x) comprising substantially the central segments of each rod 420 of the second set 42 of rods 420, said first plane being at a distance from the cutting plane by a length equal to the length of the segment [O'', O], O'' having the coordinates (x2, 0, 0) in the coordinate system (O, x, y, z).

[0061] The median planes of the second set 42 are parallel with one another, parallel to the plane (O'', x, y'')

and orthogonal to the cutting plane (O, y, z).

[0062] The use of the qualifier "substantially" in the expression "a plane comprising substantially the central segments of the rods" should be understood to mean that, the central segments of the rods in "U" form not always being rectilinear, it is necessary to consider an intermediate plane comprising substantially most of the central segments of the rods.

[0063] Attention is drawn to the fact that the first and second planes are then at a distance from one another by a distance [O', O''] equal to the sum of the thickness of the ring 40 and of the lengths of the lateral segments of the rods 410 of the first set 41 and of the rods 420 of the second set 42. Each of the first and second planes being normal to the axis (O, x), the length of the rods 410 of the first set 41 are equal to one another, as is the length of the rods 420 of the second set 42.

[0064] Such an orientation of the first and second sets relative to one another by a first angle equal to 90° makes it possible to immobilize the exchange tubes in at least one direction of each axis colinear to the axes (O, y) and (O, z) of the plane (O, y, z) respectively in the first plane and in the second plane. In other words, the orientation as illustrated makes it possible to immobilize the exchange tubes at least on the axis (O', y') and the axis (O'', z'').

[0065] In fact, if we consider the first set 41 of rods 410 positioned for example vertically, i.e. according to an axis colinear to the axis (O, z), each rod 410 has an abscissa on the axis (O', y'). If we consider two successive rods of the first set 41, their abscissae being denoted y'1 and y'2.

[0066] If we consider the second set 42 of rods 420, they are positioned horizontally since they form an angle of 90° with the rods 420 of the first set 42, i.e. according to an axis colinear to the axis (O, y). Each rod 420 has an ordinate on the axis (O'', z''). If we consider two successive rods of the second set 42, their ordinates are denoted respectively z''1 and z''2.

[0067] By orthogonal projection of the first coordinate system (O', y', z') and of the second coordinate system (O'', y'', z'') in the cutting plane (O, y, z), the rods form a frame in which the two successive rods of the first set 41 have abscissae denoted y1 and y2 and in which the two successive rods of the second set 42 have ordinates denoted respectively z1 and z2.

[0068] An exchange tube is modeled in this example by a substantially cylindrical structure having an axis of revolution colinear to the axis (O, x). Such a tube passing between two parallel rods of the first set 41 and two parallel rods of the second set 42 would be contained between the abscissae y'1 and y'2 in the first coordinate system (O', y', z') and would be contained between the ordinates z1 and z2 in the second coordinate system (O'', y'', z'').

[0069] Because of this, such a tube passes through the frame formed by the rods in the cutting plane in a pattern of the frame that is here rectangular by virtue of

the first angle equal to 90° , the tube being contained between the abscissae y_1 and y_2 and between the ordinates z_1 , z_2 .

[0070] The set of the tubes then forms an exchange tube bundle, said set forming, in the cutting plane, a mesh.

[0071] In a manner not illustrated in this figure, when two supports 400 of the invention share the same axis on (Ox), they are then, in this case, coaxial, and when they are spaced apart by a first distance, then a tube can be secured on at least one axis colinear to one of the axes (Oz) or (Oy) in any plane normal to the axis (Ox).

[0072] Moreover, when three supports 400 of the invention share the same axis on (Ox), and when the first and the second supports are spaced apart by a first distance and the second and the third supports are spaced apart by a second distance, then a tube can be secured on at least two axes colinear to the axes (Oz) and (Oy) in any plane normal to the axis (Ox).

[0073] In one practical embodiment, the first and second distances can be chosen to be equal.

[0074] Thus, only three supports of the invention make it possible to form an assembly for securing the tubes at least according to two axes colinear to the axes (Oz) and (Oy) of the plane (O, y, z).

[0075] The invention therefore makes it possible to reduce the number of rings of an exchanger making it possible to support a bundle of heat exchange tubes.

[0076] In practice, in order to have six contacts for each tube making it possible to secure a tube in the exchanger, only three rings are needed. It should be noted that, in the case where a tube might have only four contacts with the rods of the supports, the tubes can still pivot. In such a configuration, it is sufficient to have two supports, each of the tubes having two contacts per support. Consequently, in order to be able to completely guide the tubes, it is necessary to have at least six points of contact of the tubes with the rods of the supports, that is to say, at least three points of contact in each plane.

[0077] Regarding the production of the rods, the latter can, for example, be welded on the lateral faces of the ring or even shrink-fitted in holes of the same diameters on the lateral faces of the ring.

[0078] In another embodiment, the rods can be fastened to the internal wall of the ring.

[0079] Figures 5A and 5B represent diagrammatic views of the ring 40, seen from the front and from the side. Heat exchange tubes 50 are represented in figure 5B. They are supported by rods 410, 420 of the first and second sets 41, 42 of rods 410 and 420 which form a three-dimensional grid of the ring, illustrating, in this front view, a frame. The frame thus represented by the grid, which can be seen in the front view, exhibits, in this embodiment square patterns. The side view represents the set of horizontal rods 42 on one side of the ring and the set of vertical rods 41 on the other side of the ring. For the legibility of the figures, not all the rods are represented. The lines 51 mark out each space which forms a

frame into which an exchange tube can be inserted and be secured in the exchanger, these spaces being delimited by the patterns of said frame.

[0080] In another embodiment, the patterns of the frame can be triangular so that the first set of rods forms, with the second set of rods, an angle of 60° . In this way, another support that is coaxial and situated at a first distance and oriented relative to the first support, for example, at an angle of 60° would make it possible to support the exchange tubes on at least one axis colinear to one of the axes (Oz) or (Oy), and do so in any plane normal to the axis (Ox).

[0081] In the same way, a third support positioned after the first two supports and having undergone another rotation of 60° relative to the second would make it possible to secure the heat exchange tubes on at least two axes colinear to the axes (Oz) and (Oy), and do so in any plane normal to the axis (Ox).

[0082] Such a rod configuration can make it possible to define a frame exhibiting patterns, one and the same pattern being able to be passed through by one or more tubes of the exchange tube bundle.

[0083] In all the embodiments, the frames, and therefore the arrangement of the rods, are designed to allow for a passage of a fluid in the calender while minimizing the head losses and offer adequate securing for the exchange tubes.

[0084] In a preferred embodiment, the rods of one and the same set of rods are spaced apart two by two by a distance substantially equal to two times a pitch defined by the exchange tubes, the pitch being defined as the distance between axes of two contiguous exchange tubes. In the case where the exchange tubes are cylindrical, these axes are the axes of revolution of said cylindrical forms. In this way, the frame formed by the rods is particularly suited to the mesh formed, in the cutting plane, by the exchange tube bundle.

[0085] Advantageously, the pitch of the exchange tubes is substantially equal to 1.25 times the diameter of the exchange tubes, this coefficient of 1.25 being able to be adjusted according to the materials used. In practice, and advantageously, this coefficient is substantially between 1.05 and 3, this depending on the materials used but also on the operating pressure of the exchanger, on the manufacturing means, on the diameter of the exchange tubes, and on the thermal dimensioning of the exchanger.

[0086] The form of the frame is therefore defined so as to allow the passage of a tube for which the dimension of the section of the tube, its diameter when the tube has a circular section, is smaller than the greatest distance defined by a pattern of the frame. The difference between this diameter and this greatest distance defines a gap. Said gap is calculated so as to optimize the head losses of the fluids and to ensure an optimal securing of the tubes in the calender by virtue of the support through the configuration of the supports, in particular the form of the patterns of the frame formed by the rods.

[0087] The invention therefore makes it possible to reduce the number of rings needed in an exchanger. This consequently makes it possible to:

- reduce the weight of the apparatus
- reduce the number of welds, notably welds of the rings on the insertion rails,
- reduce the manufacturing time, notably to obtain a saving on machining. The manufacture is thus simplified.

[0088] Generally, a significant concern regarding the tube exchangers that comprise supports for a tube bundle is to ensure a firm contact between the exchange tubes and the securing rods in order to minimize the gap between the rod and the tube while ensuring a flexibility so as to absorb any vibrations of the structure.

[0089] This flexibility, although it is not necessary to the securing of the rods, becomes essential when there is a desire to reduce the gap to zero to have a firm contact. In practice, the firm contact is possible only if one of the two parts in contact, the tube or the rod, is adapted to the other, respectively the rod or the tube, hence the need for flexibility. In other words since the theoretical gap equal to zero does not exist, it is necessary to provide a deformation of the parts when they come into contact with one another.

[0090] The flexibility provided in the rods is obtained by virtue of the length of each side of the "U" form of each rod corresponding to the smallest length which links the ring to the rest of the rod. This arrangement of the two sets and this organization of the rods between them make it possible to obtain a flexibility of the installation while ensuring the securing of the tubes by better contacts between the tubes and the rods.

[0091] Moreover, in a preferred embodiment, the lateral segments of the "U" forms can be machined, either by turning before bending, or by grinding or milling before or after bending. This makes it possible to obtain the exact flexibility desired to secure a row of tubes.

[0092] Furthermore, the "U" form can be formed with a number of rods assembled together, preferably three, one for a central segment and one for each of the lateral segments. This can make it possible to have a different flexibility on the edges of the "U" forms, for example with rods of smaller diameter for example. Nevertheless, it would be preferable to keep the central segment as rigid as possible, particularly when the lateral segments exhibit a flexibility. In practice, given that a flexibility is added to the lateral segments of the rods in "U" form, it is strongly recommended that these central segments should remain rigid in order to guarantee that the flexibility seen by the tubes at the center of the bundle is the same as the flexibility seen by the tubes on the edges of the bundle.

[0093] The rods ensure, by deformation, a firm contact of the tubes and allows a greater manufacturing tolerance for the positioning of the rods and the tubes.

[0094] It is also simpler to produce branch points between two rings in the calender. The branch points are nozzles that make it possible to inject or recover a fluid in the exchanger between the inlet and the outlet thereof.

[0095] Furthermore, the rods can be shrink-fitted and/or welded on to the rings via holes drilled therein, notably on the lateral surfaces of said ring. In this case, there is no longer a need for a template to position the rods. This solution makes it possible to obtain a gain and a saving on a template. In practice, the drilling of the holes is all that is needed to position the rods.

[0096] The exchange tube supports of the invention make it possible to reduce the weight of the structure of an exchanger and to add a mechanical strength that better withstands the shocks and vibrations of the structure.

[0097] The rods can notably be made of stainless steel, of steel, of carbon or more generally of metal.

[0098] Finally, the solution of the invention promotes a heat exchange by reducing the head losses of the fluids exchanging heat. In the case of such a tube bundle support, the head gain is situated notably at the level of the head loss on the ring.

Claims

1. A support (400) for an exchange tube bundle forming, in a cutting plane, a mesh, said support (400) comprising a ring (40), wherein the ring (40) comprises fastening means fastening, respectively, on either side of the cutting plane of the ring, a first set (41) of rods (410) and a second set (42) of rods (420), wherein the form of the rods is a "U" form, that is to say a form having a central segment and two lateral segments forming the "U", wherein each "U" constitutes a median plane, the median planes of the first set (41) being parallel to one another and the median planes of the second set (42) being parallel to one another, the orientation of the median planes of the first set (41) and of the median planes of the second set (42) forming a first angle (α) greater than zero, a first plane comprising substantially the central segments of each rod (410) of the first set (41) of rods (410) and a second plane comprising substantially the central segments of each rod (420) of the second set (42) of rods (420), wherein the distance between the first plane and the second plane is equal to the sum of a thickness of the ring 40 and of a length of the lateral segments.
2. The support (400) as claimed in claim 1, wherein the first angle (α) and the number of rods (410, 420) of each set (41, 42) are chosen so as to form a frame exhibiting patterns corresponding to the mesh of the bundle.
3. The support (400) as claimed in any one of claims 1 or 2, wherein the first angle (α) is substantially equal

to 90°.

4. The support (400) as claimed in any one of claims 1 or 2, wherein the first angle (α) is substantially equal to 60°.
5. The support (400) as claimed in any one of claims 1 to 4, wherein the section of the ring (40) is square and/or wherein its lateral faces (401, 402) are substantially planar.
6. The support (400) as claimed in any one of claims 1 to 5, wherein the rods are fastened to the ring by shrink-fitting into holes preformed on each of the lateral faces of the ring.
7. The support (400) as claimed in any one of claims 1 to 5, wherein the rods are fastened to the ring by welding on each of the lateral faces of the ring.
8. The support (400) as claimed in any one of claims 1 to 7, wherein the rods are bent so as to obtain the "U" form.
9. The support (400) as claimed in claim 8, wherein the lateral segments are machined, either by turning before bending, or by grinding or milling before or after bending.
10. The support (400) as claimed in any one of claims 2 to 9, wherein the rods are formed by an assembly of several sections of rods so as to obtain rods having the "U" form, and preferably three rod sections, one for the central segment and one for each of the lateral segments.
11. The support (400) as claimed in any one of claims 1 to 10, wherein the central section of the rods is more rigid than the lateral sections of said rods.
12. A securing assembly comprising two supports (400) as claimed in any one of claims 1 to 11, wherein the two supports (400) are spaced apart by a first distance and oriented relative to one another by the first angle (α).
13. A securing assembly comprising at least three supports (400) as claimed in any one of claims 1 to 11, wherein the supports are mounted in series, two successive supports being spaced apart by a first distance and oriented relative to one another by the first angle (α).
14. A heat exchanger comprising a calender which encloses at least one bundle of exchange tubes and at least three exchange tube bundle supports according to claim 1.

Patentansprüche

1. Ein Halter (400) für ein Austauschröhrenbündel, der in einer Schnittebene ein Gitter ausbildet, wobei der Halter (400) einen Ring (40) umfasst, wobei der Ring (40) Befestigungsmittel umfasst, die jeweils auf jeder Seite der Schnittebene des Rings einen ersten Satz (41) Stangen (410) und einen zweiten Satz (42) Stangen (420) befestigt, wobei die Form der Stangen eine "U"-Form ist, d.h. eine Form mit einem zentralen Segment und zwei seitlichen Segmenten, die das "U" ausbilden, wobei jedes "U" eine Medianebene bildet, wobei die Medianebenen des ersten Satzes (41) parallel zueinander sind und die Medianebenen des zweiten Satzes (42) parallel zueinander sind, wobei die Ausrichtung der Medianebenen des ersten Satzes (41) und der Medianebenen des zweiten Satzes (42) einen ersten Winkel (α) bilden, der größer als null ist, wobei eine erste Ebene im Wesentlichen die zentralen Segmente von jeder Stange (410) des ersten Satzes (41) von Stangen (410) umfasst und eine zweite Ebene im Wesentlichen die zentralen Segmente von jeder Stange (420) des zweiten Satzes (42) von Stangen (420) umfasst, wobei der Abstand zwischen der ersten Ebene und der zweiten Ebene gleich der Summe einer Stärke des Rings (40) und einer Länge der seitlichen Segmente ist.
2. Der Halter (400) nach Anspruch 1, wobei der erste Winkel (α) und die Anzahl von Stangen (410, 420) jedes Satzes (41, 42) zum Ausbilden eines Rahmens gewählt werden, der Muster aufweist, welche dem Gitter des Bündels entsprechen.
3. Der Halter (400) nach einem der Ansprüche 1 oder 2, wobei der erste Winkel (α) im Wesentlichen gleich 90° ist.
4. Der Halter (400) nach einem der Ansprüche 1 oder 2, wobei der erste Winkel (α) im Wesentlichen gleich 60° ist.
5. Der Halter (400) nach einem der Ansprüche 1 bis 4, wobei der Abschnitt des Rings (40) quadratisch ist und/oder wobei seine Seitenflächen (401, 402) im Wesentlichen plan sind.
6. Der Halter (400) nach einem der Ansprüche 1 bis 5, wobei die Stangen am Ring durch Schrumpfpassung in Löcher befestigt sind, welche an jeder der Seitenflächen des Rings vorgeformt sind.
7. Der Halter (400) nach einem der Ansprüche 1 bis 5, wobei die Stangen am Ring durch Schweißen an jeder der Seitenflächen des Rings befestigt sind.
8. Der Halter (400) nach einem der Ansprüche 1 bis 7, wobei die Stangen derart gebogen werden, dass sie

die "U"-Form erreichen.

9. Der Halter (400) nach Anspruch 8, wobei die Seiten-segmente maschinell bearbeitet werden, entweder durch Drehen vor dem Biegen, oder durch Schleifen oder Fräsen vor oder nach dem Biegen.
10. Der Halter (400) nach einem der Ansprüche 2 bis 9, wobei die Stangen durch eine Anordnung von mehreren Abschnitten von Stangen ausgebildet sind, um Stangen mit der "U"-Form zu erzielen, und vorzugsweise aus drei Stangenabschnitten, einem für das zentrale Segment und einem für jedes der Seiten-segmente.
11. Der Halter (400) nach einem der Ansprüche 1 bis 10, wobei der zentrale Abschnitt der Stangen starrer als die Seitenabschnitte der Stangen ist.
12. Eine Sicherungsanordnung, umfassend zwei Halter (400) nach einem der Ansprüche 1 bis 11, wobei die zwei Halter (400) um einen ersten Abstand beabstandet sind und durch den ersten Winkel (α) in Bezug zueinander ausgerichtet sind.
13. Eine Sicherungsanordnung, umfassend zumindest drei Halter (400) nach einem der Ansprüche 1 bis 11, wobei die Halter in Reihe angebracht sind, wobei aufeinanderfolgende Halter um einen ersten Abstand beabstandet sind und durch den ersten Winkel (α) in Bezug zueinander ausgerichtet sind.
14. Ein Wärmetauscher, umfassend einen Kaland, der zumindest ein Bündel von Austauschröhren und zumindest drei Austauschröhrenbündelhalter nach Anspruch 1 einschließt.

Revendications

1. Support (400) d'un faisceau de tubes d'échange formant, dans un plan de coupe, un maillage, ledit support (400) comprenant une couronne (40), **caractérisé en ce que** la couronne (40) comprend des moyens de fixation permettant de fixer respectivement de part et d'autre du plan de coupe de la couronne un premier ensemble (41) de tiges (410) et un second ensemble (42) de tiges (420), la forme des tiges étant une forme en « U », c'est-à-dire une forme présentant un segment central et deux segments latéraux formant le « U », chaque « U » constituant un plan moyen, les plans moyens du premier ensemble (41) étant parallèles entre eux et les plans moyens du second ensemble (42) étant parallèles entre eux, l'orientation des plans moyens du premier ensemble (41) et des plans moyens du second ensemble (42) formant un premier angle (α) supérieur à zéro, un premier plan comprenant essentiellement les segments centraux de chaque tige (410) du premier ensemble (41) de tiges (410) et un second plan comprenant essentiellement les segments centraux de chaque tige (420) du second ensemble (42) de tiges (420), la distance entre le premier plan et le second plan étant égale à la somme d'une épaisseur de la couronne (40) et d'une longueur des segments latéraux.
2. Support (400) selon la revendication 1, **caractérisé en ce que** le premier angle (α) et le nombre de tiges (410, 420) de chaque ensemble (41, 42) sont choisis de manière à former une trame présentant des motifs correspondants au maillage du faisceau.
3. Support (400) selon l'une quelconque des revendications 1 et 2, **caractérisé en ce que** le premier angle (α) est sensiblement égal à 90°.
4. Support (400) selon l'une quelconque des revendications 1 et 2, **caractérisé en ce que** le premier angle (α) est sensiblement égal à 60°.
5. Support (400) selon l'une quelconque des revendications 1 à 4, **caractérisé en ce que** la section de la couronne (40) est carrée et/ou que ses faces latérales (401, 402) sont sensiblement planes.
6. Support (400) selon l'une quelconque des revendications 1 à 5, **caractérisé en ce que** les tiges sont fixées à la couronne par emmanchement dans des trous préformés sur chacune des faces latérales de la couronne.
7. Support (400) selon l'une quelconque des revendications 1 à 5, **caractérisé en ce que** les tiges sont fixées à la couronne par soudage sur chacune des faces latérales de la couronne.
8. Support (400) selon l'une quelconque des revendications 1 à 7, **caractérisé en ce que** les tiges sont cintrées de manière à obtenir la forme en « U ».
9. Support (400) selon la revendication 8, **caractérisé en ce que** les segments latéraux sont usinés, soit par tournage avant cintrage, soit par meulage ou fraisage avant ou après cintrage.
10. Support (400) selon l'une quelconque des revendications 2 à 9, **caractérisé en ce que** les tiges sont formées par un assemblage de plusieurs tronçons de tiges de manière à obtenir des tiges présentant la forme en « U », et de préférence trois tronçons de tiges, une pour le segment central est une pour chacun des segments latéraux.
11. Support (400) selon l'une quelconque des revendications 1 à 10, **caractérisé en ce que** la section

centrale des tiges est plus rigide que les sections latérales desdites tiges.

12. Ensemble de maintien comprenant deux supports (400) selon l'une quelconque des revendications 1 à 11, **caractérisé en ce que** les deux supports (400) sont espacés d'une première distance et orientés l'un par rapport à l'autre selon le premier angle (a). 5
13. Ensemble de maintien comprenant au moins trois supports (400) selon l'une quelconque des revendications 1 à 11, **caractérisé en ce que** les supports sont montés en série, deux supports successifs étant espacés d'une première distance et orientés l'un par rapport à l'autre selon le premier angle (a). 10 15
14. Echangeur de chaleur comprenant une calandre qui enferme au moins un faisceau de tubes d'échange et au moins trois supports du faisceau de tubes d'échange selon la revendication 1. 20

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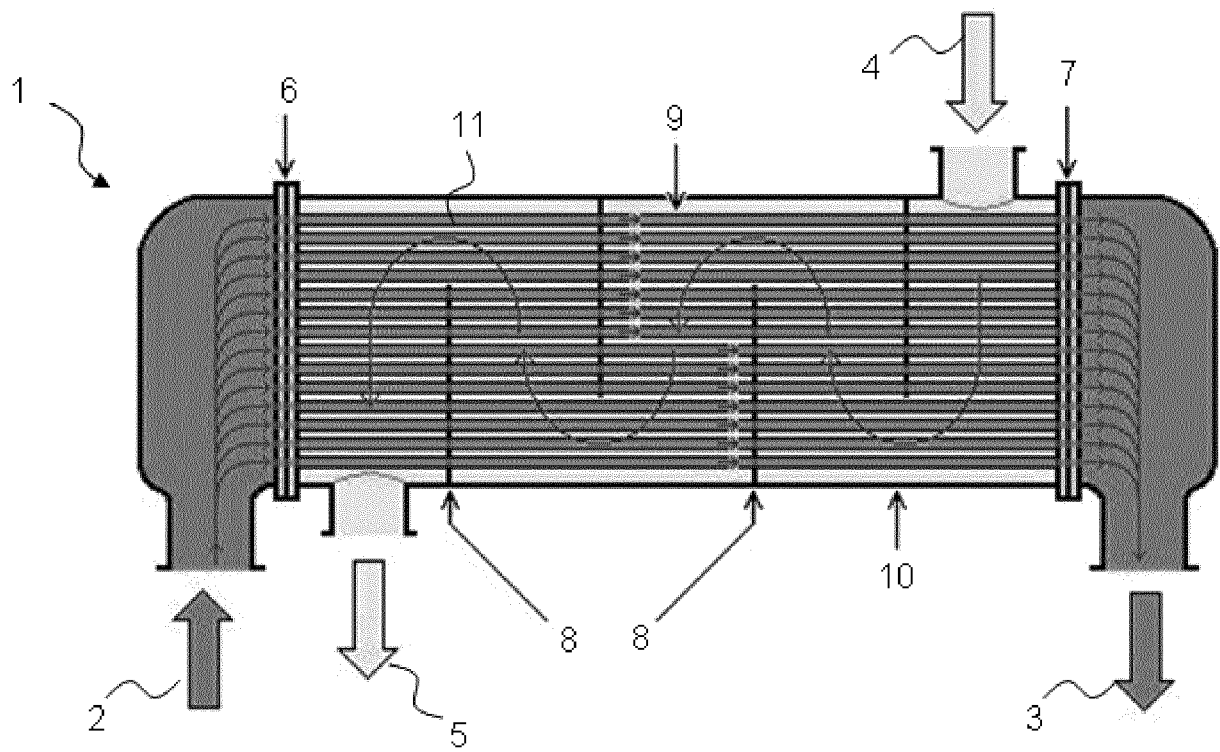


FIG. 1

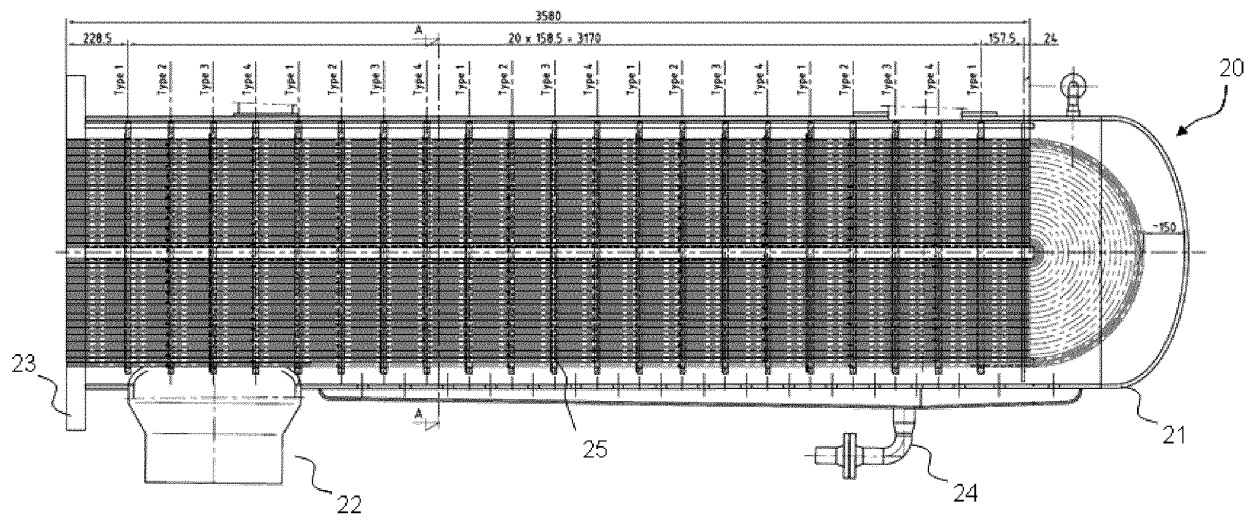


FIG. 2

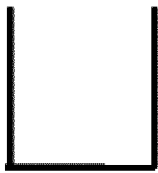


FIG. 3A

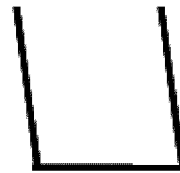


FIG. 3B

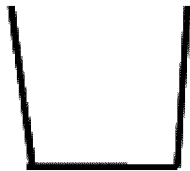


FIG. 3C

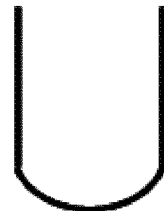


FIG. 3D

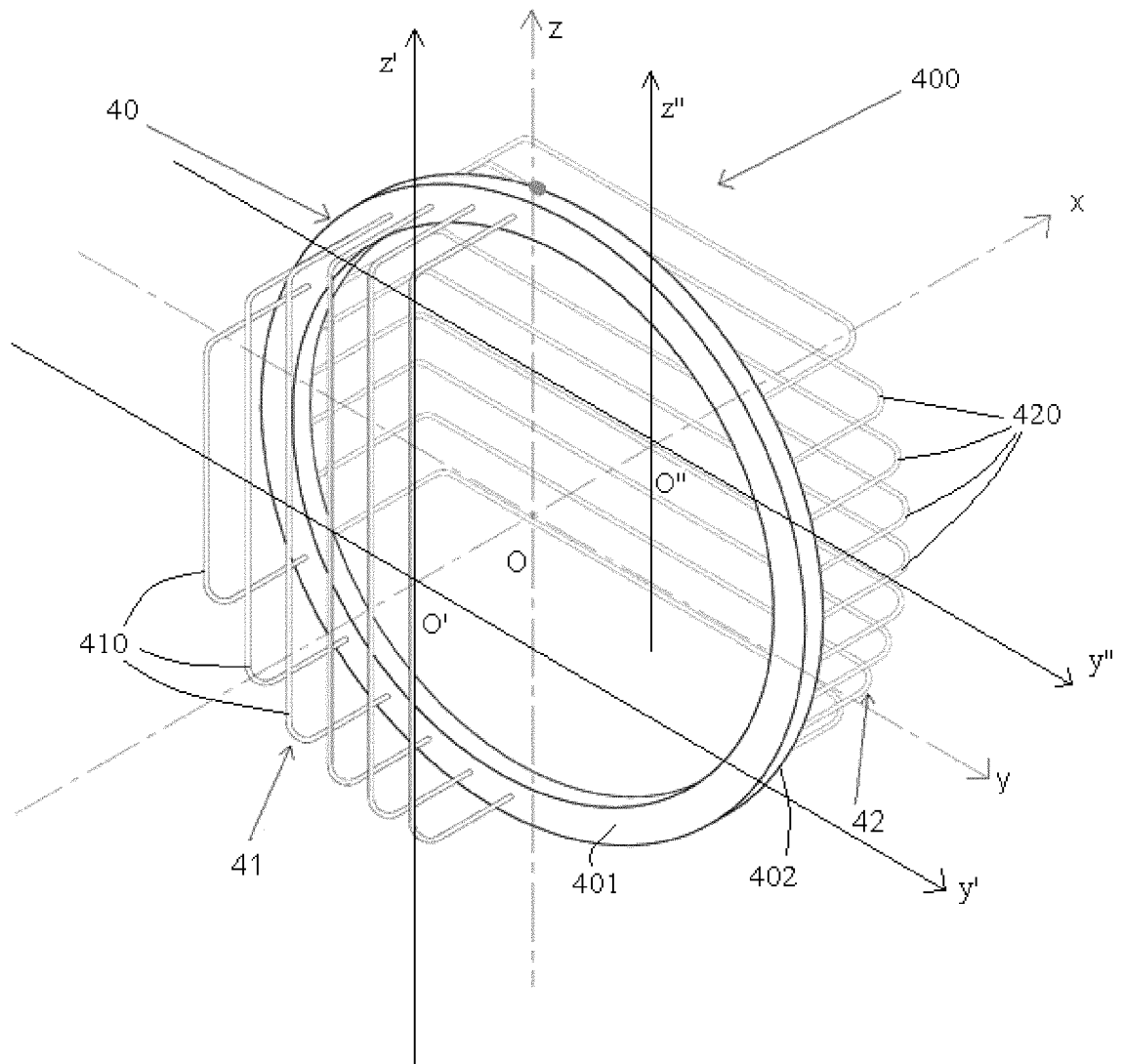


FIG. 4

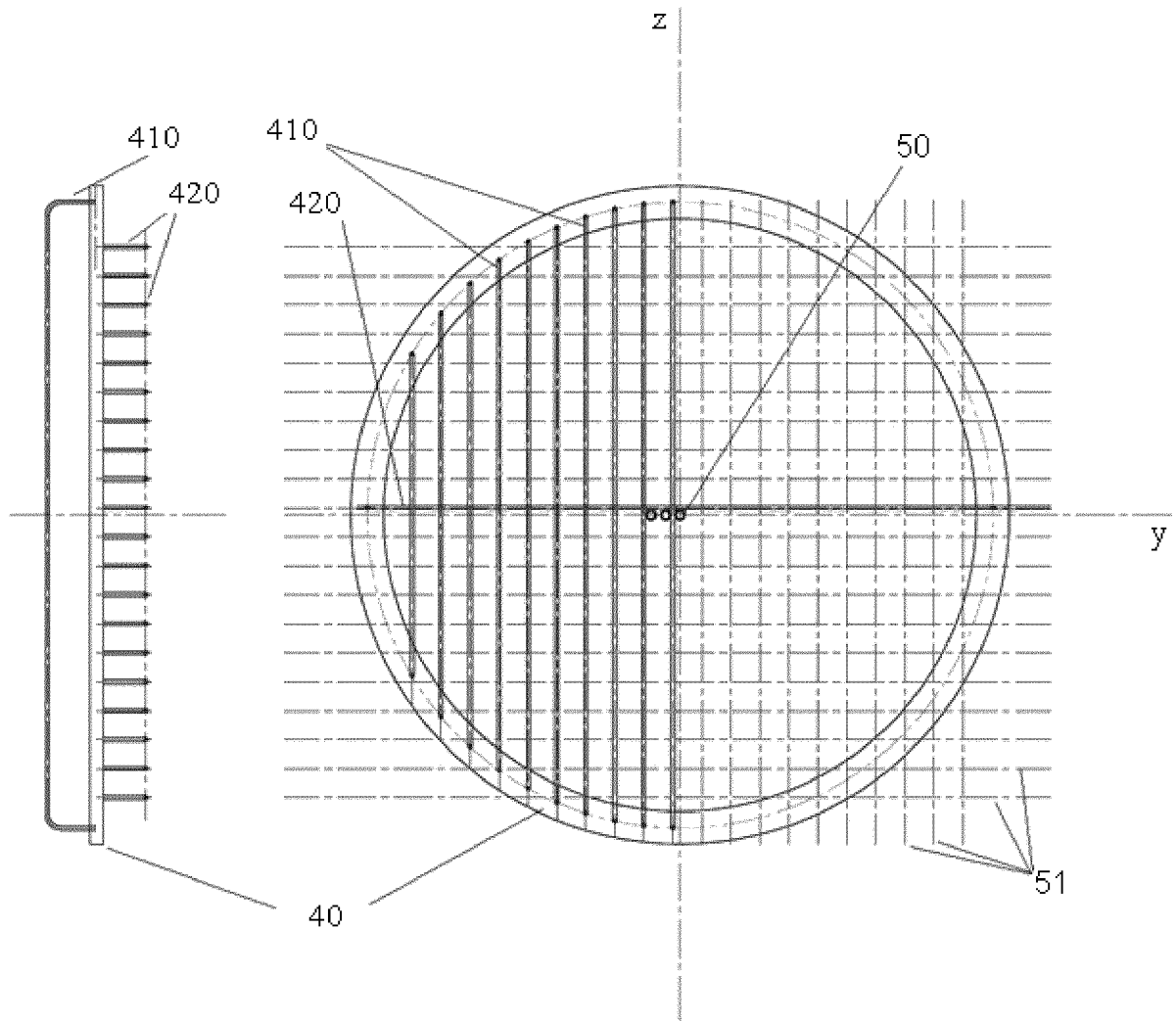


FIG. 5A

FIG. 5B

REFERENCES CITED IN THE DESCRIPTION

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