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(54) **SEG-LOK BAFFLE FOR HEAT EXCHANGER**

SEG-LOK-LEITBLECH FÜR WÄRMETAUSCHER

DÉFLECTEUR SEG-LOK POUR ÉCHANGEUR DE CHALEUR

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Description

FIELD

[0001] The present invention relates to a baffle system for a heat exchanger, including shell-and-tube or hairpin (multitube) type heat exchangers.

BACKGROUND

[0002] Heat exchangers, including shell-and-tube and hairpin (multitube) type heat exchangers, are used in a wide variety of applications to create heat exchange between streams of various fluids. Such heat exchangers generally include a combination, or bundle, of tubes housed within a cylindrically shaped shell. In operation, a first fluid, commonly referred to as the "tube-side fluid," is directed through at least some of the tubes of the tube bundle. Concurrently, a second fluid, commonly referred to as the "shell-side fluid," is directed within the shell and into any void around the tubes comprising the tube bundle, wherein the tube wall of each tube can permit heat exchange between the tube-side fluid stream flowing within the tubes and the shell-side fluid stream flowing around the tubes.

[0003] Generally, the tube bundle of a tubular heat exchanger includes a plurality of separate, self-contained individual tubes that extend in parallel to each other, wherein one or both of the ends of each respective tube is fixed to a header plate or a plurality of header plates, which are known as tube sheets. In applications that demand generally elongated heat exchangers of various lengths, known tubes and tube bundles, and the various designs thereof, of tubular heat exchangers, including shell-and-tube or hairpin (multitube) type heat exchangers, are subject to sagging and vibrations, both of which can negatively affect the heat exchanger and its components. To mitigate the negative effects of tube sagging and vibration, known tubes and tube bundles of tubular heat exchangers require baffles, intermediate support structures, or members at various points over the length of the tubes or tube bundle. Although such baffles can be effective in supporting the tubes and maintaining the desired position and spacing of the same within the shell, one drawback is that they can generally impede the flow of the shell-side fluid, such that the shell-side fluid is generally prevented from flowing along the tubes. In this way, such baffles generally inhibit the flow of the shell-side fluid along the length of the tubes.

[0004] Baffle positioning and spacing can also pose a difficult design challenge and create an impediment to efficient and optimal heat exchanger operation. In particular, when the spacing between a series of baffles is reduced to shorten the effective unsupported length of a specific tube or tube bundle and address the sagging and vibration thereof, the limited space between the baffles can adversely affect the heat exchanger by reducing the flow area for the shell-side fluid, which can result in ex-

cessive shell-side pressure drop.

[0005] Current baffle designs adapted to address the sagging and vibration of a specific tube or tube bundle but also prevent excessive shell-side pressure drops can create stratification in the flow of, or separation in the various fluids comprising, the shell-side fluid over the lengths of the tubes or tube bundle that negatively affects the efficiency of the heat exchanger. For example, the stratification of a less dense vapor from a more dense liquid in a two-phase flow application can create a sub-optimal environment for heat exchange within a heat exchanger. Specifically, stratification causes heavier, more dense liquid to settle at the bottom of the shell rendering the heat transfer surface in contact with the liquid less effective.

[0006] JP H05 296680A discloses a baffle system according to the preamble of claim 1.

[0007] Thus, there is a need in the art for an improved design for a baffle system and a heat exchanger that can effectively support the tube or the tube bundle of a heat exchanger, avoid sagging and vibration within the shell of the heat exchanger. There is further a need in the art for a baffle system and a heat exchanger that is capable of being used in connection with designs or applications where the potential for shell-side pressure drop is a potential risk/concern, while also avoiding stratification of the shell-side fluid.

SUMMARY

[0008] The objects of the present invention are solved by the features of independent claim 1. Preferred embodiments are given in the dependent claims.

BRIEF DESCRIPTION OF THE FIGURES

[0009]

FIG. 1 is a front view of a first exemplary baffle in accordance with embodiments presented herein;
FIG. 2 is a front view of a second exemplary baffle in accordance with embodiments presented herein;
FIG. 3 is a front view of a third exemplary baffle in accordance with embodiments presented herein;
FIG. 4 is a front view of a fourth exemplary baffle in accordance with embodiments presented herein;
FIG. 5 is a front view of a fifth exemplary baffle in accordance with embodiments presented herein;
FIG. 6 is a front view of a sixth exemplary baffle in accordance with embodiments presented herein;
FIG. 7 is a side view of an exemplary baffle in accordance with embodiments presented herein;
FIG. 8 is a perspective view of an exemplary baffle system in accordance with embodiments presented herein;
FIG. 9 is a perspective view of an exemplary baffle system in accordance with embodiments presented herein;

FIG. 10 is a perspective view of an exemplary baffle system in accordance with embodiments presented herein;

FIG. 11 is a perspective view of an exemplary baffle system in accordance with embodiments presented herein;

FIG. 12 is a perspective view of an exemplary baffle system in accordance with embodiments presented herein;

FIG. 13 is a perspective view of an exemplary baffle system in accordance with embodiments presented herein; and

FIG. 14 is a perspective view of an exemplary baffle system in accordance with embodiments presented herein.

DETAILED DESCRIPTION

[0010] Embodiments presented herein are generally directed to a baffle system and a heat-exchanging apparatus that can effectively support a tube or a tube bundle of a heat exchanger that avoids sagging and vibration, is capable of being used in connection with low shell-side pressure drop designs or applications, and avoids stratification of the shell-side fluid.

[0011] According to exemplary embodiments shown schematically in FIGS. 1-6, a baffle 10 can define a profile with a generally circular shape. However, it will be understood that the profile of the baffle 10 can assume any other suitable geometrical shape, including, without limitation, a triangle, a square, a pentagon, a hexagon, and any similar symmetrical and non-symmetrical shapes or series of shapes. Further, as best illustrated in FIGS. 1-6, baffle 10 can define a diameter or width W, which can generally correspond with the diameter of a heat exchanger (not shown), and more particularly, the internal diameter of the heat exchanger shell. Baffle 10 may be of any suitable diameter or width W depending upon its desired application. For example, the width W of the baffle 10 may be between about 0,3048 m (1 foot) and about 2,7432 m (9 feet) in one embodiment, between about 0,6096 m (2 feet) and about 2,1336 m (7 feet) in another embodiment, and about 1,2192 m (4 feet) in a further embodiment.

[0012] As best illustrated in FIGS. 1-6, according to exemplary embodiments, baffle 10 can receive and support a generally elongate tube 20 or series of generally elongate tubes 22 of a heat exchanger (not shown) for purposes of preventing sagging and vibration over the lengths of a specific tube 20 or series of tubes 22. According to exemplary embodiments shown schematically in FIGS. 1-6, the tube 20 or series of tubes 22 can pass through an interior section of baffle 10 and are generally axially aligned with the baffle 10. The tube 20 or series of tubes 22 may also extend in one or more multiple directions from the baffle 10. The tube 20 or series of tubes 22 may also be configured to extend perpendicularly from the profile of the baffle 10 in one or multiple directions. It

will be appreciated that a preferred embodiment of the present invention can be used with varying arrangements of tubes 20 and series of tubes 22, including, for example, straight tube or shell arrangements, single or multi-pass arrangements, and/or designs implementing parallel (co-current) or counter-flow arrangements.

[0013] FIG. 1 depicts a front-view illustration of a first exemplary baffle 10 according to exemplary embodiments presented herein. As shown schematically in FIG. 1, baffle 10 can comprise a permeable support region 30 through at least a portion of an interior section within the perimeter of the baffle 10. The permeable support region 30 can comprise support elements 32 that can contact or interface with the tube 20 or series of tubes 22 and are capable of supporting the tube 20 or series of tubes 22. Support elements 32 of permeable support region 30 can take on various shapes and orientations. For example, support elements 32 can be elongate members that are generally orientated parallel to either the x-axis or y-axis of the profile of baffle 10. Further, according to exemplary embodiments, the generally elongate support elements 32 can comprise regions that generally conform to the shape of the tube 20 or series of tubes 22 that are received and supported by support elements 32. For example, such regions can define a rounded or semi-circular shape that conforms to generally round tubes 20 or series of tubes 22. According to exemplary embodiments shown schematically in FIG. 1, support elements 32 can be oriented at generally diagonal orientations relative to the profile of the baffle 10, such that the support elements 32 are not generally orientated parallel to either the x-axis or y-axis of the profile of the baffle 10. As further depicted in FIG. 1, support elements 32 can comprise generally angled or stepped regions that generally conform to the shape of the tube 20 or series of tubes 22 that the support elements 32 receive and support. According to embodiments presented herein, support elements 32 can support the tube 20 or series of tubes 22 through various means, including, without limitation, by allowing the tube 20 or series of tubes 22 to bear on the support elements 32 through gravitational force. Support elements 32 can also be configured so that the tubes 20 can be press-fit within notches formed by the angled or stepped regions.

[0014] As best illustrated in FIG. 1, support elements 32 can be arranged within baffle 10 to define voids 34. The voids 34 defined by the support elements 32 permit shell-side fluid (not shown) to pass through baffle 10 and flow along the lengths of the tube 20 or series of tubes 22 generally without impediment, which can prevent excessive shell-side pressure drop. In combination, support elements 32 and voids 34 of baffle 10 can allow for the baffle 10 to adequately support the tube 20 or series of tubes 22 without significantly affecting the flow of shell-side fluid along the lengths of the tube 20 or series of tubes 22 and creating excessive shell-side pressure drop. The reduction in excessive shell-side pressure drop allows baffle 10 to be utilized in heat exchangers of larger

size and longer lengths, which improves the efficiency, scales of production, and general heat-exchange nature of the heat exchanger, as well as other desirable aspects for heat exchangers. Specifically, reducing excessive pressure drop in the shell-side fluid can promote the efficiency of heat transfer between tube-side fluid and shell-side fluid when compared to known baffle designs for heat exchangers.

[0015] FIG. 2 depicts a front-view illustration of a baffle 10 according to an exemplary embodiment. As best illustrated in FIG. 2, baffle 10 can have a barrier region 40 that can be comprised of a solid portion 42 that is generally impermeable. Further, barrier region 40 of the baffle 10 can define a plurality of holes 44 to receive and support a tube (not shown) or series of tubes (not shown) of a heat exchanger (not shown) for purposes of preventing sagging and vibration along the length of a specific tube or series of tubes. According to embodiments presented herein, the size of the holes 44 can correspond with the diameter of a tube received and supported thereby. Further, the holes 44 defined by the barrier region 40 can support the tube or series of tubes through various means, including, without limitation, by allowing the tube or series of tubes to bear on the barrier region 40 through gravitational force.

[0016] FIGS. 3-6 schematically illustrate additional baffle designs according to exemplary embodiments presented herein. As representatively illustrated the baffle 10 can define a permeable support region 30, including support elements 32 and voids 34, and a barrier region 40, including a solid portion 42 and a plurality of holes 44. As depicted in FIGS. 3-6, the permeable support region 30 and the barrier region 40 of a baffle 10 can correspondingly vary in size. For example, in FIG. 3, the permeable support region 30 and the barrier region 40 of the baffle 10 define corresponding semicircle shapes, wherein barrier region 40 and holes 44 defined thereby enable three (3) rows of tubes 20 to extend therethrough. However, it will be appreciated that a semicircular shape defined by the barrier region 40 of the baffle 10 can correspond with any suitable number of rows of tubes 20 as required by its application.

[0017] As best illustrated in FIGS. 4-6, the barrier region 40 of baffle 10 can define a segment of the circular profile of the baffle 10, wherein the segment is defined by a chord and arc of the circular profile of the baffle 10. The segment defined by the barrier region 40 of the baffle 10 can be a major segment, defining a proportion of the profile of the baffle 10 of greater than fifty percent, or a minor segment, defining a proportion of the profile of the baffle 10 of fifty percent or less. In a preferred embodiment, the barrier region 40 of the baffle 10 is a minor segment. As shown schematically in FIG. 4, a baffle 10 according to exemplary embodiments can comprise a segment defined by barrier region 40 and holes 44 to enable two (2) rows of tubes 20 to extend therethrough. As shown schematically in FIG. 5, a baffle 10 according to exemplary embodiments can comprise a segment de-

finer by barrier region 40 and holes 44 to enable one (1) row of tubes 20 to extend therethrough. As shown schematically in FIG. 6, a baffle 10 according to exemplary embodiments can comprise a segment defined by barrier region 40 that does not enable any rows of tubes 20 to extend therethrough. However, it will be appreciated that a segment, of various sizes, defined by the barrier region 40 of the baffle 10 can correspond with any suitable number of rows of tubes 20 as required by its application.

[0018] Further, it will be appreciated that the permeable support region 30 and the barrier region 40 of a baffle 10 can correspondingly vary in shape. For example, the permeable support region 30 and the barrier region 40 can assume various geometrical shapes. Although not depicted in FIG. 3-6, according to embodiments presented herein, the barrier region 40 can define a sector of the circular profile of the baffle 10. Such sector defined by the barrier region 40 being generally defined by two radii, which also define a central angle therebetween, and an arc of the circular profile of the baffle 10 corresponding with the central angle. The sector defined by the barrier region 40 of the baffle 10 can be a major sector, with a central angle exceeding 180°, or a minor sector, with a central angle of 180° or less. Further, the sector defined by the barrier region 40 can be a semicircle (with a central angle of approximately 180°), a quadrant (with a central angle of approximately 90°), a sextant (with a central angle of approximately 60°), an octant (with a central angle of approximately 45°), and any other sub-sector shape defined by a central angle of varying degrees.

[0019] It will be appreciated that where a baffle 10 defines a permeable support region 30 and a barrier region 40 according to embodiments disclosed herein, and either the permeable support region or the barrier region define one of the shapes discussed herein (including a triangle, a square, a pentagon, a hexagon, and any similar symmetrical and non-symmetrical shapes or series of shapes), the remainder of the profile of the baffle 10 can define the corresponding permeable support region or barrier region, which can define a shape that corresponds with the first defined region, and vice versa.

[0020] It will further be appreciated that the shape defined by either the permeable support region 30 or the barrier region 40 of a baffle 10 according to embodiments disclosed herein can be a single, continuous region or multiple, non-continuous regions. For example, as best illustrated in FIG. 3, barrier region 40 can define a single portion of the circular profile of baffle 10 and generally form a semicircle (notwithstanding the holes 44 in the solid portion 42 of the barrier region 40). Embodiments presented herein, however, can also comprise a baffle where the barrier region 40 is defined by multiple, non-continuous portions within the circular profile of the baffle 10. For example, the barrier region 40 can define two discrete and non-continuous minor segments, of equal or different sizes. Further, the barrier region 40 can define two discrete and non-continuous minor sectors, of equal or different sizes, within the circular profile of the

baffle 10 that are angularly offset by some angle between the respective sectors. Further yet, the barrier region 40 can define a single, continuous semicircle or minor segment, and the permeable support region 30 can define multiple, non-continuous portions of the circular profile of the baffle 10, such as the corresponding semicircle or major segment to the barrier region 40 and one or more minor segments or minor sectors generally within the profile defined by the single, continuous barrier region 40.

[0021] Although the size and shape of the permeable support region 30 and the barrier region 40 of a baffle 10 representatively depicted and described herein generally relate to or correspond with a baffle 10 that defines a profile with a generally circular shape, it will be appreciated that, as previously stated, the profile of the baffle 10 can assume any other suitable geometrical shape. For example, the size and shape of the permeable support region 30 and the barrier region 40 of the baffle 10, and the general proportional of each to overall profile of the baffle 10, can be translated to similar sizes, shapes, and proportions for use with a baffle 10 that defines a profile with a triangle, a square, a pentagon, a hexagon, or any similar symmetrical and non-symmetrical shapes or series of shapes.

[0022] According to embodiments presented herein, the shape and size of the baffle 10 and the permeable support region 30 (including support elements 32 and voids 34), and a barrier region 40 (including a solid portion 42 and a plurality of holes 44), can be formed through a variety of means. For example, the permeable support region 30 and a barrier region 40 of a baffle can be formed from a single piece of material, such as a metal, through a cutting process, including, without limitation, a water-jet cutting process, laser cutting, and die cutting. Use of such cutting processes allow for efficient and cost-effective production of the baffle 10, especially over other means for forming a baffle 10 that may require connecting or affixing pieces of material together, including through the use of various fastening means and welding.

[0023] FIG. 7 depicts a side-view illustration of a baffle 10 according to exemplary embodiments. As illustrated schematically in FIG. 7, baffle 10 can define a height H, which can generally correspond with the diameter of a heat exchanger (not shown). Baffle 10 may be of any suitable height H depending upon its desired application. For example, the height H of the baffle 10 may be between about 0,1016 m (4 inches) and about 1,8288 m (6 feet) in one embodiment. As further illustrated in FIG. 7, baffle 10 can define a thickness T. Baffle 10 may be of any suitable thickness T depending upon its desired application. For example, the thickness T of a baffle 10 may be between about 0,0064 m (1/4 inch) and 0,0762 m (3 inches).

[0024] As shown schematically in FIGS. 8-14, a baffle system 100 is shown according to exemplary embodiments. Baffle system 100 can comprise a series of baffles 10 that can be concentrically aligned in sequence. The baffle system 100 depicted in FIGS. 8-14 can be utilized

with a heat exchanger (not shown) comprising a generally elongate tube 20 or series of generally elongate tubes 22. As illustrated schematically in FIG. 8, the baffles 10 of baffle system 100 can be aligned to receive and support a tube 20 or series of tubes 22 that pass through the baffles 10. It will be appreciated that although FIG. 8 depicts certain components of a heat exchanger while also not depicting other components of a heat exchanger (e.g., a shell, a shroud, and so on), embodiments presented herein may comprise such components without limitation. By receiving each tube 20 or series of tubes 22 of the heat exchanger, the baffles 10 can support the tube 20 or series of tubes 22 over their lengths to prevent sagging and vibration of a specific tube 20 or series of tubes 22. As illustrated in FIG. 8, individual baffles 10 of baffle system 100 can be axially displaced from each other in a direction generally parallel to the tube 20 or series of tubes 22 that pass through and are received by the individuals baffles 10 of the baffle system 100 by a baffle spacing L. The baffle system 100 may have any suitable baffle spacing L between individual baffles depending upon its desired application. For example, the baffle spacing L of the baffle system 100 may be between about 0,1524 m (6 inches) and about 1,8288 m (6 feet) in one embodiment, between about 0,3048 m (1 foot) and about 1,2192 m (4 feet) in another embodiment, and about 0,9144 m (3 feet) in a further embodiment.

[0025] FIG. 9 depicts a perspective-view illustration of a baffle system 100 according to exemplary embodiments presented herein. As illustrated schematically in FIG. 9, at least one baffle 10 of baffle system 100 can define a barrier region 40. As further illustrated in FIG. 9, the barrier region 40 of at least one baffle 10 of baffle system 100 can be in axial alignment with the permeable support region 30 of another baffle 10 of the baffle system 100, wherein at least a portion of the permeable support region 30 of one baffle 10 is in substantially the same orientation as the barrier region 40 in a second baffle 10 that is concentrically aligned and rotationally oriented with the first baffle 10. For example, a tube (not shown) passing through the permeable support region 30 of one baffle 10 depicted in FIG. 9 can extend therefrom and pass through the barrier region 40 of a second baffle 10 where the permeable support region 30 is in axial alignment with the barrier region 40.

[0026] According to embodiments presented herein, the barrier region 40 of at least one baffle 10 of baffle system 100 can interact with the flow of shell-side fluid (not shown) as it flows through the interior of a heat exchanger along the lengths of the tube or series of tubes (not shown) and passes through each baffle 10 of the baffle system 100. The interaction between the barrier region 40 of at least one baffle 10 of the baffle system 100 and the shell-side fluid can disturb and create turbulence in the flow of the shell-side fluid. The turbulence in the flow of the shell-side fluid can prevent stratification in the flow of the shell-side fluid over the length of the tube or series of tubes. Further, the common orientation

of the barrier region 40 of at least one baffle 10 with the permeable support region 30 a different baffle 10 of the baffle system 100 can prevent the stratification in the flow of the shell-side fluid over the length of the tube or series of tubes without impeding flow of the shell-side fluid and creating excessive shell-side pressure drop within the heat exchanger. The prevention of stratification in the flow of the shell-side fluid over the length of the tube or series of tubes, without creating excessive shell-side pressure drop, increases the efficiency of the heat exchanger (not shown) and can enable the baffle system 100 to be utilized in heat exchangers of various sizes and lengths, including heat exchangers with reduced diameters. For example, a baffle system 100 of the type representatively depicted in FIG. 9 could be used in a ten-inch hairpin (multitube) type heat exchanger to optimize the hairpin (multitube) type heat exchanger by preventing stratification of the shell-side fluid over the lengths of the tube or series of tubes without creating excessive shell-side pressure drop. Optimizing ten-inch hairpin (multitube) type heat exchangers is desirable, because ten-inch hairpin (multitube) type heat exchangers can be produced more cost-effectively (e.g., smaller components, less materials, and so on) and allow for a more enhanced process of heat exchange that generally results in less fouling of the heat exchanger.

[0027] As illustrated schematically in FIGS. 10-12, a baffle system 100 is shown according to exemplary embodiments as having at least three baffles 10, wherein each baffle 10 defines a barrier region 40. As FIGS. 10-12 depict, the barrier region 40 of each baffle 10 of the baffle system 100 can be angularly offset, about a concentrically aligned longitudinal axis defined by the center points of the profile of each baffle 10. For example, the barrier region 40 of each baffle 10 of the baffle system 100 depicted in FIG. 10 can have a slight angular offset between about 10° and about 30° in one embodiment, and about 15° in another embodiment. However, at least a portion of the barrier region 40 of each baffle 10 of the baffle system 100 depicted in FIG. 10 can still be in general axial alignment with the barrier region 40 of the other baffles 10 of the baffle system 100.

[0028] As depicted in FIG. 11, the barrier region 40 of each baffle 10 of baffle system 100 can have a moderate angular offset between about 30° and about 180° in one embodiment, and about 120° in another embodiment. Further yet, as depicted in FIG. 12, the barrier region 40 of each baffle 10 of the baffle system 100 can have an angular offset of about 180° in an exemplary embodiment of the present invention, wherein the barrier regions 40 of every other baffle 10 can be in axial alignment. However, it will be appreciated that the angular offset between barrier regions 40 of each baffle 10 of a baffle system 100 may be any suitable number of degrees. For example, the angular offset can be between about 1° and about 180° in one embodiment, between about 15° and about 150° in another embodiment, between about 45° and about 120° in yet another embodiment, and about 90°.

[0029] In addition to interacting with the flow of shell-side fluid (not shown) as it flows along the lengths of the tube (not shown) or series of tubes and passes through each baffle 10 of the baffle system 100 to disturb and create turbulence in the flow of the shell-side fluid, the series of barrier regions 40, and relative arrangement thereof, depicted in FIGS. 10-12 can produce a swirl flow effect in the flow of the shell-side fluid. A swirl effect created in the flow of a shell-side fluid of a heat exchanger can have several advantages and benefits. For example, swirl effect can reduce stratification in the flow of the shell-side fluid, reduce excessive shell-side pressure drop, and can promote the efficiency of heat transfer between tube-side fluid and shell-side fluid when compared to known baffle designs for heat exchangers. The swirl flow effect can thus allow for the production of more efficient and longer heat exchangers, which generally improves the efficiency, scales of production, and general heat-exchange nature of the heat exchanger, as well as other desirable aspects for heat exchangers.

[0030] Existing means for yielding a swirling effect in the flow of the shell-side fluid have generally required impermeable baffles 10 be oriented in angled manner relative to the tube or series of tubes that are received and supported by the baffles. Alternatively, other conventional means for yielding a swirl effect in the flow of the shell-side fluid require the use of a spiraling, continuous baffle that extends over the length of the heat exchanger. Angled baffles and/or spiraling, continuous baffles however can be cost-intensive, resource-intensive, and time-intensive to produce, because the angle and spiraling nature of the baffle do not provide a flat or otherwise generally planar profile, and removing or cutting portions from the baffle as a whole, including voids and holes, is generally difficult and limited to certain complicated and complex drilling techniques. Further, spiral, continuous baffles must usually be manufactured in various twisted and spiraled baffle portions that must be connected or affixed together through the use of various fastening means and welding, which is time-intensive and creates weak points in the baffle.

[0031] FIG. 13 depicts a perspective-view illustration of a baffle system 100 according to exemplary embodiments. As illustrated schematically in FIG. 13, baffle system 100 can have at least three baffles 10, wherein at least two of the baffles 10 define a barrier region 40. According to embodiments shown schematically in FIG. 13, the profile of at least one of the baffles 10 can comprise a majority or nearly all of a barrier region 40, wherein such barrier region 40 can be in axial alignment with a second barrier region 40 of another baffle 10 of the baffle system 100. Further, such barrier region 40 can be in axial alignment with at least one of the permeable support regions 30 of the other baffles 10 of the baffle system 100.

[0032] FIG. 14 depicts a perspective-view illustration of a baffle system 100 according to exemplary embodiments. As illustrated schematically in FIG. 14, at least one baffle 10 of the baffle system 100 can define a non-

continuous barrier region 40 that can generally comprise two discrete and non-continuous minor segments, as previously described. According to embodiments illustrated schematically in FIG. 14, a baffle 10 having a non-continuous barrier region 40 can be positioned between baffles having a continuous barrier region 40.

[0033] Although FIGS. 9-14 are depicted without tube 20 or series of tubes 22, it will be appreciated that embodiments presented herein may comprise such tubes or other components of a heat exchanger (e.g., a shell, a shroud, and so on) of a heat exchanger without limitation.

[0034] It is important to note that the embodiments are presented by way of example only and are not intended as a limitation on the scope of the present inventions. The invention is defined by the appended claims.

Claims

1. A baffle system (100) for a heat exchanger comprising:

a plurality of baffles (10); and
a plurality of tubes (20) received and supported by the plurality of baffles (10);
wherein:

the plurality of baffles (10) are concentrically aligned;
at least one of the plurality of baffles (10) defines a first barrier region (40);
and at least one of the plurality of baffles (10) defines a first permeable support region (30) through at least a portion of an interior section within the perimeter of the baffle (10),

characterized in that

the first permeable support region (30) comprises support elements (32) that contact or interface with a series of tubes (22) and are configured to support the series of tubes (22) and the support elements (32) comprise stepped regions that are configured to conform to the shape of the series of tubes (22) that the support elements (32) are configured to receive and support.

2. The baffle system (100) of claim 1, wherein:

the plurality of baffles (10) comprises a first baffle; and
the first baffle defines the first permeable support region (30) and the first barrier region (40).

3. The baffle system (100) of claim 2, wherein:

the plurality of baffles (10) further comprises a

second baffle; and
the second baffle defines a second permeable support region.

4. The baffle system (100) of claim 3, wherein the second permeable support region is in axial alignment with the first barrier region (40).
5. The baffle system (100) of claim 3, wherein the second baffle further defines a second barrier region.
6. The baffle system (100) of claim 5, wherein the first permeable support region (30) is in axial alignment with the second permeable support region and/or wherein the first barrier region (40) is in axial alignment with the second barrier region.
7. The baffle system (100) of claim 3, wherein the first baffle is axially displaced from the second baffle by a baffle spacing (L), wherein the baffle spacing (L) is preferably 0.9 m (3 feet).
8. The baffle system (100) of claim 3, wherein:
the plurality of baffles (10) further comprises a third baffle; and
the third baffle defines a third permeable support region,
wherein the third permeable support region preferably is in axial alignment with the first barrier region (40).
9. The baffle system (100) of claim 8, wherein the second permeable support region is in axial alignment with the first barrier region (40).
10. The baffle system (100) of claim 8, wherein the third baffle further defines a third barrier region.
11. The baffle system (100) of claim 10, wherein the first permeable support region (30) is in axial alignment with the third permeable support region and/or wherein the first barrier region (40) is in axial alignment with the third barrier region.
12. The baffle system (100) of claim 10, wherein the second permeable support region is in axial alignment with the third permeable support region and/or wherein the second permeable support region is in axial alignment with the third barrier region.
13. The baffle system (100) of claim 10, wherein the second baffle further defines a second barrier region, wherein the second barrier region is preferably in axial alignment with the third barrier region.
14. The baffle system (100) of claim 8, wherein the first baffle is axially displaced from the third baffle by a

baffle spacing (L), wherein the baffle spacing (L) is preferably 0.9 m (3 feet).

15. A heat-exchanging apparatus comprising:

at least one heat exchanger; and
a baffle system (100) according to any of claims 1-14.

Patentansprüche

1. Umlenklechsystem (100) für einen Wärmetauscher, umfassend:

eine Vielzahl von Umlenklechen (10); und
eine Vielzahl von Rohren (20), die von der Vielzahl von Umlenklechen (10) aufgenommen und getragen werden, wobei:

die Vielzahl von Umlenklechen (10) konzentrisch ausgerichtet sind;
mindestens eines der Vielzahl von Umlenklechen (10) einen ersten Barrierebereich (40) definiert;
und mindestens eines der Vielzahl von Umlenklechen (10) einen ersten durchlässigen Trägerbereich (30) durch mindestens einen Teil eines inneren Abschnitts innerhalb des Umfangs des Umlenklechs (10) definiert,

dadurch gekennzeichnet, dass

der erste durchlässige Trägerbereich (30) Trägerelemente (32) umfasst, die eine Reihe von Rohren (22) kontaktieren oder eine Schnittstelle mit ihnen bilden und dazu konfiguriert sind, die Reihe von Rohren (22) zu tragen, und die Trägerelemente (32) gestufte Bereiche umfassen, die dazu konfiguriert sind, sich an die Form der Reihe von Rohren (22) anzupassen, für die die Trägerelemente (32) zum Empfangen und Tragen konfiguriert sind.

2. Umlenklechsystem (100) nach Anspruch 1, wobei:

die Vielzahl von Umlenklechen (10) ein erstes Umlenklech umfasst; und
das erste Umlenklech den ersten durchlässigen Trägerbereich (30) und den ersten Barrierebereich (40) definiert.

3. Umlenklechsystem (100) nach Anspruch 2, wobei:

die Vielzahl von Umlenklechen (10) weiter ein zweites Umlenklech umfasst; und
das zweite Umlenklech einen zweiten durchlässigen Trägerbereich definiert.

4. Umlenklechsystem (100) nach Anspruch 3, wobei der zweite durchlässige Trägerbereich in axialer Ausrichtung mit dem ersten Barrierebereich (40) ist.

5. Umlenklechsystem (100) nach Anspruch 3, wobei das zweite Umlenklech weiter einen zweiten Barrierebereich definiert.

6. Umlenklechsystem (100) nach Anspruch 5, wobei der erste durchlässige Trägerbereich (30) in axialer Ausrichtung mit dem zweiten durchlässigen Trägerbereich ist und/oder wobei der erste Barrierebereich (40) in axialer Ausrichtung mit dem zweiten Barrierebereich ist.

7. Umlenklechsystem (100) nach Anspruch 3, wobei das erste Umlenklech axial von dem zweiten Umlenklech um einen Umlenklechabstand (L) verschoben ist, wobei der Umlenklechabstand (L) bevorzugt 0,9 m (3 Fuß) beträgt.

8. Umlenklechsystem (100) nach Anspruch 3, wobei:

die Vielzahl von Umlenklechen (10) weiter ein drittes Umlenklech umfasst; und
das dritte Umlenklech einen dritten durchlässigen Trägerbereich definiert,
wobei der dritte durchlässige Trägerbereich bevorzugt in axialer Ausrichtung mit dem ersten Barrierebereich (40) ist.

9. Umlenklechsystem (100) nach Anspruch 8, wobei der zweite durchlässige Trägerbereich in axialer Ausrichtung mit dem ersten Barrierebereich (40) ist.

10. Umlenklechsystem (100) nach Anspruch 8, wobei das dritte Umlenklech weiter einen dritten Barrierebereich definiert.

11. Umlenklechsystem (100) nach Anspruch 10, wobei der erste durchlässige Trägerbereich (30) in axialer Ausrichtung mit dem dritten durchlässigen Trägerbereich ist und/oder wobei der erste Barrierebereich (40) in axialer Ausrichtung mit dem dritten Barrierebereich ist.

12. Umlenklechsystem (100) nach Anspruch 10, wobei der zweite durchlässige Trägerbereich in axialer Ausrichtung mit dem dritten durchlässigen Trägerbereich ist und/oder wobei der zweite durchlässige Trägerbereich in axialer Ausrichtung mit dem dritten Barrierebereich ist.

13. Umlenklechsystem (100) nach Anspruch 10, wobei das zweite Umlenklech weiter einen zweiten Barrierebereich definiert, wobei der zweite Barrierebereich bevorzugt in axialer Ausrichtung mit dem dritten Barrierebereich ist.

14. Umlenkblechsystem (100) nach Anspruch 8, wobei das erste Umlenkblech axial von dem dritten Umlenkblech um einen Umlenkblehabstand (L) verschoben ist, wobei der Umlenkblehabstand (L) bevorzugt 0,9 m (3 Fuß) beträgt.

15. Wärmetauschende Einrichtung, umfassend:

mindestens einen Wärmetauscher; und ein Umlenkblechsystem (100) nach einem der Ansprüche 1-14.

Revendications

1. Système de déflecteurs (100) pour un échangeur de chaleur comprenant :

une pluralité de déflecteurs (10) ; et
une pluralité de tubes (20) reçus et supportés par la pluralité de déflecteurs (10) ;

dans lequel :

la pluralité de déflecteurs (10) sont alignés de manière concentrique ;
au moins l'un de la pluralité de déflecteurs (10) définit une première région barrière (40) ;
et au moins l'un de la pluralité de déflecteurs (10) définit une première région de support perméable (30) à travers au moins une partie d'une section intérieure à l'intérieur du périmètre du déflecteur (10),

caractérisé en ce que

la première région de support perméable (30) comprend des éléments de support (32) qui entrent en contact ou font interface avec une série de tubes (22) et sont configurés pour supporter la série de tubes (22) et les éléments de support (32) comprennent des régions étagées qui sont configurées pour reprendre la forme de la série de tubes (22) que les éléments de support (32) sont configurés pour recevoir et supporter.

2. Système de déflecteurs (100) selon la revendication 1, dans lequel :

la pluralité de déflecteurs (10) comprend un premier déflecteur ; et
le premier déflecteur définit la première région de support perméable (30) et la première région barrière (40).

3. Système de déflecteurs (100) selon la revendication 2, dans lequel :

la pluralité de déflecteurs (10) comprend en outre un deuxième déflecteur ; et

le deuxième déflecteur définit une deuxième région de support perméable.

4. Système de déflecteurs (100) selon la revendication 3, dans lequel la deuxième région de support perméable est en alignement axial avec la première région barrière (40).

5. Système de déflecteurs (100) selon la revendication 3, dans lequel le deuxième déflecteur définit en outre une deuxième région barrière.

6. Système de déflecteurs (100) selon la revendication 5, dans lequel la première région de support perméable (30) est en alignement axial avec la deuxième région de support perméable et/ou dans lequel la première région barrière (40) est en alignement axial avec la deuxième région barrière.

7. Système de déflecteurs (100) selon la revendication 3, dans lequel le premier déflecteur est déplacé axialement par rapport au deuxième déflecteur d'un espacement de déflecteurs (L), dans lequel l'espacement de déflecteurs (L) est de préférence de 0,9 m (3 pieds).

8. Système de déflecteurs (100) selon la revendication 3, dans lequel :

la pluralité de déflecteurs (10) comprend en outre un troisième déflecteur ; et
le troisième déflecteur définit une troisième région de support perméable,
dans lequel la troisième région de support perméable est de préférence en alignement axial avec la première région barrière (40).

9. Système de déflecteurs (100) selon la revendication 8, dans lequel la deuxième région de support perméable est en alignement axial avec la première région barrière (40).

10. Système de déflecteurs (100) selon la revendication 8, dans lequel le troisième déflecteur définit en outre une troisième région barrière.

11. Système de déflecteurs (100) selon la revendication 10, dans lequel la première région de support perméable (30) est en alignement axial avec la troisième région de support perméable et/ou dans lequel la première région barrière (40) est en alignement axial avec la troisième région barrière.

12. Système de déflecteurs (100) selon la revendication 10, dans lequel la deuxième région de support perméable est en alignement axial avec la troisième région de support perméable et/ou dans lequel la deuxième région de support perméable est en ali-

gnement axial avec la troisième région barrière.

13. Système de déflecteurs (100) selon la revendication 10, dans lequel le deuxième déflecteur définit en outre une deuxième région barrière, dans lequel la deuxième région barrière est de préférence en alignement axial avec la troisième région barrière. 5
14. Système de déflecteurs (100) selon la revendication 8, dans lequel le premier déflecteur est déplacé axialement par rapport au troisième déflecteur d'un espacement de déflecteurs (L), dans lequel l'espacement de déflecteurs (L) est de préférence de 0,9 m (3 pieds). 10
15. Appareil d'échange de chaleur comprenant : 15
- au moins un échangeur de chaleur ; et
- un système de déflecteurs (100) selon l'une quelconque des revendications 1 à 14. 20

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FIG. 1

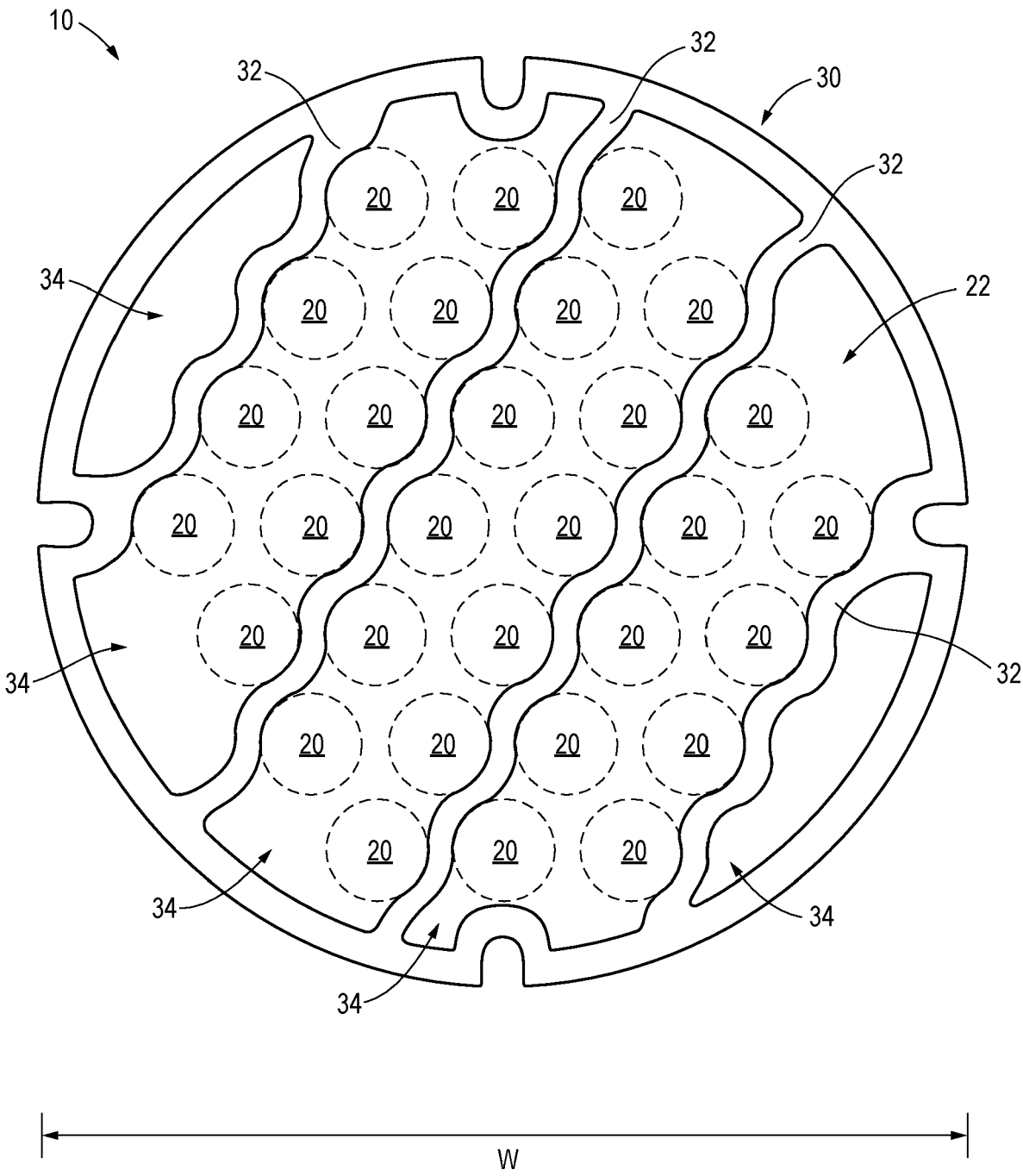


FIG. 2

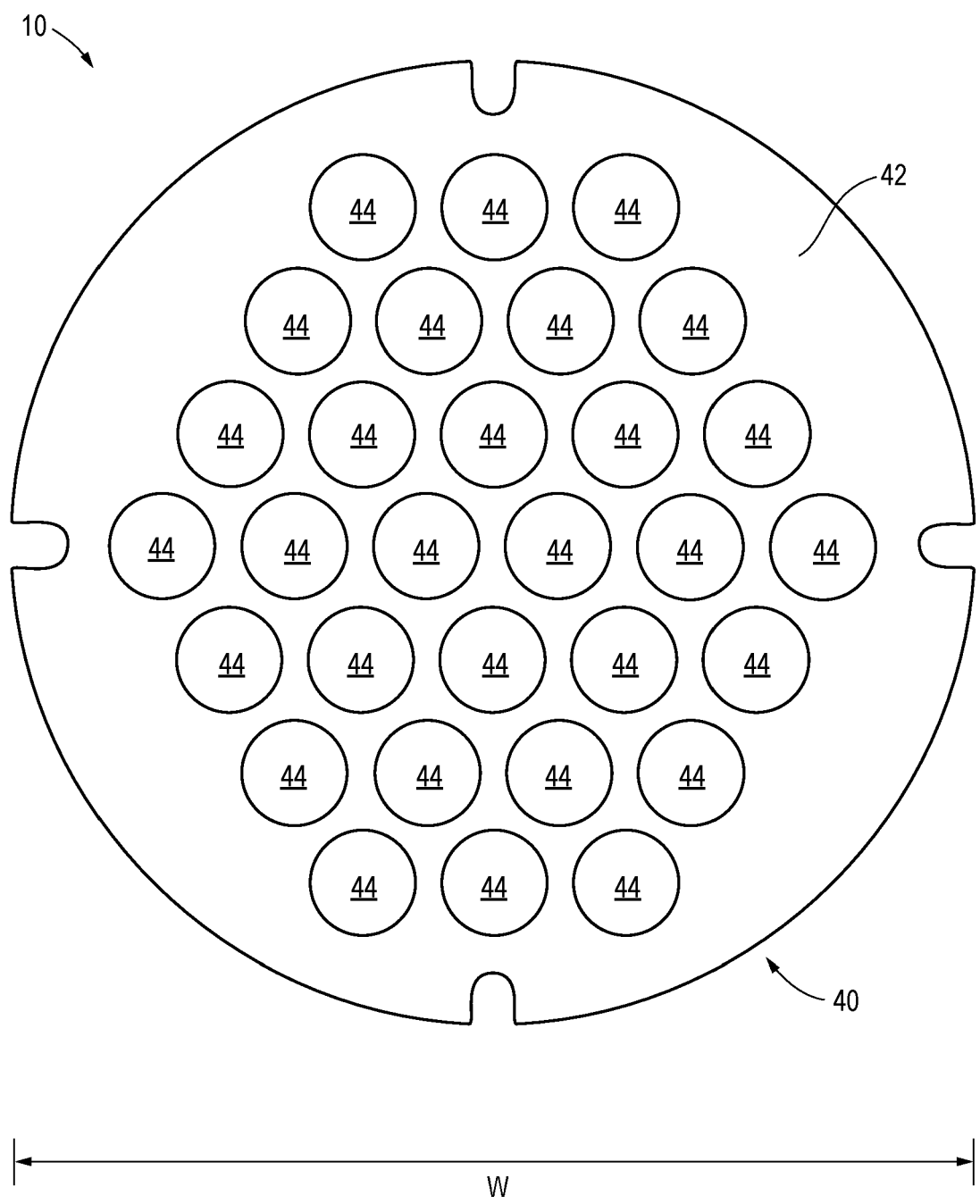


FIG. 3

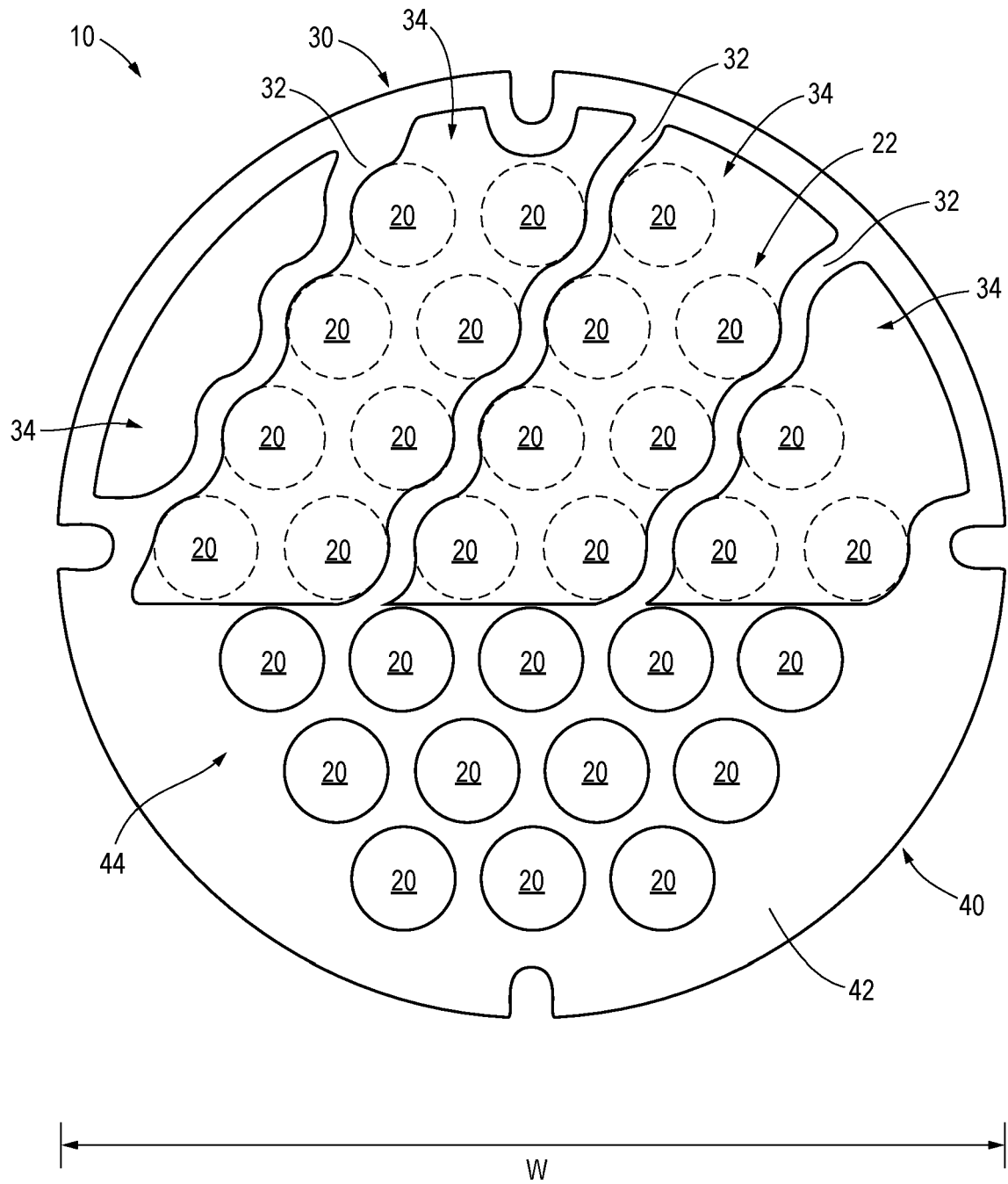


FIG. 4

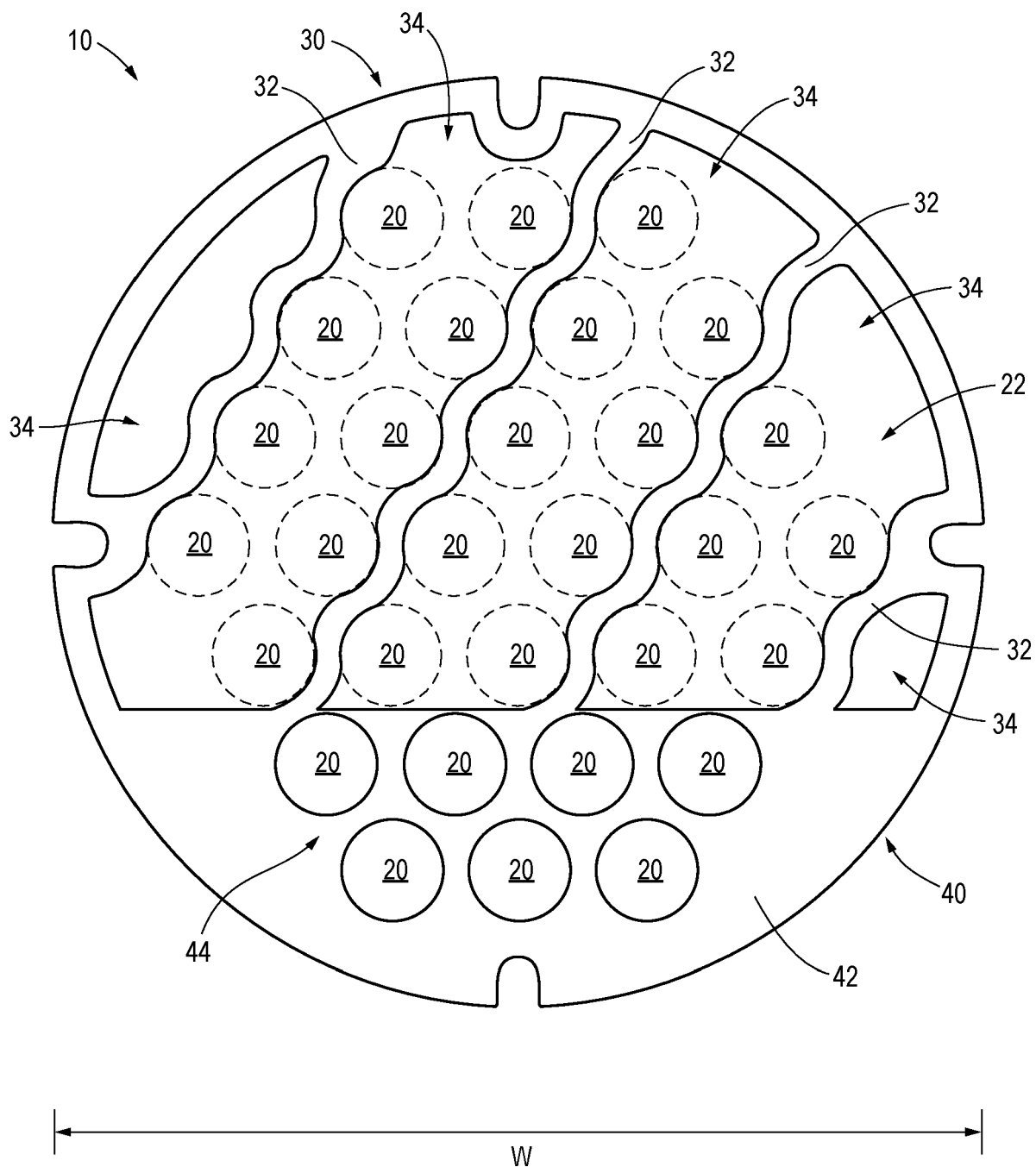


FIG. 5

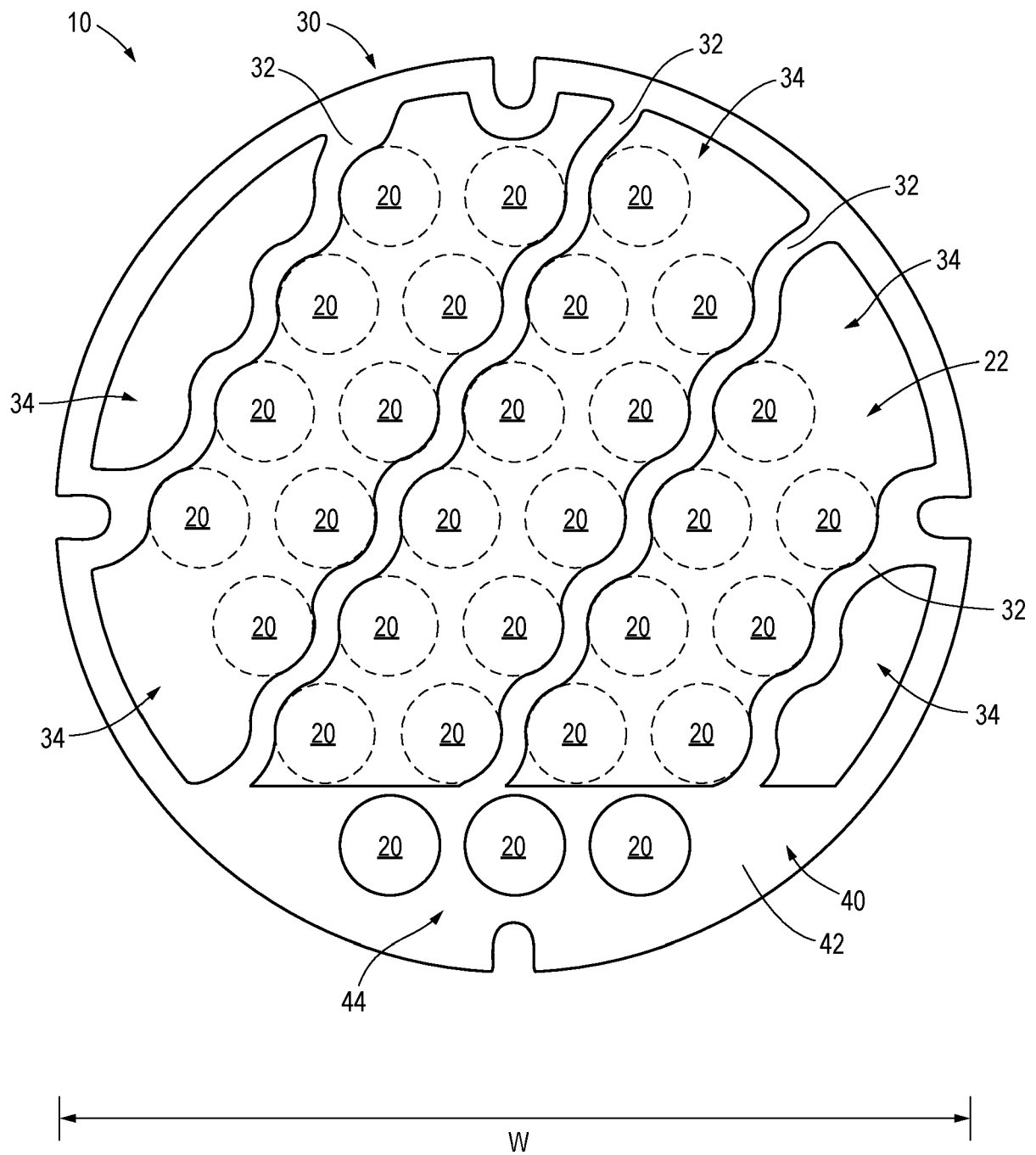


FIG. 6

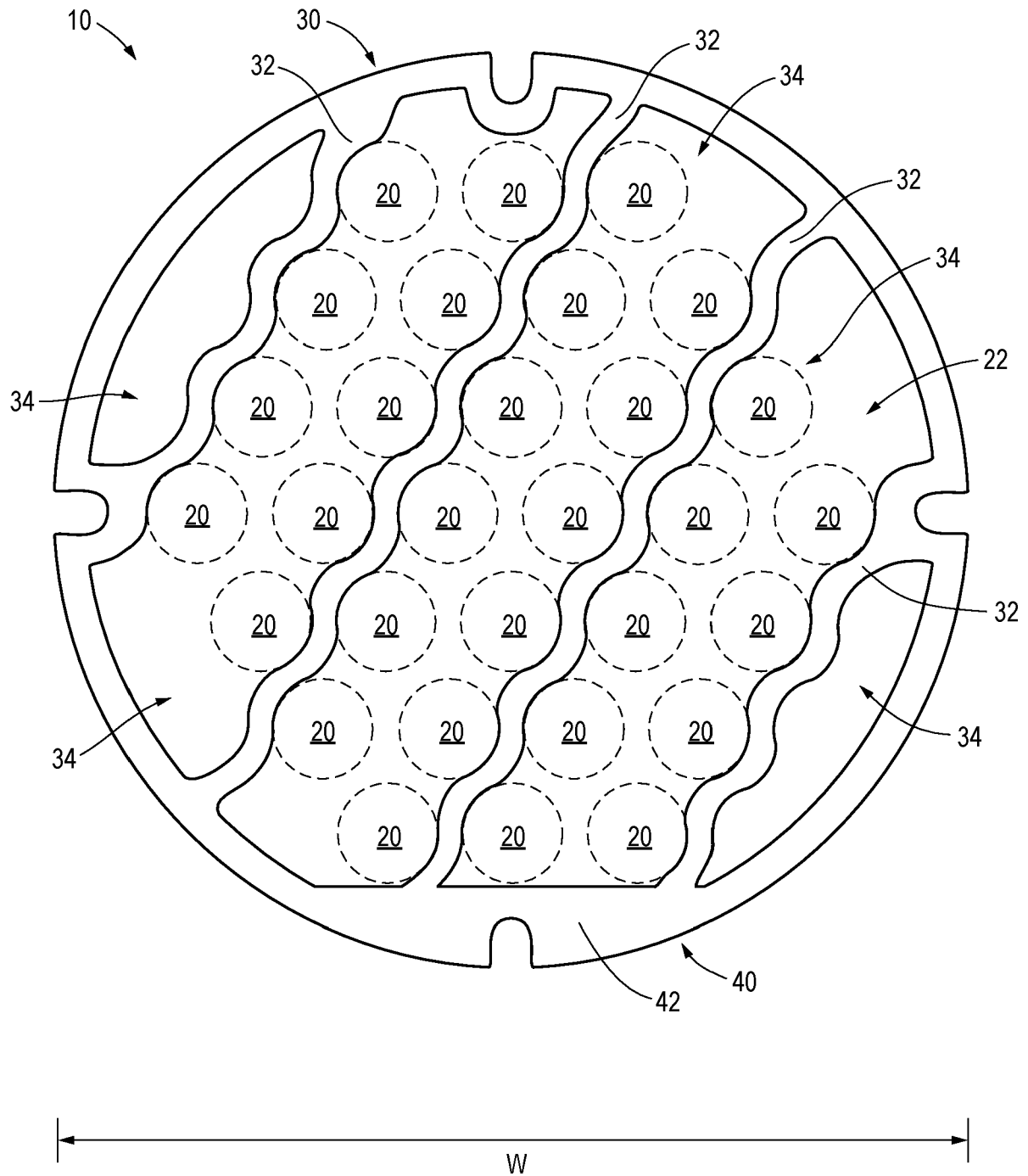


FIG. 7

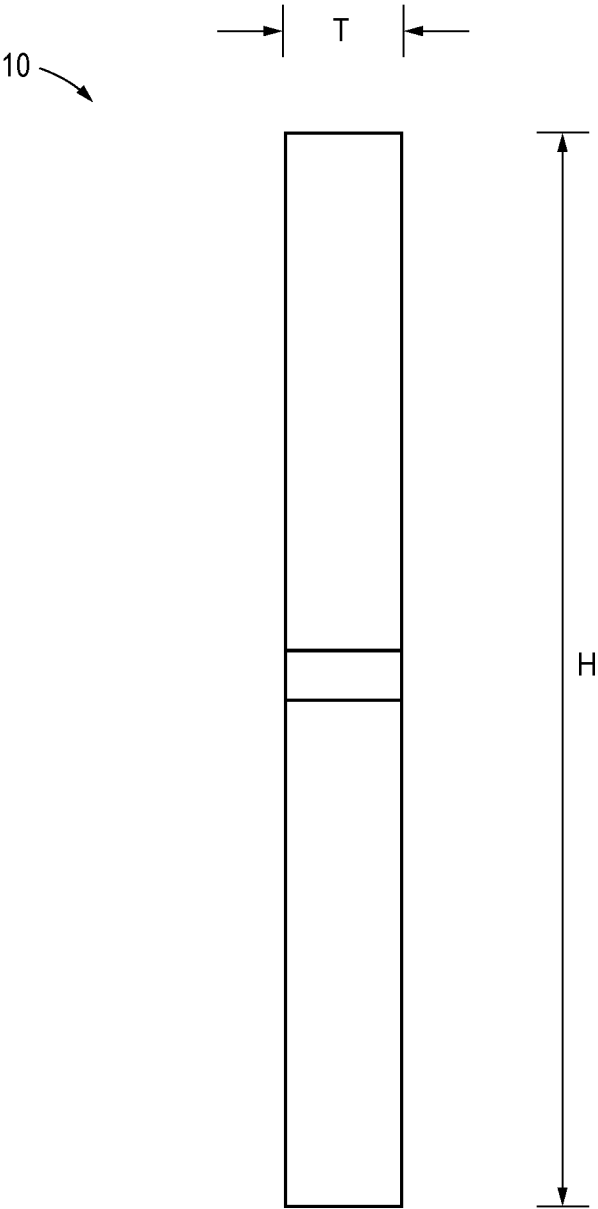


FIG. 8

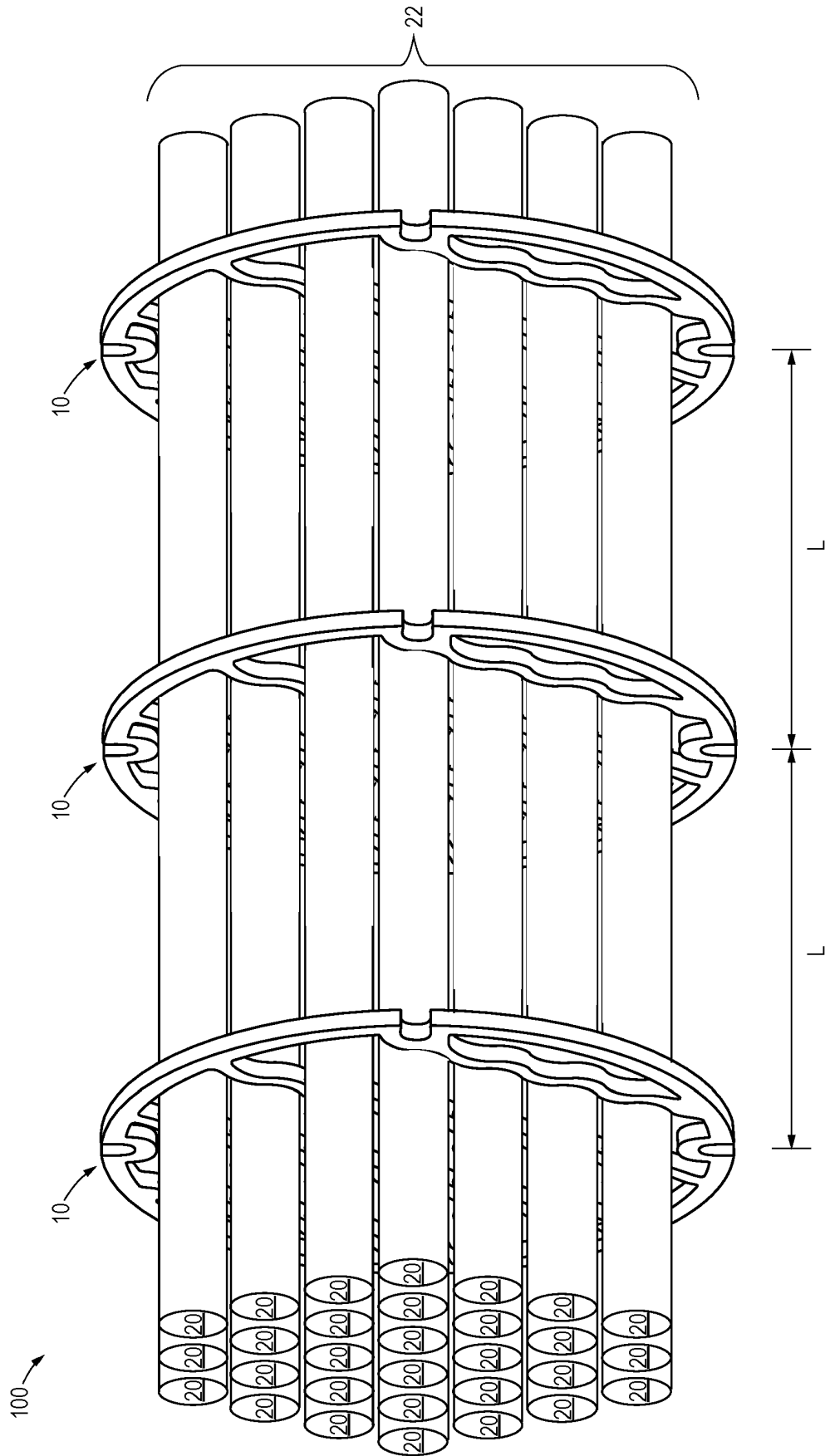


FIG. 9

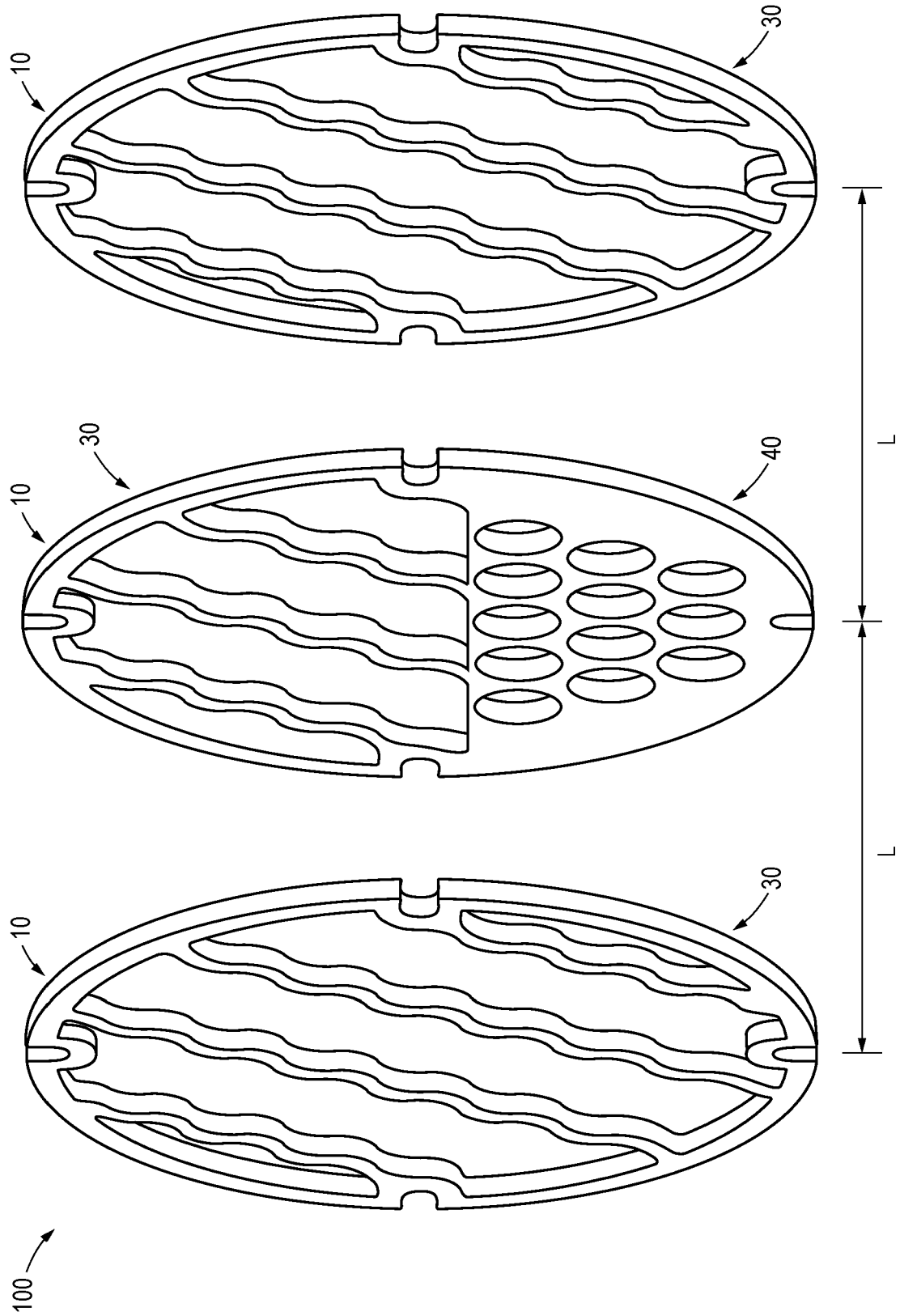


FIG. 10

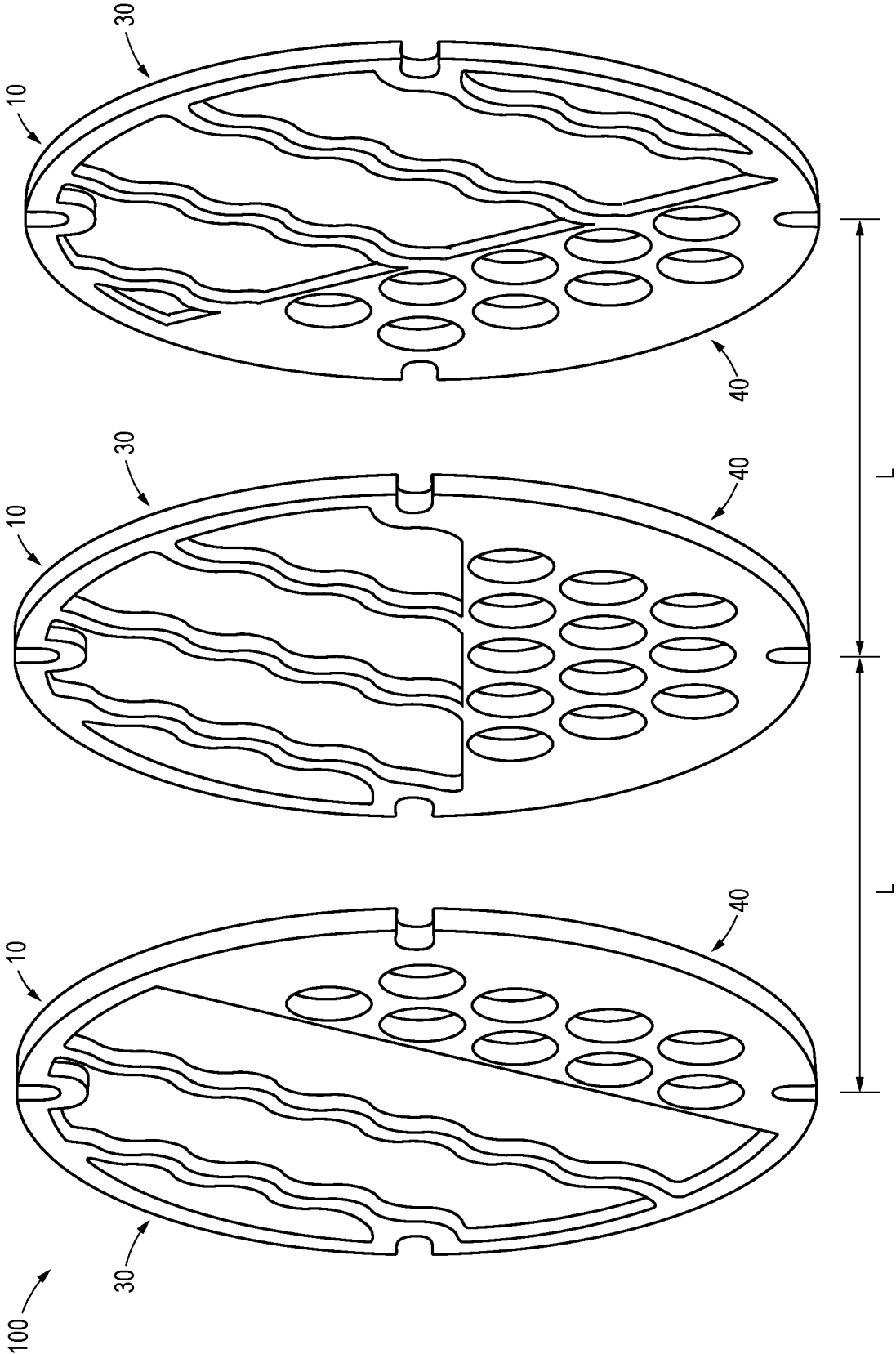


FIG. 11

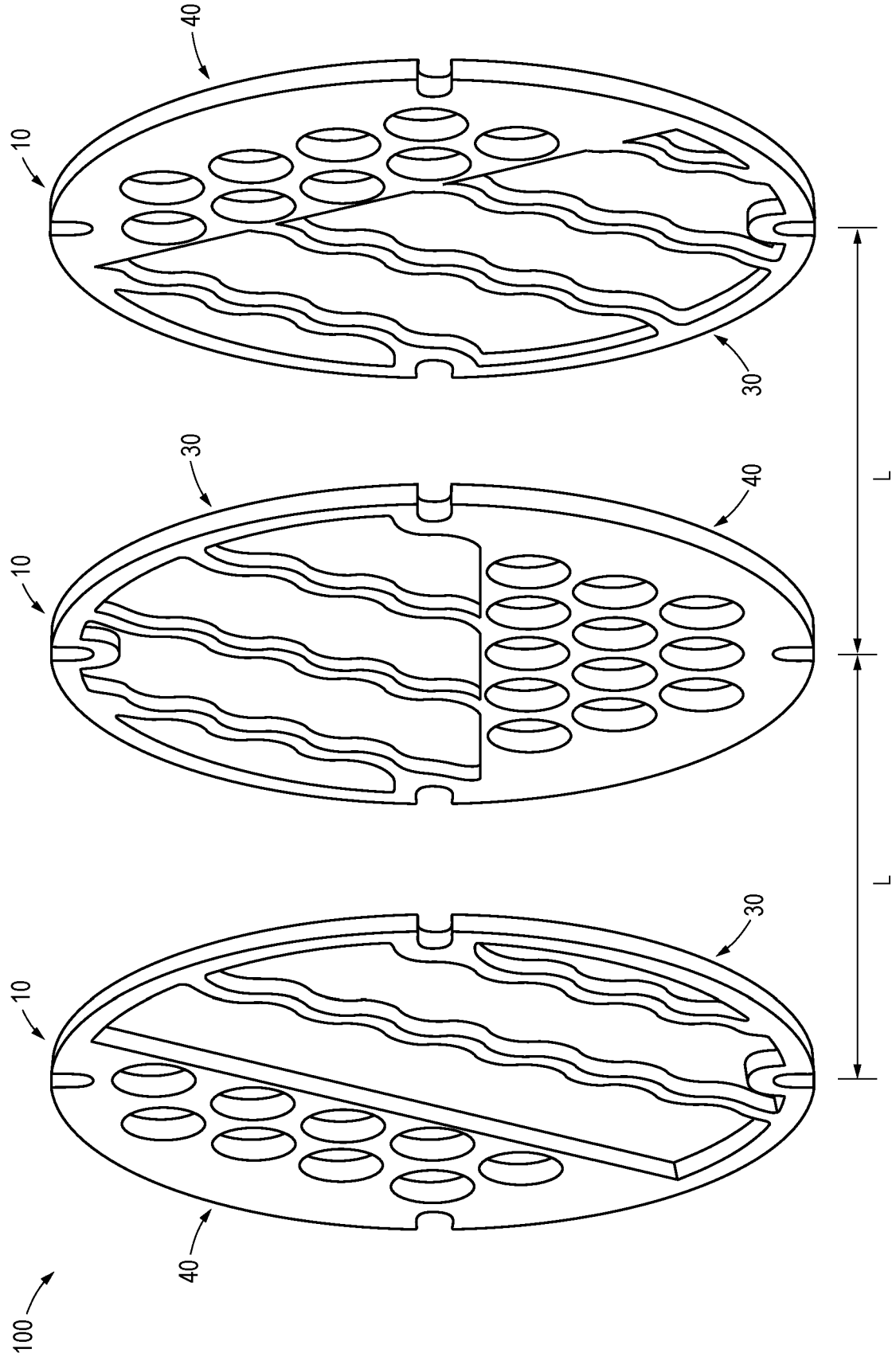


FIG. 12

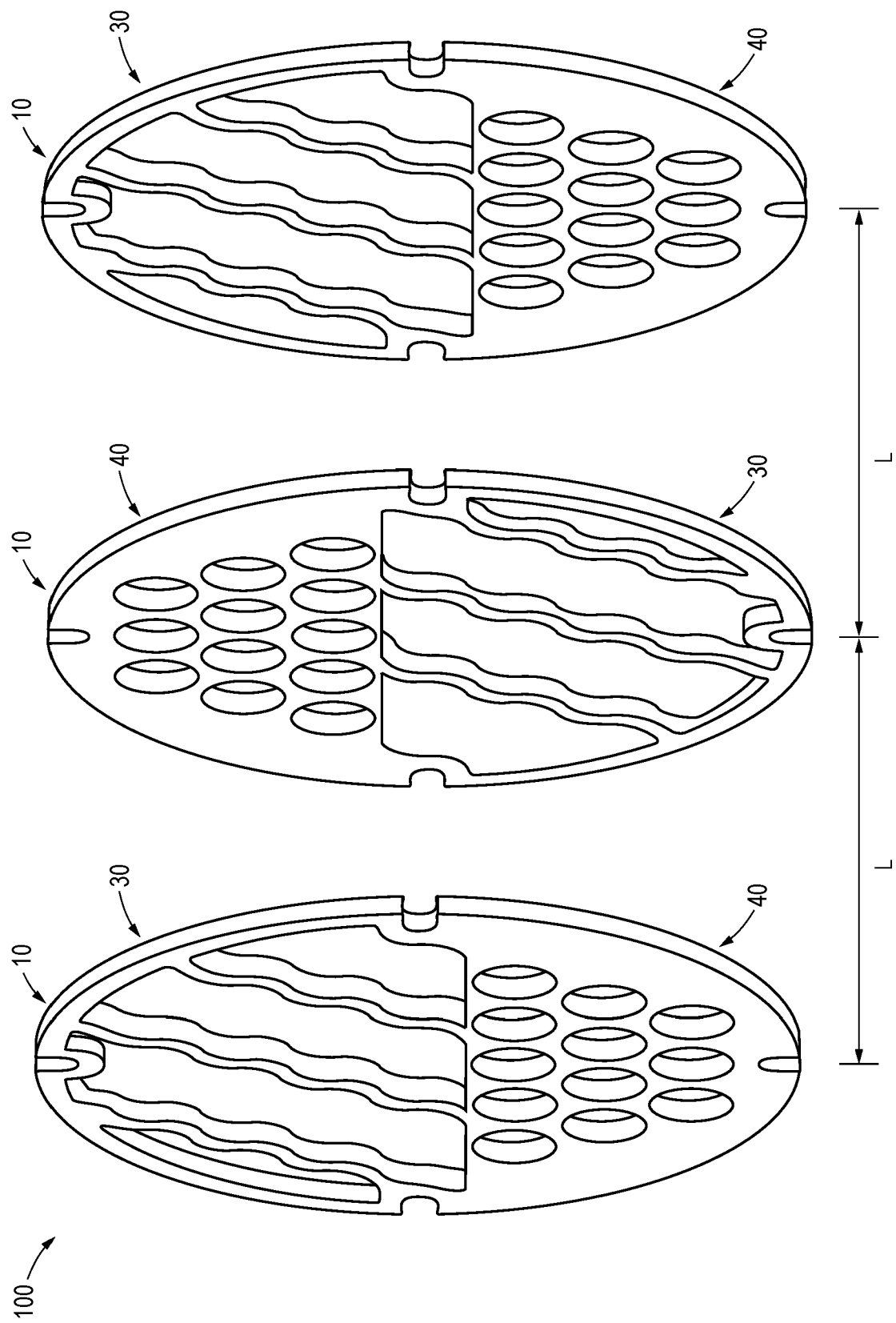


FIG. 13

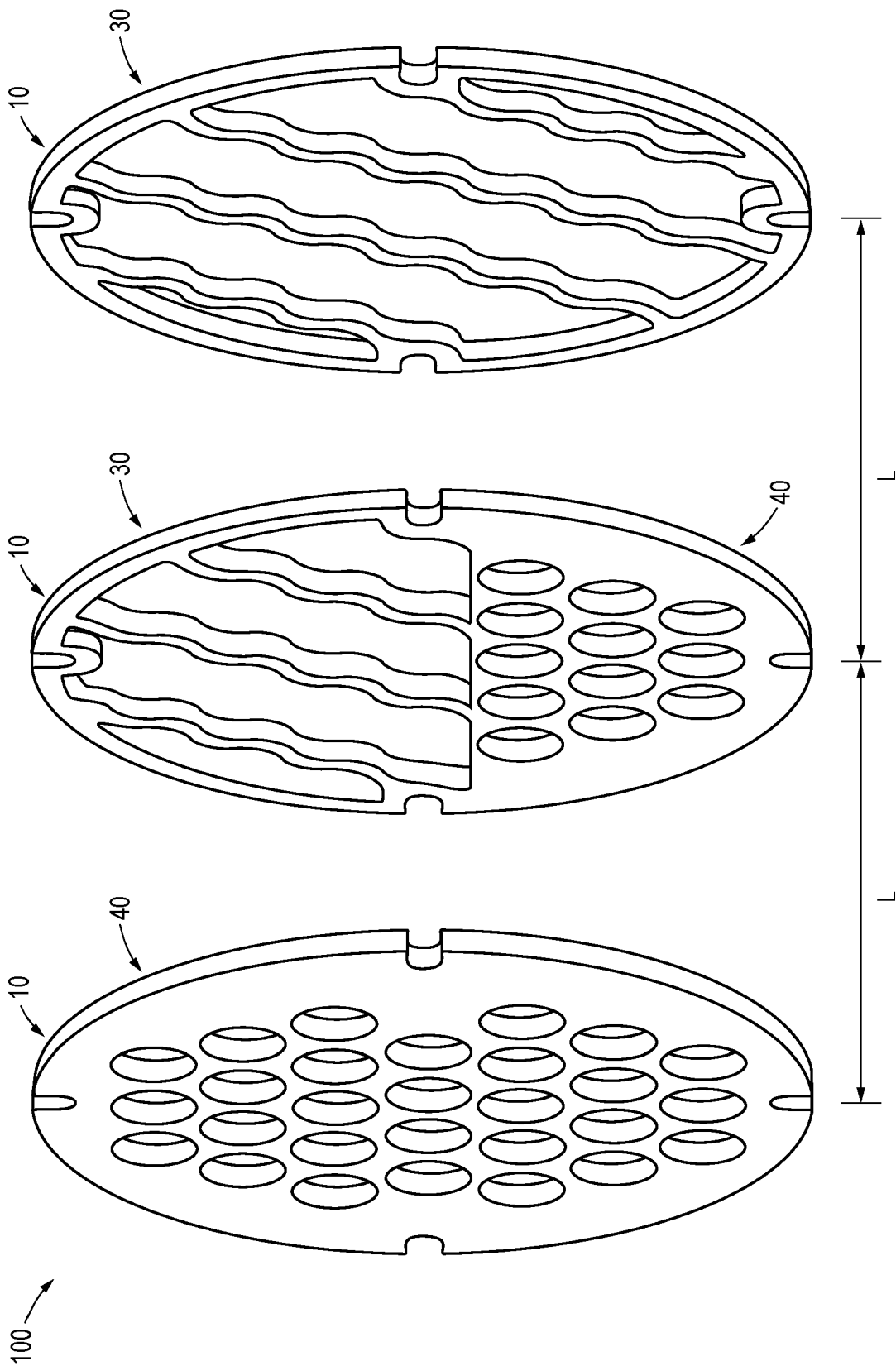
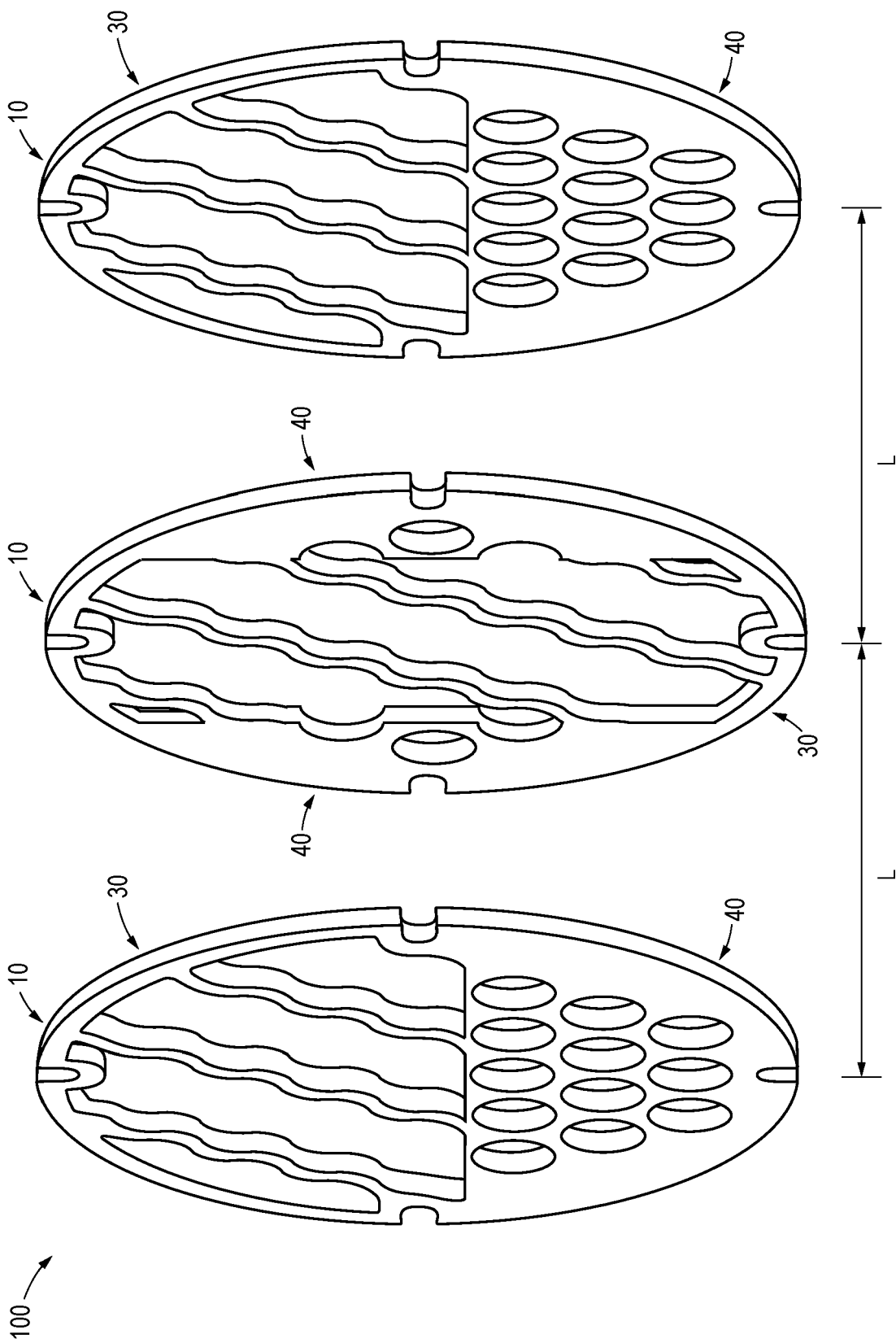


FIG. 14



REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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