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(72) Inventors:
• **Folgueira Baltar, Adrián**
E-27850 Viveiro - Lugo (ES)
• **Grande Fernández, José Antonio**
E-36206 Vigo - Pontevedra (ES)

(71) Applicant: **BORGWARNER EMISSIONS SYSTEMS SPAIN, S.L.U.**
36315 Vigo - Pontevedra (ES)

(74) Representative: **ABG Patentes, S.L.**
Avenida de Burgos, 16D
Edificio Euromor
28036 Madrid (ES)

(54) **Grooved baffle for a heat exchanger**

(57) The present invention relates to a grooved baffle for heat exchangers, primarily heat exchangers intended for cooling hot gas, for example, gas recirculated in an internal combustion engine or EGR (Exhaust Gas Recirculation) gas, by means of a coolant.

In addition to supporting the bundle of heat exchanger tubes, the baffle according to the invention allows modifying coolant flow direction by preventing or significantly limiting the occurrence of recirculation areas or stagnation points in the coolant flow.

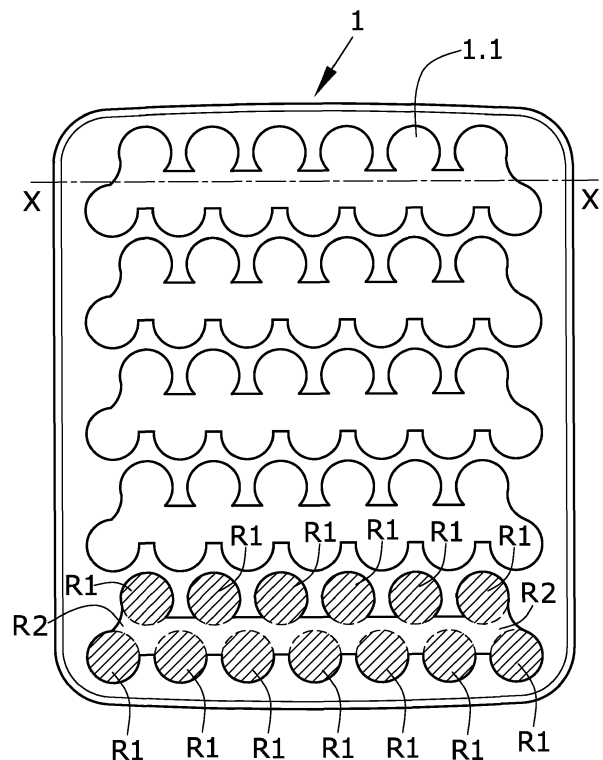


FIG.1

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Description

Object of the Invention

[0001] The present invention relates to a grooved baffle for heat exchangers, primarily heat exchangers intended for cooling hot gas, for example, gas recirculated in an internal combustion engine or EGR (Exhaust Gas Recirculation) gas, by means of a coolant.

[0002] In addition to supporting the bundle of heat exchanger tubes, the baffle according to the invention allows modifying coolant flow direction by preventing or significantly limiting the occurrence of recirculation areas or stagnation points in the coolant flow.

Background of the Invention

[0003] Heat exchangers comprise bundles of tubes housed in a shell. Heat exchangers intended for cooling hot gas, for example, gas recirculated in an internal combustion engine or EGR gas, by means of a coolant are of special interest. In these heat exchangers the coolant circulates between the shell and the bundle of tubes and allows reducing the temperature of a second fluid, i.e., the hot gas, circulating through the inside of the tubes forming said bundle of tubes.

[0004] The coolant circulates through the inside of the shell from a specific inlet to a specific outlet, where the inlet and outlet position determines the path to be followed by the coolant. To increase the degree of heat transfer between the coolant and the outer surface of the bundle of tubes, it is common to cause changes in direction in the trajectory of said coolant so that it tends to hit the tubes perpendicularly, for example, causing zigzag trajectories within the shell.

[0005] Changes in coolant flow direction are achieved by interposing baffles along the path of said coolant, distributed along the inside of the shell of the heat exchanger, closing the passage in part of the section of the shell such that they allow passage through certain windows arranged in alternating locations.

[0006] These baffles are panels or deflectors which are integrally assembled inside the shell of the heat exchanger and allow directing the coolant flow circulating around the tubes of the bundle of tubes.

[0007] The coolant flow is redirected by the baffles acting as obstacles in the trajectory of the coolant flow along its path through the inside of the shell of the heat exchanger, forcing the flow to follow the trajectory through places that are free of obstacles.

[0008] The plate-shaped baffles used in the state of the art in heat exchangers are positioned with an orientation essentially transverse to the bundle of tubes and cover only a partial area of the cross-section of the space left between the shell and the bundle of tubes. The baffle therefore occupies part of the space through which the coolant would flow if there was no baffle, leaving only part of the section of said trajectory free.

[0009] The free areas of the trajectory of the coolant flow allowing the baffles to be located in an alternating manner along the length of the heat exchanger, such that in the segment comprised between two baffles the flow is forced to perform a change in direction causing zigzag trajectories, or such that they have at least changes in direction having speed components transverse to the bundle of tubes. Additionally, the cross-section of the flow is reduced with the baffles, so fluid speed as well as pressure drop increase.

[0010] Baffles have a second structural function since they serve as a support for said tubes of the bundle of tubes of the exchanger. Said baffles maintain the position of the tubes supporting both the weight of these tubes and the strains caused by external excitations such as vibrations or accelerations.

[0011] The existence of free areas for allowing passage of the coolant flow is achieved in the state of the art by means of baffles formed by plates with perforations for the passage of a certain number of tubes but not all of them, since they have a smaller area due to the existence of free areas and correspond to a section that does not cover all the tubes of the bundle of tubes. The tubes going through the perforations are held by the baffle, but the tubes left free by the baffle must be supported by other baffles. In the event there is one baffle, the baffles arranged adjacent thereto are usually those that at least hold the tubes it left free and possibly a few more. Requirements for supporting the bundle of tubes require using a plurality of baffles, alternating the tubes that are left free and tubes that are held to assure that there are means for all the tubes intended for withstanding the strains imposed by the actual weight and vibrations.

[0012] With respect to vibrations, not only do baffles absorb forces imposed by inertia effects caused by said vibrations, but they also define vibration nodes in the tubes. These nodes establish distances that are less than the total length of the tube, so they increase the fundamental frequency thereof. It is therefore possible to reduce vibration amplitudes of the tubes by suitably selecting the distances. Since some tubes are not supported by the baffle, enough baffles must be included so that the vibration modes do not give rise to deformations in said vibration modes with excessive amplitudes in each tube.

[0013] This design gives rise to the fact that for each segment between the baffles of the heat exchanger, said baffles only support a certain number of tubes. Therefore, not all the tubes have the same vibration mode, nor are they all held by the same baffle. Additionally, increase in flow speed caused by the free area of the section of the shell which is not covered by the baffle is not homogeneous throughout the heat exchanger. In addition, stagnation zones and recirculation zones generating regions for the coolant which are susceptible to reaching the boiling temperature are produced after the baffle, causing thermal fatigue and structural damage in components of the heat exchanger.

Description of the Invention

[0014] The present invention proposes a solution to the problems identified above based on using a grooved baffle.

[0015] A first inventive aspect provides a baffle formed by a main plate in which there are one or more openings for the passage of heat exchanger tubes wherein at least one of said openings, according to the projection on the plane defined by the main plate, comprises:

- a plurality of first regions adapted for the passage of heat exchanger tubes where each of the first regions has a configuration allowing passage of one of the tubes, the edge of the opening coinciding with the first region is an attachment segment adapted for being attached by welding to the tube going through the first region,
- a second region in contact with all the first regions adapted for the passage of fluid.

[0016] According to this first inventive aspect, the baffle comprises one or more openings for the passage of tubes of the bundle of heat exchanger tubes. At least two tubes go through each opening. According to the preferred example, the main plate on which the baffle is configured extends in a main plane. The zone where the plate has material and the zone free of material are distinguished in this plane. Zones free of material include, among others, free areas allowing passage of the coolant.

[0017] Considering a specific opening, the area free of material giving rise to this opening shows two types of regions, those identified as first regions and the one identified as a second region. The first regions give rise to the passage of tubes of the bundle of tubes. Therefore, when sectioning the bundle of tubes going through the baffle when it is operatively installed in the heat exchanger by means of the main plane defined by said baffle, the section of the tube and the inside thereof occupy the so-called first region, and the region of the opening which is not occupied by the tubes and allows passage of the coolant is the second region.

[0018] When the baffle is configured in this manner and operatively arranged in the heat exchanger, each opening of the baffle always has one edge in contact with each tube going through said opening and a region allowing passage of the coolant.

[0019] When the baffle is formed by a planar plate, the plane defined by said planar plate is the reference plane. The projection of the openings on the reference plane coincides with the openings themselves. Nevertheless, there are embodiments in which the plate is not necessarily planar; it can be formed, for example, by corrugations, equidistantly distributed bulges, or other protuberances. The same occurs when in a part of the plate there are bends giving rise to parts that can be separated from the main plane. In any of these cases, the plate continues

to show a main plane and the configuration of the openings in accordance with the requirements for the first region and second region is defined in this main plane in projection.

[0020] When the baffle is operatively incorporated in a heat exchanger formed by the shell and a bundle of tubes, the openings of the baffle allow simultaneous passage of tubes of the bundle of tubes and the coolant, preventing the fluid from having to surround the baffle.

[0021] Advantageously, this allows each of the tubes of the bundle of tubes to be in contact with the baffle, such that it is supported by said baffle through the free edge which is in contact with the tube and attached by means of welding. In other words, passage of the coolant is possible and each baffle furthermore serves as a support for supporting all the tubes of the bundle of tubes.

[0022] As an additional advantage, the openings allow flow speed to increase homogeneously through the entire section of the shell of the heat exchanger without having to impose zigzag trajectories on the coolant. Nevertheless, this very baffle can incorporate additional windows which indeed impose this zigzag trajectory, although the additional openings prevent there being stagnation zones or recirculation zones after the baffle. In other words, the openings prevent the formation of stagnation zones or recirculation zones in the rear part of the baffles given that fluid goes through said baffle.

[0023] In a particular embodiment, the baffle occupies the entire cross-section of the heat exchanger, thus allowing passage of fluid only through the openings of said baffle.

[0024] Advantageously, this allows a more homogeneous increase in speed in the field of coolant speeds, given that passage of the entire flow is concentrated in the existing openings surrounding the tubes of the bundle of tubes. The increase in speed occurs in said openings, generating jets that expand suddenly, clearing possible stagnation zones.

[0025] In a particular embodiment, the baffle does not occupy the entire cross-section of the heat exchanger, but the grooving on said baffle does occupy the entire bundle of tubes. According to this configuration, in addition to preventing recirculation zones, it is possible to modify the average trajectory of the cooling flow without said flow concentrating entirely through the openings, there also being coolant flow through the windows other than said openings. This configuration reduces head losses in the coolant.

[0026] In a particular embodiment, the openings of the baffle are adapted for surrounding the tube in a contour that is somewhat greater than half the perimeter of said tube.

[0027] Advantageously, this allows suitably holding the tube in addition to a simple assembly of baffles in the tubes. Additionally, it allows a space to be arranged between the tubes through which coolant circulates. This configuration is particularly interesting when building the heat exchanger when the baffle and tubes are attached

by means of brazing. Before the welding paste goes through the furnace and gives rise to final fixing, the baffle must retain the tubes in their final position. The fact that the contour of the edge of the opening which is in contact with the tube is greater than half the perimeter of said tube allows this temporary holding before going through the furnace for brazing.

[0028] In a particular example, the first regions of one and the same opening are distributed according to a regular pattern along a specific directrix axis X-X'.

[0029] Advantageously, this allows a homogeneous distribution of the tubes of the bundle of tubes in the heat exchanger, which allows homogeneous coolant flow through the baffles and therefore through said heat exchanger.

[0030] In a particular example, the regular pattern distributes the first regions on both sides of a specific directrix axis X-X' and the second region extends along said directrix axis X-X'.

[0031] Advantageously, the tubes of the bundle of tubes are thus distributed on both sides of directrix axis X-X', a space through which the coolant can circulate being arranged between said tubes such that all the tubes of the bundle of tubes supported by the first regions are surrounded by the coolant. Likewise, die cutting this baffle allows using a single punch for this single shared opening housing a set of tubes.

[0032] In a particular example, the distribution of the first regions on both sides of directrix axis X-X' is in an alternating manner.

[0033] Advantageously, this distribution allows the tubes of the bundle of tubes housed in the first regions to be effectively supported by said first regions and the tubes to be distributed in a compact manner.

[0034] Additionally, the second region is larger according to this arrangement of the first regions, so the coolant flow is distributed more homogeneously around the tubes of the bundle of tubes and gives rise to less head loss.

[0035] In a particular example, the regular pattern is an alignment of the first regions and comprises a plurality of second regions, each second region connecting two consecutively arranged first regions.

[0036] Advantageously, connection of first regions based on a plurality of second regions allows the tubes to be held more strongly, allowing them to be aligned with one another.

[0037] Additionally, the at least one opening allows the presence of second regions between rows of adjacent tubes, such that stagnation zones are prevented and all the tubes of the bundle of tubes are in contact with the baffle maintaining good structural support.

[0038] In a particular example, the first regions of one and the same opening are distributed according to a regular pattern and said regular pattern is a set of circularly distributed first regions and the second region arranged at the center of the set of first regions and in contact with all of them.

[0039] Advantageously, contact of the second region

with all the first regions allows better coolant flow around the tubes of the bundle of tubes, whereas circular distribution of the first regions provides better seating for supporting the tubes, in addition to allowing positioning the second region at the center of said first regions.

[0040] In a particular example, the edge of the opening is a free edge. Said free edge is in contact with the tubes going through the baffle, such that it can be welded to said tubes. The free edge is obtained after die cutting the opening on the main plate of the baffle.

[0041] In a particular example, the edge of the opening comprises a flange or neck. Said flange is distributed on the contour of the opening, such that it demarcates either the first regions or the first regions and second regions.

[0042] In a particular example, the flange or neck obtained by deep drawing on the main plate of the baffle is perpendicular to said main plate. This allows better fit of the neck around the tubes going through the baffle, such that the coolant does not run into obstacles in its trajectory through the heat exchanger.

[0043] In a particular example, the flange or neck is preferably obtained by stamping on the main plate of the baffle. Advantageously, stamping allows obtaining a neck in the form of a protuberance projecting from said main plate.

[0044] A second inventive aspect provides a *heat exchanger comprising one or more baffles according to the first inventive aspect*. Specifically, said heat exchanger comprises a bundle of tubes for the passage of a fluid to be cooled housed inside a shell adapted for the passage of a coolant, where said shell comprises one or more baffles according to the first inventive aspect for holding a plurality of tubes of the bundle of tubes.

[0045] Advantageously, a heat exchanger with at least one baffle according to the first inventive aspect provides better support for the tubes of the bundle of tubes against vibrations, in addition to better cooling of said tubes, because the openings of the baffles allow speeding up coolant flow and distributing it homogeneously around each of the tubes.

[0046] In the particular case in which the heat exchanger comprises a single baffle, an option is for said baffle to be located at the mid-point of the length of the tubes of the bundle of tubes to thus obtain suitable support for said tubes, protecting them from vibrations experienced by the exchanger. In this middle position the length between vibration nodes is reduced to half on both sides of the baffle. Another option is to place the only baffle at one of the ends of the tubes of the bundle of tubes, such that stagnation zones are prevented.

[0047] In a particular case, as the number of baffles increases along the length of the tubes of the bundle of tubes, the occurrence of stagnation zones inside the heat exchanger decreases since these baffles act as diffusers clearing the stagnation zones that can occur due to the position of the coolant inlet and outlet in the shell.

[0048] Additionally, the second region present in the at least one opening of the baffle provides high speed

coolant jets between the tubes of the bundle of tubes, thus eliminating fluid recirculation zones, for example, those occurring between said tubes if the exchanger comprises baffles such as those of the state of the art.

[0049] Advantageously, the number of baffles required for proper cooling of the tubes of the bundle of tubes is less if the exchanger incorporates the baffles of the present invention than if it incorporates baffles existing in the state of the art. This is because each baffle supports each of the tubes of the bundle of tubes while at the same time increases the coefficient of convection in the entire section of the bundle of tubes.

[0050] In a particular example, the tubes of the bundle of tubes are at least welded to a baffle mounted in the heat exchanger.

[0051] Advantageously, this allows better structural support of said tubes.

[0052] In a particular embodiment, a heat exchanger according to the second inventive aspect has the projection of the main plate of one or more baffles where said projection at least partially occupies the passage section of the shell, leaving a free area between the baffle and the shell for the passage of a coolant.

[0053] The space not occupied by the baffle in the passage section of the shell allows the coolant to go through the heat exchanger without going through the openings of the baffle, such that head losses in the coolant are reduced and complete cooling of the tubes of the bundle of tubes is obtained.

[0054] In a particular embodiment, a heat exchanger according to the second inventive aspect has the projection of the main plate of one or more baffles, where said projection does not have a free area between the baffle and the shell for the passage of a coolant.

[0055] The passage of coolant only occurs through the at least one opening of the baffle, such that the trajectory of said coolant flow is concentrated between the passage regions between the tubes of the bundle of heat exchanger tubes.

Description of the Drawings

[0056] The foregoing and other advantages and features of the invention will be more clearly shown based on the following detailed description of a preferred embodiment given only by way of illustrative and non-limiting example in reference to the attached drawings.

Figure 1 shows an elevational view according to a first embodiment of a baffle according to the invention.

Figure 2 shows a detail of an elevational view according to the example of the preceding figure.

Figure 3 shows an elevational view according to a second embodiment of a baffle according to the invention.

Figure 4 shows an elevational view according to a third embodiment of a baffle according to the inven-

tion.

Figure 5 shows an elevational view according to a fourth embodiment of a baffle according to the invention.

Figure 6 shows an elevational view according to a fifth embodiment of a baffle according to the invention.

Figure 7 shows an elevational view according to a sixth embodiment of a baffle according to the invention.

Figure 8 shows an elevational view according to a seventh embodiment of a baffle according to the invention.

Figure 9 shows an elevational view according to an eighth embodiment of a baffle according to the invention.

Figure 10 shows an elevational view according to a ninth embodiment of a baffle according to the invention.

Figure 11 shows an elevational view according to a tenth embodiment of a baffle according to the invention.

Figure 12 shows a perspective view according to an eleventh embodiment of a baffle according to the invention, following a pattern of openings such as that of Figure 3.

Figure 13 shows a sectioned perspective view of a heat exchanger with a plurality of baffles according to a twelfth embodiment of baffles according to the invention, following a pattern of openings such as that of Figure 3.

Detailed Description of the Invention

[0057] According to the first inventive aspect, the present invention relates to a device adapted for providing suitable support for the tubes of the bundle of tubes present in a heat exchanger, in addition to a homogeneous distribution of coolant flow around said tubes.

[0058] Figure 1 shows a particular example of a grooved baffle (1) according to the first inventive aspect, comprising openings (1.1). The baffle (1) according to this embodiment is configured by means of a planar plate contained in a main plane. In this embodiment, the openings (1.1) have been obtained by means of die cutting and correspond to areas free of material. These areas free of material are in turn comprised by two regions (R1, R2), the so-called first regions (R1) and second regions (R2). Figure 2 shows an enlarged portion of the baffle shown in Figure 1 which distinguishes first regions (R1) and first regions (R2).

[0059] Said regions (R1, R2) are identified in the drawings in only one of the openings (1.1) of the baffle (1) for the sake of clarity, although said regions are identical in the different openings (1.1) in each of the drawings shown.

[0060] In the first embodiment, each of said openings (1.1) has a directrix axis X-X' subdividing said opening

(1.1) such that the first regions (R1) are distributed on the sides of said directrix axis X-X' in an alternating manner.

[0061] The second region (R2) allows attaching the entire set of first regions (R1) on the projection of the plate forming the grooved baffle (1) in a single opening (1.1).

[0062] Figure 2 shows the distribution of the openings (1.1) of the preceding example in detail.

[0063] In this case, circular-shaped attachment segments (1.1.1) that allow not only housing the tubes of the bundle of heat exchanger tubes but also welding said tubes to the grooved baffle (1), are distinguished on each opening (1.1).

[0064] In this drawing, the edge defining the opening (1.1) shown at the upper end is a free edge, and the drawing further distinguishes the so-called attachment segments (1.1.1), i.e., those segments of the free edge intended for being in contact with the tube and giving rise to attachment by welding, and a continuous line (1.1.2) for the rest of the free edge which is not in contact with the tube.

[0065] Figure 3 shows another embodiment of the grooved baffle (1). In this case, the openings (1.1) do not extend the entire width of the baffle but rather passage for two rows of tubes is obtained by means of two openings (1.1) that are not connected to one another. Each of these openings (1.1) in turn comprises regions (R1, R2) of the preceding example and both openings share a directrix axis X-X'. Therefore, the gap between the openings (1.1) gives rise to a stiffening element allowing better handling of the baffle (1) during assembly, making it stronger.

[0066] Figure 4 shows another embodiment of the grooved baffle (1). In this case, the openings (1.1) are distributed according to a regular pattern on the main plate of the baffle (1), in a symmetrical manner according to the two main directions of said main plate, one of them being parallel to a directrix axis X-X' and the other one being transverse to said directrix axis X-X'. In other words, each of the openings (1.1) has a directrix axis X-X' which is in turn an axis of symmetry of said opening (1.1). In this particular case, the plate of the baffle (1) has two main directions, the horizontal and the vertical, given its rectangular configuration. Nevertheless, both this pattern and the one shown in the all the described embodiments can be reproduced inside a baffle (1) formed by a plate with any perimetral configuration.

[0067] Additionally, said openings (1.1) comprise regions (R1, R2), the first regions (R1) being distributed according to a regular pattern around the second region (R2) that connects the plurality of first regions (R1), said second region (R2) being at the center of the plurality of first regions (R1).

[0068] Figure 5 shows another embodiment of the grooved baffle (1). In this case, the openings (1.1) are distributed according to a regular pattern on the main plate of the baffle (1), directrix axes X-X' of said openings (1.1) forming a specific angle with respect to one of the

main directions of the main plate forming the baffle (1).

[0069] Directrix axes X-X' of each of the openings (1.1) are parallel to one another.

[0070] In this case, each of the openings (1.1) comprises regions (R1, R2) where the first regions (R1) are distributed in an alternating manner on both sides of directrix axis X-X', whereas the second regions (R2) connect the plurality of first regions (R1) along directrix axis X-X'.

[0071] Since the openings (1.1) are oblique to the main directions of the main plate of the baffle (1), they have variable lengths depending on their position on said plate, the opening (1.1) located at the center having the longest length and the length decreases as each opening (1.1) is positioned further away from the center of the plate.

[0072] Figure 6 shows another embodiment of the grooved baffle (1), comprising the same distribution of the configuration of the opening (1.1) as in the embodiment shown in Figure 5, but in this case, the plurality of first regions (R1) arranged in an alternating manner on both sides of directrix axis X-X' of each opening (1.1) are shown more spaced apart according to the direction of said directrix axis X-X'.

[0073] Figure 7 shows another embodiment of the grooved baffle (1). In this case, the openings (1.1) are distributed according to one of the main directions of the main plate of the baffle (1), said direction coinciding with the direction of directrix axis X-X' of each opening (1.1).

[0074] In this case, the first regions (R1) are aligned along directrix axis X-X', each consecutive pair of first regions (R1) being joined together by a second region (R2).

[0075] Figures 8 and 9 show other embodiments of the grooved baffle (1). In these cases, the openings (1.1) are distributed on the main plate of the baffle (1), said openings (1.1) forming a specific angle with respect to one of the main directions of the main plate forming the baffle (1).

[0076] Directrix axes X-X' of each of the openings (1.1) are parallel to one another.

[0077] In both cases, the first regions (R1) are arranged along directrix axis X-X', each consecutive pair of first regions (R1) being joined together by a second region (R2). Figure 9 shows second regions (R2) that are wider than those shown in Figure 8, giving rise to larger passages for the coolant.

[0078] Since the openings (1.1) are oblique to the main directions of the main plate of the baffle (1), they have variable lengths depending on their position on said plate, the opening (1.1) the center of which is positioned closest to the center of the main plate of the baffle (1) having the longest length and the length decreases as each opening (1.1) is positioned further away from the center of the plate.

[0079] In the case of Figure 8, the plurality of first regions (R1) is arranged in an alternating manner in adjacent openings (1.1) according to the direction established by directrix axis X-X' to give rise to a higher degree of

compactness, such that according to the transverse direction the space occupied by each first region (R1) does not coincide with that occupied by the first region (R1) of the adjacent opening (1.1).

[0080] It must be pointed out that at the top right corner and bottom left corner of Figure 8 and at the bottom left corner of Figure 9, there are perforations for the passage of a single tube. These openings are in accordance with the state of the art; nevertheless, given that there is at least one opening (1.1) in accordance with the invention in the baffle (1), said baffle (1) has the benefit described for said invention.

[0081] Figure 10 shows another embodiment of the grooved baffle (1). In this case, the openings (1.1) are distributed according to a regular pattern on the main plate of the baffle (1). Said regular pattern arranges the plurality of first regions (R1) circularly around the second region (R2) which is positioned at the center of said plurality of first regions (R1) and connects this plurality of first regions (R1) to one another.

[0082] In this particular case, each of the openings (1.1) are a triangular distribution that is repeated along the main directions of the main plate of the baffle (1), each of the consecutive openings (1.1) being oriented in an alternating manner.

[0083] Figure 11 shows another embodiment of the grooved baffle (1). In this case, the openings (1.1) are distributed according to a circular regular pattern on the main plate of the baffle (1) formed by four first regions (R1) connected by a second region (R2), giving rise to a symmetrical distribution according to the two main directions of said main plate.

[0084] Figure 12 shows another embodiment of the grooved baffle (1). In this case, the openings (1.1) are distributed along the main plate of the baffle (1) according to the embodiment described in Figure 3, the features of this embodiment being compatible with any of the distributions of openings (1.1) described above in any of the preceding examples.

[0085] In this case, a perimetral flange obtained by means of stamping on the perimetral edge of the main plate of the baffle (1), for example, is included in the grooved baffle (1). The addition of this flange allows better seating of the baffle (1) in the shell of the heat exchanger, such that it improves damping of vibrations to which said exchanger is subjected.

[0086] Additionally, the openings (1.1) in this embodiment incorporate a set of flanges or necks going around the first regions (R1), coinciding with the tubes housed in said first regions (R1), and such that the perimetral elevation of said flanges is in contact with said heat exchanger tubes. The addition of these necks or flanges allows improving seating of the tubes on the first regions (R1), and additionally improves wettability when welding, for example, when brazing, the tubes to the baffle (1).

[0087] Regions (R1, R2) are identified in this drawing only in the space of two tubes of the bundle of heat exchanger tubes for the sake of clarity, although said re-

gions are identical in the different openings (1.1) of the baffle (1).

[0088] The flanges or necks are made by means of deep drawing or stamping on the main plate of the baffle (1), for example.

[0089] In another embodiment, the necks can be continuous, completely surrounding the perimeter of the openings (1.1).

[0090] Figure 13 shows an embodiment of the grooved baffle (1) according to Figure 12, in this case, a plurality of said grooved baffles (1) already assembled on the bundle of heat exchanger tubes.

[0091] This drawing shows different grooved baffles (1) which are separated by a distance on the longitudinal direction of said heat exchanger tubes. Said tubes are housed in regions (R1) of each grooved baffle (1), and the necks located on the perimeter in said regions (R1) are welded to each of the tubes housed in the regions.

[0092] The gap between each tube is defined by the gap between regions (R1), i.e., by regions (R2).

Claims

1. A baffle (1) for heat exchangers formed by a main plate in which there are one or more openings (1.1) for the passage of heat exchanger tubes wherein at least one of said openings (1.1), according to the projection on the plane defined by the main plate, comprises:
 - a plurality of first regions (R1) adapted for the passage of heat exchanger tubes where each of the first regions (R1) has a configuration allowing passage of one of the tubes, the edge of the opening (1.1) coinciding with the first region (R1) is an attachment segment (1.1.1) adapted for being attached by welding to the tube going through the first region (R1),
 - a second region (R2) in contact with all the first regions (R1) adapted for the passage of fluid.
2. The baffle (1) according to claim 1, where the first regions (R1) of one and the same opening (1.1) are distributed according to a regular pattern along a specific directrix axis X-X'.
3. The baffle (1) according to claim 2, where the regular pattern distributes the first regions (R1) on both sides of directrix axis X-X' and the second region (R2) extends along directrix axis X-X'.
4. The baffle (1) according to claim 3, where the distribution of the first regions (R1) on both sides of directrix axis X-X' is in an alternating manner.
5. The baffle (1) according to claim 2, where the regular pattern is an alignment of the first regions (R1) and

comprises a plurality of second regions (R2), each second region (R2) connecting two consecutively arranged first regions (R1).

6. The baffle (1) according to claim 1, where the first regions (R1) of one and the same opening (1.1) are distributed according to a regular pattern and said regular pattern is a set of circularly distributed first regions (R1) and the second region (R2) arranged at the center of the set of first regions (R1) in contact with all of them. 5
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7. The baffle (1) according to any of the preceding claims, where the edge of the opening (1.1) is a free edge. 15
8. The baffle (1) according to any of the preceding claims, where the edge of the opening (1.1) comprises a flange or neck. 20
9. The baffle (1) according to claim 8, where the flange or neck is perpendicular to the plane defined by the main plate.
10. The baffle (1) according to claim 8 or 9, where the flange or neck is preferably obtained by stamping. 25
11. A heat exchanger comprising a bundle of tubes for the passage of a fluid to be cooled housed inside a shell adapted for the passage of a coolant where said shell comprises one or more baffles (1) according to any of the preceding claims for holding a plurality of tubes of the bundle of tubes. 30
12. The heat exchanger according to claim 11, where the projection of the main plate of one or more baffles according to a plane perpendicular to the bundle of tubes at least partially occupies the passage section of the shell leaving a free area between the baffle (1) and the shell for the passage of a coolant. 35
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13. The heat exchanger according to claim 11, where the projection of the main plate of one or more baffles according to a plane perpendicular to the bundle of tubes does not have a free area between the baffle (1) and the shell for the passage of a coolant. 45

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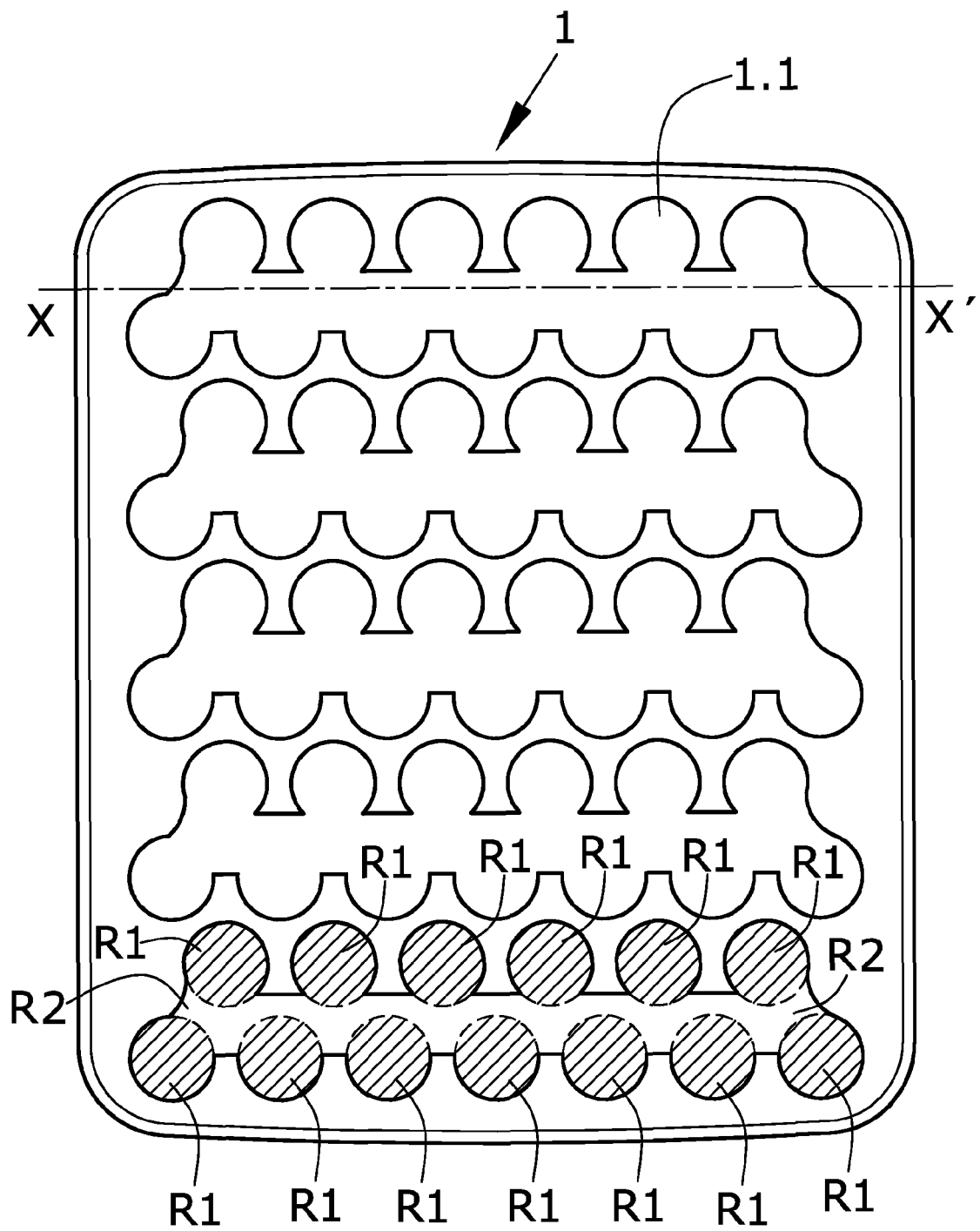


FIG.1

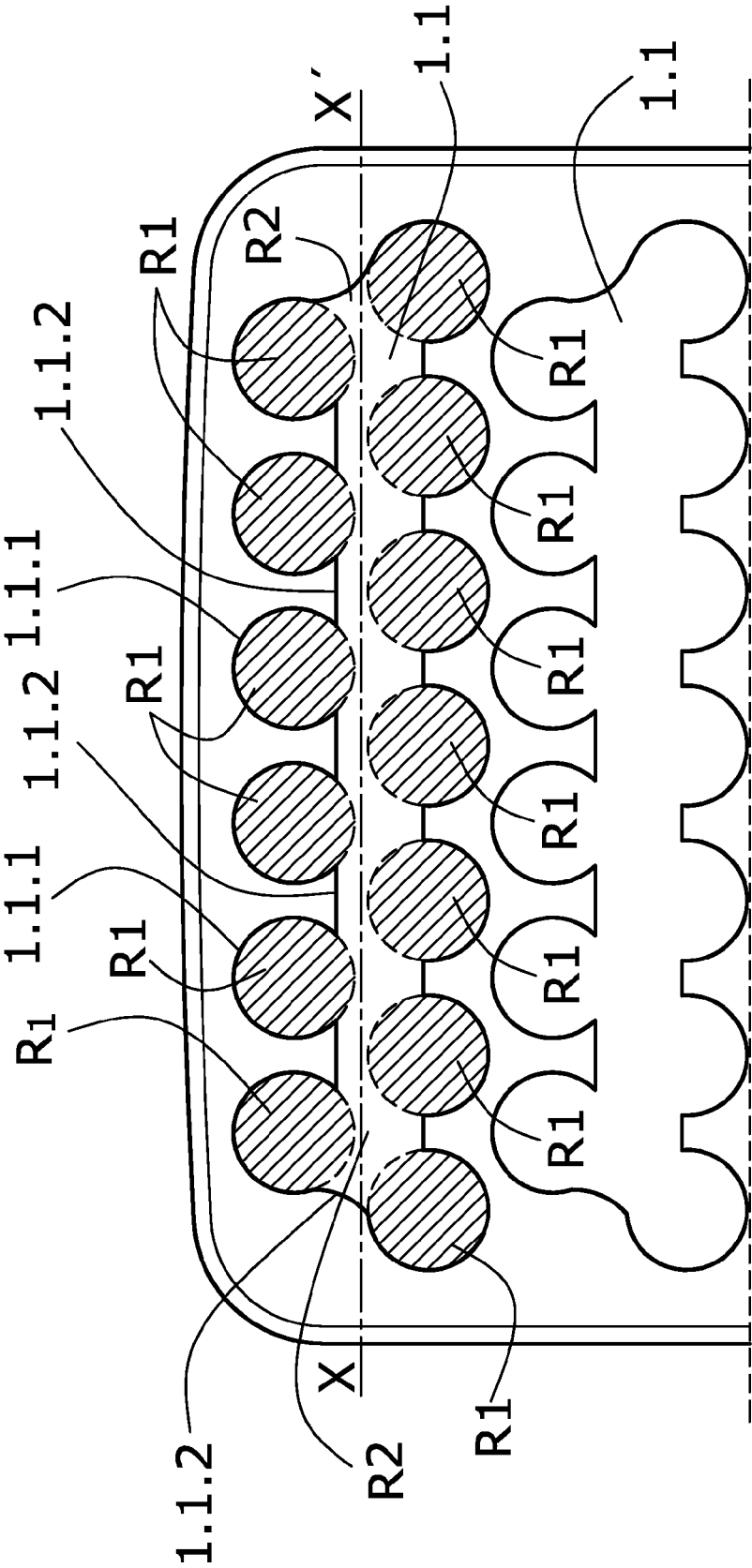


FIG.2

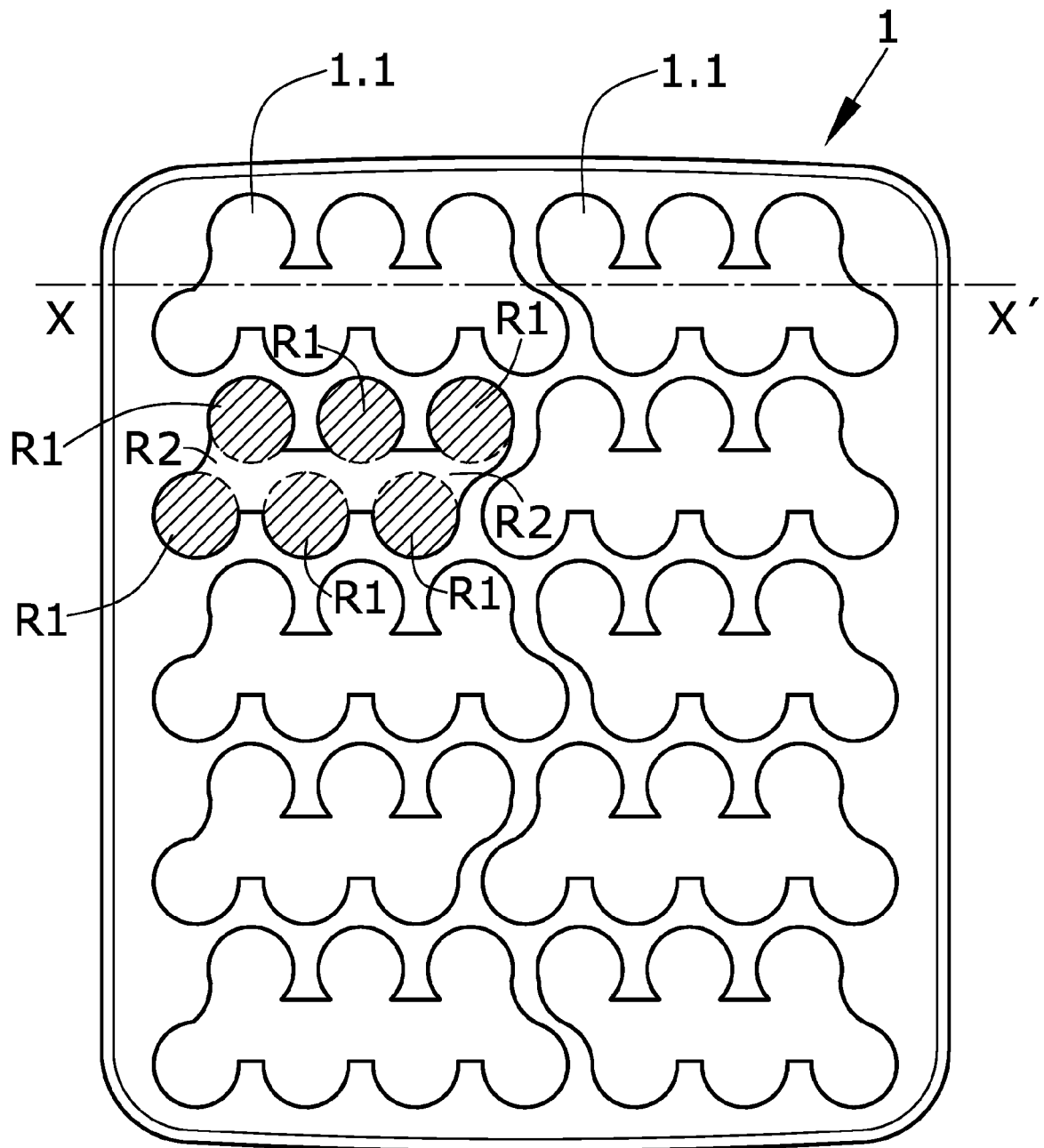


FIG.3

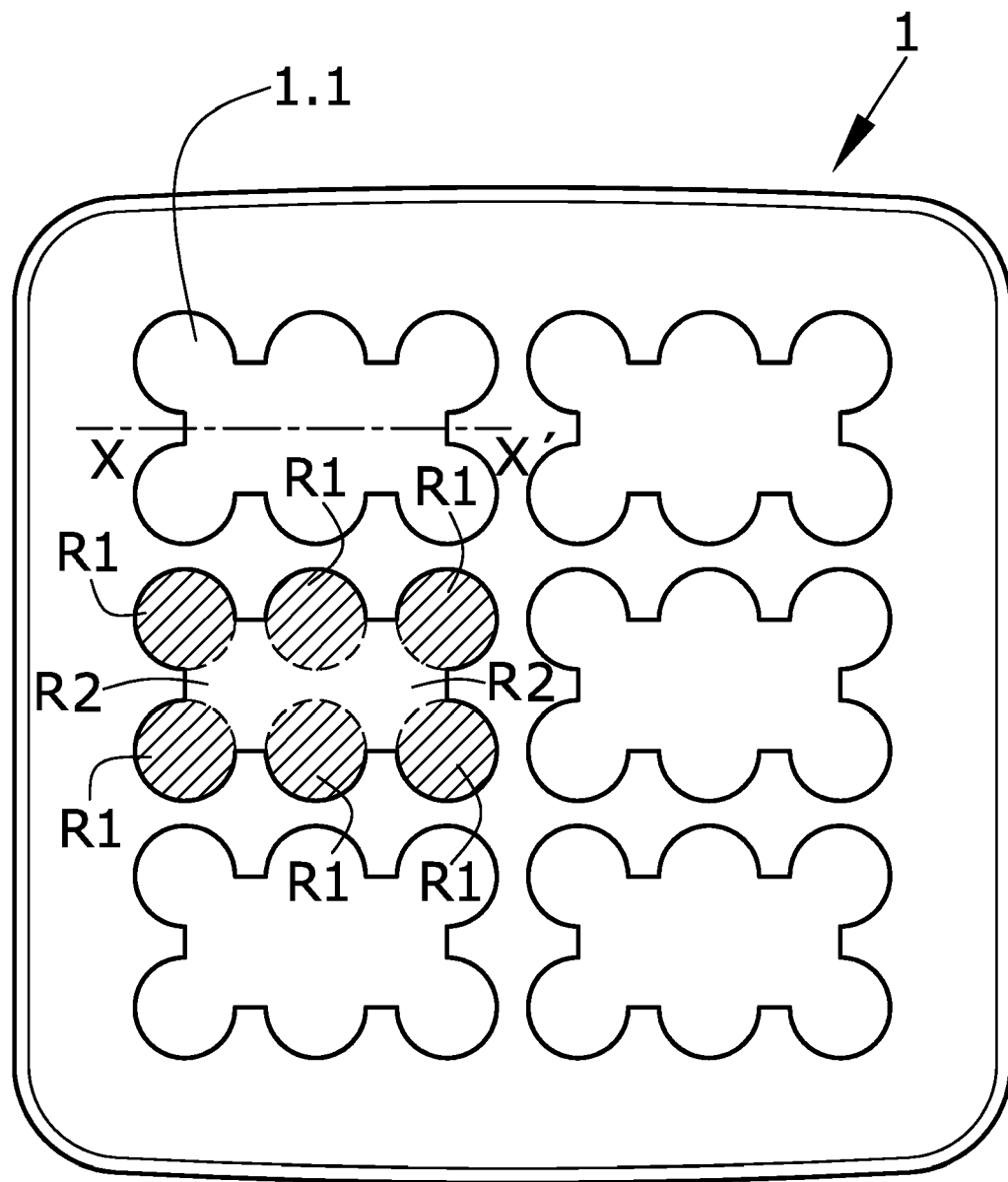


FIG.4

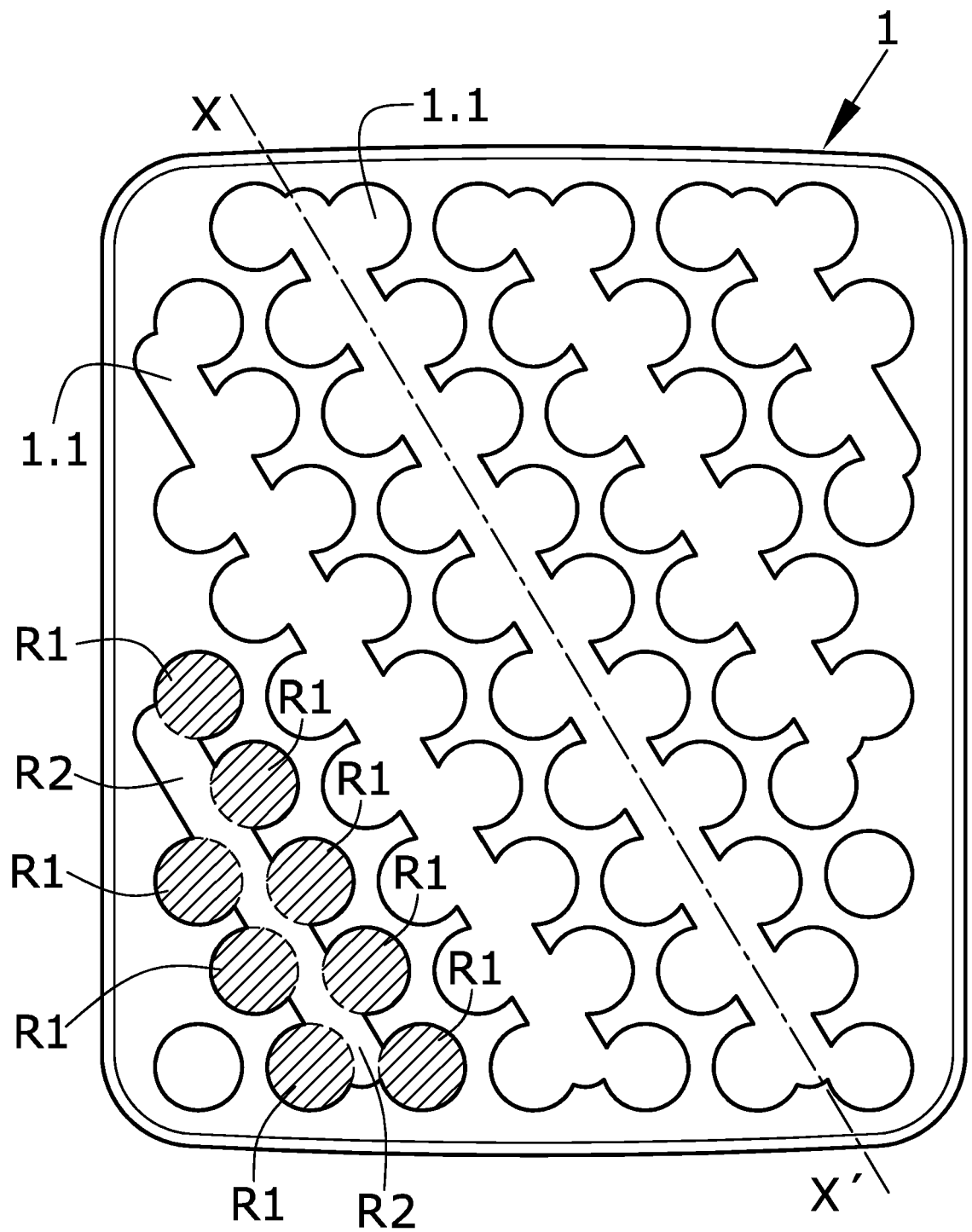


FIG.5

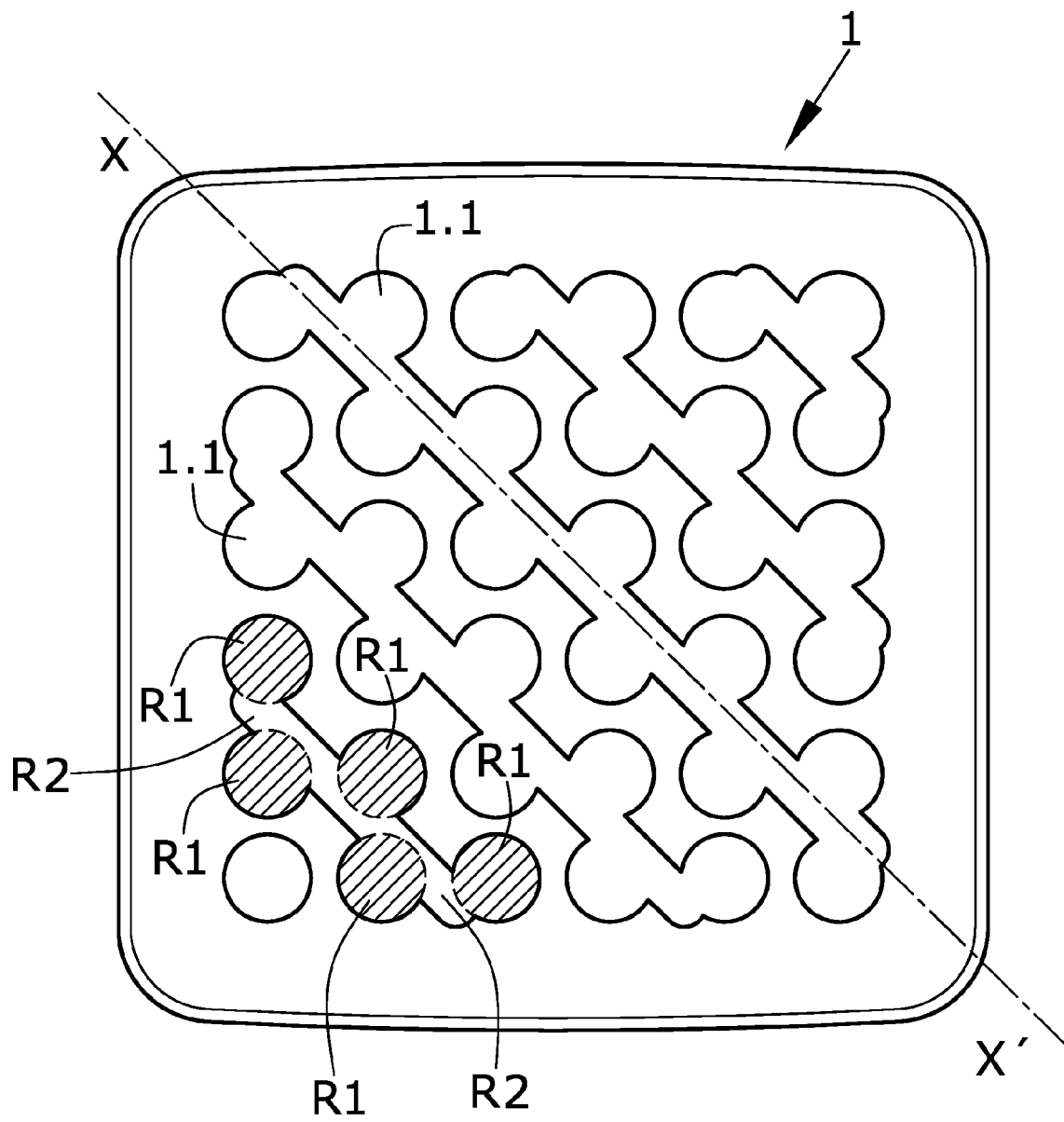


FIG. 6

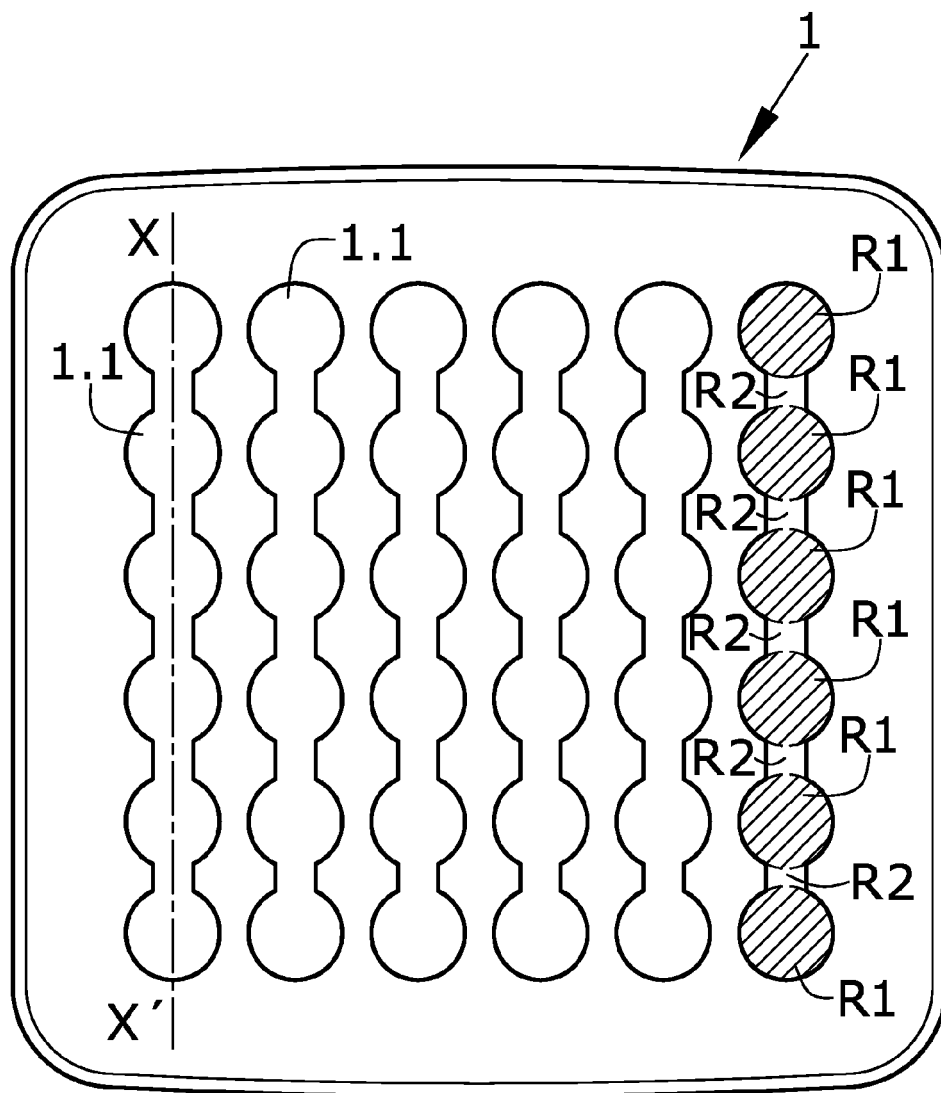


FIG. 7

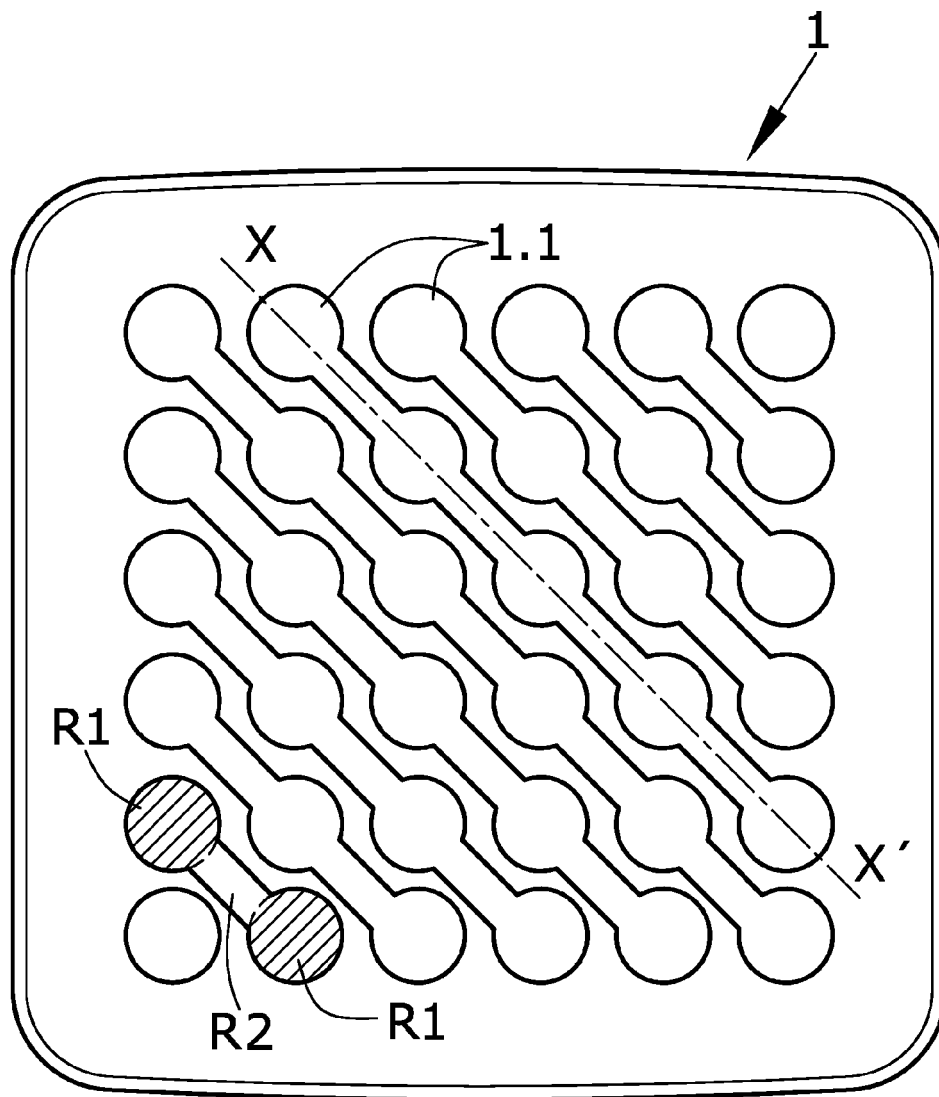


FIG. 8

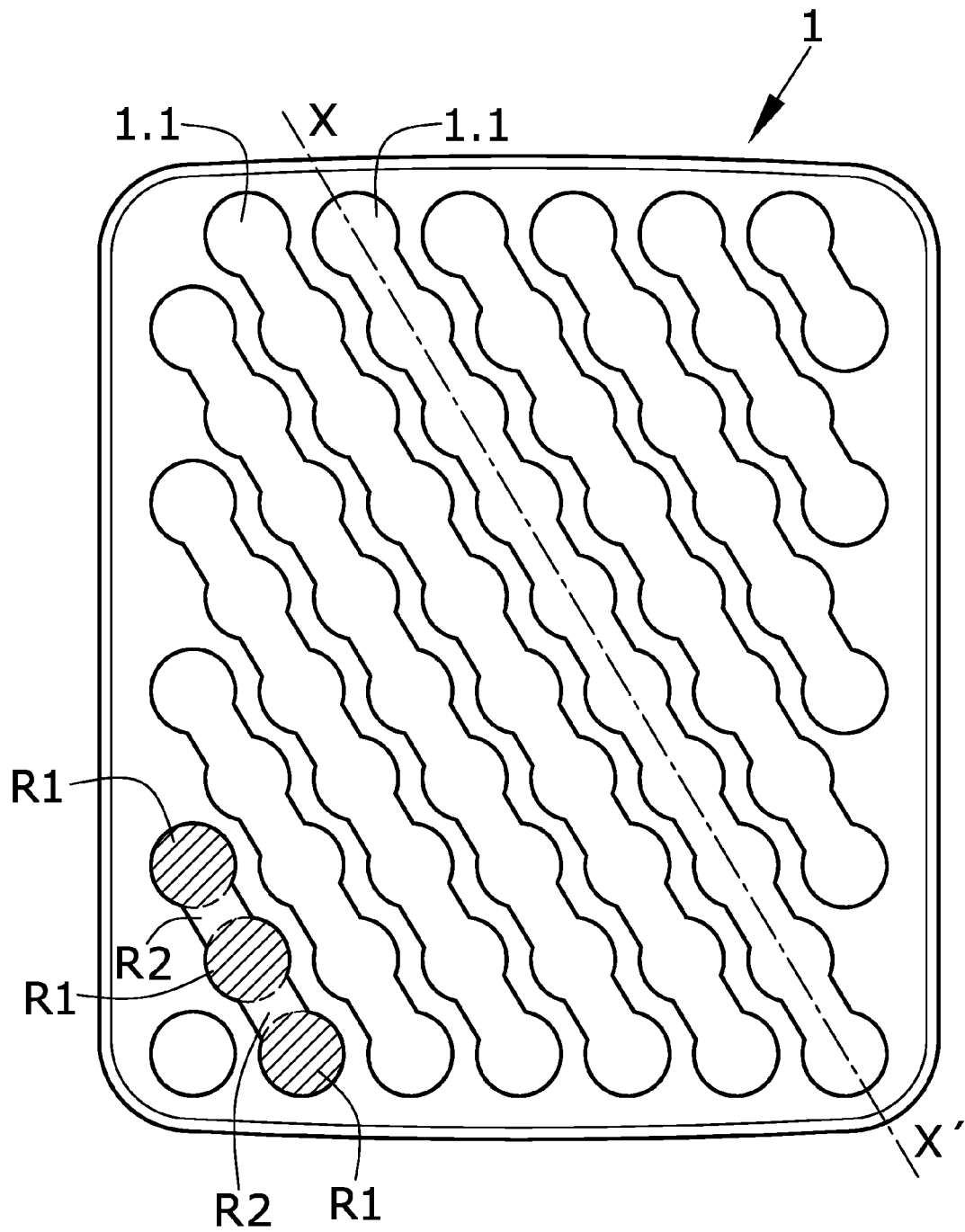


FIG.9

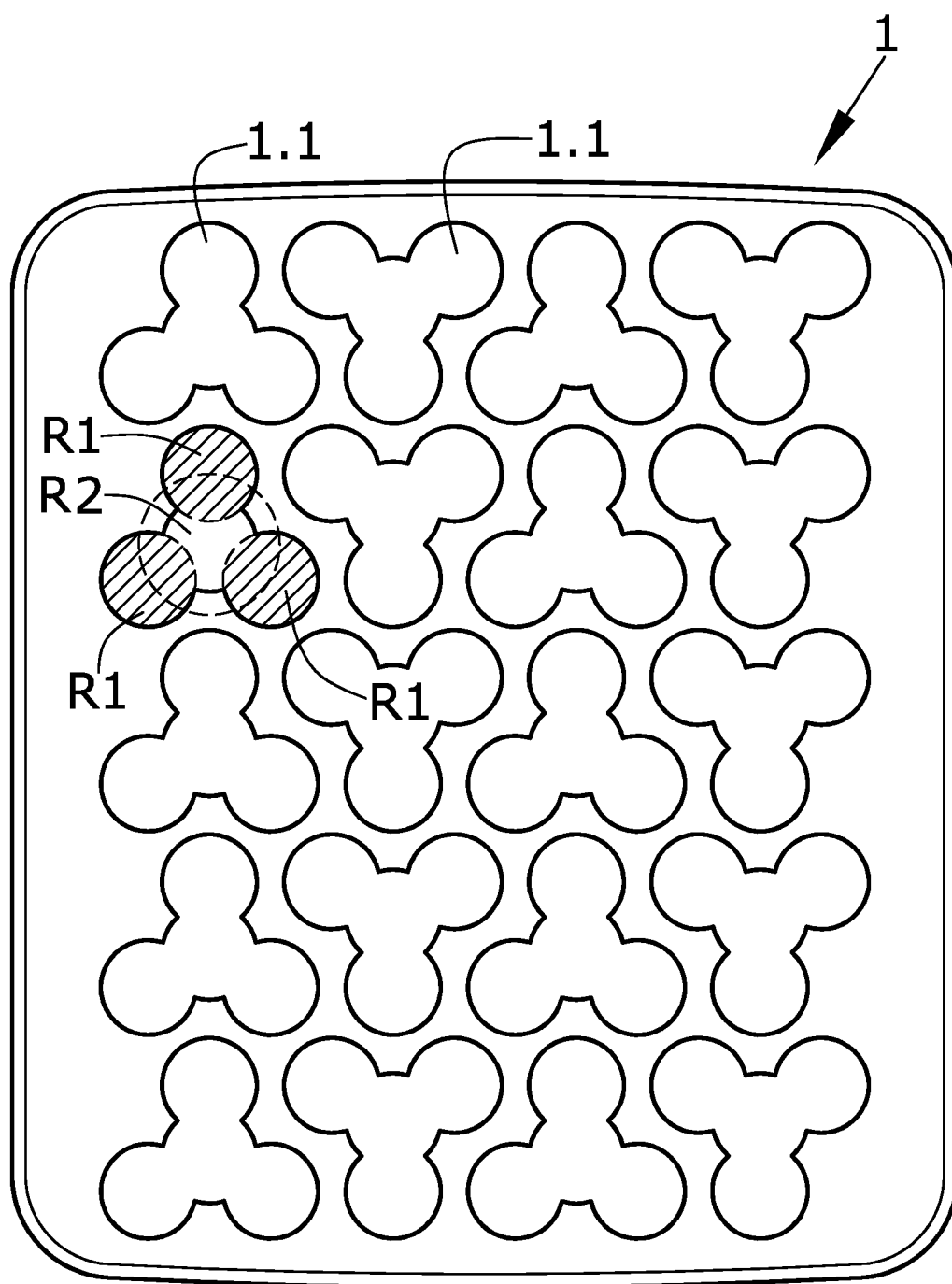


FIG.10

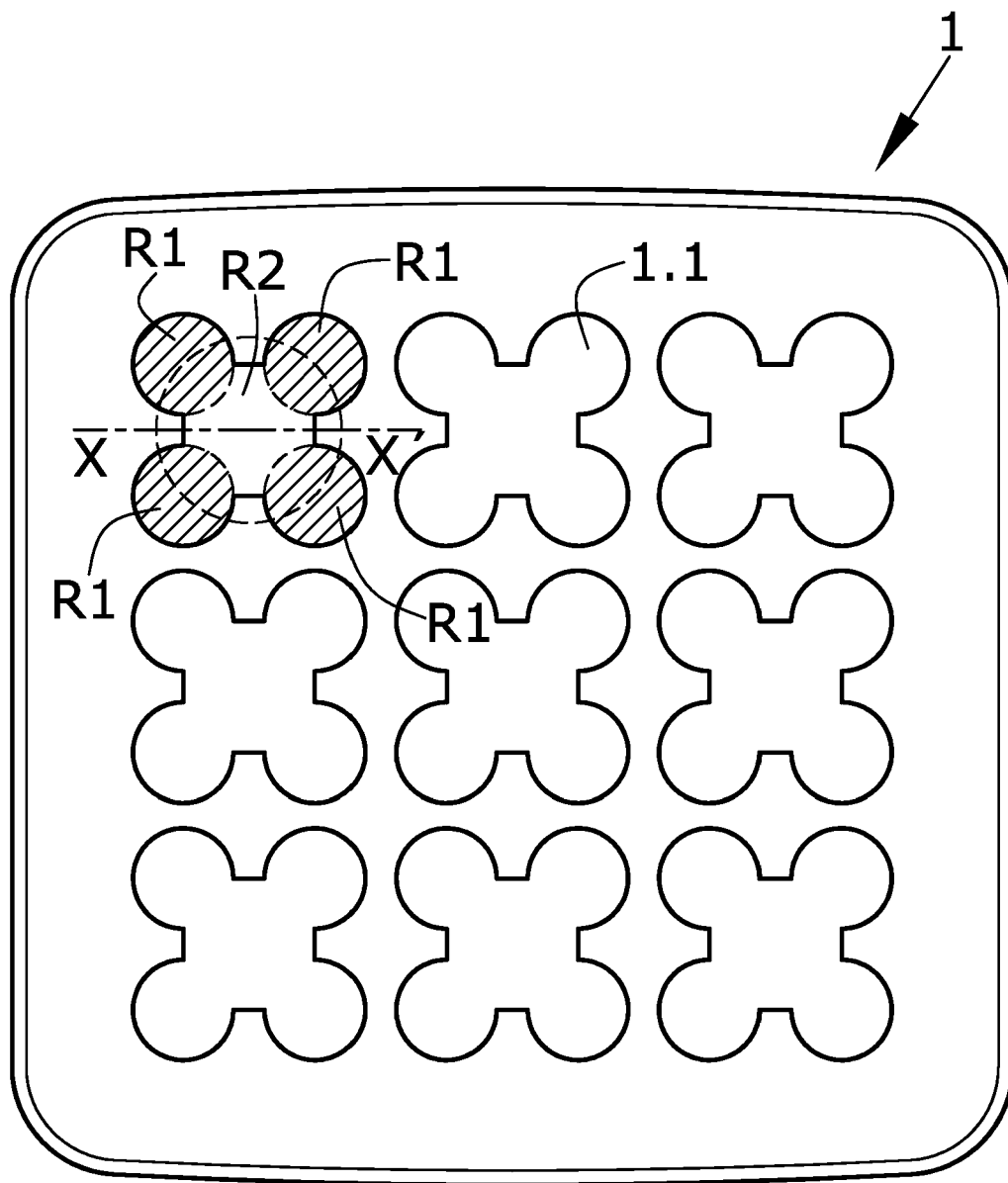


FIG. 11

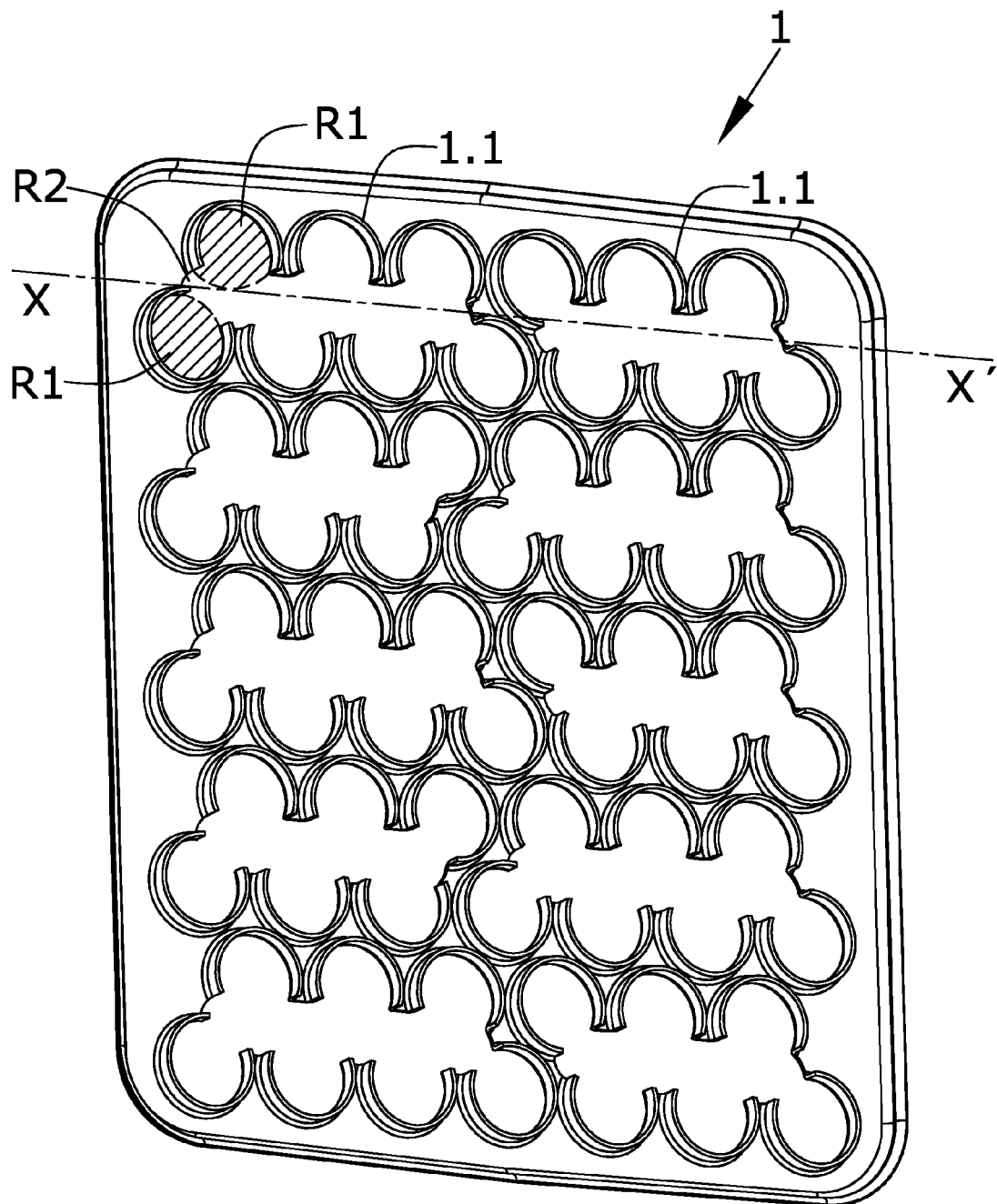


FIG.12

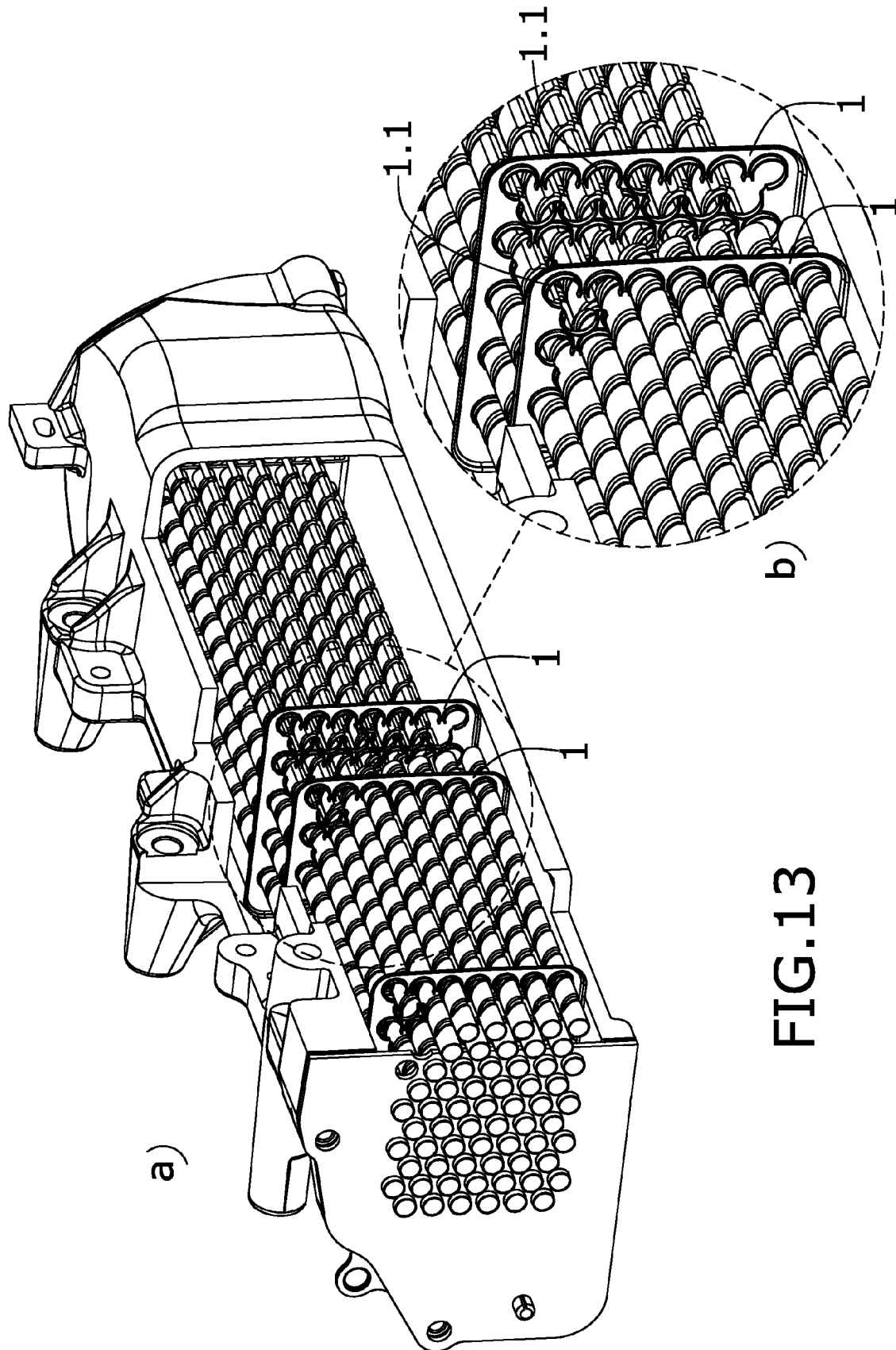


FIG.13



EUROPEAN SEARCH REPORT

 Application Number
 EP 14 38 2490

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X	FR 3 002 316 A1 (DCNS [FR]) 22 August 2014 (2014-08-22) * page 5, lines 1-26 * -----	1-4,7, 11-13	
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			F28F F28D
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 8 May 2015	Examiner Louchet, Nicolas
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

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5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
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08-05-2015

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