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(54) HEAT EXCHANGER ELEMENT

(57) A Heat exchanger element comprises a combustion chamber for the generation of hot gas; a meandering water flow channel for the flow of water to be heated; and two metal walls delimiting the water flow channel, for exchanging heat between the hot gas and water flowing through the water flow channel. The water flow channel is provided for water flow in counter direction to the flow of hot gas. The water flow channel comprises a number of consecutive parallel straight segments. The water flow channel comprises at least three U-turns which are each connecting two consecutive straight segments separated by an intermediate wall. At least one of the intermediate walls has one or a plurality of through openings.

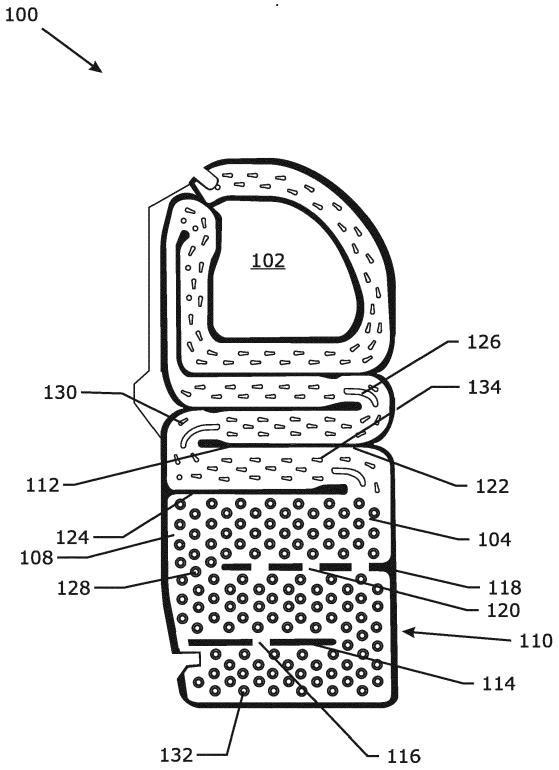

Fig. 1

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Description

Technical Field

[0001] The invention relates to the field of heat exchanger elements and heat exchangers.

Background Art

[0002] WO2015/024712A1 discloses a heat exchanger element comprising a combustion chamber for the generation of hot gas, a meandering water flow channel for the flow of water to be heated; and two metal walls delimiting the water flow channel, for exchanging heat between the hot gas and water flowing through the water flow channel. The water flow channel is provided for water flow in counter direction to the flow of hot gas. The water flow channel comprises a number of consecutive parallel straight segments. The water flow channel comprises U-turns connecting two consecutive straight segments separated by an intermediate wall.

Disclosure of Invention

[0003] The first aspect of the invention is a heat exchanger element. The heat exchanger element comprises a combustion chamber for the generation of hot gas; a meandering water flow channel for the flow of water to be heated; and two metal walls delimiting the water flow channel, for exchanging heat between the hot gas and water flowing through the water flow channel. The water flow channel is provided for water flow in counter direction to the flow of hot gas. The water flow channel comprises a number of consecutive parallel straight segments. The water flow channel comprises at least three U-turns which are each connecting two consecutive straight segments separated by an intermediate wall. At least one of the intermediate walls has one or a plurality of through openings. The through openings are provided to create a short cut for the water flow in the water flow channel.

[0004] The at least one through opening creates a short cut for the water flow in the meandering water flow channel. The short cut reduces the pressure drop in the water flow channel. Therefore, the pump provided in the heating circuit comprising a heat cell which comprises the inventive heat exchanger element for the circulation of the water consumes less energy. The benefit is that a heat cell comprising the heat exchanger elements is more energy efficient.

[0005] Preferably, the heat exchanger element is a cast heat exchanger element, more preferably provided out of aluminum or out of an aluminum alloy.

[0006] Preferably, the intermediate wall separating two consecutive parallel straight segments of the water flow channel is a metal wall common to the two consecutive parallel straight segments. More preferably, the intermediate wall is integrally cast with the heat exchanger element.

[0007] A preferred heat exchanger element comprises a most upstream intermediate wall. The most upstream intermediate wall is the intermediate wall separating the two consecutive parallel straight segments of the water channel most upstream of the water flow channel. The two most upstream consecutive parallel straight segments are connected by a U-turn. The most upstream intermediate wall comprises at least one - and preferably a plurality of - through openings.

[0008] A preferred heat exchanger element comprises a second most upstream intermediate wall. The second most upstream intermediate wall separates two consecutive parallel straight segments of the water channel that are connected by a U-turn. One of the two consecutive parallel straight segments is one of the two consecutive parallel straight segments separated by the most upstream intermediate wall. The second most upstream intermediate wall comprises at least one - and preferably a plurality of - through openings.

[0009] A preferred heat exchanger element comprises a non-interrupted intermediate wall. The non-interrupted intermediate wall separates two consecutive parallel straight segments of the water channel that are connected by a U-turn. With non-interrupted intermediate wall is meant that the intermediate wall does not comprise openings that would provide a short-cut for water flow.

[0010] A preferred heat exchanger element comprises at least two non-interrupted intermediate walls. The non-interrupted intermediate walls each separate two consecutive parallel straight segments of the water channel that are connected by a U-turn.

[0011] It is particularly advantageous to have distribution of water - via the short cut openings - in the upstream section of the water channel, to obtain efficient water distribution and to prevent local standstills of water. It is advantageous to have no short cut openings in the downstream section of the water channel, because it is preferred to have high water speeds in the downstream section and no swirls, for efficiency of heat transfer reasons and to prevent local boiling of the water in the water channel.

[0012] Preferably, the one or the plurality of through openings is/are opening(s) provided over the full height of the intermediate wall. With the full height of the intermediate wall is meant the full distance between the two metal walls delimiting the water flow channel.

[0013] In a preferred heat exchanger element, a curved baffle is provided in at least one U-turn. The curved baffle is provided parallel with and corresponding with the contour of the wall of at least part of the U-turn. The curved baffle provides a synergistic benefit, in that the through openings - establishing the short-cut openings - cooperate and interact with the curved baffles to create efficient water distribution at the baffle; improving the performance of the heat exchanger element.

[0014] Preferably, U-turns comprise reinforcing pins extending from wall to wall of the water channel. The reinforcing pins in the U-turns can e.g. be cylindrical in

cross section, or can e.g. have a drop shaped cross section, wherein the drop shape is aligned with the flow direction of the water in the water channel.

[0015] Preferably, the parallel straight segments separated by an intermediate wall and by a U-turn comprise reinforcing pins extending from wall to wall of the water channel. The reinforcing pins in the parallel straight segments can e.g. be cylindrical in cross section, or can e. g. have a drop shaped cross section, wherein the drop shape is aligned with the flow direction of the water in the water channel.

[0016] Preferably, the heat exchanger element is provided as a section for parallel side by side assembly in a sectional heat exchanger.

[0017] The second aspect of the invention is a sectional heat exchanger comprising a plurality of heat exchanger elements as in any embodiment of the first aspect of the invention. The heat exchanger elements are assembled side by side such that the at least one water channel of each of the heat exchanger elements are connected in parallel flow connection.

[0018] A preferred sectional heat exchanger comprises a chamber for the generation of flue gas. More preferably, the chamber in the sectional heat exchanger is provided by the combination of the combustion chambers of the heat exchanger elements.

[0019] The third aspect of the invention is a heat cell comprising a sectional heat exchanger as in the second aspect of the invention and a burner. The burner is provided in the chamber for the generation of hot gas of the sectional heat exchanger. Preferably the burner is a fully premixed surface stabilized premix gas burner.

Brief Description of the Drawings

[0020] Figure 1 shows a cross section of a heat exchanger element according to the invention. Figure 2 shows the heat exchanger element, of which the cross section is shown in figure 1.

Mode(s) for Carrying Out the Invention

[0021] Figure 1 shows a cross section 100 of a heat exchanger element according to the invention. Figure 2 shows the heat exchanger element 200, of which the cross section is shown in figure 1. The heat exchanger element is a cast heat exchanger element, integrally cast out of aluminum. The heat exchanger element is provided as a section for parallel side by side assembly in a sectional heat exchanger.

[0022] The heat exchanger element comprises a combustion chamber 102 for the generation of hot gas; a meandering water flow channel 104 for the flow of water to be heated; and two metal walls 105 delimiting the water flow channel, for exchanging heat between the hot gas and water flowing through the water flow channel. The cross section of figure 1 is taken at the middle between the two metal walls of the heat exchanger element.

[0023] The metal walls 105 comprise at their outside pins 136 and ribs 138 that will extend in the flue gas channel of the heat exchanger in which the heat exchanger elements is assembled. The pins and ribs are provided to increase heat exchanger from the flue gas to the water flowing through the meandering water flow channel.

[0024] The water flow channel is provided for water flow in counter direction to the flow of hot gas. The water flow channel comprises a number of consecutive parallel straight segments 108. The water flow channel comprises at least three U-turns 110, each connecting two consecutive straight segments separated by an intermediate wall 112. The intermediate walls 112 are metal walls each common to the two consecutive parallel straight segments they separate. The intermediate walls are integrally cast with the heat exchanger element.

[0025] The heat exchanger element comprises a most upstream intermediate wall 114. The most upstream intermediate wall is the intermediate wall separating the two consecutive parallel straight segments of the water channel most upstream of the water flow channel. The two most upstream consecutive parallel straight segments are connected by a U-turn. The most upstream intermediate wall comprises a plurality of through openings 116. The through openings are provided to create a short cut for the water flow in the water flow channel.

[0026] The heat exchanger element comprises a second most upstream intermediate wall 118. The second most upstream intermediate wall separates two consecutive parallel straight segments of the water channel that are connected by a U-turn. One of the two consecutive parallel straight segments is one of the two consecutive parallel straight segments separated by the most upstream intermediate wall. The second most upstream intermediate wall comprises a plurality of through openings 120.

[0027] The through openings 116, 120 are openings provided over the full height of the intermediate wall. With the full height of the intermediate wall is meant the full distance between the two metal walls delimiting the water flow channel.

[0028] The heat exchanger element also comprises non-interrupted intermediate walls 122, 124. The non-interrupted intermediate walls each separate two consecutive parallel straight segments of the water channel that are connected by a U-turn. With non-interrupted intermediate wall is meant that the intermediate wall does not comprise openings that would provide a short-cut for water flow.

[0029] Some of the U-turns comprise a curved baffle 126 parallel with and corresponding with the contour of the wall of at least part of the U-turn.

[0030] The U-turns comprise reinforcing pins 128, 130 extending from wall to wall of the water channel. Some of the reinforcing pins in the U-turns can e.g. be cylindrical in cross section128 or can e.g. have a drop shaped cross section 130, wherein the drop shape is aligned with the flow direction of the water in the water channel.

[0031] The parallel straight segments separated by an intermediate wall and by a U-turn comprise reinforcing pins 132, 134 extending from wall to wall of the water channel. Some of the reinforcing pins in the parallel straight segments have a cylindrical in cross section 132; other reinforcing pins have a drop shaped cross section 134. The drop shape is aligned with the flow direction of the water in the water channel.

Claims

1. Heat exchanger element, comprising

- a combustion chamber for the generation of hot gas;
- a meandering water flow channel for the flow of water to be heated; and
- two metal walls delimiting the water flow channel, for exchanging heat between the hot gas and water flowing through the water flow channel;

wherein the water flow channel is provided for water flow in counter direction to the flow of hot gas;
wherein the water flow channel comprises a number of consecutive parallel straight segments, wherein the water flow channel comprises at least three U-turns which are each connecting two consecutive straight segments separated by an intermediate wall;
characterized in that at least one of the intermediate walls has one or a plurality of through openings.

2. Heat exchanger element as in claim 1,
comprising a most upstream intermediate wall;
wherein the most upstream intermediate wall is the intermediate wall separating the two consecutive parallel straight segments of the water channel most upstream of the water flow channel, and wherein the two most upstream consecutive parallel straight segments are connected by a U-turn;
wherein the most upstream intermediate wall comprises at least one - and preferably a plurality of - through openings.

3. Heat exchanger element as in claim 2,
comprising a second most upstream intermediate wall,
wherein the second most upstream intermediate wall separates two consecutive parallel straight segments of the water channel that are connected by a U-turn,
wherein one of the two consecutive parallel straight segments is one of the two consecutive parallel straight segments separated by the most upstream intermediate wall; and
wherein the second most upstream intermediate wall comprises at least one - and preferably a plurality of - through openings.

4. Heat exchanger element as in any of the preceding claims,
comprising a non-interrupted intermediate wall;
wherein the non-interrupted intermediate wall separates two consecutive parallel straight segments of the water channel that are connected by a U-turn.

5. Heat exchanger element as in any of the preceding claims,
comprising at least two non-interrupted intermediate walls;
wherein the non-interrupted intermediate walls each separate two consecutive parallel straight segments of the water channel that are connected by a U-turn.

6. Heat exchanger element as in any of the preceding claims, wherein the one or the plurality of through openings is/are opening(s) provided over the full height of the intermediate wall.

7. Heat exchanger element as in any of the preceding claims, wherein in at least one U-turn a curved baffle is provided parallel with and corresponding with the contour of the wall of at least part of the U-turn.

8. Heat exchanger element as in any of the preceding claims, wherein U-turns comprise reinforcing pins extending from wall to wall of the water channel.

9. Heat exchanger element as in any of the preceding claims, wherein the parallel straight segments separated by an intermediate wall and by a U-turn comprise reinforcing pins extending from wall to wall of the water channel.

10. Heat exchanger element as in any of the preceding claims, wherein the heat exchanger element is provided as a section for parallel side by side assembly in a sectional heat exchanger.

11. Sectional heat exchanger;
wherein the sectional heat exchanger comprises a plurality of heat exchanger elements as in any of the claims 1 - 10;
wherein the heat exchanger elements are assembled side by side such that the at least one water channel of each of the heat exchanger elements are connected in parallel flow connection.

12. Sectional heat exchanger as in claim 11; comprising a chamber for the generation of flue gas.

13. Heat cell, wherein the heat cell comprises a sectional heat exchanger as in claim 12 and
wherein a burner; preferably a fully premixed surface

stabilized premix gas burner, is provided in the chamber of the sectional heat exchanger for the generation of hot gas.

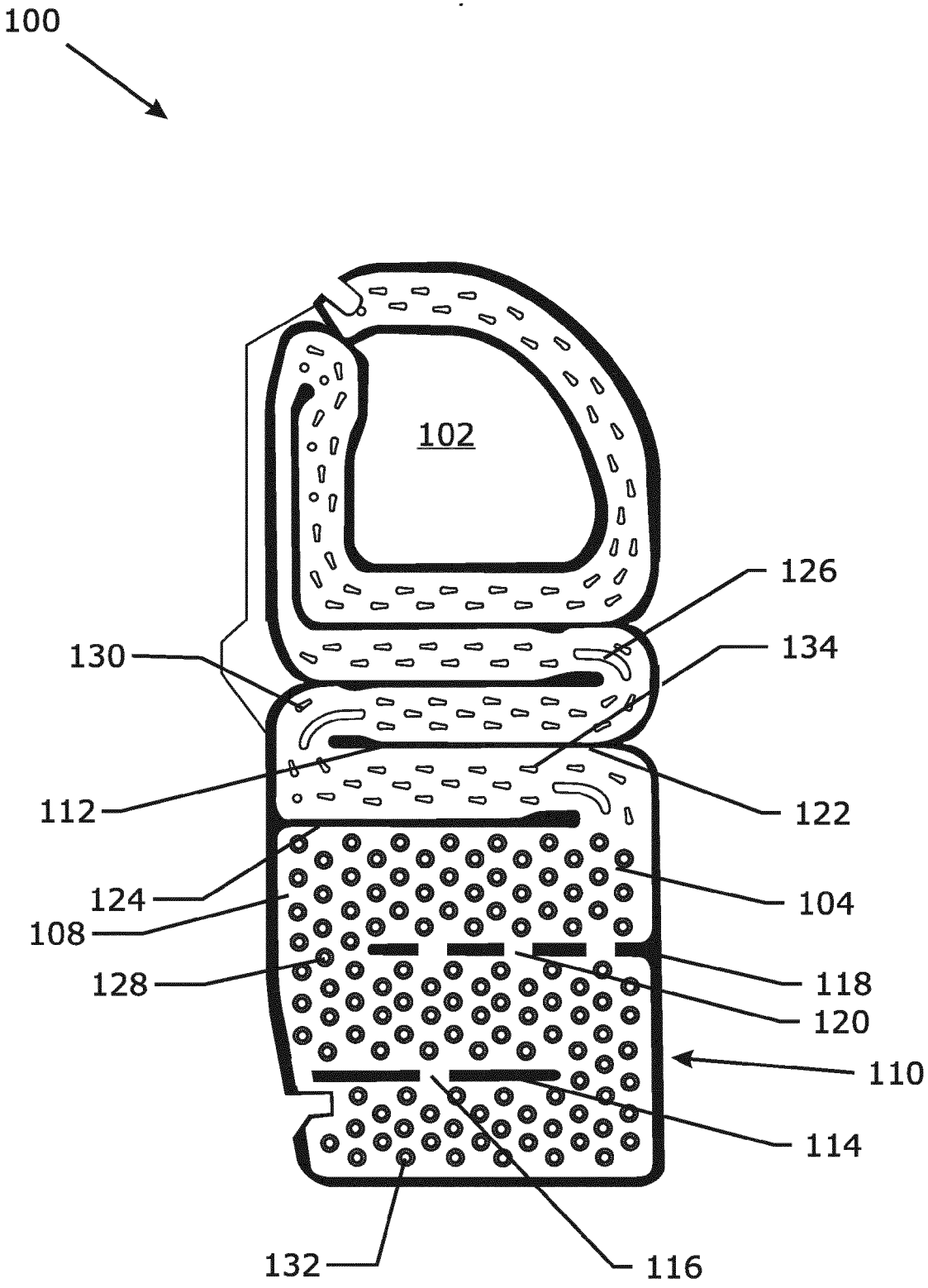
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Fig. 1

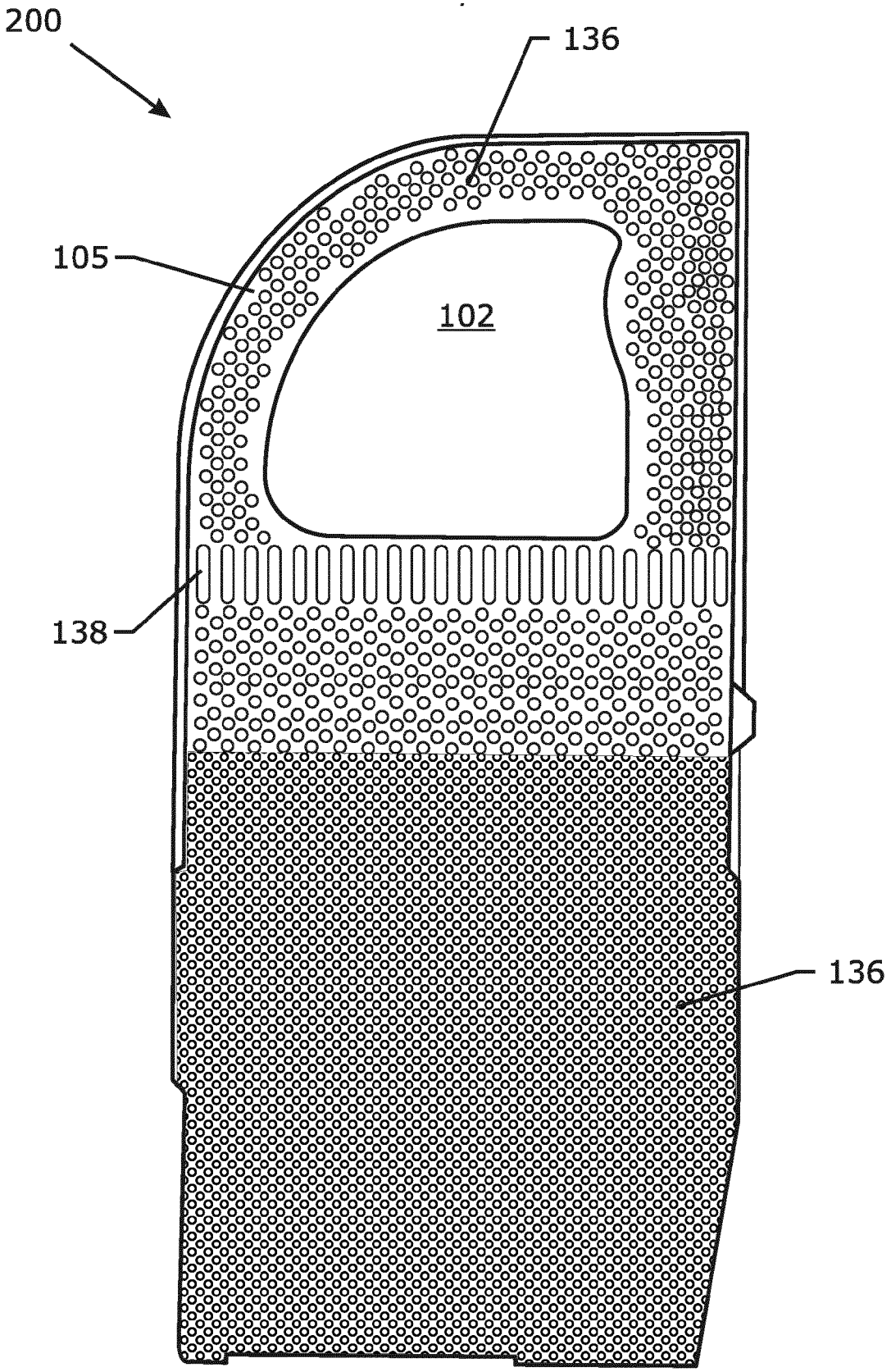

Fig. 2

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EUROPEAN SEARCH REPORT

Application Number
EP 17 18 0239

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	8 December 2017	Ast, Gabor

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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