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(54) **FLOW PATH PLATE FOR ELECTROLYTIC CELL, AND ELECTROLYTIC CELL COMPRISING SAME**

(57) The present invention relates to a passage plate for an electrolysis cell, and an electrolysis cell including the same. The passage plate for the electrolysis cell according to the present invention is a passage plate for an electrolysis cell, which faces an electrode that causes an electrochemical reaction, and includes a supply-side passage part in which a branch passage, which is branched into a plurality of passages through which a raw material fluid is supplied, is provided, and a channel part, which has one side portion connected to the supply-side passage part and in which a plurality of channels through which the supplied raw material fluid flows are provided, wherein the supply-side passage part includes a plurality of passage blocks, the plurality of branch passages are branched through the plurality of passage blocks, and respective widths of the plurality of branch passages are uniform.

EP 4 560 051 A1

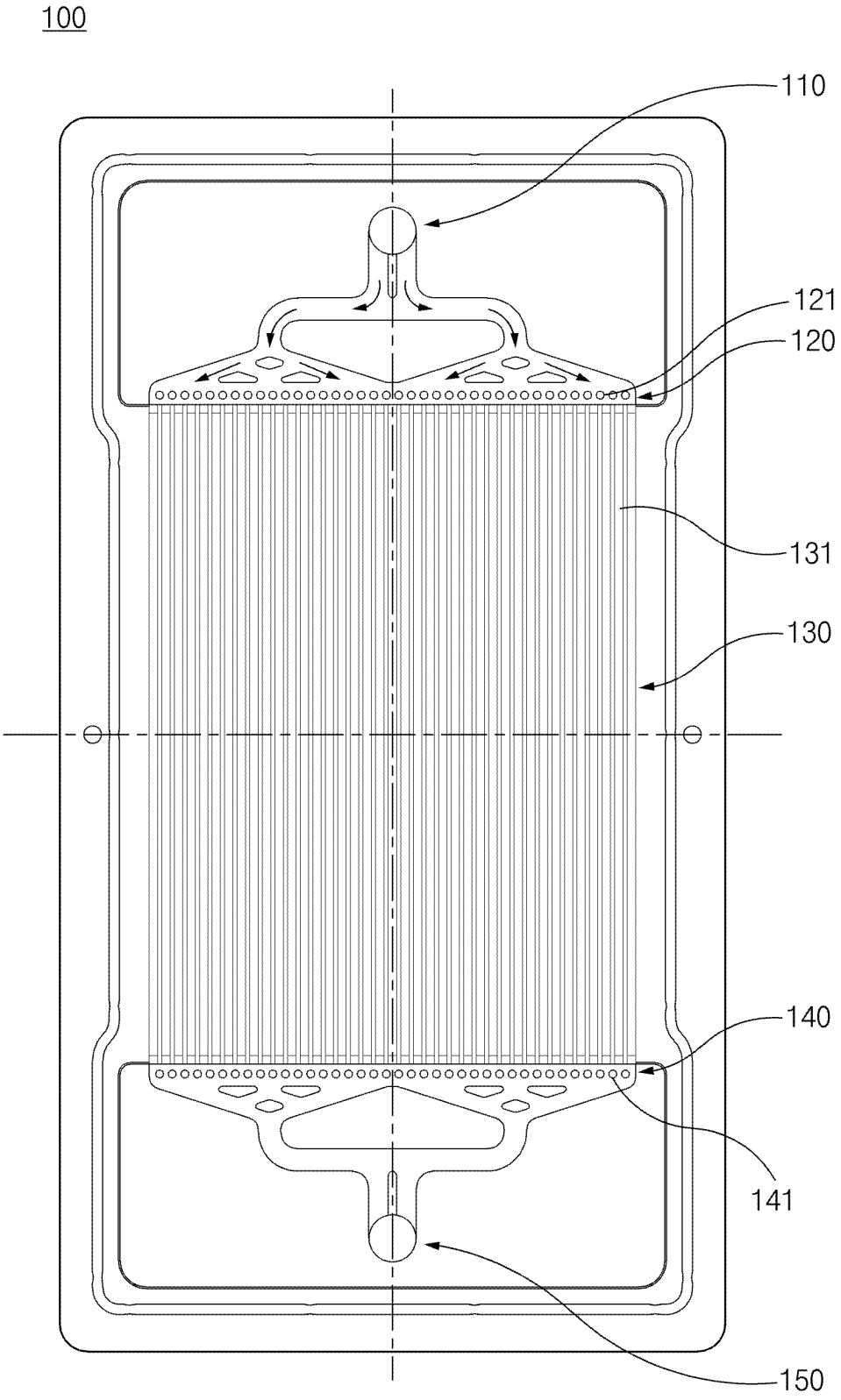

FIG.2

Description

TECHNICAL FIELD

CROSS-REFERENCE TO RELATED APPLICATION

[0001] The present application claims the benefit of the priority of Korean Patent Application Nos. 10-2022-0110644, filed on September 1, 2022, and 10-2023-0115367, filed on August 31, 2023, which are hereby incorporated by reference in their entirety.

TECHNICAL FIELD

[0002] The present invention relates to a passage plate for an electrolysis cell, and an electrolysis cell including the same.

BACKGROUND ART

[0003] Cells for electrolyzing carbon dioxides (CO_2) to convert the same into useful resources such as CO or ethylene need to secure active areas to a certain level or higher through an increase in area in addition to stacking for scale-up.

[0004] Design of a passage structure capable of uniformly supplying a CO_2 gas and an electrolyte to the entire active area is important in design of large-area cells.

[0005] Typical research on CO_2 electrochemical conversion technology is mostly focused on securing performance of small-sized cells, and when structures of these small-sized cells are applied as they are to increase the active areas of the cells, efficiency of the large-area cells may be deteriorated compared to the small-sized cells.

DISCLOSURE OF THE INVENTION

TECHNICAL PROBLEM

[0006] One aspect of the present invention is to provide a passage plate for an electrolysis cell, capable of improving material transfer properties and cell performance efficiency, and an electrolysis cell including the passage plate.

TECHNICAL SOLUTION

[0007] A passage plate for an electrolysis cell according to an embodiment of the present invention is a passage plate for an electrolysis cell, which faces an electrode that causes an electrochemical reaction, and may include a supply-side passage part, in which a branch passage, which is branched into a plurality of passages through which a raw material fluid is supplied, is provided, and a channel part, which has one side portion connected to the supply-side passage part and in which a plurality of channels through which the supplied raw material fluid flows are provided, wherein the supply-side passage part includes a plurality of passage blocks, the plurality of branch passages are branched through the plurality of passage blocks, and respective widths of the plurality of branch passages are uniform.

[0008] In addition, an electrolysis cell according to an embodiment of the present invention may include the passage plate for the electrolysis cell according to an embodiment of the present invention, and the electrode facing the passage plate.

ADVANTAGEOUS EFFECTS

[0009] According to the present invention, in the passage plate for the electrolysis cell that faces the electrode, in the supply-side passage part in which the branch passage, which is branched into the plurality of passages through which the raw material fluid is supplied, is provided, the passages may be branched through the plurality of passage blocks so as to have the uniform widths. Accordingly, the raw material fluid may be supplied so as to uniformly flow to the plurality of channels of the channel part through which the raw material fluid flows.

[0010] Accordingly, the flow of the reactant fluid is improved to improve the material transfer properties necessary for the electrochemical reaction so that the performance efficiency is optimized, and the local deterioration is prevented to improve the durability.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011]

FIG. 1 is a side view illustrating an example of an electrolysis cell according to an embodiment of the present invention.
FIG. 2 is a plan view illustrating an example of a passage plate for an electrolysis cell according to a first embodiment of the present invention.
FIG. 3 is an enlarged plan view illustrating a portion of a supply-side passage part of the passage plate for the electrolysis cell according to the first embodiment of the present invention.
FIG. 4 is a plan view illustrating an example of a passage plate for an electrolysis cell according to a second embodiment of the present invention.
FIG. 5 is an enlarged plan view illustrating a portion of a supply-side passage part of the passage plate for the electrolysis cell according to the second embodiment of the present invention.
FIG. 6 is a plan view illustrating an example of a passage plate for an electrolysis cell according to a third embodiment of the present invention.
FIG. 7 is an enlarged plan view illustrating a portion of a supply-side passage part of the passage plate for the electrolysis cell according to the third embodiment of the present invention.
FIG. 8 is an image illustrating flow velocity distribution in a passage plate for an electrolysis cell according to Comparison Example 1.
FIG. 9 is an image illustrating flow velocity distribution in a passage plate for an electrolysis cell according to Manufacturing Example 1.
FIG. 10 is an image illustrating flow velocity distribution in a passage plate for an electrolysis cell according to Manufacturing Example 2.
FIG. 11 is an image illustrating flow velocity distribution in a passage plate for an electrolysis cell according to Manufacturing Example 3.

MODE FOR CARRYING OUT THE INVENTION

[0012] The purpose, specified advantages, and novel features of the present invention will be clarified through following embodiments described with reference to the accompanying drawings. Note that like elements are designated by like reference numerals as far as possible even if they are shown in different drawings. The present invention may be embodied in different forms and should not be construed as limited to the embodiments set forth herein. Moreover, in the following description of the present invention, detailed descriptions of the related well-known art that may unnecessarily obscure subject matters of the present invention will be ruled out.

Passage plate for electrolysis cell according to first embodiment

[0013] FIG. 1 is a side view illustrating an example of an electrolysis cell according to an embodiment of the present invention. FIG. 2 is a plan view illustrating an example of a passage plate for an electrolysis cell according to a first embodiment of the present invention. FIG. 3 is an enlarged plan view illustrating a portion of a supply-side passage part of the passage plate for the electrolysis cell according to the first embodiment of the present invention.

[0014] Referring FIGS. 1 to 3, a passage plate 100 for an electrolysis cell according to the first embodiment of the present invention is a passage plate 100 for an electrolysis cell, which faces an electrode E that causes an electrochemical reduction reaction, and includes a supply-side passage part 120 that supplies a raw material fluid, and a channel part 130 in which a plurality of channels 131 through which the supplied raw material fluid flows are provided. In addition, the passage plate 100 for the electrolysis cell according to the first embodiment of the present invention may include a manifold inlet 110, a discharge-side passage part 140, and a manifold outlet 150.

[0015] In more detail, in the passage plate 100 for the electrolysis cell according to the first embodiment of the present invention, a branch passage 123, which is branched into a plurality of passages (hereinafter referred to as a plurality of branch passages 123) through which a raw material fluid is supplied, may be provided in the supply-side passage part 120. Here, the raw material fluid may include a carbon dioxide (CO_2) and an electrolyte. Here, the electrolyte may include water (H_2O).

[0016] The supply-side passage part 120 may be provided with a plurality of passage blocks 121, and the plurality of branch passages 123 may be branched through the plurality of passage blocks 121. That is, the plurality of branch passages 123 into which a passage that is a passage for supplying the raw material fluid is branched through the plurality of passage blocks 121 may be provided.

[0017] Respective widths W1 and W2 of the plurality of branch passages 123 may be uniform. Here, the term "uniform" means that a difference between the widths W1 and W2 of the plurality of branch passages 123 is constant. That is, the

widths W1 and W2 of the plurality of branch passages 123 of the supply-side passage part 120 may be the same as each other. In particular, the width W1 of each of the branch passages 123 disposed at both side portions of the supply-side passage part 120 may be provided to be the same as the width W2 of each of the other branch passages 123 of the supply-side passage part 120. Here, a recessed groove 120a that is recessed inward from each of both the side portions of the supply-side passage part 120 may be defined so that the width W1 of each of the branch passages 123 disposed at both the side portions of the supply-side passage part 120 is the same as the width W12 of each of the other branch passages 123 of the supply-side passage part 120.

[0018] Here, the plurality of branch passages 123 may be a passage portion facing the channel part 130.

[0019] Each of the widths W1 and W2 of the plurality of branch passages 123, which are branched through the plurality of passage blocks 121, of the supply-side passage part 120 may be, for example, 0.25 mm to 1 mm.

[0020] The number of the plurality of branch passages 123 of the supply-side passage part 120 may correspond to the number of the plurality of channels 131.

[0021] Positions of the plurality of branch passages 123 of the supply-side passage part 120 and positions of the plurality of channels 131 of the channel part 130 may be provided to correspond to each other. That is, for example, referring to FIG. 2, the plurality of branch passages 123 may be vertically collinear with the plurality of channels 131, respectively.

[0022] Each of the plurality of passage blocks 121 may have, for example, a cross-section having a circular or non-circular shape. Here, each of the plurality of passage blocks 121 may have, for a specific example, a circular cross-section.

[0023] The channel part 130 may have one side portion that is connected to the supply-side passage part 120, and the plurality of channels 131 through which a carbon dioxide and an electrolyte that are a raw material fluid to be supplied flow may be provided.

[0024] As the channel part 130 faces an electrode E and the plurality of channels 131 are provided on a surface, which faces the electrode E, of the channel part 130, the raw material fluid flowing through the plurality of channels 131 is in contact with the electrode E, and an electrochemical reaction occurs in the electrode E.

[0025] In the channel part 130, the plurality of channels 131 may be provided in the form of straight lines so that the raw material fluid flows in a straight-line direction from one side, at which the supply-side passage part 120 is disposed, to the other side.

[0026] Here, a plurality of channel protrusions 131a may be provided in the form of straight lines so that the channel 131 is provided in the form of a straight line. That is, the channel protrusions 131a may protrude in a direction of the electrode E and, referring to FIG. 2, extend vertically so that the channel 131 that is a passage through which a fluid vertically flows is provided.

[0027] In addition, for example, the channel 131 may have a width WC1 that is greater than each of the widths W1 and W2 of the plurality of branch passages 123 of the supply-side passage part 120.

[0028] The width WC1 of the channel 131 may be, for example, 0.5 mm to 2 mm.

[0029] The channel part 130 may have an area of, for example, 100 cm^2 or greater.

[0030] The manifold inlet 110 may be connected to the supply-side passage part 120, and the raw material fluid may flow thereinto. Here, the supply-side passage part 120 may supply the raw material fluid flowing from the manifold inlet 110.

[0031] The manifold inlet 110 may include one inflow hole.

[0032] The discharge-side passage part 140 may be connected to the other side portion of the channel part 130 to provide a plurality of passages through which reactants are discharged.

[0033] In addition, the discharge-side passage part 140 may be provided with a discharge-side passage block 141 through which a plurality of passages are branched.

[0034] In addition, the discharge-side passage part 140 may have a shape corresponding to a shape of the supply-side passage part 120. That is, a branching shape of the passages of the discharge-side passage part 140 may be the same as a branching shape of the passages of the supply-side passage part 120.

[0035] The manifold outlet 150 may be connected to the discharge-side passage part 140 so that the reactants are discharged.

[0036] Here, the reactants may be a carbon monoxide (CO), ethylene (C_2H_4), or the like.

[0037] The manifold outlet 150 may include one discharge hole.

[0038] The passage plate 100 for the electrolysis cell according to the first embodiment of the present invention configured as above is the passage plate 100 for the electrolysis cell which faces the electrode E, and the supply-side passage part 120 in which the branch passage 123, which is branched into the plurality of passages through which the raw material fluid is supplied, is provided, may provide the branch passages 123 that are branched through the plurality of passage blocks 121 so as to have uniform widths. Accordingly, the raw material fluid may be supplied so as to uniformly flow to the plurality of channels 131 of the channel part 130 through which the raw material fluid flows. Accordingly, fluid flow of the reactants is improved to improve the material transfer properties necessary for an electrochemical reaction so that the performance efficiency is optimized, and local deterioration is prevented to improve the durability.

Passage plate for electrolysis cell according to second embodiment

[0039] Hereinafter, a passage plate for an electrolysis cell according to a second embodiment of the present invention will be described.

[0040] FIG. 4 is a plan view illustrating an example of a passage plate for an electrolysis cell according to the second embodiment of the present invention. FIG. 5 is an enlarged plan view illustrating a portion of a supply-side passage part of the passage plate for the electrolysis cell according to the second embodiment of the present invention.

[0041] Referring FIGS. 1, 4, and 5, a passage plate 200 for an electrolysis cell according to the second embodiment of the present invention is a passage plate for an electrolysis cell, which faces an electrode E that causes an electrochemical reduction reaction, and includes a supply-side passage part 220 that supplies a raw material fluid, and a channel part 130 in which a plurality of channels 131 through which the supplied raw material fluid flows are provided. In addition, the passage plate 200 for the electrolysis cell according to the second embodiment of the present invention may include a manifold inlet 110, a discharge-side passage part 240, and a manifold outlet 150.

[0042] The passage plate 200 for the electrolysis cell according to an embodiment of the present invention is different in terms of a shape of passages branched through passage blocks 221 and 222 in the supply-side passage part 220, when compared to the passage plate for the electrolysis cell according to the first embodiment described above. Thus, this embodiment will be described by omitting or simply describing the content in common with the embodiment described above and focusing on differences.

[0043] In more detail, in the passage plate 200 for the electrolysis cell according to the second embodiment of the present invention, a plurality of branch passages 223 through which a raw material fluid is supplied may be provided in the supply-side passage part 220. Here, the raw material fluid may include a carbon dioxide (CO_2) and an electrolyte. Here, the electrolyte may include water (H_2O).

[0044] The supply-side passage part 220 may be provided with the plurality of passage blocks 221 and 222, and the plurality of branch passages 223 may be branched through the plurality of passage blocks 221 and 222. Here, respective widths W23 and W24 of the plurality of branch passages 223 may be uniform. That is, the widths W23 and W24 of the plurality of branch passages 223 of the supply-side passage part 220 may be the same as each other. Here, the plurality of branch passages 223 may be a passage portion facing the channel part 130.

[0045] Each of the plurality of passage blocks 221 and 222 may have, for example, a cross-section having a circular or non-circular shape. Here, each of the plurality of passage blocks 221 and 222 may have, for a specific example, a circular cross-section.

[0046] In addition, the plurality of passage blocks 221 and 222 may be arranged in a plurality of rows. Here, the plurality of passage blocks 221 and 222 arranged in the plurality of rows may be disposed to be misaligned between the rows. Accordingly, as the plurality of passage blocks 221 and 222 are arranged in the plurality of rows and disposed to be misaligned between the rows, flow distribution of the fluid may be easier performed.

[0047] Here, the plurality of branch passages 223 may be the branch passages 223 in which the flow is distributed through the passage blocks 221, which are in a row adjacent to the channel part 130, of the passage blocks 221 and 222 arranged in the plurality of rows. That is, the branch passages 223 may be the branch passages 223 in which the flow is finally distributed through the passage blocks 221 disposed in a row, which is the last row of the plurality of rows and is most adjacent to the channel part 130. For example, the number of the plurality of branch passages 223 of the supply-side passage part 220 may be provided to be greater than the number of the plurality of channels 131, but the passage plate 200 for the electrolysis cell according to the second embodiment of the present invention is not necessarily limited thereto.

[0048] In addition, the plurality of passage blocks 221 and 222 arranged in the plurality of rows may be arranged, for example, in two rows. Here, the plurality of passage blocks 221 and 222 arranged in two rows are disposed to be misaligned between the rows, and may be arranged in the form of zigzag.

[0049] When the plurality of passage blocks 221 and 222 are arranged in two rows, and when a row close to the channel part 130 is referred to as the first row, and a row close to the manifold inlet 110 is referred to as the second row, distances between the plurality of passage blocks 221 disposed in the first row may be provided to be the same, and distances between the plurality of passage blocks 222 disposed in the second row may be provided to be the same. Here, the distances between the plurality of passage blocks 221 disposed in the first row, and the distances between the plurality of passage blocks 222 disposed in the second row may be provided to be the same as each other. Accordingly, it may be easier to uniformly distribute the flow of the fluid.

[0050] Here, respective widths W21 and W22 of passages 224 branched through the plurality of passage blocks 222 disposed in the second row may be the same as each other. In addition, in the passages 224 branched through the plurality of passage blocks 222 disposed in the second row, the width W21 of each of passages disposed in both side portions of the supply-side passage part 220 may be provided to be the same as the width W22 of each of the other passages.

[0051] The channel part 130 may have one side portion that is connected to the supply-side passage part 220, and the plurality of channels 131 through which a carbon dioxide and an electrolyte that are a raw material fluid to be supplied flow may be provided.

[0052] As the channel part 130 faces an electrode E and the plurality of channels 131 are provided on a surface, which faces the electrode E, of the channel part 130, the raw material fluid flowing through the plurality of channels 131 is in contact with the electrode E, and an electrochemical reaction occurs in the electrode E.

[0053] In the channel part 130, the plurality of channels 131 may be provided in the form of straight lines so that the raw material fluid flows in a straight-line direction from one side, at which the supply-side passage part 220 is disposed, to the other side.

[0054] In addition, for example, the channel 131 may have a width WC2 that is greater than each of the widths W23 and W24 of the plurality of branch passages 223 of the supply-side passage part 220.

[0055] The manifold inlet 110 may be connected to the supply-side passage part 220, and the raw material fluid may flow thereinto. Here, the supply-side passage part 220 may supply the raw material fluid flowing from the manifold inlet 110.

[0056] The manifold inlet 110 may include one inflow hole.

[0057] The discharge-side passage part 240 may be connected to the other side portion of the channel part 130 to provide a plurality of passages through which reactants are discharged.

[0058] The discharge-side passage part 240 may have a shape corresponding to a shape of the supply-side passage part 220.

[0059] The manifold outlet 150 may be connected to the discharge-side passage part 240 so that the reactants are discharged.

[0060] Here, the reactants may be a carbon monoxide (CO), ethylene (C_2H_4), or the like.

[0061] The manifold outlet 150 may include one discharge hole.

Passage plate for electrolysis cell according to third embodiment

[0062] Hereinafter, a passage plate for an electrolysis cell according to a third embodiment of the present invention will be described.

[0063] FIG. 6 is a plan view illustrating an example of the passage plate for the electrolysis cell according to the third embodiment of the present invention. FIG. 7 is an enlarged plan view illustrating a portion of a supply-side passage part of the passage plate for the electrolysis cell according to the third embodiment of the present invention.

[0064] Referring FIGS. 1, 6, and 7, a passage plate 300 for an electrolysis cell according to the third embodiment of the present invention is the passage plate 300 for the electrolysis cell, which faces an electrode E that causes an electrochemical reduction reaction, and includes a supply-side passage part 320 that supplies a raw material fluid, and a channel part 130 in which a plurality of channels 131 through which the supplied raw material fluid flows are provided. In addition, the passage plate 300 for the electrolysis cell according to the third embodiment of the present invention may include a manifold inlet 110, a discharge-side passage part 340, and a manifold outlet 150.

[0065] The passage plate 300 for the electrolysis cell according to the third embodiment of the present invention is different in terms of a shape of passages branched through a passage block 321 in the supply-side passage part 320, when compared to the passage plates for the electrolysis cell according to the first and second embodiments described above. Thus, this embodiment will be described by omitting or simply describing the content in common with the embodiments described above and focusing on differences.

[0066] In more detail, in the passage plate 300 for the electrolysis cell according to the third embodiment of the present invention, a plurality of branch passages 323 through which a raw material fluid is supplied may be provided in the supply-side passage part 320. Here, the raw material fluid may include a carbon dioxide (CO_2) and an electrolyte. Here, the electrolyte may include water (H_2O).

[0067] The supply-side passage part 320 may be provided with a plurality of passage blocks 321, and the plurality of branch passages 323 may be branched through the plurality of passage blocks 321. Here, respective widths W31 and W32 of the plurality of branch passages 323 may be uniform. That is, the widths W31 and W32 of the plurality of branch passages 323 of the supply-side passage part 320 may be the same as each other. Here, a recessed groove 320a that is recessed inward from each of both side portions of the supply-side passage part 320 may be defined so that the width W31 of each of the branch passages 323 disposed at both the side portions of the supply-side passage part 320 is the same as the width W2 of each of the other branch passages 323 of the supply-side passage part 320.

[0068] Here, the plurality of branch passages 323 may be a passage portion facing the channel part 130.

[0069] Each of the plurality of passage blocks 321 may have, for example, a cross-section having a circular or non-circular shape. Here, each of the plurality of passage blocks 321 may have, for a specific example, a cross-section having a rhombus shape among non-circular shapes.

[0070] The channel part 130 may have one side portion that is connected to the supply-side passage part 320, and the plurality of channels 131 through which a carbon dioxide and an electrolyte that are a raw material fluid to be supplied flow may be provided.

[0071] In addition, as the channel part 130 faces an electrode E and the plurality of channels 131 are provided on a surface, which faces the electrode E, of the channel part 130, the raw material fluid flowing through the plurality of channels

131 is in contact with the electrode E, and an electrochemical reaction occurs in the electrode E.

[0072] In the channel part 130, the plurality of channels 131 may be provided in the form of straight lines so that the raw material fluid flows in a straight-line direction from one side, at which the supply-side passage part 320 is disposed, to the other side.

[0073] In addition, for example, the channel part 130 may have a width WC3 that is greater or less than each of the widths W31 and W32 of the plurality of branch passages 323 of the supply-side passage part 320, but the passage plate 300 for the electrolysis cell according to the third embodiment of the present invention is not necessarily limited thereto.

[0074] The manifold inlet 110 may be connected to the supply-side passage part 320, and the raw material fluid may flow thereinto. Here, the supply-side passage part 320 may supply the raw material fluid flowing from the manifold inlet 110.

[0075] The manifold inlet 110 may include one inflow hole.

[0076] The discharge-side passage part 340 may be connected to the other side portion of the channel part 130 to provide a plurality of passages through which reactants are discharged.

[0077] In addition, the discharge-side passage part 340 may have a shape corresponding to a shape of the supply-side passage part 320. That is, a passage shape of the discharge-side passage part 340 may be the same as a passage shape of the supply-side passage part 320.

[0078] The manifold outlet 150 may be connected to the discharge-side passage part 340 so that the reactants are discharged.

[0079] Here, the reactants may be a carbon monoxide (CO), ethylene (C_2H_4), or the like.

[0080] The manifold outlet 150 may include one discharge hole.

Electrolysis cell according to embodiment

[0081] Hereinafter, an electrolysis cell according to an embodiment of the present invention will be described.

[0082] Referring FIGS. 1 to 3, an electrolysis cell 1000 according to an embodiment of the present invention includes a passage plate 100 and an electrode E facing the passage plate 100. Here, the passage plate 100 is the passage plate 100 for the electrolysis cell, which faces the electrode E that causes an electrochemical reduction reaction, and includes a supply-side passage part 120 that supplies a raw material fluid, and a channel part 130 in which a plurality of channels 131 through which the supplied raw material fluid flows are provided. In addition, the passage plate 100 may include a manifold inlet 110, a discharge-side passage part 140, and a manifold outlet 150. The electrolysis cell 1000 according to an embodiment of the present invention may further include an ion exchange membrane I.

[0083] The electrolysis cell 1000 according to an embodiment of the present invention relates to the electrolysis cell 1000 including the passage plate for the electrolysis cell according to the first, second, or third embodiment described above. Thus, this embodiment will be described by omitting or simply describing the content in common with the embodiments of the passage plates for the electrolysis cell according to the first to third embodiments described above and focusing on differences.

[0084] In more detail, the electrode E may face the passage plate 100 to cause an electrochemical reduction reaction. Here, the electrode E may electrolyze, for example, a carbon dioxide (CO_2) into a carbon monoxide (CO), ethylene (C_2H_4), or the like.

[0085] The electrode E may include an anode A and a cathode C.

[0086] In the passage plate 100, a plurality of branch passages 123 through which a raw material fluid is supplied may be provided in the supply-side passage part 120. Here, the raw material fluid may include a carbon dioxide (CO_2) and an electrolyte. Here, the electrolyte may include water (H_2O). The supply-side passage part 120 may be provided with a plurality of passage blocks 121, and the plurality of branch passages 123 may be branched through the plurality of passage blocks 121. Here, respective widths W1 and W2 of the plurality of branch passages 123 may be uniform. That is, the widths W1 and W2 of the plurality of branch passages 123 of the supply-side passage part 120 may be the same as each other. Here, the plurality of branch passages 123 may be a passage portion facing the channel part 130.

[0087] The channel part 130 may have one side portion that is connected to the supply-side passage part 120, and the plurality of channels 131 through which a carbon dioxide and an electrolyte that are a raw material fluid to be supplied flow may be provided. In addition, as the channel part 130 faces an electrode E and the plurality of channels 131 are provided on a surface, which faces the electrode E, of the channel part 130, the raw material fluid flowing through the plurality of channels 131 is in contact with the electrode E, and an electrochemical reaction occurs in the electrode E.

[0088] The channel part 130 may have an area of, for example, 100 cm^2 or greater. Thus, the electrolysis cell 1000 according to an embodiment of the present invention may have an active area of 100 cm^2 or greater.

[0089] In addition, the passage plate 100 may be provided in plurality, and the plurality of passage plates 100 may face the anode A and the cathode C, respectively.

[0090] The plurality of passage plates 100 may include a first passage plate P1 facing the anode A, and a second passage plate P2 facing the cathode C.

[0091] Here, each of the passage plates 100, 200 and 300 for the electrolysis cell according to the first to third

embodiments described above may include at least one of the first passage plate P1 or the second passage plate P2. Here, for a specific example, each of the passage plates 100, 200 and 300 for the electrolysis cell according to the first to third embodiments described above may be the first passage plate P1, but the present invention is not necessarily limited thereto. Each of the passage plates 100, 200 and 300 may be the second passage plate P2, or the first passage plate P1 and the second passage plate P2. (See FIGS. 2, 4, and 6.)

[0092] The ion exchange membrane (IEM) I may be disposed between the anode A and the cathode C. Here, ions may move between the anode A and the cathode C through the ion exchange membrane I.

[0093] In the electrolysis cell 1000 according to an embodiment of the present invention, the first passage plate P1, the anode A, the ion exchange membrane I, the cathode C, and the second passage plate P2 may be stacked in sequence.

<Manufacturing Example 1>

[0094] A passage plate for an electrolysis cell that electrolyzes a carbon dioxide (CO_2) through an electrochemical reduction reaction was manufactured. The passage plate was provided to face an electrode in which the electrochemical reduction reaction occurs.

[0095] The passage plate was manufactured to include a supply-side passage part, in which a passage for supplying a carbon dioxide and an electrolyte, which is branched into a plurality of branch passages through a plurality of passage blocks, is provided, and a channel part, which has one side portion connected to the supply-side passage part and in which a plurality of channels through which the supplied carbon dioxide and electrolyte flow are provided. Here, the plurality of branch passages were manufactured so that respective widths thereof are uniform.

[0096] The passage plate was manufactured to further include a manifold inlet, which is connected to the supply-side passage part and into which the carbon dioxide and the electrolyte flow, a discharge-side passage part, which is connected to the other side portion of the channel part and in which a plurality of channels through which reactants are discharged, and a manifold outlet connected to the discharge-side passage part.

[0097] Each of the passage blocks was manufactured to have a circular cross-section, and the plurality of branch passages of the supply-side passage part were manufactured so that the number and positions thereof correspond to the number and positions of the plurality of channels of the channel part.

<Manufacturing Example 2>

[0098] A passage plate for an electrolysis cell was manufactured to be the same as Manufacturing Example 1, except that a plurality of passage blocks are provided in two rows, the passage blocks are disposed to be misaligned between the rows, and the number of branch passages of a supply-side passage part is provided to be greater than the number of channels of a channel part.

<Manufacturing Example 3>

[0099] A passage plate for an electrolysis cell was manufactured to be the same as Manufacturing Example 1, except that a cross-section of a passage block has a rhombus shape, the number of branch passages of a supply-side passage part is provided to be less than the number of channels of a channel part, and a recessed groove that is recessed inward from each of both side portions of the supply-side passage part is defined so that a width of each of branch passages disposed at both the side portions of the supply-side passage part is the same as a width of each of the other branch passages of the supply-side passage part.

<Comparative Example 1>

[0100] A passage plate for an electrolysis cell was manufactured to be the same as Manufacturing Example 1, except that a cross-section of a passage block has a rhombus shape, the number of branch passages of a supply-side passage part is provided to be less than the number of channels of a channel part, respective widths of the plurality of branch passages are provided to be nonuniform, and a width of each of the branch passages disposed at both side portions of the supply-side passage part is provided to be greater than a width of each of the other branch passages of the supply-side passage part.

<Experimental Example 1>

[0101] FIG. 8 is an image illustrating flow velocity distribution in the passage plate for the electrolysis cell according to Comparison Example 1. FIG. 9 is an image illustrating flow velocity distribution in the passage plate for the electrolysis cell according to Manufacturing Example 1. FIG. 10 is an image illustrating flow velocity distribution in the passage plate for the

electrolysis cell according to Manufacturing Example 2. FIG. 11 is an image illustrating flow velocity distribution in the passage plate for the electrolysis cell according to Manufacturing Example 3.

[0102] In FIGS. 8 to 11, the images show fluid-flow velocity distribution during a process from allowing of a fluid of a carbon dioxide and an electrolyte to flow into a manifold inlet to discharging of the fluid through a discharge-side outlet in the passage plates for the electrolysis cell according to Comparison Example 1 and Manufacturing Examples 1 to 3.

[0103] In addition, deviations in flow rate of the fluid in a channel part measured in Experimental Example 1 are shown in Table 1 below.

[Table 1]

	Comparison Example 1	Manufacturing Example 1	Manufacturing Example 2	Manufacturing Example 3
flow rate deviation (%)	8.45	2.99	2.96	4.40

[0104] According to the image of the flow velocity distribution in the channel part of the passage plate according to Comparison Example 1 shown in FIG. 8, both side portions are represented by hatched portions in which the flow velocity is remarkably rapid, and the other portions are represented by dark grey portions in which the partial flow velocity is relatively slow. Accordingly, it may be known that the flow velocity between the channels of the channel part is remarkably nonuniform in Comparison Example 1. In contrast, according to the images of the flow velocity distribution in the channel parts of the passage plate according to Manufacturing Example 1 shown in FIG. 9, the passage plate according to Manufacturing Example 2 shown in FIG. 10, and the passage plate according to Manufacturing Example 3 shown in FIG. 11, the flow velocity is indicated in light grey to be uniform in both side portions and the other portions. Accordingly, it may be known that the flow velocity between the channels of the channel part is remarkably uniform in Manufacturing Examples 1 to 3. Thus, it may be known that the shapes and arrangement of the passage blocks that branch the passages are nonuniform in Comparison Example 1 so that the flow rate is biased to some channels disposed at both edges, and it may be known that the shapes and arrangement of the passage blocks that branch the passages are uniform in Manufacturing Examples 1 to 3 so that the flow rate in all the channels is uniform without the flow rate biased to some channels.

[0105] In addition, referring to Table 1, it may be known that in the flow rate deviation (%), Comparison Example 1 has a deviation of 8.45 which is great, whereas Manufacturing Examples 1, 2, and 3 show deviations of 2.99, 2.96, and 4.40, respectively, which are remarkably small.

[0106] Thus, compared to Comparison Example 1, Manufacturing Examples 1 and 2 may reduce the flow rate deviation between the channels by 74%, and Manufacturing Example 3 may improve the flow rate deviation by 48%.

[0107] As a result, it may be known that when compared to the passage plate for the electrolysis cell according to Comparison Example 1, the passage plates for the electrolysis cell according to Manufacturing Examples 1 to 3 may have been remarkably improved in terms of flow distribution of reactants and products necessary for electrolysis of a carbon dioxide.

[0108] Although the present invention has been described in detail with reference to the limited embodiments, the embodiments are intended to specifically describe the present invention, and a post-processing apparatus according to the present invention is not limited thereto. The present invention may be variously implemented by those of ordinary skill in the art, to which the present invention pertains, within the technical idea of the present invention.

[0109] Moreover, the specific protective scope of the present invention will be clarified by the accompanying claims.

[Description of the Symbols]

[0110]

100,200,300,500: Passage plate
110: Manifold inlet
120,220,320: Supply-side passage part
121,221,222,321: Passage block
123,223,323: Branch passage
130: Channel part
131: Channel
131a: Channel protrusion
140,240,340: Discharge-side passage part
141,341: Discharge-side passage block
150: Manifold outlet

320a: Recessed groove
1000: Electrolysis cell
A: Anode
C: Cathode
E: Electrode
I: Ion exchange membrane
P1: First passage plate
P2: Second passage plate

Claims

1. A passage plate for an electrolysis cell, which faces an electrode configured to cause an electrochemical reaction, the passage plate comprising:

   a supply-side passage part in which a branch passage, which is branched into a plurality of passages through which a raw material fluid is supplied, is provided; and
   a channel part which has one side portion connected to the supply-side passage part, and in which a plurality of channels through which the supplied raw material fluid flows are provided,
   wherein the supply-side passage part comprises a plurality of passage blocks,
   the plurality of branch passages are branched through the plurality of passage blocks, and
   respective widths of the plurality of branch passages are uniform.

2. The passage plate of claim 1, wherein the channel part faces the electrode, wherein the plurality of channels are provided on a surface, which faces the electrode, of the channel part so that the raw material fluid flowing through the plurality of channels is in contact with the electrode, and the electrochemical reaction occurs in the electrode.

3. The passage plate of claim 1, wherein the number of the plurality of branch passages of the supply-side passage part corresponds to the number of the plurality of channels.

4. The passage plate of claim 1, wherein positions of the plurality of branch passages of the supply-side passage part and positions of the plurality of channels of the channel part are provided to correspond to each other.

5. The passage plate of claim 1, wherein each of the plurality of passage blocks has a circular cross-section.

6. The passage plate of claim 5, wherein the plurality of passage blocks are arranged in a plurality of rows,
   wherein the plurality of passage blocks arranged in the plurality of rows are disposed to be misaligned with each other between the rows.

7. The passage plate of claim 1, wherein each of the plurality of passage blocks has a non-circular cross-section.

8. The passage plate of claim 1, wherein a width of each of the branch passages disposed at both side portions of the supply-side passage part is provided to be the same as a width of each of the other passages of the supply-side passage part.

9. The passage plate of claim 1, further comprising a manifold inlet which is connected to the supply-side passage part and into which the raw material fluid flows,
   wherein the supply-side passage part supplies the raw material fluid flowing from the manifold inlet.

10. The passage plate of claim 1, wherein further comprising:

    a discharge-side passage part which is connected to the other side portion of the channel part, and in which a plurality of branches passages through which reactants are discharged are provided; and
    a manifold outlet connected to the discharge-side passage part.

11. The passage plate of claim 10, wherein the discharge-side passage part has a shape corresponding to a shape of the supply-side passage part.

12. The passage plate of claim 1, wherein the plurality of channels are provided in the form of straight lines so that the raw material fluid flows in a straight-line direction from one side, at which the supply-side passage part is disposed, to the other side.

13. The passage plate of claim 1, wherein the raw material fluid comprises a carbon dioxide (CO_2), and an electrolyte comprising water (H_2O) so that the carbon dioxide is electrolyzed in the electrode through an electrochemical reduction reaction.

14. An electrolysis cell comprising:

the passage plate for the electrolysis cell of any one of claims 1 to 13; and
an electrode facing the passage plate.

15. The electrolysis cell of claim 14, wherein the electrode comprises an anode and a cathode,

the passage plate is provided in plurality, and the plurality of passage plates face the anode and the cathode, respectively, and
the electrolysis cell further comprises an ion exchange membrane (IEM) disposed between the anode and the cathode.

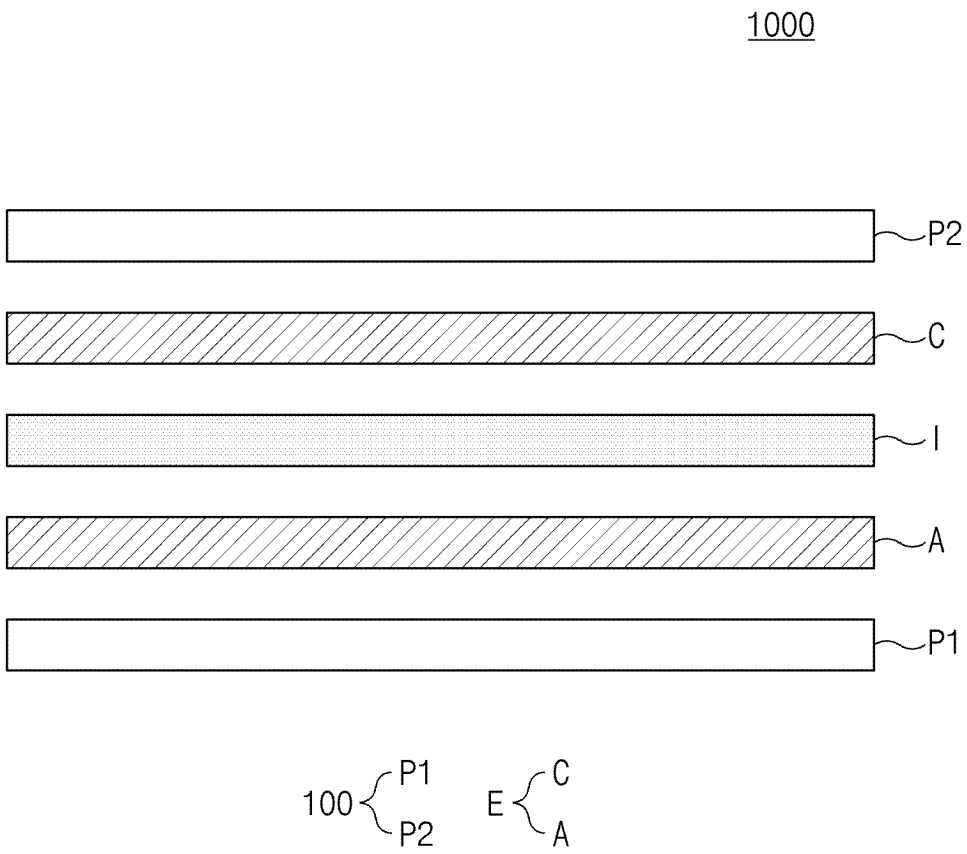

FIG.1

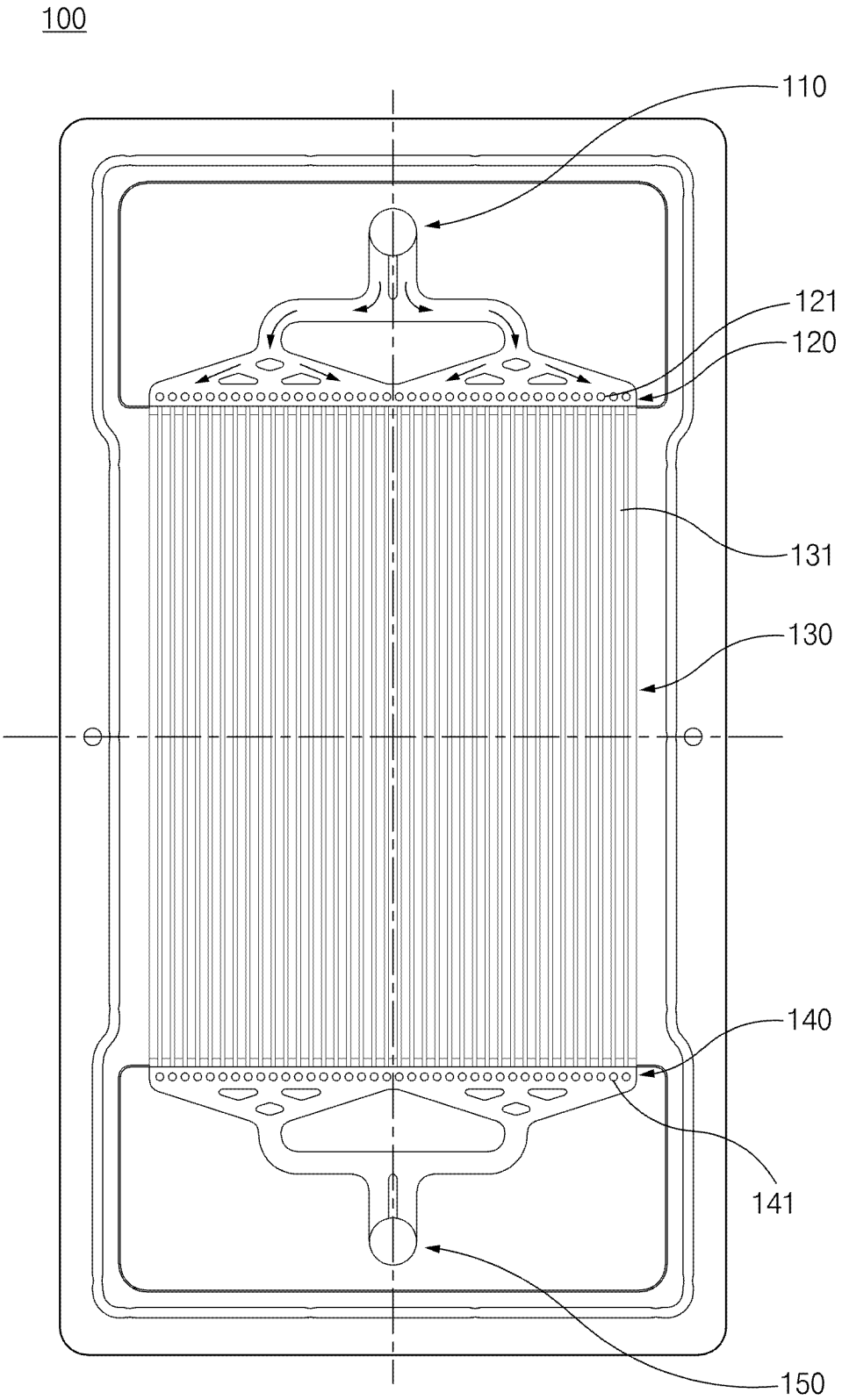

FIG.2

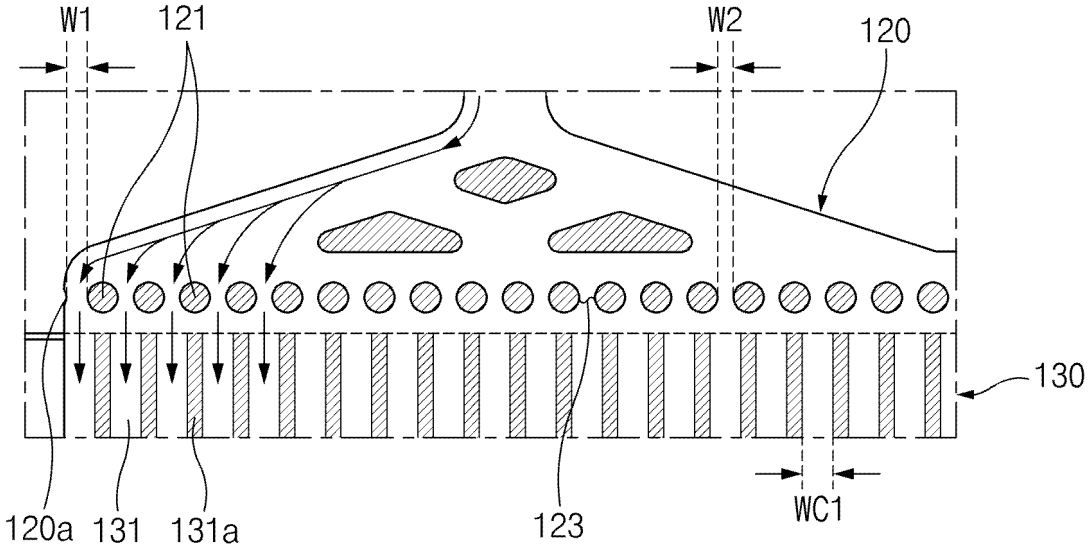

FIG.3

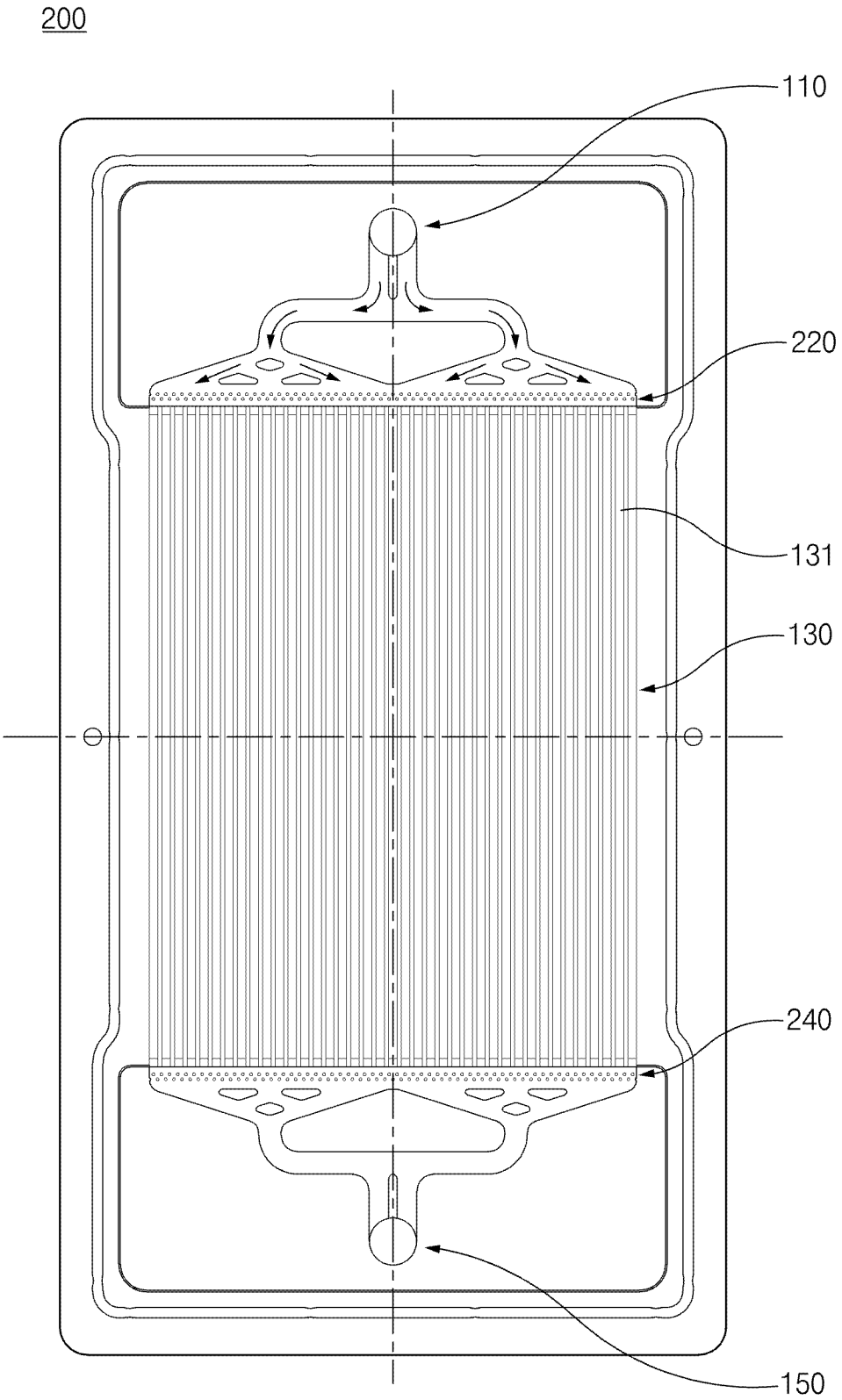

FIG.4

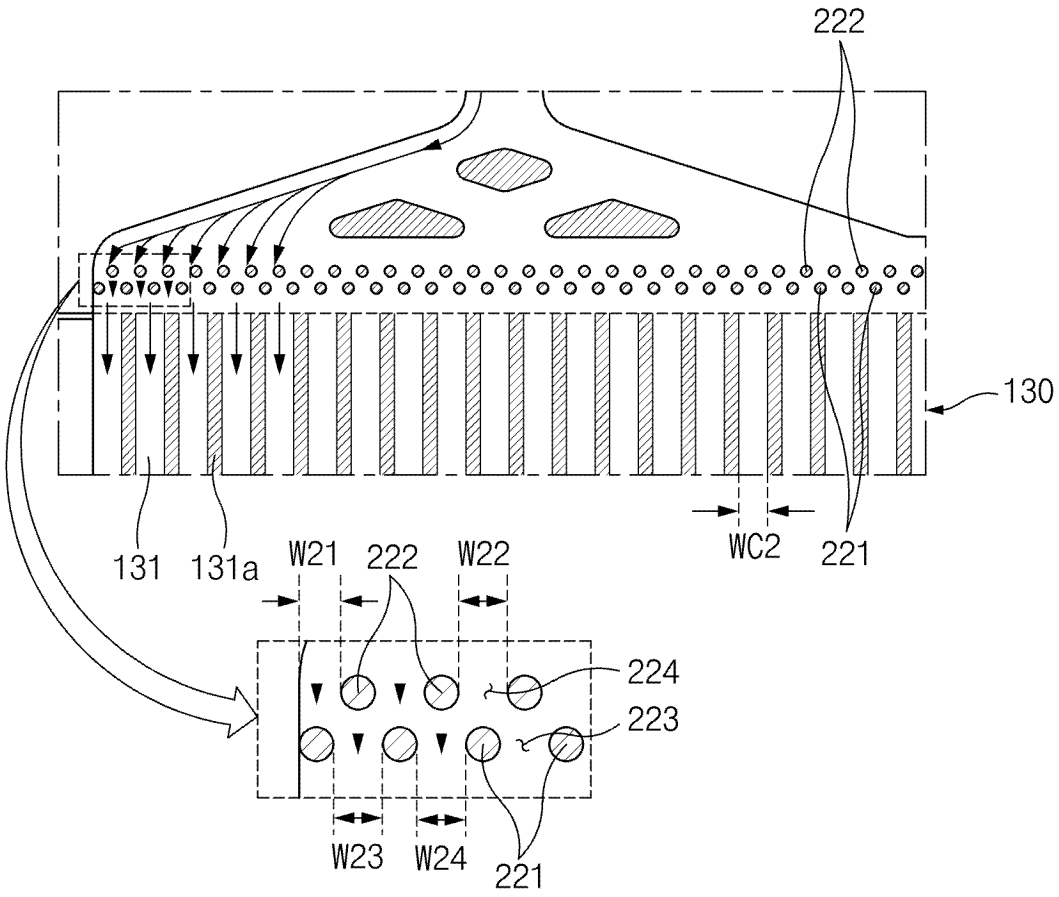

FIG.5

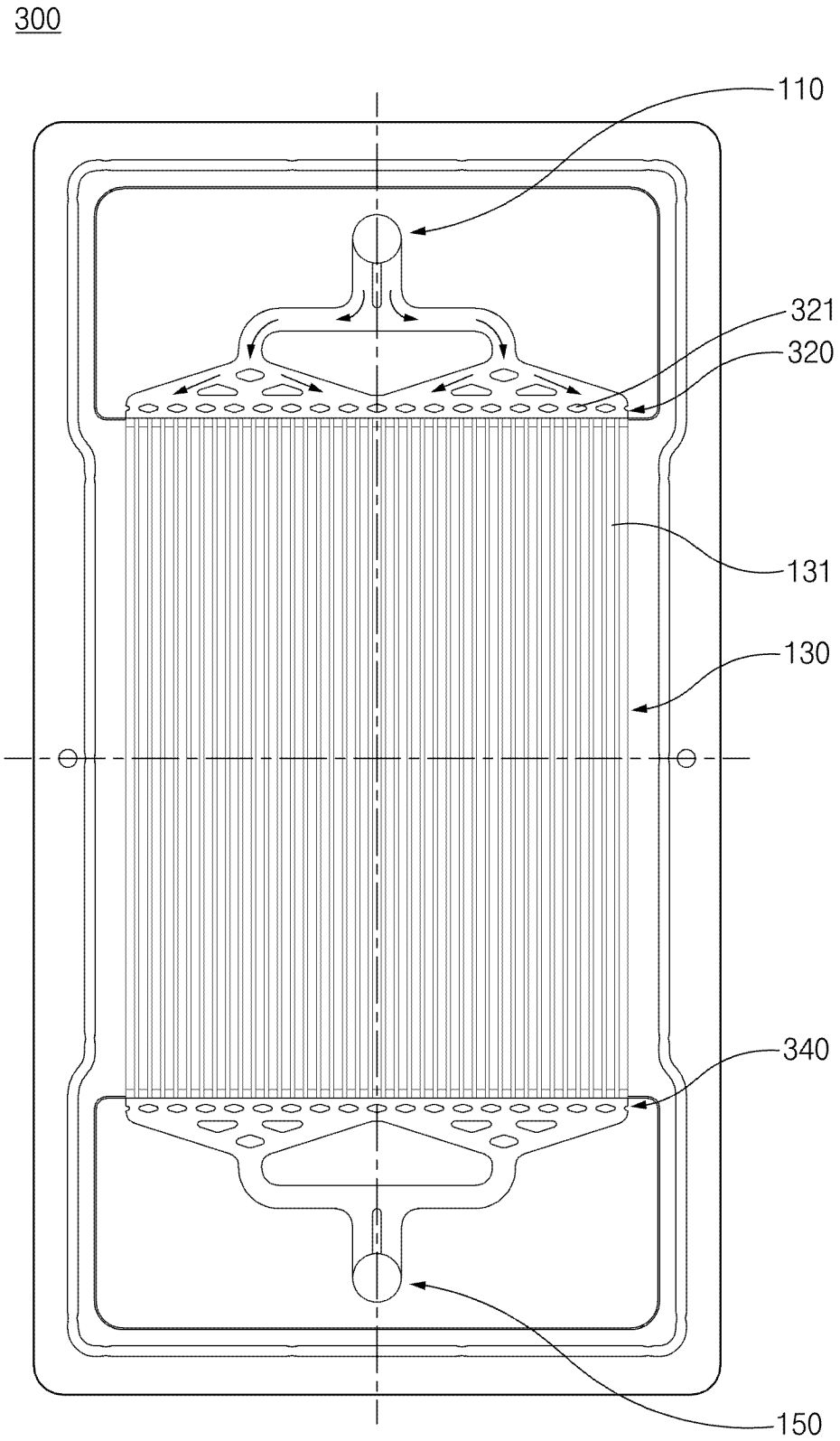

FIG.6

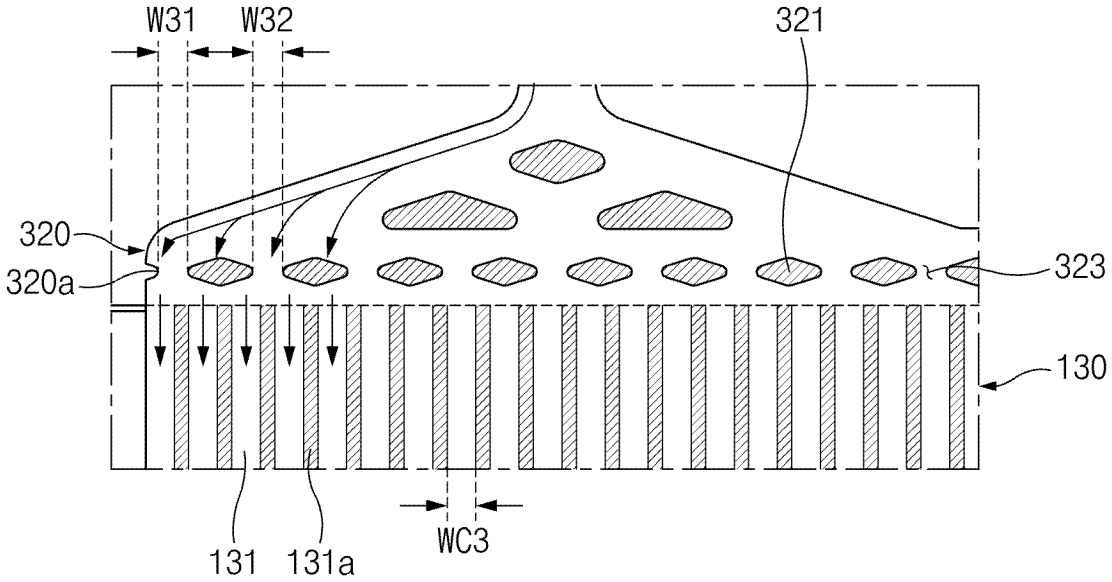

FIG.7

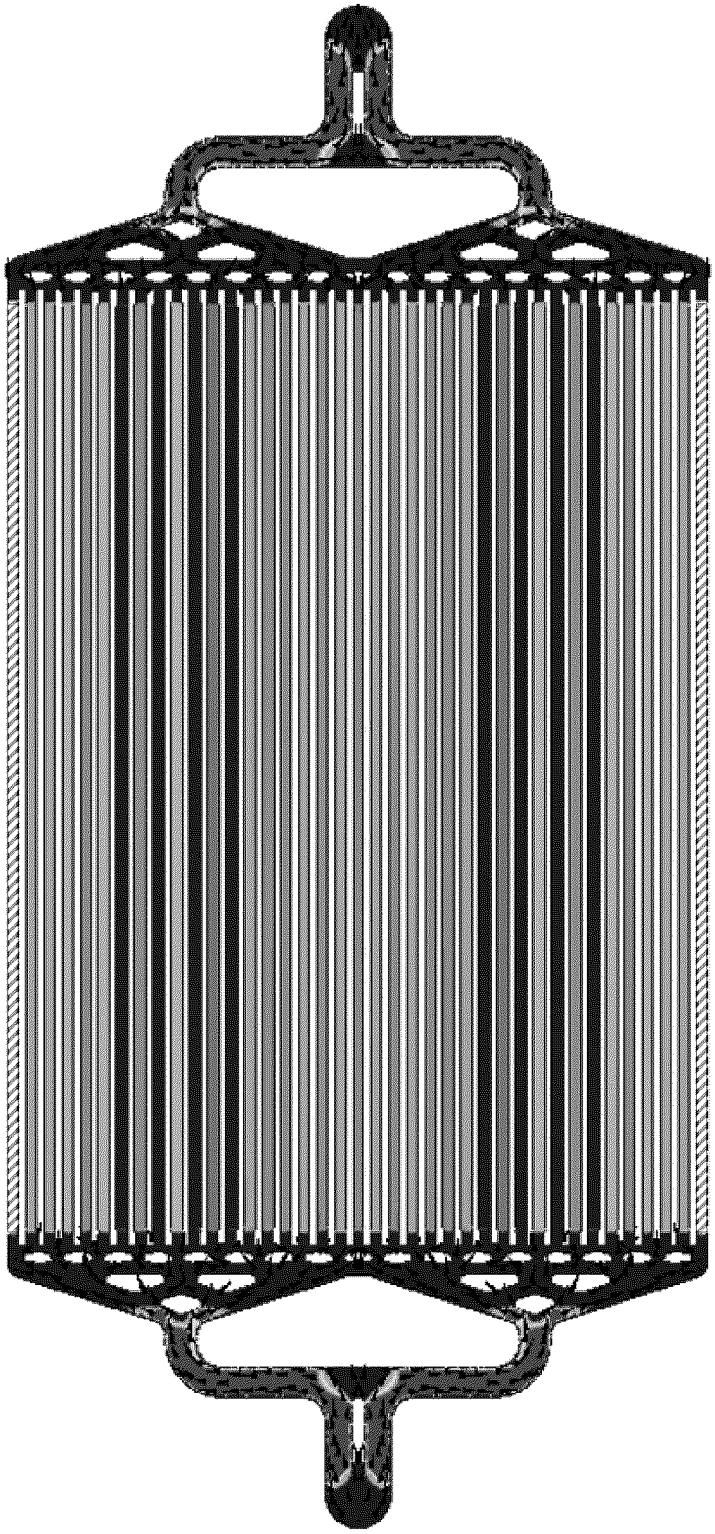

FIG.8

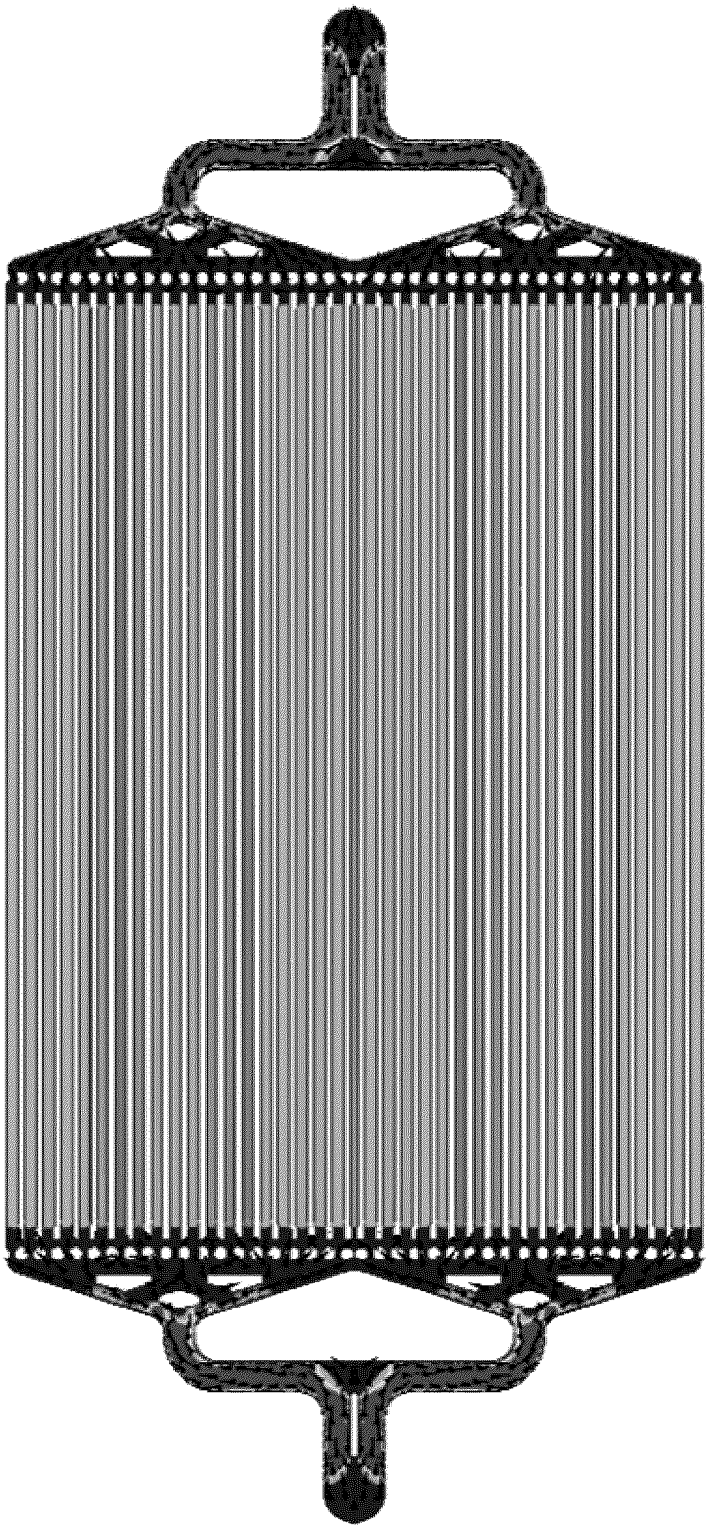

FIG.9

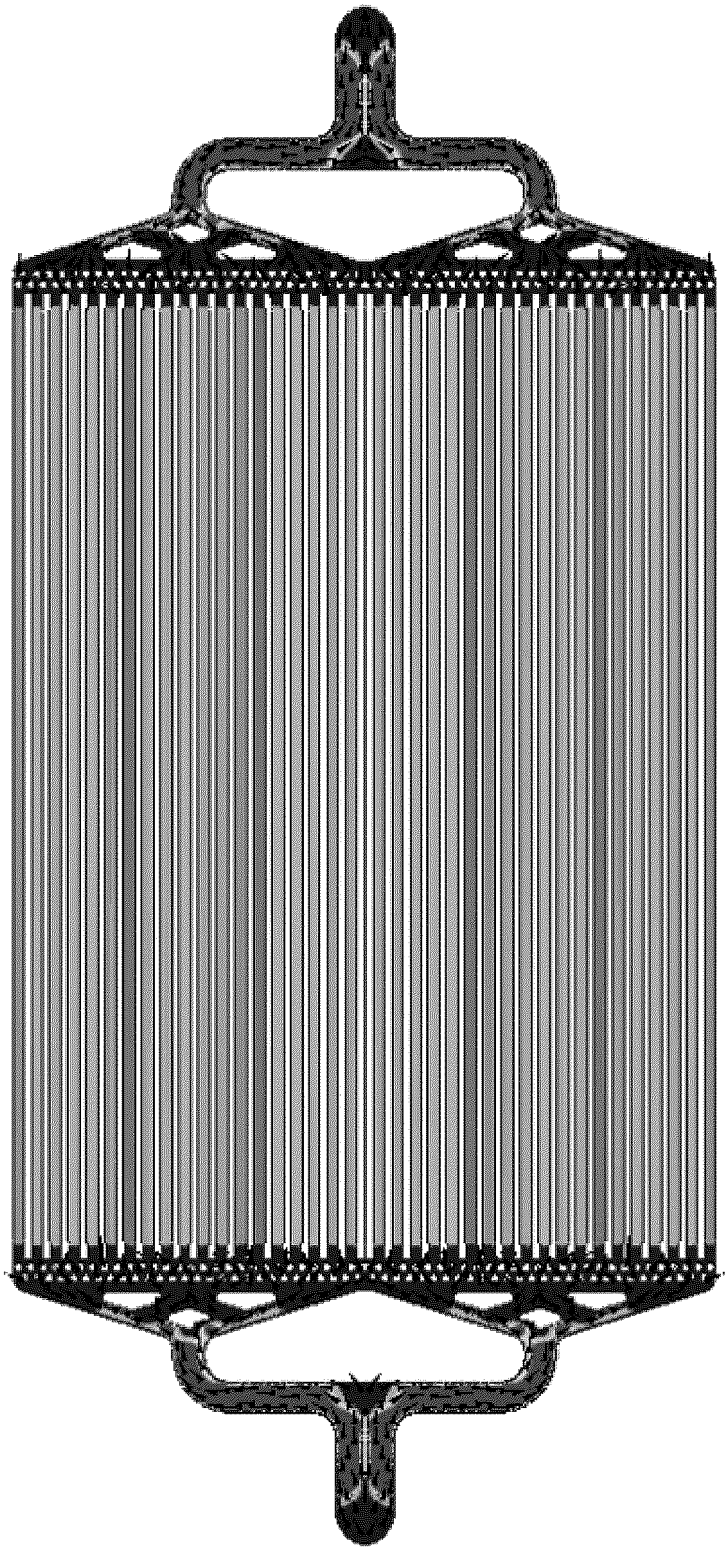

FIG.10

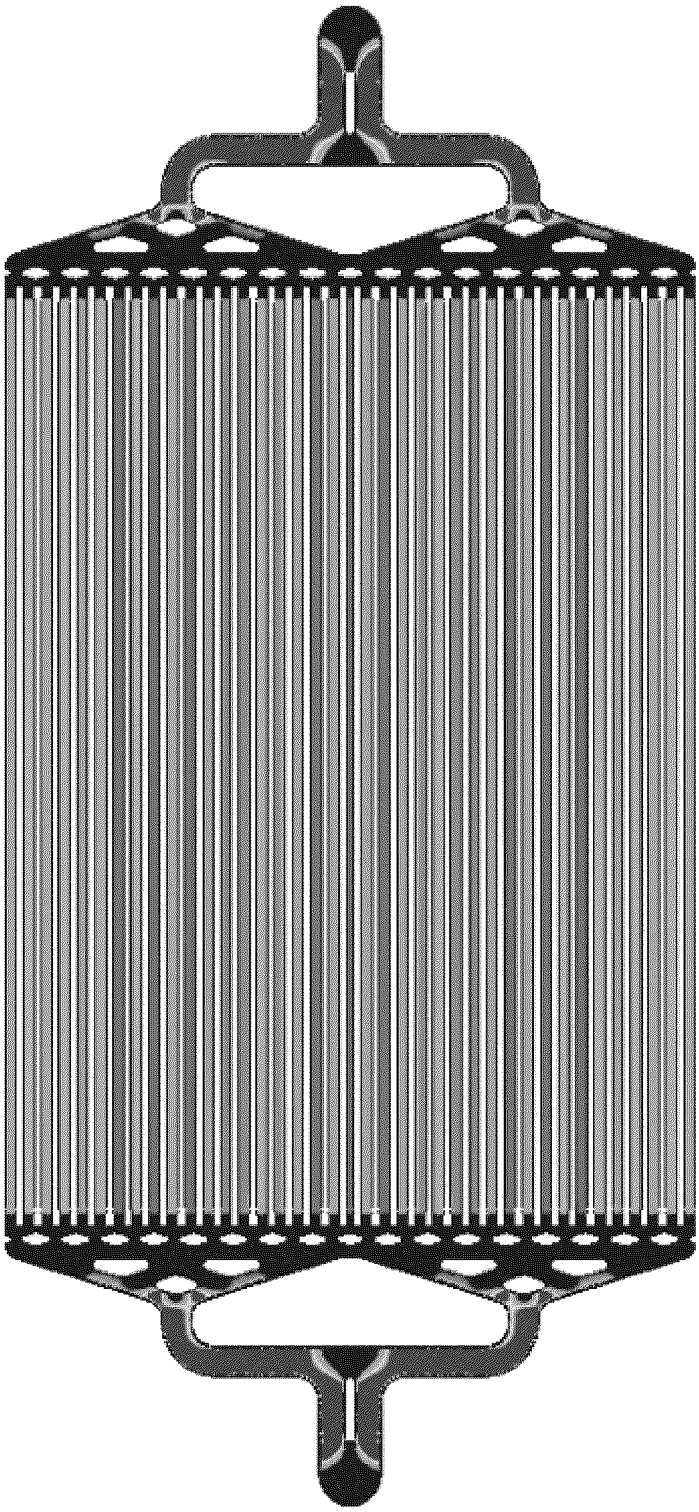

FIG.11

INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2023/013049

A. CLASSIFICATION OF SUBJECT MATTER

C25B 9/75(2021.01)i; **C25B 9/77**(2021.01)i; **C25B 15/08**(2006.01)i; **C25B 13/02**(2006.01)i; **C25B 1/23**(2021.01)i; **C25B 3/26**(2021.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

C25B 9/75(2021.01); B01J 23/46(2006.01); C25B 1/04(2006.01); C25B 9/00(2006.01); C25B 9/10(2006.01); C25B 9/21(2021.01)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Korean utility models and applications for utility models: IPC as above
Japanese utility models and applications for utility models: IPC as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

eKOMPASS (KIPO internal) & keywords: 전기분해 셀(electrolysis cell), 유로 플레이트(flow path plate), 유로블럭(flow path block), 채널(channel), 전극(electrode)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	CN 216786268 U (QINGDAO CREATIVE JINDE NEW ENERGY SCIENCE AND TECHNOLOGY CO., LTD.) 21 June 2022 (2022-06-21) See paragraphs [0030], [0033]-[0034] and [0036]; and figures 2-3.	1-15
A	KR 10-2017-0035735 A (KOREA ELECTRIC POWER CORPORATION et al.) 31 March 2017 (2017-03-31) See entire document.	1-15
A	US 2011-0132748 A1 (HARYU, Eiji et al.) 09 June 2011 (2011-06-09) See entire document.	1-15
A	KR 10-2018-0130126 A (DOOSAN CORPORATION) 07 December 2018 (2018-12-07) See entire document.	1-15

☑ Further documents are listed in the continuation of Box C. ☑ See patent family annex.

* Special categories of cited documents:
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"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
06 December 2023	**08 December 2023**
Name and mailing address of the ISA/KR **Korean Intellectual Property Office** **Government Complex-Daejeon Building 4, 189 Cheongsa-ro, Seo-gu, Daejeon 35208** Facsimile No. **+82-42-481-8578**	Authorized officer Telephone No.

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2023/013049

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	KR 10-1773969 B1 (KOREA INSTITUTE OF SCIENCE AND TECHNOLOGY) 04 September 2017 (2017-09-04) See entire document.	1-15

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/KR2023/013049

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		JP 4838879 B2	14 December 2011
		JP 4891383 B2	07 March 2012
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KR 10-2018-0130126 A	07 December 2018	KR 10-2405614 B1	03 June 2022
KR 10-1773969 B1	04 September 2017	US 10461350 B2	29 October 2019
		US 2018-0138534 A1	17 May 2018

Form PCT/ISA/210 (patent family annex) (July 2022)

REFERENCES CITED IN THE DESCRIPTION

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- KR 1020220110644 **[0001]**
- KR 1020230115367 **[0001]**