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(54) Title: A UNIT CELL ASSEMBLY OF A FUEL CELL ASSEMBLY

(57) Abstract: Present disclosure relates to a unit cell assembly (100) comprising at least one first bipolar plate (101) defined with a plurality of first corrugations (117 and 118) and a first flow field zone (113). At least one second bipolar plate (102) is defined with a plurality of second corrugations (135 and 136) complementary to the plurality of first corrugations (117 and 118) and a second flow field zone (131). The plurality of first and second corrugations comprises a first and second electrically conductive materials (124, 141) entrenched within, respectively. At least one membrane electrode assembly (103) is housed within a periphery of a cover (104) and interposed between the at least one first bipolar and the at least one second bipolar plate. The first and second electrically conductive materials are configured to contact the at least one membrane electrode assembly for electrical conductivity. A fuel cell assembly is also disclosed.

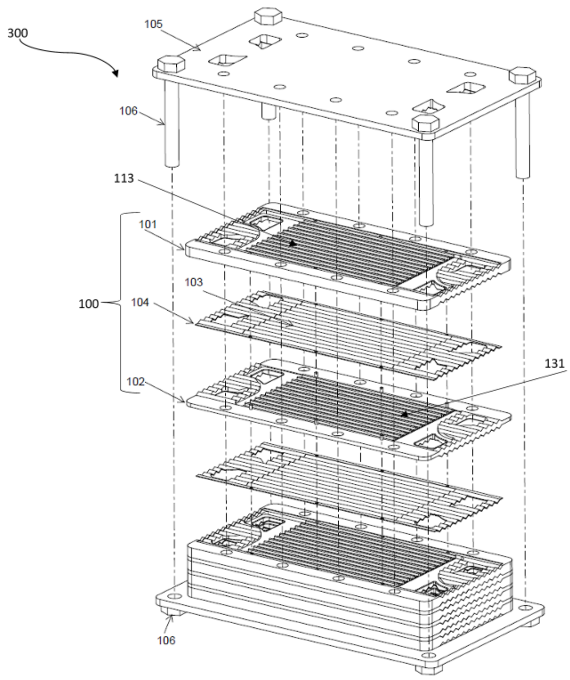

Fig. 1

FORM 2

THE PATENTS ACT 1970
(39 OF 1970)
&
The Patent Rules, 2003

Complete Specification

(See Section 10 and Rule 13)

1. TITLE OF THE INVENTION

A UNIT CELL ASSEMBLY OF A FUEL CELL ASSEMBLY

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3. PREAMBLE TO THE DESCRIPTION

COMPLETE

The following specification describes the invention and the manner in which it is to be performed

TECHNICAL FIELD

[0001] Present disclosure relates to a field of an electrochemical reaction cells. More particularly, aspects of the present disclosure relate to fuel cells and electrolysers.

BACKGROUND

[0002] Fuel cells convert chemical energy of fuel and oxidant into electrical energy. Typically, fuel cells are used in space, transportation, material handling, power backup systems and many other applications to generate continuous electric power. Electrolysers convert electric energy and water into hydrogen and oxygen. Electrolysers are used to produce hydrogen and oxygen by water electrolysis process. Fuel cells and electrolysers include at least two electrodes designated as an anode and a cathode which are separated by an electrolyte media.

[0003] Fuel cells are classified based on the type of electrolyte media used. These include Alkaline fuel cells, molten carbonate fuel cells, direct methanol fuel cells, solid oxide fuel cells, phosphoric acid fuel cells, and polymer electrolyte membrane (PEM) fuel cells. PEM fuel cells have emerged as a potential alternative to fossil fuels due to high energy density, zero carbon emissions and lower operating temperature. PEM fuel cells convert fuel and oxidant into electricity, with water and heat as by product during exothermic reaction process. Typically, PEM fuel cell comprises an ion exchange membrane generally known as polymer electrolyte membrane or proton exchange membrane (PEM) disposed between an anode electrode layer and a cathode electrode layer. An anode electrode layer and a cathode electrode layer have a catalyst material coating to promote electrochemical reaction. The polymer electrolyte membrane, an anode electrode layer and a cathode electrode layer are jointly called a membrane electrode assembly (MEA). A solid, gas impermeable plates generally known as bipolar plates comprising a plurality of gas flow channels are used to supply fuel and oxidant to anode and cathode respectively. A thin and porous layer generally known as a gas diffusion layer (GDL) is disposed between bipolar plate and electrode to facilitate rapid diffusion and transport of reactants to catalyst layer.

[0004] In operation, the fuel such as hydrogen and oxidant such as air or oxygen is supplied through flow field channels of bipolar plates to gas diffusion layers. Hydrogen diffuses rapidly through an anode gas diffusion layer and oxidized at the anode catalyst layer to release electrons and hydrogen ions. These electrons pass from the anode electrode to the cathode electrode through an external circuit. The polymer electrolyte membrane (PEM) restricts electrons from passing through but allows hydrogen ions to pass from anode electrode to cathode electrode. Further, the oxidant such as oxygen diffuses rapidly through a cathode gas diffusion layer and combine with the hydrogen ions and electrons at the cathode catalyst layer to form water.

[0005] Conventionally, the fuel cell such as the PEM fuel cell employs a flat or planar bipolar plates which comprise a plurality of flow field channels designed to supply reactants (fuel and oxidant) to the flat membrane electrode assembly (MEA). The bipolar plate performs several functions such as allowing the fuel and the oxidant to pass through the flow field channels on the anode and the cathode, respectively. The bipolar plates also collect current from electrodes and provides series connection between multiple cells at stack level and provides a structural support to the MEA. These conventional bipolar plates are manufactured from metal, graphite, or carbon composites to permit transfer of electrons between anode and cathode. However, the metallic bipolar plates have several disadvantages such as corrosion, catalyst/membrane poisoning, having relatively higher weight and formation of insulating surface oxides. The metallic bipolar plates also involve high manufacturing cost in case corrosion resistant coatings are to be employed. In addition, the graphite bipolar plates are generally formed into a flat or planar plate of required thickness and removing material to create flow field channels. Although, the graphite bipolar plates have substantial corrosion resistance and are lighter in weight but offers poor structural strength.

[0006] Furthermore, use of conventional flat or planar bipolar plates and MEA in a fuel cell stack/assembly are not leak proof as they tend to slack or loosen when subjected to dynamic loading conditions. Thus, the flat bipolar plates and the MEA undergo planar and out-of-plane separation with respect to each other causing gas cross over and leakage between MEA and flow field channels. This affects the operational efficiency and durability of the fuel cell stack.

[0007] The present disclosure is directed to overcome one or more limitations stated above or any other limitations associated with the prior art. The information disclosed in this background of the disclosure section is only for enhancement of understanding of the general background of the invention and should not be taken as an acknowledgement or any form of suggestion that this information forms the prior art already known to a person skilled in the art.

SUMMARY OF THE INVENTION

[0008] One or more shortcomings of conventional bipolar plates in a fuel cell assembly have been overcome, and additional advantages are provided through a unit cell assembly as claimed in the present disclosure. Additional features and advantages are realized through the techniques of the present disclosure. Other embodiments and aspects of the disclosure are described in detail herein and are considered a part of the claimed disclosure.

[0009] The limitations of the prior arts are addressed by a unit cell assembly of a fuel cell assembly as disclosed in the present disclosure. The unit cell assembly comprises at least one first bipolar plate defined with a plurality of first corrugations and a first flow field zone. The plurality of first corrugations comprises a first electrically conductive material entrenched within. At least one second bipolar plate is defined with a plurality of second corrugations and a second flow field zone. The plurality of second corrugations comprises a second electrically conductive material entrenched within. The plurality of second corrugations of the at least one second bipolar plate is complimentary to the plurality of first corrugations of the at least one first bipolar plate. Further, at least one membrane electrode assembly is housed within a periphery of the at least one cover and is interposed between the at least one first bipolar plate and the at least one second bipolar plate. The first electrically conductive material entrenched within the plurality of first corrugations and the second electrically conductive material entrenched within the plurality of second corrugations are configured to contact the at least one membrane electrode assembly for electrical conductivity.

[0010] In an embodiment of the present disclosure, the plurality of first corrugations comprises a plurality of first crests and a plurality of first troughs in an alternating configuration in a first flow field zone of the at least one first bipolar plate to define a plurality of first flow field channels therebetween for a flow of reactants.

[0011] In an embodiment, the plurality of second corrugations comprises a plurality of second crests and a plurality of second troughs in an alternating configuration in a second flow field zone of the at least one second bipolar plate to define a plurality of second flow field channels therebetween for the flow of reactants.

[0012] In an embodiment, the at least one first bipolar plate comprises a plurality of first cooling channels defined on a planar face of the at least one first bipolar plate for a coolant flow. At least one recess is defined around the periphery of the first flow field zone and extending across a length of the at least one first bipolar plate in a longitudinal direction. The at least one recess is configured to receive the membrane electrode assembly, the cover and the at least one second bipolar plate. Further, a plurality of provisions is defined on the at least one recess of the at least one first bipolar plate. At least one first anode inlet manifold and at least one first anode outlet manifold is provided for entry and exit of a fuel respectively of the at least one first bipolar plate. At least one first cathode inlet manifold and at least one first cathode outlet manifold is provided for entry and exit of an oxidant respectively of the at least one first bipolar plate. A first inlet header and a first outlet header through which reactants passes before entering the flow field zone of the at least one first bipolar plate. A first end corrugated surface is defined on either ends of the at least one first bipolar plate.

[0013] In an embodiment, the at least one second bipolar plate comprises a plurality of second cooling channels defined on planar faces of the at least one second bipolar plate for the coolant flow. A plurality of flanges defined on the planar faces of the at least one second bipolar plate. At least one second anode inlet manifold, and at least one second anode outlet manifold for entry and exit of the fuel respectively, of the at least one second bipolar plate. At least one second cathode inlet manifold and at least one second cathode outlet manifold is provided for entry and exit of the oxidant respectively of the at least one second bipolar plate. The at least one second bipolar plate comprises a second inlet header and a second outlet header through which the reactants pass before entering the second flow field zone of the at least one second bipolar plate. A second end corrugated surface is defined on either ends of the at least one second bipolar plate.

[0014] In an embodiment, the first and second electrically conductive materials are at least a silver, or combination of different electrically conductive materials, entrenched in form of a cross grid, a parallel grid, a coating, or a plurality of layers.

[0015] In an embodiment, the at least one first bipolar plate and the at least one second bipolar plate are formed of glass composites and more particularly of an S-glass material with a chemical composition of oxides of silicon, aluminum, and magnesium.

[0016] In an embodiment, the fuel cell stack/assembly comprises at least one end plate. The at least one end plate comprises a corrugation zone defined with a plurality of recesses configured to fit into the plurality of first crests of the at least one first bipolar plate. The corrugation zone is defined with the plurality of recesses configured to fit into a plurality of first troughs of the at least one first bipolar plate. Further, the corrugation zone is defined with a plurality of first flanges configured to fit into the plurality of first flow field channels of the at least one first bipolar plate. A plurality of second flanges is provided on both ends of the corrugation zone in a transverse direction and configured to fit into the at least one recess of the at least one first bipolar plate. An end corrugation is defined on both ends of the end plate in the longitudinal direction and configured to fit into the first end corrugated surface of the at least one first bipolar plate. A plurality of third cooling channels is defined on planar faces and are configured to receive the coolant for the coolant flow. The at least one end plate is configured to enclose the unit cell assembly, wherein the at least one end plate is fastened by a fastening means at either ends of the unit cell assembly.

[0017] In another non-limiting embodiment of the present disclosure, a fuel cell assembly is disclosed. The fuel cell assembly comprises one or more unit cell assemblies arranged in a stacked configuration. Each unit cell assembly comprises at least one first bipolar plate defined with a plurality of first corrugations and a first flow field zone. The plurality of first corrugations comprises a first electrically conductive material entrenched within. At least one second bipolar plate is defined with a plurality of second corrugations and a second flow field zone. The plurality of second corrugations comprises a second electrically conductive material entrenched within. The plurality of second corrugations is complementary to the plurality of first corrugations of the at least one first bipolar plate. Further, at least one membrane electrode assembly is housed within a periphery of a cover and is interposed between the at least one first bipolar plate and the at least one second bipolar plate. The first electrically conductive material entrenched within the plurality of first corrugations and the second electrically conductive material entrenched within the plurality of second corrugations are configured to contact the at least one membrane electrode assembly for electrical conductivity. The fuel cell assembly further comprises at least one end plate configured to enclose the stack of the one or more unit cell assemblies. The at least one end plate is fastened by a fastening means at either ends of the one or more unit cell as-assemblies.

[0018] It is to be understood that the aspects and embodiments of the disclosure described above may be used in any combination with each other. Several of the aspects and embodiments may be combined to form a further embodiment of the disclosure.

[0019] The foregoing summary is illustrative only and is not intended to be in any way limiting. In addition to the illustrative aspects and features described above, further aspects and features will become apparent by reference to the drawings and the following detailed description.

BRIEF DESCRIPTION OF ACCOMPANYING DRAWINGS

[0020] The novel features and characteristic of the disclosure are set forth in the appended claims. The disclosure itself, however, as well as a mode of use, further objectives, and advantages thereof, will best be understood by reference to the following detailed description of an embodiment when read in conjunction with reference to the accompanying drawings wherein like reference numerals represent like elements and in which:

Fig.1 illustrates a partially exploded view of a fuel cell assembly with one or more unit cell assemblies arranged in a stacked configuration in accordance with an embodiment of the present disclosure;

Fig. 2 illustrates a partially exploded front view of the fuel cell assembly with one or more unit cell assemblies arranged in a stacked configuration, in accordance with an embodiment of the present disclosure;

Fig. 3 illustrates a perspective view of the fuel cell assembly with one or more unit cell assemblies arranged in a stacked configuration, in accordance with an embodiment of the present disclosure;

Fig. 4a illustrates a perspective view of at least one first bipolar plate along with a detailed view at a portion A, in accordance with another embodiment of the present disclosure;

Figs. 4b (i), 4b (ii), 4b (iii) and 4b (iv) illustrates a top, side and front views respectively of the at least one first bipolar plate, in accordance with another embodiment of the present disclosure;

Fig. 5a illustrates a perspective view of the at least one second bipolar plate along with a detailed view at a portion A, in accordance with another embodiment of the present disclosure;

Figs. 5b (i), 5b (ii), 5b (iii) and 5b (iv) illustrates a top, side and front views respectively of at least one second bipolar plate, in accordance with another embodiment of the present disclosure;

Fig. 6 illustrates a perspective view of at least one membrane electrode assembly housed in a cover, along with a detailed view at a portion A, in accordance with another embodiment of the present disclosure;

Fig. 7 illustrates a perspective view of at least one end plate along with a detailed view at a portion A, in accordance with another embodiment of the present disclosure; and

Fig. 8 illustrates a magnified view depicting a plurality of first and second corrugations with an entrenchment of an electrically conductive material within the plurality of first and second corrugations in accordance with another embodiment of the present disclosure.

Fig. 9 illustrates a sectional view of a portion of the fuel cell stack/assembly, in accordance with another embodiment of the present disclosure.

The figures depict embodiments of the disclosure for purposes of illustration only. One skilled in the art will readily recognize from the following description that alternative embodiments of the system and methods illustrated herein may be employed without departing from the objective of the disclosure described herein. It should be appreciated by those skilled in the art that any block diagrams herein represent conceptual views of illustrative systems embodying the principles of the present subject matter.

DETAILED DESCRIPTION OF THE DRAWINGS

[0021] The foregoing has broadly outlined the features and technical advantages of the present disclosure in order that the detailed description of the disclosure that follows may be better understood. Additional features and advantages of the disclosure will be described hereinafter which forms the subject of the claims of the disclosure. It should be appreciated by those skilled in the art that, the conception and specific embodiments disclosed may be readily utilized as a basis for modifying other devices, systems, assemblies, and mechanisms for carrying out the same purposes of the present disclosure. It should also be realized by those skilled in the art that, such equivalent constructions do not depart from the scope of the disclosure as set forth in the appended claims. The novel features which are believed to be characteristics of the disclosure, to its system, together with further objects and advantages will be better understood from the following description when considered in connection with the accompanying figures. It is to be expressly understood, however, that each of the figures is provided for the purpose of illustration and description only and is not intended as a definition of the limits of the present disclosure.

[0022] In accordance with various embodiments of the present disclosure, a unit cell assembly of a fuel cell assembly may be described. The unit cell assembly comprises at least one first bipolar plate defined with a plurality of first corrugations and a first flow field zone. The plurality of first corrugations comprises a first electrically conductive material entrenched within. At least one second bipolar plate is defined with a plurality of second corrugations and a second flow field zone. The plurality of second corrugations comprises a second electrically conductive material entrenched within. The plurality of second corrugations is complimentary to the plurality of first corrugations of the at least one first bipolar plate. Further, at least one membrane electrode assembly is housed within a periphery of a cover and is interposed between the at least one first bipolar plate and the at least one second bipolar plate. The first electrically conductive material entrenched within the plurality of first corrugations and the second electrically conductive material entrenched within the plurality of second corrugations are configured to contact the at least one membrane electrode assembly for electrical conductivity. The forthcoming paragraphs will elucidate the configuration of the unit cell assembly. Forthcoming embodiments elucidate the smart ladder system and its working in detail in conjunction to Figs, 1 to 9. The present disclosure also discloses a fuel cell assembly comprising one or more unit cell assemblies arranged in a stacked configuration and enclosed with at least one end plate with a suitable fastening means.

[0023] In an embodiment, the unit cell assembly described above includes the plurality second corrugations being complimentary to the plurality of first corrugations for assembly of the at least one second bipolar plate with the at least one first bipolar plate. This provides an increased active surface area with a greater number of reaction sites for an electrochemical reaction between a fuel and an oxidant. Advantageously, this increases an output and the operational efficiency and thereby reduces the cost of installation and overall cost of the system significantly. Also, the at least one first bipolar plate and the at least one second bipolar plate have improved structural strength and lighter weight as they are made of an S-glass material compared to the conventional metallic and graphite bipolar plates.

[0024] While the embodiments in the disclosure are subject to various modifications and alternative forms, specific embodiments thereof have been shown by way of example in the figures and will be described below. It should be understood, however, that it is not intended to limit the disclosure to the particular forms disclosed, but on the contrary, the disclosure is to cover all modifications, equivalents, and alternative falling within the scope of the disclosure.

[0025] It is to be noted that a person skilled in the art would be motivated from the present disclosure and modify construction of the unit cell assembly. However, such modifications should be construed within the scope of the disclosure. Accordingly, the drawings show only those specific details that are pertinent to understand the embodiments of the present disclosure, so as not to obscure the disclosure with details that will be readily apparent to those of ordinary skill in the art having benefit of the description herein.

[0026] The terms “comprise,” “comprising,” or any other variations thereof used in the disclosure, are intended to cover a non-exclusive inclusion, such that a system and method that comprises a list of components does not include only those components but may include other components not expressly listed or inherent to such system, method, or assembly, or device. In other words, one or more elements in a system or device proceeded by “comprises… a” does not, without more constraints, preclude the existence of other elements or additional elements in the system or device.

[0027] The following paragraphs describe the present disclosure with reference to FIG(s) 1 to 9. In the figures, the same element or elements which have similar functions are indicated by the same reference signs. With general reference to the drawings, a unit cell assembly of a fuel cell assembly in accordance with the teachings of a preferred embodiment of the present disclosure is illustrated and generally identified with reference numeral 100. The unit cell assembly (100) [interchangeably referred to as the assembly (100)] may be used in the fuel cell assembly/stack to produce electricity. The unit cell assembly (100) may also be used in an electrolyser assembly/stack to produce hydrogen and oxygen by means of water electrolysis. It will be understood that the teachings of the present disclosure are not limited to any particular hoisted structure.

[0028] The following detailed description is merely exemplary in nature and is not intended to limit application and uses. Furthermore, there is no intention to be bound by any theory presented in the preceding background or summary or the following detailed description. It is to be understood that the disclosure may assume various alternative orientations and step sequences, except where expressly specified to the contrary. It is also to be understood that the specific devices or components illustrated in the attached drawings and described in the following specification are simply exemplary embodiments of the inventive concepts defined in the appended claims. Hence, specific dimensions or other physical characteristics relating to the embodiments that may be disclosed are not to be considered as limiting, unless the claims expressly state otherwise. Hereinafter, preferred embodiments of the present disclosure will be described referring to the accompanying drawings. While some specific terms of “upper,” “lower,” “below,” “above,” “right,” “left,” “rear” or “front” and other terms containing these specific terms and directed to a specific direction will be used, the purpose of usage of these terms or words is merely to facilitate understanding of the present invention referring to the drawings. Accordingly, it should be noted that the meanings of these terms or words should not improperly limit the technical scope of the present invention.

[0029] Also, it is to be understood that the phraseology and terminology used herein is for description and should not be regarded as limiting. Unless specified or limited otherwise, the terms “mounted,” “connected,” “supported,” and “coupled” and variations thereof are used broadly and encompass both direct and indirect mountings, connections, supports, and couplings. Further, “connected” and “coupled” are not restricted to physical or mechanical connections or couplings. It is to be understood that this disclosure is not limited to the specific devices, methods, applications, conditions, or parameters described and/or shown herein and that the terminology used herein is to describe particular embodiments by way of example and is not intended to be limiting of the claimed invention. Hereinafter in the following description, various embodiments will be described. For purposes of explanation, specific configurations and details are outlined to provide a thorough understanding of the embodiments. However, it will also be apparent to one skilled in the art that the embodiments may be practiced without the specific details. Furthermore, well-known features may be omitted or simplified in order not to obscure the embodiment being described.

[0030] Referring to FIGs 1 to 9 in conjunction, which illustrates various views of a unit cell assembly (100) [interchangeably referred to as the assembly (100)] of a fuel cell assembly (300) and various components associated with the assembly (100). The assembly (100) of the present disclosure may be used in passenger vehicles, heavy commercial vehicles, off-highway vehicles, maritime, aviation, unmanned aerial vehicles (UAVs), drones, backup power, space stations etc. for electric power generation by an electrochemical reaction. The assembly (100) of the present disclosure may also be used to produce hydrogen and oxygen by means of water electrolysis process. Also, application of the assembly (100) elucidated going forward should not be construed as a limitation of the present disclosure. The unit cell assembly (100) of the present disclosure provides an increased active surface area for the electrochemical reactions and thereby increases output and efficiency. The assembly (100) also provides bipolar plates with lighter weight, improved structural strength, corrosion resistance and temperature resistance for prolonged usage, thus improving life of the overall fuel cell stack/assembly (300). Figs. 1 to 3 schematically illustrates an embodiment of one or more unit cell assemblies (100) used in the fuel cell assembly (300). Hereinafter, features of the fuel cell assembly (300) along with its working may be elucidated.

[0031] The fuel cell assembly (300) comprises one or more unit cell assemblies (100) stacked together. Each unit cell assembly (100) among other components comprises at least one first bipolar plate (101), at least one second bipolar plate (102), a cover (104) and at least one membrane electrode assembly (103). The at least one first bipolar plate (101) is defined with a first flow field zone (113) and a plurality of first corrugations (117, 118) in the first flow field zone (113). In an embodiment, the first flow field zone (113) is defined at a central portion of the at least one first bipolar plate (101). The plurality of first corrugations (117, 118) in the first flow field zone (113) allow a reactants to flow through the first flow field zone (113). In an embodiment, the reactant may be a fuel such as hydrogen or an oxidant such as oxygen or air. Further, the at least one second bipolar plate (102) is defined with a plurality of second corrugations (135, 136) and a second flow field zone (131). The plurality of second corrugations (135, 136) are complementary to the plurality of first corrugations (117, 118) of the at least one first bipolar plate (101). A cover (104) is configured to disposed between the at least one first bipolar plate (101) and the at least one second bipolar plate (102). Further, at least one membrane electrode assembly (103) is housed within a periphery of the cover (104) and is interposed between the at least one first bipolar plate (101) and the at least one second bipolar plate (102). In an embodiment, a plurality of gas diffusion layers (not shown in figures) is also disposed between the at least one first bipolar plate (101) and the at least one membrane electrode assembly (103) and similarly between the at least one second bipolar plate (102) and the at least one membrane electrode assembly (103). In an embodiment, the plurality of gas diffusion layers facilitate rapid diffusion and transport of reactants to catalyst layers of the at least one membrane electrode assembly (103). The at least one second bipolar plate (102) and the at least one membrane electrode assembly (103) are positioned at either side of the at least one first bipolar plate (101). In an embodiment, one side of the least one first bipolar plate (101) functions as an anode flow field zone and another opposing side of the least one first bipolar plate (101) functions as a cathode flow field zone. Similarly, one side of the least one second bipolar plate (102) acts as the anode flow field zone and the another opposing side of the least one second bipolar plate (102) acts as the cathode flow field zone. The unit cell assemblies (100) are stacked in the fuel cell assembly (300) in such a way that, the anode flow field zone of the least one first bipolar plate (101) is in contact with the at least one membrane electrode assembly (103) followed by the cathode flow field zone of least one second bipolar plate (102) (shown in fig.2 and fig.9).

[0032] Referring to fig. 4a, the least one first bipolar plate (101) is illustrated in a perspective view. The at least one first bipolar plate (101) comprises the plurality of first corrugations (117, 118) that are defined at a central portion of the at least one first bipolar plate (101). The plurality of first corrugations (117, 118) extends in a longitudinal direction of the first flow field zone (113). The plurality of first corrugations (117, 118) are defined on opposing sides of the thickness substrate of the at least one first bipolar plate (101). The plurality of first corrugations (117, 118) comprises a plurality of first crests (115) and a plurality of first troughs (116) arranged alternatively in the first flow field zone (113). Each of the plurality of first crests (115) and the plurality of first troughs (116) are configured as a protrusion extending in normal direction from the surface of the at least one first bipolar plate (101). In an embodiment, each crest (115) is structured in a triangular convex shape at a top portion of the crest. In an embodiment, the plurality of first crests (115) may be structured in a square shape, rectangular shape, or any other polygonal shape. Each trough of the plurality of first troughs (116) is arranged next to each crest of the plurality of first crests (115). The plurality of first troughs (116) are structured in a triangular concave shape. In an embodiment, the plurality of first troughs (116) may be structured in a rectangular, square or any polygonal shape. The plurality of first crests (115) and the plurality of first troughs (116) are configured to define a first flow field channels (114) between them [shown in detail A]. Further, a first electrically conductive material (124) is entrenched within the plurality of first corrugations (117, 118). The first electrically conductive material (124) is configured to allow the flow of electrons from the anode face of the at least one first bipolar plate (101) to the cathode face of the at least one second bipolar plate (102) through an external circuit or a load. In an embodiment, the plurality of first flow field channels (114) are configured to receive a reactants such as the fuel at the anode face and an oxidant at the cathode face of the at least one first bipolar plate (101). At least one recess (119) is defined around the periphery of the first flow field zone (113) and extending across a length of the at least one first bipolar plate (101) in the longitudinal direction. The at least one recess (119) is configured to receive the at least one membrane electrode assembly (103), the cover (104) and the at least one second bipolar plate (102). Further, a plurality of provisions (121) is defined on the at least one recess (119) of the at least one first bipolar plate (101). At least one first anode inlet manifold (107) is defined on one end portion of the at least one first bipolar plate (101) for an entry of the fuel at the anode face. At least one first anode outlet manifold (108) is provided diagonally opposite to the at least one first anode inlet manifold (107) at the other end portion. The at least one first anode outlet manifold (108) is configured for an exit of the fuel from the anode face of the at least one first bipolar plate (101). At least one first cathode inlet manifold (111) and at least one first cathode outlet manifold (112) is arranged diagonally opposite to each other for the entry and exit of an oxidant, respectively. The oxidant is configured to flow on the cathode face of the at least one first bipolar plate (101). A first inlet header (109) is provided between the first flow field zone (113) and the first inlet manifold to accommodate the reactants before passing through the first flow field zone (113). The first inlet header (109) is configured to pass the reactants uniformly through the plurality of first flow field channels (114) of the first flow field zone (113). A first outlet header (110) is arranged opposite to the first inlet header (109) and is configured to store the excess reactants leaving through the first flow field zone (113) before exit of the same through the outlet manifold of the at least one first bipolar plate (101). A first end corrugated surface (122) is defined on either ends of the at least one first bipolar plate (101). The first end corrugated surface (122) is configured to align with the second end corrugated surface (139) of the at least one second bipolar plate (102) and the end corrugated surface (142) of the at least one cover (104) to restrict leakage of the fuel or the oxidant during the electro-chemical reaction and to prevent planar separation of the at least one second bipolar plate (102) and the at least one membrane electrode assembly (103). The at least one first bipolar plate (101) is further defined with a plurality of first cooling channels (120) on the periphery of the at least one first bipolar plate (101) to supply a coolant to maintain the temperature of the at least one unit cell assembly (100) in a desired range. In an embodiment, the coolant may be water or any other fluid capable of reducing and maintaining the temperature of the at least one unit cell assembly (100). The structural features of the plurality of first corrugations (117, 118) of the at least one first bipolar plate (101) is clearly depicted in fig. 4b. In an embodiment, the at least one first bipolar plate (101) is configured in a rectangular shape and however such structure cannot be construed as a limitation and the at least one first bipolar plate (101) may be structured in a square, or any polygonal shape based on the requirement. Further, the first flow field channels (114) of the first flow field zone (113) is configured in a parallel flow and however such configuration cannot be construed as a limitation and the first flow field channels (114) can be configured as a single serpentine, multi serpentine or any other configuration based on the requirement.

[0033] Referring to fig. 5a, the least one second bipolar plate (102) is illustrated in a perspective view. The least one second bipolar plate (102) comprises the plurality of second corrugations (135, 136) defined at a central portion of the least one second bipolar plate (102). The plurality of second corrugations (135, 136) extends in the longitudinal direction of the second flow field zone (131). The plurality of second corrugations (135, 136) are defined on opposing sides of the thickness substrate of the at least one second bipolar plate (102). The plurality of second corrugations (135, 136) comprises a plurality of second crests (133) and a plurality of second troughs (134) arranged alternatively in the second flow field zone (131). The plurality of second crests (133) and the plurality of second troughs (134) are configured to define a plurality of second flow field channels (132) between them [shown in detail A]. A second electrically conductive material (141) is entrenched within the plurality of second corrugations (135, 136). The second electrically conductive material (141) is configured to allow the flow of electrons from the anode face of the at least one second bipolar plate (102) to the cathode face of the at least one first bipolar plate (101) through an external circuit or a load. In an embodiment, the second flow field channels (132) are configured to receive a reactant such as the fuel at the anode face and an oxidant at the cathode face of the at least one second bipolar plate (102). A plurality of flanges (138) is defined on the periphery of the second flow field zone (131) of the at least one second bipolar plate (102). The plurality of flanges (138) is configured to engage with a plurality of provisions (121) defined on the at least one recess (119) of the at least one first bipolar plate (101). The engagement of the plurality of flanges (138) within the plurality of provisions (121) allows to couple the at least one second bipolar plate (102) at either sides of the at least one first bipolar plate (101). At least one second anode inlet manifold (125) is defined on one end portion of the at least one second bipolar plate (102) for an entry of the fuel at the anode face. At least one second anode outlet manifold (126) is provided diagonally opposite to the at least one second anode inlet manifold (125) at the other end portion. The at least one second anode outlet manifold (126) is configured for an exit of the fuel from the anode face of the at least one second bipolar plate (102). At least one second cathode inlet manifold (129) and at least one second cathode outlet manifold (130) is arranged diagonally opposite to each other for the entry and exit of an oxidant, respectively. The oxidant is configured to flow on the cathode face of the at least one second bipolar plate (102). A second inlet header (127) is provided between the second flow field zone (131) and the inlet manifold to accommodate the reactants before passing through the second flow field zone (131). The second inlet header (127) is configured to pass the reactants uniformly through the plurality of second flow field channels (132) of the second flow field zone (131). A second outlet header (128) is arranged opposite to the second inlet header (127) and is configured to store the excess reactants leaving through the second flow field zone (131) before exit of the same through the outlet manifold of the at least one second bipolar plate (102). A second end corrugated surface (139) is defined on either ends of the at least one second bipolar plate (102). The second end corrugated surface (139) is configured to firmly align with the first end corrugated surface (122) of the at least one first bipolar plate (101) and the end corrugated surface (142) of the at least one cover (104) to restrict leakage of the fuel or the oxidant during the electrochemical reaction and to prevent planar separation of the at least one second bipolar plate (102) and the at least one membrane electrode assembly (103). The at least one second bipolar plate (102) is further defined with a plurality of second cooling channels (137) on the periphery of the at least one second bipolar plate (102) to supply a coolant to maintain the temperature of the at least one unit cell assembly (100) in a desired range. The structural features of the plurality of second corrugations (135, 136) of the at least one second bipolar plate (102) is clearly depicted in fig. 5b. In an embodiment, the at least one second bipolar plate (102) is configured in a rectangular shape and however such structure cannot be construed as a limitation and the at least one second bipolar plate (102) may be structured in a square, or any polygonal shape based on the requirement. Further, the second flow field channels (132) of the second flow field zone (131) is configured in a parallel flow and however such configuration cannot be construed as a limitation and the second flow field channels (132) can be configured as a single serpentine, multi serpentine or any other configuration based on the requirement.

[0034] Now referring to Fig. 6, the at least one cover (104) with the at least one membrane electrode assembly (103) is illustrated in a perspective view. The at least one cover (104) is defined as a thin plate comprising a plurality of end corrugations (142) on either ends in longitudinal direction. The end corrugations (142) of the at least one cover (104) aligns with the first end corrugation (122) of the at least one first bipolar plate (101) on one side and similarly, the end corrugations (142) of the at least one cover (104) aligns with the second end corrugations (139) of the at least one second bipolar plate (102) on the opposite side, thereby preventing leakage and gas cross over between anode and cathode of the at least one unit cell assembly (100). At least four cutouts (145) are defined on each corner of the cover (104) such that the at least four cutouts (145) are concentric to the at least one cathode and one anode manifolds (both inlets and outlets) of the at least one first bipolar plate (101) and the at least one second bipolar plate (102). The at least four cutouts (145) allows the provision for the gas carrying manifolds to pass through in normal direction. The at least one membrane electrode assembly (103) is positioned at a central portion of the cover (104).

The at least one membrane electrode assembly (103) is structured in a corrugated shape such that the plurality of first corrugations (117, 118) and the plurality of second corrugations (135, 136) are perfectly aligned with the at least one membrane electrode assembly (103). The at least one membrane electrode assembly (103) is configured to allow the transport of positive ions of the fuel and restrict electrons from flowing through the at least one membrane electrode assembly (103). In an embodiment, the gas diffusion layers (not shown in figs.) are embedded on either sides of the at least one membrane electrode assembly (103) for rapid diffusion and transport of reactants to catalyst layers of the at least one membrane electrode assembly (103). A plurality of holes (144) is defined on the planar faces (143) of the at least one cover (104) to receive the plurality of flanges (138) defined on the at least one second bipolar plate (102). The at least one cover (104) along with the at least one membrane electrode assembly (103) are positioned within the at least one recess (119) of the at least one first bipolar plate (101). Further, the first and second electrically conductive materials (124, 141) are configured to contact the at least one membrane electrode assembly (103) for electrical conductivity between the at least one first bipolar plate (101) and the at least one second bipolar plate (102) thereby providing a series connection between successive unit cell assemblies (100) of a fuel cell stack/assembly (300).

[0035] Referring to Fig.7, the at least one end plate (105) is configured to enclose the unit cell assembly (100) is illustrated in a perspective view. The at least one end plate (105) comprises a corrugation zone (146) at the central portion. The corrugation zone (146) is defined with a plurality of first recesses (147) configured to fit into the plurality of crests (115) of the at least one first bipolar plate (101). A plurality of second recesses (148) are defined in the corrugation zone (146) to fit into a plurality of first troughs (116) of the at least one first bipolar plate (101). Further, the corrugation zone (146) is defined with a plurality of first flanges (149) configured to fit into the plurality of first flow field channels (114) of the at least one first bipolar plate (101). A plurality of second flanges (150) is provided on both ends of the corrugation zone (146) in a transverse direction and are configured to fit into the at least one recess (119) of the at least one first bipolar plate (101). An end corrugation (151) is defined on both ends of the corrugation zone in the longitudinal direction and configured to fit into the first end corrugated surface (122) of the at least one first bipolar plate (101). The corrugation zone (146) and the end corrugation (151) of the at least one end plate (105) ensures strong assembly and also prevents planar separation and leakage of the reactants from the unit cell assembly (100). At least four cutouts (156) defined on each corner of the at least one end plate (105) are concentric to the at least one anode and one cathode manifolds (both inlets and outlets) of the at least one first bipolar plate (101) and the at least one second bipolar plate (102). The at least four cutouts (156) allows the provision for the gas carrying manifolds to pass through in normal direction. The at least one end plate (105) is configured to enclose the unit cell assembly (100) and is in contact with the at least one first bipolar plate (101) (shown in fig. 9). A plurality of third cooling channels (154) is defined on the periphery of the at least one end plate (105) and are configured to receive the coolant for the coolant flow. A plurality of fastening holes (155) is defined on four corners of the at least one end plate (105) to fasten the at least one end plate (105) at either ends of the unit cell assembly (100). The at least one end plate (105) is fastened by passing a plurality of fasteners (106) through the plurality of fastening holes (155).

[0036] Referring to Fig.8, the first electrically conductive material (124) is entrenched within the plurality of first corrugations (117, 118) on the at least one first bipolar plate (101). Similarly, the second electrically conductive material (141) is entrenched within the plurality of second corrugations (135, 136) of the at least one second bipolar plate (102). The first and second electrically conductive materials (124, 141) conduct electricity and allow the flow of electrons between the at least one first and second bipolar plates (101, 102). In an embodiment, the first and second electrically conductive materials (124, 141) also provide series connection between each of the one or more unit cell assemblies (100) throughout a fuel cell stack/assembly (300).

[0037] Now referring to Fig. 9, the fuel cell assembly (300) is illustrated in a sectional view. The fuel cell assembly (300) comprises one or more unit cell assemblies (100) arranged in a stacked configuration. Each unit cell assembly (100) comprises at least one first bipolar plate (101), at least one second bipolar plate (102) and the at least one membrane electrode assembly (103) housed within the periphery of the at least one cover (104) and interposed between the at least one first bipolar plate (101) and the at least one second bipolar plate (102). The anode face of the at least one first bipolar plate (101) and the cathode face of the at least one second bipolar plate (102) are in contact with the at least one membrane electrode assembly (103). Each unit cell assembly (100) is arranged in series in such a way that the plurality of first crests (115) defined on the at least one first bipolar plate (101) engages with the plurality of first troughs (134) defined on the at least one second bipolar plate (102) to form a corrugated membrane electrode assembly (103). Consequently, the plurality of second crests (133) defined on the at least one second bipolar plate (102) engages with the plurality of first troughs (116) defined on the at least one first bipolar plate (101) to form the corrugated membrane electrode assembly (103). This alignment of the plurality of first corrugations (117, 118) with the plurality of second corrugations (135, 136) define a plurality of reaction sites between the at least one first bipolar plate (101) and the at least one second bipolar plate (102). This in turn provides an increased active surface area for the electrochemical reaction. Advantageously, this configuration of the unit cell assembly (100) increases the power output significantly and prevents the planar separation of first and second bipolar plates (101, 102) and membrane electrode assembly (103), thereby ensuring the leakage proof stack configuration. The first flow field channels (114) of the at least one first bipolar plate (101) are referenced as 114a and 114c for anode side and cathode side respectively. Similarly, the second flow field channels (132) of the at least one second bipolar plate (102) are referenced as 132a and 132c for anode side and cathode side respectively. Further, the at least one end plate (105) is configured to enclose the stack of one or more unit cell assemblies (100) such that the at least one end plate (105) is in contact with the at least one first bipolar plate (101) at either ends of the one or more unit cell assembly (100).

[0038] A working operation of the fuel cell stack/assembly (300) in accordance with the embodiments of the present disclosure as elucidated below are now explained with reference to Figs. 4a, 5a, 6, 7 and 9. Anode inlet manifolds (107, 125), anode outlet manifolds (108, 126), cathode inlet manifolds (111, 129) and cathode outlet manifolds (112, 130) pass through the cutouts (156) of the at least one end plate (105) and cutouts (145) of the at least one cover (104) in normal direction for supply and exit of reactants. The fuel such as hydrogen is supplied to the first anode inlet manifold (107) of the at least one first bipolar plate (101) of the unit cell assemblies (100). The oxidant such as air or oxygen is supplied to the second cathode inlet manifold (129) of the at least one second bipolar plate (102) of the unit cell assemblies (100). In an embodiment, the anode side and the cathode side may be defined on the at least one first bipolar plate (101) and the at least one second bipolar plate (102) alternatively depending on their arrangement in the fuel cell assembly (300) (shown in fig. 9). The fuel such as hydrogen enters the first flow field zone (113) from the at least one first anode inlet manifold (107) of the respective at least one first bipolar plate (101) and flows through the first flow field channels (114) and enters into an anode gas diffusion layer. The hydrogen diffuses rapidly through the anode gas diffusion layer and transported to the anode catalyst layer at which hydrogen is oxidized to form negative electrons and positive ions. The electrons travel from an anode electrode layer to cathode electrode layer by an external circuit while the positive ions pass through the polymer electrolyte membrane and reaches at cathode catalyst layer. Simultaneously, the oxidant such as air or oxygen enters the second flow field zone (131) from the at least one second cathode inlet manifold (129) of the corresponding at least one second bipolar plate (102) and flows through the second flow field channels (132) and enters into a cathode gas diffusion layer. The oxygen diffuses rapidly through the cathode gas diffusion layer and transported to the cathode catalyst layer at which oxygen reacts with the positive hydrogen ions and negative electrons to form a water vapor which may be expelled out through the at least one second cathode outlet manifold (130). Similarly, the unutilized hydrogen exits from the at least one first anode outlet manifold (108) which may be purged or recirculated. The same process is repeated in each of the unit cell assembly (100) to generate required electric power which is collected through the external circuit. In an embodiment, the first end corrugations (122) and the second end corrugations (135) defined on the at least one first and second bipolar plates (101, 102) and the end corrugations (142) defined on the at least one cover (104) enable leakproof assembly and prevents gas cross over between anode and cathode and entry of the foreign particles within the flow field zones of at least one first and second bipolar plates (101, 102).

[0039] In an embodiment, the at least one first bipolar plate (101) and the at least one second bipolar plate (102) are manufactured of glass composites and more particularly of an S-glass material with a chemical composition of oxides of silicon, aluminum, and magnesium. However, this cannot be construed as a limitation and the at least one first and second bipolar plates (101, 102) may be formed of metal, graphite, carbon composites or any other chemical composition having higher electrical conductivity.

[0040] In an embodiment, the use of the S-glass material provides higher tensile and compressive strength with lower density to the at least one first and second bipolar plates (101, 102). This improves the overall strength and increases the power-to-weight ratio of the fuel cell assembly (300). Further, S-glass material offers higher corrosion resistance and temperature resistance thereby increasing the life of at least one first and second bipolar plates (101, 102) and prevents the degradation of catalyst layers and polymer electrolyte membrane of the at least one membrane electrode assembly (103).

[0041] In an embodiment, the plurality of first corrugations (117, 118) and the plurality of second corrugations (135, 136) may be configured to extend in a transverse direction of the at least one first and second bipolar plates (101, 102) respectively.

[0042] In an embodiment, the configuration of the first and second flow field channels (114, 132) may be parallel, single serpentine, multi serpentine, interdigitated or of any other configuration as per requirement.

WE CLAIM:

1. A unit cell assembly (100) of a fuel cell assembly (300), the unit cell assembly (100) comprising:
at least one first bipolar plate (101) defined with a plurality of first corrugations (117, 118) and a first flow field zone (113), wherein a first electrically conductive material (124) is entrenched within the plurality of first corrugations (117, 118);
at least one second bipolar plate (102) defined with a plurality of second corrugations (135, 136) and a second flow field zone (131), wherein a second electrically conductive material (141) is entrenched within the plurality of second corrugations (135, 136), and the plurality of second corrugations (135, 136) are complementary to the plurality of first corrugations (117, 118) of the at least one first bipolar plate (101);
at least one membrane electrode assembly (103) housed within a periphery of the at least one cover (104) and interposed between the at least one first bipolar plate (101) and the at least one second bipolar plate (102); and
wherein the first electrically conductive material (124) entrenched within the plurality of first corrugations (117, 118) and the second electrically conductive material (141) entrenched within the plurality of second corrugations (135, 136) are configured to contact the at least one membrane electrode assembly (103) for electrical conductivity.

2. The unit cell assembly (100) as claimed in claim 1, wherein the plurality of first corrugations (117, 118) comprises a plurality of first crests (115) and a plurality of first troughs (116) in an alternating configuration in the first flow field zone (113) of the at least one first bipolar plate (101) to define a plurality of first flow field channels (114) therebetween for a flow of reactants.

3. The unit cell assembly (100) as claimed in claim 1, wherein the plurality of second corrugations (135, 136) comprises a plurality of second crests (133) and a plurality of second troughs (134) in an alternating configuration in the second flow field zone (131) of the at least one second bipolar plate (102) to define a plurality of second flow field channels (132) therebetween for the flow of reactants.

4. The unit cell assembly (100) as claimed in claim 2, wherein the plurality of first crests (115) defined on the at least one first bipolar plate (101) engages with the plurality of second

troughs (134) defined on the at least one second bipolar plate (102) to form a corrugated membrane electrode assembly (103).

5. The unit cell assembly (100) as claimed in claim 3, wherein the plurality of second crests (133) defined on the at least one second bipolar plate (102) engages with the plurality of first troughs (116) defined on the at least one first bipolar plate (101) to form the corrugated membrane electrode assembly (103).

6. The unit cell assembly (100) as claimed in claim 1, wherein the at least one first bipolar plate (101) comprises:
a plurality of first cooling channels (120) defined on a planar face (123) of the at least one first bipolar plate (101) for a coolant flow;
at least one recess (119) defined around the periphery of the first flow field zone (113) and extending across a length of the at least one first bipolar plate (101) in a longitudinal direction, wherein the at least one recess (119) is configured to receive the at least one membrane electrode assembly (103), the at least one cover (104) and the at least one second bipolar plate (102);
a plurality of provisions (121) defined on the at least one recess (119) of the at least one first bipolar plate (101);
at least one first anode inlet manifold (107), and at least one first anode outlet manifold (108) for entry and exit of a fuel respectively, of the at least one first bipolar plate (101);
at least one first cathode inlet manifold (111), and at least one first cathode outlet manifold (112) for entry and exit of an oxidant respectively, of the at least one first bipolar plate (101);
a first inlet header (109), and a first outlet header (110) through which reactants passes before entering into the first flow field zone (113) of the at least one first bipolar plate (101); and
a first end corrugated surface (122) defined on either ends of the at least one first bipolar plate (101).

7. The unit cell assembly (100) as claimed in claim 1, wherein the at least one second bipolar plate (102) comprises:
a plurality of second cooling channels (137) defined on planar faces (140) of the at least one second bipolar plate (102) for the coolant flow;
a plurality of flanges (138) defined on the planar faces (140) of the at least one second bipolar plate (102);

at least one second anode inlet manifold (125), and at least one second anode outlet manifold (126) for entry and exit of the fuel respectively, of the at least one second bipolar plate (102);
at least one second cathode inlet manifold (129), and at least one second cathode outlet manifold (130) for entry and exit of the oxidant respectively, of the at least one second bipolar plate (102);
a second inlet header (127), and a second outlet header (128) through which the reactants pass before entering into the second flow field zone (131) of the at least one second bipolar plate (102); and
a second end corrugated surface (139) defined on either ends of the at least one second bipolar plate (102).

8. The unit cell assembly (100) as claimed in claim 7, wherein the plurality of flanges (138) is configured to engage within the plurality of provisions (121) defined on the at least one first bipolar plate (101) to couple the at least one second bipolar plate (102) on either side of the at least one first bipolar plate (101).

9. The unit cell assembly (100) as claimed in claim 1, wherein the first and second electrically conductive materials (124, 141) are at least a silver, or combination of different electrically conductive materials, entrenched in form of a cross grid, a parallel grid, a coating, or a plurality of layers.

10. The unit cell assembly (100) as claimed in claim 1 wherein the at least one first bipolar plate (101) and the at least one second bipolar plate (102) are formed of glass composites and more particularly of an S-glass material with a chemical composition of oxides of silicon, aluminum, and magnesium.

11. The unit cell assembly (100) as claimed in claim 1 wherein the at least one first bipolar plate (101) and the at least one second bipolar plate (102) are manufactured from materials selected from at least one of graphite, carbon composites or metals.

12. The unit cell assembly (100) as claimed in claim 1 comprises at least one end plate (105), the at least one end plate (105) comprising:
a corrugation zone (146) defined with a plurality of first recesses (147) configured to fit into the plurality of crests (115) of the at least one first bipolar plate (101), wherein the corrugation

zone (146) is defined with the plurality of second recesses (148) configured to fit into a plurality of troughs (116) of the at least one first bipolar plate (101); and

the corrugation zone (146) defined with a plurality of first flanges (149) configured to fit into the plurality of first flow field channels (114) of the at least one first bipolar plate (101);

a plurality of second flanges (150) provided on both ends of the corrugation zone (146) in a transverse direction and configured to fit into the at least one recess (119) of the at least one first bipolar plate (101);

an end corrugation (151) defined on both ends of the corrugation zone (146) in the longitudinal direction and configured to fit into the first end corrugated surface (122) of the at least one first bipolar plate (101);

a plurality of third cooling channels (154) defined on planar faces (152) configured to receive coolant for the coolant flow; and

wherein the at least one end plate (105) is configured to enclose the unit cell assembly (100), wherein the at least one end plate (105) is fastened by a fastening means (106) at either ends of the unit cell assembly (100).

13. A fuel cell assembly (300) comprising:

one or more unit cell assemblies (100) arranged in a stacked configuration, wherein each unit cell assembly (100) comprises:

at least one first bipolar plate (101) defined with a plurality of first corrugations (117, 118) and a first flow field zone (113), wherein a first electrically conductive material (124) is entrenched within the plurality of first corrugations (117, 118);

at least one second bipolar plate (102) defined with a plurality of second corrugations (135, 136) and a second flow field zone (131), wherein a second electrically conductive material (141) is entrenched within the plurality of second corrugations (135, 136) and, wherein the plurality of second corrugations (135, 136) are complementary to the plurality of first corrugations (117, 118) of the at least one first bipolar plate (101);

at least one membrane electrode assembly (103) housed within a periphery of the at least one cover (104) and interposed between the at least one first bipolar plate (101) and the at least one second bipolar plate (102); and

wherein the first electrically conductive material (124) entrenched within the plurality of first corrugations (117, 118) and the second electrically conductive material (141) entrenched within the plurality of second corrugations (135, 136) are configured to contact the at least one membrane electrode assembly (103) for electrical conductivity and,

at least one end plate (105) configured to enclose one or more unit cell assemblies (100) in a stacked configuration, wherein the at least one end plate (105) is fastened by a fastening means (106) at either ends of the one or more unit cell assemblies (100).

Dated this 10th day of January 2023

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ABSTRACT

A UNIT CELL ASSEMBLY OF A FUEL CELL ASSEMBLY

Present disclosure relates to a unit cell assembly (100) comprising at least one first bipolar plate (101) defined with a plurality of first corrugations (117 and 118) and a first flow field zone (113). At least one second bipolar plate (102) is defined with a plurality of second corrugations (135 and 136) complementary to the plurality of first corrugations (117 and 118) and a second flow field zone (131). The plurality of first and second corrugations comprises a first and second electrically conductive materials (124, 141) entrenched within, respectively. At least one membrane electrode assembly (103) is housed within a periphery of a cover (104) and interposed between the at least one first bipolar and the at least one second bipolar plate. The first and second electrically conductive materials are configured to contact the at least one membrane electrode assembly for electrical conductivity. A fuel cell assembly is also disclosed.

[FIG. 1 and FIG. 9 are the representative figures]

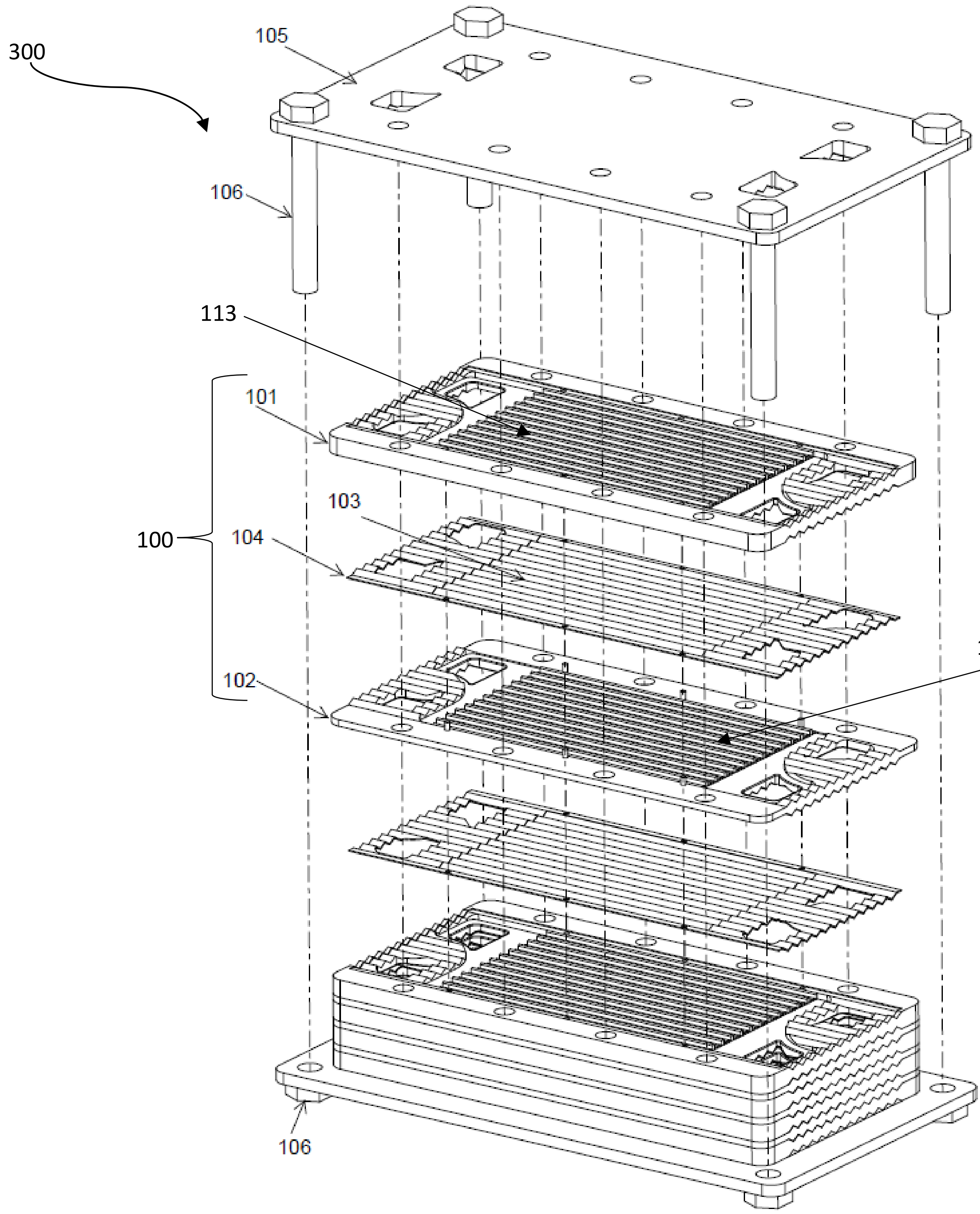

Fig. 1

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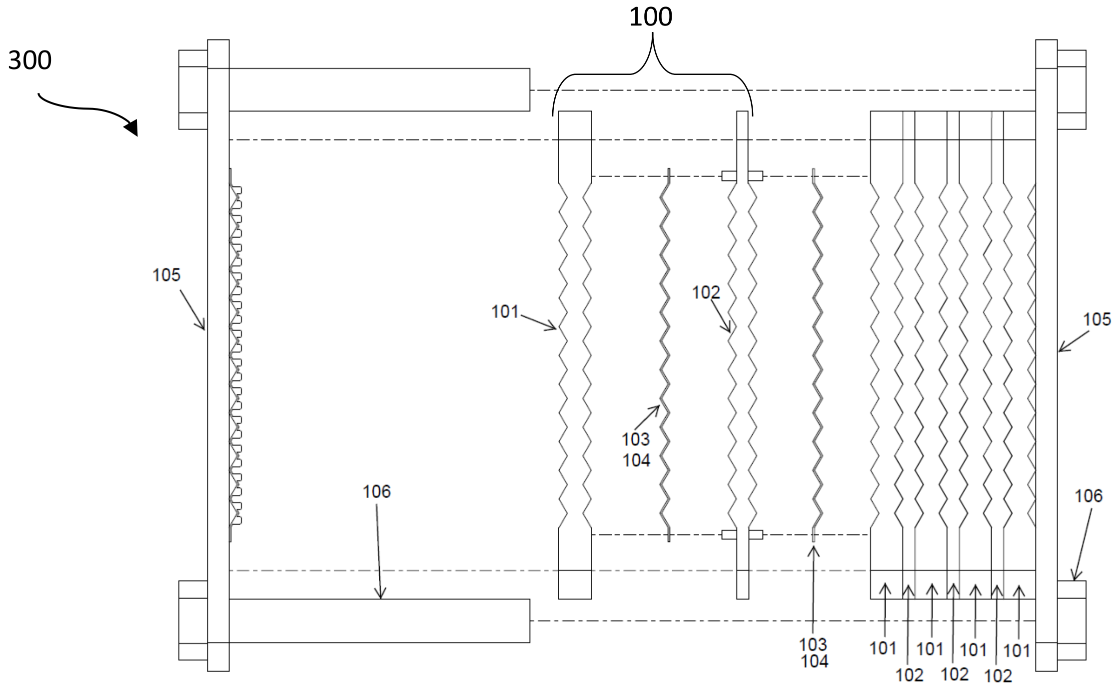

Fig. 2

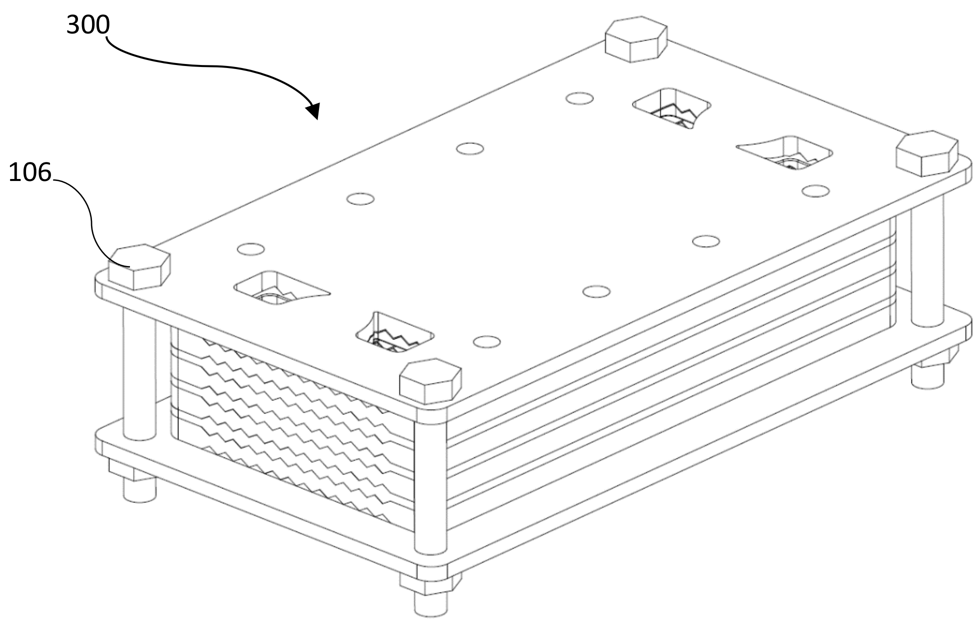

Fig. 3

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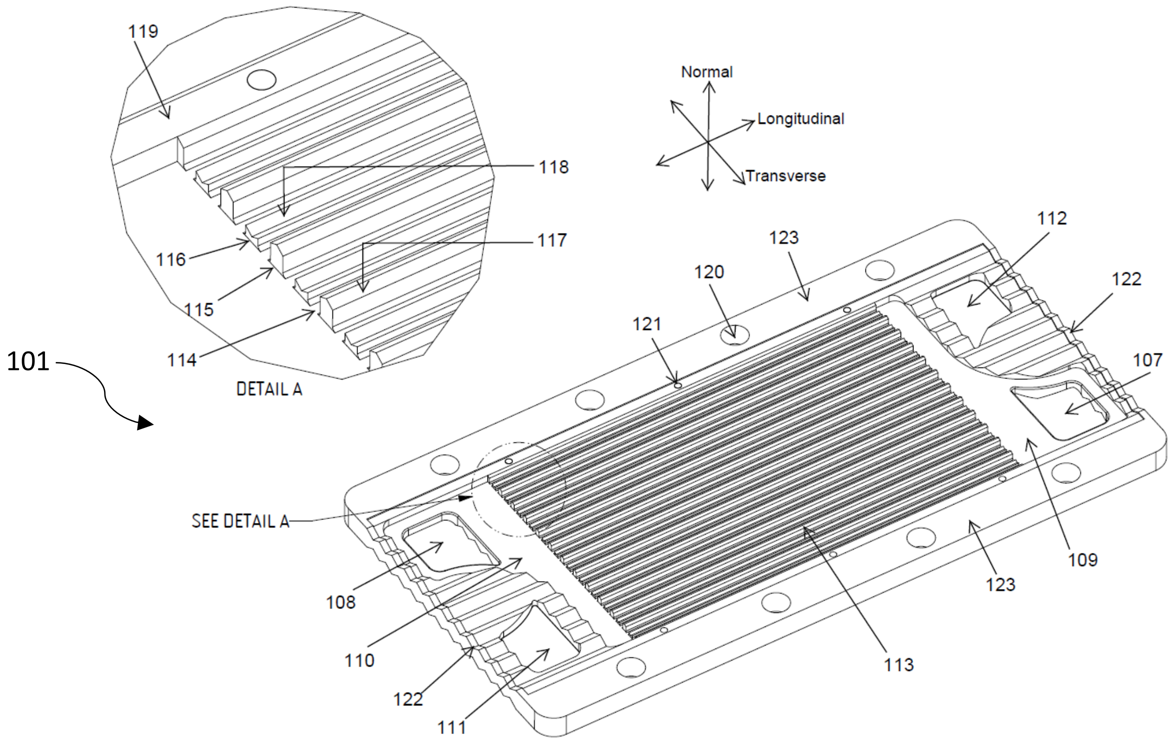

Fig. 4a

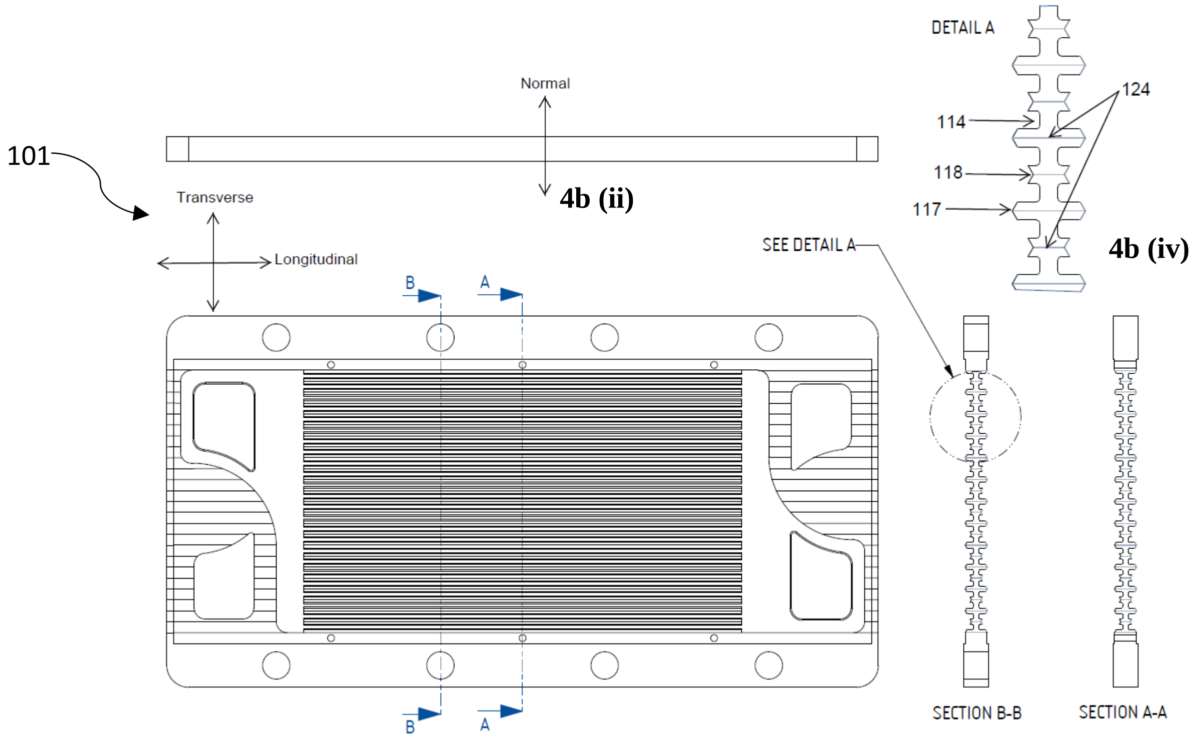

Fig. 4b(i)

4b (iii)

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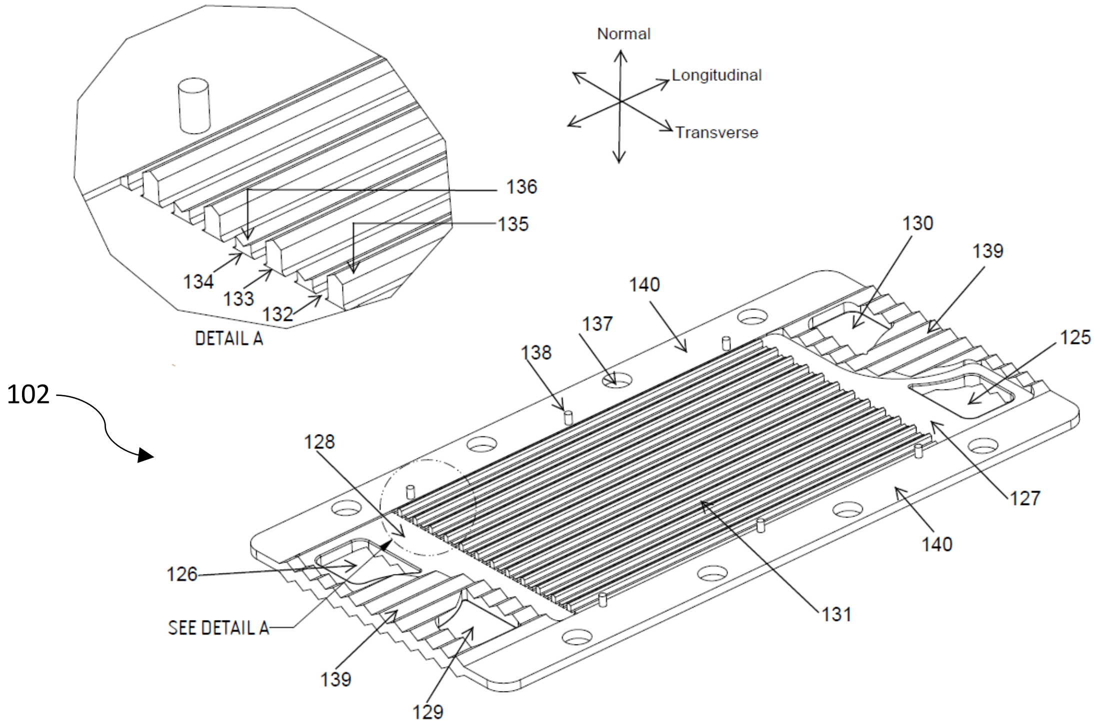
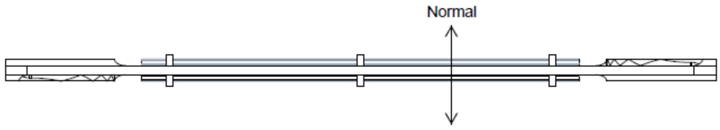
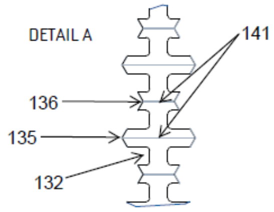


Fig. 5a



5b (ii)



5b (iv)

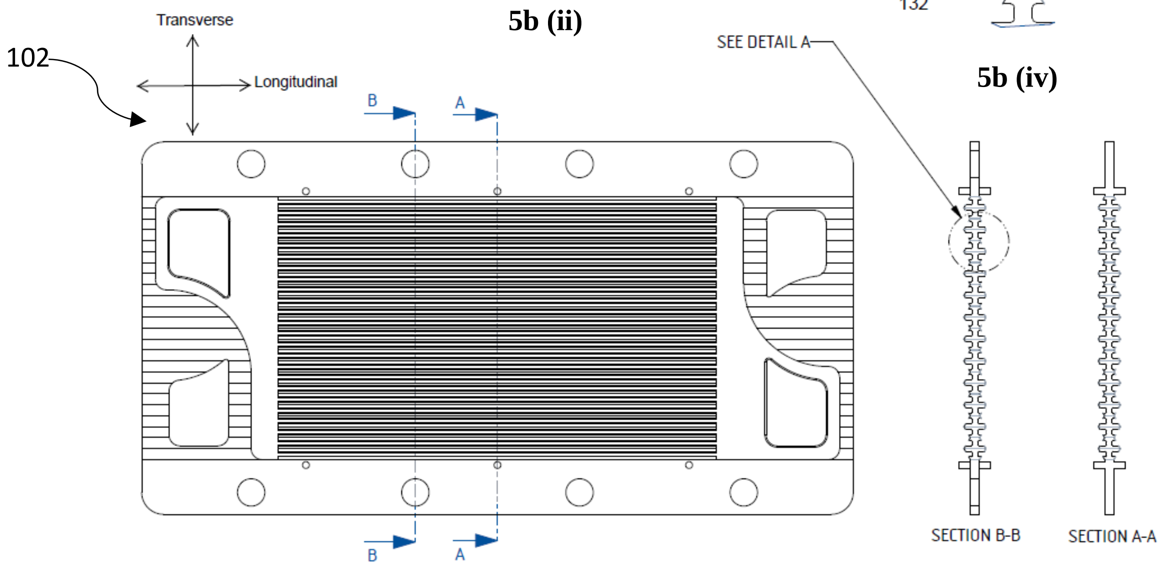


Fig. 5b (i)

5b (iii)

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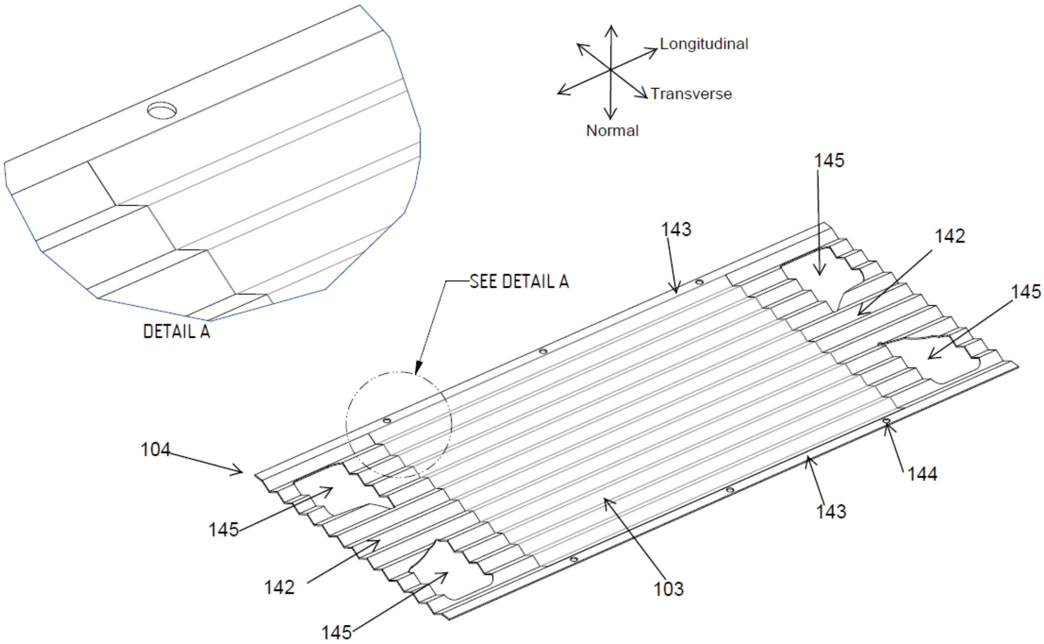

Fig. 6

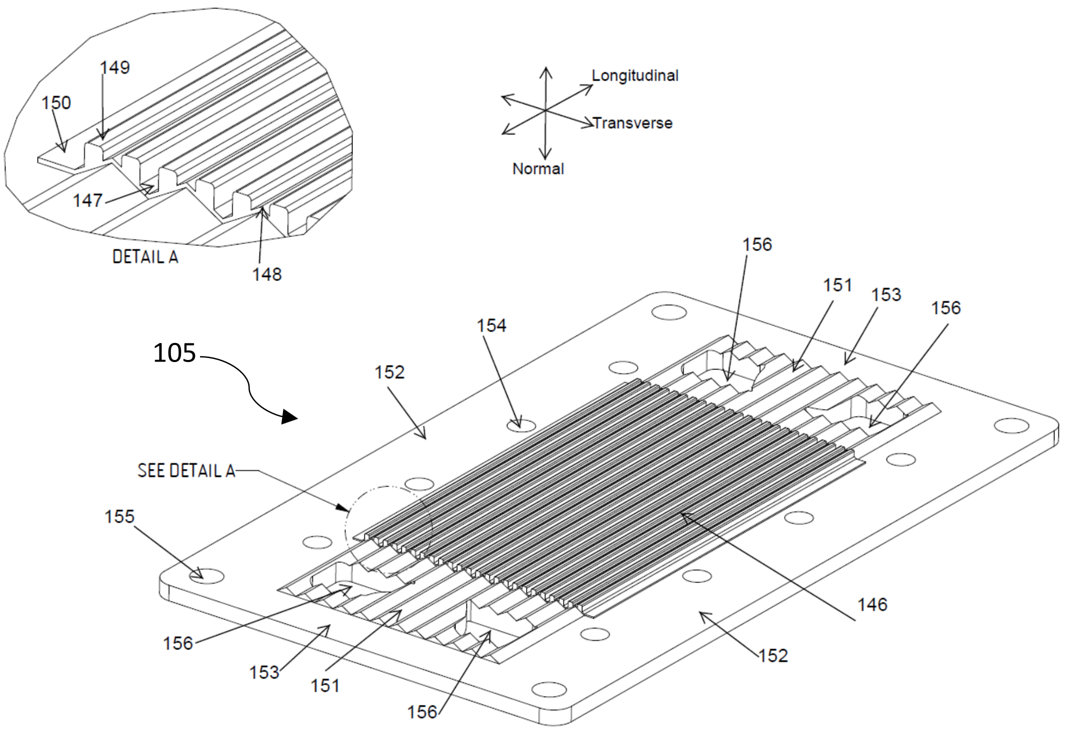

Fig. 7

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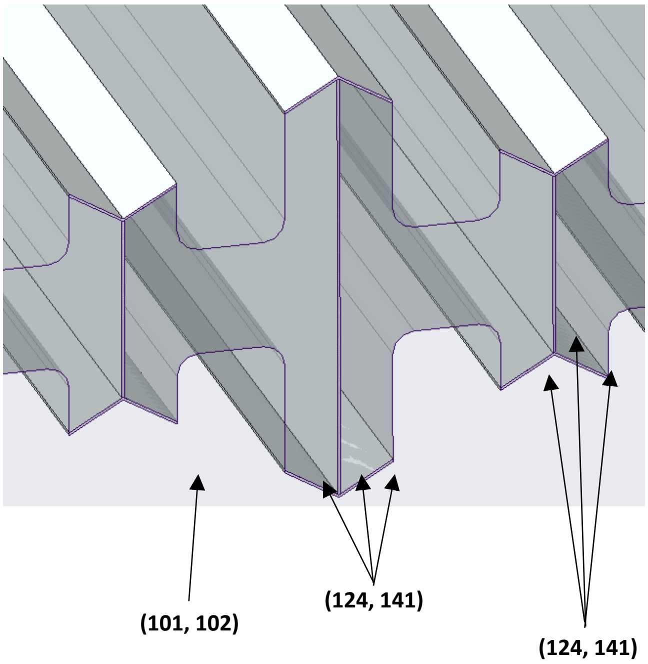

Fig. 8

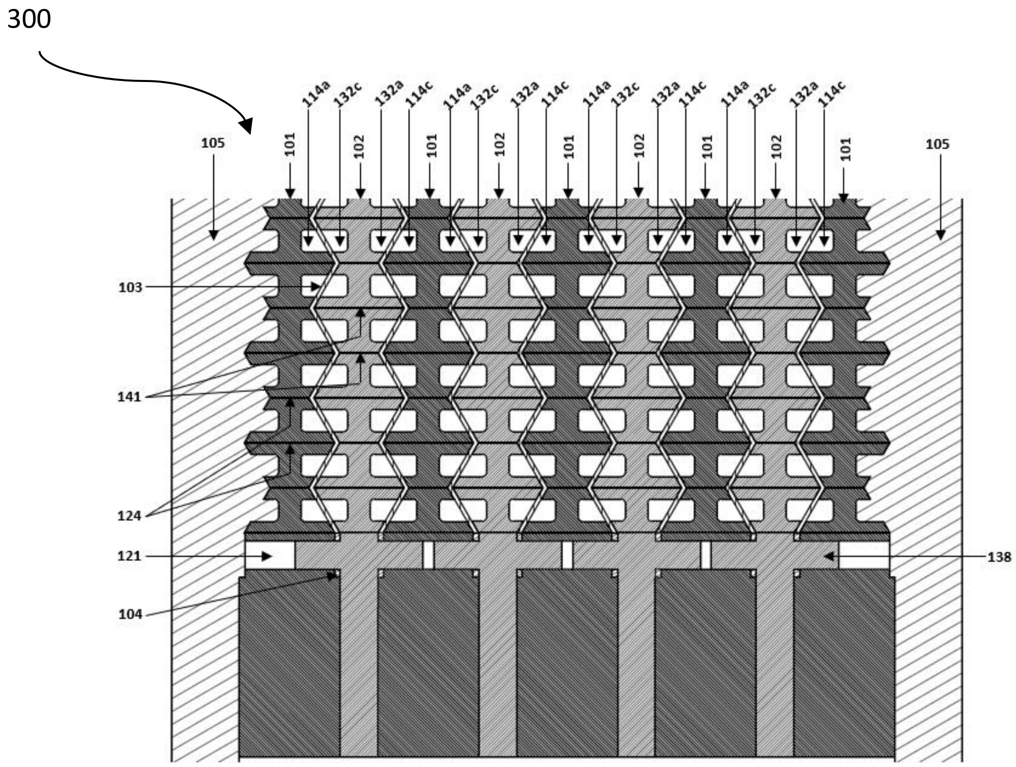

Fig. 9

-- Digitally Signed--
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