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United States Patent	12394813
Kind Code	B2
Date of Patent	August 19, 2025
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Fuel cell stack assembly device

Abstract

A fuel cell stack assembly device includes a rotating body disposed to be inclined in an up-down direction on a jig frame and rotatably installed on the jig frame, a press body installed to be movable in the up-down direction at an upper portion of the rotating body to correspond to a cell stacking base provided below the rotating body, at least one first swing body swingably installed at a front portion of the rotating body, at least one second swing body swingably installed at a rear portion of the rotating body, a cell stacking guide portion provided at each of the at least one first swing body and the at least one second swing body, and a cell fastening guide portion provided at each of the at least one first swing body and the at least one second swing body.

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Appl. No.: 18/077651

Filed: December 08, 2022

Prior Publication Data

Document Identifier	Publication Date
US 20230253604 A1	Aug. 10, 2023

Foreign Application Priority Data

KR	10-2022-0014745	Feb. 04, 2022
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Publication Classification

Int. Cl.: H01M8/248 (20160101); H01M8/2404 (20160101)

U.S. Cl.:

CPC H01M8/248 (20130101); H01M8/2404 (20160201);

Field of Classification Search

CPC: H01M (8/248); H01M (8/2404)

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Background/Summary

CROSS REFERENCE TO RELATED APPLICATIONS

(1) This application claims priority to and the benefit of Korean Patent Application No. 10-2022-0014745 filed in the Korean Intellectual Property Office on Feb. 4, 2022, the entire contents of which are incorporated herein by reference.

BACKGROUND

(a) Field

(2) An exemplary embodiment of the present disclosure relates to a fuel cell stack assembly device, and more particularly, to a fuel cell stack assembly device in which a plurality of unit cells are aligned and fastened.

(b) Description of the Related Art

(3) As is known, fuel cell stacks are a kind of power generation devices that generate electric energy through an electrochemical reaction between hydrogen and oxygen by a plurality of unit cells.

(4) For example, fuel cell stacks are applied to a fuel cell vehicle (commonly referred to as a 'hydrogen powered vehicle' or a 'hydrogen electric vehicle' by those skilled in the art).

(5) Fuel cell stacks are electricity generating assemblies in which a plurality of unit cells are continuously arranged. Each of the plurality of unit cells includes a membrane electrode assembly

(MEA) and separators disposed on both sides of the membrane electrode assembly, respectively.

(6) In an example, the plurality of unit cells are fastened through an end plate and a band-type fastening member in a stacked and pressed state by a fuel cell stack assembly device, and may be assembled as a module-type fuel cell stack.

(7) In another example, a plurality of unit cells may be fastened through an end plate and a box-type enclosure in a stacked and pressed state by the fuel cell stack assembly device, and may also be assembled as a module-type fuel cell stack.

(8) Here, the fuel cell stack assembly device applied to another example includes a press mechanism for aligning and pressing a plurality of unit cells, and a press mechanism for aligning and pressing the enclosure.

(9) Therefore, according to the related art, since the plurality of unit cells are aligned and pressed and the enclosure is aligned and pressed, assembling man-hours, equipment investment cost, and manufacturing cost are increased due to the alignment and pressing of the plurality of unit cells and the enclosure.

(10) The above information disclosed in this Background section is only for enhancement of understanding of the background of the disclosure, and therefore it may contain information that does not form the prior art that is already known in this country to a person of ordinary skill in the art.

SUMMARY

(11) The present disclosure has been made in an effort to provide a fuel cell stack assembly device having advantages of reducing assembling man-hours and facility investment costs associated with assembling a fuel cell stack.

(12) An exemplary embodiment of the present disclosure provides a fuel cell stack assembly device including a rotating body disposed to be inclined in an up-down direction on a jig frame and rotatably installed on the jig frame, a press body installed to be movable in the up-down direction at an upper portion of the rotating body to correspond to a cell stacking base provided below the rotating body, at least one first swing body swingably installed at a front portion of the rotating body, at least one second swing body swingably installed at a rear portion of the rotating body, a cell stacking guide portion provided at each of the at least one first swing body and the at least one second swing body, and a cell fastening guide portion provided at each of the at least one first swing body and the at least one second swing body.

(13) The cell stacking base may include at least one first connection recess connected to at least one guide groove respectively formed at front and rear edges of a lower end plate.

(14) The press body may include at least one second connection recess connected to at least one guide groove respectively formed at front and rear edges of an upper end plate.

(15) The at least one first swing body may include a first rotating block rotatably installed at each of an upper portion and a lower portion of the rotating body, and a first swing block connected to the first rotating block in the vertical (up-down) direction.

(16) The at least one second swing body may include a second rotating block rotatably installed at each of an upper portion and a lower portion of the rotating body, and a second swing block connected to the second rotating block in the vertical (up-down) direction.

(17) The first swing block may be fixedly and rotatably connected to the first rotating block through at least one first joint member.

(18) The second swing block may be fixedly and rotatably connected to the second rotating block through at least one second joint member.

(19) The cell stacking guide portion may be provided at each of a first section set in the first swing block and a second section set in the second swing block.

(20) The cell fastening guide portion may be provided at each of a third section set in the first swing block and a fourth section set in the second swing block.

(21) The cell stacking guide portion may be selectively disposed at a position corresponding to

front and rear edges of the lower end plate, a plurality of unit cells, and the upper end plate stacked in the up-down direction on the cell stacking base.

(22) The cell stacking guide portion may include guide protrusions formed at the first section and the second section in the up-down direction.

(23) The guide protrusion may be coupled to at least one guide groove formed at each of front and rear edges of the lower end plate, the plurality of unit cells, and the upper end plate stacked in the up-down direction on the cell stacking base.

(24) The cell fastening guide portion may be selectively disposed at a position corresponding to an enclosure configured to fasten the lower end plate, the plurality of unit cells, and the upper end plate pressed by the press body.

(25) The cell fastening guide portion may include a guide block coupled to the third section and the fourth section in the up-down direction.

(26) The guide block may be coupled to at least one connection recess formed at each of front and rear edges of the cell stacking base and the press body to support the enclosure.

(27) The rotating body may include a first stopper provided to be retractable in the up-down direction to correspond to the first rotating block, and a second stopper provided to be retractable in the up-down direction to correspond to the second rotating block.

(28) The first swing block may be fixed to the first rotating block, and the second swing block may be fixed to the second rotating block.

(29) The cell stacking guide portion may be provided at each of the first section set in the first swing block and a second section set in the second swing block.

(30) The cell fastening guide portion may be mounted to and detached from the first section and the second section.

(31) The cell fastening guide portion may be fixed to each of the first section and the second section through at least one magnet.

(32) According to an exemplary embodiment of the present disclosure, the assembly man-hours, equipment investment costs, and manufacturing costs for guiding and aligning a plurality of unit cells and both end plates and guiding and aligning an enclosure may be reduced.

(33) In addition, the effects obtainable or predicted by the exemplary embodiments of the present disclosure are disclosed directly or implicitly in the detailed description of the exemplary embodiments of the present disclosure. That is, various effects predicted according to an exemplary embodiment of the present disclosure are disclosed in the detailed description to be described later.

Description

BRIEF DESCRIPTION OF THE FIGURES

- (1) Since these drawings are for reference in describing an exemplary embodiment of the present disclosure, the technical spirit of the present disclosure should not be construed as being limited to the accompanying drawings.
- (2) FIGS. 1 and 2 are perspective views illustrating a fuel cell stack assembly device according to an exemplary embodiment of the present disclosure.
- (3) FIG. 3 is a view illustrating an example of a fuel cell stack assembled by a fuel cell stack assembly device according to an exemplary embodiment of the present disclosure.
- (4) FIG. 4 is a view illustrating a cell stacking base of a rotating body applied to a fuel cell stack assembly device according to an exemplary embodiment of the present disclosure.
- (5) FIG. 5 is a view illustrating a press body applied to a fuel cell stack assembly device according to an exemplary embodiment of the present disclosure.
- (6) FIGS. 6, 7, 8A, and 8B are views illustrating a portion of a first swing body applied to a fuel cell stack assembly device according to an exemplary embodiment of the present disclosure.

- (7) FIGS. **9**, **10**, **11A** and **11B** are views illustrating a portion of a second swing body applied to a fuel cell stack assembly device according to an exemplary embodiment of the present disclosure.
- (8) FIG. **12** is a view illustrating a cell stacking guide portion applied to a fuel cell stack assembly device according to an exemplary embodiment of the present disclosure.
- (9) FIGS. **13A** and **13B** are views illustrating a cell fastening guide portion applied to a fuel cell stack assembly device according to an exemplary embodiment of the present disclosure.
- (10) FIG. **14** is a view illustrating a modification of a fuel cell stack assembly device according to an exemplary embodiment of the present disclosure.
- (11) It is to be understood that the drawings referenced above are not necessarily drawn to scale, but present a rather simplified representation of various preferred features illustrating the basic principles of the disclosure. Certain design features of the present disclosure, including, for example, particular dimensions, orientation, location, and shape, will be determined in part by the particular intended application and environment of use.

DETAILED DESCRIPTION

- (12) Hereinafter, exemplary embodiments of the present disclosure will be described in detail with reference to the accompanying drawings to allow those skilled in the art to practice the present disclosure. The present disclosure may be implemented in various different forms and is not limited to the examples as described herein.
- (13) The terminology used herein is for the purpose of describing specific exemplary embodiments and is not intended to limit the present disclosure. As used herein, the singular forms are also intended to include the plural forms, unless the context clearly dictates otherwise. As used herein, it should be understood that the terms ‘include and/or ‘including’ refer to the presence of specified features, integers, steps, operations, elements and/or components, but do not exclude the presence or addition of one or more other features, integers, steps, operations, components, and/or groups thereof. As used herein, the term ‘coupled’ denotes a physical relationship between two components directly connected to each other or indirectly connected through one or more intervening components.
- (14) Furthermore, as used herein, the term ‘and/or’ includes any one or all combinations of one or more of the associated listed items. And, ‘operably connected’ or similar terms mean that at least two members are directly or indirectly connected to each other to transmit power.
- (15) Furthermore, “vehicle,” “of vehicle,” “automobile,” or other similar terms used herein includes hydrogen powered vehicles. Such hydrogen-powered vehicles may include passenger vehicles, sport utility vehicles (SUVs), electric vehicle-based purpose-built vehicles (PBV), buses, trucks, and passenger automobiles including various commercial vehicles.
- (16) Hereinafter, exemplary embodiments of the present disclosure will be described in detail with reference to the accompanying drawings.
- (17) FIGS. **1** and **2** are perspective views illustrating a fuel cell stack assembly device according to an exemplary embodiment of the present disclosure.
- (18) Referring to FIGS. **1** and **2**, a fuel cell stack assembly device **100** according to an exemplary embodiment of the present disclosure may be applied to a process of assembling a fuel cell stack **1** (refer to FIG. **3** below) mounted on a hydrogen-powered vehicle.
- (19) As shown in FIG. **3**, the fuel cell stack **1** assembled by the fuel cell stack assembly device **100** according to an exemplary embodiment of the present disclosure includes an assembly structure of a plurality of unit cells (commonly referred to as ‘a plurality of fuel cells’ by those skilled in the art) **3** generating electric energy by an electrochemical reaction between hydrogen gas and air.
- (20) Here, the plurality of unit cells **3** may be stacked on each other, and may be pressed by both end plates **5** and **6** disposed on the outermost sides, respectively. The both end plates **5** and **6** collect current generated in the plurality of unit cells **3** and supply and discharge hydrogen air and air.
- (21) Furthermore, the fuel cell stack **1** includes an enclosure **7** configured to protect the plurality of unit cells **3**.

(22) In an example, the enclosure **7** includes a pair of housing structures **8a** and **8b** bisected from each other. The pair of housing structures **8a** and **8b** may surround the plurality of aligned and pressed unit cells **3** and may be fastened to both end plates **5** and **6**. Such an enclosure **7** may be mounted on a vehicle body of a hydrogen powered vehicle.

(23) In an exemplary embodiment of the present disclosure, the fuel cell stack **1** as described above is described as being mounted on a hydrogen-powered vehicle, but the present disclosure is not limited thereto, and the technical spirit of the present disclosure may be applied to any fuel cell stack mounted on various mobile devices and power generation facilities.

(24) In this disclosure, 'upper end portion', 'upper portion', 'upper end or 'upper surface' of a component indicates an end portion, part, end, or face of a component that is relatively upper in the drawing, and 'lower end portion', 'lower portion', 'lower end or 'lower surface' indicates an end portion, part, end, or face of a component that is relatively lower in the drawing.

(25) In addition, in the present disclosure, the end (e.g., one end or the other end, etc.) of a component indicates the end of the component in any one direction, and an end portion of the component (e.g., one end portion or the other end portion, etc.) indicates a certain portion of the component including the end.

(26) Meanwhile, in the present disclosure, among the both end plates **5** and **6**, when viewed in an up-down direction, the end plate located below may be defined as a lower end plate **5**, and the end plate located above may be defined as an upper end plate **6**.

(27) The fuel cell stack assembly device **100** according to an exemplary embodiment of the present disclosure is configured to align and press a plurality of unit cells **3** and both end plates **5** and **6** in the up-down direction and fasten the enclosure **7** to both end plates **5** and **6**.

(28) The fuel cell stack assembly device **100** according to an exemplary embodiment of the present disclosure has a structure that may reduce assembly man-hours and facility investment costs associated with assembling the fuel cell stack **1**.

(29) Referring to FIGS. **1** to **3**, the fuel cell stack assembly device **100** according to an exemplary embodiment of the present disclosure includes a jig frame **10**, a rotating body **20**, a press body **30**, and at least one first swing body **40**, at least one second swing body **60**, a cell stacking guide portion **80**, and a cell fastening guide portion **90**.

(30) In an exemplary embodiment of the present disclosure, the jig frame **10** is fixed to a floor surface of a process workshop. In an example, the jig frame **10** includes a base frame **11** and a vertical frame **13** disposed on the base frame **11** in an up-down direction.

(31) In an exemplary embodiment of the present disclosure, the rotating body **20** is disposed to be inclined in the up-down direction on the jig frame **10**. That is, the rotating body **20** may be disposed to be inclined in a front-rear direction from an upper portion of the vertical frame **13** toward the base frame **11**.

(32) Furthermore, the rotating body **20** is rotatably installed on the vertical frame **13** of the jig frame **10**. The rotating body **20** may be rotated by the driving of a first driving unit **21**. The first driving unit **21** is installed on the vertical frame **13**. The first driving unit **21** may include a servo motor well known to those skilled in the art.

(33) The rotating body **20** includes an upper body **23** and a lower body **25**. The upper body **23** is operatively connected to a first driving unit **21**. The lower body **25** is disposed to be spaced apart from the upper body **23**, and is connected to the upper body **23** through a plurality of support rods **27**.

(34) Here, the lower body **25** is provided with a cell stacking base **29** as shown in FIG. **4**. The cell stacking base **29** is configured to support a plurality of unit cells **3** and both end plates **5** and **6**.

(35) The cell stacking base **29** includes at least one first connection recess **26** formed at front and rear edges, respectively. The at least one first connection recess **26** may be connected to the at least one first guide groove **9a** (refer to FIG. **3**) formed on the front and rear edges of the lower end plate **5** in the up-down direction.

(36) Referring to FIGS. 1 to 4, in an exemplary embodiment of the present disclosure, the press body 30 is configured to press a plurality of unit cells 3 supported by the cell stacking base 29 of the lower body 25 of the rotating body 20, the lower end plate 5, and the upper end plate 6.

(37) The press body 30 is installed to be movable in the up-down direction at an upper portion of the rotating body 20 to correspond to the cell stacking base 29 of the lower body 25.

(38) The press body 30 is installed to be movable in the up-down direction at the upper body 23 of the rotating body 20. As shown in FIG. 5, the press body 30 may be moved in the up-down direction by the driving of a second driving unit 31. The second driving unit 31 is installed at the upper body 23 and is operatively connected to the press body 30. The second driving unit 31 may include a working cylinder or servo motor well known to those skilled in the art.

(39) The press body 30 is coupled to the plurality of support rods 27 to be movable in the up-down direction. The press body 30 includes at least one second connection recess 33 formed on each of front and rear edges. The at least one second connection recess 33 may be connected to the at least one second guide groove 9b formed on front and rear edges of the upper end plate 6 in the up-down direction.

(40) Referring to FIGS. 1 and 2, in an exemplary embodiment of the present disclosure, at least one first swing body 40 is disposed between the front and the rear of the rotating body 20 with the cell stacking base 29 and the press body 30 interposed therebetween and is swingably installed at the front of the rotating body 20.

(41) In an example, the at least one first swing body 40 may be installed on both sides of the front of the rotating body 20.

(42) FIGS. 6 to 8 are views illustrating a portion of the first swing body applied to a fuel cell stack assembly device according to an exemplary embodiment of the present disclosure.

(43) Referring to FIGS. 6 to 8, the at least one first swing body 40 according to an exemplary embodiment of the present disclosure includes a first rotating block 41 and a first swing block 43.

(44) The first rotating block 41 is rotatably installed on each of upper and lower portions of the rotating body 20. The first rotating block 41 is rotatably installed on each of the upper body 23 and the lower body 25 of the rotating body 20. The first rotating block 41 may be rotated in a left-right direction (indicated by the arrow in the drawing) perpendicular to a front-rear direction of the rotating body 20.

(45) The first rotating block 41 is rotatably coupled to a first rotating shaft 45 fixed to each of the upper body 23 and the lower body 25. The first rotating block 41 may be rotated in the left-right direction at a set rotation angle (e.g., 180 degrees).

(46) The set rotation angle of the first rotating block 41 may be determined by the plurality of support rods 27 and the lower portion of the cell stacking base 29 as mentioned above. That is, the first rotating block 41 may be stopped by the plurality of support rods 27 and the lower portion of the cell stacking base 29.

(47) Here, the first rotating block 41 provided at the lower body 25 includes a first handle 47. The first handle 47 is provided at an end opposite to an end coupled to the first rotating shaft 45 in the first rotating block 41.

(48) Furthermore, in the rotating body 20, a first stopper 49 is installed at the lower body 25 provided with the first rotating block 41.

(49) The first stopper 49 prevents the first rotating block 41 stopped at the lower portion of the cell stacking base 29 from being rotated toward the plurality of support rods 27. The first stopper 49 is installed at the lower body 25 to be retractable (movable) in the vertical (up-down) direction to correspond to the first rotating block 41.

(50) In an example, the first stopper 49 may be operatively connected to the first working cylinder 51 provided at the lower body 25, and move in the vertical direction by driving the first working cylinder 51.

(51) The first swing block 43 is connected to the first rotating block 41 in the vertical direction. The

first swing block **43** may be swing-rotated in the horizontal (left-right) direction by the first rotating block **41**.

(52) In an example, the first swing block **43** may be provided in the form of a block in which four sides are formed in the front-rear direction and the horizontal direction.

(53) The first swing block **43** may be fixedly and rotatably connected to the first rotating block **41** by at least one first joint member **53** (refer to FIG. **8**). The at least one first joint member **53** may be provided as a pin that passes through a lower portion of the first swing block **43** and is fitted into the first rotating block **41**.

(54) When the at least one first joint member **53** is separated from the lower portion of the first swing block **43** and the first rotating block **41**, the first swing block **43** may be supported by the first rotating block **41**, and in this state, the first swing block **43** may be rotated in the left-right direction.

(55) Also, when the at least one first joint member **53** passes through the lower portion of the first swing block **43** and is fitted into the first rotating block **41**, the first swing block **43** may be fixed to the first rotating block **41**.

(56) Referring to FIGS. **1** and **2**, in an exemplary embodiment of the present disclosure, the at least one second swing body **60** is disposed between the front and the rear of the rotating body **20** and swingably installed at the rear of the rotating body **20** with the cell stacking base **29** and the press body **30** interposed therebetween. That is, the at least one second swing body **60** is disposed at the rear portion of the rotating body **20** to correspond to the at least one first swing body **40**.

(57) In an example, the at least one second swing body **60** may be installed on both sides of the rear portion of the rotating body **20**, respectively.

(58) FIGS. **9** to **11** are views illustrating a portion of the second swing body applied to a fuel cell stack assembly device according to an exemplary embodiment of the present disclosure.

(59) Referring to FIGS. **9** to **11**, the at least one second swing body **60** according to an exemplary embodiment of the present disclosure includes a second rotating block **61** and a second swing block **63**.

(60) The second rotating block **61** is rotatably installed at each of upper and lower portions of the rotating body **20**. The second rotating block **61** is rotatably installed at each of the upper body **23** and the lower body **25** of the rotating body **20**. The second rotating block **61** may be rotated in the left-right direction (indicated by the arrow in the drawing) perpendicular to the front-rear direction of the rotating body **20**.

(61) The second rotating block **61** is rotatably coupled to a second rotating shaft **65** fixed to each of the upper body **23** and the lower body **25**. The second rotating block **61** may be rotated in the left-right direction at a set rotation angle (e.g., 180 degrees).

(62) The set rotation angle of the second rotating block **61** may be determined by the plurality of support rods **27** and the lower portion of the cell stacking base **29** as mentioned above. That is, the second rotating block **61** may be stopped by the plurality of support rods **27** and the lower portion of the cell stacking base **29**.

(63) Here, the second rotating block **61** provided at the lower body **25** includes a second handle **67**. The second handle **67** is provided at an end portion opposite to the end portion coupled to the second rotating shaft **65** in the second rotating block **61**.

(64) Furthermore, in the rotating body **20**, a second stopper **69** is installed at the lower body **25** provided with the second rotating block **61**.

(65) The second stopper **69** prevents the second rotating block **61** stopped at the lower portion of the cell stacking base **29** from being rotated toward the plurality of support rods **27**. The second stopper **69** is installed at the lower body **25** to be retractable (e.g., movable) in the up-down direction to correspond to the second rotating block **61**.

(66) In an example, the second stopper **69** may be operatively connected to a second working cylinder **71** provided at the lower body **25**, and move in the up-down direction by driving the

second working cylinder **71**.

(67) The second swing block **63** is connected to the second rotating block **61** in the up-down direction. The second swing block **63** may be swing-rotated in the left-right direction by the second rotating block **61**.

(68) In an example, the second swing block **63** may be provided in the form of a block in which four sides are formed in the front-rear direction and the left-right direction.

(69) The second swing block **63** may be fixedly and rotatably connected to the second rotating block **61** by at least one second joint member **73** (see FIG. **11**). The at least one second joint member **73** may be provided as a pin that passes through a lower portion of the second swing block **63** and is fitted into the second rotating block **61**.

(70) When the at least one second joint member **73** is separated from the lower portion of the second swing block **63** and the second rotating block **61**, the second swing block **63** may be supported by the second rotating block **61**, and in this state, the second swing block **63** may be rotated in the left-right direction.

(71) Also, when the at least one second joint member **73** passes through the lower portion of the second swing block **63** and is fitted into the second rotating block **61**, the second swing block **63** may be fixed to the second rotating block **61**.

(72) Referring to FIGS. **6** to **11** together with FIGS. **1** and **2**, in an exemplary embodiment of the present disclosure, the cell stacking guide portion **80** is configured to guide and align the lower end plate, the plurality of unit cells **3**, and the upper end plate **6** vertically stacked on the cell stacking base **29** of the rotating body **20** (refer to FIGS. **3** and **4** below).

(73) The cell stacking guide portion **80** is provided at each of the at least one first swing body **40** and at least one second swing body **60**.

(74) The cell stacking guide portion **80** may be selectively disposed in a position corresponding to front and rear edges of the lower end plate **5**, the plurality of unit cells **3**, and the upper end plate **6** stacked in the up-down direction on the cell stacking base **29**.

(75) The cell stacking guide portion **80** is provided at each of the first swing block **43** of the at least one first swing body **40** and the second swing block **63** of the at least one second swing body **60**. Furthermore, as shown in FIG. **12**, the cell stacking guide portion **80** is provided at a first section **55** set on four sides of the first swing block **43**, and is provided at a second section **75** set on four sides of the second swing block **63**.

(76) Here, as the first swing block **43** and the second swing block **63** are selectively rotatable, the first section **55** may be a front or rear side among the four sides of the first swing block **43** and, the second section **75** may be a front or rear side among the four sides of the second swing block **63**.

(77) The cell stacking guide portion **80** includes guide protrusions **81** respectively formed at the first section **55** of the first swing block **43** and the second section **75** of the second swing block **63** in the up-down direction, respectively.

(78) The guide protrusion **81** is formed to protrude from the first section **55** and the second section **75**. The guide protrusion **81** is configured to substantially guide and align the lower end plate **5**, the plurality of unit cells **3**, and the upper end plate **6** stacked on the cell stacking base **29** in the up-down direction.

(79) The guide protrusion **81** may be coupled to the front and rear edges of the lower end plate **5**, the plurality of unit cells **3**, and the upper end plate **6** in the up-down direction. Further, the guide protrusion **81** may be coupled to at least one first guide groove **9a** respectively formed at front and rear edges of the lower end plate **5**, at least one second guide groove respectively formed at front and rear edges of the upper end plate **6**, and at least one third guide groove **4a** respectively formed at front and rear edges of the plurality of unit cells **3** in the up-down direction (refer to FIG. **3**).

(80) Referring to FIGS. **6** to **11** together with FIGS. **1** and **2**, in an exemplary embodiment of the present disclosure, the cell fastening guide portion **90** is configured to guide, align, and press the enclosure **7** fastening the lower end plate **5**, a plurality of unit cells **3**, and the upper end plate **6**

pressed by the press body **30** (refer to FIGS. **3** and **4** below).

(81) That is, the cell fastening guide portion **90** is configured to guide, align, and press each of a pair of bisected housing structures **8a** and **8b** of the enclosure **7** (refer to FIGS. **3** and **4** below).

(82) The cell fastening guide portion **90** is provided at each of the at least one first swing body **40** and at least one second swing body **60**. The cell fastening guide portion **90** may be selectively disposed at positions respectively corresponding to the pair of housing structures **8a** and **8b** of the enclosure **7**.

(83) The cell fastening guide portion **90** is provided at each of the first swing block **43** of the at least one first swing body **40** and the second swing block **63** of the at least one second swing body **60**. Furthermore, as shown in FIG. **13**, the cell fastening guide portion **90** is provided at a third section **57** set on four sides of the first swing block **43**, and is provided at a fourth section **77** set on four sides.

(84) Here, as the first swing block **43** and the second swing block **63** are selectively rotatable, the third section **57** may be a front or rear side among the four sides of the first swing block **43**, and the fourth section **77** may be a front or rear side among the four sides of the second swing block **63**.

(85) In an example, as shown in FIG. **12**, when the cell stacking guide portion **80** is provided at the first section **55** of the first swing block **43**, as shown in FIG. **13**, the cell fastening guide portion **90** may be provided at the third section **57** opposite to the first section **55**.

(86) Also, as shown in FIG. **12**, when the cell stacking guide portion **80** is provided at the second section **75** of the second swing block **63**, as shown in FIG. **13**, the cell fastening guide portion **90** may be provided at the fourth section **77** opposite to the second section **75**.

(87) The cell fastening guide portion **90** includes a guide block **91** coupled to the third section **57** of the first swing block **43** and the fourth section **77** of the second swing block **63** in the up-down direction, respectively.

(88) The guide block **91** may be configured to substantially guide, align, and press each of the pair of bisected housing structures **8a** and **8b** of the enclosure **7**.

(89) The guide block **91** may be coupled to the at least one first connection recess **26** of the cell stacking base **29** and the at least one second connection recess **33** of the press body **30** mentioned above to support each of the pair of housing structures **8a** and **8b** of the enclosure **7**.

(90) Hereinafter, the operation of the fuel cell stack assembly device **100** configured as described above and a method of assembling a fuel cell stack according to an exemplary embodiment of the present disclosure will be described in detail with reference to FIGS. **1** to **13**.

(91) First, in an exemplary embodiment of the present disclosure, the press body **30** is in a state of having moved in an upward direction through the plurality of support rods **27** by the driving of the second driving unit **31**.

(92) Here, the first rotating block **41** of the at least one first swing body **40** is rotated from the front of the rotating body **20** toward the plurality of support rods **27** (e.g., in an open state).

(93) At this time, the first stopper **49** is in a state of having moved downward by the driving of the first working cylinder **51**, and the first rotating block **41** is stopped by the plurality of support rods **27**. Accordingly, the first swing block **43** of the at least one first swing body **40** is located to be adjacent to the plurality of support rods **27**. In addition, the first swing block **43** is fixed to the first rotating block **41** by at least one first joint member **53**.

(94) In addition, the second rotating block **61** of the at least one second swing body **60** is in a state of having rotated from the rear portion of the rotating body **20** to a lower side of the cell stacking base **29** (e.g., in a closed state).

(95) At this time, the second stopper **69** is in a state of having moved upward by the driving of the second working cylinder **71**. The second stopper **69** prevents the second rotating block **61** from rotating toward the plurality of support rods **27**. Accordingly, the second swing block **63** of the at least one second swing body **60** is located to be adjacent to the cell stacking base **29**. In addition, the second swing block **63** is fixed to the second rotating block **61** by at least one second joint

member **73**.

(96) Further, the cell stacking guide portion **80** faces the rear portion of the rotating body **20** at the first section **55** of the first swing block **43**, and faces the front of the rotating body **20** at the second section **75** of the second swing block **63**.

(97) In addition, the cell fastening guide portion **90** faces the front of the rotating body **20** at the third section **57** of the first swing block **43**, and faces the rear of the rotating body **20** at the fourth section **77** of the second swing block **63**.

(98) In this state, the lower end plate **5**, the plurality of unit cells **3**, and the upper end plate **6** are sequentially stacked on the upper surface of the cell stacking base **29** of the rotating body **20** in an upward direction.

(99) At the second section **75** of the second swing block **63**, the cell stacking guide portion **80** guides the lower end plate **5**, the plurality of unit cells **3**, and the upper end plate **6** in a downward direction to be aligned on the upper surface of the cell stacking base **29**.

(100) Here, the cell stacking guide portion **80** is coupled to at least one first guide groove **9a** of the lower end plate **5**, at least one third guide groove **4a** of the plurality of unit cells **3**, and at least one second guide groove **9b** of the upper end plate **6** through the guide protrusion **81**. Accordingly, the cell stacking guide portion **80** may guide and align the lower end plate **5**, the plurality of unit cells **3**, and the upper end plate **6** in the vertical direction.

(101) Furthermore, since the rotating body **20** is disposed to be inclined in the vertical direction on the jig frame **10**, the cell stacking guide portion **80** may guide and align the lower end plate **5**, the plurality of unit cells **3**, and the upper end plate **6** more easily.

(102) In a state in which the lower end plate **5**, the plurality of unit cells **3**, and the upper end plate **6** are stacked as described above, the press body **30** is moved downward by the driving of the second driving unit **31**. Then, the lower end plate **5**, the plurality of unit cells **3**, and the upper end plate **6** aligned on the upper surface of the cell stacking base **29** are pressed by the press body **30**.

(103) Then, one of the pair of housing structures **8a** and **8b** of the enclosure **7** is mounted at a portion of the lower end plate **5**, a plurality of unit cells **3**, and the upper end plate **6** pressed by the press body **30**.

(104) Next, the first rotating block **41** of the at least one first swing body **40** is rotated toward a lower side of the cell stacking base **29**. Accordingly, the first swing block **43** of the at least one first swing body **40** is located to be adjacent to the cell stacking base **29**. At this time, the first stopper **49** is moved upward by the driving of the first working cylinder **51**, and prevents the first rotating block **41** from rotating toward the plurality of support rods **27**.

(105) Here, the cell fastening guide portion **90** facing the front of the rotating body **20** at the third section **57** of the first swing block **43** faces the rear of the rotating body **20**. Also, the cell stacking guide portion **80** facing the rear of the rotating body **20** at the first section **55** of the first swing block **43** faces the front of the rotating body **20**.

(106) Further, in the third section **57** of the first swing block **43**, the cell fastening guide portion **90** is coupled to the at least one first connection recess **26** of the cell stacking base **29** and the at least one second connection recess **33** of the press body **30** through the guide block **91**. Accordingly, the cell fastening guide portion **90** guides, aligns, and presses one of the pair of housing structures **8a** and **8b** to a set position.

(107) Then, one of the pair of housing structures **8a** and **8b** is fastened to the lower end plate **5** and the upper end plate **6** by fastening members (not shown) well known to those skilled in the art, such as bolts and nuts.

(108) Thereafter, the rotating body **20** is rotated by 180 degrees in one direction by the driving of the first driving unit **21**. Accordingly, the front and rear positions of the at least one first swing body **40** and the at least one second swing body **60** are interchanged from each other.

(109) In this state, the second stopper **69** is moved downward by the driving of the second working cylinder **71**. In addition, the second rotating block **61** of the at least one second swing body **60** is

rotated toward the plurality of support rods **27**. Accordingly, the second swing block **63** of the at least one second swing body **60** is located to be adjacent to the plurality of support rods **27**. At this time, at the second section **75** of the second swing block **63**, the cell stacking guide portion **80** faces the front of the rotating body **20**. Also, at the fourth section **77** of the second swing block **63**, the cell fastening guide portion **90** faces the rear of the rotating body **20**.

(110) Then, the at least one second joint member **73** is separated from the lower portion of the second swing block **63** and the second rotating block **61**. Next, the second swing block **63** is rotated by 180 degrees in one direction, while being supported by the second rotating block **61**.

(111) Accordingly, at the second section **75** of the second swing block **63**, the cell stacking guide portion **80** facing the front of the rotating body **20** faces the rear of the rotating body **20**. Also, at the fourth section **77** of the second swing block **63**, the cell fastening guide portion **90** facing the rear of the rotating body **20** faces the front of the rotating body **20**.

(112) Thereafter, the other of the pair of housing structures **8a** and **8b** of the enclosure **7** is mounted at the other portion of the lower end plate **5**, a plurality of unit cells **3**, and the upper end plate **6** pressed by the press body **30**.

(113) Next, the second rotating block **61** of the at least one second swing body **60** is rotated toward a lower side of the cell stacking base **29**. Accordingly, the second swing block **63** of the at least one second swing body **60** is located to be adjacent to the cell stacking base **29**. At this time, the second stopper **69** is moved upward by the driving of the second working cylinder **71**, and prevents the second rotating block **61** from rotating toward the plurality of support rods **27**.

(114) Here, at the second section **75** of the second swing block **63**, the cell stacking guide portion **80** facing the rear of the rotating body **20** faces the front of the rotating body **20**. Also, at the fourth section **77** of the second swing block **63**, the cell fastening guide portion **90** facing the front of the rotating body **20** faces the rear of the rotating body **20**.

(115) Further, at the fourth section **77** of the second swing block **63**, the cell fastening guide portion **90** is coupled to the at least one first connection recess **26** of the cell stacking base **29** and the at least one second connection recess **33** of the press body **30** through the guide block **91**.

Accordingly, the cell fastening guide portion **90** guides, aligns, and presses the other of the pair of housing structures **8a** and **8b** to a set position.

(116) Subsequently, the other of the pair of housing structures **8a** and **8b** is fastened to the lower end plate **5** and the upper end plate **6** by fastening members (not shown) well known to those skilled in the art, such as bolts and nuts.

(117) Accordingly, the fuel cell stack assembly device **100** according to an exemplary embodiment of the present disclosure undergoes a series of processes as described above, and the fuel cell stack **1** in which the plurality of unit cells **3** are fastened by both end plates **5** and **6** and the enclosure **7** may be assembled.

(118) Meanwhile, in the fuel cell stack assembly device **100** according to an exemplary embodiment of the present disclosure, when the series of processes described above is performed in the reverse order, a repair process of the plurality of unit cells **3** of the fuel cell stack **1** may be performed.

(119) The repair process may be performed through the rotation of the first rotating block **41** and the first swing block **43** of the at least one first swing body **40** and the rotation of the second rotating block **61** and the second swing block **63** of the at least one second swing body **60**.

(120) The fuel cell stack assembly device **100** according to an exemplary embodiment of the present disclosure as described so far includes at least one first swing body **40** and at least one second swing body **60** provided in the rotating body **20** and the cell stacking guide portion **80** and the cell fastening guide portion **90** provided in the at least one first swing body **40** and the at least one second swing body **60**.

(121) Accordingly, the fuel cell stack assembly device **100** according to an exemplary embodiment of the present disclosure guides and aligns the plurality of unit cells **3** and both end plates **5** and **6**,

and guides and aligns the enclosure 7 in a single facility.

(122) Accordingly, the fuel cell stack assembly device **100** according to an exemplary embodiment of the present disclosure may reduce assembly man-hours, equipment investment costs, and manufacturing costs for guiding and aligning the plurality of unit cells **3** and both end plates **5** and **6** and guiding and aligning the enclosure **7**.

(123) Furthermore, the fuel cell stack assembly device **100** according to an exemplary embodiment of the present disclosure may further improve the structural stability, repairability, and manufacturability of the fuel cell stack **1**.

(124) FIG. **14** is a view illustrating a modification of a fuel cell stack assembly device according to an exemplary embodiment of the present disclosure.

(125) Referring to FIG. **14**, in the modification of the fuel cell stack assembly device **100** according to an exemplary embodiment of the present disclosure, the first swing block **143** of the at least one first swing body **140** may be fixed to the first rotating block **141**. Also, in the modification, the second swing block **163** of the at least one second swing body **160** may be fixed to the second rotating block **161**.

(126) Furthermore, in this modification, the cell stacking guide portion **180** may be provided at each of the set first section **155** of the first swing block **143** and the set second section **175** of the second swing block **163**. The cell stacking guide portion **180** includes guide protrusions **181** protruding from the first section **155** and the second section **175**, respectively.

(127) Also, in this modification, the cell fastening guide portion **190** may be provided to be mounted on and detached from the first section **155** and the second section **175** described above. In an example, the cell fastening guide portion **190** may include a guide plate **195** and at least one magnet **197** provided at the guide plate **195**.

(128) Here, the guide block **191** is coupled to the guide plate **195**. The guide plate **195** may be mounted (e.g., fixed) to each of the first section **155** and the second section **175** through at least one magnet **197**, and may be detachable (e.g., separable) from the first section **155** and the second sections **175**.

(129) Accordingly, in a modification of the fuel cell stack assembly device **100** according to an exemplary embodiment of the present disclosure, since the position of the cell fastening guide portion **190** may be freely set through at least one magnet **197** based on the position of the cell stacking guide portion **180**, the assembly man-hours required for assembling the fuel cell stack may be further reduced.

(130) Although the exemplary embodiment of the present disclosure has been described above, the present disclosure is not limited thereto, and it is possible to carry out various modifications within the claim coverage, the description of the disclosure, and the accompanying drawings, and such modifications also fall within the scope of the present disclosure.

Claims

1. A fuel cell stack assembly device comprising: a rotating body inclined in a vertical direction on a jig frame and rotatably connected to the jig frame; a press body movable in the vertical direction at an upper portion of the rotating body to correspond to a cell stacking base provided below the rotating body; at least one first swing body swingably installed at a front portion of the rotating body; at least one second swing body swingably installed at a rear portion of the rotating body; a cell stacking guide portion provided at each of the at least one first swing body and the at least one second swing body; and a cell fastening guide portion provided at each of the at least one first swing body and the at least one second swing body.

2. The fuel cell stack assembly device of claim 1, wherein: the cell stacking base includes at least one first connection recess formed at a front edge of a lower end plate, the at least one first connection recess being connected to at least one guide groove formed at a rear edge of the lower

end plate, and the press body includes at least one second connection recess formed at a front edge of an upper end plate, the at least one second connection recess being connected to at least one guide groove formed at a rear edge of the upper end plate.

3. The fuel cell stack assembly device of claim 1, wherein: the at least one first swing body includes: a first rotating block rotatably installed at each of an upper portion and a lower portion of the rotating body; and a first swing block connected to the first rotating block in the vertical direction.

4. The fuel cell stack assembly device of claim 3, wherein: the at least one second swing body includes: a second rotating block rotatably installed at each of an upper portion and a lower portion of the rotating body; and a second swing block connected to the second rotating block in the vertical direction.

5. The fuel cell stack assembly device of claim 4, wherein: the first swing block is fixedly and rotatably connected to the first rotating block through at least one first joint member, and the second swing block is fixedly and rotatably connected to the second rotating block through at least one second joint member.

6. The fuel cell stack assembly device of claim 5, wherein: the cell stacking guide portion is provided at each of a first section set in the first swing block and a second section set in the second swing block; and the cell fastening guide portion is provided at each of a third section set in the first swing block and a fourth section set in the second swing block.

7. The fuel cell stack assembly device of claim 5, wherein: the cell stacking guide portion is disposed at a position corresponding to front and rear edges of the lower end plate, a plurality of unit cells, and the upper end plate stacked in the vertical direction on the cell stacking base.

8. The fuel cell stack assembly device of claim 6, wherein: the cell stacking guide portion includes guide protrusions formed at the first section and the second section in the vertical direction.

9. The fuel cell stack assembly device of claim 8, wherein: the guide protrusion is coupled to at least one guide groove formed at each of front and rear edges of the lower end plate, the plurality of unit cells, and the upper end plate stacked in the up-down direction on the cell stacking base.

10. The fuel cell stack assembly device of claim 5, wherein: the cell fastening guide portion is disposed at a position corresponding to an enclosure configured to fasten the lower end plate, the plurality of unit cells, and the upper end plate pressed by the press body.

11. The fuel cell stack assembly device of claim 10, wherein: the cell fastening guide portion includes a guide block coupled to the third section and the fourth section in the vertical direction.

12. The fuel cell stack assembly device of claim 11, wherein: the guide block is coupled to at least one connection recess formed at each of front and rear edges of the cell stacking base and the press body to support the enclosure.

13. The fuel cell stack assembly device of claim 4, wherein: the rotating body includes: a first stopper retractable in the vertical direction to correspond to the first rotating block; and a second stopper retractable in the vertical direction to correspond to the second rotating block.

14. The fuel cell stack assembly device of claim 4, wherein: the first swing block is fixed to the first rotating block; and the second swing block is fixed to the second rotating block.

15. The fuel cell stack assembly device of claim 14, wherein: the cell stacking guide portion is provided at each of the first section set in the first swing block and a second section set in the second swing block; and the cell fastening guide portion is mounted to and detached from the first section and the second section.

16. The fuel cell stack assembly device of claim 15, wherein: the cell fastening guide portion is fixed to each of the first section and the second section through at least one magnet.
