(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
22 July 2010 (22.07.2010)

PCT

(10) International Publication Number
WO 2010/082934 A1

(51) International Patent Classification:
H01M 8/02 (2006.01) *H01M 8/24* (2006.01)
H01M 8/04 (2006.01)

(21) International Application Number:
PCT/US2009/031368

(22) International Filing Date:
19 January 2009 (19.01.2009)

(25) Filing Language: English

(26) Publication Language: English

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(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Declarations under Rule 4.17:

— *of inventorship (Rule 4.17(iv))*

Published:

— *with international search report (Art. 21(3))*

WO 2010/082934 A1

(54) Title: FUEL CELL SEAL

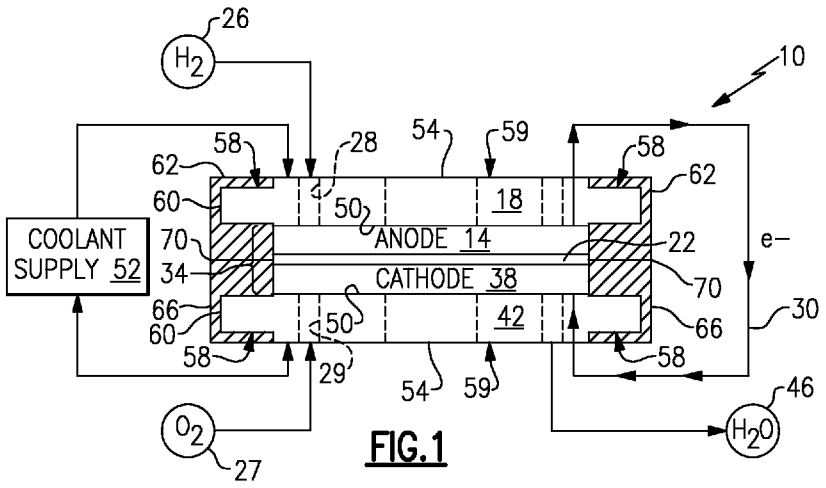


FIG.1

(57) Abstract: An example fuel cell assembly includes a seal that is configured to be placed over a portion of a fuel cell plate. The fuel cell plate has two opposite facing surfaces and a peripheral plate area that includes an outer lateral edge between the two surfaces. The seal is received over the peripheral plate area of the fuel cell plate and contacts each of the two opposite facing surfaces and the outer lateral edge.

FUEL CELL SEAL

Technical Field

[0001] This disclosure relates generally to fuel cells and, more particularly, to a sealing arrangement for a fuel cell.

Description of Related Art

[0002] Fuel cell stack assemblies (CSAs) are well known and typically include multiple individual fuel cells. Some fuel cells includes a polymer electrolyte membrane (PEM) positioned between porous carbon electrodes containing a platinum catalyst, which together establish a unitized electrode assembly. One of the electrodes operates as an anode while the other operates as a cathode. Some fuel cells include bipolar plates arranged adjacent each of the porous carbon electrodes. The fuel cells utilize fuel and oxidant, such as hydrogen and air, to generate electrical energy in a known manner. The fuel cells may also generate liquid and thermal byproducts. Some CSAs move pressurized coolant through the bipolar plates and various internal manifolds to remove byproducts from the CSA.

[0003] Seals help control fluid flow within the CSA. For example, some CSAs include elastomeric interfacial seals and thermoplastic bond seals to control coolant movement within the CSA. Many CSAs are also coated with sealing coatings or incorporate additional seals to control undesirable coolant leakage from the CSA, especially from the peripheral edges of the porous bipolar plates and the unitized electrode assembly, which are exposed in many CSA designs. Seals do not protect the bipolar plates and the unitized electrode assembly at the outer edges of the CSA where they are exposed to the surrounding environment. Coatings also prevent electrical shorting and protect the CSA in some examples. Utilizing multiple seals and coatings for such CSAs is expensive and results in multiple interfaces between the adjacent seals.

SUMMARY

[0004] An example fuel cell assembly includes a seal that is configured to be placed over a portion of a fuel cell plate. The fuel cell plate has two opposite facing surfaces and a peripheral plate area that includes an outer lateral edge between the two surfaces. The seal is received over the peripheral plate area of the fuel cell plate and contacts each of the two opposite

facing surfaces and the outer lateral edge.

[0005] An example fuel cell seal assembly includes a first portion of a seal molded against a first side of a fuel cell plate, a second portion of the seal molded against an opposing, second side of the fuel cell plate, and a third portion of the seal molded against an outer lateral edge that extends between the first side and the second side of the fuel cell plate. The first, second, and third portions are molded together.

[0006] An example method of limiting flow of a fuel cell fluid includes using a molded fuel cell seal that extends from a first side of the fuel cell plate to a second, opposite side of the fuel cell plate. At least a portion of the first side configured to contact a unitized electrode assembly if the plate is positioned within a fuel cell stack.

[0007] These and other features of the disclosed examples can be best understood from the following specification and drawings. The following is a brief description of the drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] Figure 1 shows a schematic view an example fuel cell.

[0009] Figure 2 shows a perspective view of another example fuel cell.

[0010] Figure 3 shows a section view of the Figure 2 fuel cell.

[0011] Figure 4 shows an exploded section view of the Figure 2 fuel cell.

[0012] Figure 5 shows an example mold for molding the Figure 2 fuel cell seal.

DETAILED DESCRIPTION

[0013] Referring to Figure 1, an example fuel cell 10 includes an anode electrode 14 positioned between an anode plate 18 and a polymer electrolyte membrane (PEM) 22. Hydrogen moves from a fuel supply 26 through a plurality of ports 28 in plate 18 to the flow field contacting the anode electrode 14. The hydrogen then moves from the anode electrode 14 to a cathode electrode 38 positioned between a cathode plate 42 and the PEM 22. Oxygen moves from an oxidant supply 27 through a plurality of ports 29 in plate 42 to the flow field contacting the cathode electrode 38. In one example, the plate 18 and 42 each comprise a porous bipolar plate.

[0014] In this example, the anode electrode 14, the PEM 22, and the cathode electrode 38 together form a unitized electrode assembly (UEA) 34 that provides electrical energy in a known manner. As the hydrogen ions and oxygen combine proximate the cathode electrode 38, generated byproducts include water 46 and heat.

[0015] Coolant is provided from a coolant supply 52 to remove heat from the fuel cell 10 in a known manner. The coolant comprises pressurized water in one example. For simplicity and discussion purposes, only one fuel cell 10 is schematically shown, but a cell stack assembly (CSA) typically includes a plurality of fuel cells in a stacked relationship as known.

[0016] The plates 18 and 42 include UEA facing surfaces 50 and oppositely facing surfaces 54. A peripheral area 58 of the plates 18 and 42 is near the exterior portions of the fuel cell 10. In this example, the peripheral area 58 of the plate 18 and the peripheral area 58 of the plate 42 extend laterally outward past the UEA 34 (e.g., further to the left and right in the illustration). The peripheral areas 58 terminate at respective outer lateral plate edges 60.

[0017] In this example, a seal 62 is secured to the peripheral area 58 of the plate 18, and a second seal 66 is secured to the peripheral area 58 of the plate 42. The example seals 62 and 66 are secured to the peripheral areas 58 around the entire outer periphery of the plates 18 and 42. A seal interface 70 between the seals 62 and 66 corresponds generally to the location of the UEA 34. The seals 62 and 66 maintain fuel cell fluids within desired location in the CSA and prevent leakage of such fluids from the CSA by sealing the area including the peripheral areas 58 of the plates 18 and 42.

[0018] In this example, the seal 62 is an elastomer that is overmolded directly to a portion of the peripheral area 58 of the plate 18 as a single monolithic piece. The seal 66 is similarly overmolded to the plate 42. Example processes suitable for forming the seals 62 and 66 include compression molding, transfer molding or injection molding.

[0019] Referring now to Figures 2-4, once molded, the seal 62 in the fuel cell 10a includes a notch 74 that is formed about a thinned portion 76 at the outermost portion of the peripheral area 58. In this example, the peripheral area 58 includes the thinned portion 76, an intermediate portion 77, and some of the body portion 59 of the plate 18. The intermediate portion 77 provides a transition between the body portion 59 and the thinned portion 76. The thinned portion 76 has a thickness t_1, which is thicker than a thickness t_2 of an intermediate portion 77, but thinner than a thickness t_3 of the body portion 59 of plate 18. The varied

thicknesses of the illustrated plate 18 result in portions of the peripheral area 58 having a varying stepped profile as shown.

[0020] In this example, the thinned portion 76, the intermediate portion 77, and the body portion 59 each includes the UEA facing surfaces 50 and the UEA opposing surfaces 54. Spaces s_1 and s_2 represent the distances between the surfaces 50 and 54 on the thinned portion 76, and the surfaces 50 and 54 of the body portion 59 of the plate 18. In this example, the thinned portions 76 and the intermediate portions 77 of the plates 18 and 42 are entirely coved by one of the seals 62 and 66 that extend around the entire outer periphery of the plates 18 and 42.

[0021] The spaces s_1 and s_2 of the plate 18 are filled by the seal 62 to create a generally planar surface 80 for stacking another fuel cell adjacent the illustrated cell within a fuel cell stack assembly.

[0022] Referring now to Figure 5 with continuing reference to Figures 3 and 4, the stepped profile of the peripheral area 58 provides shoulders 63 that contain the seal 62 during the molding. A mold 68 contain the remaining portions of the seal 62 as material from a material supply 72 fill a mold cavity 75 of a mold 68 during molding.

[0023] In this example, the seal 62 includes protrusions 78 configured to contact the seal of a fuel cell when the fuel cells are arranged in a CSA. The protrusions 78 are compresses when the CSA is assembled thus act as interfacial seals between fuel cells.

[0024] The example fuel cell includes a bond film 82 separating the seal 62 from the seal 66. In this example, the bond film 82 comprises two separate portions that contact opposing sides of an edge portion of the UEA 34. The example bond film 82 is a thermoplastic material that acts as an adhesive when exposed to heat and pressure, which are applied to the fuel cell 10 during assembly. The bond film 82 secures the plates 18 and 42, the UEA 34, and the seals 62 and 66, together when making the fuel cell 10.

[0025] In this example, the intermediate portions 77 of the plates 18 and 42 each include a notch 86 that accommodates some of the bond film 82 within the fuel cell 10. The bond film 82 is positioned between the corresponding surface on the intermediate portion 77 and the laterally outward edges of the UEA 34. The thickness t_2 plus the thickness of the bond film 82 within the notch 86 corresponds generally to the thickness t_3 of the body portion 59 of the plate 18, which facilitates aligning the plates 18 and 42 against the UEA 34. The body portion 59 of the plates 18 and 42 having the thickness t_3 directly contacts the UEA 34 without any

sealing material between them. The body portion 59 is configured to achieve the necessary fluid flow to facilitate the desired electrochemical reaction.

[0026] Although a preferred embodiment has been disclosed, a worker of ordinary skill in this art would recognize that certain modifications would come within the scope of this invention. For that reason, the following claims should be studied to determine the true scope and content of this invention.

CLAIMS

We claim:

1. A fuel cell seal assembly, comprising:

a seal that is configured to be placed over a portion of a fuel cell plate, the fuel cell plate having two opposite facing surfaces and a peripheral plate area that includes an outer lateral edge between the two surfaces, the seal received over the peripheral plate area of the fuel cell plate and contacting each of the two opposite facing surfaces and the outer lateral edge.

2. The fuel cell seal assembly of claim 1, including a unitized electrode assembly positioned adjacent the fuel cell plate within a fuel cell stack, the seal being positioned laterally outward from the fuel cell stack of the unitized electrode assembly.

3. The fuel cell seal assembly of claim 1, including a unitized electrode assembly positioned adjacent the fuel cell plate within a fuel cell stack, the outer lateral edge positioned laterally outward from the fuel cell stack of the unitized electrode assembly.

4. The fuel cell seal assembly of claim 1, including a bond film between the fuel cell plate and a unitized electrode assembly within a fuel cell stack, the bond film configured to secure the fuel cell plate within a fuel cell stack.

5. The fuel cell seal assembly of claim 1, including a second seal and a second fuel cell plate having a second peripheral plate area within a fuel cell stack, the second seal configured to be placed over a portion of the second peripheral plate area, the second seal contacting two oppositely facing sides of the second peripheral plate area and contacting an outer lateral edge between the two oppositely facing sides.

6. The fuel cell assembly of claim 5, including a bond film between the seals and a unitized electrode assembly between the plates.

7. The fuel cell assembly of claim 1, wherein the seal is a monolithic, single piece.

8. The fuel cell assembly of claim 1, wherein the plate comprises a thinned portion comprising a nominal thickness, an intermediate portion adjacent the thinned area, the intermediate portion having a second, thickness less than the nominal thickness, and a body portion adjacent the intermediate portion having a third thickness greater than the nominal thickness and the second thickness; and

wherein the seal is received over at least the thinned portion.

9. The fuel cell assembly of claim 1, wherein the seal is a molded seal.

10. The fuel cell assembly of claim 1, wherein the seal is overmolded onto the portion of the peripheral plate area.

11. The fuel cell assembly of claim 1, wherein the seal is secured around the entire periphery of the fuel cell plate.

12. The fuel cell assembly of claim 1, wherein the fuel cell plate is at least one of a porous anode bipolar plate and a porous cathode bipolar plate.

13. The fuel cell assembly of claim 1, wherein the entire seal comprises the same material.

14. A fuel cell seal assembly, comprising:

a first portion of a seal molded against a first side of a fuel cell plate;

a second portion of the seal molded against an opposing, second side of the fuel cell plate; and

a third portion of the seal molded against an outer lateral edge between the first side and the second side of the fuel cell plate, wherein the third portion is molded together with the first portion and the second portion.

15. The fuel cell seal assembly of claim 14, wherein the first, second, and third portions all comprise the same material.

16. The fuel cell seal assembly of claim 14 wherein the seal is overmolded onto the fuel cell plate.

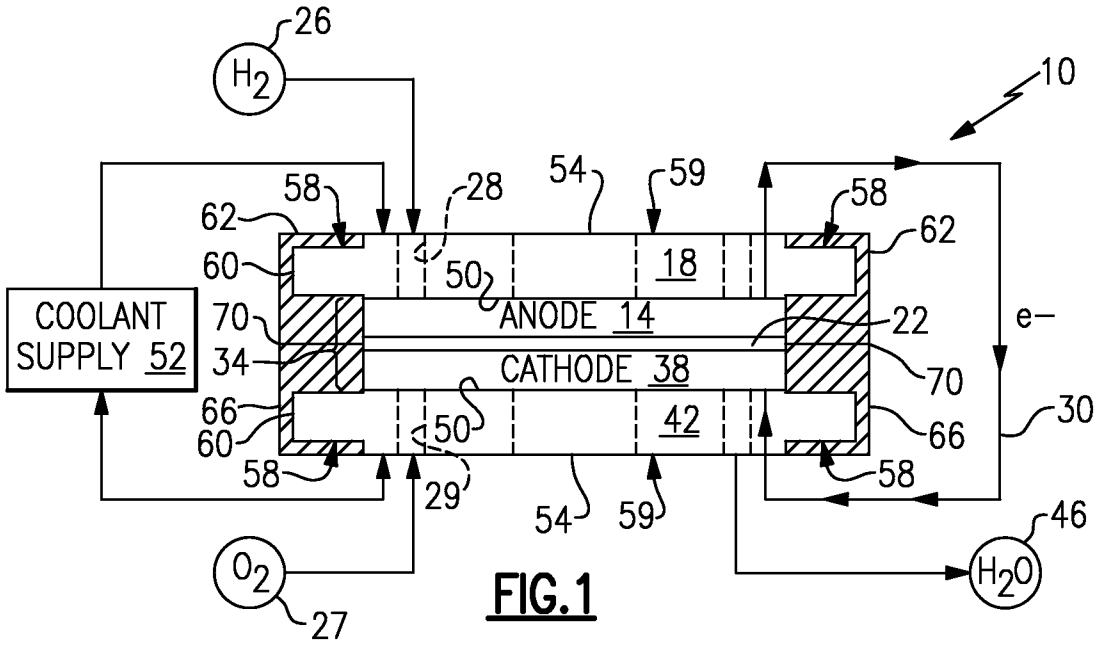
17. The fuel cell seal assembly of claim 14 wherein the first portion comprises at least one protrusion extending away from the seal, the protrusion operative to seal an interface between the seal and a second, adjacent seal within a fuel cell stack.

18. A method of sealing a fuel cell interface, comprising:

(a) limiting flow of a fuel cell fluid using a seal molded over a peripheral area of a fuel cell plate, the seal extending from a first side of the fuel cell plate to a second, opposite side of the fuel cell plate, at least a portion of the first side configured to contact a unitized electrode assembly if the plate is positioned within a fuel cell stack.

19. The method of claim 18, wherein the seal comprises at least one protrusion operative to seal an interface between the seal and a second, adjacent seal within a fuel cell stack.

20. The method of claim 18, wherein the seal is overmolded onto the peripheral area.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34
CATHODE 38
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H_2O
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FIG.1

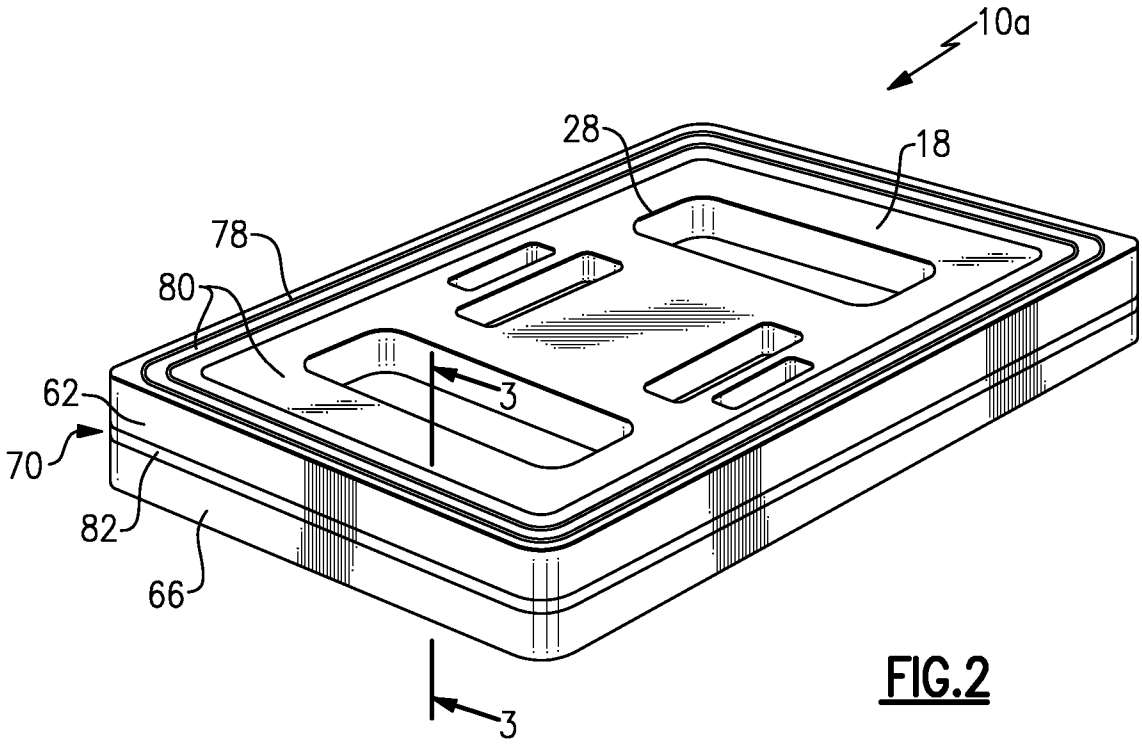
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FIG.2

FIG.3

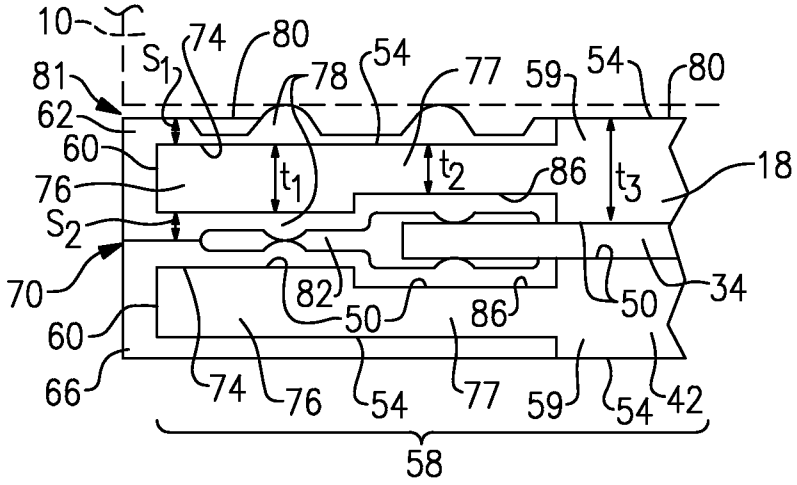


FIG.4

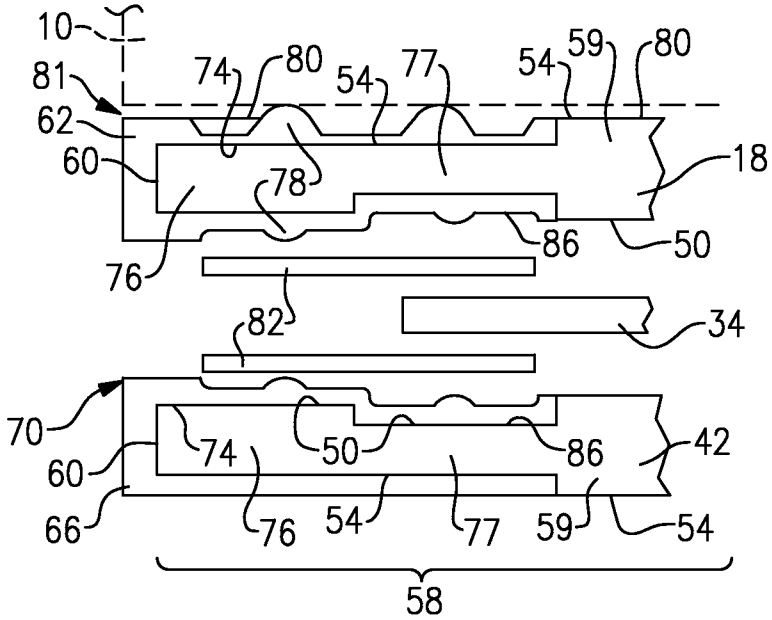
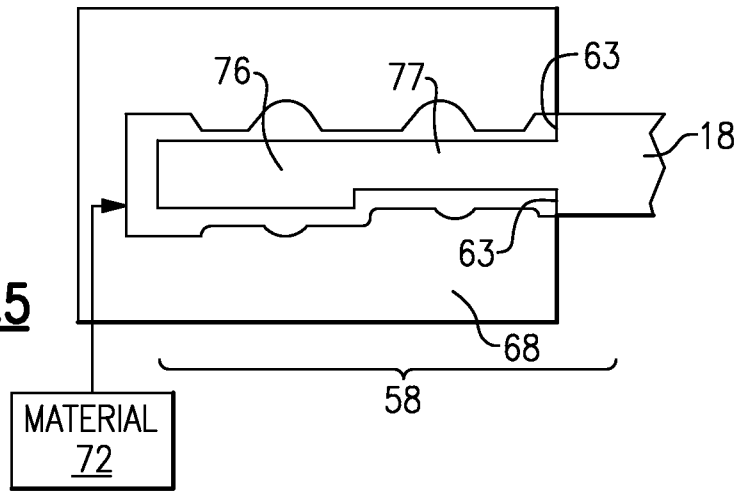


FIG.5



INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2009/031368

A. CLASSIFICATION OF SUBJECT MATTER

H01M 8/02(2006.01)i, H01M 8/04(2006.01)i, H01M 8/24(2006.01)i

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC: H01M 8/02

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

KoreanUtility Models and Applications for Utility Models since 1975

Japanese Utility Models and Applications for Utility Models since 1975

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

eKOMPASS(KIPO), DELPHION("fuel", "cell", "seal", "gasket", "peripheral", "lateral", "plate")

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 7226684 B2 (PFLAESTERER, J.) 05-06-2007 see claims, figures 1-2, description (column 6, paragraph 29-column 7, paragraph 37)	1-20

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents:

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Date of the actual completion of the international search	Date of mailing of the international search report
31 AUGUST 2009 (31.08.2009)	**31 AUGUST 2009 (31.08.2009)**

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Authorized officer

KIM Young Min

Telephone No. 82-42-481-5575

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/US2009/031368

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 7226684 B2	05-06-2007	DE 10160905 A1	03-07-2003
		EP 01320142 B1	07-05-2008