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Declaration under Rule 4.17:

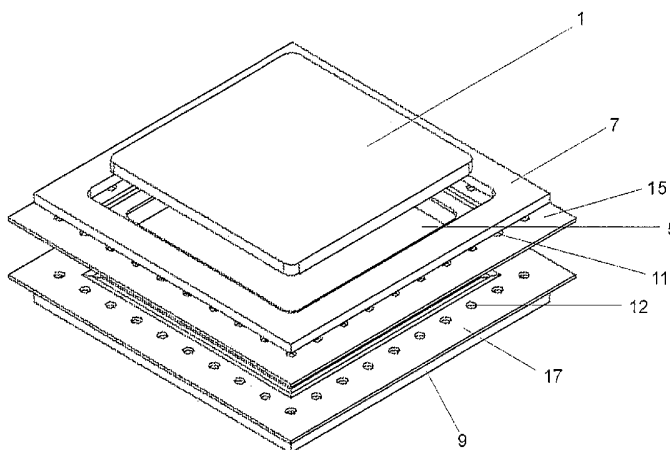
— of inventorship (Rule 4.17(iv))

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[Continued on next page]

(54) Title: LONG-LIFE MEMBRANE ELECTRODE ASSEMBLIES



(57) Abstract: The present invention relates to a membrane electrode assembly comprising a) two electrochemically active electrodes (1, 3) separated by a polymer electrolyte membrane (5) wherein the surfaces of the polymer electrolyte membrane (5) are in contact with the electrodes (1, 3) in such a way that the first electrode (1) partially or totally covers the front of the polymer electrolyte membrane (5) and the second electrode (3) partially or totally covers the back of the polymer electrolyte membrane (5); b) two gasket layers (15, 17) made of a first gasket material wherein the first gasket layer (15) partially covers the front of the polymer electrolyte membrane (5) and/or the first electrode (1) and the second gasket layer (17) partially covers the back of the polymer electrolyte membrane (5) and/or the second electrode (3); wherein the membrane electrode assembly also comprises a second gasket material (7, 9) on the front of the first gasket layer (15) and on the back of the second gasket layer (17); each of the gasket layers (15, 17) comprises at least one recess (11, 12); the second gasket material (7) on the front of first gasket layer (15) is in contact with the second gasket material (9) on the back of the second gasket layer (17). The present membrane electrode assemblies may be used in particular for producing fuel cells which have a particularly high long-term stability.



(88) Date of publication of the international search report:

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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2005/008488

A. CLASSIFICATION OF SUBJECT MATTER

INV. H01M8/02 H01M8/10 H01M8/24

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)

H01M

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

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

EPO-Internal, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 1 391 956 A (NOK CORPORATION; KABUSHIKI KAISHA TOSHIBA) 25 February 2004 (2004-02-25) figure 4 paragraphs [0033] - [0035], [0048], [0061], [0062], [0069], [0070], [0073], [0074], [0134], [0135] claims 1-17	1-14, 22-27
Y		15-21
Y	DE 102 46 459 A1 (CELANESE VENTURES GMBH) 15 April 2004 (2004-04-15) cited in the application the whole document	15-21
	-/--	

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

☒ See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

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"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search

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INTERNATIONAL SEARCH REPORT

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PCT/EP2005/008488

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	DE 100 28 395 A1 (NOK CORP., FUJISAWA) 21 December 2000 (2000-12-21) figures 5,6 column 7, line 5 - column 8, line 13 -----	1-27
A	WO 01/89016 A (AVISTA LABORATORIES, INC; FUGLEVAND, WILLIAM, A; DEVRIES, PETER, D; LL) 22 November 2001 (2001-11-22) figure 9 -----	1-27

INTERNATIONAL SEARCH REPORT

International application No.
PCT/EP2005/008488

Box II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.
2. ☒ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest.
- ☐ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1,23

A membrane electrode assembly and method for its production
 - said membrane electrode assembly comprising
 a) two electrochemically active electrodes separated by a polymer electrolyte membrane wherein the surfaces of the polymer electrolyte membrane are in contact with the electrodes in such a way that the first electrode partially or totally covers the front of the polymer electrolyte membrane and the second electrode partially or totally covers the back of the polymer electrolyte membrane;
 b) two gasket layers made of a first gasket material wherein the first gasket layer partially covers the front of the polymer electrolyte membrane and/or the first electrode and the second gasket layer partially covers the back of the polymer electrolyte membrane and/or the second electrode;
 c) a second gasket material on the front of the first gasket layer and on the back of the second gasket layer;
 - each of the gasket layers comprising at least one recess;
 - the second gasket material on the front of first gasket layer being in contact with the second gasket material on the back of the second gasket layer.

1.1. claims: 1(part),2-14,22(part),23-26,27(part)

The membrane electrode assembly of claim 1, wherein said gasket is characterized in that
 the at least one recess in the first gasket layer is a hole through the first gasket layer and the at least one recess in the second gasket layer is a hole through the second gasket layer;
 the first gasket material is a polyimide;
 the thickness of the gasket layers is in the range from 5 μ m to 1000 μ m;
 the gasket layers on the polymer electrolyte membrane each form a frame;
 at least one of the gasket layers is in contact with at least one of the electrodes;
 the two gasket layers extend beyond the membrane and are in flat contact with one another;
 the second gasket material is a thermoplastically processable material;
 the second gasket material is a fluoropolymer; and/or
 the second gasket material is in contact with electrically conducting separator plates.

1.2. claims: 1(part),15-18,20-22(part),27(part)

The membrane electrode assembly of claim 1, wherein said polymer electrolyte membrane is characterized in that
 it comprises polyazoles; and/or
 it is doped with an acid.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

1.3. claims: 19,21(part)

A method of producing a polymer electrolyte membrane comprising the steps of

A) mixing one or more aromatic tetraamino compounds with one or more aromatic carboxylic acids and/or esters thereof containing at least two acid groups per carboxylic acid monomer, or mixing one or more aromatic and/or heteroaromatic diaminocarboxylic acids in polyphosphoric acid to form a solution and/or dispersion,

B) applying a layer using the mixture according to step A) to a support or to an electrode,

C) heating the sheetlike structure/layer obtainable according to step B) under inert gas to temperatures of up to 350°C, preferably up to 280°C, to form the polyazole polymer,

D) treating the membrane formed in step C) until it is self-supporting.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2005/008488

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