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Case Number: W 0011/07 - 3.3.07

Application Number: PCT/DK2006/000278

Publication Number: WO 2006/122566

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Title of invention:
Membrane for filtering of water

Applicant:
AQUAPORIN APS

Opponent:
-

Headword:
-

Relevant legal provisions:
Decision of the Administrative Council of 28 June 2001 on the transitional provisions under Article 7 of the Act revising the EPC of 29 November 2000
PCT R. 13.1, 13.2, 40.2(c)(e)

Relevant legal provisions (EPC 1973):
EPC Art. 154(3)

Keyword:
"Single general inventive concept (yes)"

Decisions cited:
-

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Case Number: W 0011/07 - 3.3.07

International Application No. PCT/DK2006/000278

D E C I S I O N
of the Technical Board of Appeal 3.3.07
of 12 March 2009

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Decision under appeal: **Protest according to Rule 40.2(c) of the Patent Cooperation Treaty made by the applicants against the invitation (payment of additional fees) of the European Patent Office (International Searching Authority) dated 16 October 2006.**

Composition of the Board:

Chairman: B. ter Laan
Members: G. Santavicca
S. Hoffmann

Summary of Facts and Submissions

I. International application PCT/DK2006/000278, filed on 19 May 2006 and published under No. WO 2006/122566, contains 45 claims. Claims 1, 11, 24 to 29, 33 to 35, 42 and 44 read as follows:

"1. A water membrane comprising a sandwich construction having at least two permeable support layers separated by at least one lipid bilayer comprising functional aquaporin water channels."

"11. A water membrane comprising a sandwich construction having at least two lipid monolayers, which, when assembled into one bilayer, comprises functional aquaporin water channels, said at least two lipid monolayers being separated by at least one permeable support layer."

"24. A method of preparing a water membrane comprising the steps of
a) obtaining lipid micro-vesicles containing aquaporin water channels comprising at least 0.1 % mol/mol of said micro-vesicles,
b) fusing said vesicles into a planar lipid bilayer on an essentially planar, permeable support having a hydrophilic surface, wherein the aquaporin protein covers at least 1 % of the bilayer area,
c) optionally repeating step b) to obtain multiple fused bilayers,
d) depositing a second essentially planar, permeable support having a hydrophilic surface on the lipid bilayer obtained in step b) or step c) to obtain a sandwich structure, and

e) optionally enclosing the obtained sandwich structure in a permeable stabilizing membrane."

"25. A method of preparing a water membrane comprising
a) obtaining lipid micro-vesicles containing aquaporin water channels comprising at least 0.1 % mol/mol of said micro-vesicles,
b) fusing said vesicles into planar lipid bilayers assembled around an essentially planar, permeable support having a hydrophobic surface, wherein the aquaporin protein covers at least 1 % of the bilayer area, and
c) optionally enclosing the obtained sandwich structure in a permeable stabilising membrane."

"26. A method for preparing an ultra-pure water filtrate, comprising filtering an aqueous solution through the water membrane according to any one of claims 1-23, so as to retain ions, particles, organic matter and colloids, whereby the filtrate is water being essentially free from ions, particles, organic matter and colloids."

"27. A reverse osmosis water filtering device for the production of desalinated water from a salt water source, said desalinated water being useful for irrigation agriculture and/or as potable water, wherein at least one of a final reverse osmosis filtering membrane(s) has been replaced by a water membrane comprising functional aquaporin water channels."

"28. A reverse osmosis water filtering device for the production of ultra-pure water from a crude water source said ultra-pure water being useful in the semi-

conductor industry and/or in the pharmaceutical industry, wherein at least one of a final reverse osmosis filtering membrane(s) has been replaced by a water membrane a water membrane comprising functional aquaporin water channels." (sic)

"29. A reverse osmosis water filtering device for the production of pure water from a crude water source useful in the municipal water industry, chemical industry, drinking water industry, food industry, electronic industry, oil and gas industry, refineries industry, pulp and paper industry, metal industry, mining industry, and power industry, wherein at least one of a final reverse osmosis filtering membrane(s) has been replaced by a water membrane comprising functional aquaporin water channels."

"33. A water filtering device for extracting and recovering water from body fluids, such as urine, milk and sweat/perspiration, comprising a water membrane comprising functional aquaporin water channels, such as a water membrane according to any one of claims 1-22."

"34. A method for purifying water obtained from a water source, the method comprising filtering the water obtained from the source through the water filtering device according to any one of claims 27-33."

"35. A hydrophobic polymer film comprising multiple perforations, wherein said perforations are evenly distributed in the film and substantially all of substantially the same geometric shape in the intermediate plane between the 2 surfaces of the film."

"42. A membrane comprising a sandwich construction having at least two permeable support layers separated by at least one lipid bilayer comprising functional transmembrane proteins."

"44. A membrane comprising a sandwich construction having at least two lipid monolayers, which, when assembled into one bilayer, comprises functional transmembrane proteins, said at least two lipid monolayers being separated by at least one permeable support layer."

II. With a communication posted on 16 October 2006, the European Patent Office (EPO), in its capacity as International Searching Authority (ISA), issued an invitation under Article 17(3)(a) and Rule 40.1 PCT to pay **two** additional search fees since the requirement of unity of invention as laid down in PCT Rules 13.1, 13.2 and 13.3 was not met. The ISA argued as follows:

1. The claims of the application concerned multiple groups of inventions, identified as follows:

(1) A first group of inventions, which was in fact made up of two subgroups, concerning, respectively, the following subject-matter:

(1.1) A membrane for water purification comprising a sandwich construction having at least two permeable support layers separated by at least one lipid bilayer comprising aquaporin water channels.

A method for preparing such a membrane for water purification comprising aquaporin water channels.

A method for preparing an ultra—pure water filtrate by using such a membrane comprising aquaporin water channels

[as defined in Claims 1—10, 18—23 (in part and insofar as relating to Claim 1), 24, 26 (in part and insofar as relating to Claim 1) and 32 (in part and insofar as relating to Claim 1)].

(1.2) A water filtering device comprising a membrane for the purification of water comprising functional aquaporin water channels [as defined in Claims 27—31, 33 and 34].

(2) A second group of inventions concerning:

A hydrophobic polymer film comprising multiple perforations, wherein said perforations are evenly distributed in the film and substantially all of substantially the same geometric shape in the intermediate plane between the 2 surfaces in the film [as defined in Claims 35—41].

(3) A third group of inventions concerning the following objects:

A membrane for water purification comprising a sandwich construction having at least two permeable support layers separated by ate least two lipid monolayers, which, when assembled into one bilayer, comprises functional aquaporin water channels, said at least two lipid monolayers being separated by at least one permeable support layer.

A method for preparing such a membrane for water purification comprising aquaporin water channels.

A method for preparing an ultra—pure water filtrate by using such a membrane comprising aquaporin water channels

[as defined in Claims 11—17, 18—23 (in part and insofar as relating to Claim 11), 25, 26 (in part and insofar as relating to Claim 11) and 32 (in part and insofar as relating to Claim 11)].

2. The reasons for which the inventions of Groups (1) to (3) were not so linked as to form a single general inventive concept (Rule 13.1 PCT) were given as follows:

2.1 The inventions belonging to Group (1.1), in particular those defined in independent Claims 1 and 24, and those belonging to Group (3), e.g. those defined in Independent Claims 11 and 25, shared the technical features of a membrane for water purification comprising a sandwich construction with at least a lipid layer comprising aquaporin and at least a permeable support.

However, those common features made no contribution over the prior art and could not be considered as special technical features within the meaning of Rule 13.2 PCT, as they were not inventive according to Article 33(3) PCT, having regard to Document D1 (US2004/049230).

Document D1 addressed the same general technical

problems as those mentioned in the application under examination, i.e. to provide a membrane comprising aquaporin capable of purifying water with the highest purity (Description page 3, 1ines 20—22), and thus described the closest prior art. In particular, Dl disclosed a membrane suitable for water filtration comprising a sandwich construction with an ultrafiltration disk on one side and a porous PVDF (PolyVinylideneDiFluoride) membrane on the other side, those layers being separated by a layer of synthetic triblock copolymer comprising functional aquaporin water channels (D1: Abstract; Paragraphs [0006], [0076]) and [0078]).

The subject—matter of Claim 1 differed from the known membrane in that the synthetic triblock copolymer layer had been replaced by at least one lipid bilayer.

The effect of using a lipid bilayer was to provide an adequate matrix for supporting the aquaporin water channels in a membrane suitable for water purification.

Consequently, the problem to be solved by the present invention was to provide an adequate matrix for supporting the aquaporin water channels.

Since the lipid bilayer was the natural and biological environment of aquaporins, and since no unexpected technical effect or advantage of the use of a lipid bilayer had been shown, it would have been obvious for a person skilled in the art to replace the synthetic triblock copolymer of Dl by a lipid bilayer as claimed.

Furthermore, the effects obtained by the two groups of inventions mentioned above did not represent any further possible common features, because the membranes defined in Claims 1 and 11 were merely two alternative membranes for water purification serving the same aim: providing a membrane comprising aquaporin water channels capable of purifying water with the highest purity (application, description, page 3, 1ines 20—22), said aim being known from Dl (Paragraph [0076]).

Since the membranes of Claims 1 and 11 were not linked by a general inventive concept, they therefore belonged to **two** non-unitary invention groups.

As regards the further independent claims, Claim 24 belonged to Group (1.1), Claim 25 belonged to Group (3) and Claim 26 was considered to be a use claim of both of the membranes according to any of Claims 1 and 11. Those further independent claims were permissible.

2.2 As regards the inventions of Group (1.2) in relation to those of Groups (1.1) and (3), the features common to the independent claims were those of a membrane for the purification of water comprising functional aquaporin water channels.

However, those features were not novel (Article 33(2) PCT), since they were disclosed in document Dl (Abstract and Paragraphs [0006] and [0076]).

Consequently, those common features could not be considered as special technical features nor could any technical relationship within the meaning of Rule 13.2 PCT be seen. Also, the effects obtained by each of the

groups of inventions mentioned above did not represent common features of a single general inventive concept, because the problem to be solved was the same, i.e. to provide a membrane comprising aquaporin water channels or a device with a membrane comprising aquaporin water channels capable of purifying water with the highest purity (Description, Page 3, lines 20—22), and it was known from Dl (Paragraph [0076]).

Therefore, the inventions of Groups (1.1), (3) and (1.2) were non-unitary.

Although the inventions of Groups (1.1) and (1.2) were not linked by a single general inventive concept, they could however be searched without effort, so that an additional fee was not justified.

2.3 As regards the inventions defined in Claims 35—41 (i.e. of Group (2)), concerning a hydrophobic polymer film comprising multiple perforations, in relation to those defined in the rest of the claims (i.e. those of groups (1.1), (1.2.) and (3)), concerning membranes comprising functional transmembrane proteins such as aquaporins, no common technical features linked these groups of inventions that could define a contribution over the prior art, so that no technical relationship as defined in Rule 13.2 PCT between those two groups existed. Hence, the inventions were *a priori* not so linked as to form a single general inventive concept (Rule 13.1 PCT).

2.4 Therefore, the search report only related to the subject-matter defined in the Claims belonging to Groups (1.1) and (1.2), i.e. to Group (1) only.

III. On 16 November 2006, the applicants paid **one** additional search fee for the third group of inventions listed by the Search Examiner [i.e. Group (3)], under protest (Rule 40.2(c) PCT), arguing as follows:

- The inventions of Groups (1) and (3) related to the same general inventive concept, i.e. the use of aquaporins incorporated in a lipid bilayer.

- Although it was known that aquaporins in nature were incorporated in lipid bilayer membranes of living cells, the existence in nature did not necessarily render this technical feature obvious for exchanging a feature in a technical setting (i.e. for replacing the triblock copolymers taught in D1). In particular, in nature, aquaporins were present in spherical lipid bilayer membranes, whereas the presently disclosed membranes were planar. This constituted a technical difference, since the provision of a stable planar lipid bilayer including aquaporins imposed altered requirements on both the lipid composition and the concentration of aquaporins and other proteins in the membrane. There was hence a huge difference between the physicochemical properties of a natural lipid bilayer membrane and a membrane used in the present invention, which applied to capacity for water transport, uniformity and production of the membrane, but possibly also to the activity of the aquaporins.

- Also, the exchange of block copolymers with lipid bilayers was not an obvious choice for the skilled person, who had to consider simple questions such as, *inter alia*: would a lipid bilayer be mechanically stable when prepared in industrial scale sizes? Would

it be possible to incorporate a sufficient number of aquaporins in a lipid bilayer to provide for a commercially useful membrane? Was it at all technically feasible to incorporate functional aquaporins in an artificial planar lipid bilayer? All those questions would have to be answered in the affirmative before it could even be considered that the exchange of block copolymers with a lipid bilayer was lacking an inventive step.

IV. Pursuant to PCT Rule 40.2(c)(e), on 29 January 2007, the ISA mailed a notification regarding the review of the justification for the invitation to pay the said two additional search fees, informing the applicants that, according to the review body constituted in the framework of the ISA, the invitation to pay the two additional search fees was justified, because the application lacked unity of invention for the reasons stated in the "Invitation to Pay Additional Fees". Thus, the request for refund of the additional search fee paid by the applicants was not justified, and the request of the ISA for that payment was upheld. Furthermore, the applicants were invited to pay the protest fee (Rule 40.2(e) PCT).

V. By letter dated 28 February 2007, faxed on the same day, the applicants (appellants) paid the protest fee and offered further arguments, as follows:
- The search report for the inventions of Groups (1) and (3) provided exactly the same list of prior art references as did the partial search report which only related to inventions of Group (1). This was circumstantial evidence that there had been no extra

burden on the Search Division in performing a search for the allegedly non unitary inventions (3).
- Since the Search Division had not been able to identify one single piece of prior art that was detrimental to the novelty of the independent claims concerning the inventions of Groups (1) and (3), it would *prima facie* seem that the use of lipid membranes incorporating aquaporin was a common inventive feature.
- The discussion of whether or not this feature was inventive having regard to the prior art was by no means settled and should it turn out that the applicant could convince the EPO that it was indeed inventive the unity objection would be erroneous *a posteriori*; however, in such a situation, the applicant would not be able to reclaim a clearly unjustified search fee.

VI. The appellants request that inventions (1) and (3) be searched together and that the search fee for searching inventions (3) as well as the protest fee be refunded in full.

Reasons for the Decision

1. According to the Decision of the Administrative Council of 28 June 2001 on the transitional provisions under Article 7 of the Act revising the European patent Convention of 29 November 2000 (see Article 1, Point 6., second sentence), Article 154(3) of the version of the Convention in force before 13 December 2007 continues to apply to international applications pending at the time of entry into force of the revised Convention (13 December 2007).

The present international application was pending at that date, so that Article 154(3) EPC continues to apply to it.

Therefore, the Board of Appeal may decide on the protest and the protest is admissible (PCT Rule 40.2(c)(e)).

2. Four groups of non-unitary inventions have been identified in the invitation to pay additional search fees: Groups (1.1), (1.2), (2) and (3) (Point II.1, *supra*).

3. The inventions belonging to Groups (1.1) [including Claim 1] and (1.2) have been searched (partial search report mailed on 16 October 2006 together with the invitation to pay additional search fees) (see also Point II.2.2, *supra*). As to the inventions belonging to Group (2), the applicants did not contest the non-unity objection raised against the subject-matter of Claims 35 to 41 nor did they pay any additional search fees. It follows from the above that the only issue to be decided is whether or not the inventions of Group (3) share a single general inventive concept (Rule 13.1 PCT) with those as defined in the Claims of Group (1), in particular with those of the claims of Group (1.1).

3.1 Group (1.1) comprises the subject-matter defined in Claims 1—10, 18—23 (in part and insofar as relating to Claim 1), 24, 26 (in part and insofar as relating to Claim 1) and 32 (in part and insofar as relating to Claim 1).

3.2 Group (3) comprises the subject-matter defined in Claims 11-17, 18-23 (in part and insofar as relating to Claim 11), 25, 26 (in part and insofar as relating to Claim 11) and 32 (in part and insofar as relating to Claim 11).

3.3 Independent Claims 1 and 11 concern water membranes. Claim 24 concerns a method of preparing a water membrane that comprises features as defined in Claim 1. Claim 25 concerns a method of preparing a water membrane that comprises features as defined in Claim 11.

3.4 Claim 26 as well as Claims 18-23 and 32 refer not only to Claim 11 but also to Claim 1. Furthermore, Claim 32 is dependent on both Claims 27 and 1.

4. The only distinction between the water membrane defined in Claim 1 and that defined in Claim 11 lies in the position of the micro lipid vesicles containing aquaporin water channels. In the membrane of Claim 1 the at least one lipid bilayer comprising functional aquaporin water channels is sandwiched between two permeable support layers, whereas in the membrane of Claim 11, the permeable support layer is sandwiched between the at least two lipid monolayers, which when assembled form a lipid bilayer comprising functional aquaporin water channels. A structure according to Claim 1 is shown in Figure 1, that according to Claim 11 is described on page 15, last paragraph, and shown in Figure 3, of the International application.

4.1 Since Claim 11 mentions that the lipid monolayers when assembled into a bilayer comprise aquaporin water channels, the features common to the membranes defined

in Claims 1 and 11 are those of a water membrane comprising a sandwich construction having at least one lipid bilayer comprising functional aquaporin water channels and at least a permeable support layer.

4.2 Since Claim 25 mentions that the lipid vesicles containing aquaporin water channels are fused into lipid bilayers, the same common features as stated above also link the membranes obtained according to the methods defined in Claims 24 and 25.

5. According to the ISA, those common features were not inventive having regard to D1, which the appellants contest.

The disclosure of D1

5.1 D1 discloses a biomimetic membrane, comprising: a block copolymer matrix simulating a natural biological membrane and natural protein environment; and membrane proteins incorporated into said matrix to form a membrane/protein composite (Claim 1).

The membrane/protein composite can compose a device having the function of the incorporated membrane protein (Claim 2), the protein function including channels and energy transducers (Claim 3).

Said membrane proteins can be natural biological proteins (Claim 11).

Thus, D1 concerns man-made devices having the properties and functions of biological membranes and membrane proteins (Paragraph [0002]).

5.1.1 In one aspect D1 has to do with use of water transport proteins to enable water purification from arbitrary water sources.

For water purification, the membrane proteins can be selected to transport only water molecules, i.e. said biomimetic membrane can be a water filter (Claim 4). In particular, said membrane proteins can be selected from the aquaporin family of proteins (Claim 5).

As regards the matrix, it can be formed from tri-block copolymer (Claim 6), it can be impermeable to water and contain membrane proteins selected to permit passage of water molecules under pressure (Claim 7) and it can be supported in a water purification device to separate said device into first and second chambers, so that said membrane proteins permit only water to flow between said chambers (Claim 8). Those membrane proteins can be aquaporins (Claim 9). The matrix can be made of biocompatible polymer selected from the group including poly(vinyl alcohol), poly(acrylamide) and sol-gels (Claim 10).

D1 also discloses a method of fabricating a biological membrane, comprising:
fabricating a block copolymer matrix; and
inserting in said matrix natural or genetically engineered membrane proteins (Claim 26), the method further including the possibilities of orienting said membrane proteins in said matrix (Claim 27) and of selecting said proteins to produce a corresponding membrane functionality (Claim 28).

As a preferred embodiment, D1 discloses the fabrication and testing of a membrane having the form of a conventional filter disk, as follows:
A 5 nm thick monolayer of synthetic triblock copolymer and protein is deposited on the surface of a 25 mm commercial ultrafiltration disk using a Langmuir-Blodgett trough. The monolayer is then exposed to 254 nm UV light to cross-link the polymer and increase its durability. Lastly, a 220 nm pore size PVDF membrane is epoxy glued to the disk surface to ensure safe handling and prevent leakage at the edges (Paragraph [0078]).

Hence, this first aspect of D1 concerns synthetic polymer membranes that can incorporate aquaporins.

5.1.2 In a second aspect D1 concerns the creation of composite membranes containing two different proteins which, when acting in concert, result in a device which creates electricity from light, the "Biosolar Cell" (Paragraph [0006]).

In particular, D1 discloses the use of two different proteins (Bacteriorhodopsin (BR) and cytochrome oxidase (COX)), incorporated and aligned in a membrane such as lipid layer membranes (Paragraph [0013]).

There are instances in that second aspect in which reference is made to lipid layer membranes, in particular those of Figures 4A and 4B as well as those of paragraphs [0042] and [0043], as follows:

Figures 4A and 4B concern prior art and show, respectively, liposomal incorporation into a planar solid supported lipid bilayer, and the merger of

vesicles incorporated with COX into the planar membrane. In particular, the embodiment is made up of a planar support of gold (44), on which thiol-functionalized peptide chains (42) are bound, which have the function of tethering the lipid monolayers of DMPE (dimyristoyl phosphatidyl ethanolamine) assembled in a lipid bilayer (46,40). Hence, this disclosure has to do with biosensors, which is not the subject of the present application. Nor does it mention that the planar support of gold is perforated, or the presence of any water transport membrane protein.

Paragraph [0042] *inter alia* mentions that a large number of biological enzymes have been incorporated into artificial lipid membranes in laboratory experiments while retaining their function for experimentally useful times. However, this mention is made in the context of the use of both lipid and polymer membranes for the production of BR/COX light powered devices, which is not relevant for water filtration.

According to Paragraph [0043], membrane proteins could be solubilized with the addition of a detergent such as Triton-X or sodium dodecyl sulfate and incorporated into liposomes by gentle sonication of the protein/lipid solution and the liposomes could be allowed to form a planar surface in the presence of a flat substrate. The function of the proteins could be maintained and concentrations of the protein thousands of times higher than that in vivo could be obtained, resulting in high experimental sensitivity and accuracy. However, this disclosure too does not relate to the common features linking the water membranes defined in

Claims 1 and 11, or the methods defined in Claims 24 and 25.

Novelty

6. It is apparent from the above analysis of D1 that it does not disclose a **water membrane comprising** a sandwich construction having at least **one lipid bilayer comprising functional aquaporin water channels** (emphasis added) **and** at least **a permeable** support layer. Therefore, the common features linking the membranes of Claims 1 and 11 are novel having regard to D1. So do those linking Claims 24 and 25.

Closest prior art

7. The present application concerns a membrane comprising functional aquaporin channels or tetramers suitable for filtering pure water (page 1, lines 3 to 7). D1 has also to do with the filtering of water through membranes comprising functional aquaporin channels (Claim 9). Hence, D1 belongs to the same technical field of the present application and addresses similar objectives. In fact, D1 is also acknowledged as prior art in the application under appeal. Therefore, D1 can be considered to describe the closest prior art.

Problem and solution

8. According to the present application, there was no guidance in D1 as to how to select a synthetic triblock copolymer nor was there any data in support of the actual function of the embedded aquaporin (page 3, lines 13 to 15). Always according to the present

application, it had been suggested that a water purification technology could be created by expressing the aquaporins into lipid bilayer vesicles and casting these membranes on porous supports (page 3, lines 16 to 19). However, at the date of filing of the present application no known techniques or filters could perform the task of purifying water with the highest purity in industrial water filtration devices incorporating aquaporins in a membrane.

The present application contains 6 examples titled, respectively: "the reconstitution of AQP-1 in DPPC lipid vesicles (proteoliposomes)" (Example 1); "the formation of lipid bilayer and possibly further multiple bilayers on porous muscovite mica to obtain a water membrane as schematically illustrated by Fig. 1" (Example 2); "the reconstitution of AQP-1 in E. Coli lipid extract vesicles" (Example 3); "formation of planar bilayers and voltage-clamp studies: AQP-1 incorporated into lipid bilayers without increasing ionic conductance" (Example 4); "osmotic gradient studies: AQP-1 incorporated into lipid bilayers imposed an osmotic gradient leading to an increase in the ion concentration in the unstirred layer on the hypotonic side" (Example 5); and "UPW system comprising the membrane according to the invention" (Example 6).

However, the present application does not contain any comparative examples over D1, so that an improvement over D1 has not been established.

Therefore, the problem to be solved has to be formulated as to develop further water filtration

membranes incorporating aquaporins for industrial devices (page 3, lines 20 to 22).

Obviousness

9. It remains to be decided whether the solution to that problem as defined in the claims of the International application was rendered obvious by D1.

9.1 According to the Background of the Invention disclosed in D1 (Paragraph [0003]):
"Biological membrane proteins have a large variety of functions, including acting as pumps, channels, valves, energy transducers, and mechanical, thermal, and electrical sensors, among many others. Since these proteins are nanometres in size and highly efficient, they are highly attractive for use in artificial devices. However, their natural lipid membrane environment suffers from shortcomings such as low strength, necessity of an aqueous environment, and susceptibility to chemical or bacterial degradation.".
Hence, D1 addresses the shortcomings of the "natural lipid membrane" environment.

10. Those shortcomings are in particular overcome as given in the Summary of the Invention disclosed in D1 (Paragraph [0004]): "... in one aspect of the invention, natural or genetically engineered membrane proteins are incorporated into a block co-polymer matrix, producing membranes with a wide variety of inherent functionality, including the ability to selectively transport and/or filter compounds between fluids.".
Hence, D1 discloses that the natural lipid membranes can be replaced with block co-polymer matrices.

11. Particular properties of block copolymers suitable for that replacement are mentioned in paragraph [0005] of D1, as follows:
"Suitable polymers need only form membranes which separate the top and bottom halves of membrane proteins, be sufficiently similar to natural lipid membranes as to permit easy insertion of the proteins when they are properly oriented, and that they do not compromise the protein's natural function. Polymers which satisfy these conditions include tri-block copolymers having general properties of hydrophilic outer blocks and hydrophobic inner blocks.".
Hence, D1 specifically hints at using tri-block co-polymeric membranes incorporating membrane proteins.

12. Although D1 mentions in other instances lipid bilayer membranes (e.g. Paragraph [0073]), those instances relate to aspects other than water filtration, e.g. "Biosolar cells". Furthermore, also in those instances D1 stresses the desirability of the use of polymer membranes, for several reasons. Hence, D1 contains no hint at incorporating aquaporins in lipid bilayer membranes, let alone to obtain rugged water membranes. The teaching of D1 may be summarised in that the natural lipid membranes should be replaced by a tri-block copolymer membranes.

13. Therefore, the replacement of the tri-block copolymer matrix for water membrane of D1 with a lipid bilayer matrix is not rendered obvious by D1, which in fact deters the skilled person from doing so.

14. No further documents are cited in the Invitation to pay additional search fees that might be combined with D1.

15. In particular, the Board cannot find anything relating to the suggestion for creating a water purification technology made by Swartz (application as filed, page 3, lines 16 to 19).

Conclusion

16. It follows from the above that the Board cannot concur with the opinion of the ISA that the common features defined in Claims 1 and 11 were obvious from the disclosure of D1, and that therefore they could not form a single general inventive concept linking together the inventions of Groups (1.1) and (3).

16.1 Also, it is not understood why the search of the objects of Claims 27 to 31, which do not concern the lipid bilayers mentioned in Claim 1, and whose common features were said to be known from D1, did not require any effort justifying an additional search fee, whereas the objects of Claims 11 and 25, which concern the same elements of Claim 1, albeit assembled (sandwiched) differently, did apparently require such an effort. The argument of the appellants that the search report of both Groups of inventions (1.1) and (3) included the same references as the partial search report has some weight.

17. For the foregoing reasons the Board comes to the conclusion that the single general concept linking the separate inventions defined in Groups (1.1) and (3) was not obvious having regard to the mentioned documents.

18. Consequently, the invitation made under Rule 40.1 PCT to pay an additional search fee was not justified.

Order

For these reasons it is decided that:

Reimbursement of the additional search fee and of the protest fee paid by the applicants is ordered.

The Registrar: The Chairman:

C. Eickhoff B. ter Laan