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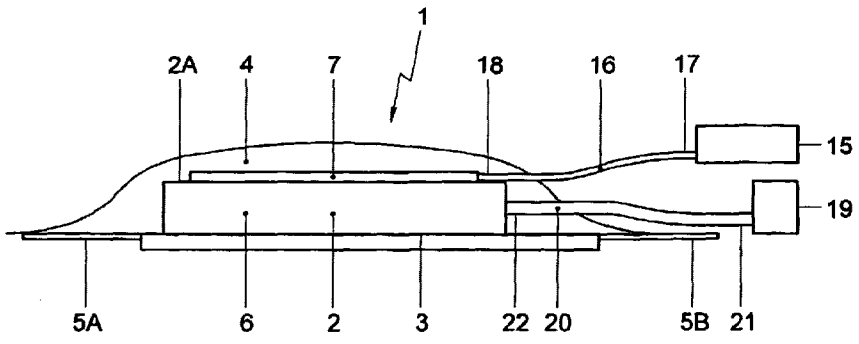
(54) **Title:** WOUND-STIMULATING UNIT



(57) **Abstract:** The invention relates to a wound-stimulating unit comprising a wound- stimulating device for use in combination with a vacuum assisted closure. The closure comprises a hydrophilic body to be placed on a wound surface, a cover sealing the hydrophilic body and a skin portion surrounding the wound surface, and a vacuum system for generating an underpressure in a closure space limited by the wound surface, the skin portion surrounding the wound surface and the cover. Further, the wound-stimulating device comprises a connector provided with an intermediate channel structure having an input section and multiple output sections, the device further comprising a pressure system for supplying wound stimulating agents to the input section of the intermediate channel structure.

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Title: Wound-stimulating unit

The invention relates to a wound-stimulating unit.

Chronic wounds have a complicated pathophysiology. Usually, intervention in wound healing is focused on different aspects of this pathophysiology. During use of known bandages in treating chronic wound interaction occurs with respect to different aspects, such as modulating metalloproteinase, optimizing moisture and controlling of infection.

However, no evidence has been found indicating that such interventions have much effect. This might be due to the fact that such interventions are focused on merely one or a few pathophysiological aspects of chronic wounds.

A vacuum assisted closure (VAC) that is known from e.g. International patent publication WO 00/59424 interferes with multiple pathophysiological aspects of chronic wounds. A VAC comprises a hydrophilic body to be placed on a wound surface for receiving drained moisture of the wound, a cover sealing the hydrophilic body and a skin portion surrounding the wound surface, and a vacuum system for generating an underpressure in a closure space limited by the wound surface, the skin portion surrounding the wound surface and the cover.

It has been found that wound-stimulating agents, such as nutrition, growing stimulating materials and/or medicines, e.g. antibiotics, may have a beneficial effect during wound healing. As a disadvantage, it has also been found that it is very difficult to supply wound-stimulating agents to the wound, as inserted agents are immediately sucked away due to the underpressure in the closure space.

It is an object of the invention to provide a woudstimulating unit, wherein the disadvantage identified above is reduced. In particular, the invention aims at obtaining a wound-stimulating unit wherein wound-

stimulating agents can be supplied in a vacuum assisted closure that are not immediately sucked away. Thereto, according to an aspect of the invention, the wound-stimulating unit comprises a wound-stimulating device for use in combination with a vacuum assisted closure, wherein the wound-stimulating device comprises a connector provided with an intermediate channel structure having an input section and multiple output sections, the device further comprising a pressure system for supplying wound stimulating agents to the input section of the intermediate channel structure.

By applying a wound-stimulating device in combination with a vacuum assisted closure, the proven advantages of the vacuum assisted closure can be combined the feature of successful supplying wound-stimulating agents. By further providing a pressure system for supplying wound stimulating agents to the input section of the intermediate channel structure, wound-stimulating agents can be supplied under pressure into the vacuum assisted closure. In addition, by providing a connector that has an intermediate channel structure with an input section and multiple output sections the supplied stimulating agents can be distributed and directed to the wound surface or even to the wound tissue under the wound surface, so that the stimulating agents are not directly sucked away by the underpressure system.

In a very attractive embodiment according to the invention, the wound-stimulating unit comprises multiple microtubes each having a connector end being connected to an output section of the intermediate channel structure, so that the wound-stimulating agents can advantageously be directed and/or brought to desired locations near or inside the wound tissue. As an alternative, the wound-stimulating agents are injected by the output sections of the intermediate channel structure, so that a cheaper system is obtained which might be used if the generated pressure in the intermediate channel structure is high enough to enforce that the wound-stimulating agents reach their desired location.

Advantageously, the intermediate channel structure substantially extends in a connector plane that is during use substantially along the wound surface, wherein the multiple microtubes are substantially oriented transverse with respect to the connector plane, so that the wound stimulating agents can easily be brought near or into the wound tissue. Further the chance that the connection between the microtubes and the intermediate channel structure remains intact thus improves during the application of an underpressure, as shear forces on the connector ends of the microtubes are relatively small or absent.

In a preferred embodiment, the hydrophilic body is squeezable and the microtubes each have a protruding end extending away from the connector and penetrating the hydrophilic body such that in an atmospheric state of the vacuum assisted closure the protruding ends of the microtubes extend to near the wound surface and that in an underpressure state of the vacuum assisted closure the microtubes penetrate through the wound surface into wound tissue. In this way, the protruding ends of the microtubes can be positioned above the surface skin during attaching the wound-stimulating unit to the wound while in an elegant way the generation of the underpressure in the closure space also causes the protruding ends of the microtubes to penetrate the wound surface so that wound-stimulating agents can directly be supplied to wound tissue below the wound surface. The movement of the protruding ends of the microtubes is driven by an orientation of the protruding ends towards the wound surface and by the fact that by using a squeezable hydrophilic body the volume in the closure space is reduced during the generation of local underpressure. It is stated however, that the protruding ends can also be brought, during transferral of the atmospheric state to the underpressure state in a position near and above the wound surface, e.g. if (further) damage of the wound surface is to be avoided.

By providing a control unit to the pressure system, wherein the control unit is arranged for supplying wound stimulating agents to the input

section of the intermediate channel structure in a continuous or intermitted way, the start, end, volume and way of the stimulating agents supply can advantageously be controlled. Alternatively, the pressure system does not comprise an explicit control unit, but provides a static pressure that can manually be activated and terminated.

The invention further relates to a method.

Other advantageous embodiments according to the invention are described in the following claims.

By way of example only, embodiments of the present invention will now be described with reference to the accompanying figures in which

Fig. 1 shows a schematic view of a cross section of a wound-stimulating unit according to the invention in an atmospheric state;

Fig. 2 shows a schematic view of a cross section of the wound-stimulating unit of Figure 1 in a underpressure state; and

Fig. 3 shows a schematic view of a cross section of a connector of the wound-stimulating unit of Figure 1.

The figures are merely schematic views of a preferred embodiment according to the invention. In the figures, the same reference numbers refer to equal or corresponding parts.

Figure 1 shows a schematic view of a cross section of a wound-stimulating unit 1 according to the invention in an atmospheric state. The wound-stimulating unit 1 that consists of a combination of a vacuum assisted closure and a wound-stimulating device. The vacuum assisted closure comprises a hydrophilic body 2 to be placed on a wound surface 3, a cover 4 sealing the hydrophilic body 2 and a skin portion 5A, 5B surrounding the wound surface 3, and a vacuum system for generating an underpressure in a closure space 6 limited by the wound surface 3, the skin portion 5A, 5B surrounding the wound surface 3 and the cover 4.

The squeezable, hydrophilic body 2 can be implemented as a synthetic sponge and serves for receiving drained moisture of the wound.

However, also other squeezable, hydrophilic materials can be applied for the body 2. Further, the squeezable feature of the sponge 2 causes the closure space 6 to diminish its volume during application of an underpressure. The cover 4 is formed from an airtight material in order to prevent pressure leakage in the wound-stimulating unit 1.

The wound-stimulating device comprises a connector 7 provided with an intermediate channel structure 8 having an input section 9 and multiple output sections 10, the device further comprising a pressure system for supplying wound stimulating agents to the input section 9 of the intermediate channel structure 8.

Fig. 3 shows a schematic view of a cross section of a connector 7 in more detail. The intermediate channel structure 8 substantially extends in a connector plane C along the wound surface 3. Further, the unit 1 comprises microtubes 11 each having a connector end 12 connected to an output section of the intermediate channel structure 8, and a protruding end 13 during which wound-stimulating agents are supplied. The multiple microtubes 11 are substantially oriented transverse with respect to the connector plane C. The multiple microtubes 11 are offset with respect to each other with a distance substantially ranging from approximately 1 cm to approximately 5 cm, more preferably substantially ranging from approximately 2 cm to approximately 3 cm, depending on pathophysiological conditions of the wound. In principle, also other distances are possible, e.g. more than 5 cm. It is also possible to apply only a single microtube, e.g. if the wound surface 3 is relatively small. Further, the multiple microtubes 11 are positioned arbitrarily or in a structured pattern, such as an array having substantially equal distances between adjacent microtubes 11. The diameter of the microtubes 11 is preferably several micrometers, e.g. ranging from circa 1 μm to 5 μm, but also other dimensions can be applied.

The intermediate channel structure 8 is formed in a rigid, solid, plate-like body 14, so that the channel structure 8 does not suffer from an

underpressure applied in the closure space 6. The rigid body 14 thus forms a housing of the channel structure 8. It is of course also possible to reduce damage of the intermediate channel structure 8 by applying an open discrete framework surrounding the channel structure 8. Further, it is also possible to provide a relatively rigid lining to the channel structure.

The pressure system comprises a pressure pump 15 and a first pressure line 16 having an upstream end 17 being connected to the pressure pump 15 and a downstream end 18 that sealingly penetrates the cover 4 and is connected to the input section 9 of the intermediate channel structure 8. As the intermediate channel structure 8 is in fluid communication with the pressure pump 15 a perfusion system is obtained for supplying wound-stimulating agents, such as nutrition, growing stimulating materials and/or medicines, such as antibiotics.

As shown in Figure 1, the connector 7 is located between a top surface 2A of the hydrophilic body 2 and the cover 4 of the vacuum assisted closure 4. The protruding ends 13 of the microtubes 11 extend away from the connector 7 and penetrate the hydrophilic body 2.

The vacuum system of the vacuum assisted closure comprises a vacuum pump 19 and a second pressure line 20 having a downstream end 21 being connected to the vacuum pump 19 and having an upstream end 22 sealingly penetrating the cover 4 and being situated in the closure space 6 limited by the wound surface 3, the skin portion 5A, 5B surrounding the wound surface 3 and the cover 4. Preferably, the upstream end of the second pressure line 20 is inserted in the hydrophilic body 2.

The wound-stimulating unit 1 described above is used to treat wounds, in particular chronic wounds. In doing so, one has to perform the steps of placing the hydrophilic body 2 on the wound surface 3 of the wound, sealing the hydrophilic body 2 and a skin portion 5A, 5B surrounding the wound surface 3 by means of a cover 4, placing a connector 7 between a top surface 2A of the hydrophilic body 2 and the cover 4, and transferring the unit

1 from an atmospheric state wherein the pressure in the closure space 6 limited by the wound surface 3, the skin portion 5A, 5B surrounding the wound surface 3 and the cover 4 is substantially at an atmospheric level to an underpressure state wherein the pressure in the closure space 6 is substantially below an atmospheric level.

By transferring the unit 1 from the atmospheric state to the underpressure state the protruding ends 13 of the microtubes 11 move from a position wherein they extend to near the wound surface 3, see Figure 1, to a position wherein they penetrate through the wound surface 3 into wound tissue below the wound surface 3, see Figure 2.

Further, the pressure system of the wound-stimulating device comprises a control unit (not shown) that is arranged for supplying wound stimulating agents to the input section 9 of the intermediate channel structure 8 in a continuous or intermitted way, so that the wound-stimulating agents flow from the pressure pump 15 subsequently via the first pressure line 16, the intermediate channel structure 8 and the microtubes 11 into the wound tissue below the wound surface 3.

The invention is not restricted to the embodiments described herein. It will be understood that many variants are possible.

Instead of using a single hydrophilic body multiple hydrophilic bodies can be used, e.g. for reducing the chance that distinct portions of the wound contaminate each other.

Other such variants will be obvious for the person skilled in the art and are considered to lie within the scope of the invention as formulated in the following claims.

Claims

1. A wound-stimulating unit comprising a wound-stimulating device for use in combination with a vacuum assisted closure comprising a hydrophilic body to be placed on a wound surface, a cover sealing the hydrophilic body and a skin portion surrounding the wound surface, and a vacuum system for generating an underpressure in a closure space limited by the wound surface, the skin portion surrounding the wound surface and the cover, wherein the wound-stimulating device comprises a connector provided with an intermediate channel structure having an input section and multiple output sections, the device further comprising a pressure system for supplying wound stimulating agents to the input section of the intermediate channel structure.

2. A wound-stimulating unit according to claim 1, comprising multiple microtubes each having a connector end being connected to an output section of the intermediate channel structure.

3. A wound-stimulating unit according to claim 2, wherein the intermediate channel structure substantially extends in a connector plane that is during use substantially along the wound surface and wherein the multiple microtubes are substantially oriented transverse with respect to the connector plane.

4. A wound-stimulating unit according to any previous claim, wherein the multiple microtubes are offset with respect to each other with a distance ranging substantially from approximately 1 cm to approximately 5 cm.

5. A wound-stimulating unit according to any previous claim, wherein the connector comprises a rigid, plate-like body wherein the intermediate channel structure is formed.

6. A wound-stimulating unit according to any previous claim, wherein the pressure system for delivering a wound stimulating substance to the input

section of the intermediate channel structure comprises a pressure pump and a first pressure line having an upstream end being connected to the pressure pump and having a downstream end for sealingly penetrating the cover and being connected to the input section of the intermediate channel structure.

7. A wound-stimulating unit according to any previous claim, comprising the vacuum assisted closure, wherein the connector of the wound-stimulating device is located between a top surface of the hydrophilic body and the cover of the vacuum assisted closure.

8. A wound-stimulating unit according to any previous claim, wherein the hydrophilic body is squeezable and wherein the microtubes each have a protruding end extending away from the connector and penetrating the hydrophilic body such that in an atmospheric state of the vacuum assisted closure the protruding ends of the microtubes extend to near the wound surface and that in an underpressure state of the vacuum assisted closure the microtubes penetrate through the wound surface into wound tissue.

9. A wound-stimulating unit according to any previous claim, wherein the vacuum system of the vacuum assisted closure comprises a vacuum pump and a second pressure line having a downstream end being connected to the vacuum pump and having an upstream end sealingly penetrating the cover and being situated in the closure space limited by the wound surface, the skin portion surrounding the wound surface and the cover.

10. A wound-stimulating unit according to any previous claim, wherein the pressure system of the wound-stimulating device comprises a control unit that is arranged for supplying wound stimulating agents to the input section of the intermediate channel structure in a continuous or intermitted way.

11. A method for applying a wound-stimulating unit to an external wound, comprising the steps of placing a hydrophilic body on the wound surface of the wound, sealing the hydrophilic body and a skin portion surrounding the wound surface by means of a cover, placing a connector between a top surface of the hydrophilic body and the cover, the connector

being provided with an intermediate channel structure having an input section and multiple output sections, the input section being in fluid communication with a pressure system for supplying wound stimulating agents, and transferring the unit from an atmospheric state wherein the pressure in a closure space limited by the wound surface, the skin portion surrounding the wound surface and the cover is substantially at an atmospheric level to an underpressure state wherein the pressure in the closure space is substantially below an atmospheric level.

12. A method according to claim 11, further comprising the step of supplying wound stimulating agents to the input section of the intermediate channel structure in a continuous or intermitted way.

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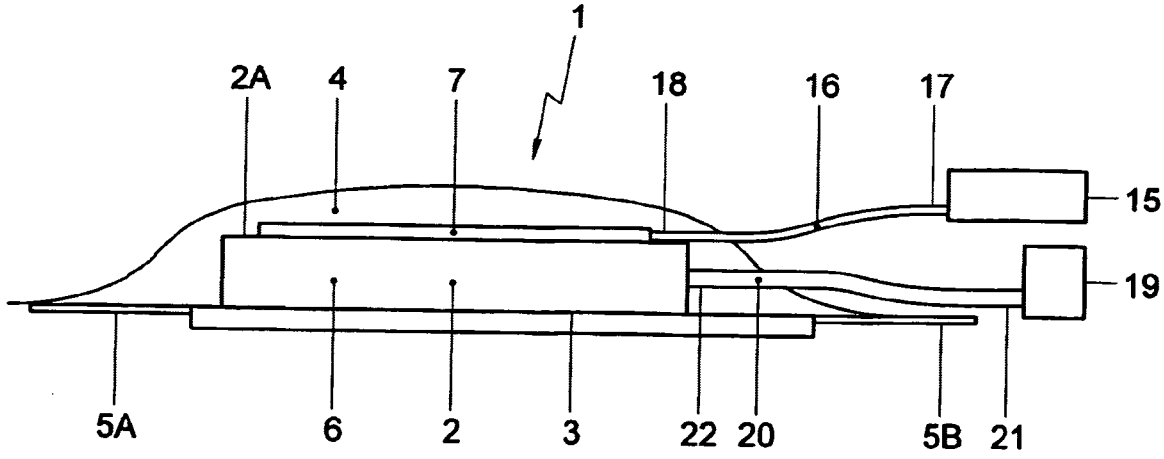

Fig. 1

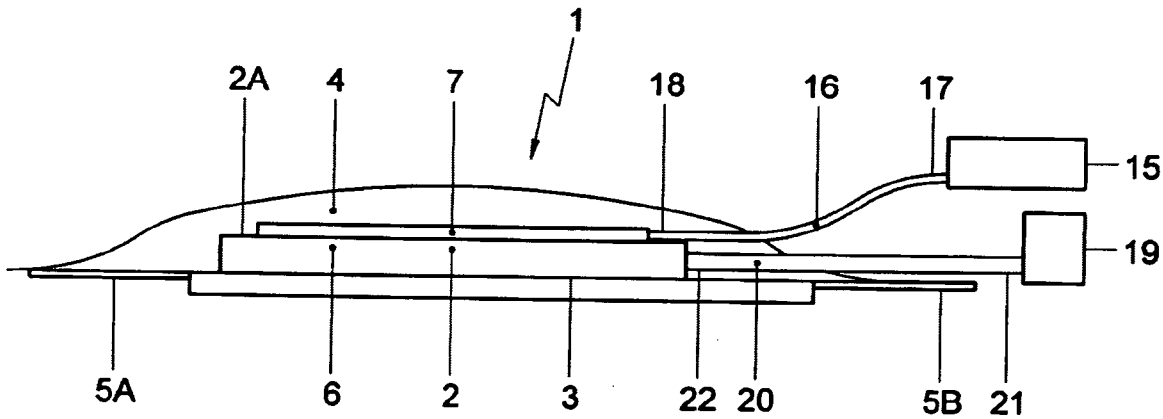

Fig. 2

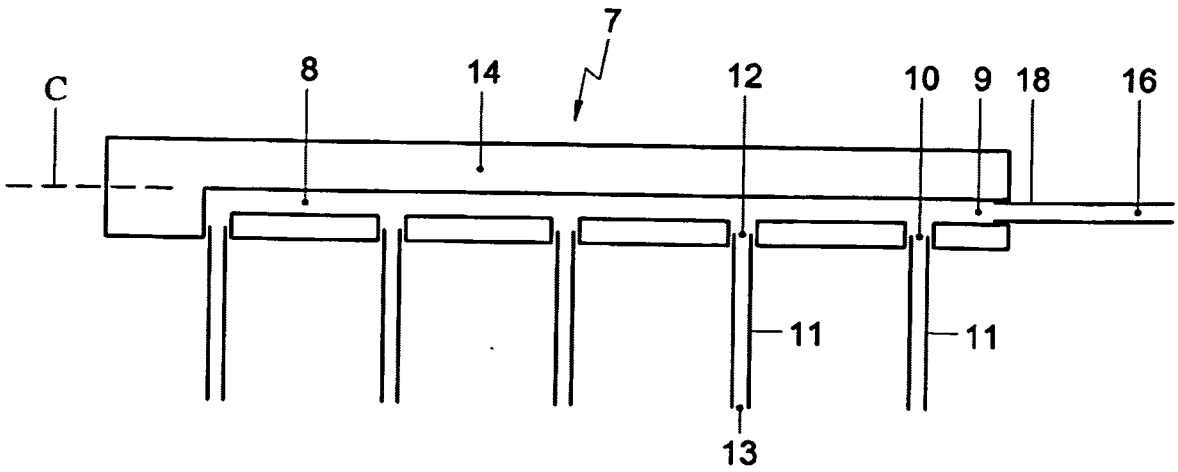

Fig. 3

INTERNATIONAL SEARCH REPORT

International application No
PCT/NL2007/050391

A. CLASSIFICATION OF SUBJECT MATTER
INV. A61F13/00 A61M1/00

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)
A61F A61M

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 00/59424 A (KINETIC CONCEPTS INC [US]; JOHNSON ROYCE W [US]) 12 October 2000 (2000-10-12) cited in the application page 3, line 32 - page 5, line 17; claim 1; figure 1	1-10
A	WO 2005/105175 A (SMITH & NEPHEW [GB]; BLOTT PATRICK LEWIS [GB]; GREEN CLARE [GB]; MARTI) 10 November 2005 (2005-11-10) the whole document	1-10

☐ 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

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"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	Date of mailing of the international search report
8 November 2007	23/11/2007

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Boccignone, Magda

INTERNATIONAL SEARCH REPORT

International application No.
PCT/NL2007/050391

Box No. 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. [X] Claims Nos.: 11,12
because they relate to subject matter not required to be searched by this Authority, namely:

Rule 39.1(iv) PCT - Method for treatment of the human or animal body by therapy

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 No. 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:

1. [ ] As all required additional search fees were timely paid by the applicant, this international search report covers allsearchable claims.

2. [ ] As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.

3. [ ] As only some of the required additional search fees were timely paid by the applicant, this international search reportcovers 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 and, where applicable, the payment of a protest fee.

[ ] The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

[ ] No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/NL2007/050391

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 0059424 A	12-10-2000	AU 773002 B2	13-05-2004
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		US 2007014837 A1	18-01-2007
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