



(51) International Patent Classification:

*E04C 2/292* (2006.01)      *E04D 3/365* (2006.01)  
*E04C 2/38* (2006.01)      *E04D 3/369* (2006.01)  
*E04D 3/35* (2006.01)

(21) International Application Number:

PCT/IE2012/000004

(22) International Filing Date:

9 February 2012 (09.02.2012)

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data:

2011/0057      9 February 2011 (09.02.2011)      IE

(71) Applicant (for all designated States except US): **KING-SPAN RESEARCH AND DEVELOPMENTS LIMITED** [IE/IE]; Dublin Road, Kingscourt, County Cavan (IE).

(72) Inventors; and

(75) Inventors/Applicants (for US only): **CAROLAN, James** [IE/IE]; Drumpeak, Kingscourt, County Cavan (IE). **FLYNN, Gregory** [IE/IE]; Teach Mhuilinn, Rathdaniel, Collon, County Louth (IE).

(74) Agents: **O'BRIEN, John A.** et al.; c/o John A. O'Brien & Associates, Third Floor, Duncairn House, 14 Carysfort Avenue, Blackrock, Count Dublin (IE).

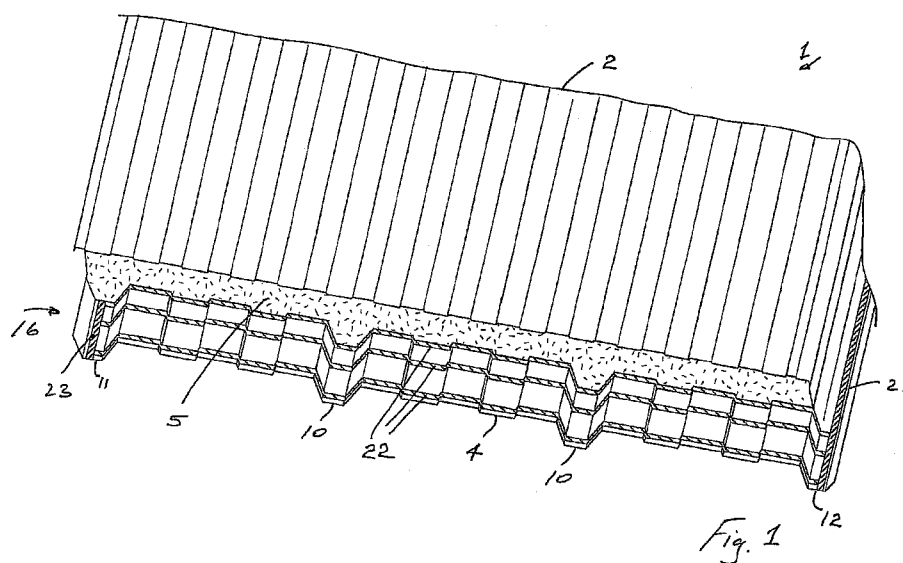
(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, 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, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, 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, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AL, 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, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

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

(54) Title: A COMPOSITE INSULATION PANEL



(57) Abstract: A manufactured composite insulating panel (1) comprises an external sheet (4) having an outer face and an inner face, an internal sheet (2) having an outer face and an inner face, and an insulating body (5) between the inner face of the external sheet (4) and the inner face of the internal sheet (2). The external sheet (4) has a portion that extends beyond the internal sheet (2) and the insulating body (5) to define an overlap part for overlapping with part of an adjacent panel, on assembly and a seal (21, 22) is applied to the inner face of the overlap part of the external sheet (4). The panel has a side overlap part (12) to which a side seal (21) is factory applied. An end seal (22) is also factory applied to an end overlap part (16) of the panel.

- 1 -

## **“A COMPOSITE INSULATION PANEL”**

### Introduction

- 5 The invention relates to composite insulation panels of the type comprising inner and outer sheets with a body of insulation therebetween.

Insulation panels are widely known and used extensively, especially for wall and roof panels in buildings.

10

A building cladding is built up by interengaging a plurality of the panels and mounting the panels to an underlying support. There are several important steps which are required to be performed on site to fit the panels.

- 15 There is a need to simplify the steps that must be performed on site when installing such panels.

### Statements of Invention

- According to the invention there is provided a manufactured composite insulating panel  
20 comprising:-

an external sheet having an outer face and an inner face;

an internal sheet having an outer face and an inner face;

25

an insulating body between the inner face of the external sheet and the inner face of the internal sheet;

30

the external sheet having a portion that extends beyond the internal sheet and the insulating body to define an overlap part for overlapping with part of an adjacent panel, on assembly; and

a seal applied to the inner face of the overlap part of the external sheet.

- 2 -

In one embodiment the seal is adapted to fixedly bond to the inner face of the overlap part, on application, and to provide an outer exposed surface for releasably bonding to an adjacent panel on assembly on site.

5

The seal is advantageously of a material which is compatible with the insulating body.

The seal is advantageously a foam material, particularly a closed cell foam material.

- 10 In one case the seal is of a closed cell foam material which fixedly bonds to the inner face of the overlap part and which provides an outer exposed surface for releasably sealing with an adjacent panel, on assembly on site.

In one embodiment the overlap part comprises an end overlap part.

15

The seal may comprise a bead of sealant which extends across the inner face of the end overlap part.

The seal may comprise a plurality of beads of sealant which extend across the inner face of the

- 20 end overlap part. At least some of the beads of sealant may be interconnected.

Alternatively or additionally the overlap part comprises a side overlap part. In this case the seal may comprise a bead of sealant which extends along the inner face of the side overlap part.

- 25 In one embodiment the external sheet comprises a plurality of longitudinally extending ribs.

In one case the insulating body comprises a foam such as a polyisocyanurate or phenolic foam material.

- 30 The external sheet may be of metallic material such as a steel material.

The internal sheet may be of a metallic material such as a steel material.

In one case the panel comprises a roof panel.

- 3 -

In one case the panel comprises a wall panel.

In one case the panel comprises a floor panel.

5

The invention also provides a roof assembly comprising a plurality of manufactured panels of the invention.

In another aspect the invention also provides a method for manufacturing a composite insulated  
10 panel comprising the steps of:-

providing an insulation panel comprising an external sheet, an internal sheet and an insulating body between the external sheet and the internal sheet the external sheet having an overlap part; and

15

applying a seal to the inner face of the overlap part of the external sheet.

In one case the overlap part comprises an end overlap part and the seal is applied across the end overlap part. The seal may comprise a plurality of beads of sealant which are applied across the  
20 end overlap part. The method may comprise interconnecting at least some of the beads of sealant.

Alternatively or additionally the overlap part comprises a side overlap part and the seal is applied along the side overlap part.

25

#### Brief Description of the Drawings

The invention will be more clearly understood from the following description thereof given by way of example only, in which: -

30

Fig. 1 is a perspective, partially cross sectional view of a manufactured insulating panel of the invention;

Fig. 2 is a cross sectional view of the panel of Fig. 1;

- 4 -

Fig. 3 is a cross sectional view showing a side overlap between adjacent like panels;

Fig. 4 is a cross sectional partially cut-away view showing an end overlap between adjacent like panels; and

Fig. 5 is a schematic of a part of a manufacturing installation used to manufacture the panels.

#### 10 Detailed Description

Referring to the drawings and initially to Figs. 1 to 4 there is illustrated an insulating panel 1 according to the invention comprising a first or external sheet 4, a second or inner sheet 2 with an insulating body, in this case an insulating foam 5 therebetween. The external sheet 4 has inner and outer faces and the inner sheet 2 also has internal and external faces. The foam 5 extends between the inner face of the external sheet 4 and the inner face of the internal or liner sheet 2. The foam 5 may, for example be a polyisocyanurate foam or a phenolic foam. In this case the panel 1 is a roof panel 1 comprising a profiled external sheet 4 which is typically of metal, such as galvanised steel. The inner metal liner sheet 2 may be of painted galvanised steel.

The external sheet 4 is profiled and in this case the profile comprises a plurality of projections, in this case comprising elongate crowns 10 which extend longitudinally along the length of the external sheet 4. The crowns 10 in this case are of generally trapezoidal form. The external and/or internal sheets may have a plurality of elongate strengthening ribs which extend longitudinally along the length of the external sheet 2.

The external sheet 4 has overlap parts for overlapping with parts of adjacent panels, on assembly. In this case there are both end overlap features and side overlap features. The side overlap features in this case comprise a side underlap crown 11 on one side of the external sheet 4 and a side overlap crown 12 on the opposite side of the panel. In use, like panels are overlapped by overlapping the overlap crown 12 of one panel with the underlap crown 11 of an adjacent panel as illustrated in Fig. 3. Stitching screws 17 are used to secure the overlapped panels together on-site.

- 5 -

The end overlap features also comprise an end underlap portion 15 and an end overlap portion 16 for end lapping of adjacent like panels. The external sheet 4 has portions that extend beyond the internal sheet 2 and the foam core 5 to define the side overlap part 12 and the end overlap part 16 for overlapping with corresponding underlap parts 11, 15 of adjacent panels, on assembly. The  
5 end overlap is illustrated in Fig. 4. Stitching screws 18 are used to secure the overlapped panels together on-site. Main panel fixing screws 19 are used to fasten the overlapped panels to an underlying support which in this case comprises a purlin 20.

A side seal comprising a bead 21 of a sealant material is factory applied to the inner face of the  
10 side underlap part 12 of the external sheet 4 along the length of the sheet 4. This greatly simplifies the installation process as a site worker does not have to apply a seal from an applicator as the panels are being laid to form a roof. The new system also improves site safety as there is less work to be carried out at roof level. Further, as the seal is applied in the factory it is assured that the correct seal is in place at the correct location on the panel to further assure  
15 weather tightness at the side joint between adjacent overlapped panels.

Advantageously, the seal is of a material which is adapted to fixedly bond to the inner face of the overlap part, on application. The outer exposed surface of the seal is tacky for releasably bonding to an adjacent panel on assembly on site. This is achieved without requiring any  
20 temporary cover such as a peel-off paper over the exposed face of the seal. This eliminates waste paper which is often discarded in an unsightly manner.

Importantly, the seal does not cause the panels to become permanently fixed to one another. The seal allows the disassembly of the panels at any time. This facilitates building end of life  
25 disassembly for material recycling.

Advantageously, the seal is of a foam material which is compatible with the insulation foam of the panel. As similar materials are used in the seal and in the foam the seal can be readily utilised in a factory without any additional handling/safety issues. The seal may be formed from  
30 a polyol component and an isocyanate component with additives to maintain the foam in a bead-like shape. The polyol may be Dow Hyperlast (Trademark) 2851264. The isocyanurate may be Dow Hyperlast LE 5000. The additive may be Jeffamine (Trademark) D230.

- 6 -

In one case the seal is of a butyl rubber. However, one problem with such a material is that panels become permanently fixed together at the joint therebetween (similar to welding) and presents major problems if the panels need to be disassembled, for example, for material recycling at building end life.

5

An end seal comprising a plurality of beads 22 of a sealant material are factory applied to the inner face of the side underlap part 12 of the external sheet 4 across substantially the width of the panel. This greatly simplifies the installation process as a site worker does not have to apply end seals from an applicator as the panels are being laid to form a roof. The new system improves  
10 site safety as there is less work to be carried out at roof level. Further, as the end seals are applied in the factory it is assured that the correct seals are in place at the correct location on the panel to further assure weather tightness at the end joint between adjacent overlapped panels. In this case the beads 23 of sealant are interconnected by longitudinally extending portions 25 of sealant. This feature provides for enhanced sealing and facilitates efficient application of the  
15 seals in the factory.

Composite panels may be manufactured by a continuous process as described in our GB2309412 A and GB2402101 A, the entire contents of which are herein incorporated by reference.

20 The panels are manufactured with the outer face of the external sheet 2 lowermost. Liquid foam reactants are laid down onto the inner face of the external sheet 4 and the inner liner sheet 2 is positioned over the foam. The sandwich thus formed is then led through an oven in which the foam expands.

25 Referring to Fig. 5 there is illustrated a manufacturing station 50 at which the side and end sealants 21, 22 are applied. The side sealant is supplied in liquid form along supply lines 51 (which may be heated) to a side seal applicator head 52. The end sealant is supplied in liquid form along supply lines 53 (which may be heated) to movable end seal applicator head 54. The applicator head 54 is mounted to a robotic arm 55 which is moved by further robotic arms 56  
30 under the control of a controller 57. The applicator head 54 is moved over and back across the end overlap portion 16 of the external sheet to apply the beads of sealant 22 as the panel moves through the applicator station.

- 7 -

The panels may be used to construct part of or all of a building envelope including part or all of one or more of the roof, walls and floor.

Modifications and additions can be made to the embodiments of the invention described herein  
5 without departing from the scope of the invention. For example, while the embodiments described herein refer to particular features, the invention includes embodiments having different combinations of features. The invention also includes embodiments that do not include all of the specific features described.

10 Many variations on the embodiments described will be readily apparent. Accordingly the invention is not limited to the embodiments hereinbefore described which may be varied in detail.

- 8 -

Claims

1. A manufactured composite insulating panel comprising:-
  - 5 an external sheet having an outer face and an inner face;  
  
an internal sheet having an outer face and an inner face;  
  
an insulating body between the inner face of the external sheet and the inner face of  
10 the internal sheet,  
  
the external sheet having a portion that extends beyond the internal sheet and the  
insulating body to define an overlap part for overlapping with part of an adjacent  
panel, on assembly; and  
15 a seal applied to the inner face of the overlap part of the external sheet.
2. A manufactured panel as claimed in claim 1 wherein the seal is adapted to fixedly bond  
to the inner face of the overlap part, on application, and to provide an outer exposed  
20 surface for releasably bonding to an adjacent panel on assembly on site.
3. A manufactured panel as claimed in claim 2 wherein the seal is of a material which is  
compatible with the insulating body.
- 25 4. A manufactured panel as claimed in claim 2 or 3 wherein the seal is a foam material.
5. A manufactured panel as claimed in claim 4 wherein the seal is a closed cell foam  
material.
- 30 6. A manufactured panel as claimed in any of claims 1 to 5 wherein the seal is of a closed  
cell foam material which fixedly bonds to the inner face of the overlap part and which  
provides an outer exposed surface for releasably sealing with an adjacent panel, on  
assembly on site.

- 9 -

7. A manufactured panel as claimed in any of claims 1 to 6 wherein the overlap part comprises an end overlap part.
8. A manufactured panel as claimed in claim 7 wherein the seal comprises a bead which extends across the inner face of the end overlap part.
9. A manufactured panel as claimed in claim 8 wherein the seal comprises a plurality of beads of sealant which extends across the inner face of the end overlap part.
10. A manufactured panel as claimed in claim 9 wherein at least some of the beads of sealant are interconnected.
11. A manufactured panel as claimed in any of claims 1 to 10 wherein the overlap part comprises a side overlap part.
12. A manufactured panel as claimed in claim 11 wherein the seal comprises a bead which extends along the inner face of the side overlap part.
13. A manufactured panel as claimed in any of claims 1 to 12 wherein the external sheet comprises a plurality of longitudinally extending ribs.
14. A manufactured panel as claimed in any of claims 1 to 13 wherein the insulating body comprises a foam.
15. A manufactured panel as claimed in claim 14 wherein the foam comprises a polyisocyanurate foam material.
16. A manufactured panel as claimed in claim 14 wherein the foam comprises a phenolic foam material.
17. A manufactured panel as claimed in any of claims 1 to 16 wherein the external sheet comprises a metallic material.

- 10 -

18. A manufactured panel as claimed in any of claims 1 to 17 wherein the external sheet comprises a steel material.
19. A manufactured panel as claimed in any of claims 1 to 18 wherein the internal sheet  
5 comprises a metallic material.
20. A manufactured panel as claimed in any of claims 1 to 19 wherein the internal sheet comprises a steel material.
- 10 21. A manufactured panel as claimed in any of claims 1 to 20 wherein the panel comprises a roof panel.
22. A manufactured panel as claimed in any of claims 1 to 20 wherein the panel comprises a wall panel.  
15
23. A manufactured panel as claimed in any of claims 1 to 20 wherein the panel comprises a floor panel.
24. A manufactured panel substantially as hereinbefore described with reference to the  
20 drawings.
25. A roof assembly comprising a plurality of manufactured panels as claimed in any of claims 1 to 21 or 24.
- 25 26. A method for manufacturing a composite insulated panel comprising the steps of:-
- providing an insulation panel comprising an external sheet, an internal sheet and an insulating body between the external sheet and the internal sheet the external sheet having an overlap part; and
- 30
- applying a seal to the inner face of the overlap part of the external sheet.
27. A method as claimed in claim 26 wherein the overlap part comprises an end overlap part and the seal is applied across the end overlap part.

- 11 -

28. A method as claimed in claim 27 wherein the seal comprises a plurality of beads which are applied across the end overlap part.

5 29. A method as claimed in claim 28 comprising interconnecting at least some of the beads of sealant.

30. A method as claimed in any of claims 26 to 29 wherein the overlap part comprises a side overlap part and the seal is applied along the side overlap part.

10

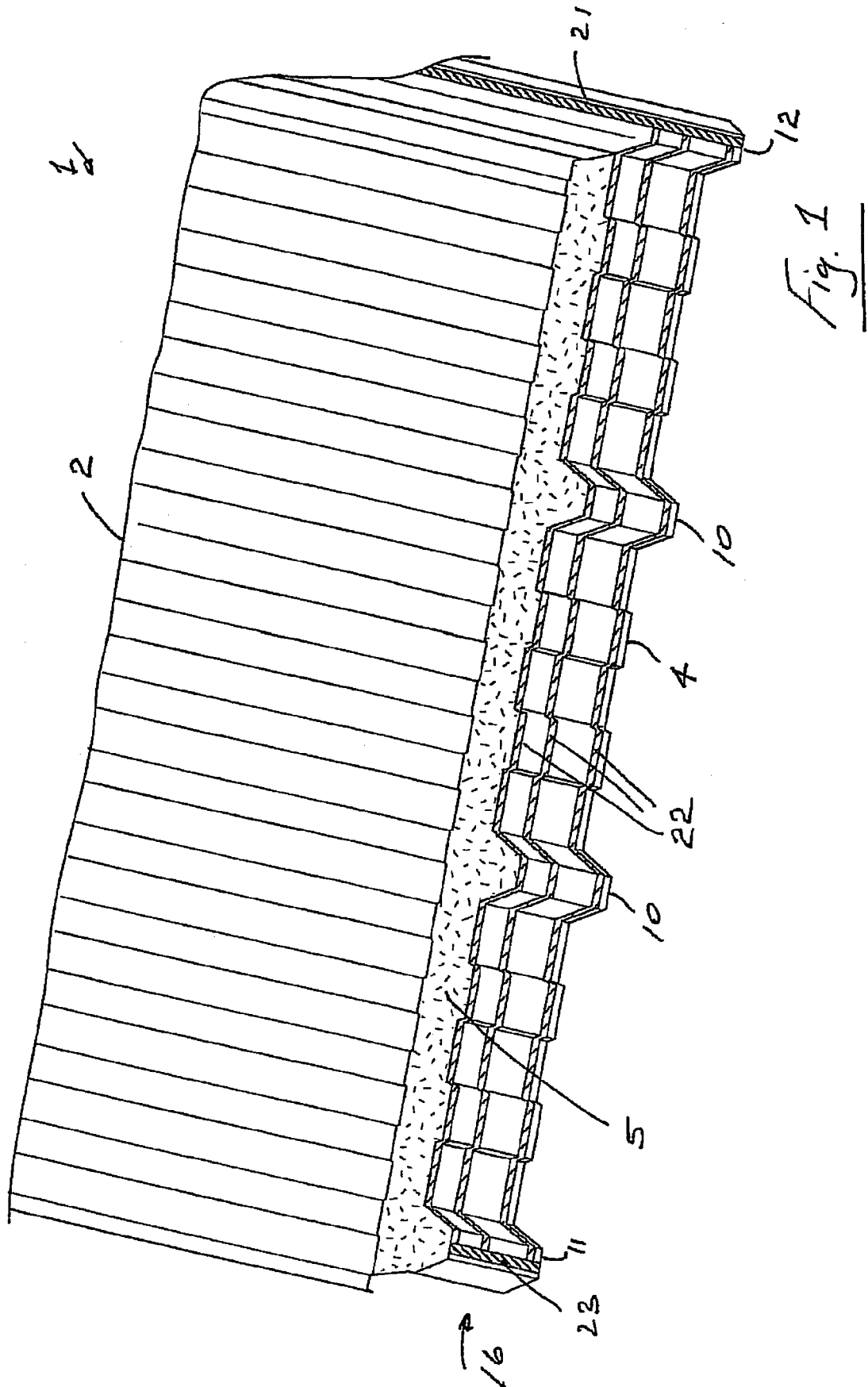
31. A method for manufacturing a composite insulated panel substantially as hereinbefore described.

15

20

25

30



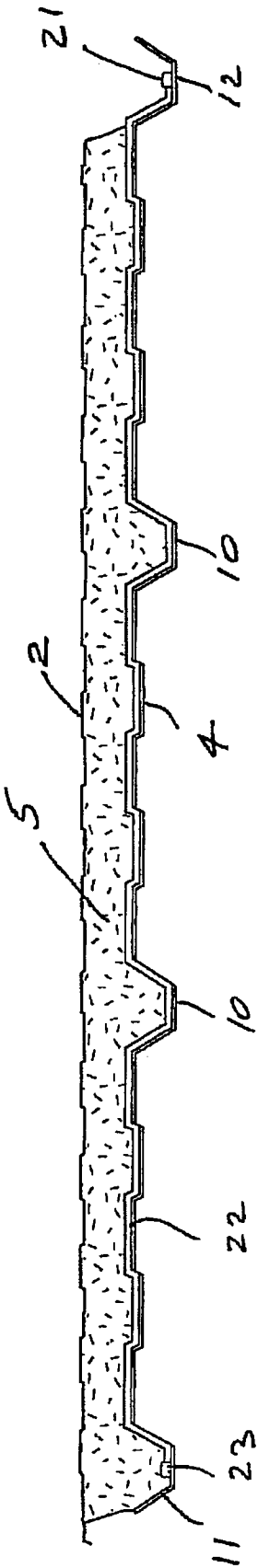


Fig. 2

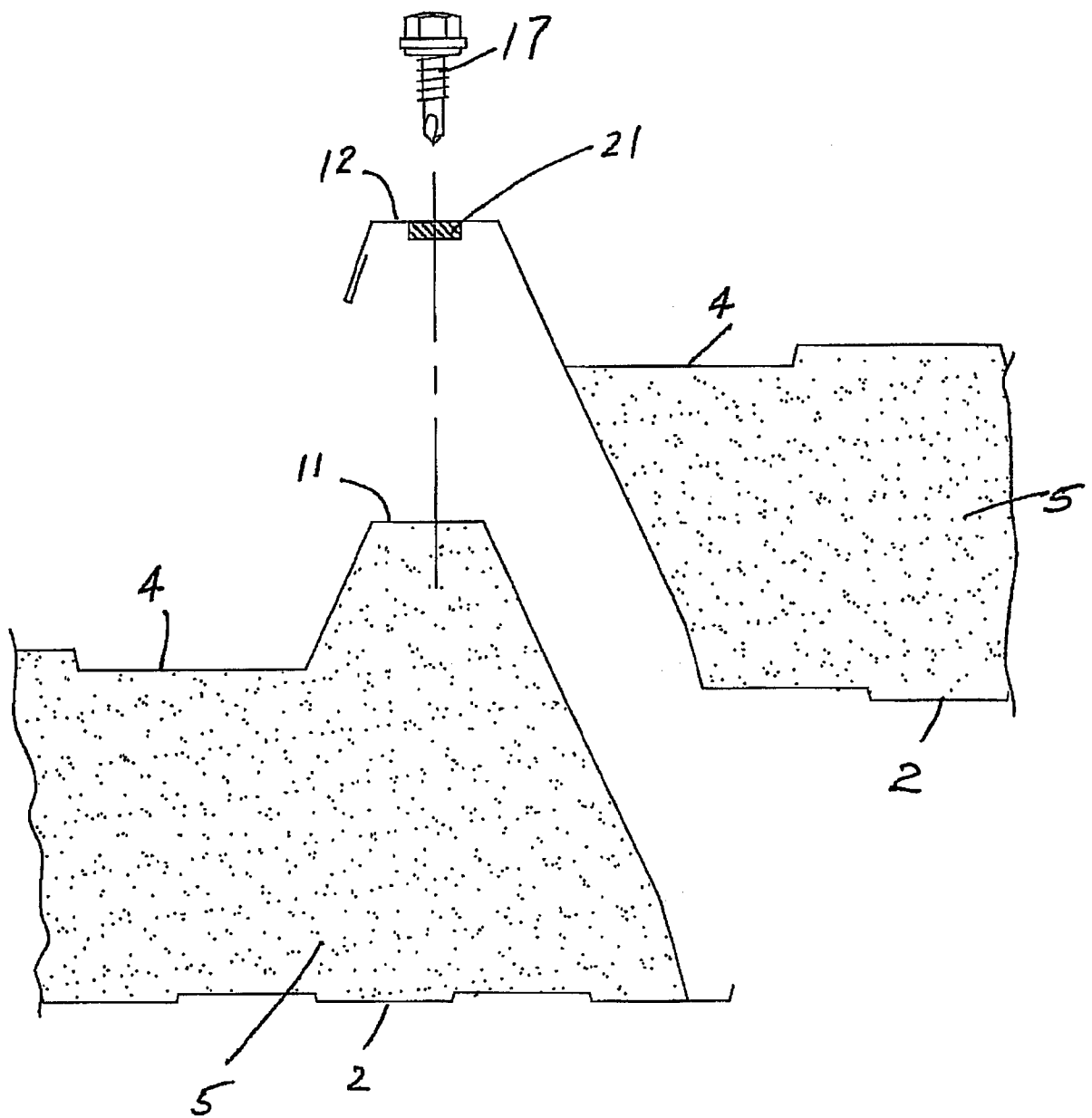


Fig. 3

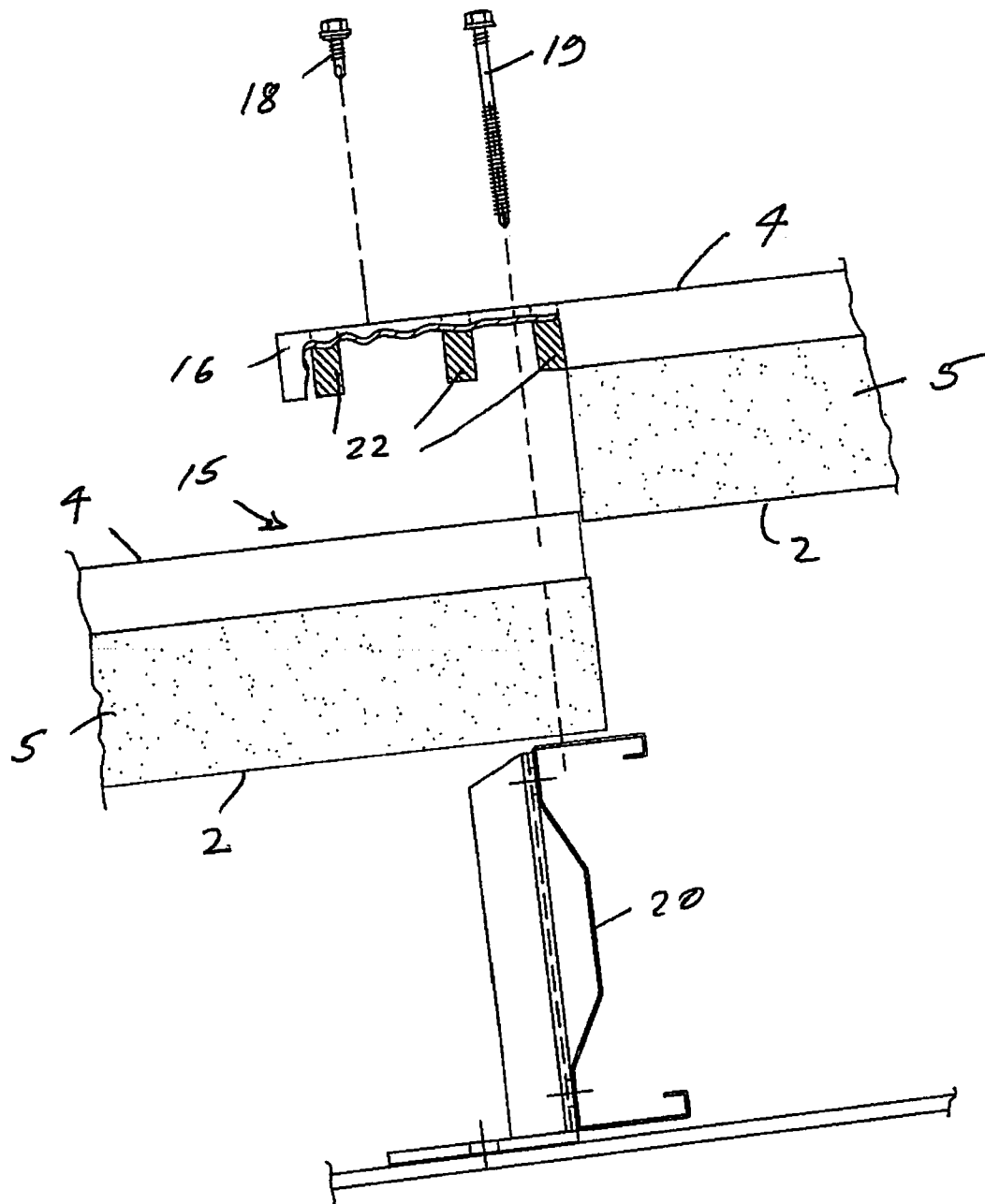


Fig. 4

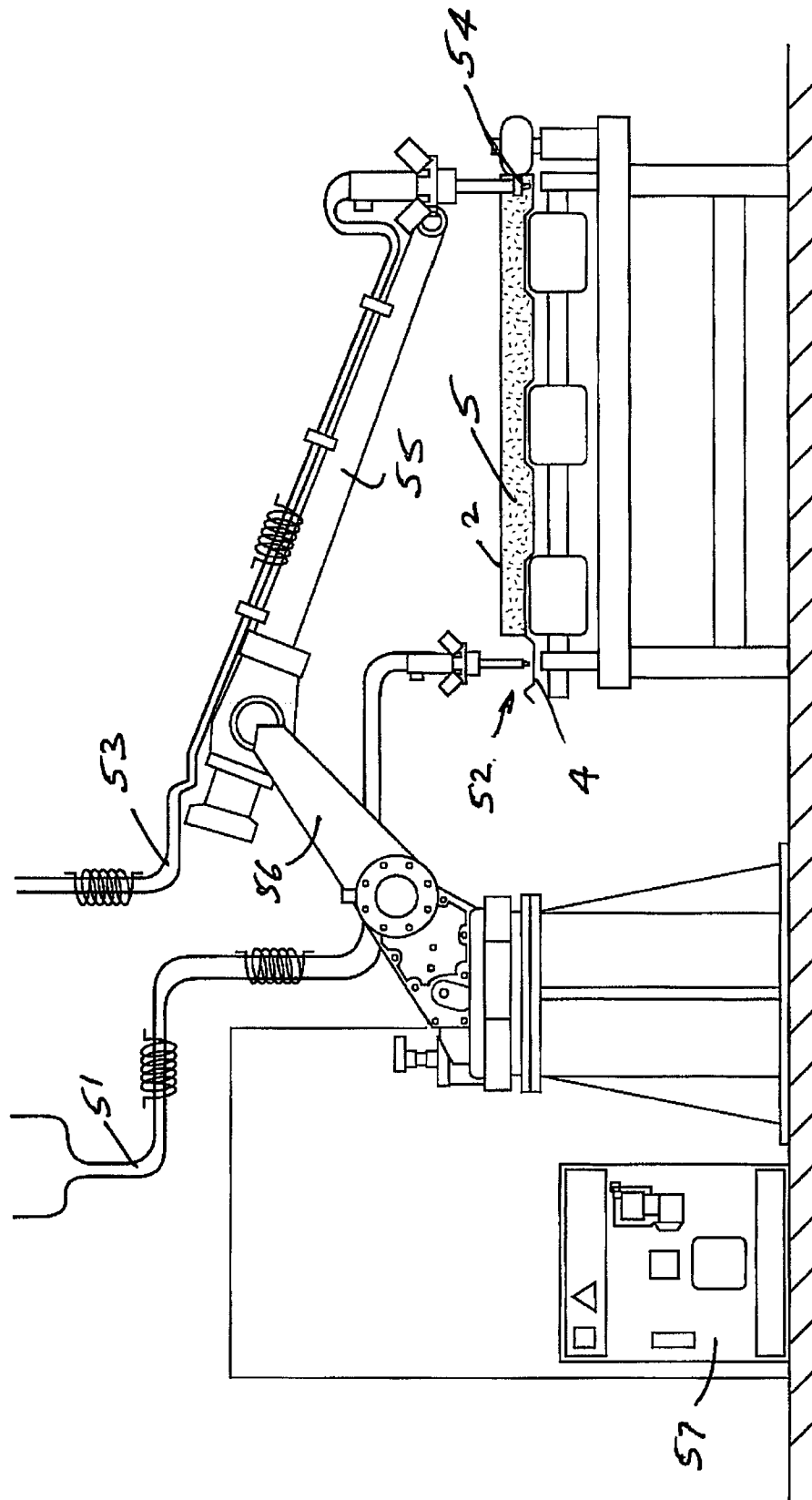


Fig. 5

## INTERNATIONAL SEARCH REPORT

International application No  
PCT/IE2012/000004

| <b>A. CLASSIFICATION OF SUBJECT MATTER</b><br>INV. E04C2/292 E04C2/38 E04D3/35 E04D3/365 E04D3/369<br>ADD.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                        |                                                                      |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------|
| According to International Patent Classification (IPC) or to both national classification and IPC                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                        |                                                                      |
| <b>B. FIELDS SEARCHED</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                        |                                                                      |
| Minimum documentation searched (classification system followed by classification symbols)<br>E04C E04D                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                        |                                                                      |
| 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)<br>EPO-Internal                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                        |                                                                      |
| <b>C. DOCUMENTS CONSIDERED TO BE RELEVANT</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                        |                                                                      |
| Category*                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Citation of document, with indication, where appropriate, of the relevant passages                                                                     | Relevant to claim No.                                                |
| X                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | GB 2 439 189 A (KINGSPAN RES & DEV LTD [IE]) 19 December 2007 (2007-12-19)                                                                             | 1-6,9,<br>10,<br>13-15,<br>17,19,<br>24-26,<br>28,29,31              |
| Y                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | page 1, line 5 - page 2, line 9<br>page 3, line 8 - line 28<br>page 5, line 7 - line 25; figures 1,2,3a,<br>3b, 5a,5b                                  | 7,8,11,<br>12,16,<br>18,<br>20-23,<br>27,30                          |
| Y                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | -----<br>US 5 502 939 A (ZADOK PETER [US] ET AL)<br>2 April 1996 (1996-04-02)<br>column 3, line 35 - column 5, line 39;<br>figures 1-5<br>-----<br>-/- | 7,8,11,<br>12,27,30                                                  |
| <input checked="" type="checkbox"/> Further documents are listed in the continuation of Box C. <input checked="" type="checkbox"/> See patent family annex.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                        |                                                                      |
| * Special categories of cited documents :<br>"A" document defining the general state of the art which is not considered to be of particular relevance<br>"E" earlier document but published on or after the international filing date<br>"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)<br>"O" document referring to an oral disclosure, use, exhibition or other means<br>"P" document published prior to the international filing date but later than the priority date claimed<br>"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<br>"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<br>"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.<br>"&" document member of the same patent family |                                                                                                                                                        |                                                                      |
| Date of the actual completion of the international search<br><br>23 April 2012                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                        | Date of mailing of the international search report<br><br>03/05/2012 |
| Name and mailing address of the ISA/<br>European Patent Office, P.B. 5818 Patentlaan 2<br>NL - 2280 HV Rijswijk<br>Tel. (+31-70) 340-2040,<br>Fax: (+31-70) 340-3016                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                        | Authorized officer<br><br>Giannakou, Evangelia                       |

## INTERNATIONAL SEARCH REPORT

International application No  
PCT/IE2012/000004

| C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT |                                                                                                                                                                     |                       |
|------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|
| Category*                                            | Citation of document, with indication, where appropriate, of the relevant passages                                                                                  | Relevant to claim No. |
| Y                                                    | GB 2 460 762 A (KINGSPAN RES & DEV LTD [IE]) 16 December 2009 (2009-12-16)<br>page 2, line 21 - line 31<br>page 5, line 9 - line 10; figure 1<br>-----              | 16,21-23              |
| Y                                                    | GB 2 345 705 A (TALFAB HOLDINGS LTD [GB])<br>19 July 2000 (2000-07-19)<br>page 1, line 3 - line 5<br>page 13, line 33 - page 21, line 20;<br>figures 4a-7b<br>----- | 18,20                 |
| A                                                    | US 6 314 701 B1 (MEYERSON STEVEN C [US])<br>13 November 2001 (2001-11-13)<br>column 4, line 5 - column 5, line 18;<br>figures 1-3<br>-----                          | 1-31                  |
| A                                                    | US 4 575 981 A (PORTER WILLIAM H [US])<br>18 March 1986 (1986-03-18)<br>column 2, line 52 - column 4, line 19;<br>figures 1-3<br>-----                              | 1-31                  |

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/IE2012/000004

| Patent document<br>cited in search report | Publication<br>date | Patent family<br>member(s) | Publication<br>date         |
|-------------------------------------------|---------------------|----------------------------|-----------------------------|
| GB 2439189                                | A                   | 19-12-2007                 | AU 2007258785 A1 21-12-2007 |
|                                           |                     |                            | CA 2654360 A1 21-12-2007    |
|                                           |                     |                            | EP 2027348 A1 25-02-2009    |
|                                           |                     |                            | GB 2439189 A 19-12-2007     |
|                                           |                     |                            | NZ 572579 A 26-08-2011      |
|                                           |                     |                            | US 2009165412 A1 02-07-2009 |
|                                           |                     |                            | WO 2007144862 A1 21-12-2007 |
| -----                                     |                     |                            |                             |
| US 5502939                                | A                   | 02-04-1996                 | NONE                        |
| -----                                     |                     |                            |                             |
| GB 2460762                                | A                   | 16-12-2009                 | GB 2460762 A 16-12-2009     |
|                                           |                     |                            | IE 20090454 A1 23-12-2009   |
|                                           |                     |                            | WO 2009150639 A1 17-12-2009 |
| -----                                     |                     |                            |                             |
| GB 2345705                                | A                   | 19-07-2000                 | NONE                        |
| -----                                     |                     |                            |                             |
| US 6314701                                | B1                  | 13-11-2001                 | CO 4870729 A1 27-12-1999    |
|                                           |                     |                            | US 6314701 B1 13-11-2001    |
| -----                                     |                     |                            |                             |
| US 4575981                                | A                   | 18-03-1986                 | NONE                        |
| -----                                     |                     |                            |                             |