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(74) Agent: **GRIFFITH HACK**; GPO Box 4164, Sydney, New
South Wales 2001 (AU).

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(71) Applicant (for all designated States except US):
IP.THREE PTY LTD [AU/AU]; c/- Level 29, St Martins
Tower, 31 Market Street, Sydney, New South Wales 2000
(AU).

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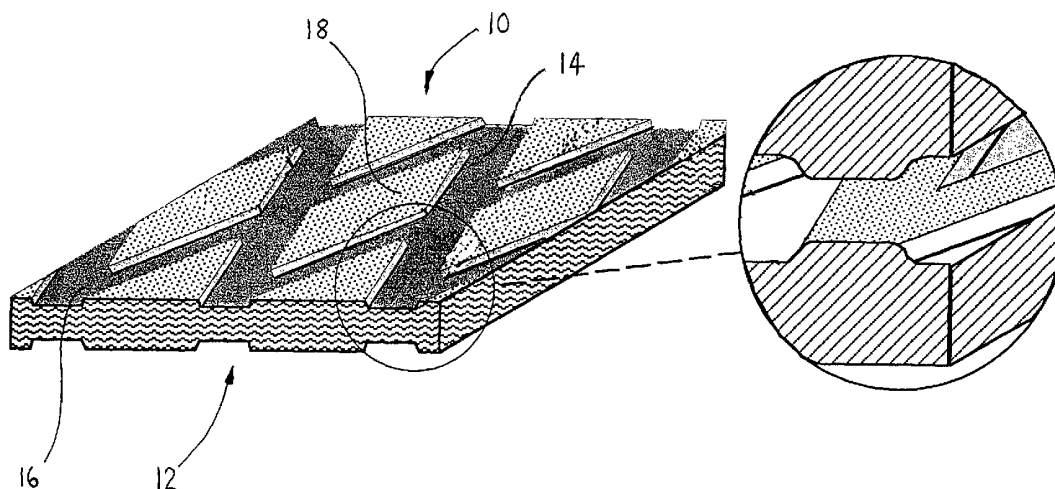
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(72) Inventor; and

(75) Inventor/Applicant (for US only): **HORTON, David, R.**
[AU/AU]; 35 Alexandra Street, Drummoyne. New South
Wales 2047 (AU).

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ance Notes on Codes and Abbreviations" appearing at the begin-
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(54) Title: A PANEL



(57) Abstract: The present invention relates generally to a panel (10) comprising a grid pattern (12) provided on both of its oppos-
ing surfaces. The grid pattern (12) includes a plurality of recesses such as (14) arranged in a predetermined configuration dictated
generally by the structural requirements of the panel (10). The panel (10) is of an increased density at the recessed grid pattern (12).
This is important in increasing the stiffness of the panel (10).



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A PANEL

FIELD OF THE INVENTION

The present invention relates generally to a panel such as
5 a constructional panel having a grid pattern. The
invention further relates to a method of forming a panel
such as the constructional panel having the grid pattern.
The invention relates particularly, though not
exclusively, to filtration membranes.

10

BACKGROUND TO THE INVENTION

Within the filtration industry, and with particular regard
to the filtration of viscous liquids, that is oils and
molten plastics, a "sintered metal membrane" can be used.
15 However, there are problems in using a sintered metal
membrane due to short life spans which result in limits of
its application. These problems increase, while the life
span of a sintered metal membrane decreases, when the
sintered metal membrane for the purposes of filtration of
20 fluids containing a lesser degree of viscosity. In the
particular case of filtration of waste water as the liquid
being filtered, the velocities and pressures achieved
during the filtration process create flexions in the
sintered metal membrane which deteriorates the material.

25

The sintered metal membranes as being discussed are
generally manufactured through multiple layering of fine
stainless steel fibrous wires with the fibrous wire
generally being parallel. The layers formed are placed
30 with the fibrous wires having different alignment, forming
a stratum containing a specified grade of microscopic
openings. Several varied grades of strata are layered and
then pressure and heat are simultaneously applied (i.e.

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pressurised sintering), thus producing the sintered metal membrane. The diameter of the steel fibres are low and therefore the elastic and plastic modulus are believed to be extremely low. The heat sintering process bonds the
5 matted steel fibres into a pressed sheet of material which reduces the overall bulk modulus to a substantially non-existent quantity.

It is understood that during a filtration, flexions occur
10 which weaken the internal structure of the membrane. This is followed by expansion, stretching and tearing of the fibrous wires. This cyclic softening results in ruptures which renders the material useless for the proposed use.

15 SUMMARY OF THE INVENTION

According to one aspect of the present invention there is provided a panel comprising a pair of opposing surfaces at least one of which includes a grid pattern having a plurality of recesses arranged in a predetermined
20 configuration, the panel at the recesses being of an increased density and across both of its opposing surfaces being of a non-uniform density.

Preferably the panel is a constructional panel.
25 Alternatively the panel is in the form of a filter membrane.

Typically the predetermined configuration of the recesses is effective in stiffening the panel. More typically the
30 plurality of recesses are disposed symmetrically across the panel whereby together they form a repeating grid pattern.

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Preferably the grid pattern is formed on both of the opposing surfaces of the panel. More preferably the grid pattern is generally aligned on the opposing surfaces of the panel.

5

Typically the recesses are each formed to a depth of between about 5 to 25% the thickness of the panel. More typically the recesses are each about 10 to 20% the thickness of the panel.

10

According to another aspect of the invention there is provided a method of forming a panel, said method comprising the steps of compressing at least one of opposing surfaces of a sheet to form a grid pattern

15 including a plurality of recesses arranged in a predetermined configuration, the panel at the recesses being of an increased density and across both of its opposing surfaces being of a non-uniform density.

20 Generally the panel is constructed of a porous material such as a cementitious or cellulosic material.

Preferably the step of compressing the sheet involves rolling the sheet between a pair of opposing roll formers.

25 Alternatively compression of the sheet is effected between a pair of opposing substantially planar presses.

Typically the method also comprises a step of heating the sheet prior to or during compression of the sheet. More typically the roll formers or the presses are heated to provide heating of the sheet whilst it is compressed.

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According to a further aspect of the present invention there is provided a membrane made from compressed layers of fibrous material and having minute openings therein, said membrane having a recessed grid pattern formed at
5 least on one side thereof by means of compressing the fibrous materials.

Preferably, the recessed grid pattern is formed on both sides of the material with the elevated grid patterns
10 being aligned with each other. The grid patterns can also be unaligned if desired.

Preferably, the recessed grid patterns formed on the membrane are such that the upper and lower surface
15 portions are in parallel planes and the portions connecting the upper and lower surface portions intersect the parallel planes at approximately 45 degrees. Preferably the intersections are rounded. This ensures that there are no sharp perpendicular surface angles which
20 effectively reduces cyclic softening through absorption of flexions and stretching. This provides a gradient from a rigid plastic modulus formed within the recessed grid patterns to the semi-rigid elastic modulus formed within the membrane material.

25 Preferably, lower surface portions are compressed to be 65% to 92% of the thickness of the upper surface portions of the compressed material.

30 Preferably, the fibrous material is a stainless steel fibrous material. Alternatively other materials can be used.

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It is also preferable that the compression of the material is accompanied by heating the material, i.e. the process of sintering. Alternatively, electric currents can be passed through the materials during the compression
5 process.

Preferably the membrane is used to filter fluids.

According to yet another aspect of the present invention
10 there is provided a method of manufacture of a membrane, said method comprising the steps of compressing layers of fibrous material having minute openings therein and thus forming an elevated grid pattern on at least one side thereon.

15 Preferably the method includes the forming of recessed grid patterns on both sides of the membrane, the elevated grid patterns preferably being aligned with each other.

20 The aligned recessed grid patterns are preferably formed by corresponding elevated grid patterns on compression plates whereby the pressure is exerted in a controlled and interlinking pattern to form upper and lower surface portions which are in parallel planes with the portions
25 connecting the upper and lower portions intersect the parallel planes at approximately 45 degrees. Preferably the intersections are rounded.

Preferably the aligned corresponding elevated grid
30 patterns on the compression plates compress the material there between to be 65% to 92% of the thickness of the compressed material.

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Preferably the fibrous material is a stainless steel fibrous material. Alternatively other materials can be used.

5 It is also preferable that the compression of the material is accompanied by heating the material, i.e. the process of sintering. Alternatively, electric currents can be passed through the materials during the compression process.

10

Preferably, the membrane is used to filter fluids.

BRIEF DESCRIPTION OF THE DRAWINGS

In order to facilitate a better understanding of the
15 nature of the present invention preferred embodiments of a panel and their method of construction will now be described, by way of example only, with reference to the accompanying drawings in which:

Figure 1 is a perspective view of one embodiment of a
20 panel according to the invention;

Figure 2 is schematic view of another embodiment of a panel according to the invention;

Figure 3 are enlarged sectional views of the panel of Figure 2 being progressively formed;

25 Figure 4 is a schematic illustration of an apparatus for forming the panel;

Figure 5 is a schematic illustration of an alternative apparatus for forming the panel;

Figure 6 are perspective views of a press of the
30 apparatus of Figure 5;

Figure 7 are schematic sectional views of a pair of the presses of Figure 6 in a "compressed" and separated condition.

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DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

As schematically shown in Figure 1 there is a panel 10 comprising a grid pattern designated as 12 provided on both of its opposing surfaces. The grid pattern 12 includes a plurality of recesses such as 14 arranged in a predetermined configuration dictated generally by the structural requirements of the panel 10.

10 The panel 10 of Figure 1 is a filter membrane constructed of a sintered stainless steel material. The grid pattern 12 is disposed symmetrically across the panel 10 wherein it forms a repeating grid pattern. The repeating grid pattern 12 is formed by a plurality of diagonally crossed channels such as 16 which together define adjacent and symmetrically disposed diamonds such as 18. The channels 16 are formed wherein the density of the panel 10 is increased at the recessed grid pattern 12. This is important in increasing the stiffness of then panel or filter membrane 10 which is of a sintered mesh porous construction. In this embodiment the depth of each of the channels such as 16 of the filter membrane 10 is approximately 15% of the overall thickness of the filter membrane 10. Furthermore, as best shown in the enlarged sectional view of Figure 1, the grid pattern 12 is formed wherein the "integrity" of the material is retained. That is, the channels such as 16 of the grid pattern 12 are formed with appropriate radii to avoid fracture of the panel 10 material which in this example is fibrous stainless steel.

Figures 2 and 3 depict an alternative embodiment of a panel 100 constructed in accordance with the invention.

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- For ease of reference "equivalent" components of the alternative panel 100 compared to the preceding panel 10 have been designated with an additional "0". For example, the grid pattern has been designated as 120. The
- 5 alternative panel 100 is formed predominantly of cellulosic material in the form of plywood which in a conventional manner is formed from a plurality of adjacent fibrous layers 101 of a timber material.
- 10 The plywood sheet is progressively compressed wherein the grid pattern 120 is formed. The grid pattern 120 includes longitudinally and transversely extending channels such as 160. The channels 160 or recesses 140 are formed wherein the plywood panel 100 is of an increased density at the
- 15 channels 160. The predetermined configuration of the grid pattern 120 together with the increased density of the plywood panel 100 at the recesses or channels 140 or 160 maintains the rigidity of the panel 100 whilst minimising the material used. Additionally, the plywood panel 100
- 20 including the grid pattern 120 has an increased fire rating and improved acoustic rating as a result of the increase in density of the cellulosic material at the grid pattern 120.
- 25 Figure 4 schematically illustrates one form of an apparatus 20 used for forming the panel 10 or 100 of the preceding embodiment. The apparatus 20 includes a housing 22 in which two pairs of opposing roll formers 24 and 26, respectively, are rotably housed. Although not depicted
- 30 the roll formers 24 and 26 include an "embossing" pattern formed on their peripheral surface. The embossed pattern is shaped complementary to the grid pattern 12 or 120 which is formed in the panel 10 or 100. The grid pattern

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12 or 120 is progressively formed in the sheet material as best shown in Figure 3. Thus, the initial pair of rollers such as 24 includes the "embossed" pattern to a shallower depth compared to the pattern formed in the final pair of rollers such as 26. Additionally, the apparatus 22 includes a plurality of pairs of spaced apart guide rollers such as 28 which are designed to feed the sheet material to the housing 22 of the roll forming apparatus 20.

10

Figure 5 illustrates an alternative embodiment of an apparatus for forming the panels such as 10 or 100. In this embodiment the apparatus 200 includes a pair of opposing presses designated as 202 and 204 respectively. Opposing internal faces of the presses 202 and 204 include an "embossed" grid pattern which is shaped complementary to that which is to be formed on the panel 10 or 100. The "embossed" pattern 206 of each of the presses 202 or 204 is best shown in Figure 6. The pattern 206 is preferably formed in the press 202 or 204 by machining of the appropriate forging element. The "edge" portions defined between the ridges and rebates of the grid pattern 206 are radiused or bevelled so as to minimise stress concentration resulting from deformation of the sheet material whilst it is formed. The alternative forming apparatus 200 of Figure 5 is preferably actuated via one or more hydraulic rams such as 208 operatively coupled to one or both of the presses 202 and 204.

30 As best shown in Figure 7 the pair of presses 202 and 204 are moved toward one another so as to form the panel such as 10 or 100 from the sheet material. The left hand representation of the apparatus 200 shows the presses 202

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and 204 in the fully formed or "compressed" condition
whereas the representation on the right hand side depicts
the presses 202 and 204 separated. Importantly, the ridges
of the "embossed" grid 206 of the opposing presses 202 and
5 204 are aligned. The presses 202 and 204 in this
embodiment form the sheet material wherein the grid
pattern such as 12 is formed to a depth of about 15% of
the overall thickness of the panel 10. Similarly, the
plywood panel such as 100 of Figure 3 is "compressed"
10 wherein the channels such as 160 are formed at a depth of
about 15% of the overall thickness of the panel 100. In
this example, the compression is assisted by the
application of steam which inhibits "fracturing" of the
fibrous timber material.

15
It should be appreciated that the panel and its method of
construction may extend to a range of materials in
addition to those already described. Preferably the
material is porous wherein it is amenable to compression
20 so that the panel is of an increased density in those
"compressed" zones. The material from which the panel may
be formed may include bronze materials, stainless steel
fibres, paper products, lime based materials, timber,
polymeric materials, clay rich materials, glass, and any
25 composite or combination thereof.

Now that several preferred embodiments of the various
aspects of the invention have been described in some
detail it will be apparent to those skilled in the art
30 that the panel and its method of construction have at
least the following advantages:

(i) a relatively stiff yet lightweight panel is provided;

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- (ii) the panel has improved physical properties including improved acoustic and fire ratings;
- (iii) the panel can be produced from a range of materials with reduced "raw material" usage; and
- 5 (iv) the panels are relatively easy to form based on conventional roll forming or pressing.

Those skilled in the art will appreciate that the invention described herein is susceptible to variations
10 and modifications other than those specifically described. For example, the grid pattern may vary from those described provided the panel has zones of different densities wherein the mechanical properties of the panel are enhanced. The grid pattern need not be symmetric and
15 uniform but rather may vary across the panel depending on its mechanical or loading requirements.

All such variations and modifications are to be considered within the scope of the present invention the nature of
20 which is to be determined from the foregoing description.

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CLAIMS:

1. A panel comprising a pair of opposing surfaces at least one of which includes a grid pattern having a plurality of recesses arranged in a predetermined configuration, the panel at the recesses being of an increased density and across both of its opposing surfaces being of a non-uniform density.
2. A panel as defined in claim 1 wherein the panel is a constructional panel.
3. A panel as defined in claim 1 wherein the panel is in the form of a filter membrane.
4. A panel as defined in any one of the preceding claims wherein the predetermined configuration of the recesses is effective in stiffening the panel.
5. A panel as defined in any of the preceding claims wherein the plurality of recesses are disposed symmetrically across the panel whereby together they form a repeating grid pattern.
6. A panel as defined in any one of the preceding claims wherein the grid pattern is formed on both of the opposing surfaces of the panel.
7. A panel as defined in claim 6 wherein the grid pattern is generally aligned on the opposing surfaces of the panel.

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8. A panel as defined in any one of the preceding claims wherein the recesses are each formed to a depth of between about 5 to 25% the thickness of the panel.

5 9. A panel as defined in any one of claims 1 to 7 wherein the recesses are each about 10 to 20% the thickness of the panel.

10 10. A method of forming a panel, said method comprising the steps of compressing at least one of opposing surfaces of a sheet to form a grid pattern including a plurality of recesses arranged in a predetermined configuration, the panel at the recesses being of an increased density and across both of its opposing surfaces being of a non-
15 uniform density.

11. A method of forming a panel as defined in claim 10 wherein the panel is constructed of a porous material.

20 12. A method of forming a panel as defined in claim 11 wherein the porous material is a cementitious or cellulosic material.

13. A method of forming a panel as defined in claim 10
25 wherein the step of compressing the sheet involves rolling the sheet between a pair of opposing roll formers.

14. A method of forming a panel as defined in claim 10 wherein compression of the sheet is effected between a
30 pair of opposing substantially planar presses.

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15. A method of forming a panel as defined in any one of claims 10 to 14 also comprising a step of heating the sheet prior to or during compression of the sheet.
- 5 16. A method of forming a panel as defined in claim 15 wherein the roll formers or the presses are heated to provide heating of the sheet whilst it is compressed.
- 10 17. A membrane made from compressed layers of fibrous materials and having minute openings therein, said membrane having a recessed grid pattern formed at least on one side by means of compressing the fibrous materials.
- 15 18. A membrane as defined in claim 17 wherein the recessed grid pattern is formed on both sides of the material with the elevated grid patterns being aligned or not aligned with each other.
- 20 19. A membrane as defined in claim 17 wherein the recessed grid patterns formed on the membrane are such that the upper and lower surface portions are in parallel planes and the portions connection the upper and lower surface portions intersect the parallel planes at approximately 45 degrees.
- 25 20. A membrane as defined in claim 17 wherein lower surface portions are compressed to be 65% to 92% of the thickness of the upper surface portions of the compressed material.
- 30 21. A method of manufacture of a membrane, said method comprising the steps of compressing layers of fibrous

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material having minute openings therein and thus forming an elevated grid pattern on at least one side thereon.

22. A method of manufacture of a membrane as defined in
5 claim 21 involving the forming of recessed grid patterns on both sides of the membrane, the elevated grid patterns being aligned with each other.

23. A method of manufacture of a membrane as defined in
10 claim 22 wherein the aligned recessed grid patterns are formed by corresponding elevated grid patterns on compression plates whereby the pressure is exerted in a controlled and interlinking pattern to form upper and lower surface portions which are in parallel planes with
15 the portions connecting the upper and lower portions intersect the parallel planes at approximately 45 degrees.

24. A method of manufacture of a membrane as defined in
claim 23 wherein the aligned corresponding elevated grid
20 patterns on the compression plates compress the material there between to be 65% to 92% of the thickness of the compressed material.

25. A method of manufacture of a membrane as defined in
25 claim 21 wherein the compression of the material is accompanied by heating the material.

26. A method of manufacture of a membrane as defined in
claim 21 wherein electric currents can be passed through
30 the materials during the compression process.

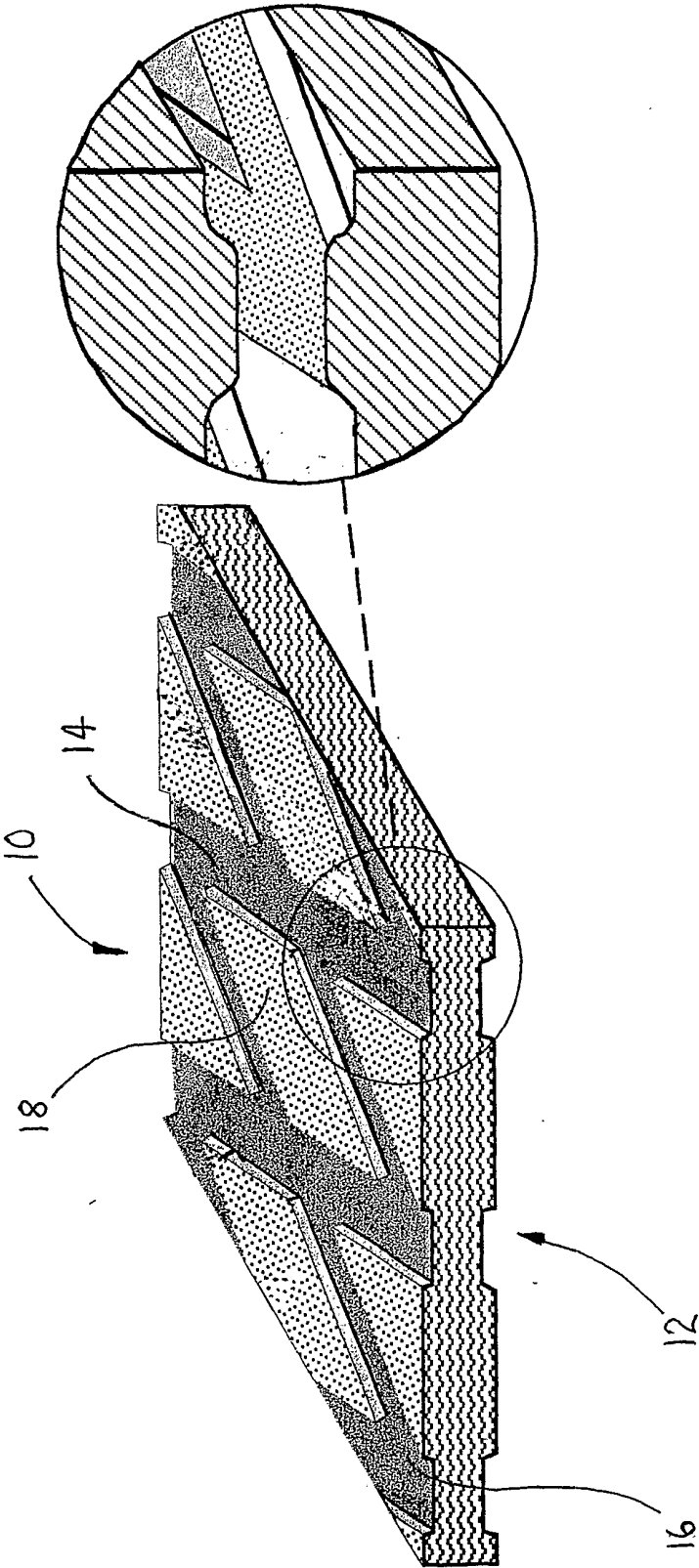


FIG. 1

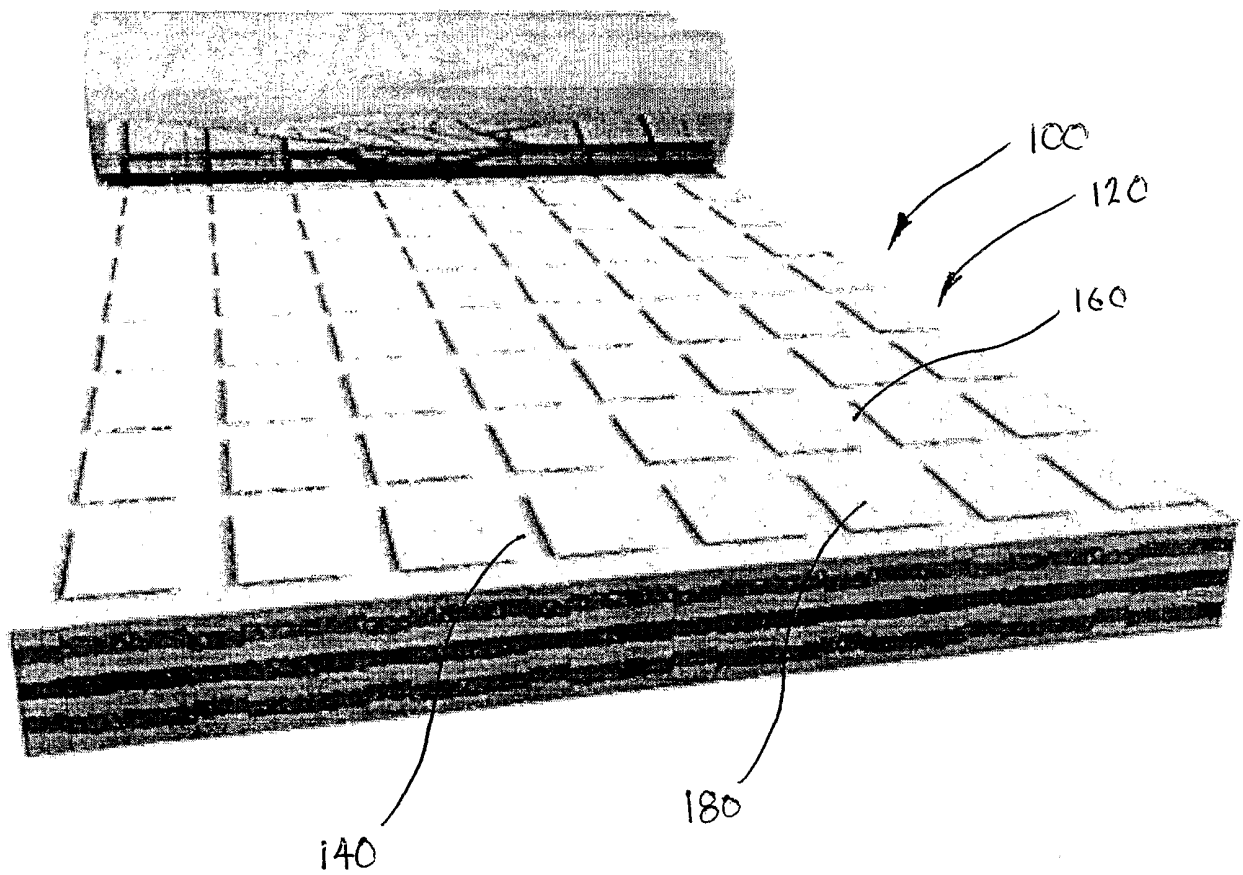


FIG. 2

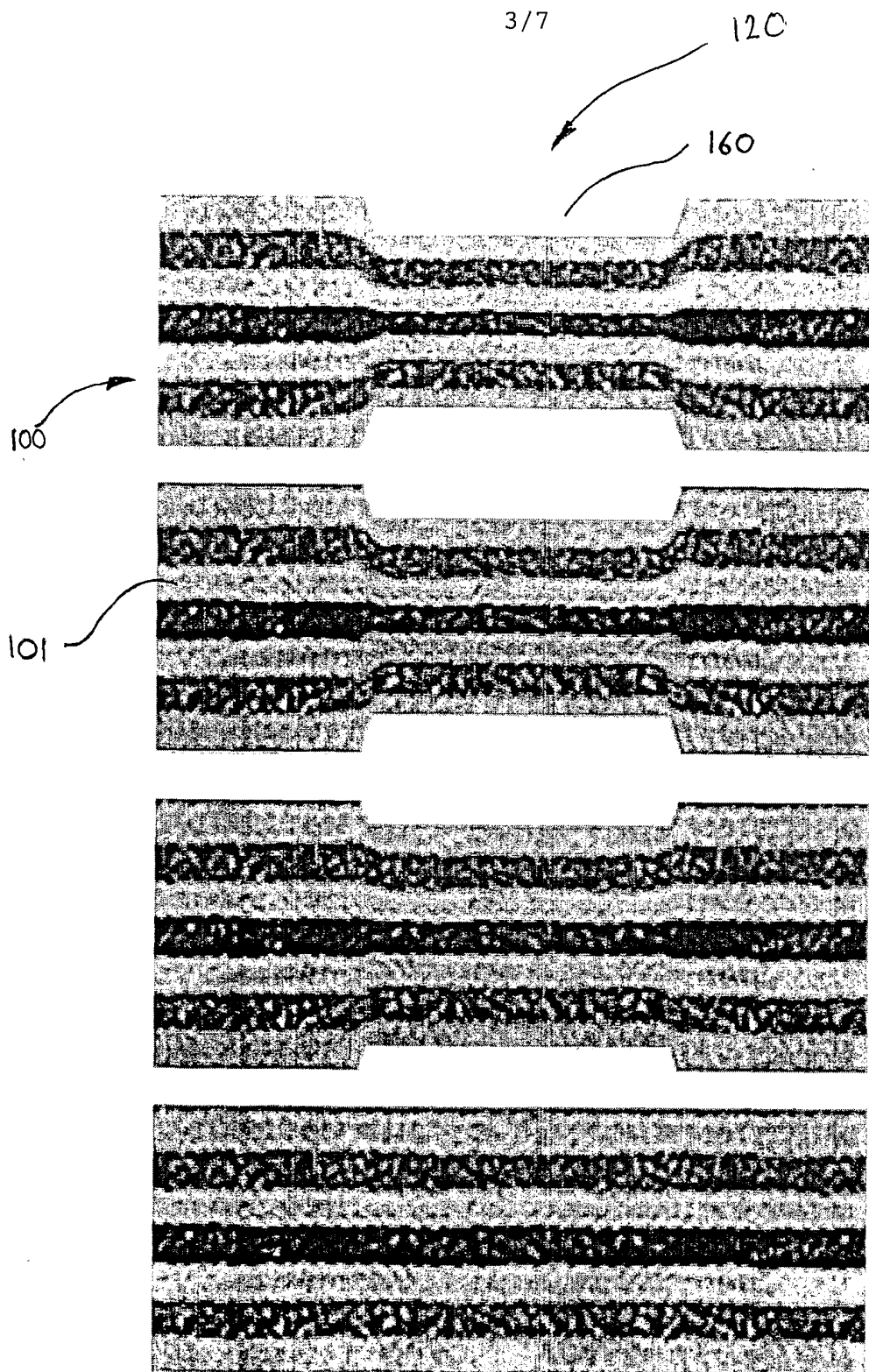


FIG. 3

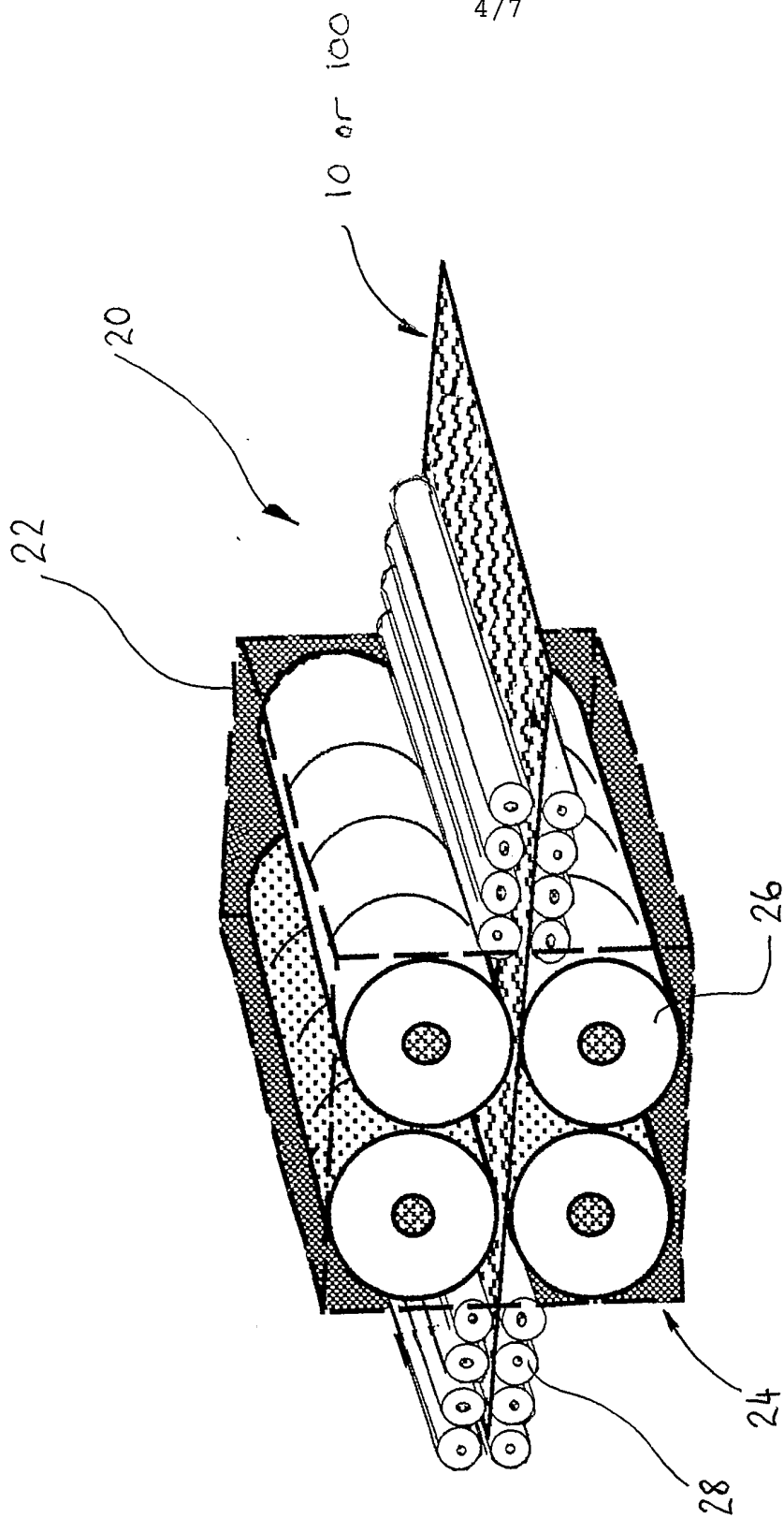


FIG. 4

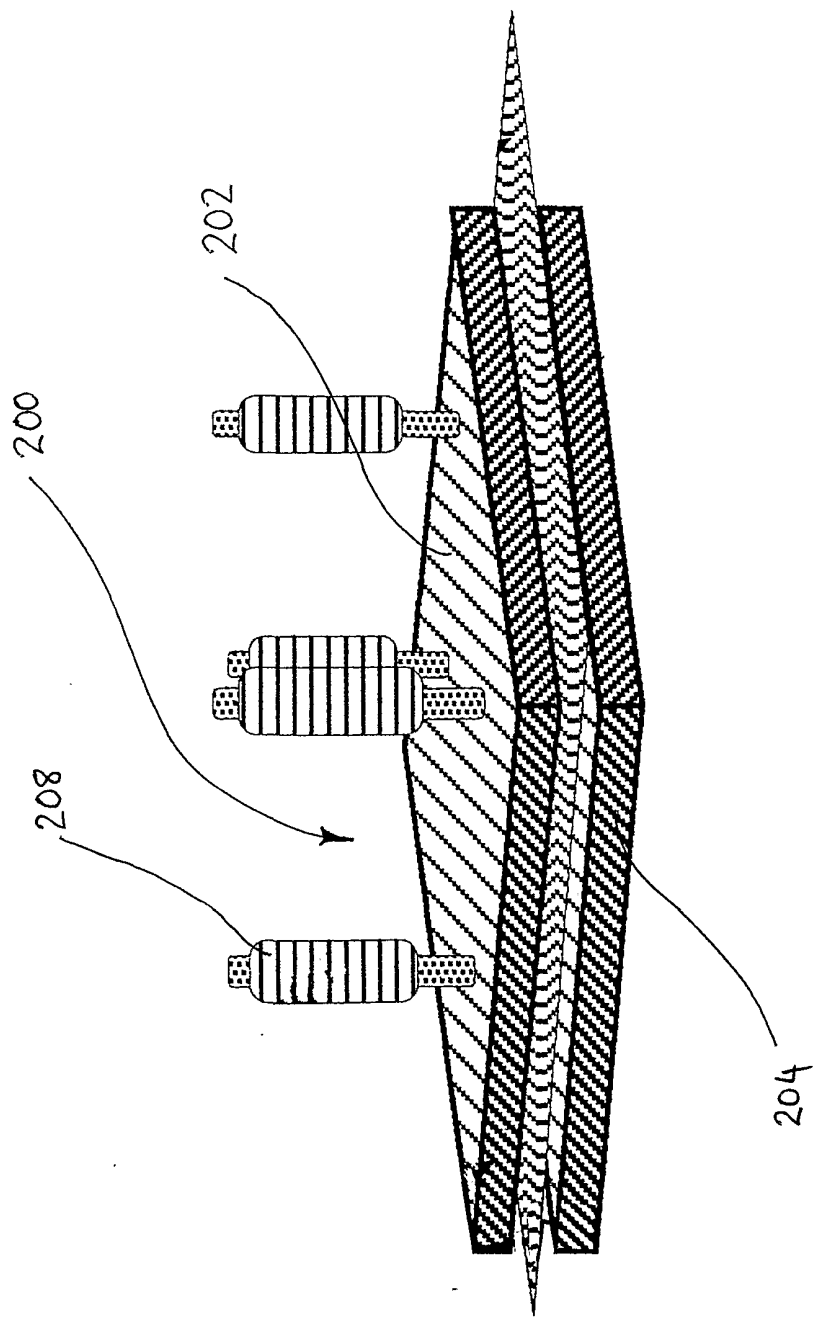


FIG. 5

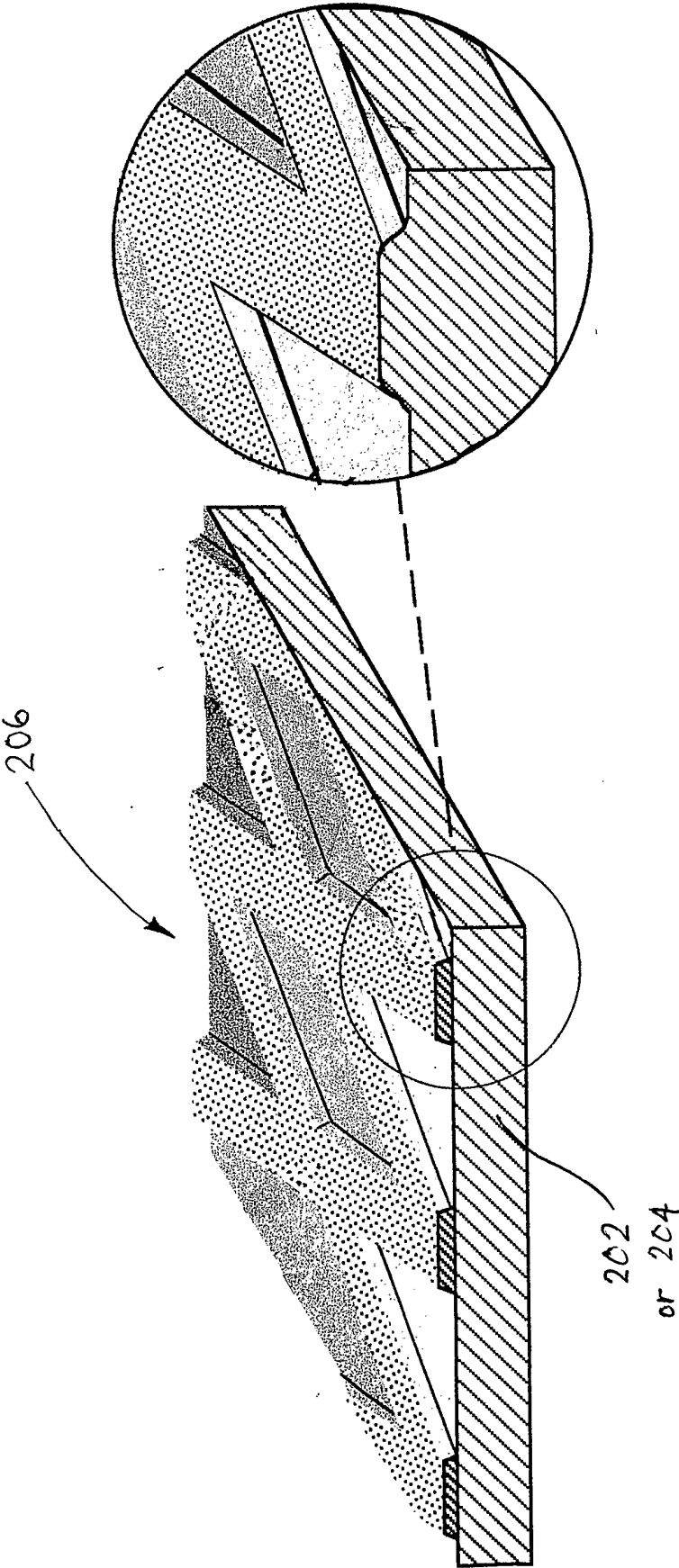


FIG. 6

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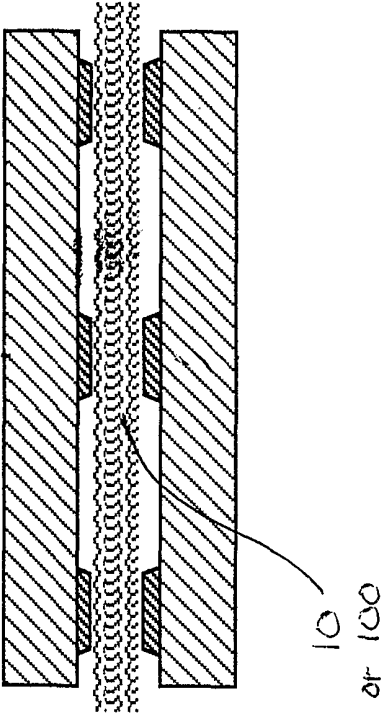
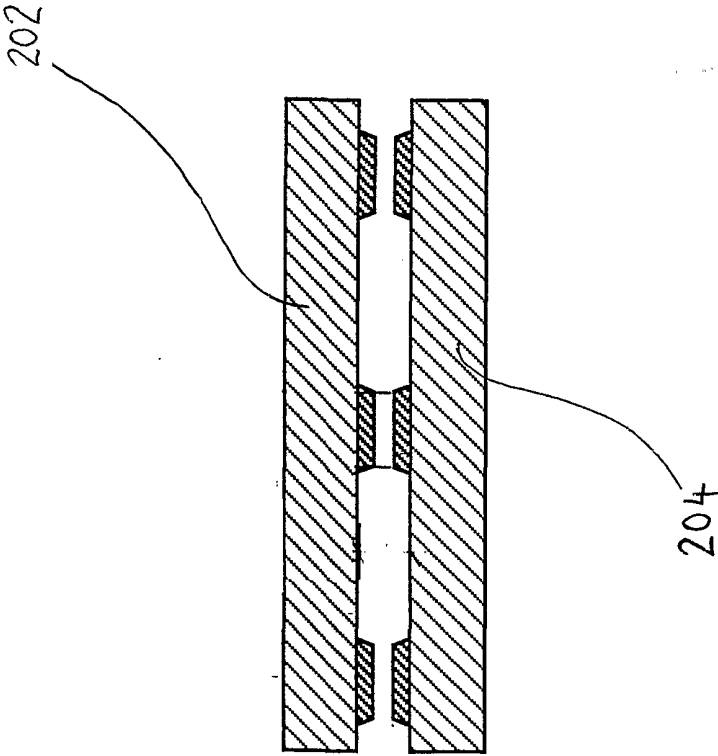


FIG. 7

INTERNATIONAL SEARCH REPORT

 International application No.
PCT/AU01/00768

A. CLASSIFICATION OF SUBJECT MATTER		
Int. Cl. ⁷ : B01D 69/02, 69/04, E04C 2/08, 2/16, 2/32, 2/42, D21J 1/04		
According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED		
Minimum documentation searched (classification system followed by classification symbols) IPC (7): B01D, E04C, D21J, F16S, B29C		
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 practicable, search terms used) DWPI		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 6136239 (LUNDGREN et al.), 24 October 2000 Whole document	1-16
X	US 4584230 (SAEGUSA), 22 April 1986 Whole document	1-16
X	US 4428454 (CAPAUL et al.), 31 January 1984 Whole document	1-16
☒ Further documents are listed in the continuation of Box C ☐ See patent family annex		
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Name and mailing address of the ISA/AU AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA E-mail address: pct@ipaustalia.gov.au Facsimile No. (02) 6285 3929		Authorized officer ADRIAN GILLMORE Telephone No : (02) 6283 2125

INTERNATIONAL SEARCH REPORT

International application No.

PCT/AU01/00768

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	GB 2092192 (FAESITE SpA), 11 August 1982 Whole document	1-16
X	WO 95/27871 (N.V. BEKAERT), 19 October 1995 Whole document, Page 2 lines 30-34	17-26