

(19) **DANMARK**

(10) **DK/EP 2459362 T3**



(12) **Oversættelse af  
europæisk patentskrift**

Patent- og  
Varemærkestyrelsen

- 
- (51) Int.Cl.: **B 29 C 70/08 (2006.01)**
- (45) Oversættelsen bekendtgjort den: **2015-07-13**
- (80) Dato for Den Europæiske Patentmyndigheds bekendtgørelse om meddelelse af patentet: **2015-04-08**
- (86) Europæisk ansøgning nr.: **10752888.7**
- (86) Europæisk indleveringsdag: **2010-07-28**
- (87) Den europæiske ansøgnings publiceringsdag: **2012-06-06**
- (86) International ansøgning nr.: **FR2010051601**
- (87) Internationalt publikationsnr.: **WO2011015770**
- (30) Prioritet: **2009-07-28 FR 0955260**
- (84) Designerede stater: **AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO SE SI SK SM TR**
- (73) Patenthaver: **Saertex France, Parc d'Activité du pays des couleurs, 38510 Arandon, Frankrig**
- (72) Opfinder: **KLETHI, Thierry, 888 route de Villeneuve Neyrieu, F-01300 Saint Benoit, Frankrig  
PINAN, Frédéric, 107 Alameda Circle, Mooresville, North Carolina NC 28117, USA**
- (74) Fuldmægtig i Danmark: **Budde Schou A/S, Hausergade 3, 1128 København K, Danmark**
- (54) Benævnelse: **Fremgangsmåde til fremstilling af en kerne med integrerede forbindende fibre til paneler af kompositmateriale, panel tilvejebragt derved, samt apparatur**
- (56) Fremdragne publikationer:  
**EP-A1- 0 611 741  
EP-A1- 0 822 062  
EP-A1- 1 686 210**



The present invention relates to a method for producing a  
5 core with integrated bridging fibres, for manufacturing  
composite panels.

The invention also covers the panel obtained as well as  
the device for producing it.

10

These panels comprise, in a known fashion, a core made  
from lightweight material of the foam type, a core on  
either side of which two skins are attached.

15 These skins are each secured to the faces of the core. It  
is the skins that confer the mechanical properties on the  
panel, because of the increase in the moment of inertia  
by spacing of these two skins.

20 Each of the skins is secured to the core.

Industry is seeking panels made from composite material  
with improved mechanical capabilities through the  
elimination of the effects limiting these properties  
25 caused by delamination and the rupture of the heart of  
the core.

It is therefore necessary to use compatible materials for  
making this connection and compensating for the mediocre  
30 mechanical properties of the core.

This is because each skin is produced from a mat of fibres embedded in the resin.

It is necessary to provide compatibility between the  
5 resin used as a matrix and said foam.

Nevertheless, the panels thus obtained have mechanical properties that remain limited and which are possible to enhance very significantly.

10

This is because, under some forces, in particular bending forces, delamination of one of the skins by disconnection of this skin from the core is found.

15 In fact, in order to increase resistance to delamination and to profit fully from the complete strength of the panel, improvements have been conceived.

Thus producing bridges between the two skins is known.

20

These bridges have been produced by holes provided in the core so that the resin pours through these holes when the skins are produced.

25 Nevertheless, though this is an improvement, the improvement in the mechanical performances remains insufficient.

Because of this, it has been imagined binding the skins  
30 to the core by passing fibres from at least one of the skins through the core either right through if one of the

skins is concerned or partially through or completely through if both skins are concerned.

Thus the resin can migrate along the partially or  
5 completely traversing fibres and thus form bridges between the two skins, which are thus themselves bridges made from composite material.

European patent EP 1 686 210 describes a composite panel  
10 that thus comprises a core with two fibre skins, these fibre skins being connected to the core by a solidified binding material, and connecting fibres originating from at least one of the skins have been pushed in, particularly perpendicularly, into the intermediate space  
15 between the skins and therefore into the core.

This document also describes a device that makes it possible to produce, continuously and simultaneously, a skin on each side of a core and to make some of the  
20 fibres in these skins penetrate through the core, either right through or not, by needlepunching.

French patent application FR 2 921 076 describes an  
25 improvement to the patent mentioned above.

This application provides that at least some of the connecting fibres pushed in from at least one of the two skins have at least an oblique orientation with respect to at least one of the two skins.

30

Thus the two skins are connected together by bridges comprising fibres issuing from these two skins.

The drawback of such panels is the choice of fibres. This is because it will be understood that the fibres that constitute the skins are not necessarily suitable for  
5 another use, namely the migration of resin and the "bridging" of the skins.

This is because the nature, diameter, length and type of the fibres constituting the skins do not give rise to  
10 sufficient mechanical properties or a sufficiently rapid migration capability, to mention only the essential parameters.

Finally, not only are the fibres of a single type but  
15 needlepunching may prove to be unsuitable when the thickness of each of the skins varies or the density. The combinations are therefore very limited.

However, there exists a demand for products with a high  
20 mechanical strength and requirements for high rates of production of the panels, so that the migrating capability of the resins must also be improved.

The rates are important but the diversity of the  
25 requirements also, so that it would be advantageous to be able to have available cores prepared on the one hand and skins prepared in advance or produced in situ but thus allowing many combinations.

30 One of the objects of the present invention, among other things, is to propose a method for producing a core including preconnections, intended to receive at least

one skin in order to form a panel with high mechanical strength and with very great resistance to delamination.

Another subject matter of the invention is a core thus  
5 obtained by the method and a panel produced from this core as well as the device for achieving this.

The invention is now described in detail according to a particular non-limitative embodiment with regard to the  
10 drawings, which depict:

- Figures 1A to 1D: a synoptic view illustrating the method used by the present invention for manufacturing a core with fibre reinforcement,  
15
- Figures 2A and 2B: two views of two panels produced from a core obtained by the method,
- Figure 3: a schematic view of the device for producing  
20 the core according to the present invention.

The method according to the invention is described with respect to the synoptic view in Figure 1. This method comprises, in step A, providing a slab 10 of lightweight  
25 material, for example a rigid foam with a density of 30 kg/m<sup>3</sup> to give a rough idea, which constitutes a core 11. This slab of lightweight material is, in a known fashion, a sheet with a parallelepipedal shape, a few centimetres high, to give a simple example. Sheet means a solid sheet  
30 or a reconstituted, single-material or multi-material sheet.

This core 11 next receives, during step B, at least one type of bridging fibre 12 on at least one face, in this case on the top face of the core. These fibres are deposited on the surface without any connecting element.

5

In the remainder of the description, "fibre" means either single-filament fibres, multi-filament fibres or threads.

In the remainder of the description, only one type of bridging fibre is spoken of, but there may be various types thereof simultaneously.

These fibres 12 issue for example from a multiple cutting of continuous threads so as to generate fibres of suitable length. There exist cutters making it possible to manufacture these portions of fibre in situ.

These fibres 12 are deposited on the face in a quantity at least equal to the bridging requirements. In this case, these fibres are deposited in a higher quantity. These fibres are suitable for bridging and can be chosen, for example, from threads in the form of clusters of filaments with a low numbering of 6 to 30  $\mu\text{m}$ , clusters that are threads with a high numbering of 30 to 10,000 tex.

25  
30

Said filaments are bound together in such a way that cutting this thread leaves the ends of the filaments connected.

The bridging thread may be produced by covering said cluster of filaments by means of a connecting thread with

the same nature as or with a nature different from the material constituting the filaments of the cluster, with a winding in a helix for example of this connecting thread around said cluster.

5

This covered thread has significant advantages, in particular that of controlling the quantity of fibres introduced and that of improving the migration of the resin when it is used for producing panels, as will be explained below. In addition, such a covered thread makes it possible to produce high-quality bridging threads.

10

Through a step C, provision is made for making the bridging fibres 12 penetrate either right through or partially through the core.

15

A known and industrial acceptable means for manufacturing such products is needlepunching.

Needlepunching consists of making needles penetrate through the core 11. Each needle comprises an end with a profile suitable for ensuring the driving of the bridging threads in the direction of introduction of the needle and for withdrawing the needle without drawing the threads.

25

Provision is also made for the threads to penetrate partially into the core or completely through the core, and therefore being traversing.

30

These threads may be introduced perpendicularly with respect to the plane formed by the face 18 of the core 11

on which the bridging fibres 12 are attached, but these fibres may be introduced obliquely with respect to this face 18, the angle being able to be positive or negative or some with a positive angle and some with a negative  
5 angle within the same core.

The angle varies appreciably and normally between 45° and 90°.

10 It will be understood that the bridging fibres may also be introduced in a predetermined pattern.

Once some of the bridging fibres are integrated in the core, the excess bridging fibres are removed, Figure 1D.

15

In this way a core is obtained with bridging fibres visible on at least one face and at least partially integrated in the core.

20 According to a variant, it is also possible to provide for the sheet to be turned so as to reach the second face 20, which is oriented upwards, to deposit excess bridging fibres, as on the face 18.

25 These fibres are in their turn needlepunched so as to be partially integrated in the thickness of the core 11 or right through.

30 Once the fibres concerned have been needlepunched, the non-needlepunched excess is removed from the core. In this case, the fibres are right through on both sides and partially integrated on both sides.

In the same way, without any difference, the placing of the fibres, the needlepunching and the removals of the excesses on each face can be carried out simultaneously on the two faces. The fibres on the face oriented downwards are then held temporarily during the needlepunching by a cover for example.

So as to simplify the following description, the example adopted covers an embodiment in which a core 10 is disposed with bridging fibres that completely pass through the core, issuing from each of the two faces and which are visible on both faces 18 and 20 of the core 10, see Figure 2B.

Nevertheless, another example with a layer of fibres on only one face is depicted in Figure 2A, the bridging fibres 12 being right through and partially integrated in the core.

Likewise, a bridging thread of a single type is chosen in this example.

The core 11 thus obtained, with integrated bridging fibres, is ready for the production of a panel 22.

Such a panel receives a layer of skin fibres 24 on each face 18, 20.

According to a first embodiment, this layer of skin fibres 24 is manufactured in advance and deposited on each face, the sandwich comprising the three layers then

being placed in a mould within which resin is infused through several inlets to afford good distribution over the entire surface of the panel.

- 5 The mould is generally heated in order to ensure polymerisation of the resin more rapidly.

It is of course possible to use other techniques such as that of fibres preimpregnated with resin, which it is  
10 necessary to increase in temperature in order to ensure good diffusion initially and polymerisation secondly.

The choice of the technique is not a crucial point and depends on the applications envisaged and the equipment  
15 available.

According to a second embodiment, the skin fibres 24 are deposited on the two faces and held in place by a cover that also provides an excellent final surface finish  
20 after removal from the mould.

The projecting ends of the bridging fibres are, in the first or second variant, situated within the layer of skin fibres 24.  
25

The resin in both cases is distributed and migrates within the skin fibres but also migrates in the bridging fibres, which it also wets, thus producing composite fibre/resin bridges between the skin fibres of the two  
30 faces.

The skin fibres are chosen according to the mechanical performances, the surface finish to be obtained, and the migration quality of the resin, while the bridging fibres are chosen according to their suitability for being  
5 needlepunched, their mechanical strength, their suitability for being cut, and their suitability for allowing appropriate migration of the resin.

In the embodiment adopted that has just been described by  
10 way of example, a panel is obtained with a core, two skins, one on either side of said core, and bridges between the two skins.

The panel thus obtained is particularly advantageous  
15 since it is completely optimised according to the application.

It should also be noted that the manufacturing method according to the present invention is advantageous in  
20 terms of management of the cores since, using the same type of core, the panel manufacturer can combine various types of fibre for the skin or even combinations of various types of fibre.

25 These skin fibres can also undergo superficial needlepunching only with the core, without any mechanical performance, while awaiting the application of resin and the polymerisation.

30 In this case, this needlepunching has no bridging role but rather a "fastening" role.

To achieve the vertical needlepunching of the bridging fibres on the core according to the present invention, a device is provided that comprises:

- 5 - a station 26 for supplying a slab 10 of lightweight material,
- a station 28 for depositing bridging fibres on each slab,
- 10 - a needlepunching station 30,
- a station 32 for angular orientation of the slab supply station with respect to the needlepunching station,
- 15 - a station 34 for eliminating non-needlepunched fibres, provided that there are some,
- station 36 for discharging the cores 11 obtained with  
20 integrated bridging fibres.

Thus it is possible to obtain needlepunching with an inclination on either side of the vertical axis, according to requirements.

- 25 Thus the inclined fibres 12 work perfectly in absorbing forces in particular when the panel produced with these cores is subjected to bending and the vertical fibres work perfectly in eliminating the risks of delamination.
- 30 Naturally, since the forces are often combined, all the bridging fibres are subjected to forces.

The supply station comprises a double moving belt provided on either side of the needlepunching station.

The fibre-depositing station comprises a cutter that cuts  
5 the thread in order to form the bridging fibres.

The method according to the present invention makes it possible to offer a core 11 prepared for the manufacturers of panels with flexibility of the possible  
10 combinations of all the elements, namely: the nature of the slab of lightweight material, the nature of the type or types of bridging fibres and the nature of the type or types of skin fibres.

15 It should also be noted that it is thus possible to determine with great precision the quantity of bridging fibres and the quantity of skin fibres.

The density of the bridges may also be chosen and applied  
20 so that it is possible to vary this density from a few bridges per  $m^2$  to a few bridges per  $cm^2$ .

Likewise the geometry of implantation of the bridges can be controlled with for example staggered distribution.  
25

It will consequently be understood that the method for producing a core according to the method of the invention allows all combinations for the manufacture of a panel.

30 In fact, the precise adaptation to requirements avoids over-reinforcements, unnecessary consumptions of raw material, and excessive weight of the finished panels

that it is then necessary for example to transport for millions of kilometres on the lorry that is equipped therewith.

- 5 Finally, this limitation of the raw materials also reduces the costs and the quantities of material to be recycled at the end of its life.

**PATENTKRAV**

1. Fremgangsmåde til fremstilling af en kerne (11) med integrerede forbindende fibre (12), til fremstilling af kompositpaneler, **kendetegnet ved, at** den omfatter udførelse af
- 5 følgende trin:
- tilvejebringelse af en blok (10) af letvægtsmateriale,
  - anbringelse af forbindende fibre (12) i overskud på i det mindste én overflade (18, 20) af blokken (10),
  - at bringe nogle af disse forbindende fibre (12) til at trænge ind i kernen,
  - 10 - fjernelse af de ubrugte overskydende forbindende fibre (12).
2. Fremgangsmåde til fremstilling af en kerne (11) med forbindende fibre (12) i overensstemmelse med krav 1, **kendetegnet ved, at** nålestansning anvendes til at bringe de forbindende fibre (12) til at trænge ind i blokken (10).
- 15
3. Fremgangsmåde til fremstilling af en kerne (11) med forbindende fibre (12) i overensstemmelse med ethvert af de foregående krav, **kendetegnet ved, at** indtrængningen af de forbindende fibre (12) går helt igennem, således at hver forbindende fiber (12) er tilgængelig på begge sider af kernen.
- 20
4. Fremgangsmåde til fremstilling af en kerne (11) med forbindende fibre (12) i overensstemmelse med ethvert af de foregående krav, **kendetegnet ved, at** de forbindende fibre (12) er af forskellige typer.
- 25
5. Fremgangsmåde til fremstilling af en kerne (11) med forbindende fibre (12) i overensstemmelse med ethvert af kravene 1 til 4, **kendetegnet ved, at** de forbindende fibre (12) er dele af tråde, som omfatter bundter af omspundne filamenter.
- 30
6. Fremgangsmåde til fremstilling af en kerne (11) med forbindende fibre (12) i overensstemmelse med ethvert af kravene 1 til 5, **kendetegnet ved, at** de forbindende fibre (12) indføres med en hældning i forhold til overfladerne på blokken (10) af letvægtsmateriale.
- 35
7. Kerne (11) tilvejebragt ved implementering af fremgangsmåden i overensstemmelse med ethvert af de foregående krav, **kendetegnet ved, at** den kun omfatter én blok (10) af letvægtsmateriale og forbindende fibre (12), som er trængt ind i blokken, idet i

det mindste nogle af fibrene, som er trængt ind, stikker ud på i det mindste en overflade af blokken (10).

8. Kerne (11) i overensstemmelse med krav 7, **kendetegnet ved, at** densiteten af de  
5 forbindende fibre (12) pr. overfladeenhed er kontrolleret.

9. Kerne (11) i overensstemmelse med krav 7 eller 8, **kendetegnet ved, at** fordelings-  
geometrien for de forbindende fibre (12) pr. overfladeenhed er kontrolleret.

10 10. Panel (22) af kompositmateriale, omfattende en kerne (11), fremstillet ved  
anvendelse af en kerne i overensstemmelse med ethvert af kravene 7 til 9,  
**kendetegnet ved, at** den omfatter i det mindste overfladefibre (24), som er indlejrede i  
en harpiksmatrix, fastgjort til den nævnte kerne (11), idet harpiksen også er trængt ind  
i de forbindende fibre (12).

15

11. Panel (22) i overensstemmelse med krav 10, **kendetegnet ved, at** enderne af de  
forbindende fibre (12) er indlejrede i harpiksmatrixen sammen med overfladefibrene  
(24).

20 12. Panel (22) i overensstemmelse med krav 10 eller 11, **kendetegnet ved, at** de  
forbindende fibre (12) er skråtstillede i forhold til kernens plan.

13. Apparat til fremstilling af en kerne i overensstemmelse med ethvert af kravene  
10, 11 eller 12, **kendetegnet ved, at** det omfatter:

25

- en station (26) til at tilføre blokke (10) af letvægtsmateriale,
- en station (28) til at anbringe forbindende fibre på hver kerne,
- en nålestansningsstation (30),
- en station (32) til vinklet orientering af stationen (26) til at tilføre blokke i forhold  
til nålestansstationen,

30

- en station (36) til at afgive kernerne (11) med integrerede forbindende fibre.

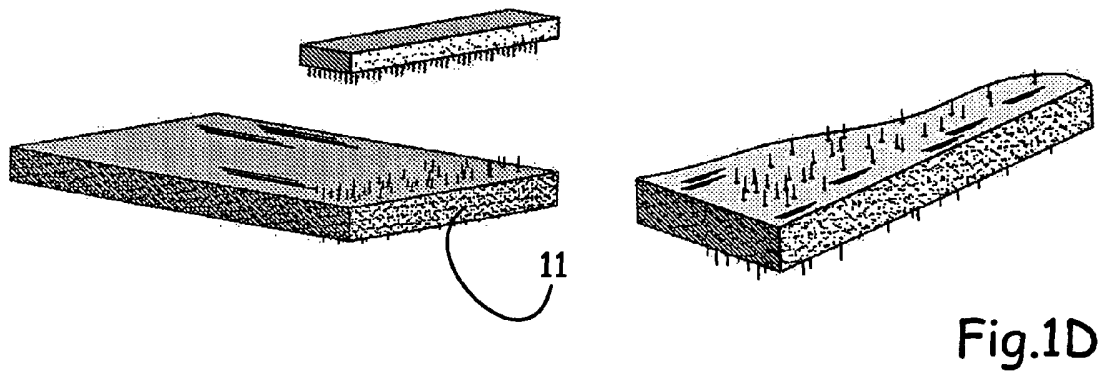
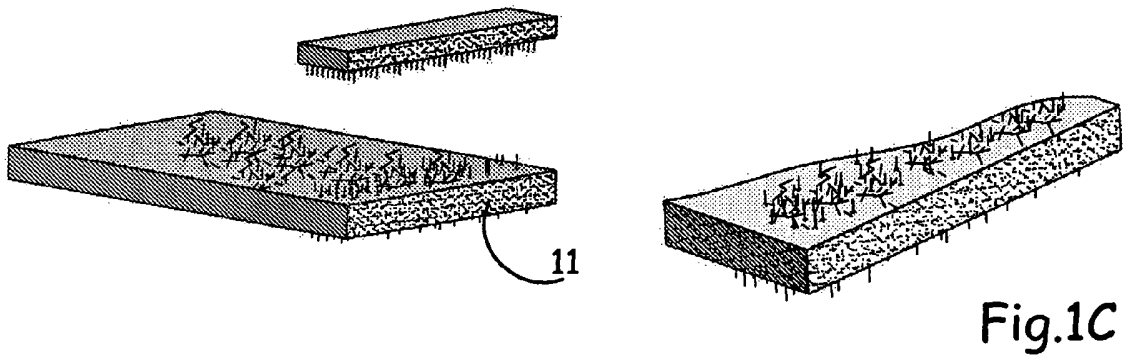
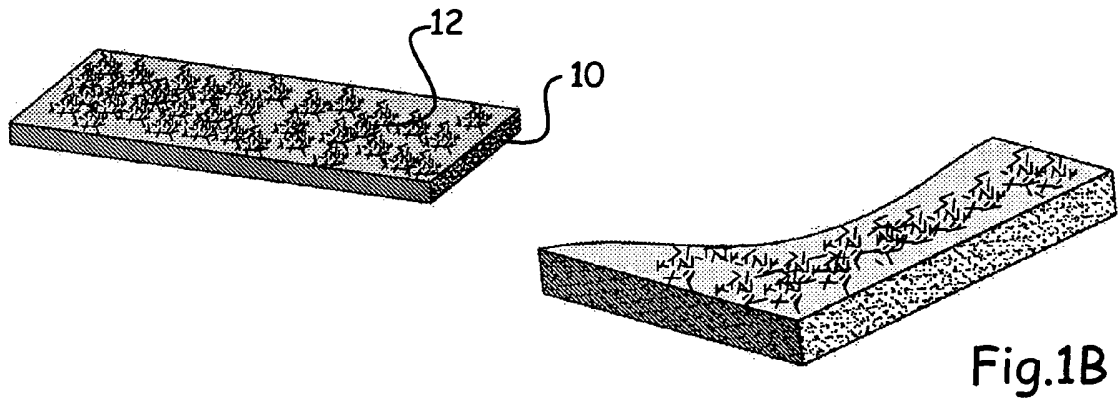
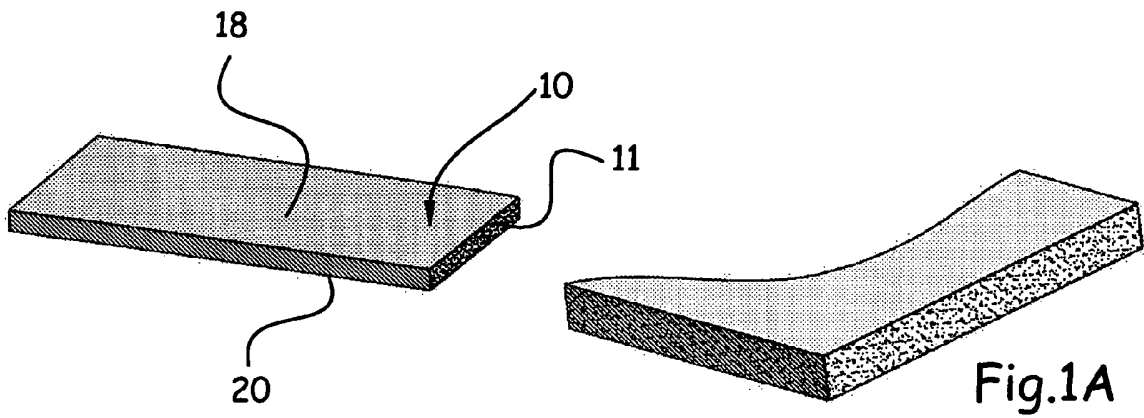
14. Apparat til fremstilling af en kerne i overensstemmelse med krav 13,  
**kendetegnet ved, at** det omfatter:

35

- en station (26) til at tilføre blokke (10) af letvægtsmateriale,
- en station (28) til at anbringe forbindende fibre på hver kerne,
- en nålestansstation (30),

- en station (32) til vinklet orientering af stationen til at tilføre blokke i forhold til nålestansestationen,
- en station (34) til at eliminere de ikke-nålestansede fibre,
- en station (36) til at afgive kernerne (11), som er tilvejebragt, med integrerede forbindende fibre.

5



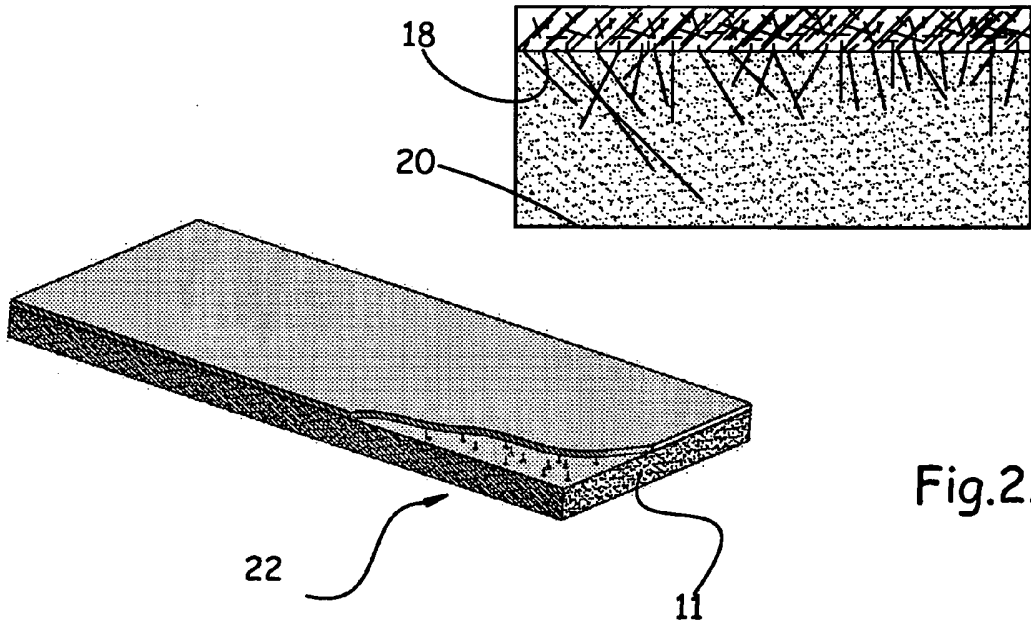


Fig.2A

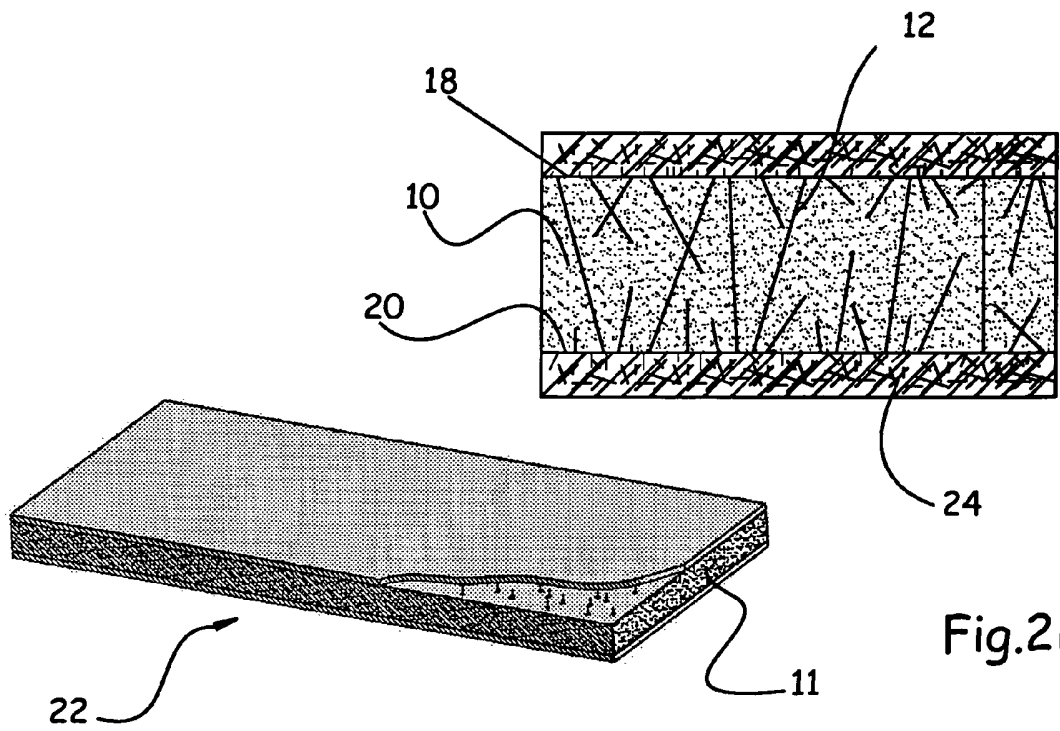


Fig.2B

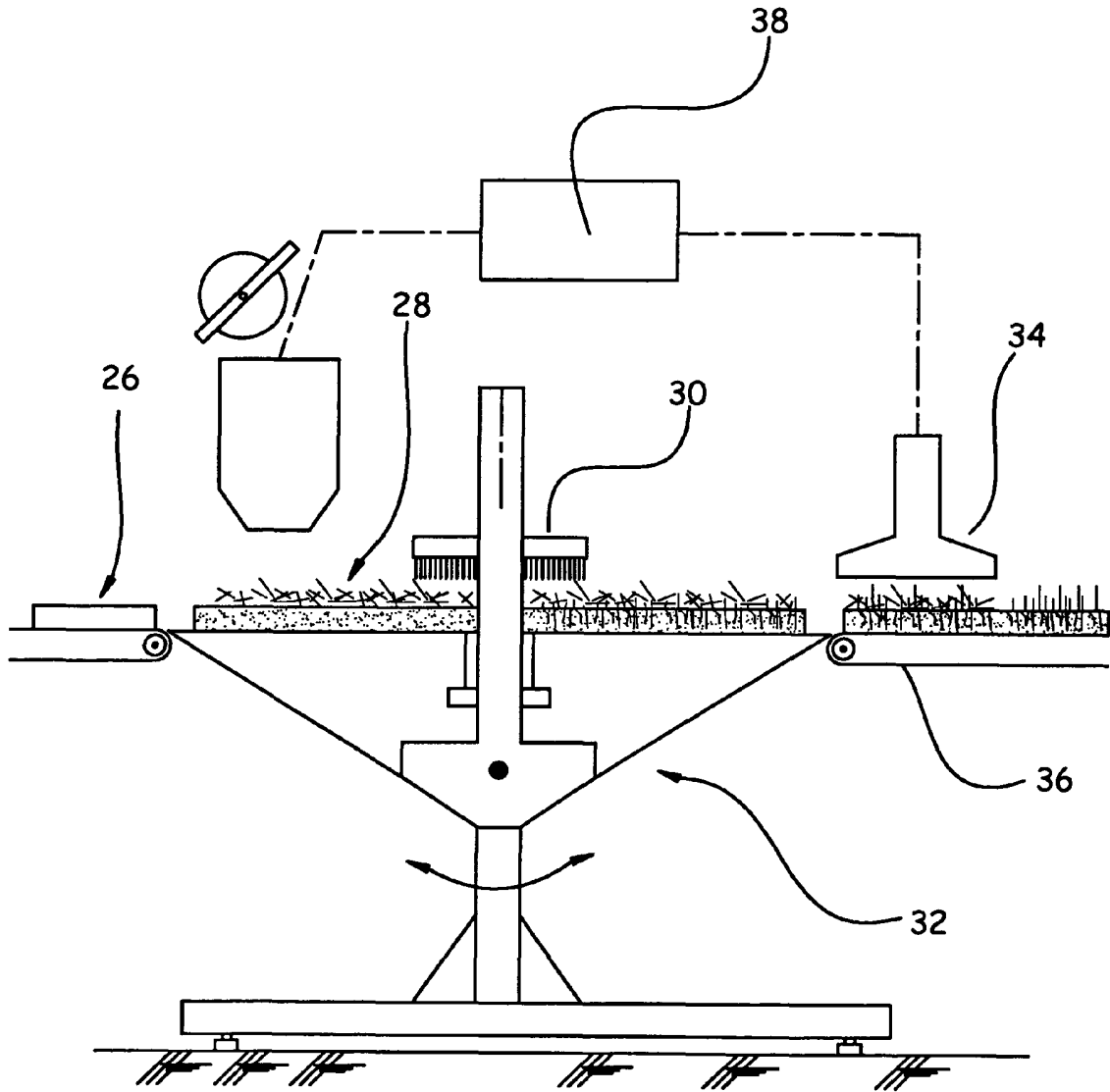


Fig.3