HU000034089T2

(19) **HU** (11) Lajstromszám: **E 034 089** (13) **T2**

MAGYARORSZÁG
Szellemi Tulajdon Nemzeti Hivatala

EURÓPAI SZABADALOM
SZÖVEGÉNEK FORDÍTÁSA

(21) Magyar ügyszám: **E 10 790422**
(22) A bejelentés napja: **2010. 12. 09.**

(96) Az európai bejelentés bejelentési száma:
EP 20100790422
(97) Az európai bejelentés közzétételi adatai:
EP 2509759 A1 **2011. 06. 16.**
(97) Az európai szabadalom megadásának meghirdetési adatai:
EP 2509759 B1 **2017. 05. 17.**

(51) Int. Cl.: ***B29B 11/16*** *(2006.01)*

(86) A nemzetközi (PCT) bejelentési szám:
PCT/EP 10/069291
(87) A nemzetközi közzétételi szám:
WO 11070118

(30) Elsőbbségi adatok:
102009044834 **2009. 12. 09.** **DE**

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(54) **Félgyártmány és eljárás egy félgyártmány előállítására egy szálerősítésű kompozit alkatrész számára**

Intermediate Product and Method for Producing an Intermediate Product for a Fibre Composite Component

[0001] The present invention concerns a method for producing a textile intermediate product for a preform. The invention further concerns a textile intermediate product for producing a preform for a fibre composite component.

[0002] There are two main approaches used in producing fibre composite components. In one method, fibre intermediate products pre-impregnated with resin (also referred to a composites or prepregs) are placed in the mould and then cured. In the other method, preforms composed of fibre layers provided with binding agents (also referred to a preforms) can also be provisionally placed in the mould and then later embedded in a mould in a matrix resin by methods such as RTM (resin transfer moulding), RIM (resin injection moulding), or other vacuum and/or pressure-supported injection methods, and then cured.

[0003] The preforms have the advantage of being not only flexible, but also shearable to a certain extent, so that they can fit into moulds. An important function of the binding agent is to bind the fibres of the preformed blank to one another such that the preform has the dimensional stability required for further handling.

[0004] Ordinarily, in a separate working step, the binding agent is applied in powder form to the layers of reinforcing fibres, with the binding agent powder being sintered or melted onto the fibres so that it does not flow out during the subsequent transportation or further processing steps. However, this process causes the textile intermediate products to be inherently rigid and lose their soft textile character. They can then only be reshaped in a heated state, i.e. hot, in order to produce a preform therefrom.

[0005] As an alternative to powdered application of the binding agent, it is also possible to add fibres composed of binding agents to the reinforcing fibres and/or to sew together individual fibre layers with threads composed of binding agents. As a rule, the binding agent fibres or threads are composed of thermoplastic-based binding agents such as polyesters, polyamides, polyether sulfones or mixtures thereof. The drawback is that such binding agent fibres or threads have a high melting point and must therefore often be heated to above 200°C in order to ensure sufficient dimensional stability of the preforms. Moreover, these binding agent fibres or threads are often only poorly compatible with the matrix resin system in further processing of the preforms into fibre composite materials.

[0006] A method is known from EP 1060069 B1 and WO 99/44810 in which non-woven fibres comprising binding agents such as copolyesters are loosely disposed as binding agents between fibre ply fabric layers. The fibre ply layers and the nonwoven fabric layers are sewn to one another in order to insure the cohesion and thus the handling properties of the fibre ply configuration. In order to produce a preform from this fibre ply configuration, said configuration is heated to the melting or processing temperature of the binding agent nonwoven fabric and pressed in a mould into a predetermined shape. After subsequent cooling, the preform is removed from the mould.

[0007] US 6,096,669 describes a method for producing a preform in which a netlike thin resin layer is applied between layers of unidirectional fibres by means of a roller. The fibre layers and the resin layer are preheated and joined by means of heated rollers, during which process the resin layer melts.

[0008] The object of the present invention is to improve the known methods of producing preforms for fibre composite materials.

[0009] The object of the invention is achieved by a method for producing a textile intermediate product for a preform comprising the following steps:

* formation of at least one fibre reinforcing layer;
* application of a binding agents based on long-chain reactive resins that are solid at room temperature by spraying of said binding agent as a spun web onto at least one fibre reinforcing layer.

[0010] Here, long-chain reactive resins are understood to be solid resins without curing agents, i.e. uncured duroplasts, which therefore still have thermoplastic properties, but nevertheless show a certain degree of brittleness in a cooled state. A spun web is understood to be a three-dimensional configuration of fine continuous thread or a plurality of fine threads and/or thread fragments.

[0011] By spray application of binding agents based on long-chain reactive resins that are solid at room temperature as a spun web, the fibre reinforcing layer is provided with a binding agent such that it retains its textile moulding properties and makes it possible to drape a mould with the fibre reinforcing layer provided with said binding agent or mould the fibre reinforcing layer in a cold state, i.e. without any additional heating step prior to the moulding step. This spray application makes it possible for the binding agent to be cooled in the ambient air prior to contact with the fibre reinforcing layer to such an extent that it is already at least partially solidified, causing a spun web to form.

[0012] Preparation of the binding agent as a spun web has the further advantage of allowing rapid, efficient, and uniform impregnation of the preform with matrix resin in further processing into the fibre composite component.

[0013] The fibre reinforcing layers can be individual laid fabric-forming layers, laid fabrics, woven fabrics, crocheted fabrics, webs, mats or braided fabrics or combinations thereof. Laid fabric-forming layers are also referred to as plies and in particular form unidirectional, bidirectional, biaxial or multiaxial laid fabrics. More complex laid fabrics may also be composed of laminated layers, unidirectional, bidirectional, biaxial and/or multiaxial laid fabrics, woven fabrics, crocheted fabrics, webs, mats, braided fabrics or combinations thereof. For example, fibre reinforcing layers may consist of synthetic fibres, glass fibres, carbon fibres, basalt fibres, aramid fibres, natural fibres and/or hybrid fibres or combinations thereof. In this case, aramid fibres are particularly preferred synthetic fibres. Hybrid fibres are understood in particular to be fibres composed of combinations of the above-mentioned fibre materials.

[0014] It is to be noted that in each individual case, it is particularly preferred to select binding agents that are compatible with the matrix resin for use in further processing of the different preforms into fibre composite components.

[0015] Application of the binding agent in the form of a spun web makes it possible, particularly compared to the introduction of a binding agent web layer, to operate with sharply reduced masses per unit area of the binding agent and nevertheless achieve a similar binding action. In particular, this applies in the use of binding agent webs based on long-chain reactive resins, which are solid at room temperature, and even more particularly to the use of duroplast-based binding agent webs. The binding agent web is advantageously sprayed on with a mass per unit area in the range of 3 g/m^2 bis 10 g/m^2, and preferably 5 g/m^2 bis 7 g/m^2.

[0016] During spray application, it has been found to be advantageous to select the distance from the fibre reinforcing layer such that the binding agent is not yet fully solidified when it comes into contact with the fibre reinforcing layer. In places where a still-soft binding agent web fibre comes into direct contact with the underlying fibre reinforcing layer, an adhesive effect can be produced that causes the binding agent web to be fixed at least to a minor extent in its position on the fibre reinforcing layer. This effect can be further increased using binding agents based on long-chain reactive resins that are solid at room temperature, particularly those that are duroplast based, in order to take advantage of the brittleness of the binding agent web and the resulting frequent hooking of spun fibres and fragments, which also reduces slipping of the spun web as a whole relative to the underlying fibre reinforcing layer. Nevertheless, because of the special structure of a spun web, which is comparable for example to the structure of cotton candy, the drapability and moldability of the fibre reinforcing layer provided with the binding agent web are not significantly impaired, even during cold forming.

[0017] The binding agent sprayed on preferably has a melting point below 125°C, and particularly preferably below 100°C. In selecting the binding agent, one should preferably consider which matrix resin is to be used in further processing into a fibre composite component. A low-melting point binding agent is advantageous in that this allows additional energy to be saved in production of the preform or providing the reinforcing layers with said agent, because low-melting-point binding agents do not require much heating in order to be sprayed on.

[0018] Advantageously, the binding agent web is sprayed onto the underlying fibre reinforcing layer as a discontinuous pattern such as a dot or line pattern. Specifically, it has been found that on providing the binding agents as a spun web, sufficient fixation of the shape of a preform or a draped or formed fibre reinforcing layer provided with binding agent web is already achieved without the binding agent web forming a continuous surface. Spraying on as a discontinuous pattern also allows local variations in the amount of binding agent that can be adapted to the respective preform without any complex process technology requirements. This makes locally larger continuous areas of the binding agent web possible.

[0019] In particularly preferred embodiments, after application of a binding agent, a second fibre reinforcing layer is arranged thereon. Optionally, this second fibre reinforcing layer can also be provided with a binding agent web. The number of fibre reinforcing layers and the selection of which fibre reinforcing layers are provided with a binding agent web are advantageously based on the mechanical requirements on the respective preform or on the fibre composite component to be produced therefrom.

[0020] In a further aspect, the object is achieved by a method for producing a preform for a fibre composite component comprising the following steps:

- production of a textile intermediate product according to the method described above;
- cold forming of the at least one fibre reinforcing layer provided with a binding agent web;
- heating and subsequent cooling of the formed fibre reinforcing layer provided with binding agents.

[0021] After cold forming, addition of heat is required only for fixing the formed fibre reinforcing layer in the desired form. In this case, however, heating that leads to melting and thus adhesion of the binding agent to the fibre reinforcing layer using the thermoplastic properties of the long-chain reactive resins used as binding agents is sufficient. Complete melting of the binding agent is not required. This leads not only to simplification, but overall to significant savings in energy and cost in the production of preforms for the further processing into fibre composite components.

[0022] A further advantage is that the binding agent web is brittle, and that in further processing or handling and/or transport prior to the further step of moulding, in some cases, smaller fragments of the binding agent web break off and penetrate into the fibre reinforcing layer. This also causes the binding agent to be distributed in the fibre reinforcing layer, which allows more efficient form fixing of the preform by application of heat after cold forming of the fibre reinforcing layer provided with binding agents. As the risk of binding agent loss is lower than in the case of scattering of the binding agent as a powder, additional fixing of the binding agent, e.g. by sintering, can be dispensed with, which is advantageous with respect to process engineering.

[0023] In the production of a preform, heating of the formed fibre reinforcing layer(s) is advantageously carried out by means of hot air and/or infrared radiation and/or microwave radiation. In particular, heating of hot air is promoted due to the highly permeable structure of the binding agent web, which allows efficient rapid heating and fixing of the formed fibre reinforcing layer(s) with relatively low complexity with respect to process engineering. Cooling of the preform is also preferably carried out using air, specifically cold air. For this purpose, under certain circumstances, the same blowing device can be used as in heating with hot air. In particular, these variations of the forming process make it possible in a simple manner to carry out subsequent corrections, for example in the position of the textile intermediate product in the mould.

[0024] The object is further achieved by means of a textile intermediate product for producing a preform for a fibre composite component that comprises, on at least one fibre reinforcing layer, a binding agent web based on long-chain reactive resins that are solid at room temperature, wherein the binding agent is sprayed as a spun web onto the at least one fibre reinforcing layer. The textile Intermediate product corresponds to the one or more fibre reinforcing layer(s) provided with the binding agent web as produced in the first steps of the above-described method for producing a preform for a fibre composite component as an intermediate product.

[0025] In this case, the binding agent web is based on long-chain reactive resins that are solid at room temperature, particularly on uncured duroplasts. This leads to distribution of the binding agent in the fibre composite layer(s) as well due to partial disintegration. The additional hooking of individual spun web fibres or fragments into the fibre composite layer(s) further increases the binding action in later form fixing of a preform. The spun web structure of the binding agent allow favorable drapability of the textile intermediate product even in a cold state.

[0026] The textile intermediate product preferably comprises a binding agent web with a mass per unit area in the range of 3 g/m^2 bis 10 g/m^2, and preferably 5 g/m^2 to 7 g/m^2, which can be a spun web due to the special structure of the binding agent. For example, it has been possible to date to obtain binding agent web layers with such a low mass per unit area only with difficulty and at great expense, while the above-described method makes it possible to obtain such masses per unit area for binding agents without problems and inexpensively.

[0027] The binding agent web is advantageously applied in a discontinuous pattern such as a dot or line pattern. This contributes towards a lower mass per unit area over the entire surface of the textile intermediate product, but at the same time allows a locally higher mass per unit area in areas for which a particularly high binding effect is desired for the later shape of the preform. For example, this can be the case in the edge zone area.

[0028] An illustrative embodiment of the invention is explained below with reference to the drawing. The drawing shows the following:

Fig. 1 is a flow diagram of the process of an embodiment of the method for producing a preform;

Fig. 2 is a schematic view of a first variant of the working steps for producing a textile intermediate product as a precursor to the preform;

Figs. 3a,b are schematic detail views of the structure of the binding agent web in a top view and a section;

Figs. 4a,b are schematic views of a second variant of the working steps for producing a textile intermediate product as a precursor to the preform;

Figs. 5a,b are schematic views of possible configurations of the binding agent web on an underlying fibre layer; and

Fig. 6 is a schematic view of a third variant of the working steps for producing a textile intermediate product as a precursor to the preform.

[0029] Fig. 1 shows the process of an embodiment of the method for producing a preform for a fibre composite component. With reference to Fig. 1 and the following figures, the invention is to be explained in illustrative fashion by means of a fibre reinforcing structure comprising two fibre reinforcing layers between which a binding agent web is arranged. In the present example, the two fibre reinforcing layers are configured as laid fabric layers, which together form a bidirectional laid fabric layer. However, it should be noted that the at least one fibre reinforcing layer can be configured as a laid fabric-forming layer, a laid fabric layer, a woven fabric, a knitted fabric, a crocheted fabric, a web, a mat, a braided fabric or a combination thereof. In particular, the laid fabrics can be unidirectional, biaxial, bidirectional or multiaxial. The number and selection of the configuration of the fibre reinforcing layer(s) are primarily determined by the type and form of the fibre composite component to be produced from the preform and the mechanical requirements placed thereon. For example, three, four, five, six or more fibre reinforcing layers of different types can be arranged one atop the other, with the type and number of fibre reinforcing layers provided with a binding agent web depending on the specific form of the preform and the resulting requirements on the local binding action of the binding agent web. In a preferred variant, all of the fibre reinforcing layers up to the uppermost fibre reinforcing layer are provided with a binding agent web. Adaptations to the locally varying requirements on the binding action can be made by varying the density of the binding agent web. In the case of more than two fibre reinforcing layers, a binding agent web is preferably provided between at least two fibre reinforcing layers.

[0030] In the present example, the fibre reinforcing layers are composed of glass fibres, but they may also be composed of carbon fibres, synthetic fibres, natural fibres, hybrid fibres or combinations thereof. In selecting the type of fibre, one should preferably consider which matrix resin is to be used in further processing into a fibre composite component.

[0031] In order to produce a preform for a fibre composite component, a fibre reinforcing layer is first formed (step 10 in Fig. 1). Next, the binding agent is applied by spraying as a spun web onto the fibre reinforcing layer (step 12). The binding agent should preferably be an uncured duroplast-based binding agent. Longer molecular chain resins that are solid at room temperature, also referred to as hotmelts, have been found to be particularly suitable, with spray application in the form of a spun web preventing planar migration in the underlying fibre reinforcing layer and thus allowing favorable cold formability to be achieved. Epoxy resin systems without curing agents are preferred. For example, polyester or phenol resin systems can also be used. In selecting the binding agent material, one should preferably consider which matrix resin is to be used in further processing into a fibre composite component. It is particularly advantageous to use resins that are based on the same monomers as the subsequent matrix resin, but with the polymers having shorter chains than the subsequent matrix resin. In the present example, a bisphenol A resin-based binding agent such as the product "Shell 1004" manufactured by Shell is sprayed on as a spun web. It has a melting temperature of 90°C, so it can also be favorably combined with fibres having lower thermal resistance. In addition to the bisphenols, the novolacs are also particularly preferred for use as binding agents, with it being possible to use all of the above-proposed solid resin systems without curing agents.

[0032] In order to carry out spray application of the binding agent as a spun web, the binding agent can already be present in liquid form, for example in a storage tank of a spray device, or it can be liquefied by heating, for example between the storage tank and the nozzle. On exiting the nozzle, the binding agent material cools, and it comes into contact with the fibre reinforcing layer in a partially or fully solidified state. When the binding agent exits the nozzle, there is preferably enough built-up pressure to cause turbulence of the exiting binding agent material jet. In this manner, the binding agent is deposited on the fibre reinforcing layer as a fine thread web, similar to cotton candy, or as a cast of fine continuous threads. The structure and density of the spun web can be influenced by means of the nozzle shape and size and its distance from the fibre reinforcing layer, and by means of the pressure and the turbulence resulting therefrom.

[0033] From the standpoint of production technology, it is a highly advantageous that by means of the spraying step, the binding agent web can be integrated into the production of the fibre reinforcement "online," as it were.

[0034] After the two method steps, formation of a fibre reinforcing layer (step 10) and spray application of a binding agent web (step 12), and optionally after repeating step 10 and/or step 12, an intermediate product is first produced that will be referred to below as the textile intermediate product and can be immediately processed into a preform or temporarily stored and then subsequently, for example at a different location, subjected to further processing. The method steps described above can be carried out continuously or discontinuously.

[0035] Further processing of the textile intermediate into the preform comprises, as essential steps, cold forming of the fibre reinforcing layer provided with a binding agent web (step 14) and heating and subsequent cooling of the formed fibre reinforcing layer provided with a binding agent (step 16). In cold forming, the textile intermediate product is placed in a mould, where it is draped in such a manner that it assumes the shape of said mould. This provides major advantages with respect to complexity of production technology, required energy, and cost in that this process can be carried out at room temperature without heating the textile intermediate product. Specifically, the provision of a binding agent in the form of a spun web does not significantly impair the textile properties of the fibre reinforcing layers and thus their formability. Heating with subsequent cooling is only necessary for form fixing. In this process, the binding agent is melted and again allowed to solidify, with the fibre reinforcing layers being maintained in the desired shape. Heating, and in particular cooling, is carried out with correspondingly temperature-controlled air taking advantage of the porous structure of the fibre reinforcing layers provided with the binding agent web. This makes particularly rapid temperature change possible. After cooling, the preform can be removed from the mould. If applicable, it can be subjected to post-processing by means of surface treatments, separation, or other processing steps. By means of methods such as RTM (resin transfer moulding), RIM (resin injection moulding), or other vacuum and/or pressure-supported injection methods carried out in the mould, the preform can be embedded as is in a matrix resin that is subsequently cured in order in this manner to produce fibre composite components.

[0036] Fig. 2 is a schematic illustration of a first variant of the first steps of production of a preform, specifically up to production of the textile intermediate product, taking as a representative example a bidirectional laid fabric composed of two glass fibre ply layers with a bisphenol A resin-based binding agent web arranged between them, which is configured in the present example as a bidiagonal laid fabric. For this purpose, a first insertion 101 of fibre reinforcing material is provided that forms a first glass fibre ply layer as a fibre reinforcing layer, wherein the fibre reinforcing material can be fed in in thread or web form. On the insertion 101, a binding agent web 107 is formed using a spray device 105 from which a turbulent spray jet 109 is emitted. A second glass fibre ply layer is formed thereon via a second insertion 103 as a fibre reinforcing layer. The two laid fabric layers are arranged at +45° or -45° to the processing direction indicated by the arrow and together form a bidiagonal laid fabric. The material web 113 of a textile intermediate product composed of bidiagonal laid fabric provided with a bisphenol A-based binding agent web is needled or sewn for better handling using the sewing or needling device 111.

[0037] Needling is carried out in particular in order to secure the two laid fabric layers against one another and prevent excessive slippage. The uncured duroplast-based binding agent web itself hooks into the underlying fibre reinforcing layer because of its brittleness. By adjusting the distance of the spray device 105 from the underlying fibre reinforcing layer, the degree of solidification of the spun web when it comes into contact with the fibre reinforcing layer can be modified. When it comes into contact with said layer, the spun web is preferably not yet fully solidified, so that a kind of adhesive effect or positive locking occurs at the contact sites on contact with the fibre reinforcing layer. The brittleness of the duroplast-based binding agent also results in partial disintegration, so that the spun web fragments are also distributed in the fibre reinforcing layer, which causes an improved binding action in form fixing in further processing into the preform. This disintegration and distribution of the fragments into adjacent fibre reinforcing layers is promoted by the needling.

[0038] A schematic representation of the structure of the duroplast-based binding agent web composed of fibres 207 or arranged between fibre reinforcing layers 203, 205, 213 is shown in Figs. 3a,b in a top view (Fig. 3a) in the x-y plane and a sectional view (Fig. 3b) in the z-direction of a textile intermediate product 201. Fig. 3a is a top view of a fibre reinforcing layer 205 provided with fibres 207 of a binding agent web under which a further fibre reinforcing layer 203 oriented in another direction is arranged. The spun fibres 207 have different lengths and curvatures, and extend not only in the x-y plane, but also perpendicularly thereto in the z-direction. In some cases, they have disintegrated into smaller fragments 209, as shown in the side view of Fig. 3b, wherein a binding agent web is arranged between two fibre reinforcing layers 205, 213. The fragments 209 can flow between the fibres of the fibre reinforcing layer 205. By sewing the fibre reinforcing layers 205, 213 to each other, fragments can also be drawn into the overlying fibre reinforcing layer 213. If the spun fibres 207 are not yet fully solidified when they come into contact with the fibres of the fibre reinforcing layer 205, contact sites 211 are formed at which the spun fibres 207 bind to the fibres of the fibre reinforcing layer 205. The depth of penetration of the spun fibres 207 into the adjacent fibre reinforcing layers 205 (in the z-direction in the example shown here) can be influenced by the brittleness of the binding agent material.

[0039] A variant of the structure for producing a textile intermediate product shown in Fig. 2 is shown in Figs.

4a,b in a side view (Fig. 4a) and a top view (Fig. 4b). A first fibre reinforcing layer 303 is formed via a first thread insertion 301 on a conveyor belt 305 moving in the direction of the arrow. A binding agent web 313 is applied thereto by means of a spray device 307 with a nozzle 309 that forms a turbulent spray jet 311. The use of the conveyor belt 305 allows a high degree of accuracy in deposition of the first fibre reinforcing layer 303 and application of the binding agent web 313. On the binding agent web 313, a second fibre reinforcing layer 315 is formed via a second thread insertion 317. The fibre reinforcing layers 303, 315 with the binding agent web 313 arranged between them are provided in the sewing device 319 with stitching 323, and the textile intermediate product 321 produced in this manner is rolled for further transport onto a roller 325.

[0040] The structure shown in Figs. 4a,b differs from that shown in Fig. 2 in that the spray device 307 can be moved back and forth perpendicularly to the transport direction of the conveyor belt 305 (indicated by the double arrow). This allows the binding agent web 313 to be applied for example as a line pattern, as also shown in schematic and illustrative form in Figs. 5a,b. Any other desired discontinuous application patterns may also be selected.

[0041] The spun web 505 is applied in a meandering line pattern to the fibre reinforcing layer 503 on the textile intermediate product 501 of Fig. 5a. The spun web 515 is applied with relative movement of the spray device parallel to the transport direction of the conveyor belt in a spiral-shaped line pattern to the fibre reinforcing layer 513 on the textile intermediate product 511 of Fig. 5b. By adjusting the speed of the conveyor belt and the speed of the spray device, a highly selective effect can be exerted on the density of the spun web and its local mass per unit area. In this process, however, by maintaining the average mass per unit area of the binding agent in the range of 3 g/m^2 to 10 g/m^2, and preferably 5 g/m^2 to 7 g/m^2, sufficient binding agent concentrations can be achieved in all areas to allow the production of more complex preforms as well. In particular, application in a line pattern allows an optimal binding action of the binding agent web without requiring application of a continuous surface of the binding agent web.

[0042] The coverage with the binding agent web depends on the fibre material, the degree of forming, the structure of the fibre reinforcing layers and the required stiffness of the preform. Looking at the example of two glass fibre ply layers having orientations of +45° and -45° with a binding agent web between them that is preferably duroplast-based, for example based on bisphenol A resin, from which an L profile with a local spherical bulge is to be produced, the majority of the surface would be covered with approx. 5-7 g/m^2 of binding agent. In the area of the spherical bulge, the binding agent concentration would be locally increased to about 10-12 g/m^2 in order to control the restoring forces of the fibres of the fibre reinforcing layers. The binding agent concentration over the entire area of the glass fibre ply would average less than 10 g/m^2.

[0043] Fig. 6 shows a further variant of the structure of Fig. 2 for producing a textile intermediate product as a precursor to the preform. A first thread insertion 601 is provided that forms a first glass fibre ply layer as a fibre reinforcing layer. A binding agent web 607 is formed on this layer using a spray device 605 from which a turbulent spray jet 609 is emitted. A second glass fibre ply layer is formed on this layer as a fibre reinforcing layer via a second thread insertion 603. The two laid fabric layers are arranged at +45° or -45° to the processing direction indicated by the arrow and together form a bidiagonal laid fabric. The material web 623 of the textile intermediate product composed of a bidiagonal laid fabric provided with a bisphenol A resin-based binding agent web is needled using a sewing device 611 for better handling properties.

[0044] Compared to the structure of Fig. 2, the structure of Fig. 6 also comprises a dispersing device 615 used in the present example for adding powdered additives 617 to the binding agent web 607. For example, the additive powder 617 may comprise additives that affect the fire or flame behavior of the preform and the fibre composite component produced therefrom. Mechanical properties such as the toughness of the fibre composite component can also be affected by selective addition of additives as desired. If needed, the additive powder 617 can be fixed on the fibre reinforcing layer or in the binding agent web 607, for example by means of sintering with a heating device 619 using thermal radiation 621 in order to prevent excessive flowing out of said powder. Depending on the temperature reached, the binding agent web can also form a larger number of contact sites with the underlying fibre reinforcing layer.

[0045] Depending on the type and composition of the additive, it can also be added to the binding agent material and sprayed on as a spun web together with said binding agent material. The additive(s) can also be sprayed on in a separate method step. Additives that increase the toughness of the subsequent fibre composite component, also referred to as tougheners, are particularly well-suited for spray application.

Reference numbers

[0046]

101	First thread insertion
103	Second thread insertion
105	Spray device
107	Spun web
109	Spray jet
111	Sewing device
113	Material web
201	Textile intermediate product
203	Fibre reinforcing layer
205	Fibre reinforcing layer
207	Spun fibre
209	Spun web fragment
211	Contact site
213	Fibre reinforcing layer
301	First thread insertion
303	First fibre reinforcing layer
305	Conveyor belt
307	Spray device

309	Nozzle
311	Spray jet
313	Spun web
315	Second fibre reinforcing layer
317	Second thread insertion
319	Sewing device
321	Material web
323	Stitching
325	Material roller
501	Textile intermediate product
503	Fibre reinforcing layer
505	Spun web
511	Textile intermediate product
513	Fibre reinforcing layer
515	Spun web
601	First thread insertion
603	Second thread insertion
605	Spray device
607	Spun web
609	Spray jet
611	Sewing device
613	Material web
615	Dispersing device
617	Powder
619	Heater
621	Thermal radiation
623	Material web
10 – 16	Method steps

Félgyártmány és eljárás egy félgyártmány előállítására egy szálerősítésű kompozit alkatrész számára

Szabadalmi igénypontok

1. Eljárás egy textil félgyártmány előállítására egy előforma számára a következő lépésekkel:

- legalább egy szálerősítésű réteget képezünk;

- szobahőmérsékleten szilárd állapotú, hosszú láncú reaktív gyanta alapú kötőanyagot viszünk fel, a kötőanyag fonadékként való felszórásával.

2. Az 1. igénypont szerinti eljárás, ***azzal jellemezve***, hogy a kötőanyag-fonadékot a 3 g/m^2 és 10 g/m^2 közötti tartományba eső területsúllyal szórjuk fel.

3. Az 1. vagy 2. igénypont szerinti eljárás, ***azzal jellemezve***, hogy a felszórásnál a szálerősítésű rétegtől való távolságot úgy választjuk meg, hogy a kötőanyag a szálerősítésű rétegen való felütközésnél még ne legyen teljesen megszilárdulva.

4. Az 1-3. igénypontok bármelyike szerinti eljárás, ***azzal jellemezve***, hogy egy 125°C alatti olvadáspontú kötőanyagot szórunk fel.

5. Az 1-4. igénypontok szerinti bármelyike eljárás, ***azzal jellemezve***, hogy a kötőanyag-fonadékot nem összefüggő mintaként szórjuk fel.

6. Az 1-5. igénypontok bármelyike szerint eljárás, ***azzal jellemezve***, hogy a kötőanyag felvitele után fölötte egy második szálerősítésű réteget rendezünk el.

7. Eljárás egy előforma előállítására egy szálerősítésű kompozit alkatrész számára a következő lépésekkel:

- egy textil félgyártmányt állítunk elő az 1-6. igénypontok bármelyike szerint;

- hidegen alakítjuk a legalább egy, kötőanyag-fonadékkal ellátott szálerősítésű réteget;

- felmelegítjük, majd ezt követően lehűtjük az alakított, kötőanyaggal ellátott szálerősítésű réteget.

8. A 7. igénypont szerinti eljárás, ***azzal jellemezve***, hogy az alakított szálerősítésű réteg(ek) felmelegítését forró levegővel és/vagy infravörös sugárzással és/vagy mikrohullámú sugárzással végezzük.

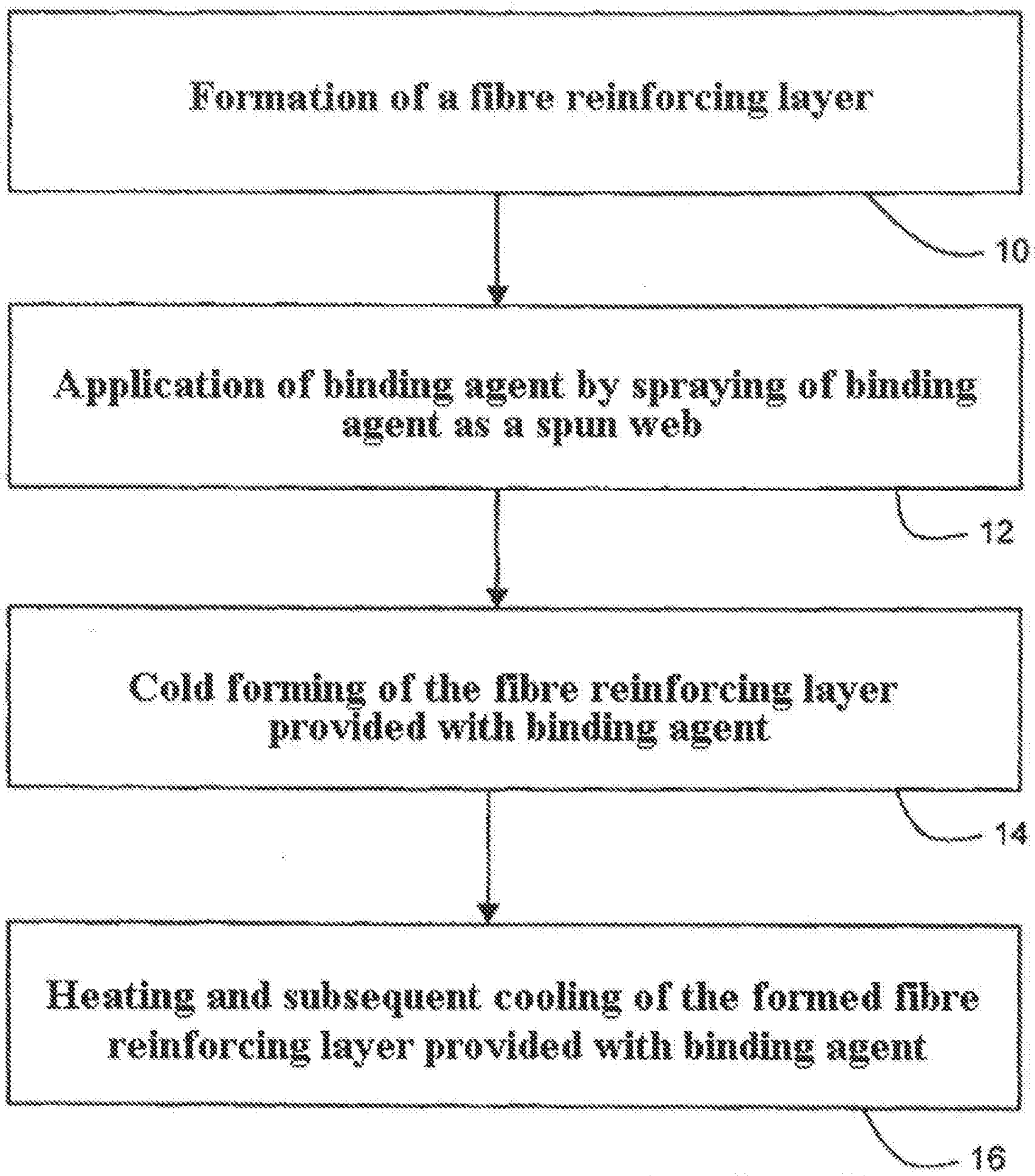
9. A 7. vagy 8. igénypont szerinti eljárás, ***azzal jellemezve***, hogy a lehűtést hideg levegővel végezzük.

10. Textil félgyártmány egy előforma előállításához egy szálerősítésű kompozit alkatrész számára, amely legalább egy szálerősítésű rétegen (503, 513) egy hosszú láncú, szobahőmérsékleten szilárd halmazállapotú reaktív gyanta alapú kötőanyagból álló fonadékkal (505, 515) rendelkezik, ***azzal jellemezve***, hogy a kötőanyag fonadékként (505, 515) a legalább egy szálerősítésű rétegre (503, 513) van felszórva.

11. A 10. igénypont szerinti textil félgyártmány, ***azzal jellemezve***, hogy 3 g/m^2 és 10 g/m^2 közötti tartományba eső területsúllyal rendelkező kötőanyag-fonadékot (505, 515) tartalmaz.

12. A 10. vagy 11. igénypont szerinti textil félgyártmány, ***azzal jellemezve***, hogy a kötőanyag-fonadék (505, 515) nem összefüggő mintában van felhordva.

Fig. 1


Formation of a fibre reinforcing layer
10
Application of binding agent by spraying of binding agent as a spun web
12
Cold forming of the fibre reinforcing layer provided with binding agent
14
Heating and subsequent cooling of the formed fibre reinforcing layer provided with binding agent
16

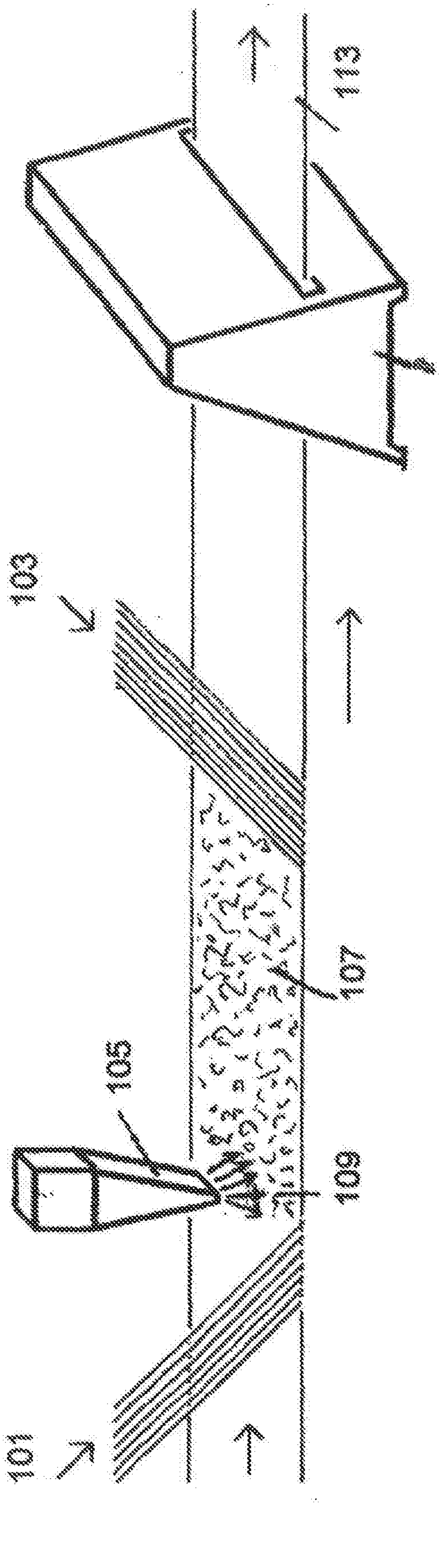


FIG. 2

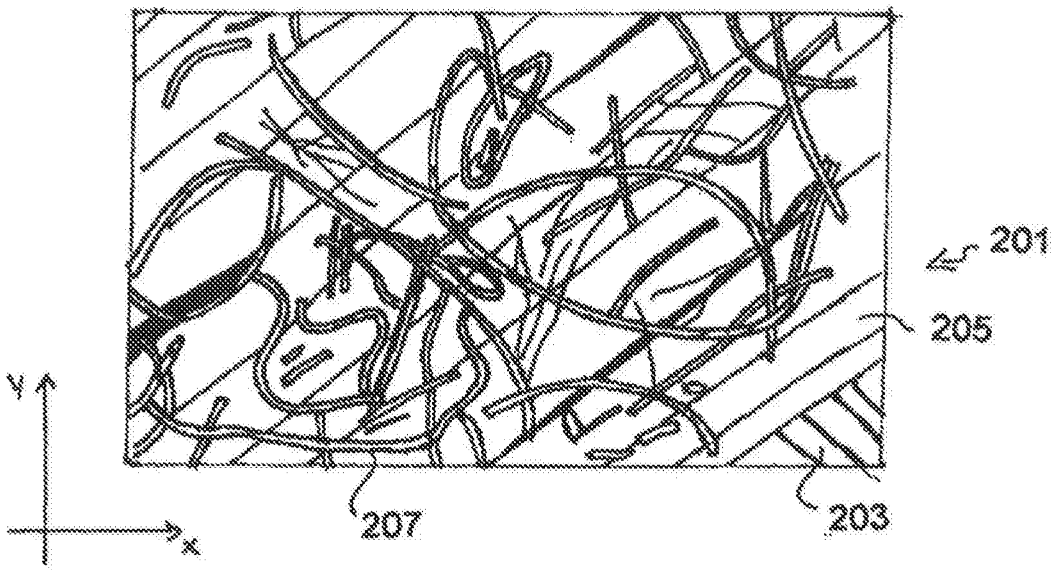


FIG. 3a

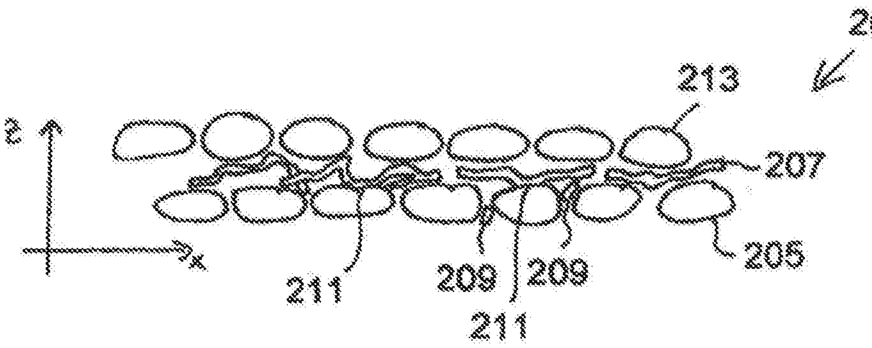
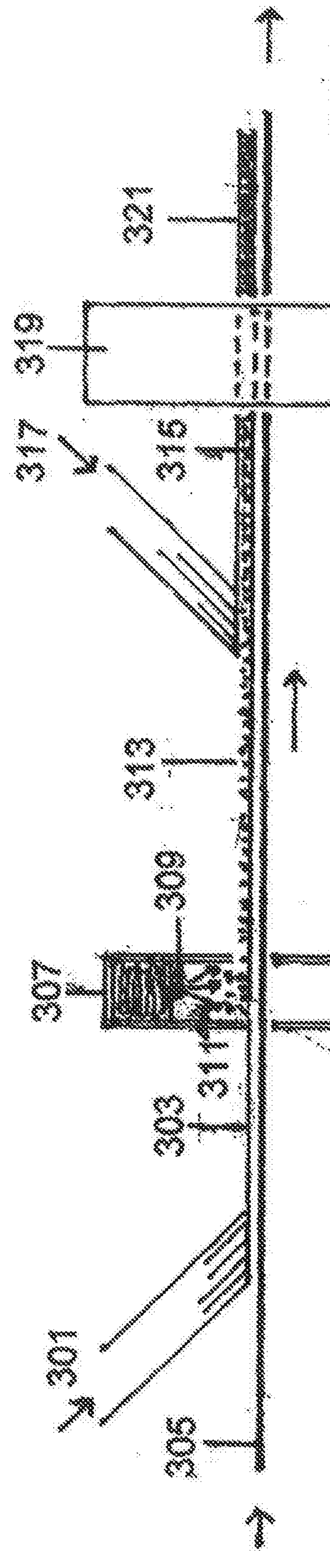


FIG. 3b


305
301
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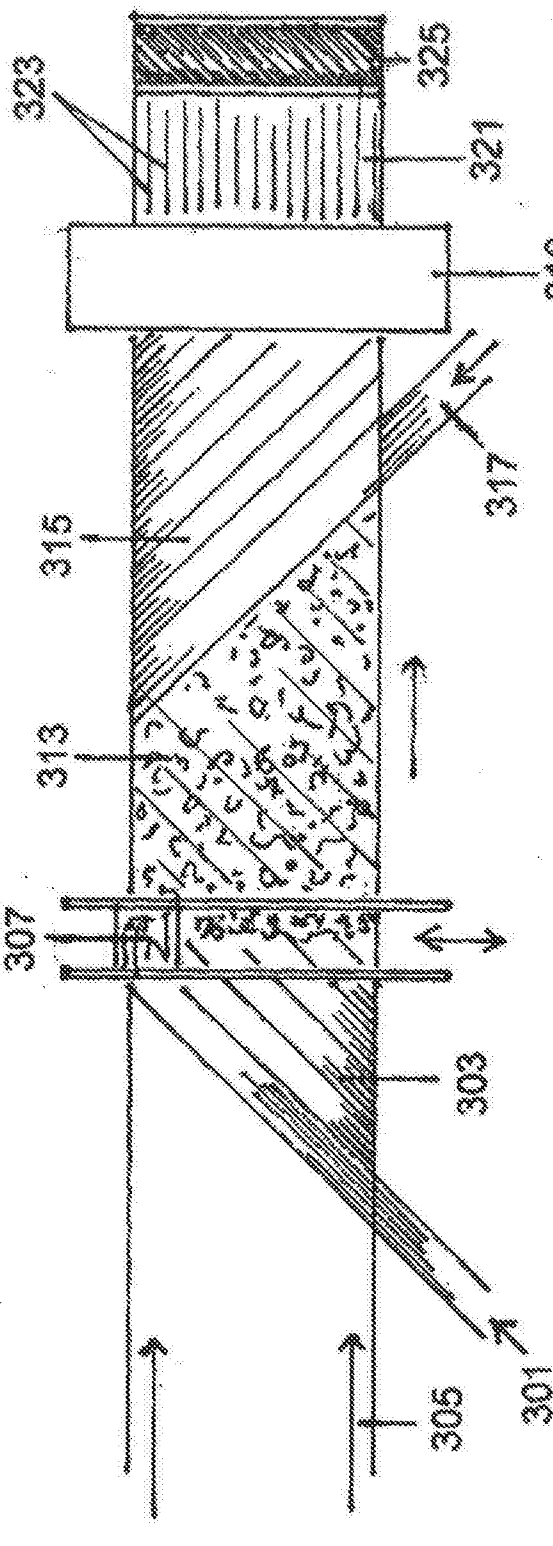
321

FIG.4a


305
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323
325

FIG.4b

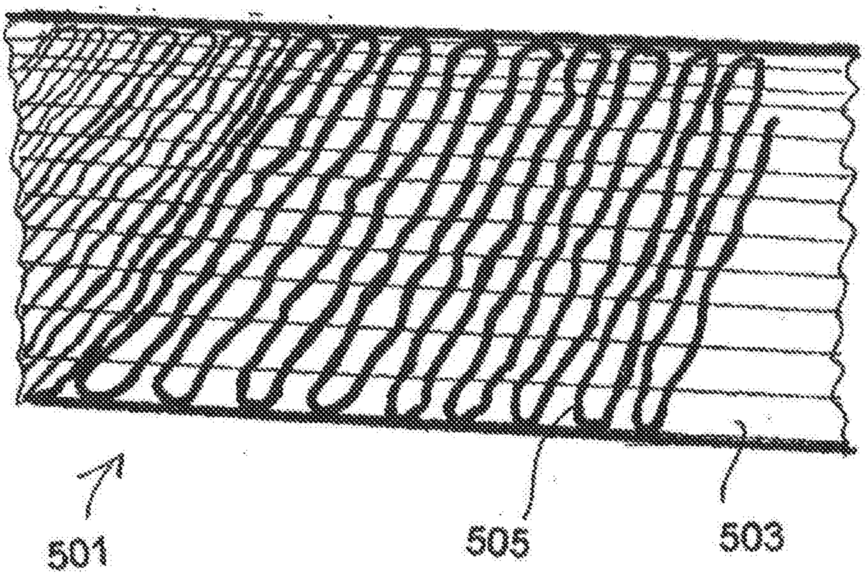

FIG.5a

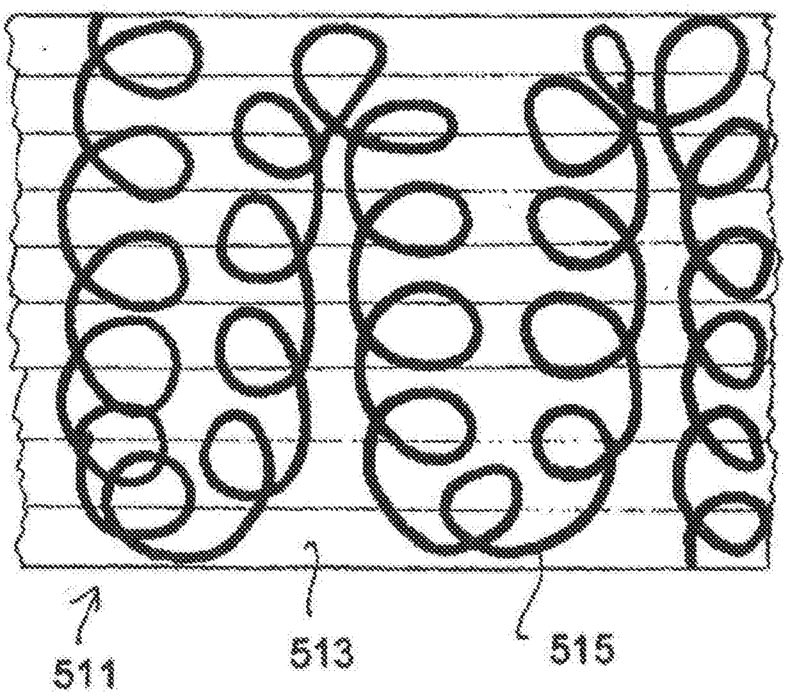

FIG.5b

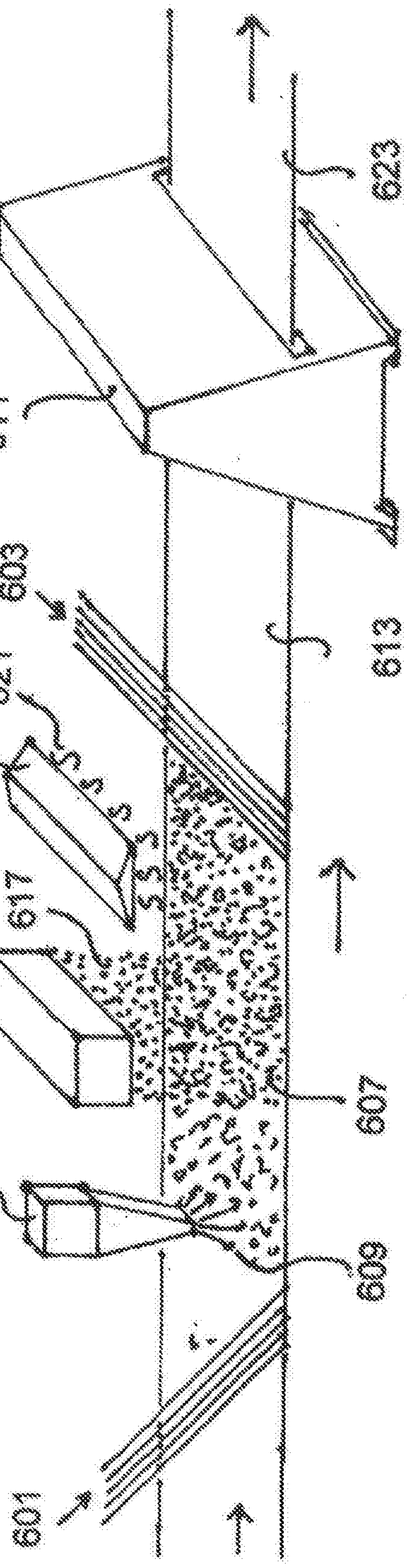

FIG.6