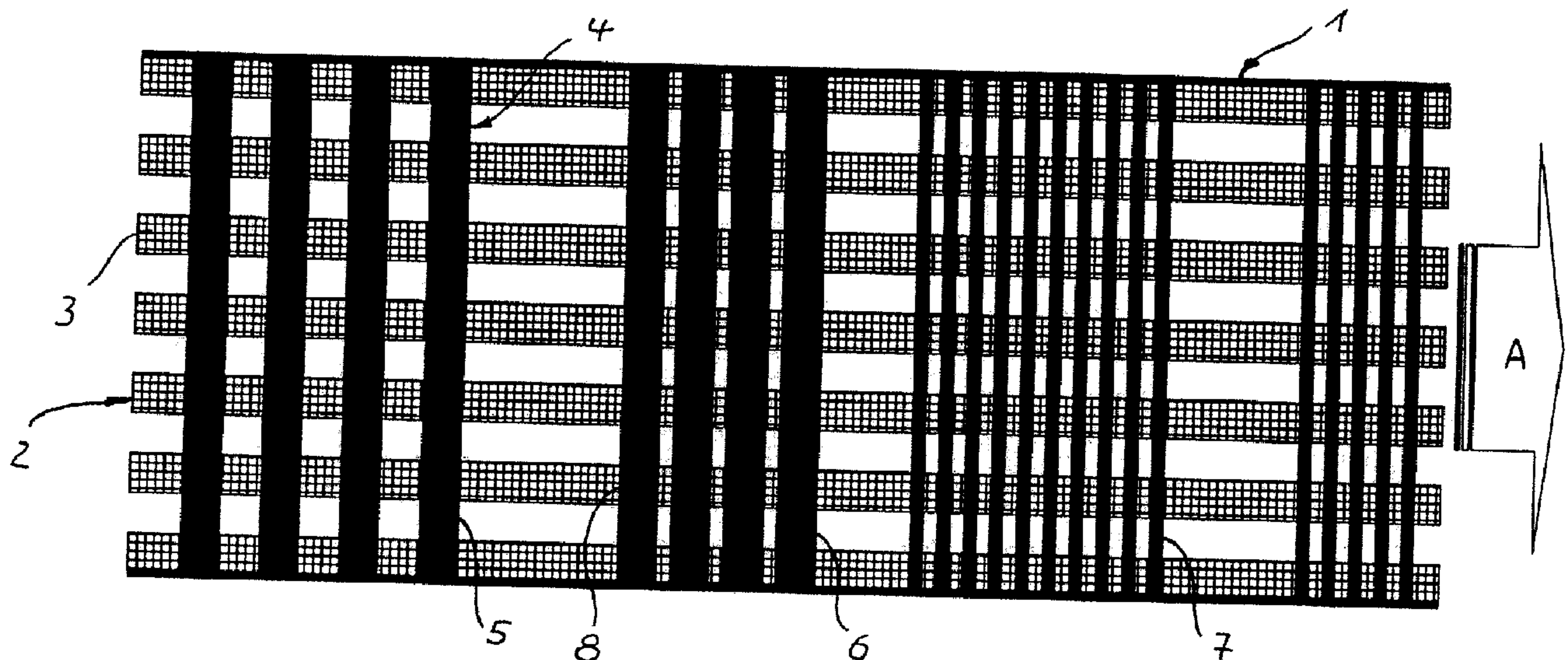




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(57) Abrégé/Abstract:

This invention relates to a porous drying screen (1, 11) for a drying section of a paper machine, comprising a filament lay-up made of at least one layer (2, 12) of longitudinal filaments (3, 13) and at least one layer (4, 14) of transverse filaments (5, 6, 7; 15) which cross the longitudinal filaments (3, 13), wherein the longitudinal and transverse filaments (3, 13; 5, 6, 7; 15) are adhesively bonded to each other via an adhesive at crossing points (8, 16). The invention further relates to a method of producing the porous drying screen of the invention.

70233-130

Abstract

This invention relates to a porous drying screen (1, 11) for a drying section of a paper machine, comprising a filament lay-up made of at least one
5 layer (2, 12) of longitudinal filaments (3, 13) and at least one layer (4, 14) of transverse filaments (5, 6, 7; 15) which cross the longitudinal filaments (3, 13), wherein the longitudinal and transverse filaments (3, 13; 5, 6, 7; 15) are adhesively bonded to each other via an adhesive at
10 crossing points (8, 16). The invention further relates to a method of producing the porous drying screen of the invention.

DescriptionHeimbach GmbH & Co., An Gut Nazareth 73, D-52353 DürenPaper machine clothing and a method of producing the same

This invention relates to porous paper machine clothing for dewatering a paper web in a paper machine, particularly as a paper machine felt or drying screen, comprising a filament lay-up made of at least one layer of longitudinal filaments and at least one layer of transverse filaments which cross the longitudinal filaments, wherein the longitudinal and transverse filaments are adhesively bonded to each other via an adhesive in the region of crossing points. The invention further relates to a method of producing porous paper machine clothing, wherein a filament lay-up is produced by arranging at least one layer of longitudinal filaments and at least one layer of transverse filaments, which cross the longitudinal filaments, one above the other, and joining the longitudinal and transverse filaments to each other using adhesive in the region of crossing points.

Porous paper machine clothing comprises long, wide belts which circulate in different parts of a paper machine and on which the paper web is conveyed through the paper machine. In the first part, which is termed the sheet forming section, a fibrous pulp is deposited on the paper machine clothing, whereupon a web of fibrous material is formed. This is dewatered through the paper machine

clothing. The paper machine clothing consists of a textile filament product which is sufficiently porous for the liquid which originates from the web of fibrous material to be conveyed away through the paper machine clothing as a result of the effect of gravity and reduced pressure. In the subsequent press section, the paper web and the paper machine clothing are passed through roll presses so that the liquid which still remains in the paper web is pressed out through the paper machine clothing. In general, the paper machine clothing is formed as a felt comprising a support made of a textile filament product. In the subsequent drying section, the paper web and the paper machine clothing are passed over heated rolls, whereby further dewatering occurs - which is more precisely termed drying in this case. In the drying section, paper machine clothing which consists of filament-containing products is mainly used, i.e. as a drying screen, which is also porous, in order to convey the vapour away via the pores.

These textile filament products are mainly formed as woven fabrics. In addition, what are termed filament lay-ups are also known, in which the filaments are not bound to each other, i.e. they are not woven to or meshed with each other. US 3,097,413 A discloses paper machine clothing such as this. It has a filament lay-up comprising a layer of longitudinal filaments which extend parallel to and at a distance from each other, and which are not joined to each other. A fibrous felt, which surrounds the

longitudinal filaments and which is needle-bonded thereto, is applied to this layer.

Paper machine clothing such as this only has a low transverse strength, however. A change has therefore been made to the use of a combination of a layer of longitudinal filaments with a layer of transverse filaments (DE 1 802 560 A; EP 0 394 293 B). In this procedure, modules consisting of a fibrous layer and of a fibrous web needle-bonded thereto are first formed, and these modules are combined and are needle-bonded again. This manner of production is not suitable for paper machine clothing which consists of one filament product only. In this situation, US 4,555,440 A proposes that the individual fibrous layers be joined to each other by binding filaments.

In particular, in the aforementioned paper machine clothing of this type, the resistance to displacement between the individual layers, and thus the dimensional stability, is unsatisfactory. If binding filaments are used, they constitute extraneous bodies and significantly complicate the manufacturing process. In order to eliminate these disadvantages, US 5,888,915 A proposes that the layers of longitudinal and transverse filaments are laid directly on each other and are fused to each other by heating at their crossing points. The pre-requisite for this, however, is that two-component filaments are used in which the filament core has a higher melting temperature than the filament cladding. Fusion occurs by heating to a temperature above the melting point of the filament

cladding and below the melting point of the filament core.

Due to the direct bonding of the filaments of the individual layers, the dimensional stability of the paper machine clothing is improved. One disadvantage, however, is that special filaments, namely two-component filaments, have to be used. These are expensive, and their material properties cannot always be adjusted in the optimum manner to suit the conditions in the respective part of the paper machine.

FR 1 571 179 A discloses paper machine clothing of this type which comprises a filament lay-up which consists of a layer of longitudinal filaments and two layers of transverse filaments which surround said layer. In order to join the longitudinal filaments to the transverse filaments, all three layers are firstly placed one above another. Thereafter, continuous strands of adhesive, which are bonded to the longitudinal filaments between the transverse filaments and which extend beyond the transverse filaments, are applied to both sides of the longitudinal filaments.

This type of adhesive bonding between the layers of the filament lay-up of the paper machine clothing has considerable disadvantages. Thus, considerable amounts of adhesive are necessary in order to produce strands of adhesive along all the longitudinal filaments, and moreover a relatively thick application of adhesive is necessary in

order to produce the bond. Furthermore, the strength of the bond in the region of the crossing points is unsatisfactory, i.e. the strength of the filament lay-up is not particularly high. In addition, the strands of adhesive are completely exposed and the surfaces thereof are therefore subject to the risk of being converted to into a slightly tacky state under the prevailing conditions of humidity and temperature in the paper machine. Contaminant particles or fibres are then deposited thereon, i.e. the filament lay-up is contaminated. Adhering particles of contaminants can even result in an impairment of the quality of the paper web.

The underlying object of the present invention is therefore to effect joining of the longitudinal and transverse filaments in paper machine clothing of the type cited at the outset so that the consumption of material which is necessary therefor is significantly reduced, the strength is improved, and the risk of contamination is considerably reduced.

A second object consists of providing a method of producing the same.

The first object is achieved according to the invention in that the adhesive is disposed between the mutually opposite faces of the longitudinal and transverse filaments and joins said faces. The basic concept of the invention is therefore to join the mutually opposite faces of the longitudinal and transverse filaments at their crossing

points via the adhesive. In this manner, the application of adhesive can be limited to these faces, whereby comparatively small amounts of adhesive are necessary. Moreover, there is no risk of contaminating the filament lay-up and thus of damaging the paper web. In addition, the joining of the mutually opposite faces by an adhesive improves the strength of the joints and thus of the filament lay-up as a whole.

Particularly suitable adhesives comprise hot-melt adhesives, the melting temperature of which is below that of the filaments, diffusion adhesives, contact adhesives and/or reaction adhesives.

In one embodiment of the invention, the longitudinal and transverse filaments are additionally positively attached to each other at crossing points, wherein each joint consists of an aperture in one filament and of a projection, which fits suitably therein, on the crossing filament, or of apertures which are mutually aligned at the crossing points and of pins which pass through said apertures, which may consist of bolts or rivets made of plastics or metal, for example. A positive attachment such as this assists the adhesive joint and imparts even more strength.

It is particularly preferred if the longitudinal and transverse filaments are formed as flat filaments with a rectangular cross-section. In this manner, surface contact occurs at the crossing points, and the area over

which the filaments are adhesively bonded to each other is considerably enlarged and is thus stronger. A range from 2 to 20 mm, preferably from 8 to 12 mm, has proved to be an advantageous width for the longitudinal and transverse filaments. The thickness should range between 0.3 and 2 mm, preferably between 0.6 and 1.2 mm, wherein the transverse filaments should have a thickness which as a maximum is the same as that of the longitudinal filaments.

In order to ensure sufficient permeability to water or vapour, particularly for very wide, flat filaments, passageway openings can be provided in the longitudinal and/or transverse filaments. The permeability can be controlled as desired by the size and number of the passageway openings, and it is also possible to arrange for the permeability to be different over the width of the paper machine clothing, e.g. for it to be higher in the middle than in the edge regions or vice versa. The passageway openings can be formed as round holes or as elongated slits.

The paper machine clothing according to the invention may comprise any number of layers, wherein each layer comprising longitudinal filaments alternates with a layer comprising transverse filaments, i.e. said layers are each adjacent to each other. An advantageous number of layers is two or three layers, wherein in the former case a lower longitudinal filament lay-up is preferably combined with an upper transverse filament lay-up, and in

the latter case each layer comprising transverse filaments is surrounded on both sides by a layer of longitudinal filaments. In this manner, a longitudinal structure is formed on the upper and lower sides. It is also possible, of course, to employ the converse procedure, so that a transverse structure exists on the upper and lower sides due to the transverse filaments which are present there.

The permeability of the paper machine clothing can also be adjusted within wide limits by the width dimensions of the longitudinal and/or transverse filaments and/or by the filament density thereof, for example. It is also possible for the longitudinal filaments to be disposed in at least one layer so that in the middle region they have a filament density which is different from that in the edge regions, and so that in particular they have a density in the middle region which is less than that in the edge regions.

With the filament lay-up according to the invention, eyelets can also be formed in a simple manner on the end faces of the paper machine clothing by wrapping round longitudinal filaments with the formation of loops, in order to form an inserted wire joint therewith. This can be effected by wrapping the end pieces of longitudinal filaments of a first layer round the end faces of the paper machine clothing with the formation of loops on the side, which is remote from said layer, of the layer comprising transverse filaments, and fixing them to a plu-

rality of said transverse filaments, preferably to at least five transverse filaments. The end pieces can also be fixed to the longitudinal filaments themselves, however. In both cases, fixation can be effected positively, e.g. by means of pins or rivets made of plastics or metal.

Loop formation should advantageously be affected only with part of the longitudinal filaments, so that the loops of the two end edges fit into each other in the manner of combs and can thus form a passageway channel for an inserted wire. In an alternating manner, at least one end piece should preferably be looped round with the formation of a loop, and at least one end piece should end at the respective outer transverse filament without the formation of a loop. So that the permeability in this region is not impaired, longitudinal filaments from a second layer, which is seated against the layer comprising transverse filaments, should adjoin the ends of the end pieces, i.e. these longitudinal filaments should abut the end pieces flush therewith, but should not overlap them, so that there is no densification of longitudinal filaments in this region.

In principle, there are no limitations with regard to the material of the filaments; they should have a high tensile strength, a low elongation and a high initial modulus. Examples of suitable materials include PET, PA in all modifications, PPS, PEK, PEEK, elastic polyesters, PBT or PTT or combinations thereof. The filaments can be rein-

forced, e.g. fibre-reinforced with glass fibres, carbon fibres and/or ceramic fibres, wherein the fibres can also be present as short chopped fibres.

The paper machine clothing according to the invention can be used in all parts of a paper machine, and due to its flexibility can be adapted in the optimum manner to the respective requirements in these parts. Constructions in which the paper machine clothing consists of a filament lay-up are particularly suitable for use in the sheet forming and drying sections. This does not rule out the combination of a filament lay-up with other components, for example with a fibrous felt. For the press section, it is recommended that the filament lay-up according to the invention is used as a support and is provided on one or both sides with a fibrous layer, for example by the needle-bonding or laminating of fibrous felts or spun felts to one or both sides, for example.

In order to produce the paper machine clothing described above, a method is proposed according to the invention in which the adhesive is disposed between the mutually opposite faces of the longitudinal and transverse filaments for the purpose of joining said faces.

According to a further feature of the invention, provision is made for the longitudinal and transverse filaments to be additionally positively attached to each other at crossing points, e.g. by the interlocking of a projection on one filament with a complementary aperture

on the crossing filament, or by means of inserting a pin, such as a bolt or rivet, in aligned apertures in the filaments. The joint at the crossing points is thereby further strengthened.

In detail, the filament lay-up can be produced by firstly clamping longitudinal filaments parallel to each other, for example between two parallel filament beams, and then laying transverse filaments, individually or in groups, successively on said longitudinal filaments and adhesively bonding longitudinal and transverse filaments to each other at the crossing points, wherein a positive joint can be produced in addition by pushing connecting pins into holes which are aligned at the crossing points, or by pushing a projection on one filament into a complementary aperture in the other filament.

If a felt is to be formed, for example for use in the press section of a paper machine, a fibrous layer should be applied to one or both sides of the filament lay-up and fixed thereto. Fixing can be effected by means of needle-bonding, adhesive bonding, or contact fusion.

It should be understood that the transverse filaments do not have to extend perpendicularly to the longitudinal filaments, but that filament lay-ups can also be produced by the method according to the invention in which the transverse filaments extend obliquely to the longitudinal filaments. At the same time, two layers of transverse filaments can also be provided in which the transverse

70233-130

12

filaments of one layer cross the longitudinal filaments at a different angle to that of the other layer.

In accordance with one aspect of the present invention there is provided porous drying screen for a drying section of a paper machine, comprising a filament lay-up comprising at least one layer of longitudinal filaments and at least one layer of transverse filaments which cross the longitudinal filaments, wherein the longitudinal filaments comprise edge regions and a middle region, and wherein the longitudinal and transverse filaments are comprised of thermoplastic material and are adhesively bonded to each other by an adhesive at crossing points between the longitudinal and transverse filaments and characterized in that the longitudinal and transverse filaments are flat filaments and the adhesive is applied solely to mutually opposite faces of the longitudinal and transverse filaments.

In accordance with a second aspect of the present invention there is provided a method of producing a porous dryer screen for a dryer section of a paper machine wherein a filament lay-up is produced by arranging at least one layer of longitudinal filaments and at least one layer of transverse filaments, which cross the longitudinal filaments, one above the other, and wherein the longitudinal and transverse filaments are comprised of thermoplastic material and are joined to each other by adhesive at crossing points between the longitudinal and transverse filaments and characterized in that flat filaments are used for the longitudinal and transverse filaments and that adhesive is disposed between the mutually opposite faces of the longitudinal and transverse filaments for the purpose of joining said faces.

70233-130

12a

The invention is illustrated in more detail, with reference to examples of embodiments, in the drawings, where:

Figure 1 is a schematic plan view of the paper machine clothing;

Figure 2 is a side view of the paper machine clothing shown in Figure 1;

Figure 3 is a cross-section through the paper machine clothing shown in Figures 1 and 2;

Figure 4 is an enlarged side view of the paper machine clothing shown in Figures 1 to 3;

Figure 5 is a plan view of part of the paper machine clothing with additional positive attachment of the filaments; and

Figure 6 is a partial cross-section through the paper machine clothing shown in Figure 5.

The paper machine clothing 1 illustrated in Figures 1 to 4 consists of a filament lay-up, the lower layer 2 of which is formed by longitudinal filaments - denoted by 3, for example. As can be seen in particular from Figure 3, the longitudinal filaments 3 have a rectangular cross-

section and are at identical spacings from each other. For the production process, the left-hand ends of the longitudinal filaments are wound on a filament beam, which is not shown here. A second beam, which is likewise not shown here, but on which the finished paper machine clothing 1 is wound up, is provided on the right-hand side. The paper machine clothing 1 is moved in this direction (arrow A).

An upper layer 4 comprising mutually parallel transverse filaments - denoted by 5, 6, 7, for example - is laid on the lower layer 2. The transverse filaments 5 are disposed at a wide spacing which substantially corresponds to the spacing between the longitudinal filaments 3, whilst the transverse filaments 6 are disposed at a narrow spacing for the purpose of reducing the permeability of the paper machine clothing 1, and the transverse filaments 7 are likewise disposed at a narrow spacing but have a width which is substantially less than that of the transverse filaments 5, 6. It should be understood that these differences are not present on actual paper machine clothing, i.e. identical transverse filaments are used at identical spacings from each other. The object of the illustration in the form shown here is to emphasise that the method according to the invention enables very different types of longitudinal and transverse filaments 3, 5, 6, 7 and filament densities to be employed. The same applies to the longitudinal filaments 3, wherein it is also possible here for the spacings thereof to be varied over the width thereof, e.g. to provide a filament den-

sity in the middle region which is less than that in the two end regions, or vice versa.

In order to produce the paper machine clothing 1 the longitudinal filaments 3 are clamped between the two beams, and the transverse filaments 5, 6, 7 are then laid over the longitudinal filaments 3. This can be effected by machine, using a transverse table apparatus such as that which is known in principle from US-A-3,097,413 for example. In order to join the transverse filaments 5, 6, 7 to the longitudinal filaments 3, they are adhesively bonded to each other at their crossing points - denoted by 8, for example - by a layer of adhesive -denoted by 10, for example. The adhesive can be applied to the longitudinal and/or transverse filaments 3, 5, 6, 7 as spots or two-dimensionally, wherein in the latter case it should be possible subsequently to remove the adhesive, for example with the aid of a solvent which is applied to the finished paper machine clothing. In addition, a plate can be laid on the upper layer 4, e.g. a glass plate which presses the transverse filaments 5, 6, 7 on to the longitudinal filaments 3 and thus prevents displacement between the two until the adhesive bond has become solid.

Figures 5 and 6 show portions of a different paper machine clothing 11 comprising a lower layer 12 made of longitudinal filaments - denoted by 13 for example - and an upper layer 14 made of transverse filaments - denoted by 15 for example. It should be understood that a multiplicity of a longitudinal filaments 13 is present, and

that the transverse filaments 15 extend over the entire width of the paper machine clothing 11.

The longitudinal and transverse filaments 13, 15 likewise have a rectangular cross-section here, wherein the transverse filaments 15 are flatter than the longitudinal filaments 13. At their crossing points - denoted by 16, for example - the longitudinal and transverse filaments 13, 15 are positively joined to each other via connecting pins - denoted by 17, for example - which each pass through mutually aligned holes - denoted by 18, 19, for example - in the longitudinal and transverse filaments 13, 15. Instead of this, however, the connecting pins 17 can also be integrally formed on the longitudinal filaments 13 or on the transverse filaments 15, so that only the respective other filaments comprise holes into which the connecting pins 17 are then pushed.

The positive joint ensures additional fixing of the longitudinal and transverse filaments 13, 15 at their crossing points 16, and assists the joint which is formed by means of layers of adhesive - denoted by 20, for example.

DescriptionHeimbach GmbH & Co., An Gut Nazareth 73, D-52353 DürenPaper machine clothing and a method of producing the same

This invention relates to porous paper machine clothing for dewatering a paper web in a paper machine, particularly as a paper machine felt or drying screen, comprising a filament lay-up made of at least one layer of longitudinal filaments and at least one layer of transverse filaments which cross the longitudinal filaments, wherein the longitudinal and transverse filaments are adhesively bonded to each other via an adhesive in the region of crossing points. The invention further relates to a method of producing porous paper machine clothing, wherein a filament lay-up is produced by arranging at least one layer of longitudinal filaments and at least one layer of transverse filaments, which cross the longitudinal filaments, one above the other, and joining the longitudinal and transverse filaments to each other using adhesive in the region of crossing points.

Porous paper machine clothing comprises long, wide belts which circulate in different parts of a paper machine and on which the paper web is conveyed through the paper machine. In the first part, which is termed the sheet forming section, a fibrous pulp is deposited on the paper machine clothing, whereupon a web of fibrous material is formed. This is dewatered through the paper machine

clothing. The paper machine clothing consists of a textile filament product which is sufficiently porous for the liquid which originates from the web of fibrous material to be conveyed away through the paper machine clothing as a result of the effect of gravity and reduced pressure. In the subsequent press section, the paper web and the paper machine clothing are passed through roll presses so that the liquid which still remains in the paper web is pressed out through the paper machine clothing. In general, the paper machine clothing is formed as a felt comprising a support made of a textile filament product. In the subsequent drying section, the paper web and the paper machine clothing are passed over heated rolls, whereby further dewatering occurs - which is more precisely termed drying in this case. In the drying section, paper machine clothing which consists of filament-containing products is mainly used, i.e. as a drying screen, which is also porous, in order to convey the vapour away via the pores.

These textile filament products are mainly formed as woven fabrics. In addition, what are termed filament lay-ups are also known, in which the filaments are not bound to each other, i.e. they are not woven to or meshed with each other. US 3,097,413 A discloses paper machine clothing such as this. It has a filament lay-up comprising a layer of longitudinal filaments which extend parallel to and at a distance from each other, and which are not joined to each other. A fibrous felt, which surrounds the

longitudinal filaments and which is needle-bonded thereto, is applied to this layer.

Paper machine clothing such as this only has a low transverse strength, however. A change has therefore been made to the use of a combination of a layer of longitudinal filaments with a layer of transverse filaments (DE 1 802 560 A; EP 0 394 293 B). In this procedure, modules consisting of a fibrous layer and of a fibrous web needle-bonded thereto are first formed, and these modules are combined and are needle-bonded again. This manner of production is not suitable for paper machine clothing which consists of one filament product only. In this situation, US 4,555,440 A proposes that the individual fibrous layers be joined to each other by binding filaments.

In particular, in the aforementioned paper machine clothing of this type, the resistance to displacement between the individual layers, and thus the dimensional stability, is unsatisfactory. If binding filaments are used, they constitute extraneous bodies and significantly complicate the manufacturing process. In order to eliminate these disadvantages, US 5,888,915 A proposes that the layers of longitudinal and transverse filaments are laid directly on each other and are fused to each other by heating at their crossing points. The pre-requisite for this, however, is that two-component filaments are used in which the filament core has a higher melting temperature than the filament cladding. Fusion occurs by heating to a temperature above the melting point of the filament

cladding and below the melting point of the filament core.

Due to the direct bonding of the filaments of the individual layers, the dimensional stability of the paper machine clothing is improved. One disadvantage, however, is that special filaments, namely two-component filaments, have to be used. These are expensive, and their material properties cannot always be adjusted in the optimum manner to suit the conditions in the respective part of the paper machine.

FR 1 571 179 A discloses paper machine clothing of this type which comprises a filament lay-up which consists of a layer of longitudinal filaments and two layers of transverse filaments which surround said layer. In order to join the longitudinal filaments to the transverse filaments, all three layers are firstly placed one above another. Thereafter, continuous strands of adhesive, which are bonded to the longitudinal filaments between the transverse filaments and which extend beyond the transverse filaments, are applied to both sides of the longitudinal filaments.

This type of adhesive bonding between the layers of the filament lay-up of the paper machine clothing has considerable disadvantages. Thus, considerable amounts of adhesive are necessary in order to produce strands of adhesive along all the longitudinal filaments, and moreover a relatively thick application of adhesive is necessary in

order to produce the bond. Furthermore, the strength of the bond in the region of the crossing points is unsatisfactory, i.e. the strength of the filament lay-up is not particularly high. In addition, the strands of adhesive are completely exposed and the surfaces thereof are therefore subject to the risk of being converted to into a slightly tacky state under the prevailing conditions of humidity and temperature in the paper machine. Contaminant particles or fibres are then deposited thereon, i.e. the filament lay-up is contaminated. Adhering particles of contaminants can even result in an impairment of the quality of the paper web.

The underlying object of the present invention is therefore to effect joining of the longitudinal and transverse filaments in paper machine clothing of the type cited at the outset so that the consumption of material which is necessary therefor is significantly reduced, the strength is improved, and the risk of contamination is considerably reduced.

A second object consists of providing a method of producing the same.

The first object is achieved according to the invention in that the adhesive is disposed between the mutually opposite faces of the longitudinal and transverse filaments and joins said faces. The basic concept of the invention is therefore to join the mutually opposite faces of the longitudinal and transverse filaments at their crossing

points via the adhesive. In this manner, the application of adhesive can be limited to these faces, whereby comparatively small amounts of adhesive are necessary. Moreover, there is no risk of contaminating the filament lay-up and thus of damaging the paper web. In addition, the joining of the mutually opposite faces by an adhesive improves the strength of the joints and thus of the filament lay-up as a whole.

Particularly suitable adhesives comprise hot-melt adhesives, the melting temperature of which is below that of the filaments, diffusion adhesives, contact adhesives and/or reaction adhesives.

In one embodiment of the invention, the longitudinal and transverse filaments are additionally positively attached to each other at crossing points, wherein each joint consists of an aperture in one filament and of a projection, which fits suitably therein, on the crossing filament, or of apertures which are mutually aligned at the crossing points and of pins which pass through said apertures, which may consist of bolts or rivets made of plastics or metal, for example. A positive attachment such as this assists the adhesive joint and imparts even more strength.

It is particularly preferred if the longitudinal and transverse filaments are formed as flat filaments with a rectangular cross-section. In this manner, surface contact occurs at the crossing points, and the area over

which the filaments are adhesively bonded to each other is considerably enlarged and is thus stronger. A range from 2 to 20 mm, preferably from 8 to 12 mm, has proved to be an advantageous width for the longitudinal and transverse filaments. The thickness should range between 0.3 and 2 mm, preferably between 0.6 and 1.2 mm, wherein the transverse filaments should have a thickness which as a maximum is the same as that of the longitudinal filaments.

In order to ensure sufficient permeability to water or vapour, particularly for very wide, flat filaments, passageway openings can be provided in the longitudinal and/or transverse filaments. The permeability can be controlled as desired by the size and number of the passageway openings, and it is also possible to arrange for the permeability to be different over the width of the paper machine clothing, e.g. for it to be higher in the middle than in the edge regions or vice versa. The passageway openings can be formed as round holes or as elongated slits.

The paper machine clothing according to the invention may comprise any number of layers, wherein each layer comprising longitudinal filaments alternates with a layer comprising transverse filaments, i.e. said layers are each adjacent to each other. An advantageous number of layers is two or three layers, wherein in the former case a lower longitudinal filament lay-up is preferably combined with an upper transverse filament lay-up, and in

the latter case each layer comprising transverse filaments is surrounded on both sides by a layer of longitudinal filaments. In this manner, a longitudinal structure is formed on the upper and lower sides. It is also possible, of course, to employ the converse procedure, so that a transverse structure exists on the upper and lower sides due to the transverse filaments which are present there.

The permeability of the paper machine clothing can also be adjusted within wide limits by the width dimensions of the longitudinal and/or transverse filaments and/or by the filament density thereof, for example. It is also possible for the longitudinal filaments to be disposed in at least one layer so that in the middle region they have a filament density which is different from that in the edge regions, and so that in particular they have a density in the middle region which is less than that in the edge regions.

With the filament lay-up according to the invention, eyelets can also be formed in a simple manner on the end faces of the paper machine clothing by wrapping round longitudinal filaments with the formation of loops, in order to form an inserted wire joint therewith. This can be effected by wrapping the end pieces of longitudinal filaments of a first layer round the end faces of the paper machine clothing with the formation of loops on the side, which is remote from said layer, of the layer comprising transverse filaments, and fixing them to a plu-

rality of said transverse filaments, preferably to at least five transverse filaments. The end pieces can also be fixed to the longitudinal filaments themselves, however. In both cases, fixation can be effected positively, e.g. by means of pins or rivets made of plastics or metal.

Loop formation should advantageously be affected only with part of the longitudinal filaments, so that the loops of the two end edges fit into each other in the manner of combs and can thus form a passageway channel for an inserted wire. In an alternating manner, at least one end piece should preferably be looped round with the formation of a loop, and at least one end piece should end at the respective outer transverse filament without the formation of a loop. So that the permeability in this region is not impaired, longitudinal filaments from a second layer, which is seated against the layer comprising transverse filaments, should adjoin the ends of the end pieces, i.e. these longitudinal filaments should abut the end pieces flush therewith, but should not overlap them, so that there is no densification of longitudinal filaments in this region.

In principle, there are no limitations with regard to the material of the filaments; they should have a high tensile strength, a low elongation and a high initial modulus. Examples of suitable materials include PET, PA in all modifications, PPS, PEK, PEEK, elastic polyesters, PBT or PTT or combinations thereof. The filaments can be rein-

forced, e.g. fibre-reinforced with glass fibres, carbon fibres and/or ceramic fibres, wherein the fibres can also be present as short chopped fibres.

The paper machine clothing according to the invention can be used in all parts of a paper machine, and due to its flexibility can be adapted in the optimum manner to the respective requirements in these parts. Constructions in which the paper machine clothing consists of a filament lay-up are particularly suitable for use in the sheet forming and drying sections. This does not rule out the combination of a filament lay-up with other components, for example with a fibrous felt. For the press section, it is recommended that the filament lay-up according to the invention is used as a support and is provided on one or both sides with a fibrous layer, for example by the needle-bonding or laminating of fibrous felts or spun felts to one or both sides, for example.

In order to produce the paper machine clothing described above, a method is proposed according to the invention in which the adhesive is disposed between the mutually opposite faces of the longitudinal and transverse filaments for the purpose of joining said faces.

According to a further feature of the invention, provision is made for the longitudinal and transverse filaments to be additionally positively attached to each other at crossing points, e.g. by the interlocking of a projection on one filament with a complementary aperture

on the crossing filament, or by means of inserting a pin, such as a bolt or rivet, in aligned apertures in the filaments. The joint at the crossing points is thereby further strengthened.

In detail, the filament lay-up can be produced by firstly clamping longitudinal filaments parallel to each other, for example between two parallel filament beams, and then laying transverse filaments, individually or in groups, successively on said longitudinal filaments and adhesively bonding longitudinal and transverse filaments to each other at the crossing points, wherein a positive joint can be produced in addition by pushing connecting pins into holes which are aligned at the crossing points, or by pushing a projection on one filament into a complementary aperture in the other filament.

If a felt is to be formed, for example for use in the press section of a paper machine, a fibrous layer should be applied to one or both sides of the filament lay-up and fixed thereto. Fixing can be effected by means of needle-bonding, adhesive bonding, or contact fusion.

It should be understood that the transverse filaments do not have to extend perpendicularly to the longitudinal filaments, but that filament lay-ups can also be produced by the method according to the invention in which the transverse filaments extend obliquely to the longitudinal filaments. At the same time, two layers of transverse filaments can also be provided in which the transverse

filaments of one layer cross the longitudinal filaments at a different angle to that of the other layer.

The invention is illustrated in more detail, with reference to examples of embodiments, in the drawings, where:

Figure 1 is a schematic plan view of the paper machine clothing;

Figure 2 is a side view of the paper machine clothing shown in Figure 1;

Figure 3 is a cross-section through the paper machine clothing shown in Figures 1 and 2;

Figure 4 is an enlarged side view of the paper machine clothing shown in Figures 1 to 3;

Figure 5 is a plan view of part of the paper machine clothing with additional positive attachment of the filaments; and

Figure 6 is a partial cross-section through the paper machine clothing shown in Figure 5.

The paper machine clothing 1 illustrated in Figures 1 to 4 consists of a filament lay-up, the lower layer 2 of which is formed by longitudinal filaments - denoted by 3, for example. As can be seen in particular from Figure 3, the longitudinal filaments 3 have a rectangular cross-

section and are at identical spacings from each other. For the production process, the left-hand ends of the longitudinal filaments are wound on a filament beam, which is not shown here. A second beam, which is likewise not shown here, but on which the finished paper machine clothing 1 is wound up, is provided on the right-hand side. The paper machine clothing 1 is moved in this direction (arrow A).

An upper layer 4 comprising mutually parallel transverse filaments - denoted by 5, 6, 7, for example - is laid on the lower layer 2. The transverse filaments 5 are disposed at a wide spacing which substantially corresponds to the spacing between the longitudinal filaments 3, whilst the transverse filaments 6 are disposed at a narrow spacing for the purpose of reducing the permeability of the paper machine clothing 1, and the transverse filaments 7 are likewise disposed at a narrow spacing but have a width which is substantially less than that of the transverse filaments 5, 6. It should be understood that these differences are not present on actual paper machine clothing, i.e. identical transverse filaments are used at identical spacings from each other. The object of the illustration in the form shown here is to emphasise that the method according to the invention enables very different types of longitudinal and transverse filaments 3, 5, 6, 7 and filament densities to be employed. The same applies to the longitudinal filaments 3, wherein it is also possible here for the spacings thereof to be varied over the width thereof, e.g. to provide a filament den-

sity in the middle region which is less than that in the two end regions, or vice versa.

In order to produce the paper machine clothing 1 the longitudinal filaments 3 are clamped between the two beams, and the transverse filaments 5, 6, 7 are then laid over the longitudinal filaments 3. This can be effected by machine, using a transverse table apparatus such as that which is known in principle from US-A-3,097,413 for example. In order to join the transverse filaments 5, 6, 7 to the longitudinal filaments 3, they are adhesively bonded to each other at their crossing points - denoted by 8, for example - by a layer of adhesive -denoted by 10, for example. The adhesive can be applied to the longitudinal and/or transverse filaments 3, 5, 6, 7 as spots or two-dimensionally, wherein in the latter case it should be possible subsequently to remove the adhesive, for example with the aid of a solvent which is applied to the finished paper machine clothing. In addition, a plate can be laid on the upper layer 4, e.g. a glass plate which presses the transverse filaments 5, 6, 7 on to the longitudinal filaments 3 and thus prevents displacement between the two until the adhesive bond has become solid.

Figures 5 and 6 show portions of a different paper machine clothing 11 comprising a lower layer 12 made of longitudinal filaments - denoted by 13 for example - and an upper layer 14 made of transverse filaments - denoted by 15 for example. It should be understood that a multiplicity of a longitudinal filaments 13 is present, and

that the transverse filaments 15 extend over the entire width of the paper machine clothing 11.

The longitudinal and transverse filaments 13, 15 likewise have a rectangular cross-section here, wherein the transverse filaments 15 are flatter than the longitudinal filaments 13. At their crossing points - denoted by 16, for example - the longitudinal and transverse filaments 13, 15 are positively joined to each other via connecting pins - denoted by 17, for example - which each pass through mutually aligned holes - denoted by 18, 19, for example - in the longitudinal and transverse filaments 13, 15. Instead of this, however, the connecting pins 17 can also be integrally formed on the longitudinal filaments 13 or on the transverse filaments 15, so that only the respective other filaments comprise holes into which the connecting pins 17 are then pushed.

The positive joint ensures additional fixing of the longitudinal and transverse filaments 13, 15 at their crossing points 16, and assists the joint which is formed by means of layers of adhesive - denoted by 20, for example.

70233-130

16

CLAIMS:

1. Porous drying screen for a drying section of a paper machine, comprising a filament lay-up comprising at least one layer of longitudinal filaments and at least one
5 layer of transverse filaments which cross the longitudinal filaments, wherein the longitudinal filaments comprise edge regions and a middle region, and wherein the longitudinal and transverse filaments are comprised of thermoplastic material and are adhesively bonded to each other by an
10 adhesive at crossing points between the longitudinal and transverse filaments and characterized in that the longitudinal and transverse filaments are flat filaments and the adhesive is applied solely to mutually opposite faces of the longitudinal and transverse filaments.
- 15 2. The porous drying screen according to claim 1, wherein the adhesive is at least one of a hot-melt adhesive, a diffusion adhesive, a contact adhesive or a reaction adhesive.
3. The porous drying screen according to claim 1
20 or 2, wherein the longitudinal and transverse filaments are further attached to each other at the crossing points, said crossing points forming joints.
4. The porous drying screen according to claim 3,
25 wherein each joint comprises an aperture in one of the longitudinal filament or the transverse filament and a projection extending from the other of said longitudinal or transverse filament, said projection fitting within said aperture.
5. The porous drying screen according to claim 3,
30 wherein each joint consists of mutually aligned apertures in

70233-130

17

the filaments and of a pin which passes through the mutually aligned apertures.

6. The porous drying screen according to any one of claims 1 to 5, wherein the longitudinal and transverse
5 filaments are formed as flat filaments with a rectangular cross-section.

7. The porous drying screen according to claim 6, wherein the longitudinal and transverse filaments have a width of 2 to 20 mm.

10 8. The porous drying screen according to claim 6, wherein the longitudinal and transverse filaments have a width of 8 to 12 mm.

9. The porous drying screen according to any one of claims 1 to 8, wherein said longitudinal filaments have a
15 width in the middle region of said longitudinal filaments which differs from that in said longitudinal filament edge regions.

10. The porous drying screen according to any one of claims 6 to 9, wherein the longitudinal and transverse
20 filaments have a height of 0.3 to 2mm.

11. The porous drying screen according to any one of claims 6 to 10, wherein the transverse filaments have a maximum thickness which is the same as that of the longitudinal filaments.

25 12. The porous drying screen according to any one of claims 1 to 11, wherein the longitudinal and transverse filaments comprise openings, which openings comprise holes or slits.

70233-130

18

13. The porous drying screen according to any one of claims 1 to 11 wherein the longitudinal or transverse filaments comprise openings which openings comprise holes or slits.

5 14. The porous drying screen according to any one of claims 1 to 13, comprising at least three layers and wherein at least one layer comprising longitudinal filaments is adjacent to at least one layer comprising transverse filaments.

10 15. The porous drying screen according to claim 14, wherein each layer comprising transverse filaments is surrounded on both sides by a layer of longitudinal filaments.

15 16. The porous drying screen according to any one of claims 1 to 15, wherein at least one layer comprising said longitudinal filaments has a filament density in said longitudinal filaments' middle region which differs from a filament density in said longitudinal filaments' edge regions.

20 17. The porous drying screen according to any one of claims 1 to 16, wherein the longitudinal filaments comprise end pieces, and said end pieces of said longitudinal filaments are wrapped around and fixed to an end face of the drying screen with the formation of loops.

25 18. The porous drying screen according to claim 17, wherein the end pieces are fixed to transverse filaments on a side of the layer comprising transverse filaments which is remote from the layer comprising the longitudinal filaments.

70233-130

19

19. The porous drying screen according to claim 17, wherein the end pieces are fixed to the longitudinal filaments.

20. The porous drying screen according to any one of
5 claims 17 to 19, wherein non-loop-forming end pieces of the longitudinal filaments are each fixed to a last of said transverse filaments on said end face of said drying screen.

21. The porous drying screen according to any one of
10 claims 17 to 20, wherein at least one end piece is wrapped round with the formation of a loop, and at least one end piece ends at an outer edge of the last transverse filament on the end face of the drying screen.

22. The porous drying screen according to any one of
15 claims 17 or 21, wherein the longitudinal filaments of a second layer comprising longitudinal filaments, which is seated against a layer comprising transverse filaments, adjoin the ends of the end pieces.

23. The porous drying screen according to any one of
20 claims 1 to 22, wherein the longitudinal and transverse filaments are comprised of PET, PA, PPS, PEK, PEEK, an elastic polyester, PBT, PTT, or a combination thereof.

24. The porous drying screen according to any one of
claims 1 to 23, wherein at least one of the longitudinal and transverse filaments are fibre-reinforced.

25 25. The porous drying screen according to any one of
claims 1 to 24, wherein a fibrous layer is provided on at least one side of the filament lay-up.

70233-130

20

26. A method of producing a porous dryer screen for a dryer section of a paper machine wherein a filament lay-up is produced by arranging at least one layer of longitudinal filaments and at least one layer of transverse filaments, which cross the longitudinal filaments, one above the other, and wherein the longitudinal and transverse filaments are comprised of thermoplastic material and are joined to each other by an adhesive at crossing points between the longitudinal and transverse filaments and characterized in that flat filaments are used for the longitudinal and transverse filaments and that adhesive is disposed between the mutually opposite faces of the longitudinal and transverse filaments for the purpose of joining said faces.

27. The method according to claim 26, wherein the longitudinal and transverse filaments are further attached to each other at crossing points.

28. The method according to claim 26 or 27, wherein the longitudinal filaments are clamped parallel to each other, and the transverse filaments are then laid, individually or in groups, successively on said longitudinal filaments and are fixed to a first side of the longitudinal filaments, and that the filament lay-up is conveyed in a longitudinal direction and is then rolled up.

29. The method according to claim 28, wherein the transverse filaments are further fixed, simultaneous with or subsequent to fixing to the first side of the longitudinal filaments, to a second side of the longitudinal filaments.

30. The method according to claim 28 or 29, wherein temporary fixing is effected by the application of additional weight.

70233-130

21

31. The method according to any one of claims 26 to 30, wherein the layers are temporarily pressed on to each other at the crossing points for fixation.

32. The method according to any one of claims 26
5 to 31, wherein a fibrous layer is applied to one or both sides of the filament lay-up and is fixed thereto.

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Fig. 1

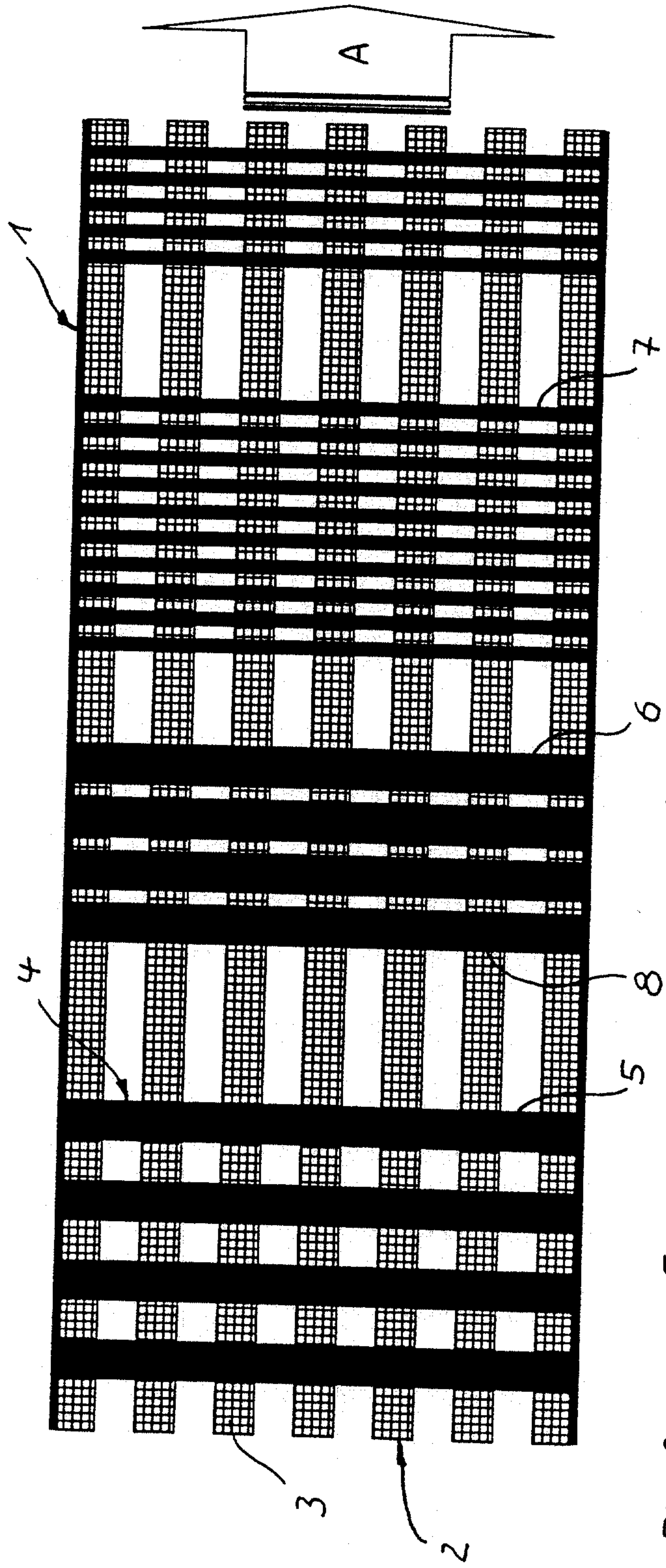


Fig. 2

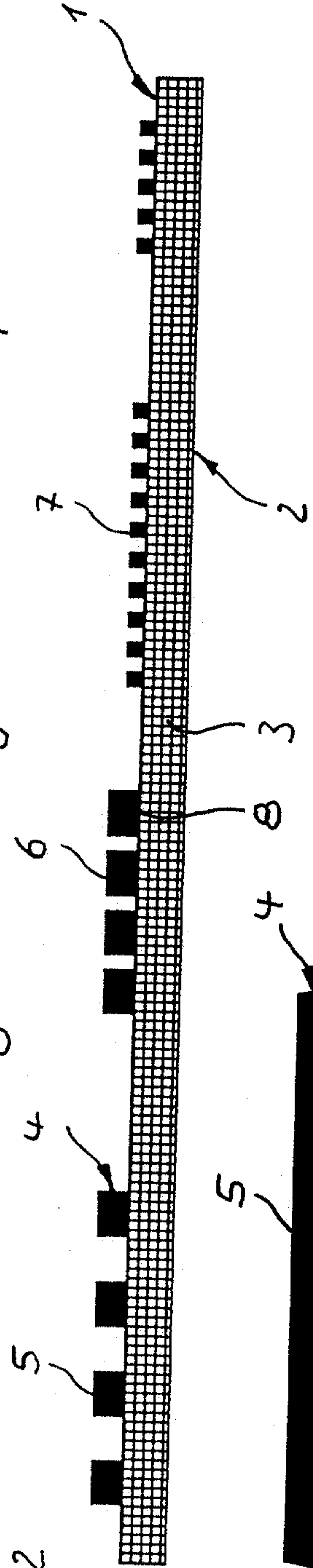


Fig. 3

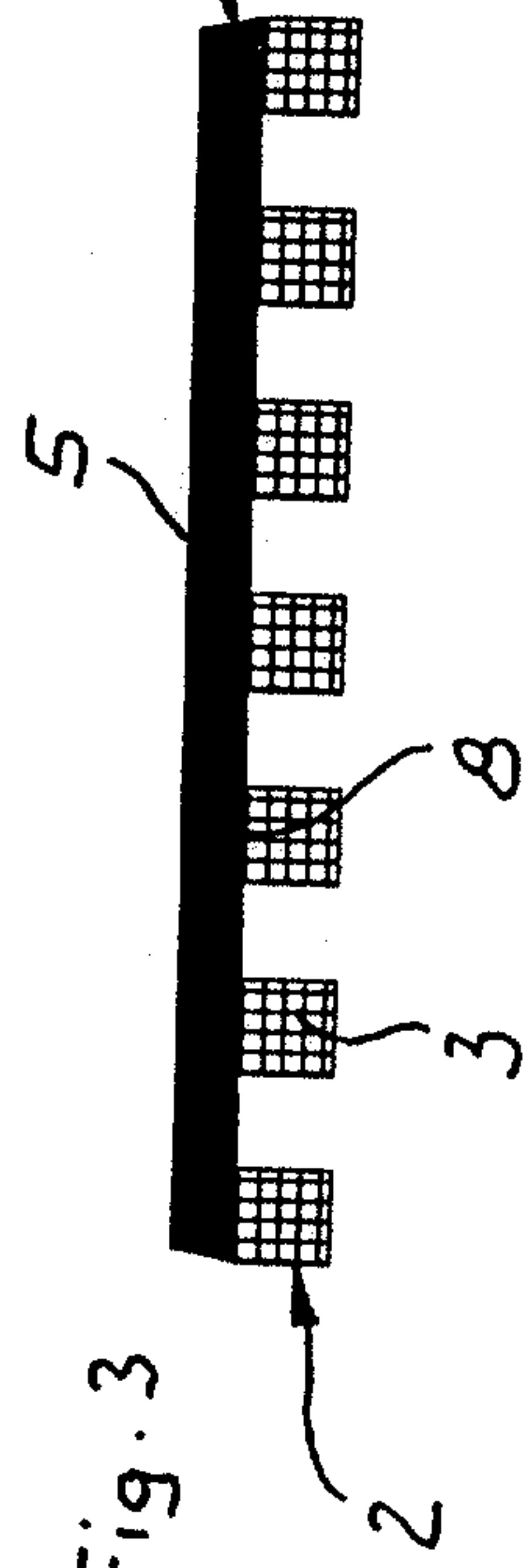


Fig. 4

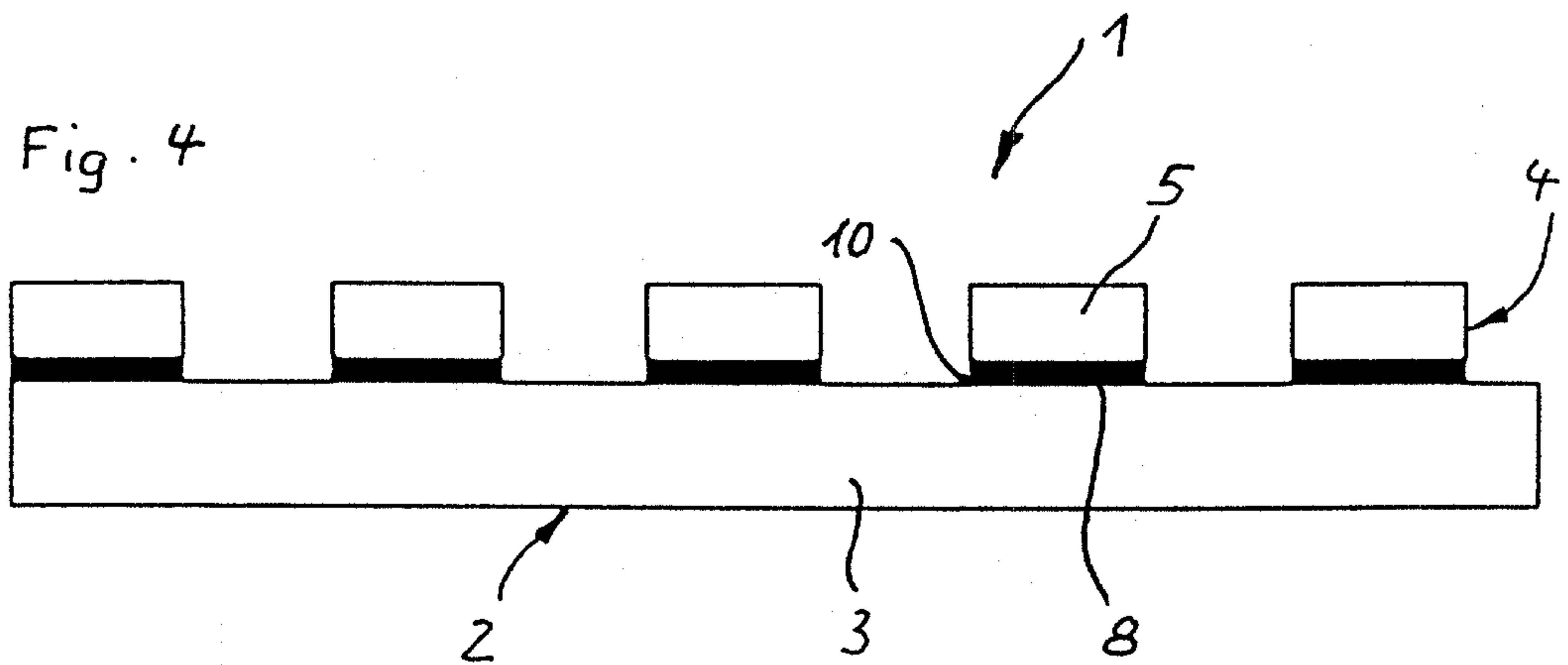


Fig. 5

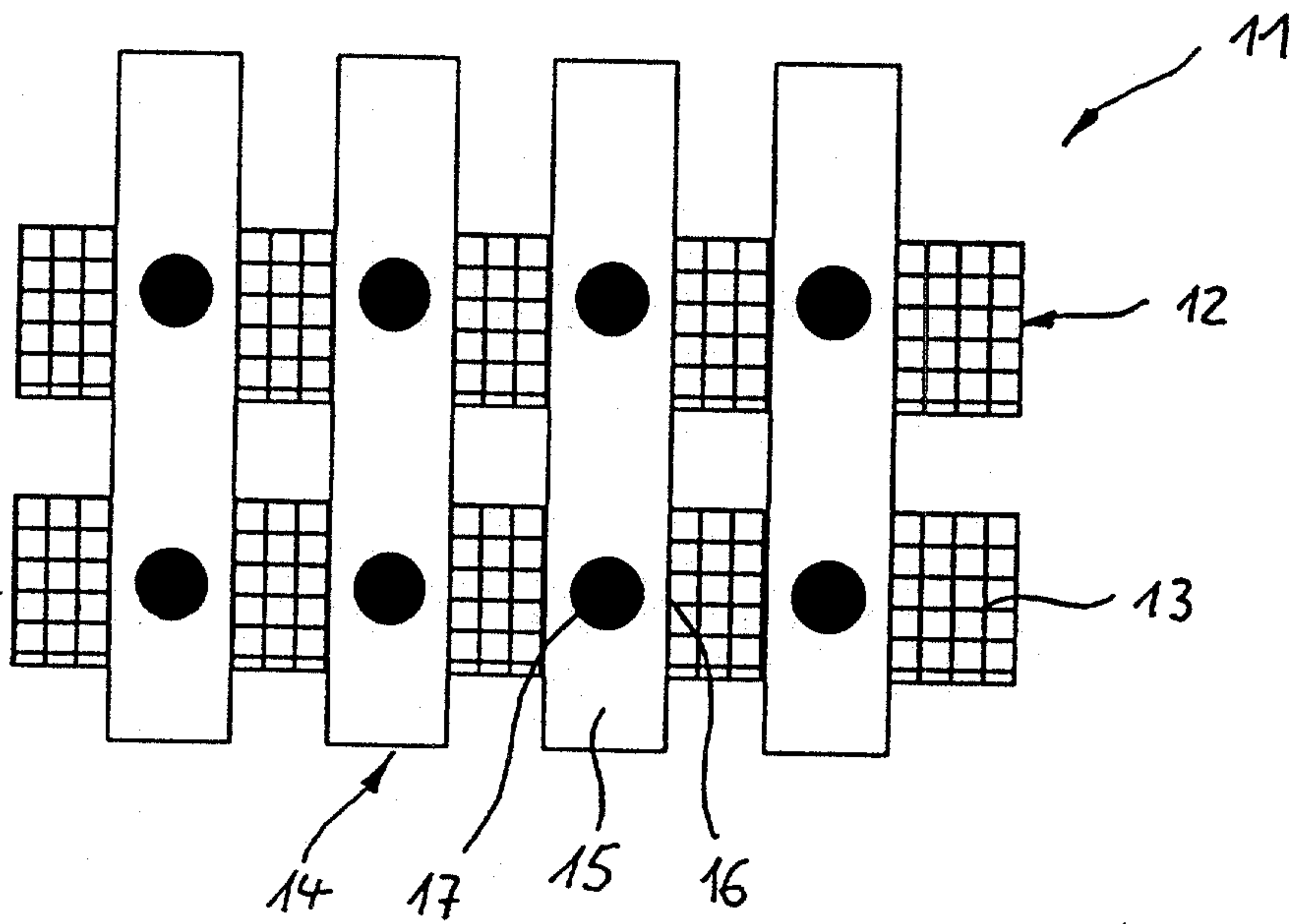


Fig. 6

