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CA 2645700 A1 2009/06/04

(21) 2 645 700

(12) DEMANDE DE BREVET CANADIEN
CANADIAN PATENT APPLICATION

(13) A1

(22) Date de dépôt/Filing Date: 2008/12/03

(41) Mise à la disp. pub./Open to Public Insp.: 2009/06/04

(30) Priorité/Priority: 2007/12/04 (EP07 023 458.8)

(51) Cl.Int./Int.Cl. *D21F 1/10* (2006.01), *D03D 25/00* (2006.01), *D03D 9/00* (2006.01), *D21F 7/08* (2006.01)

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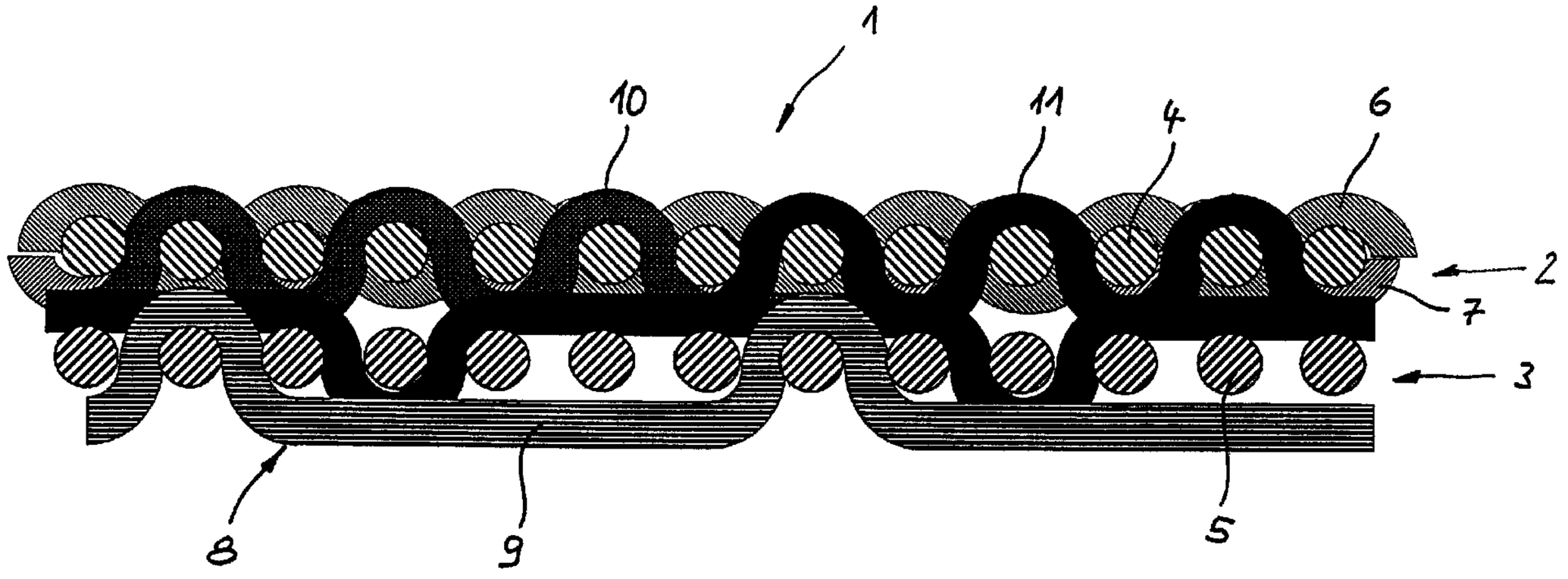
(54) Titre : CLASSEUR DE FACONNAGE POUR MACHINE A PAPIER
(54) Title: FORMING SCREEN FOR USE IN A PAPER MACHINE



(57) Abrégé/Abstract:
The invention relates to a forming screen for use in the forming section of a paper machine, comprising a paper and a machine side as well as longitudinal threads extending in the intended running direction and binding cross threads extending transversely thereto, wherein the longitudinal threads are divided in the ratio of the number of threads of 1:1 in a longitudinal thread layer on the machine side and a longitudinal thread layer on the paper side, and the binding cross threads bind in both longitudinal thread layers, which is characterized in that the forming screen has a fiber support index (FSI) which is in the range of 230 to 250 and has an air permeability which is in the range of 5700 to 10600 $m^3/m^2/h$.

Abstract

The invention relates to a forming screen for use in the forming section of a paper machine, comprising a paper and a machine side as well as longitudinal threads extending in the intended running direction and binding cross threads extending transversely thereto, wherein the longitudinal threads are divided in the ratio of the number of threads of 1:1 in a longitudinal thread layer on the machine side and a longitudinal thread layer on the paper side, and the binding cross threads bind in both longitudinal thread layers, which is characterized in that the forming screen has a fiber support index (FSI) which is in the range of 230 to 250 and has an air permeability which is in the range of 5700 to 10600 $m^3/m^2/h$.

Forming Screen For Use In A Paper Machine

The invention relates to a forming screen for use in the forming section of a paper machine, comprising a paper side and a machine side as well as longitudinal threads extending in the intended running direction and cross threads extending transversely thereto, whereby the longitudinal threads are divided in the ratio of the number of threads of 1:1 into a longitudinal thread layer on the machine side and a longitudinal thread layer on the paper side and the binding cross threads bind in both longitudinal thread layers.

Forming screens are used in the sheet forming region of a paper machine. These are endless web bands of several ten meters in length and several meters in width which are guided over rollers in such a way that they form an essentially even surface on the top. At the start of the run, a fiber pulp is applied to said surface which is drained downward through the forming screen, while the fibers accumulate on the surface of the forming screen and in this way form a paper web. At the end of the forming screen, the paper web, which is still very sensitive, is then taken over by a press conveyor and then conveyed to the pressing part for further draining and to the drying part for thermal drying.

A number of various web constructions have been proposed for the web structure of forming screens. The present invention relates to a type of web in which the longitu-

dinal threads are warp threads and are arranged in two longitudinal thread layers with longitudinal threads arranged above one another in the ratio of the number of threads of 1:1. Forming screens of this type are, for example, known from EP 1 362 142 B1, WO 2004/094719 A1 and WO 2005/001197 A1. The longitudinal thread layers are joined by means of binding cross threads which bind both in the machine side and in the paper side of the longitudinal thread layer. In addition to these binding cross threads, further cross threads can also be present which bind only in the longitudinal thread layer on the paper side and/or only in the longitudinal thread layer on the machine side. The aforementioned type of web is distinguished by a good compromise between the contradictory requirements for good fiber support on the one hand - EP 1 362 142 B1 notes an FSI value of 185 and/or 188 for this - and, on the other hand, high dewatering efficiency.

Basically, forming screens are today made of plastic threads formed from monofilaments. In this case, high-strength plastics prevail more and more in order to be able, at the same strength, to realize smaller thread diameters, in particular in longitudinal direction, and thus a lower fill degree of longitudinal threads, and consequently a higher permeability (see WO 03/046277 A1 in a generically foreign forming screen having two cross thread layers and binding warp threads). In this type of web, the fill degree of longitudinal threads is usually at at least 100%, partially much higher (see WP 2006/034576 A1; WO 01/27385 A1; EP 0 998 607 B1; WO

2004/013410 A1), that is in spite of the use of high-strength longitudinal or warp threads. In part, lower longitudinal thread fill degree are also noted (see US 4,314,589; EP 0010 311; US 4,379,735), whereby, however, this type of web is not comparable in this respect with the generic type of web. In generically foreign types of webs, air permeability of between 7,500 to 10,500 $m^3/m^2/h$ (WO 2004/013410 A1) or 3,500 to 8,200 $m^3/m^2/h$ (see WO 01/27385 A1) are attained.

Despite the advances achieved in the interim, as before, there is need for improvement in order to increase the efficiency of forming screens with respect to their degree of fiber support on the one hand and dewatering efficiency on the other hand, and thereby obtain a paper web at the end of the forming screen which has a lower degree of moisture content and a higher fiber density and consequently strength. The result of improvements of this type are that the subsequent sections of the paper machine are stress-relieved or high degrees of dryness are attained and paper tears prevented.

Consequently, the object of the invention is to design a forming screen in such a way that a paper web is obtained at the end of the forming screen which has a higher strength and a lower degree of moisture content.

According to the invention, this object is solved by a forming screen which has a fiber support index (FSI) which is in the range of 230 to 250 and has an air permeability which is - always measured at 100 Pa - in the

range of 5700 to 10600 $m^3/m^2/h$ (correspondingly 350 - 650 cfm, measured at 127 Pa), preferably in the range of 6500 to 8200 $m^3/m^2/h$ (correspondingly 400 - 500 cfm, measured at 127 Pa). Thus, the basic idea of the invention is to design the web structure of the forming screen in such a manner that a superior fiber support is obtained at constant strength and in spite of very high air permeability and with therefore dewatering effect, so that only a small portion of fibers is lost during the water draining and a paper web of realtively good strength, which is uniform over the surface, is formed. In this case, it should be taken into account that, when calculating the fiber support index, not only the number of longitudinal and cross threads per cm comes into it, but also two coefficients which depend on the type of binding of the longitudinal and cross threads and their contributions to the fiber support, i.e. the fiber support index indirectly also says something about the web structure of the forming screen.

The fiber support index is calculated according to the publication "Approved Standard Measuring Method" of the Papier-machine Clothing Association, 19, rue de la République, 45000 Orléans/France, of June 2004 according to the following formula:

$$FSI = 1{,}693\ (a \times Nm + 2 \times b \times Nc),$$

wherein

a = coefficient for the support contribution of the longitudinal threads;

Nm = number of longitudinal threads per cm in transverse direction on the paper side of the forming screen;

b = coefficient for the support contribution of the cross threads;

Nc = number of cross threads per cm in longitudinal direction on the paper side of the forming screen.

The coefficients a and b depend on the weave and can be found in a table which is contained in the aforementioned document.

The air permeability is also measured according to the particulars in the aforementioned document using a differential pressure of 100 or 127 Pa (see above).

In an embodiment of the invention, it is provided that the distribution of longitudinal and cross threads is obtained in such a way that there are 1200 to 1600 flow-through passages per cm surface of the forming screen on the paper side. Thread run and thread structure should thereby be such that the flow-through passages are rectangular in shape with a ratio of extension in longitudinal direction to the extension in transverse direction of

1:1,8 to 1:3,4. In this way, a good dewatering effect results at high fiber retention.

According to a further feature of the invention, it is provided that the fill degree of the longitudinal threads in the longitudinal thread layer on the paper side is maximum 32% in order to obtain a high degree of openness in this longitudinal thread layer. On the whole, the fill capacity of the longitudinal threads should be maximum 90%, preferably maximum 85%, and thus clearly lower than in the previously known forming screens of this type.

According to a further feature of the invention, it is provided that the diameter of the longitudinal threads, at least in the longitudinal thread layer on the paper side, is in the range of 0.08 to 0.12 mm, preferably 0.11 mm, and the diameter of the longitudinal threads in the longitudinal thread layer on the machine side in the range of 0.15 or 0.25 mm. Due to this comparatively small diameter of the longitudinal threads, in particular in the longitudinal thread layer on the paper side, a small fill degree can be realized yet at a high specific thread number, i.e. a relatively open web is obtained which nevertheless still offers a good fiber retention. In order to be able to meet high strength requirements despite the small diameters, the longitudinal threads should consist of a high-strength plastic, e.g. of PET (polyethylene terephthalate) having an intrinsic viscosity (IV) of at least 0.8 dl/g and a modulus of elasticity

of at least 10 N/mm^2 and/or of PEN (polyethylene naphthalate).

A good compromise between dewatering effect, on the one hand, and fiber retention, on the other hand, is obtained when the number of longitudinal threads is in the range of 50 to 60 threads per cm in transverse direction. With respect to the number of cross threads, it should be in the range of 100 to 110 threads per cm in longitudinal direction.

In principle, a forming screen according to the invention - with respect to cross threads - can be realized only with binding cross threads, i.e. with such (first) cross threads which bind in both longitudinal thread layers and in this way make a connection between these layers. However, the fiber retention can be improved if there are, in addition, two cross threads which are only bound in the longitudinal thread layer on the paper side and alternate advantageously with the binding cross threads in a specific regular way. Preferably, the second cross thread taken separately should form a plain weave with the longitudinal threads of the longitudinal thread layer on the paper side.

According to a further feature of the invention, it is provided that the binding cross threads are arranged adjacent to one another to form groups of at least two binding cross threads, one of the binding cross threads binding in the longitudinal thread layer on the machine side when the other binding cross thread or the other

binding cross threads bind(s) in the longitudinal thread layer on the paper side. Within the groups of adjacent binding cross threads, therefore, the binding cross threads should extend so as to be staggered vis-à-vis one another in transverse direction of the forming screen. However, they each have the same repeating, i.e. bind in the same way in the longitudinal thread layer both on the machine side and on the paper side. Preferably, the respectively adjacent binding cross threads should bind in the longitudinal thread layer with their repeating staggered in such a way that their binding patterns complement one another without a gap, i.e. along their extension, preferably such that the complementary bindings form a pattern on the paper side which corresponds to that of the optionally present second cross threads, for example, also produce a type of plain weave.

It is also advantageous for the fiber support if the binding cross threads bind in the longitudinal thread layer on the machine side within a connection with fewer longitudinal threads than in the longitudinal thread layer on the paper side, preferably with not more than two longitudinal threads in the longitudinal thread layer on the machine side. In the longitudinal thread layer on the paper side, the binding cross threads bind within a repeating, advantageously with more than three longitudinal threads.

According to a further feature of the invention, it is provided that there are third cross threads which bind only in the longitudinal thread layer on the machine

side. In particular, they are to be used to provide wearing volume on the machine side of the forming screen for the purpose of protecting the tensile-stressed longitudinal threads in the longitudinal thread layer on the machine side. For this purpose, it is advantageous if the third cross threads float on the outer side of the longitudinal thread layer on the machine side over several longitudinal threads, whereby the number of these longitudinal thread is always greater than the number of longitudinal threads with which the third cross threads bind between two floatings. Preferably, the floatings should go over at least three, better still at least five longitudinal threads. A binding with a single longitudinal thread of the longitudinal thread layer on the machine side reaches between the floatings.

All range data, both in the description and in the claims, also refer to those values and thus also disclose those which lie between the threshold values given for the ranges. Therefore, they are not explicitly noted.

The invention is illustrated in greater detail in the drawing with reference to an embodiment. It shows, in cross section, i.e. transversely to the intended running direction, a section of the forming screen 1 according to the invention.

The forming screen 1 is a two-layer web having an upper longitudinal thread layer 2 on the paper side and a lower longitudinal thread layer 3 on the machine side. Both longitudinal thread layers 2, 3 are formed by longitudi-

nal or warp threads - for example, designated with 4 or 5, respectively - in the ratio of the number of threads of 1:1, whereby a longitudinal thread 4 of the longitudinal thread layer 2 on the paper side is arranged exactly above a longitudinal thread 5 in the longitudinal thread layer 3 on the machine side, i.e. the longitudinal threads 4, 5 each lie in pairs above one another.

The diameter of the longitudinal threads 4 in the longitudinal thread layer 2 on the paper side is 0.11 mm and the diameter of the longitudinal threads 5 in the longitudinal thread layer 3 on the machine side is 0.18 mm. They consist of PEN. The number of longitudinal threads is 58 per cm in transverse direction.

Second cross threads 6, 7 are bound in the longitudinal thread layer 2 on the paper side while forming a plain weave with the longitudinal threads 4 of this longitudinal thread layer 2. Vertically to the plane of the drawing, adjacent second cross threads 6, 7 follow in each case. The second cross threads 6, 7 consist of PET and they have a diameter of 0.11 mm.

Third cross threads are only bound in the longitudinal thread layer 3 on the machine side, only one of said third cross threads can be seen here. The third cross threads 8 each form floatings (designated with 9 by way of example) going over five longitudinal threads 5 on the machine side of the forming screen 1 and then each binds with a single longitudinal thread 5. The floatings 9 represent abrasives for protecting the longitudinal

thread layer 3 on the machine side which is under great tensile stress. The diameter of the third longitudinal threads is 0.22 mm. The material can be PET and/or PAM.

The longitudinal thread layers 2, 3 are joined by pairs of two binding cross threads 10, 11 each adjacent to one another in longitudinal direction. They have a diameter of 0.11 mm and consist of PET. They bind in the longitudinal thread layer 2 on the paper side one after the other, alternatively on the top and bottom with longitudinal threads 4, then extend between the two longitudinal thread layers 2, 3 over three longitudinal threads 4 or 5 and then bind with a single longitudinal thread 5 in the longitudinal thread layer 3 on the machine side before they then again float between the two longitudinal thread layers 2 and 3. They each have the same repeating, however, they are staggered vis-à-vis one another in such a way in transverse direction , i.e. in their longitudinal direction, that the binding patterns in the longitudinal thread layer 2 on the paper side complement one another, so that they then together form a fabric pattern similar to the second cross threads 6, 7. In this way, an almost uniform plain weave pattern is produced on the paper side of the forming screen 1, said plain weave pattern offering a high fiber retention.

The fill degree of the longitudinal thread layer 2 on the paper side is 31%, the total fill degree of the longitudinal threads 4, 5 is 82%. The number of cross threads is 108 per cm in longitudinal direction of the forming screen 1. This results in a high openness and thus a

good dewatering effect in spite of a high fiber retention.

We Claim:

1. A forming screen (1) for use in the forming section of a paper machine, comprising a paper and a machine side as well as longitudinal threads (4, 5) extending in the intended running direction and binding cross threads (10, 11) extending transversely thereto, wherein the longitudinal threads (4, 5) are divided in the ratio of the number of threads of 1:1 in a longitudinal thread layer (3) on the machine side and a longitudinal thread layer (2) on the paper side, and the binding cross threads (10, 11) bind in both longitudinal thread layers (2, 3), characterized in that the forming screen (1) has a fiber support index (FSI) which is in the range of 230 to 250 and an air permeability which is in the range of 5700 to 10600 $m^3/m^2/h$.

2. The forming screen according to claim 1, characterized in that the air permeability is in the range of 6500 to 8200 $m^3/m^2/h$.

3. The forming screen according to claim 1 or 2, characterized in that the forming screen (1) on the paper side has 1200 to 1600 flow-through openings per cm^2 surface of the forming screen (1).

4. The forming screen according to one of the claims 1 to 3, characterized in that the flow-through openings are rectangular in shape with a ratio of the

extension in running direction to the extension in transverse direction of 1:1,8 to 1:3,4.

5. The forming screen according to one of the claims 1 to 4, characterized in that the fill degree of the longitudinal threads (4) in the longitudinal thread layer (2) on the paper side is maximum 32%.

6. The forming screen according to one of the claims 1 to 5, characterized in that the total fill degree of all longitudinal threads (4, 5) is maximum 90%, preferably maximum 85%.

7. The forming screen according to one of the claims 1 to 6, characterized in that the diameter of the longitudinal threads (4, 5), at least in the longitudinal thread layer (2) on the paper side, is in the range of 0.08 to 0.12 mm.

8. The forming screen according to on of the claims 1 to 7, characterized in that the diameter of the longitudinal threads (5) in the longitudinal thread layer (3) on the machine side is in the range of 0.15 to 0.25 mm.

9. The forming screen according to one of the claims 1 to 8, characterized in that at least a part of the longitudinal threads (4, 5) consist of PET with an intrinsic viscosity of at least 0.8 dl/g and an elasticity module of at least 10 N/mm^2.

10. The forming screen according to one of the claims 1 to 9, characterized in that at least a part of the longitudinal threads (4, 5) consist of PEN.

11. The forming screen according to one of the claims 1 to 10, characterized in that the number of longitudinal threads (4, 5) are in the range of 50 to 66 threads per cm in transverse direction.

12. The forming screen according to one of the claims 1 to 11, characterized in that the number of cross threads (6, 7, 9, 10, 11) are in the range of 100 to 110 threads per cm in longitudinal direction.

13. The forming screen according to one of the claims 1 to 12, characterized in that there are second cross threads (6, 7) which are only bound in the longitudinal thread layer (2) on the paper side.

14. The forming screen according to claim 13, characterized in that the second cross threads (6, 7), taken alone, form a plain weave with the longitudinal thread layer (2) on the paper side.

15. The forming screen according to one of the claims 1 to 14, characterized in that the binding cross threads (10, 11) are arranged adjacent to one another to form groups of at least two binding cross threads (10, 11) each, whereby one of the binding cross threads (10, 11) binds in the longitudinal thread layer on the machine side when the other

binding cross thread (11, 10) or the other binding cross threads bind in the longitudinal thread layer (2) on the paper side.

16. The forming screen according to claim 15, characterized in that the respectively adjacent binding cross threads (10, 11) bind in the longitudinal thread layer (2) on the paper side with their repeating staggered vis-à-vis one another in such a way that their binding patterns complement one another in transverse direction without a gap.

17. The forming screen according to claim 15 or 16, characterized in that the binding cross threads (10, 11) bind in the longitudinal thread layer (3) on the machine side within a repeating with less longitudinal threads (5) than in the longitudinal thread layer (2) on the paper side.

18. The forming screen according to claim 17, characterized in that the binding cross threads (10, 11) bind in the longitudinal thread layer (3) on the machine side within a repeating with not more than two longitudinal threads (5).

19. The forming screen according to one of the claims 1 to 18, characterized in that there are third cross threads (8) which only bind in the longitudinal thread layer (3) on the machine side.

20. The forming screen according to claim 19, characterized in that the third cross threads (8) float on the outer side of the longitudinal thread layer (3) on the machine side over several longitudinal threads (5), wherein the number of these longitudinal threads (5) is always greater than the number of the longitudinal threads (5) with which the third cross threads (8) bind between two floatings (9).

21. The forming screen according to claim 20, characterized in that the third cross threads (8) float over more than three longitudinal threads (5) on the outside and, in between, only bind with one longitudinal thread (5).

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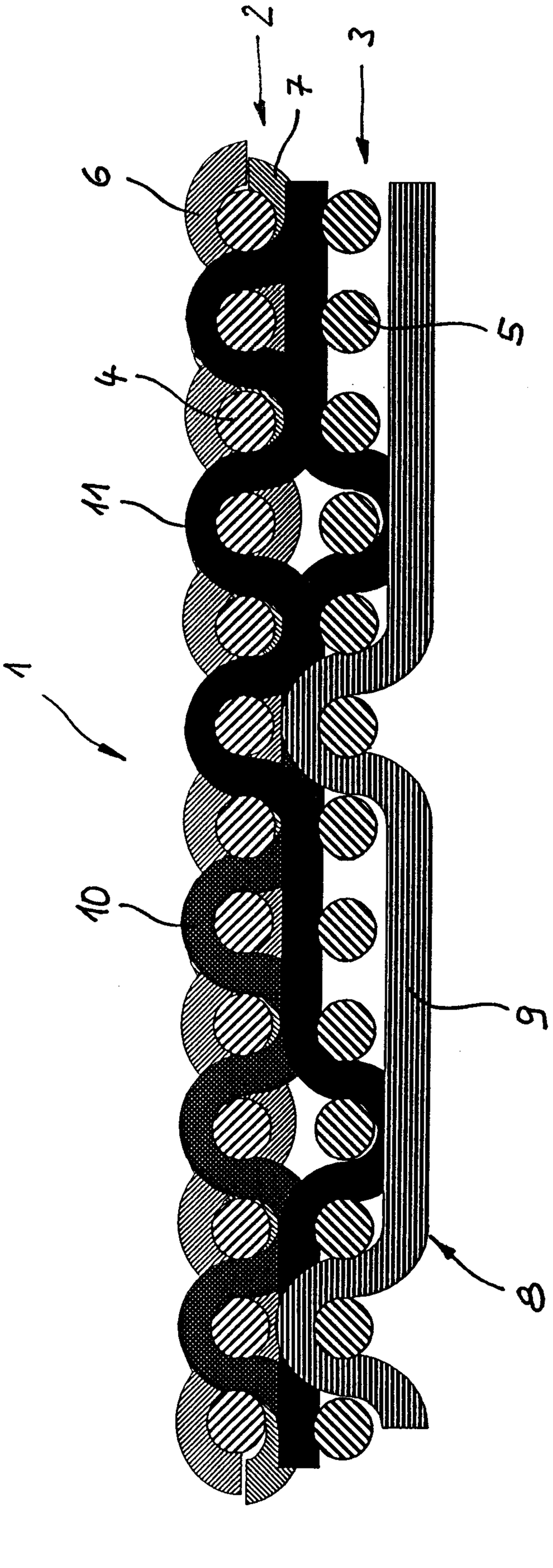
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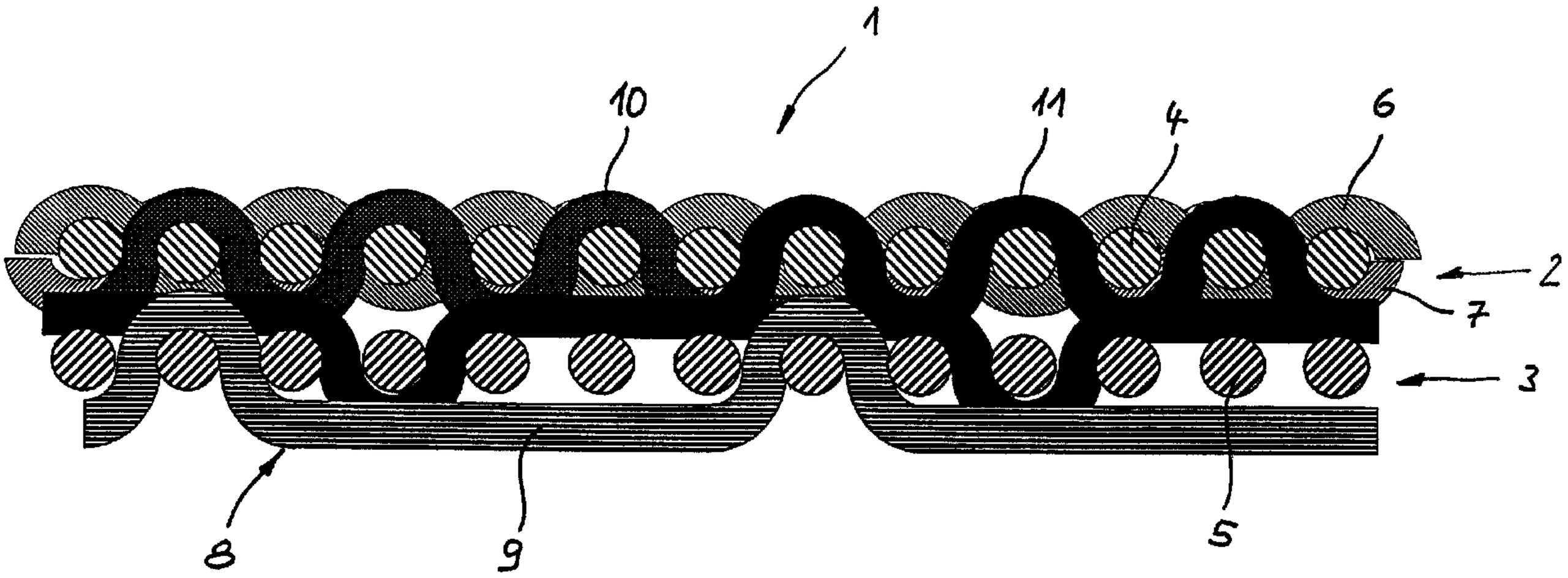
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