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SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ,
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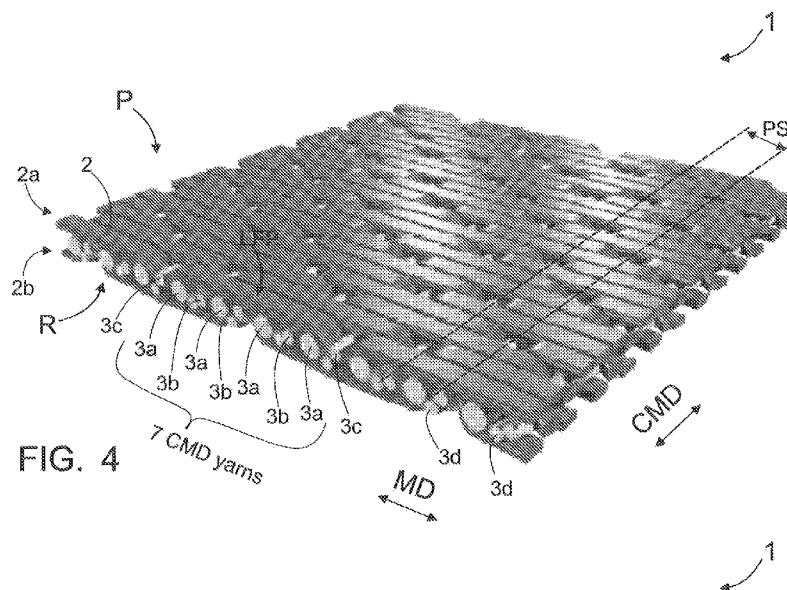
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(54) **Title:** DRYER FABRIC



(57) **Abstract:** The invention relates to a dryer fabric, which is woven of machine direction yarns (2) and cross machine direction yarns (3). The machine direction yarns (2) have free long float above at least seven cross machine yarns on a paper side (P) of the dryer fabric (1). Further, the fabric has double cloth structure having machine direction yarns in two successive layers (2a, 2b).

DRYER FABRIC

Background of the invention

The invention relates to a dryer fabric, which is designed to be used on a dryer section of a paper machine. The dryer fabric is a woven structure and comprises machine direction yarns i.e. warp yarns, and cross machine direction yarns i.e. weft yarns.

The field of the invention is defined more specifically in a preamble of the independent claim.

Dryer fabrics, wires and screens are used on a dryer section of a paper machine. The dryer fabrics allow the paper web to be dried to be guided through the dryer section. However, the known solutions have shown to contain some disadvantages.

Brief description of the invention

An object of the invention is to provide a novel and improved dryer fabric.

The dryer fabric of the invention is characterized by the characterized features of the independent claim.

An idea of the disclosed solution is that flat yarns are used as machine direction yarns, i.e. MD-yarns or warp yarns. The fabric has a double machine direction yarn structure, i.e. double warp system, whereby the machine direction yarns are arranged in two successive layers. Furthermore, the MD-yarns have extremely long floats at least on a paper side surface of the dryer fabric. The long float means that the MD-yarns pass over at least seven cross machine direction yarns, i.e. CMD-yarns or weft yarns.

Further, the dryer fabric has a double-cloth structure. Then, the dryer fabric has two independent fabric layers comprising yarns of their own. However, the structure is self-stitched so that the layers of the fabric are bound together so that the machine direction yarns engage to paper side layer and to roll side layer at suitable intervals.

An advantage of the disclosed solution is that the paper side of the dryer screen is very smooth and the contact area thereof is large. The smooth surface prevents the marking to the product. The extensive contact area also allows an appropriate heat transmission between the paper web and the dryer fabric, whereby the structure provides a higher drying power for the fabric.

The disclosed dryer fabric also provides good running properties at the dryer section of a paper machine. This is due to the fact that the amount of air conducted by a smooth-surface dryer fabric is small. Thus, the fabric may have low air transportation and good aerodynamic properties.

5 In addition, the affinity, or the force keeping the web in position, is good on a smooth dryer fabric, and thereby the fabric controls the course of the web also at high speeds. Another advantage of a smooth-surfaced dryer fabric is that the fabric is kept clean, and can easily be cleaned in case it is dirtied.

10 The disclosed double cloth structure, or double warp structure, of the dryer fabric makes the fabric strong and stable. Machine direction elongation of the fabric may be small since the structure comprises a large amount of machine direction material thanks to the double cloth structure. Furthermore, wear resistance of the disclosed dryer fabric may be excellent because of the
15 large amount of machine direction material.

 According to an embodiment, the dryer fabric has eight shed double cloth structure.

 According to an embodiment, machine direction yarns are vertically stacked in the structure of the dryer fabric. Alternatively, the machine direction
20 yarns are positioned vertically one above each other, but they have a slight offset relative to each other.

 According to an embodiment, contact area of the paper side of the dryer fabric is 50 % or more. The large contact area is formed by means of long floats of flat machine direction yarns. It has been noted that when the
25 contact area 50 % or more, then the drying capacity is excellent.

 According to an embodiment, air permeance of the dryer fabric is between 90 – 400 cfm (cubic foot per minute) after heat treatment. The heat treatment substantially makes the fabric dense since the MD-yarns are moved closer to each other due shrinkage of the fabric.

30 According to an embodiment, the cross machine direction yarns are strongly shrinking yarns, whereby heat treatment of the dryer fabric is configured to cause cross direction shrinkage of the dryer fabric so that adjacent machine direction yarns are being moved closer to one another. Further, the shrinkage of the cross machine direction yarn is over 10 % and that after
35 weaving the dryer fabric has shrunk by means of heat treatment at least 10 %

in the cross machine direction. The shrinking of the dryer fabric in transverse direction also increases amount of contact area of the paper side.

According to an embodiment, thickness or caliper of the dryer fabric is between 1.4 – 1.8 mm. When the thickness is as disclosed, the dryer fabric
5 has needed stability and is still not too thick.

According to an embodiment, the dryer fabric has a single-layer structure. Then, the dryer fabric has cross machine direction yarns only in one single layer.

According to an embodiment, cross section of the cross machine di-
10 rection yarn is round or substantially round.

According to an embodiment, diameter of the cross machine direc-
tion yarn ranges between 0.4 and 0.8 mm.

According to an embodiment, cross section of the machine direction
yarns is rectangular or substantially rectangular. The cross sectional shape of
15 the rectangular may have round edges. Further, width of the machine direc-
tion yarn is 0.6 mm or more, and height 0.4 mm or less.

According to an embodiment, the machine direction yarns and the
cross machine direction yarns are polyethylene terephthalate (PET) yarns.
PET-yarns are less expensive compared to polyphenylene sulfide (PPS)
20 yarns, for example. The PET-yarns may comprise an additive for improving
heat resistance and stability. Thanks to the disclosed fabric structure, less
expensive material may be used without hampering wear properties, stability
and durability of the dryer fabric.

According to an embodiment, the dryer fabric is a flat woven fabric.
25 Then the dryer fabric has two opposite longitudinal edges in the machine di-
rection and two opposite connecting ends in the cross machine direction. The
connecting ends may be fastened together during installation of the dryer fab-
ric on a dryer section.

According to an embodiment, the dryer fabric is provided with a first
30 seam end and a second seam end in the cross machine direction of the fabric.
The seam ends are provided with connecting members for connecting the
seam ends in order to form a seam and allowing and endless dryer fabric to
be formed by the seam. The dryer fabric may be flat woven and it may be pro-
vided with any kind of integrated or separate seaming aids or connecting
35 members for connecting the distal ends together when installing the dryer fab-
ric to a use position.

According to an embodiment, at least part of the machine direction yarns are arranged to form seam loops at the seam ends. The machine direction yarns may then provide the dryer fabric with a strong and non-marking warp loop seam. The seam loops may be relatively long because of the long floats of the machine direction yarns which form the seam loops. Thanks to relatively long seam loops, installation of the dryer fabric is easy and fast. However, the long seam loops do not cause marking to the web.

According to an embodiment, all of the machine direction yarns form seam loops at both seam ends. Seaming of such a dryer fabric is simple and fast.

According to an embodiment, at least part of the machine direction yarns are arranged to form seam loops at the seam ends. The loops are grouped at the seam end so that two adjacent MD-yarns are arranged to form a pair of long loops and following two adjacent MD-yarns are arranged to form short loops and again next two adjacent MD-yarns form two long seam loops and so on. Thus, the seam ends may comprise so called double-seam-loops.

According to an embodiment, the seam ends are provided with seam spirals which serve as connecting members.

According to an embodiment, the dryer fabric is made by using endless weaving technology, whereby the dryer fabric does not comprise any seam ends. Instead the dryer fabric has a shape of an endless loop.

According to an embodiment, the machine direction yarns pass below at least seven cross machine direction yarns on the roll side of the dryer fabric, thereby forming long floats on the roll side. Long floats of the machine direction yarns on the roll side surface improve wear durability of the dryer fabric.

According to an embodiment, the machine direction yarns have free long floats passing at least eleven cross machine direction yarns. It is possible that the machine direction yarns pass over fifteen, nineteen or even several CMD-yarns on the paper side surface and/or on the roll side surface.

According to an embodiment, the dryer fabric has an asymmetric structure regarding the free long flow of the machine direction yarns on the paper surface side and the roll surface side. This means magnitude of the floats may be different on the paper side surface and the roll side surface.

According to an embodiment, adjacent machine direction yarns have a phase shift of two cross machine yarns.

According to an embodiment, the machine direction yarns are monofilament yarns.

According to an embodiment, the cross machine direction yarns are monofilament yarns.

5 According to an embodiment, the dryer fabric has at least eight shed weaving structure. Thus, the fabric may have 8, 10, 12 or 16 shed structure regarding its weaving pattern. Thanks to this structure, the fabric may have extremely long free floats of MD-yarns.

10 The above disclosed embodiments can be combined in order to form suitable solutions provided with necessary features.

Brief description of the figures

Some embodiments are described in more detail in the accompanying drawings, in which

15 Figure 1 is a schematic perspective view of a dryer fabric provided with a seam and thereby having a shape of an endless loop,

Figure 2 is a schematic view of a dryer fabric seen from a paper side surface,

20 Figure 3 shows schematically and seen from the cross machine direction an end portion of a feasible single layer dryer fabric provided with connecting seam loops for allowing formation of a seam,

Figures 4 and 5 are schematic views of a dryer fabric provided with long floats of machine direction yarns on a paper side surface and on a roll or machine side surface,

25 Figure 6 illustrates schematically difference between a prior art solution provided with short floats of MD-yarns and the disclosed solution provided with long floats of MD-yarns,

Figure 7 illustrates a surface of a paper side surface of a dryer fabric,

30 Figure 8 illustrates a surface topography of a paper side surface of a dryer fabric and potential surface contact area is shown in the Figure by using different colour, and

Figure 9 shows an example of features and properties of a dryer fabric according to the disclosed solution.

For the sake of clarity, the figures show some embodiments of the disclosed solution in a simplified manner. In the figures, like reference numerals identify like elements.

Detailed description of some embodiments

5 Figures 1 and 2 show some basic features of a feasible drying fabric 1. The dryer fabric 1 may be a woven structure comprising machine direction yarns 2 and cross machine direction yarns 3, which are crossing each other. The dryer fabric may be flat woven and its seam ends SE1 and SE2 may be connected to each other for forming a seam S when installed on a
10 dryer section of a paper machine. The dryer fabric 1 is configured to run in the machine direction MD. The dryer fabric 1 comprises a paper side surface P against which a paper web to be dried is arranged on the dryer section. An opposite side is a roll side surface which is against rolls and other machine elements of the paper machine.

15 Figure 3 shows an end portion of a feasible single layer dryer fabric 1 provided with connecting seam loops 4. A seam S is formed when opposing seam ends SE1 and SE2 are arranged against to each other so that the seam loops 4 at their ends are being interdigitated and a seam channel is formed. A
20 connecting yarns or seam yarn 5 is inserted inside the seam channel for connecting the seam ends SE1 and SE2.

 In Figure 3 the basic structure of the dryer fabric 1 is single layer fabric, wherein cross machine direction yarns 3a and 3b are in one single layer. The structure may comprise cross machine direction filler yarns 3a and basic cross machine direction yarns 3b. Yarns 3b are connected with the machine direction yarns 2. The machine direction yarns 2 are arranged in two
25 layers 2a, 2b which are one above the other so that the yarns 2a are running on the paper side surface P and the yarns 2b are running on the roll side surface R. Thus, the fabric has double fabric structure comprising a double warp yarn system. The machine direction yarns form seam loops at the seam ends
30 SE1 and SE2. The machine direction yarns 2 have free long floats LFP over seven cross machine direction yarns 3 on the paper side surface P. The roll side surface R may also be provided with the long floats LFR. The number of cross machine yarns 3 passed by the machine direction yarns 2 at the long floats may be the same or it may be different, which means that the structure
35 may be symmetrical or it may be asymmetric. As can be seen in Figure 3, the

dryer fabric has eight shed -weave structure, wherein the machine direction yarn 2 passes above seven CMD-yarns 3, below one CMD-yarn 3 and continues repeating the same pattern. Let it be mentioned that other weave patterns, allowing extremely long floats, may also be used.

5 Figures 4 and 5 show a dryer fabric 1 having a double cloth structure having CMD-yarns 3 in two layers. In Figures 4 and 5 CMD-yarns of a bottom layer are marked with reference numeral 3d. Further, the dryer fabric 1 is provided with long floats FLP of machine direction yarns 2 on a paper side surface P, and also on the roll or machine side surface R. Figure 4 also illustrates that all the machine direction yarns 2 may have the same weave pattern, but an adjacent MD-yarn pattern comprises a phase shift of one or two CMD-yarn in the same direction.

10 Figure 6 illustrates schematically difference between a prior art solution provided with short floats SF of MD-yarns 2 and the disclosed solution provided with long floats LF of MD-yarns 2.

15 Figure 7 illustrates a surface of a paper side surface P of a dryer fabric 1. In Figure 8 it is shown a surface topography of a paper side surface P of a dryer fabric 1. Potential surface contact area is shown in the Figure 8 by using yellow colour. The yellow or lighter colour indicates the potential contact surface areas whereas red or darker colour indicates non contacting areas. As can be easily noted from Figure 8, the contact areas represent over 50 % of the total surface of the dryer fabric 1.

20 Figure 9 shows an example of features and properties of a dryer fabric according to the disclosed solution.

25 Both the MD-yarns and CMD-yarns may be monofilaments and are made of plastic material. Flat threads are used as MD-yarns, the cross section of which preferably resembles a rectangle with rounded corners. Such a thread is provided with a larger contact area compared, for example, with flat oval-shaped threads, which can basically also be applied. The cross section of the CMD-yarns may, in turn, be substantially round, in which case the MD-yarns run as smoothly as possible between the CMD-yarns, when passing between paper side P and roll side R of the fabric. Extremely strongly shrinking threads may be employed as the CMD-yarns, meaning that the longitudinal shrinkage of an individual thread is at least 10 %. Furthermore the shrinkage in the width direction of the entire dryer fabric is at least 10 %.

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This application relates to a dryer fabric used on a dryer section of a paper machine. However, it has been noted that the disclosed fabric structure could also be utilized in filtering devices such as in horizontal belt filters. The disclosed structure may also be beneficial to be used as a conveyor belt
5 in paper machine or in any other machine which processes fibre web.

The drawings and the specification associated thereto is merely intended to illustrate the idea of the invention. The details of the invention may vary within the scope of the claims.

CLAIMS

1. A dryer fabric for a dryer section of a paper machine, the dryer fabric (1) being a woven structure and comprising:
- 5 a paper side surface (P), which is facing towards a fibre web to be dried during use of the dryer fabric (1);
- a roll side surface (R), which is facing towards the paper machine during use at the dryer section;
- several machine direction (MD) yarns (2), which have flat cross
- 10 sections; and
- several cross machine direction (CMD) yarns (3);
- c h a r a c t e r i z e d in that
- the dryer fabric (1) has a double machine direction yarn structure comprising machine direction yarns (2) in two successive layers (2a, 2b);
- 15 the machine direction yarns (2) pass above at least seven cross machine direction yarns (3) on at least the paper side (P) of the dryer fabric (1), thereby forming long floats (LF, LFP) on the paper side (P), and providing the dryer fabric (1) with smooth surface on the paper side (P) for preventing generation of markings to the fibre web;
- 20 and further, the dryer fabric has a double-cloth structure so that the fabric has two independent fabric layers one above the other and the fabric layers being self-stitched to connect the fabric layers together.
2. The dryer fabric as claimed in claim 1, c h a r a c t e r i z e d in
- 25 that
- contact area of the paper side (P) of the dryer fabric (1) is 50 % or more.
3. The dryer fabric as claimed in claim 1 or 2, c h a r a c t e r i z e d
- 30 in that
- the cross machine direction yarns (3) are strongly shrinking yarns, whereby heat treatment of the dryer fabric is configured to cause cross direction shrinkage of the dryer fabric so that adjacent machine direction yarns (2) are being moved closer to one another; and

the shrinkage of the cross machine direction yarn (3) is over 10 % and that after weaving the dryer fabric (1) has shrunk by means of heat treatment at least 10 % in the cross machine direction.

5 4. The dryer fabric as claimed in any one of the preceding claims 1 – 3, characterized in that

the dryer fabric has a single-layer structure so that the fabric has cross machine direction yarns (3) only in one single layer.

10 5. The dryer fabric as claimed in any one of the preceding claims 1 – 4, characterized in that

cross section of the machine direction yarns (2) is rectangular or substantially rectangular; and

width of the machine direction yarn (2) is 0.6 mm or more and
15 height 0.4 mm or less.

6. The dryer fabric as claimed in any one of the preceding claims 1 – 5, characterized in that

20 the machine direction yarns (2) pass below at least seven cross machine direction yarns (3) on the roll side (R) of the dryer fabric (1), thereby forming long floats (LFT) on the roll side (R).

7. The dryer fabric as claimed in any one of the preceding claims 1 – 6, characterized in that

25 the machine direction yarns (2) have long free floats (LF, LFP, LFR) passing over at least eleven cross machine direction yarns (3) on at least one surface of the dryer fabric (1).

30 8. The dryer fabric as claimed in any one of the preceding claims 1 – 7, characterized in that

the dryer fabric has at least eight shed weaving structure.

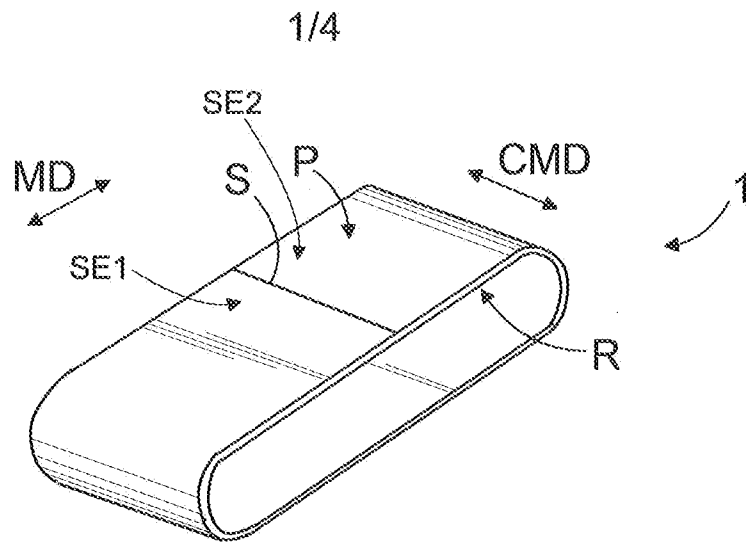


FIG. 1

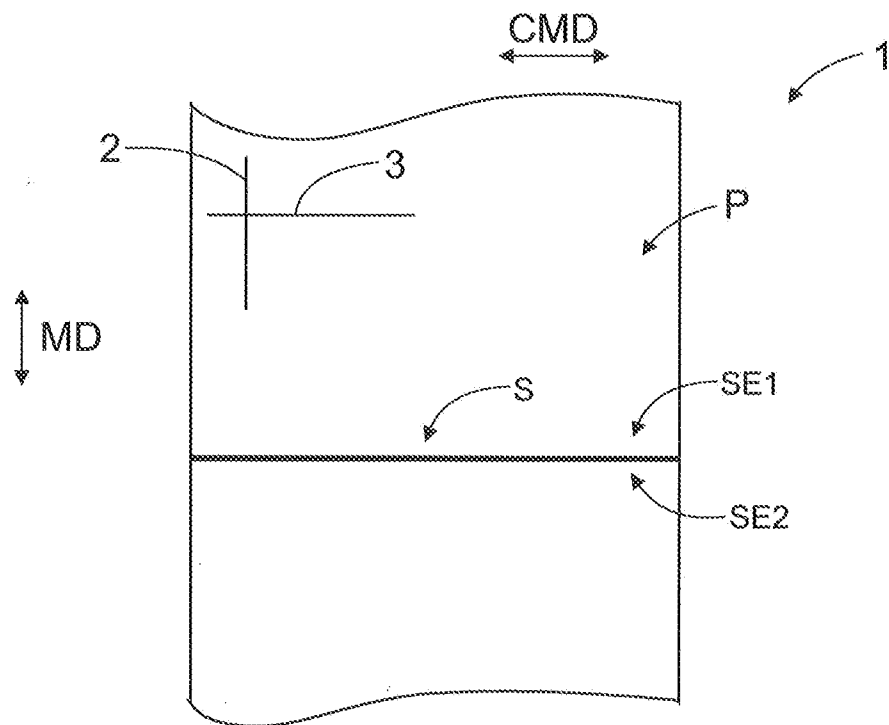


FIG. 2

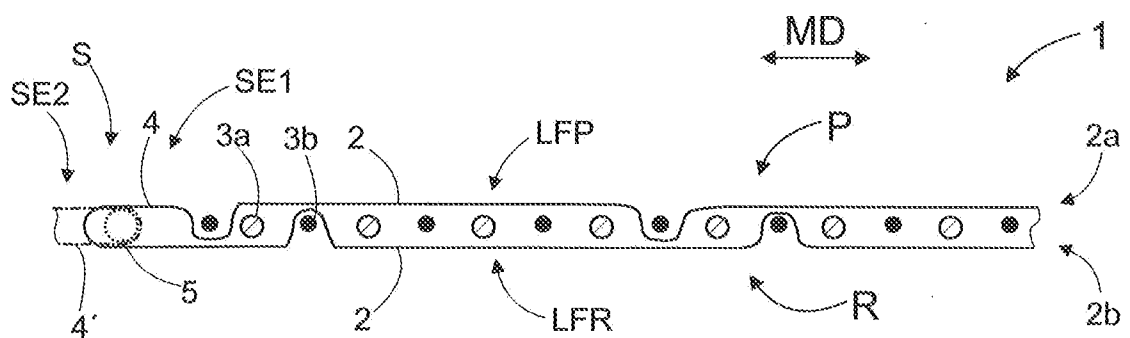


FIG. 3

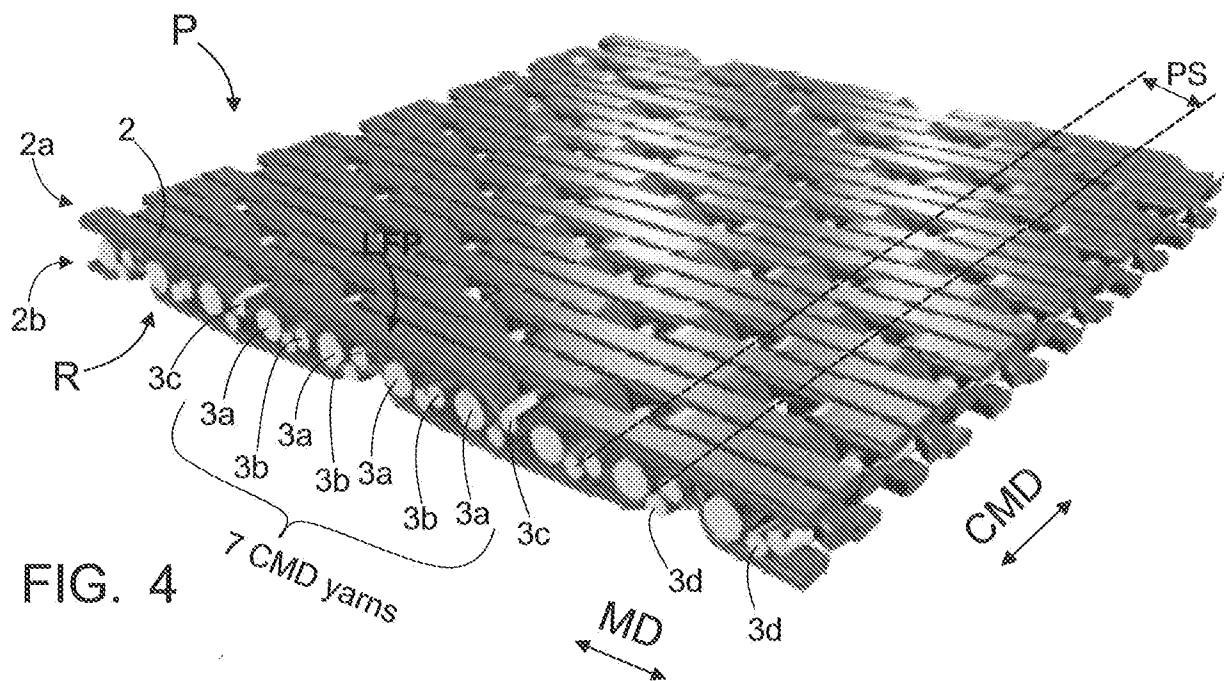


FIG. 4

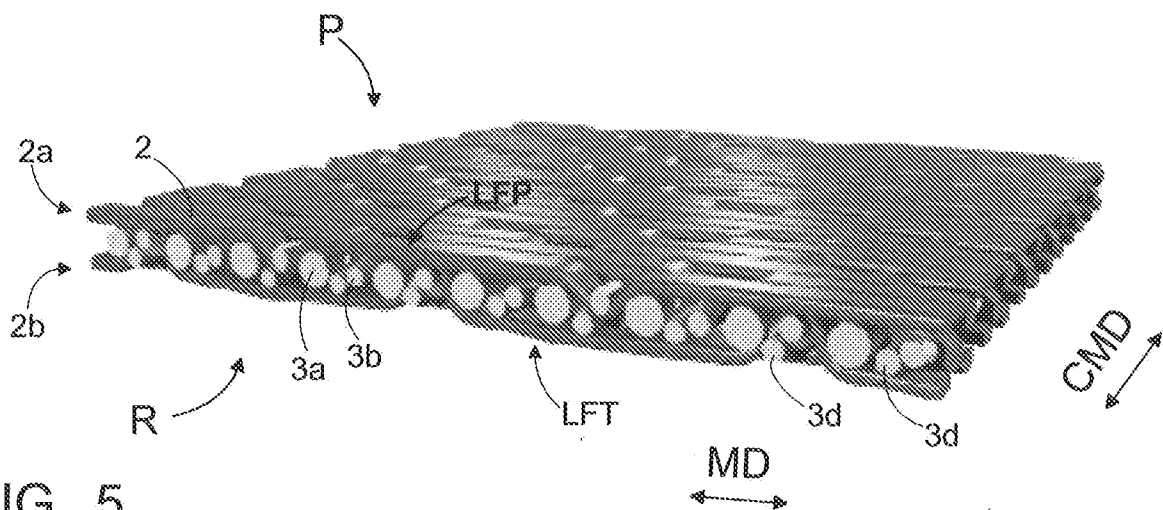


FIG. 5.

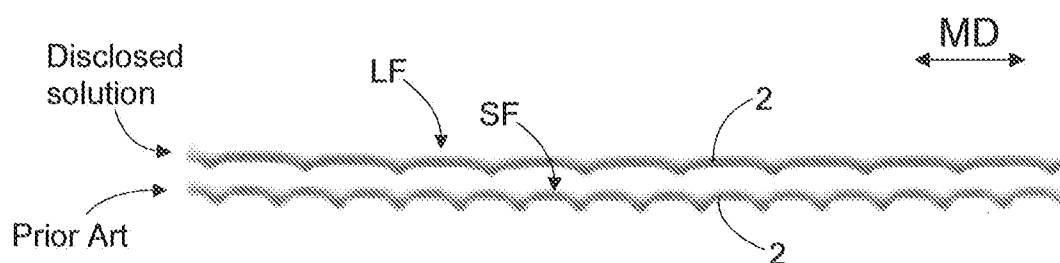


FIG. 6

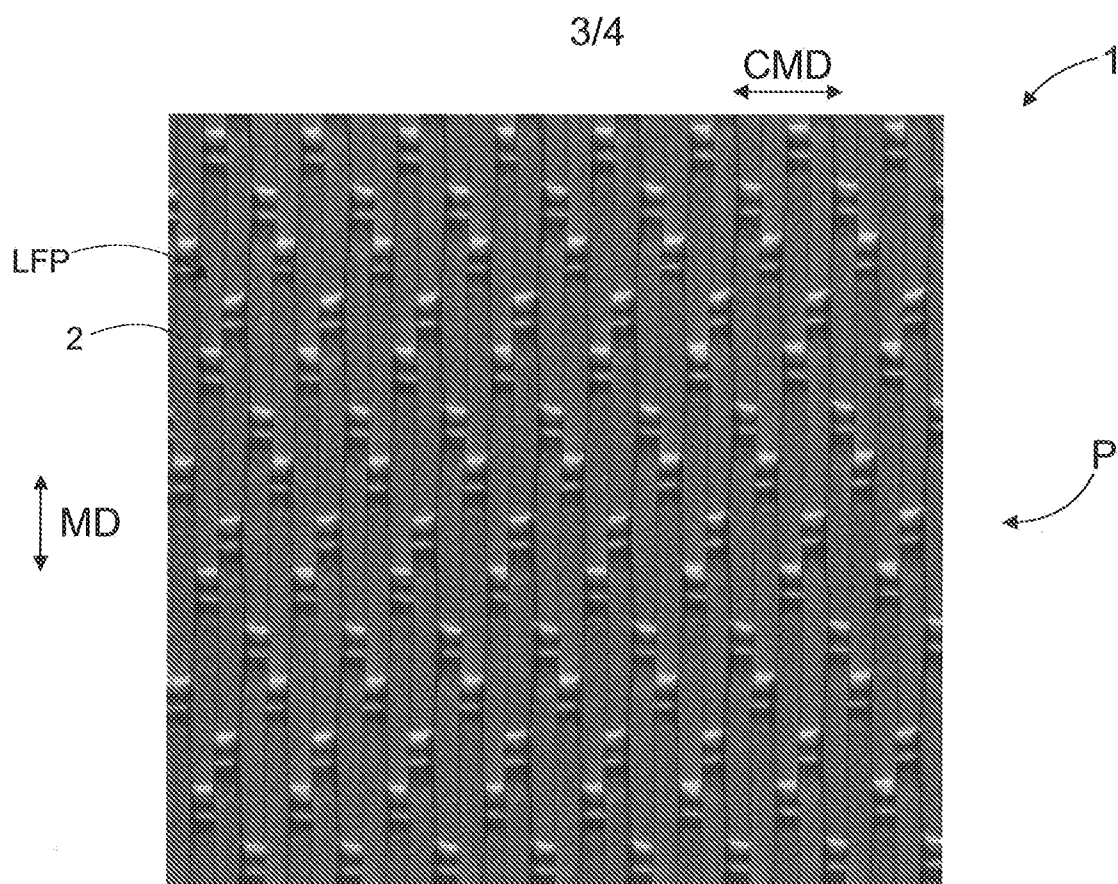


FIG. 7

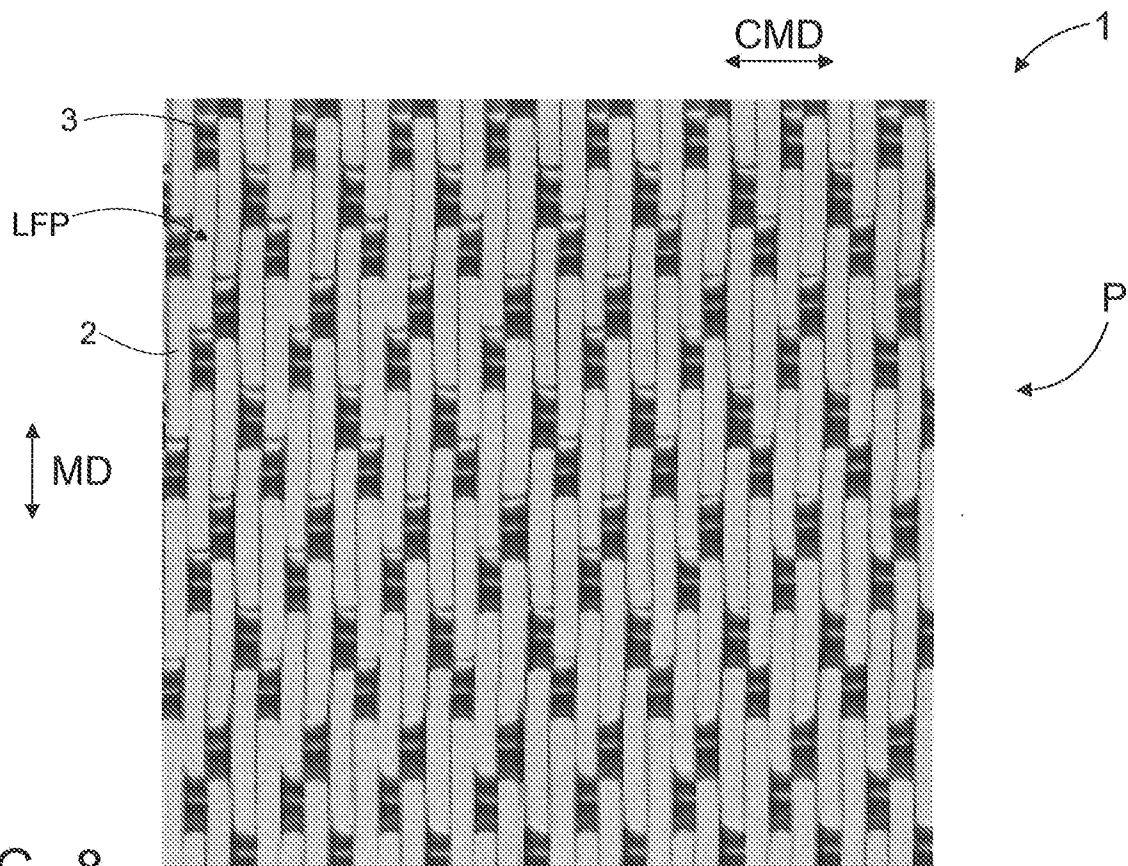
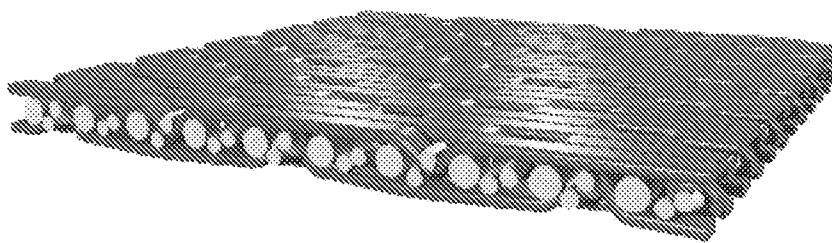


FIG. 8

Laboratory measurements for an example dryer fabric of 110 cfm, and being according to the disclosed solution:



*	Design	8 shed DC
*	Warp profile, mm	0.3 x 0.8
*	Warp count, 1/10 cm	240
*	Caliper, mm	1,6
*	Basic weight, g/m ²	1300
*	MD strength, kN/m	270
*	MD elongation @ 5 kN/m, %	0,9
*	CMD stiffness, mN	250
*	Contact area, %	52

FIG. 9

INTERNATIONAL SEARCH REPORT

International application No.

PCT/FI2016/050168

A. CLASSIFICATION OF SUBJECT MATTER

See extra sheet

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC: D21F, D01D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
FI, SE, NO, DK

Electronic data base consulted during the international search (name of data base, and, where practicable, search terms used)

EPO-Internal, WPIAP

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	US 5713397 A (QUIGLEY SCOTT [US]) 03 February 1998 (03.02.1998) abstract; column 3, line 9 – column 4, line 40; Figs. 2-4	1, 2, 4-8 3
X Y	US 5975149 A (LEE HENRY J [US] et al.) 02 November 1999 (02.11.1999) abstract; column 1, lines 8-14; column 2, lines 9-24, lines 36-40; lines 46-50; Figs. 1 and 3	1, 2, 4-8 3
Y A	US 6742548 B2 (ENQVIST RAUNO [FI]) 01 June 2004 (01.06.2004) abstract; column 1, lines 18-42; column 1, line 66 – column 2, line 2; column 2, lines 19-41 and lines 47-49; column 4, lines 45-49 and lines 55-59	3 5
A	US 5429686 A (CHIU KAI F [US] et al.) 04 July 1995 (04.07.1995) abstract; column 2, lines 46-62; column 3, lines 34-36	5

☐ Further documents are listed in the continuation of Box C.
 ☒ See patent family annex.

* Special categories of cited documents:	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
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Date of the actual completion of the international search

22 June 2016 (22.06.2016)

Date of mailing of the international search report

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/FI2016/050168

CLASSIFICATION OF SUBJECT MATTER

IPC
D21F 7/08 (2006.01)
D21F 7/12 (2006.01)

INTERNATIONAL SEARCH REPORT
Information on Patent Family Members

International application No.
PCT/FI2016/050168

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