



(51) International Patent Classification:
D21F 1/00 (2006.01)

(21) International Application Number:
PCT/IB2016/053442

(22) International Filing Date:
10 June 2016 (10.06.2016)

(25) Filing Language: Italian

(26) Publication Language: English

(30) Priority Data:
102015000022907 11 June 2015 (11.06.2015) IT

(71) Applicant: **FELTRI MARONE S.P.A.** [IT/IT]; Via
Giotto, 3, 20145 Milano (IT).

(72) Inventor: **ROSSETTI, Clara**; Via Vesto, 2, 25054 Ma-
rone (IT).

(74) Agents: **CERNUZZI, Daniele** et al.; c/o STUDIO TORTA
S.p.A., Via Viotti, 9, 10121 Torino (IT).

(81) Designated States (unless otherwise indicated, for every
kind of national protection available): AE, AG, AL, AM,
AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY,
BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM,

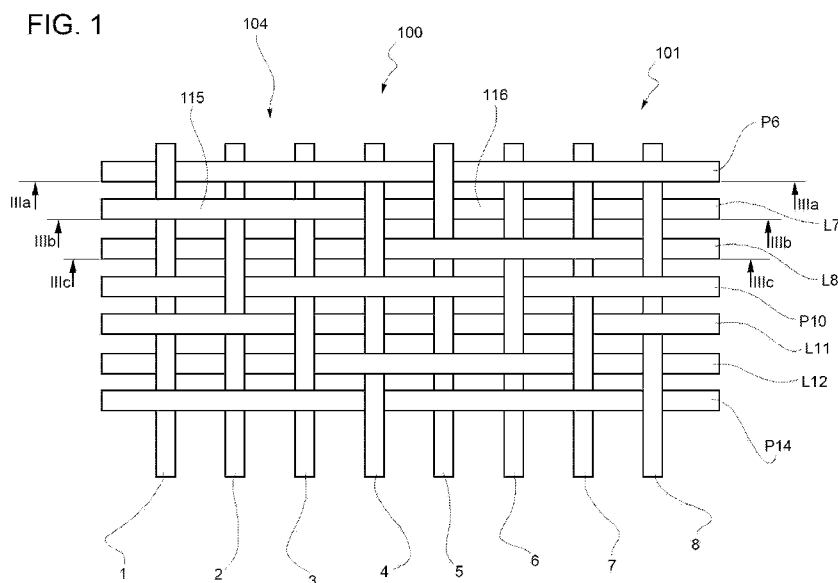
DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT,
HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR,
KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG,
MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM,
PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC,
SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN,
TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every
kind of regional protection available): ARIPO (BW, GH,
GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ,
TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU,
TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE,
DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU,
LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK,
SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ,
GW, KM, ML, MR, NE, SN, TD, TG).

Published:

- with international search report (Art. 21(3))
- before the expiration of the time limit for amending the
claims and to be republished in the event of receipt of
amendments (Rule 48.2(h))

(54) Title: TRIPLE PAPERMAKING FABRIC



(57) Abstract: A papermaking fabric (100) has a fabric repeating unit (104) that comprises eight top MD yarns (1-8) and eight bot-
tom MD yarns (9-16) that extend in machine direction (MD); three top CMD yarns (P6,P10,P14) interwoven only with the top MD
yarns (1-8); three bottom CMD yarns (MC5,MC9,MC13) interwoven only with the bottom MD yarns (9-16); and two pairs of bind-
ing yarns (L7, L8, L11, L12) interwoven with both the top MD yarns (1-8) and the bottom MD yarns (9-16); the binding yarns (L7,
L8, L11, L12) of each pair cross each other under respective transition yarns (T); the binding yarns (L7, L8, L11, L12) of each pair,
together, leave exposed on a top surface of the fabric (100) only single isolated transition yarns (T), all separated from each other in
cross machine direction by a plurality of adjacent top MD yarns (1-8).



"TRIPLE PAPERMAKING FABRIC"TECHNICAL FIELD

The present invention relates to a papermaking fabric, in particular intended for use as a forming fabric in a forming section of a papermaking machine.

BACKGROUND ART

The traditional fourdrinier papermaking process mainly provides three successive steps, carried out in the corresponding sections of the papermaking machine: forming section, pressing section, drying section.

In the forming section, an aqueous pulp of cellulose fibers (and any possible other components) is arranged on a so-called forming fabric or canvas, which is tape-shaped closed in a loop and supported by rollers. The removal of water from the pulp through the forming fabric leads to the progressive formation of a wet paper material tape, with a relatively high water content still remaining. A further removal of water takes place in the pressing section, in which the paper material is pressed by passing through one or more pairs of rollers. The paper material is then sent to the drying section for final moisture removal. The paper thus formed is ready for the subsequent finishing and packaging steps.

In the following, as customary in the field of papermaking and related fabrics, the terms "machine direction" (abbreviated "MD") and "cross machine direction" (abbreviated "CMD") are used to indicate respectively a direction aligned with the feed direction of the forming fabric in the papermaking machine, and a direction parallel to the fabric surface and crosswise (perpendicular) to the feed direction. Also direction or orientation of the warp and weft yarns of the forming fabric are indicated with reference to the machine direction and cross machine direction.

It is also intended, again as customary in the industry, that the surface of the forming fabric in contact with the cellulose pulp (i.e. with the paper material being formed) is the top surface of the fabric; and that the opposite surface facing the machine is the bottom surface. This reference is also adopted to describe the vertical spatial arrangement of the yarns in the forming fabric.

Some characteristics of the papermaking fabrics are of particular importance, such as the support capacity and filtration capacity, especially in the forming section.

Furthermore, the papermaking fabrics should show excellent stability even when moved at high speeds, a high permeability to reduce the amount of water retained in the pulp when transferred to the pressing section, and a reduced energy consumption for the handling thereof.

Although various types of papermaking fabrics are known, in particular for use in the forming section, margins of improvement in this field still seem to be possible, for example in terms of mechanical strength, stability, life span, draining capacity and quality of the formed paper.

For example, WO2014/091410 describes a papermaking fabric having a top layer formed by top CMD yarns interwoven only with top MD yarns; a bottom layer formed by bottom yarns CMD interwoven only with bottom MD yarns; binding yarns are interwoven with both the top and bottom MD yarns, therefore binding the top and bottom layer.

On the other hand, it is known that even small changes of the structure can unpredictably affect the fabric performance and therefore, the properties of the paper manufactured from said fabric. It is well known in the field that apparently even

very similar structures can behave in a completely different manner.

In fact, the fabric structure has a direct impact on the quality of the paper sheet being formed on the fabric, intimately in contact with the same: but the way in which structural changes to the fabric may affect the quality of the paper is not predictable.

DISCLOSURE OF INVENTION

It is therefore an object of the present invention to provide a papermaking fabric that maintains these characteristics to a satisfactory extent, resulting in particular, fully effective, high drainage, resistant and stable in time, and ensuring the formation of high quality paper.

The present invention therefore relates to a papermaking fabric as defined, in essential terms, in the appended claim 1 and, in its additional characters, in the dependent claims.

The present invention also relates to the use of said fabric in a papermaking machine, and specifically in the forming section of the machine, as defined in the appended claim 18.

The invention provides a papermaking fabric which, as some known fabrics, has a two layer structure, each of which is formed by independent weft and warp yarns, and a binding system formed by pairs of binding yarns; however, the invention is distinguished by the specific fabric structure which allows a fully effective fabric to be obtained, high drainage, resistant and stable in time, and capable of ensuring the formation of high quality paper.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention is further described in the following non-limiting examples of embodiments, with reference to the

accompanying figures wherein:

- Figure 1 is a schematic top plan view of a top fabric layer according to the invention, of which a fabric repeating unit is shown;

5 - Figure 2 is a schematic top plan view of a bottom fabric layer of Figure 1;

- Figures 3a, 3b, 3c are sectional views according to the trace planes IIIa-IIIa, IIIb-IIIb, IIIc-IIIc of Figures 1 and 2, respectively;

10 - Figure 4 is a schematic top plan view of an alternative of the top fabric layer according to the invention;

- Figure 5 is a schematic top plan view of a bottom fabric layer of Figure 4;

15 - Figures 6a, 6b, 6c, 6d are sectional views according to the trace planes VIa-VIa, VIb-VIb, VIC-VIC, VID-VID of Figures 4 and 5, respectively;

- Figure 7 is a view in machine direction (warp) of a detail of the fabric of the invention.

20 BEST MODE FOR CARRYING OUT THE INVENTION

With reference to Figures 1-3, the number 100 denotes as a whole a papermaking fabric, in particular a forming fabric for use in the forming section of a papermaking machine.

25 The fabric 100 is a triple 16 harness fabric and comprises a top layer 101 and a bottom layer 102 formed, as usual, by respective repeat units which together form one fabric repeating unit 104; in Figures 1 and 2 a single fabric repeating unit 104 is shown; it is understood that in
30 commercial and industrial applications the unit 104, as well as the repeat units of the individual layers 101, 102, may be repeated several times, both in machine direction and in cross machine direction, to form a fabric 100 having suitable sizes for use on a papermaking machine.

35

In general, the fabric 100 is formed by longitudinal warp

yarns that extend in machine direction (MD) and cross weft yarns, substantially orthogonal to the preceding ones, which extend in cross machine direction (CMD). In the following (and as usual in the field), the longitudinal warp yarns that extend in machine direction will be indicated, for brevity, as "MD yarns", and cross weft yarns which extend in cross machine direction as "CMD yarns".

In this case, a repeat unit 104 of the fabric 100 comprises eight top MD yarns 1-8, three top CMD yarns P6,P10,P14, eight bottom MD yarns 9-16, three bottom CMD yarns MC5,MC9,MC13, and four binding yarns L7,L8,L11,L12 comprising respective support portions 115 and respective binding portions 116.

The top layer 101 comprises the top MD yarns 1-8 and the top CMD yarns P6,P10,P14, as well as the support portions 115 of the binding yarns L7,L8,L11,L12.

The bottom layer 102 comprises the bottom MD yarns 9-16 and the bottom CMD yarns MC5,MC9,MC13, as well as the binding portions 116 of the binding yarns L7,L8,L11,L12 which extend to bind the bottom MD yarns 9-16.

The top CMD yarns P6,P10,P14 are interwoven only with the top MD yarns 1-8, and the bottom CMD yarns MC5,MC9,MC13 are interwoven only with the bottom MD yarns 9-16. The binding yarns L7,L8,L11,L12 bind the top MD yarns 1-8 with the bottom MD yarns 9-16.

The top MD yarns 1-8 and the top CMD yarns P6,P10,P14 are interwoven so that each top CMD yarn P6,P10,P14 passes over three adjacent top MD yarns and under a following top MD yarn, and so on. For example, as shown in Figure 3a, the top CMD yarn P6 passes under the top MD yarn 1, over the top MD yarns 2,3,4, under the top MD yarn 5, over the top MD yarns 6,7,8 and so on.

The same pattern is followed by all the top CMD yarns P6,P10,P14, but the top CMD yarns are offset in cross machine direction, by one or two top MD yarns, specifically.

5

In particular, the top CMD yarn P10 is offset by a top MD yarn with respect to the preceding top CMD yarn P6 (then passing under the top MD yarns 2, 6 and over the remaining top MD yarns 1,3,4,5,7,8), and the top CMD yarn P14 is offset by two
10 top MD yarns with respect to the preceding top CMD yarn P10 (then passing under top MD yarns 4,8 and over the remaining top MD yarns 1,2,3,5,6,7).

The layers 101, 102 are joined and bound together to form the
15 fabric 100 by means of the binding yarns L7,L8,L11,L12.

Each binding yarn L7,L8,L11,L12 comprises, in a fabric repeating unit 104, a support portion 115, which is arranged over the top MD yarns 1-8 and is interwoven with the same, and
20 a binding portion 116, which is arranged under the top MD yarns 1-8 and is interwoven with the bottom MD yarns 9-16.

The binding yarns L7,L8,L11,L12 are arranged in pairs between pairs of adjacent top CMD yarns P6,P10,P14. Each pair of
25 binding yarns L7,L8 and L11,L12 is arranged between two adjacent top CMD yarns P6,P10,P14.

In particular, the pair of binding yarns L7,L8 is arranged between the top CMD yarns P6,P10, and the pair of binding
30 yarns L11,L12 is arranged between the top CMD yarns P10,P14.

35

The binding yarns L7,L8; L11,L12 of each pair (though
5 represented side by side, for clarity, in relation to the out
of scale schematic views of Figures 2 and 3) are interwoven
together and are vertically overlapped, so that the support
portions 115 of a binding yarn of the pair are overlapping the
binding portions 116 of the other binding yarn of the pair,
10 and vice versa; the two binding yarns of a pair cross each
other along some of the top MD yarns 1-8 which define
respective transition yarns T, which pass over both the
binding yarns of the pair and under which, the binding yarns
of the pair cross each other, which define the transition
15 between the support portions 115 and the binding portions 116.

The binding yarns L7,L8; L11,L12 of each pair, together, leave
exposed (on the top surface of the fabric 100) only single
isolated transition yarns T. For each pair of binding yarns
20 L7,L8; L11,L12 each transition yarn T is separated from the
other transition yarns T in cross machine direction by a
plurality of other top MD yarns; in other words, the
transition yarns T are all separated from each other in cross
machine direction by a plurality of other top MD yarns. There
25 are, therefore, only individual transition yarns T (not
adjacent to one another), regularly spaced from one another in
the cross machine direction by a plurality of other top MD
yarns. There are, instead, no adjacent transition yarns T. In
particular, the transition yarns T are separated from each
30 other by other three adjacent top MD yarns.

For the pair of binding yarns L7,L8 the transition yarns T are
the top MD yarns 4 and 8; for the pair of binding yarns
L11,L12 the transition yarns T are the top MD yarns 3 and 7.
35 The transition yarns T of each pair of binding yarns L7,L8;
L11,L12 are spaced by three adjacent top MD yarns; the

transition yarns T of the two pairs of binding yarns L7,L8; L11,L12 are offset by one top MD yarn.

Each of the binding yarns L7,L8,L11,L12 passes over three
5 adjacent top MD yarns 1-8 (defining a supporting portion 115)
and under the following five adjacent top MD yarns 1-8
(defining a binding portion 116).

The binding yarns L7,L8; L11,L12 of each pair are interwoven
10 so that the support portions 115 of one are arranged over the
binding portions 116 of the other.

The two binding yarns L7,L8; L11,L12 of each pair, together,
pass over three adjacent top MD yarns, under a following top
15 MD yarn and so on, following the same pattern (i.e. the same
interlacing) of the top CMD yarns P6,P10,P14. The pairs of
binding yarns L7,L8; L11,L12, however, are offset with respect
to adjacent top CMD yarns (between which the pair of binding
yarns is arranged), so as to pass over the top MD yarns that
20 are left exposed by the adjacent top CMD yarns.

Both binding yarns L7,L8,L11,L12 of a pair pass under the
transition yarns T.

25 For example (Figure 3b), the binding yarn L7 passes over the
top MD yarns 1,2,3 with its own support portion 115 and passes
under the top MD yarns 4,5,6,7,8 with its own binding portion
116; the binding yarn L8 (Figure 3c) passes over the top MD
yarns 5,6,7 with its own support portion 115, as it passes
30 under the top MD yarns 1,2,3,4,8 with its own binding portion
116. Both binding yarns L7, L8 pass under the transition yarns
T defined by the top MD yarns 4 and 8.

In the fabric repeating unit 104, each binding yarn
35 L7,L8,L11,L12 binds (passes over) a tern of adjacent top MD 1-
8 yarns and binds (passes under) a bottom MD yarn 9-16, in

particular being offset in the machine cross direction by an even number of positions (for example, two positions or four positions) with respect to the tern of top bound MD yarns.

5 For example, the binding yarn L7 (Figure 3b) passes over (i.e. binds) the top MD yarns and under 1,2,3 (i.e. binds) the bottom MD yarn 15, which is offset by four positions in cross machine direction with respect to the top MD yarn 3; the binding yarn L8 (Figure 3c) passes over the top MD yarns 5,6,7
10 and under the bottom MD yarn 9, which is offset by two positions in cross machine direction with respect to the top MD yarn 7.

In the other pair of binding yarns L11,L12, the binding yarn
15 L11 passes over (i.e. binds) the top MD yarns 1,2,8, and under the top MD yarns 3,4,5,6,7 and passes under (i.e. binds) the bottom MD yarn 14, which is offset by four positions in cross machine direction with respect to the top MD yarn 2; the binding yarn L12 passes over the top MD yarns 4,5,6, under the
20 top MD yarns 1,2,3,7,8 and under the bottom MD yarn 10, which is also offset by four positions in cross machine direction with respect to the top MD yarn 7.

Ultimately, each binding yarn L7,L8,L11,L12 passes over three
25 adjacent top MD yarns 1-8 and under the following five adjacent top MD yarns 1-8, and so on; and under one bottom MD yarn 9-16 and over all the following bottom MD yarns 9-16, and so on.

30 In this way, the binding yarns L7,L8,L11 L12 and the top CMD yarns P6,P10,P14 form a four satin structure (four harness satin) with the top MD yarns 1-8 (Figure 1).

The bottom layer 102 (Figure 2) comprises the bottom MD yarns
35 9-16, the bottom CMD yarns MC5,MC9,MC13 and the binding portions 116 of the binding yarns L7,L8,L11,L12.

The bottom CMD yarns MC5,MC9,MC13 are interwoven with the bottom MD yarns 9-16 with a "over-2/under-6" sequence. For example, as shown in Figure 3a, the bottom CMD yarn MC5 passes
5 over the bottom MD yarns 10,11 and under the bottom MD yarns 9 and 12-16.

The other bottom CMD yarns MC9,MC13 follow a similar pattern "over-2/under-6" with respect to the bottom MD yarns 9-16, but
10 each is offset with respect to the adjacent bottom CMD yarn in cross machine direction (in particular by one position) so as to form an interrupted six harness twill structure.

The bottom layer 102 comprises, furthermore, the binding
15 portions 116 of the binding yarns L7,L8,L11,L12.

As already described, each binding yarn L7,L8,L11,L12 binds, in the fabric repeating unit 104, three adjacent top MD yarns 1-8 and one bottom MD yarn 9-16; in particular, each binding
20 yarn L7,L8,L11,L12 binds (by passing over) a tern of adjacent MD yarns 1-8 and (by passing over) one bottom MD yarn 9-16 which is offset by two or four positions in cross machine direction with respect to the tern of top MD yarns (specifically, with respect to the third and last top MD yarn
25 of the tern).

For example, the binding yarn L7 (Figure 3b) passes over (i.e. binds) the top MD yarns 1,2,3 and passes under (i.e. binds) the bottom MD yarn 15, which is offset by four positions in
30 cross machine direction with respect to the top MD yarn 3; the binding yarn L8 (Figure 3c) passes over the top MD yarns 5,6,7 and under the bottom MD yarn 9, which is offset by two positions in cross machine direction with respect to the top MD yarn 7.

Each binding yarn L7, L8, L11, L12 passes over a tern of
35 adjacent top MD yarns and under the following five top MD

yarns, and so on; and under one bottom MD yarn, and over the following seven bottom MD yarns, and so on.

5 The binding yarns L7,L8; L11,L12 of each pair, together, with respect to the top MD yarns 1-8, follow a sequence identical to the sequence of the top CMD yarns P6,P10,P14 with respect to the top MD yarns 1-8. In particular, the binding yarns L7,L8,L11,L12 of each pair follow an "over-3/under-1" sequence with respect to the top MD yarns 1-8, which is, specifically,
10 the same sequence of the top CMD yarns P6,P10,P14 with respect to the top MD yarns 1-8.

Again, the binding yarns L7,L8;L11,L12 of each pair, together, follow an "under-1/over-5" sequence (pair of binding yarns
15 L7,L8), or an "under-1/over-3" sequence (pair of binding yarns L11,L12), with respect to the bottom MD yarns 9-16.

Alternatively, the two pairs of binding yarns L7,L8; L11,L12 can follow the same sequence (and in particular one of the two
20 indicated), preferably being offset by one position in cross machine direction with respect to one another.

The interweave of the yarns L7,L8,L11,L12 with the top MD yarns 1-8 and bottom MD yarns 9-16 can however assume other
25 shapes.

As can be seen, as a whole, from the figures in the repeat unit 104 of the fabric 100 there are eight bottom MD yarns and eight top MD yarns.

30

The fabric 100 has a ratio between weft and warp yarns of 4:1.

It is intended as ratio between the weft and warp yarns the ratio between the number of weft yarns that are repeated to
35 form the fabric in machine direction and the number of the warp yarns that are repeated in cross machine direction to

form the fabric.

In the fabric 100 there are four weft yarns for each warp; this corresponds to the manufacturing mode of the fabric: in the weaving on a loom, four weft yarns are inserted for each warp yarn.

In cross section (section perpendicular to the machine direction), the fabric 100 thus has a sequence of four weft yarns that are repeated in machine direction for each warp yarn (that is alternately a top or bottom yarn depending on the weaving with the weft yarns).

In other words, the fabric repeating unit 104 is formed by a single warp yarn (MD yarn) every four weft yarns (CMD yarn): for each warp yarn (which can be a top MD yarn 1-8 or a bottom MD yarn 9-16, depending on the weave with the weft CMD yarns), there is in fact one top CMD yarn (one of P6,P10,P14), one bottom CMD yarn (one of MC5,MC9,MC13) and a pair of binding yarns (L7,L8; L11,L12).

In Figures 3a, 3b, 3c of the warp yarns are schematically shown overlapped in pairs to form the two layers; in reality, the warp yarns are thus arranged due to the interweaving effect with the weft yarns, but in cross machine direction there is only one warp yarn which is repeated.

The ratio between weft and warp yarns of 4:1 reflects the weaving mode of the fabric 100; at each beat (or insertion) of the fabric forming frame, on each warp yarn four consecutive weft yarns are inserted.

The fabric 100 has, therefore, a warp yarn every four weft insertions. Each top or bottom MD yarn is associated, in every frame insertion or beat, with a top CMD yarn, a bottom CMD yarn and a pair of binding yarns.

Those skilled in the art will recognize that the fabrics, according to the present invention, can take various shapes.

5 For example, with respect to what has been previously described, the number and/or the position of the binding yarn with respect to the number and/or the position of the top CMD yarns can be varied (for example there can be a binding yarn every two or three top CMD yarns, or there can be two or three
10 or more binding yarns for each top CMD yarn).

Also the number of the top and bottom CMD yarns of the fabric repeating unit can vary with respect to what is described and illustrated purely by way of example.

15

Moreover, all the weaving patterns or structures described for the layers 101, 102 can be different from those illustrated and described; for example, the top surface of the fabric does not necessarily need to be formed by a four harness satin
20 structure as shown, but can be like canvas, twill, broken twill, etc.; and the bottom surface of the fabric doesn't need to be a six harness broken twill structure, but can have another shape, such as a broken satin, plain structure (canvas), a broken twill, a twill, etcetera. Again, further
25 alternative structure patterns may be used in the fabric according to the present invention.

Yarns of various shapes (for example having a rounded or flattened section) and size.

30

The shape of the yarns used in the fabric of the invention can vary, also depending on the properties to impart to the final product. For example, the yarns may be monofilament yarns, flat monofilament yarns, multifilament yarns, multifilament or
35 monofilament interwoven yarns, yarns of any kind, or any combination thereof. The materials of which the yarns are made

of, can be those commonly used in the field. For example polyester, polyamide, polyamide/polyester yarns, or the like can be used. The technician skilled in the art will be able to select the materials of the yarns also as a function of the specific application for which the final fabric is intended to be used.

For example, the top MD yarns, the top CMD yarns and the binding yarns can have a diameter (equal or different from one another) comprised between about 0.10 and 0.25 mm; the bottom MD yarns can have a diameter between about 0.12 and 0.30 mm; the bottom CMD yarns can have a diameter between about 0.10 and 0.35 mm; these are purely exemplary dimensions, and yarns of other sizes can be used depending on specific needs. The knit also (i.e. the knit size) of the fabric may also vary. For example, the knit size of the top surface can be between about 34x38 and 37x48 (warp yarns per cm x weft insertions per cm) and the total knit size may vary between about 66x74 and 78x96 (warp yarns per cm x weft insertion per cm).

A fabric with a ratio of 4:1 and with the bottom layer having an six harness interrupted twill structure, produced according to the invention, has, for example, the characteristics shown in Table 1.

TABLE 1

YARN	Dimensions
top MD	0.12 mm
bottom MD	0.12 mm
binding	0.11 mm
top CMD	0.11 mm
bottom CMD	0.18 mm
mesh (top surface)	37 x 44 *
mesh (total)	74 x 88 *

(*) warp yarns per cm x weft insertions per cm

In Figures 4-6, wherein the details similar or identical to

those already described are indicated with the same reference numbers, an alternative of the fabric 100 of the invention is shown.

5 As shown in Figures 4 and 6a, the top layer 101 still has a four satin structure: the top CMD yarns, of which only a pair of adjacent yarns P14,P2 are represented, are in fact interwoven with the top MD yarns 1-8 with a sequence "over-3/under-1" (each top CMD yarn passes over three adjacent top
10 MD yarns and under a following top MD yarn, and so on).

As shown in Figures 5 and 6b, the bottom layer 102 has a structure: the bottom CMD yarns, of which only a pair of adjacent yarns MC13,MC1 are represented, are interwoven with
15 the bottom MD yarns 9-16 with a sequence "over-3/under-1" (each bottom CMD yarn passes over one bottom MD yarn and under the following three adjacent bottom MD yarns, and so on).

Figures 4, 5, 6c and 6d show a pair of binding yarns L15, L16,
20 which together have the same interlacing as described above: each binding yarn L15, L16 binds (passes over) a tern of adjacent top MD yarns 1-8 and binds (passes under) a bottom MD yarn 9-16, in particular offset in the cross direction by an even number of machine positions (for example, four positions)
25 with respect to the tern of bound top MD yarns.

The binding yarn L15 (Figure 6c) passes over (i.e. binds) the top MD yarns 1,2,3 and passes under (i.e. binds) the bottom MD yarn 15, which is offset by four positions in cross machine
30 direction with respect to the top MD yarn 3; the binding yarn L16 (Figure 6d) passes over the top MD yarns 5,6,7 and under the bottom MD yarn 11, which is also offset by four positions in cross machine direction with respect to the top MD yarn 7.

35 In all embodiments of the invention, it is possible to bind the top layer 101 and the bottom layer 102, as well as by

means of the binding yarns extending in cross machine direction (i.e. in the weft direction) as above described, also in machine direction (i.e. in the warp direction).

5 For this purpose, as shown in Figure 7, in the fabric repeating unit 104 at least a pair of overlapped MD yarns, i.e., one top MD yarn and one bottom MD yarn overlapping one another (belonging to the top layer 101 and to the bottom layer 102, respectively), as for example the top MD yarn 6 and
10 the bottom MD yarn 14 located directly under the top MD yarn 14, cross each other in machine direction, i.e. in the warp direction, so as to define a pair of warp binding yarns MD6, MD14, while maintaining the weaving patterns of both the top layer 101 (example: four satin), and of the bottom layer 102
15 (example: interrupted six twill structure).

The warp binding yarns MD6, MD14 of each pair are arranged directly one over the other, and cross each other maintaining the same basic structure (four satin). Each top MD yarn 1-8
20 and each bottom MD yarn 9-16 then maintains its weaving position even if acting as a warp binding yarn between the top layer 101 and the bottom layer 102.

In the fabric repeating unit 104 the warp binding yarns MD6,
25 MD14 cross each other only once.

In the unit 104 several pairs of overlapped MD yarn may cross each other, even all the pairs, to define respective pairs of warp binding yarns: preferably, adjacent pairs of warp binding
30 yarns cross each other, in offset positions, in machine direction.

It is understood that the binding in machine direction (warp) applies to all the embodiments of the invention and to all the
35 weaving patterns of the fabric 100 mentioned above and others, that furthermore, fall under the invention.

According to an aspect of the invention, the fabric 100 described above is used in a papermaking process, in particular in the forming section of a papermaking machine.

5 The process comprises the steps of:

(A) providing a papermaking fabric as described above;

(B) arranged on the top surface of the fabric an aqueous pulp of cellulose and/or a paper material to be formed; and

(C) removing water from the pulp and/or from the paper
10 material to be formed.

Said process is, essentially known and well understood by those skilled in the art, therefore further details in this respect are not necessary.

15

It remains understood that, with what has been described and illustrated herein further modifications and alternatives can be applied which do not depart from the scope of the invention as defined in the appended claims.

20

CLAIMS

1) A triple papermaking fabric (100), having at least one fabric repeating unit (104) that comprises:

5 - a set of warp yarns or machine direction (MD) yarns (1-16), that extend in machine direction (MD) and subdivide in eight top MD yarns (1-8) and eight bottom MD yarns (9-16);

- a set of weft yarns or cross machine direction (CMD) yarns (P6,P10,P14; MC5,MC9,MC13; L7,L8,L11,L12), that extend in
10 cross machine direction and specifically comprise: three top CMD yarns (P6,P10,P14), three bottom CMD yarns (MC5,MC9,MC13) and two pairs of binding yarns (L7,L8,L11,L12) comprising respective support portions (115) and respective binding portions (116);

15 wherein:

- the top CMD yarns (P6,P10,P14) are interwoven only with the top MD yarns (1-8) to form a top fabric layer (101);

- the bottom CMD yarns (MC5,MC9,MC13) are interwoven only with the bottom MD yarns (9-16) to form a bottom fabric layer
20 (102);

- the binding yarns (L7,L8,L11,L12) are interwoven with both the top MD yarns (1-8) and the bottom MD yarns (9-16) so as to bind the top layer (101) with the bottom layer (102);

- the binding yarns (L7,L8,L11,L12) are arranged in pairs
25 between pairs of adjacent top CMD yarns (P6,P10,P14); and the binding yarns (L7,L8,L11,L12) of each pair intersect with each other under respective transition yarns (T), which pass over both the binding yarns of the pair;

the fabric being characterized in that:

30 - the binding yarns (L7,L8; L11,L12) of each pair, together, leave exposed on a top surface of the fabric (100) only single isolated transition yarns (T), all separated from each other in cross machine direction by a plurality of adjacent top MD yarns (1-8); and

35 - the transition yarns (T) defined by a first pair of binding yarns (L7,L8) are offset by one top MD yarn with respect to

the transition yarns (T) defined by a second pair of binding yarns (L11,L12).

2) The fabric according to claim 1, wherein the transition
5 yarns (T) of each pair of binding yarns (L7,L8,L11,L12) are separated from each other by terns of adjacent top MD yarns (1-8).

3) The fabric according to claim 1 or 2, wherein the sequence
10 of the two binding yarns (L7,L8; L11,L12) of each pair, together, with respect to the top MD yarns (1-8) is the same as the sequence of the top CMD yarns (P6,P10,P14) with respect to the top MD yarns (1-8).

15 4) The fabric according to one of the preceding claims, wherein the two binding yarns (L7,L8; L11,L12) of each pair, together, pass over three adjacent top MD yarns (1-8) and under the following top MD yarn, and so on.

20 5) The fabric according to one of the preceding claims, wherein each binding yarn (L7,L8,L11,L12) passes over three adjacent top MD yarns (1-8) and under the following five adjacent top MD yarns (1-8), and so on; and under one bottom MD yarn (9-16) and over all the following bottom MD yarns (9-
25 16), and so on.

6) The fabric according to one of the preceding claims, wherein the pairs of binding yarns (L7,L8; L11,L12) are offset with respect to the adjacent top CMD yarns (P6,P10,P14) so, as
30 to pass over the top MD yarns (1-8) which are instead left exposed by the adjacent top CMD yarns (P6,P10,P14).

7) The fabric according to one of the preceding claims, wherein each binding yarn (L7,L8,L11,L12) binds, i.e. passes
35 over, a tern of adjacent top MD yarns (1-8) and binds, i.e. passes under, one bottom MD yarn (9-16) which is offset in

cross machine direction by an even number of positions with respect to said tern of top MD yarns.

8) The fabric according to claim 7, wherein each binding yarn (L7,L8,L11,L12) binds a tern of adjacent top MD yarns (1-8) and one bottom MD yarn (9-16) which is offset by two or four positions in cross machine direction with respect to the third and last top MD yarn of the tern.

9) The fabric according to one of the preceding claims, wherein each top CMD yarn (P6,P10,P14) passes over three adjacent top MD yarns (1-8) and under the next top MD yarn (1-8), and so on.

10) The fabric according to claim 9, wherein the top CMD yarns (P6,P10,P14) are offset in cross machine direction by one or two top MD yarns (1-8).

11) The fabric according to claim 9 or 10, wherein the fabric repeating unit (104) there is a first, a second and a third top CMD yarns (P6,P10,P14); the second top CMD yarn (P10) being offset by one top MD yarn with respect to the preceding first top CMD yarn (P6) and the third top CMD yarn (P14) being offset by two top MD yarns with respect to the preceding second top CMD yarn (P10).

12) The fabric according to one of the preceding claims, wherein the binding yarns (L7,L8,L11,L12) and the top CMD yarns (P6,P10,P14) form a four harness satin structure with the top MD yarns (1-8).

13) The fabric according to one of the preceding claims, wherein the bottom CMD yarns (MC5,MC9,MC13) are interwoven with the bottom MD yarns (9-16) with an "over-2/under-6" sequence.

14) The fabric according to the preceding claim, wherein each bottom CMD yarns (MC5,MC9,MC13) is offset by one position in cross machine direction with respect to the preceding bottom CMD yarn.

5

15) The fabric according to one of the preceding claims, wherein the fabric (100) has a ratio between weft and warp yarns of 4:1.

10 16) The fabric according to one of the preceding claims, wherein the top layer (101) and the bottom layer (102) are also bound in machine direction, i.e. in the warp direction.

15 17) The fabric according to claim 16, wherein in the fabric repeating unit (104) at least a pair of directly overlapped MD yarns (MD6,MD14), i.e. a top MD yarn and a bottom MD yarn directly overlapping one another, cross each other in machine direction, i.e. in the warp direction, so as to define a pair of binding warp yarns (MD6,MD14) maintaining the weaving
20 patterns of both the top layer (101) and the bottom layer (102).

18) Use of a fabric (100) according to any one of the preceding claims in a papermaking machine for conveying a
25 cellulose pulp and/or a paper material to be formed.

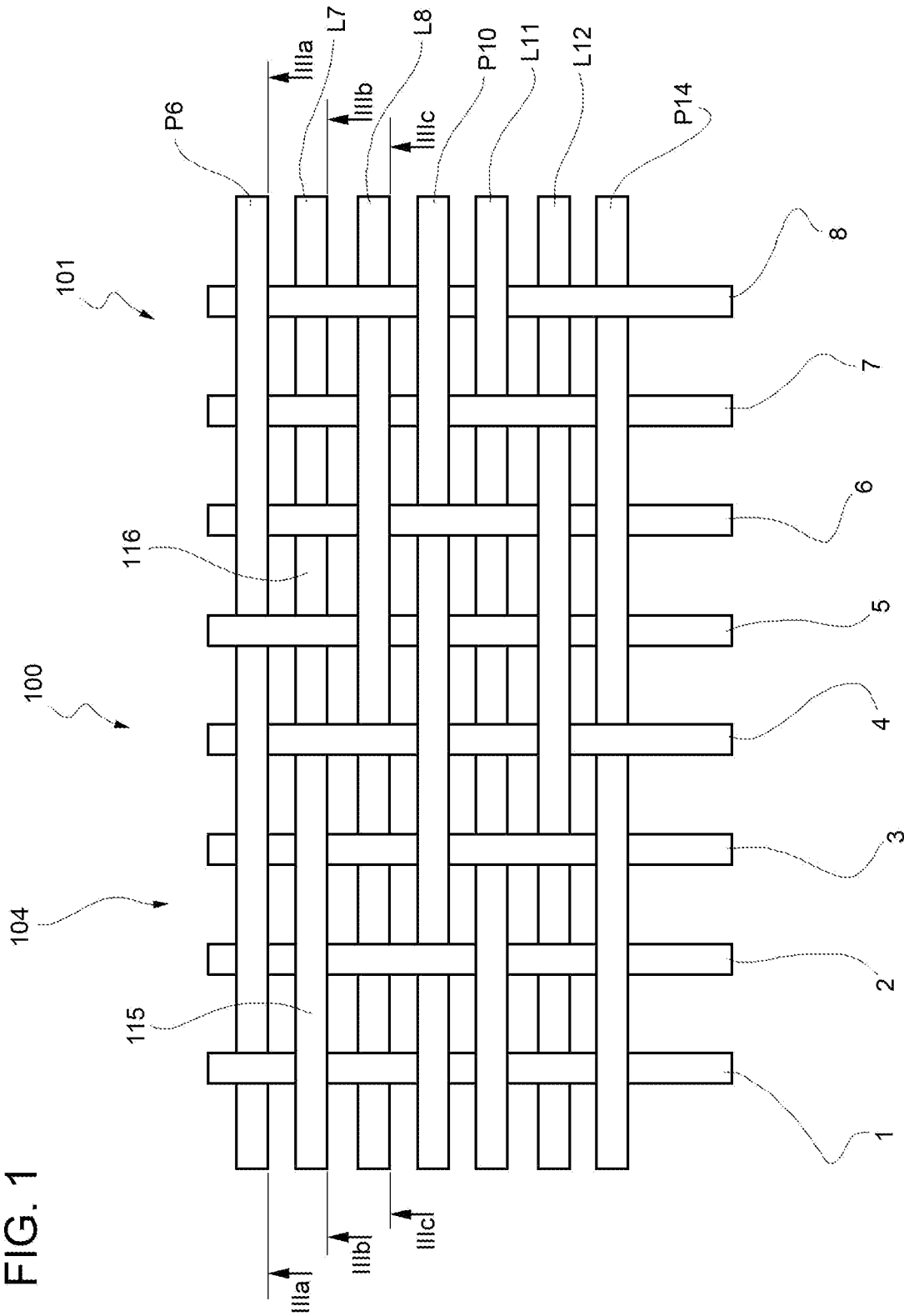


FIG. 2

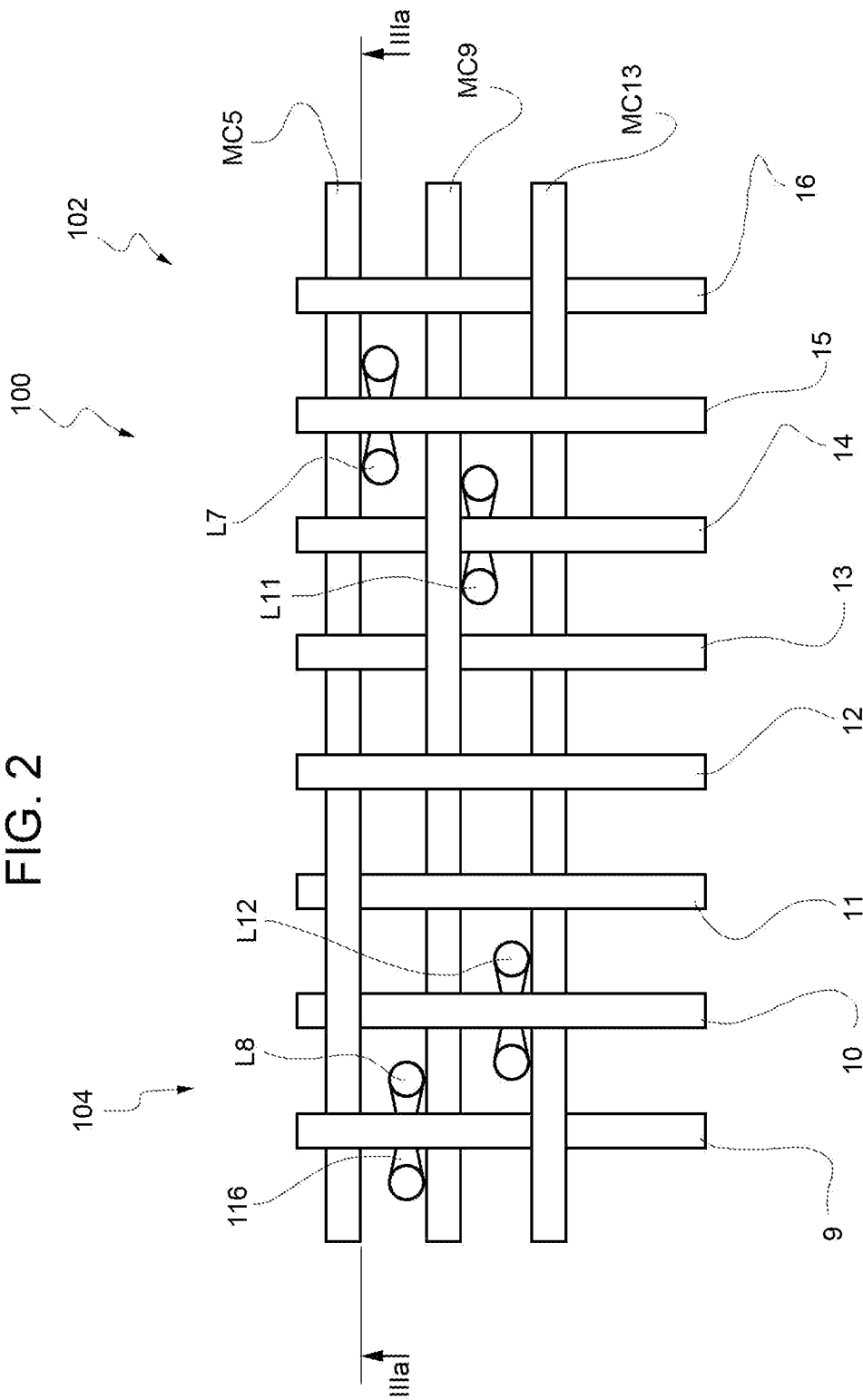


FIG. 3a

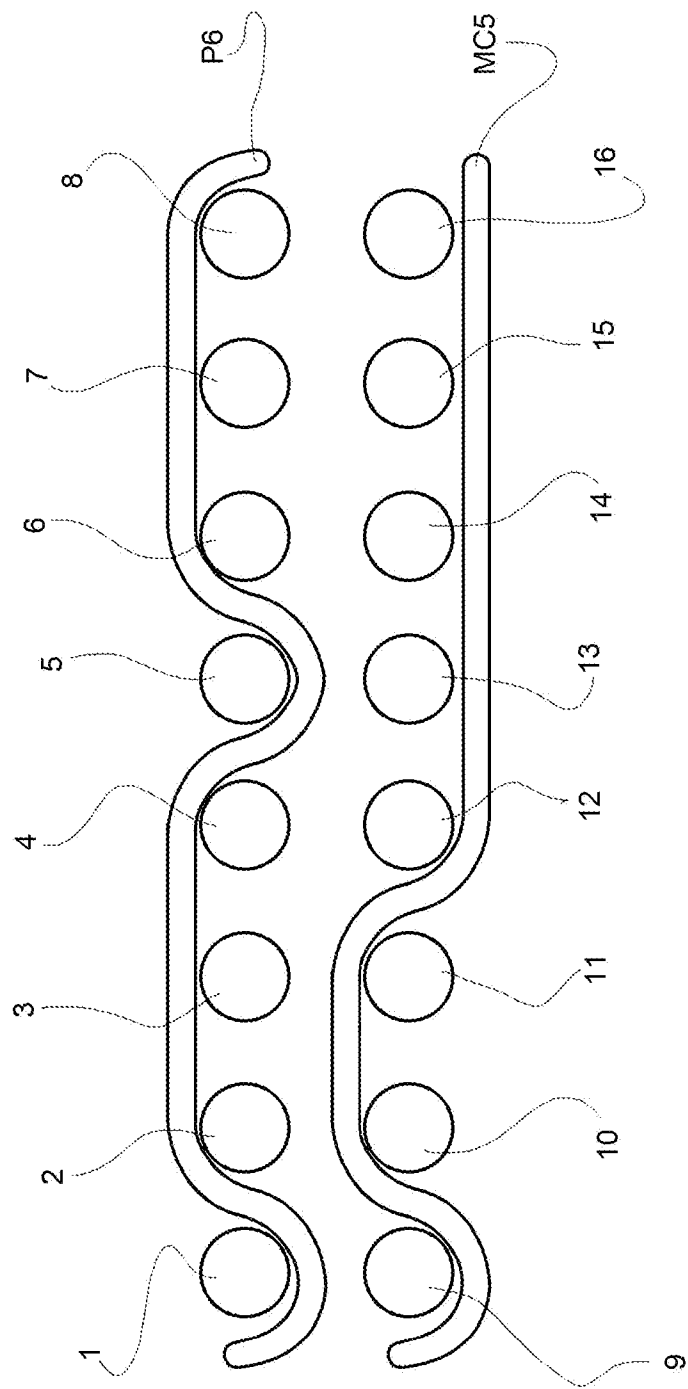


FIG. 3b

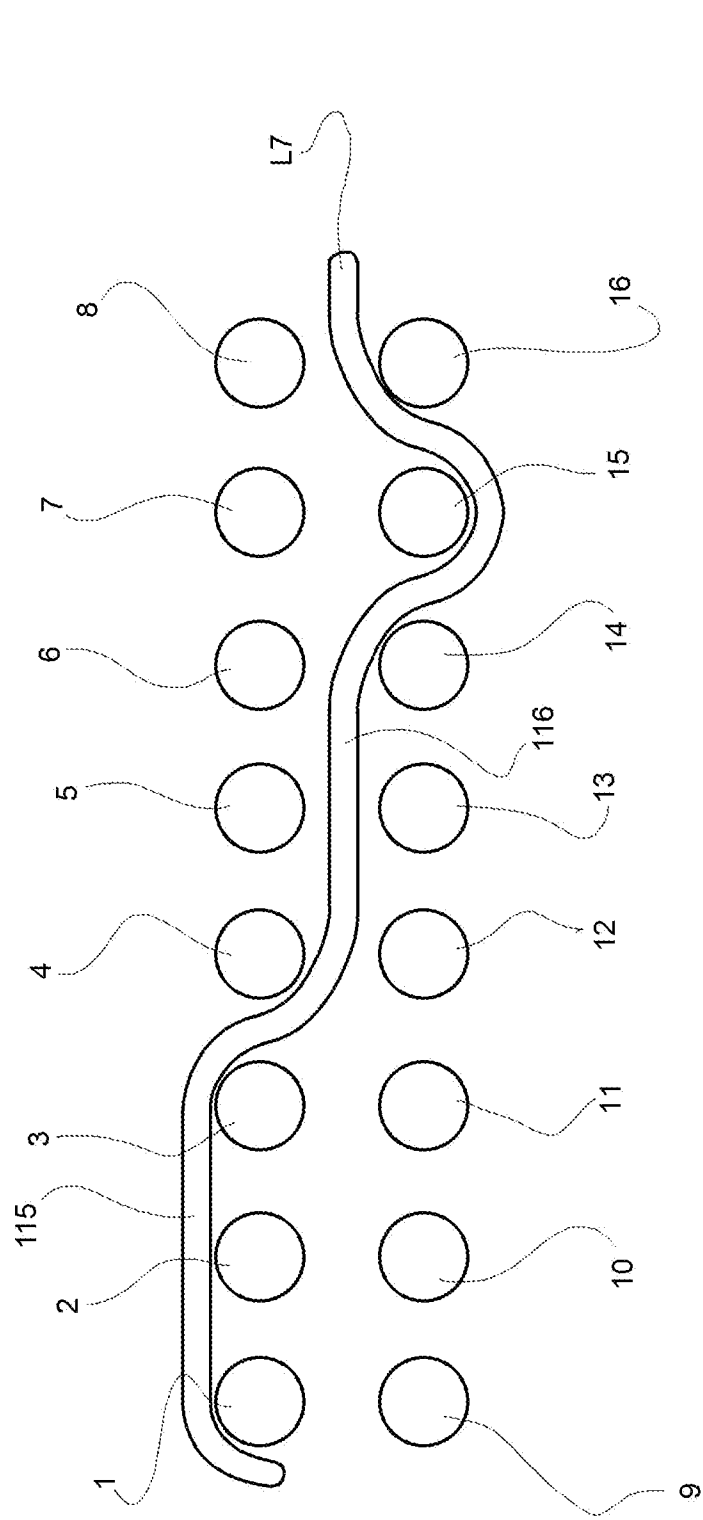


FIG. 3c

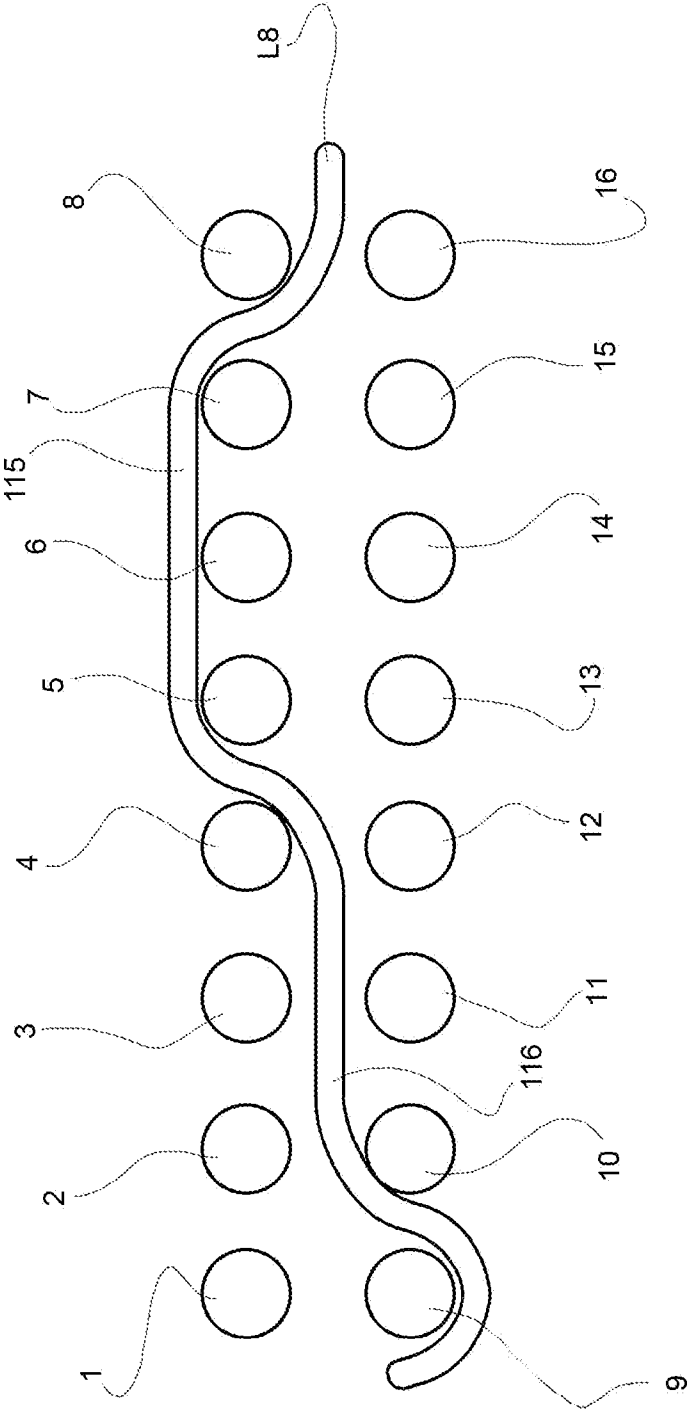


FIG. 4

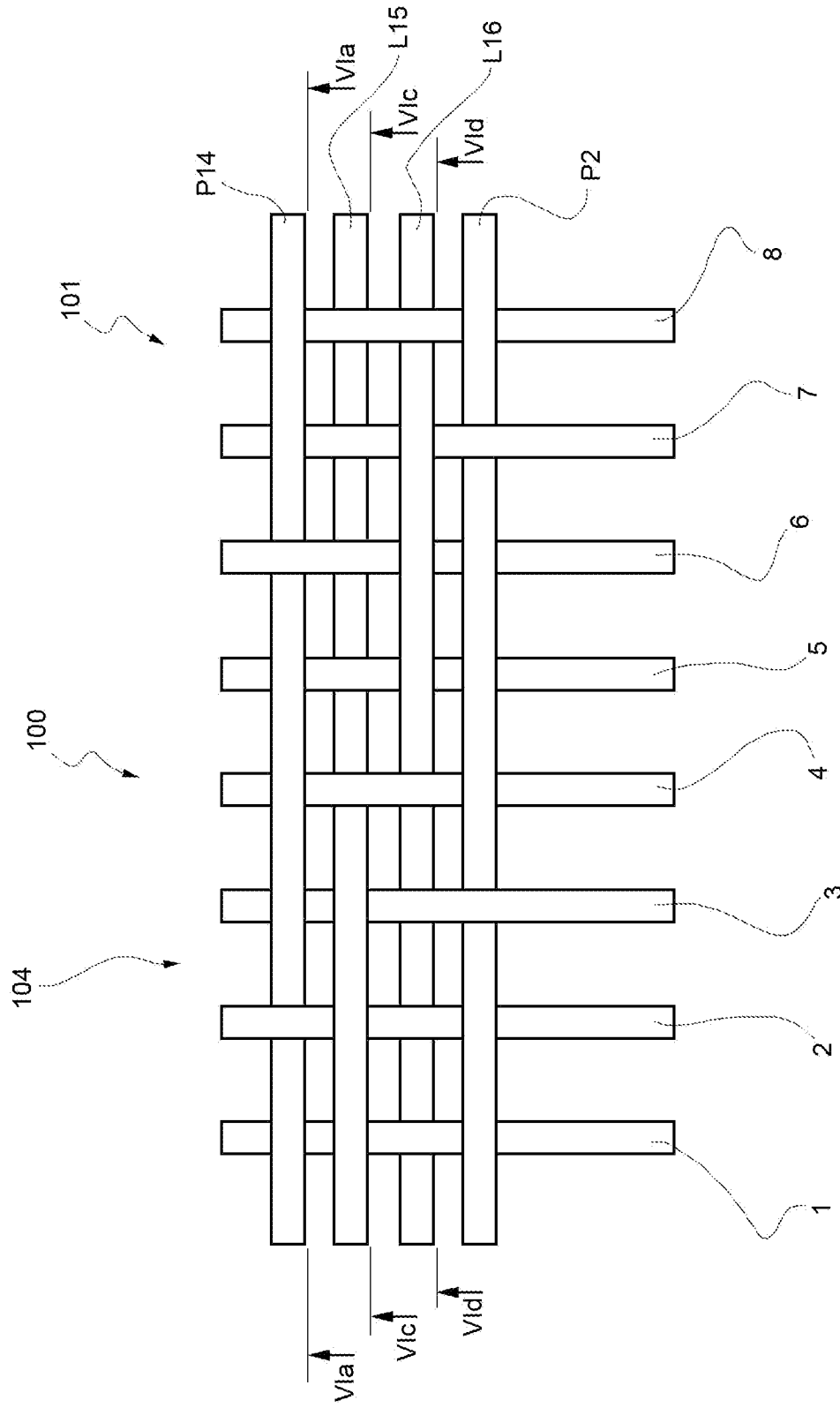
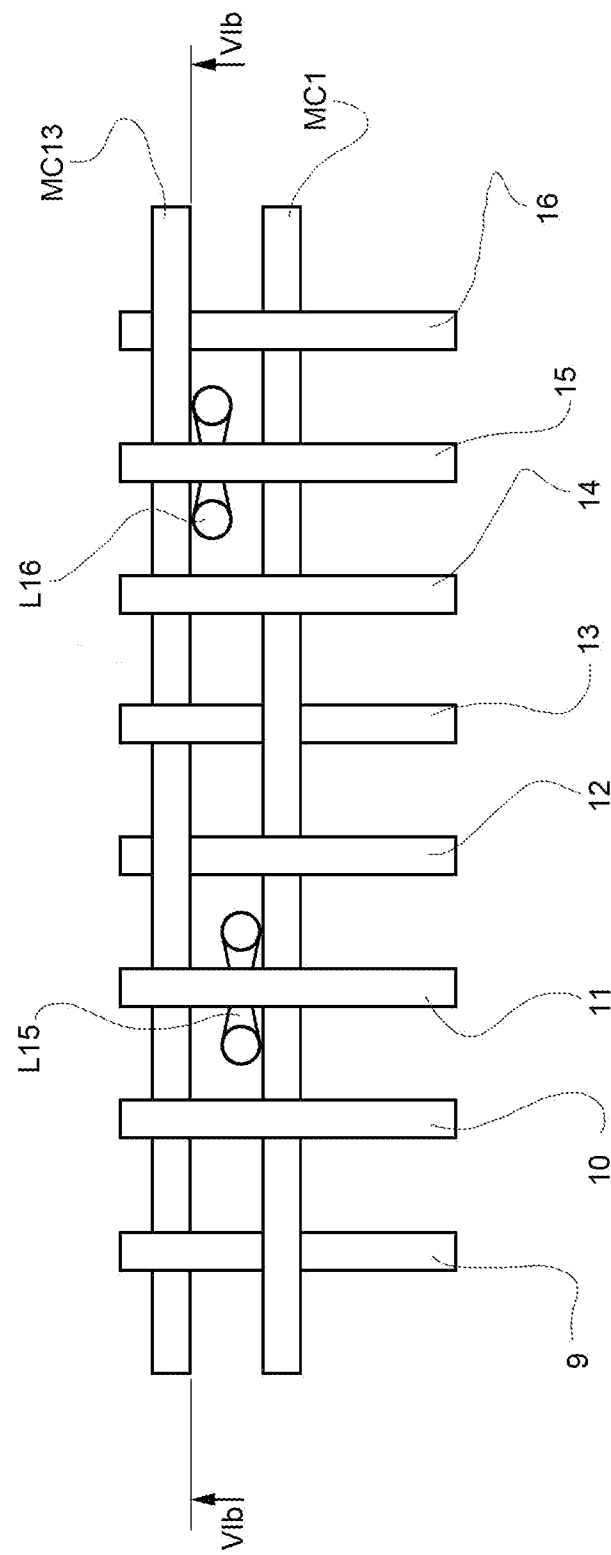
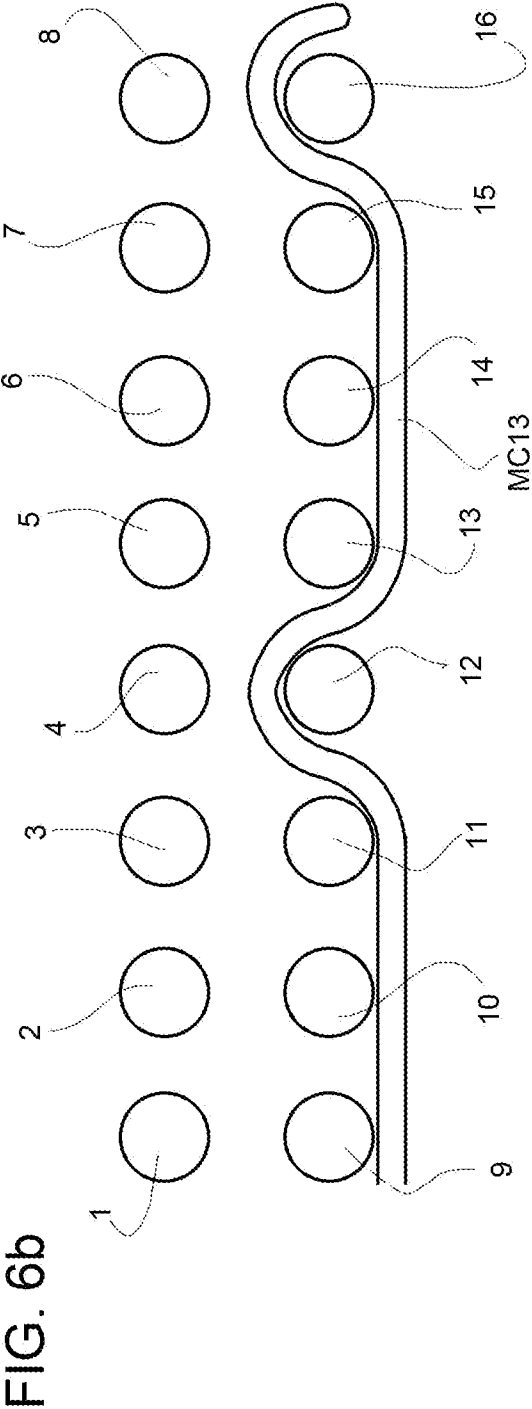
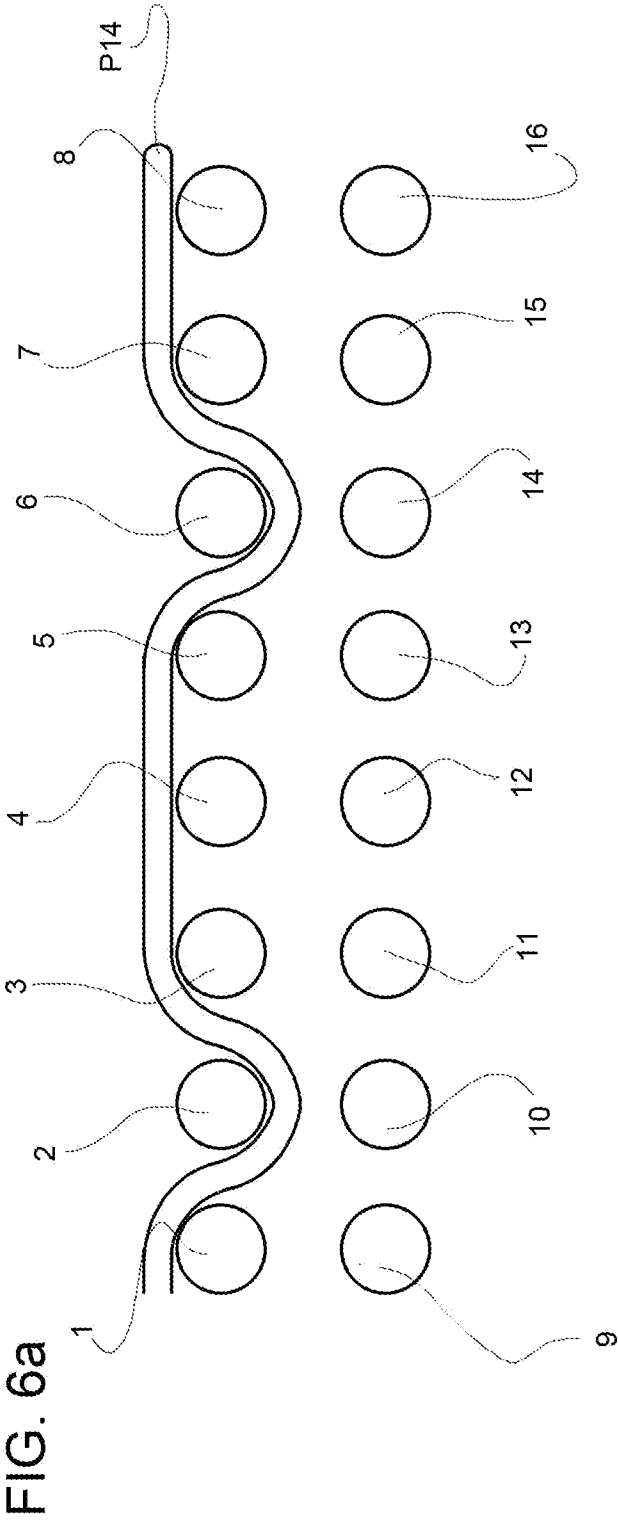


FIG. 5





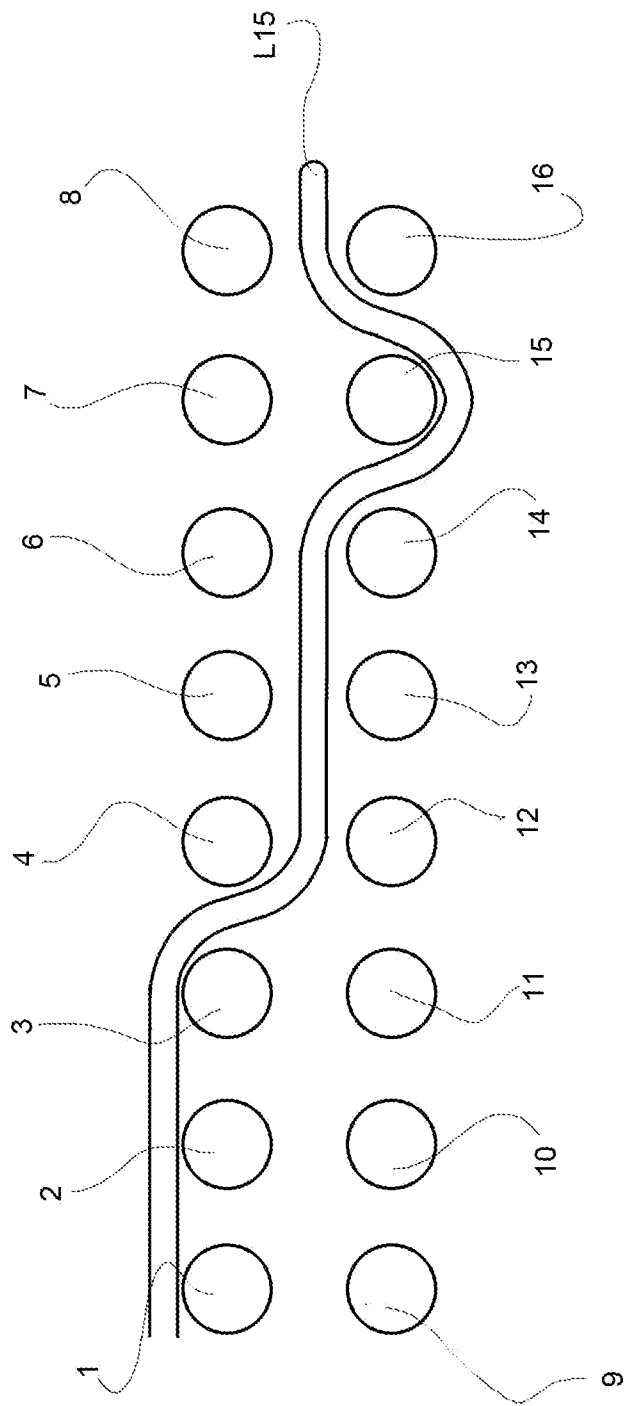


FIG. 6c

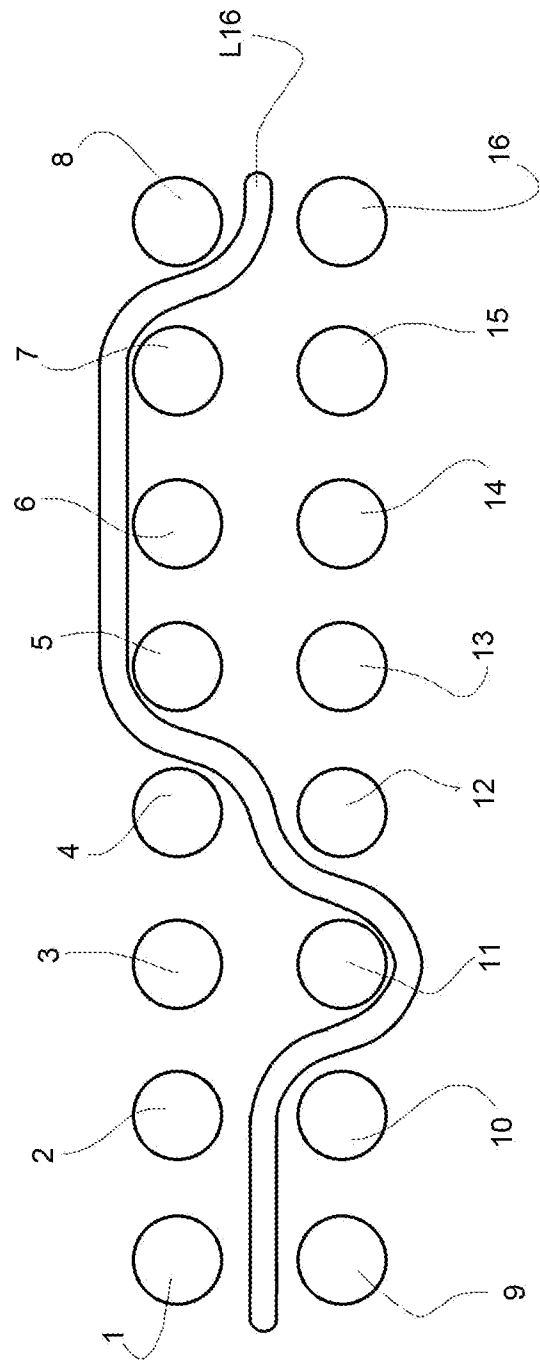
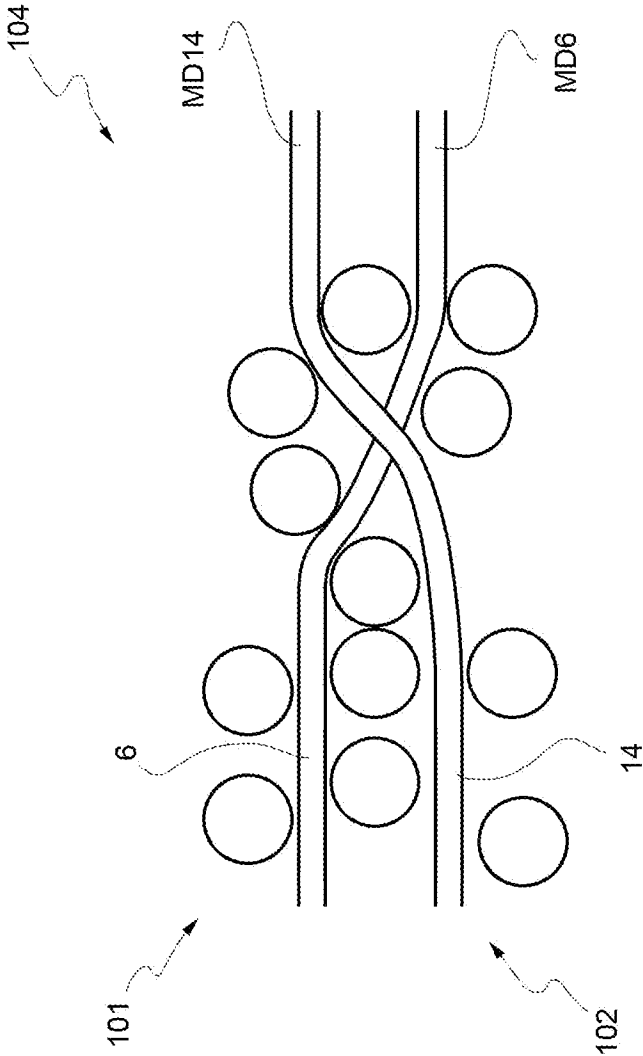


FIG. 6d

FIG. 7



INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2016/053442

A. CLASSIFICATION OF SUBJECT MATTER
INV. D21F1/00
ADD.

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)
D21F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

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

EP0-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2014/091410 A1 (FELTRI MARONE S P A [IT]) 19 June 2014 (2014-06-19) cited in the application figure 1 -----	1-18
A	DE 10 2011 003304 A1 (VOITH PATENT GMBH [DE]) 2 August 2012 (2012-08-02) figure 8 -----	1-18
A	WO 2012/120191 A1 (METSO FABRICS INC [FI]; TAIPALE SEPPO [FI]; SEPPAENEN MARI [FI]) 13 September 2012 (2012-09-13) claim 1; figures 2-6 -----	1-18
A	US 2007/062598 A1 (BARRATTE CHRISTINE [FR]) 22 March 2007 (2007-03-22) claim 1; figures 1-6 -----	1-18

☐

Further documents are listed in the continuation of Box C.

☒

See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"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

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

22 September 2016

Date of mailing of the international search report

30/09/2016

Name and mailing address of the ISA/

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040,
Fax: (+31-70) 340-3016

Authorized officer

Iamandi, Daniela

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/IB2016/053442

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2014091410 A1	19-06-2014	NONE	

DE 102011003304 A1	02-08-2012	CN 103459712 A	18-12-2013
		DE 102011003304 A1	02-08-2012
		EP 2668332 A1	04-12-2013
		US 2014027080 A1	30-01-2014
		WO 2012101099 A1	02-08-2012

WO 2012120191 A1	13-09-2012	CA 2828773 A1	13-09-2012
		CN 103443356 A	11-12-2013
		EP 2681359 A1	08-01-2014
		FI 20115222 A	05-09-2012
		JP 2014507573 A	27-03-2014
		KR 20140025372 A	04-03-2014
		US 2013327490 A1	12-12-2013
		WO 2012120191 A1	13-09-2012

US 2007062598 A1	22-03-2007	AR 057825 A1	19-12-2007
		AT 532898 T	15-11-2011
		AU 2006220386 A1	05-04-2007
		BR PI0603942 A	14-08-2007
		CA 2558427 A1	22-03-2007
		CN 1982535 A	20-06-2007
		EP 1767691 A2	28-03-2007
		JP 4602955 B2	22-12-2010
		JP 2007084994 A	05-04-2007
		KR 20070033928 A	27-03-2007
		US 2007062598 A1	22-03-2007
