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(54) **PAPERMAKING FABRIC**

(57) A papermaking fabric (1) is formed by MD yarns (11-18) extending in machine direction interwoven with CMD yarns (21-24) extending in cross machine direction; the fabric extends between two longitudinally opposite end transverse edges (3), provided with seaming loops (25) formed by some pairs of MD yarns (11-16) and joined by a seam (4) having a repetition unit repeating in cross machine direction; in the repetition unit of the seam (4) there are N+1 pairs of MD yarns (11-18), where N is equal to or greater than 3; and the fabric has a seaming ratio, defined as the ratio between the number of pairs of MD yarns (11-16) forming seaming loops (25) and the number of pairs of MD yarns (17,18) that do not form seaming loops, equal to N:1.

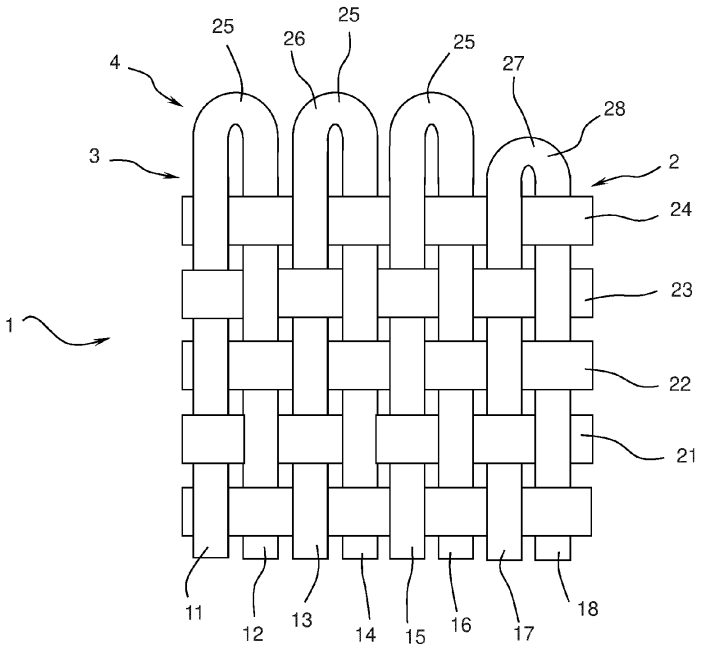


FIG. 1

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## Description

### CROSS-REFERENCE TO RELATED APPLICATIONS

**[0001]** This Patent Application claims priority from Italian Patent Application No. 102021000007658 filed on March 29, 2021.

### TECHNICAL FIELD

**[0002]** The present invention relates to a papermaking fabric, that is, a fabric for papermaking machines.

**[0003]** In particular, the invention relates to a fabric provided with a seam joining two opposite ends of the fabric to form an endless belt.

**[0004]** The fabric according to the present invention is particularly suitable for use as a drying fabric in the drying section of the papermaking machine.

### STATE OF THE PRIOR ART

**[0005]** In general, a papermaking fabric, that is, intended for use in one of the various sections of a papermaking machine, consists of warp yarns and weft yarns interwoven according to various patterns and extending respectively in machine direction (MD yarns) and in cross machine direction (CMD yarns), where the terms "machine direction" (abbreviated as "MD") and "cross machine direction" (abbreviated as "CMD") indicate a direction aligned with the direction of feed of the fabric in the papermaking machine, and a direction transverse (orthogonal) to the direction of feed, respectively.

**[0006]** The fabric is normally made in a flat shape and then closed to form an endless belt, either during production or directly on the papermaking machine, by joining the two opposite ends of the fabric by means of a junction, commonly known as a seam.

**[0007]** Various methods for making the junction or seam are known. For example, in one of the cases, the ends of the fabric are provided with seaming loops, formed by folded MD yarns, which are then made to interpenetrate so as to form a tubular passage through which one or more joining wires are inserted.

**[0008]** The joining area is usually the weakest part of the fabric and the one more subject to wear and deterioration in use, and it also causes a discontinuity in the fabric which can imprint surface defects on the paper being formed and carried by the fabric.

**[0009]** US9976254B2 discloses a fabric joined in the form of an endless belt and having in the seam a repetition unit formed by three pairs of MD yarns intertwined with CMD yarns, wherein two of the three pairs of MD yarns form seaming loops at the end edges of the fabric and wherein all the seaming loops have the same length. In this way, two thirds of the MD yarns have ends folded to form the seaming loops.

**[0010]** However, there remains a need to increase the strength of the joining area and its duration over time, and to prevent or at least reduce the formation of defects on the paper.

### OBJECT OF THE INVENTION

**[0011]** It is therefore an object of the present invention to provide a papermaking fabric which overcomes the drawbacks of the prior art, in particular allowing the strength of the joining area to be increased and the formation of defects on the paper to be reduced.

**[0012]** Therefore, the present invention relates to a papermaking fabric as defined in essential terms in the appended claim 1 and, in its additional features, in the dependent claims.

### BRIEF DESCRIPTION OF THE DRAWINGS

**[0013]** The invention is further described in the following non-limiting embodiments, with reference to the attached figure which is a partial, schematic top plan view of a fabric according to the invention.

**[0014]** In the attached figure, the numeral 1 indicates a papermaking fabric, that is, a fabric intended for use on papermaking machines.

### PREFERRED EMBODIMENT OF THE INVENTION

**[0015]** For example, but not necessarily, the fabric 1 is used as a drying fabric in the drying section of the papermaking machine.

**[0016]** The fabric 1 is formed by MD yarns, that is, longitudinal warp yarns extending in machine direction (MD), and CMD yarns, that is, transverse weft yarns orthogonal to the MD yarns and extending in cross machine direction (CMD).

**[0017]** Preferably, the fabric 1 has a single-layer structure, that is, the MD yarns and the CMD yarns are interwoven with each other to form a single layer of fabric.

**[0018]** The MD yarns and the CMD yarns are interwoven with each other according to a repeated weaving pattern both in machine direction and in cross machine direction. The weaving pattern can be of various types. For example, in the illustrated embodiment, the fabric 1 has a plain weaving pattern. It should be understood that the fabric 1 may have a different weaving pattern.

**[0019]** The fabric 1 extends between two longitudinally opposite ends 2 having respective transverse edges 3, only one of which is shown in the attached figure.

**[0020]** The edges 3 are configured to be joined by a seam 4, which joins the opposite ends 2 of the fabric 1 to form an endless belt.

**[0021]** The attached figure only shows some of the MD yarns and CMD yarns, which obviously are repeated to form the whole fabric 1. In particular, the fabric is formed by MD yarns 11-18, which are repeated in cross machine direction, and CMD yarns 21-24, which are repeated in machine direction.

**[0022]** It should be understood that, with respect to

what is described and illustrated herein, the fabric 4 may comprise a different number of repeating MD yarns and CMD yarns, depending on the weaving pattern chosen for the fabric 1.

**[0023]** The seam 4 has a repeating unit comprising N+1 pairs of MD yarns 11-18, where N is greater than or equal to 3; where N pairs of MD yarns 11-16 form respective seaming loops 25 along the edge 3, whereas a further pair of MD yarns 17-18 does not form seaming loops.

**[0024]** The fabric 1 therefore comprises N seaming loops every N+1 pairs of MD yarns, where N is greater than or equal to 3.

**[0025]** In the example illustrated herein, N is equal to 3. The repeating unit of the seam 4 therefore comprises four pairs of MD yarns 11-18: the three pairs of MD yarns 11,12; 13,14 and 15,16 form respective seaming loops 25; whereas a fourth pair of MD yarns 17,18 does not form seaming loops.

**[0026]** The seaming loops 25 project longitudinally from the edge 3 beyond an end CMD yarn arranged along the edge 3 (i.e., beyond the last CMD yarn 24 at the end 2 of the fabric 1).

**[0027]** Each seaming loop 25 is defined by a folded yarn portion 26 joining the respective pair of MD yarns. Clearly, each pair of MD yarns 11-18 and the respective folded yarn portion 26 make up a single yarn, which is woven so as to define the pair of adjacent MD yarns 11-18 and leave the seaming loop 25 projecting beyond the edge 3. It is therefore understood that the term "pairs of MD yarns" is intended to indicate the two parts of a single folded yarn.

**[0028]** Each seaming loop 25 is formed by two adjacent MD yarns (that is, consecutive in cross machine direction) laterally abutting against each other. As just highlighted, the two adjacent MD yarns are actually two parts of a single folded yarn.

**[0029]** Preferably, but not necessarily, the seaming loops 25 all have the same length in machine direction.

**[0030]** In the embodiment illustrated herein, the MD yarns 11-16 forming the seaming loops 25 are interwoven with the CMD yarns 21-24 and consecutive, all in the same manner, forming a plain weaving pattern. It should be understood, however, that the MD yarns 11-16 and the CMD yarns 21-24 can be interwoven in other ways, according to different patterns and weaves.

**[0031]** The further pair of MD yarns 17,18, which does not form seaming loops, defines a pair of binding MD yarns forming a binding 27. In particular, the binding 27 is defined by a folded binding portion 28 which joins the two binding MD yarns 17,18.

**[0032]** The binding MD yarns 17,18 are adjacent: the folded binding portion 28 passes around the end CMD yarn 24 arranged along the edge 3 (the last CMD yarn at the end 2 of the fabric 1) and is formed by adjacent binding MD yarns 17,18 laterally abutting against each other. Clearly, the binding MD yarns 17,18 and the respective folded binding portion 28 also make up a single yarn, which is woven so as to define the pair of binding MD yarns 17-18 and the folded binding portion 28. In this case too, therefore, the two binding yarns 17,18 are actually the two parts of a single folded yarn.

**[0033]** Preferably, each pair of MD yarns 11-16 forming a seaming loop 25 is formed by two adjacent MD yarns laterally abutting against each other. Whereas the pair of binding MD yarns 17,18 can be formed by either two adjacent MD yarns 17,18 (which bind the end CMD yarn 24), or two non-adjacent MD yarns (which bind a seaming loop 25).

**[0034]** In the embodiment illustrated herein, the pair of binding MD yarns 17,18 does not bind any loop 25 formed by the pairs of MD yarns 11-16. It should be understood that the pair of binding MD yarns 17,18 may bind any one of the loops 25.

**[0035]** Clearly, with N greater than 3 there will be N pairs of MD yarns forming respective loops 25; these pairs of MD yarns are always arranged in sequence and the pair of binding MD yarns may or may not bind any one of the loops 25.

**[0036]** The seaming loops 25 are advantageously located at each end 2 of the fabric 1. In order to close the fabric 1 in the form of an endless belt, the seaming loops 25 located at the respective opposite ends 2 are made to interpenetrate side by side, so as to define a tubular passage through which a wire or other retaining element is inserted and thus form a seam which makes the fabric 1 an endless belt.

**[0037]** In the example illustrated herein, the fabric 1 has a seaming ratio, defined as the ratio between the number of pairs of MD yarns contributing to the seam (forming seaming loops 25) and the number of pairs of MD yarns not contributing to the seam (since they do not form seaming loops), of 3:1.

**[0038]** In general, in a fabric having N+1 pairs of MD yarns in the repeating unit of the seam 4, the seaming ratio is N:1, where N is greater than or equal to 3.

**[0039]** In accordance with the invention, the seam is thus ensured by a higher number of MD yarns than in the prior art, for example that described in US9976254B2, where only two thirds of the MD yarns (66.6%) contribute to the seam.

**[0040]** For example, in the 3:1 seaming ratio embodiment, 75% of MD yarns contribute to the seam, with an increase of more than 13% with respect to the prior art.

**[0041]** With a seaming ratio of 4:1 (i.e., N=4), the MD yarns contributing to the seam rise to 80%, with an increase of 20% compared to a seam according to the prior art where only two thirds of the yarns (66.6%) contribute to the seam.

**[0042]** With a seaming ratio of 5:1 (N=5), the MD yarns contributing to the seam are 83%, and with a seaming ratio of 6:1 (N=6), the MD yarns contributing to the seam are 85.7%.

**[0043]** Although fabrics in accordance with the invention can be made even with N greater than 6, the increase in the strength becomes less significant, whereas it can

become more difficult to obtain a flat seam.

**[0044]** In any case, the fabric in accordance with the present invention allows a particularly efficient and strong seam to be provided.

**[0045]** In fact, generally, the seam is all the stronger the more numerous the yarns contributing to the seam itself.

**[0046]** Moreover, the seams of fabrics according to the present invention usually have a longer service life, since the normal wear of the MD yarns (which manifests itself with a progressive reduction in the size of the yarns) is compensated by a greater number of yarns contributing to the seam.

**[0047]** Finally, the joining area is sufficiently homogeneous to avoid or in any case limit the occurrence of defects on the paper being formed.

**[0048]** It is understood that, with regard to the above, the fabric in accordance with the present invention may have a different weaving pattern or weave, not necessarily a plain weaving pattern.

**[0049]** Yarns of various shapes (for example, with a round or flattened cross-section) and sizes may also be used.

**[0050]** The materials with which the yarns are made can be those commonly used in the field. For example, yarns made of polyester, polyamide, polyamide/polyester, polyphenylene sulfide (PPS), or any other synthetic textile material can be used.

**[0051]** Lastly, it is understood that further modifications and variations can be made to the fabric as described and illustrated herein without departing from the scope of the invention as defined in the appended claims.

## Claims

1. A papermaking fabric (1), formed by MD yarns (11-18) extending in machine direction interwoven with CMD yarns (21-24) extending in cross machine direction; the fabric extending between two longitudinally opposite transverse edges (3), provided with seaming loops (25) formed by some pairs of MD yarns (11-16) and joined by a seam (4) having a repetition unit repeating in cross machine direction; wherein in the repetition unit of the seam (4) there are N+1 pairs of MD yarns (11-18), where N is equal to or greater than 3; and the fabric has a seaming ratio, defined as the ratio between the number of pairs of MD yarns (11-16) forming seaming loops (25) and the number of pairs of MD yarns (17,18) that do not form seaming loops, equal to N:1.

2. The fabric according to claim 1, wherein the repetition unit of the seam (4) comprises N pairs of MD yarns (11-16) forming respective seaming loops (25) along the edge (3), and a pair of binding MD yarns (17,18) forming a binding (27) about an end CMD yarn (24) positioned along the edge (3), or about a seaming loop (25) .

3. The fabric according to claim 2, wherein the pair of binding MD yarns (17,18) is formed by either two adjacent MD yarns, that bind the end CMD yarn (24), or two non-adjacent MD yarns, that bind a seaming loop (25).

4. The fabric according to claim 2 or 3, wherein each pair of MD yarns (11-16) forming a seaming loop (25) and the pair of binding MD yarns (17,18) comprise respective pairs of adjacent MD yarns laterally abutting against each other.

5. The fabric according to one of the preceding claims, wherein N is equal to 3.

6. The fabric according to one of the preceding claims, wherein N is equal to 4.

7. The fabric according to one of the preceding claims, wherein N is equal to 5.

8. The fabric according to one of the preceding claims, wherein N is equal to 6.

9. The fabric according to one of the preceding claims, wherein each seaming loop (25) is defined by a folded yarn portion (26) joining the respective pair of MD yarns (11-16).

10. The fabric according to one of the preceding claims, wherein each seaming loop (25) is formed by two adjacent MD yarns (11-16) laterally abutting against each other.

11. The fabric according to one of the preceding claims, wherein the seaming loops (25) all have the same length in machine direction.

12. The fabric according to one of the preceding claims, wherein the MD yarns (11-16) forming the seaming loops (25) are interwoven with the CMD yarns (21-24) all in the same manner.

13. The use of a fabric (1) according to any one of the preceding claims in a papermaking machine.

14. The use according to claim 13, wherein the fabric (1) is used as a drying fabric in a drying section of the papermaking machine.

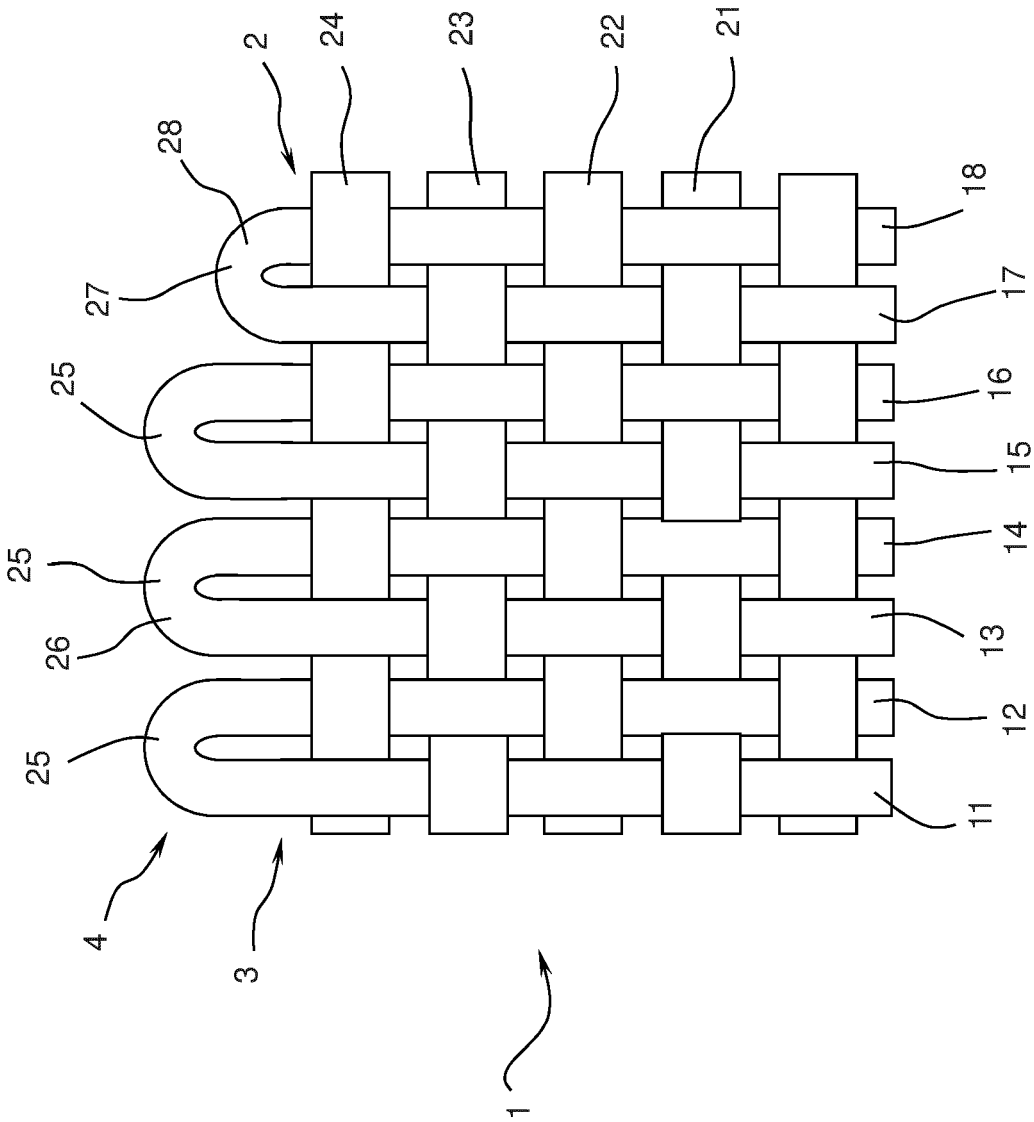


FIG. 1

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# EUROPEAN SEARCH REPORT

Application Number
EP 22 16 5180

## DOCUMENTS CONSIDERED TO BE RELEVANT

| Category | Citation of document with indication, where appropriate, of relevant passages | Relevant to claim | CLASSIFICATION OF THE APPLICATION (IPC) |
|---|---|---|---|
| X | EP 1 790 772 A1 (VOITH PATENT GMBH [DE]) 30 May 2007 (2007-05-30) | 1-6,9-14 | INV. D21F1/00 |
| A | * paragraphs [0008] - [0010], [0025], [0028]; figures * | 7,8 | D21F7/10 |
| A,D | US 9 976 254 B2 (VOITH PATENT GMBH [DE]) 22 May 2018 (2018-05-22) * column 4, line 66 - column 5, line 49; figures * | 1-14 | |
| A | WO 99/27181 A1 (ASTEN INC [US]) 3 June 1999 (1999-06-03) * page 4, lines 1-25; figures * | 1-14 | |
| A | US 4 991 630 A (PENVEN PATRICK H [US]) 12 February 1991 (1991-02-12) * column 2, line 52 - column 3, line 52; figures * | 1-14 | |

TECHNICAL FIELDS SEARCHED (IPC)

D21F

The present search report has been drawn up for all claims

| Place of search | Date of completion of the search | Examiner |
|---|---|---|
| Munich | 11 August 2022 | Pregetter, Mario |

CATEGORY OF CITED DOCUMENTS

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# ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 22 16 5180

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11-08-2022

| Patent document cited in search report | Publication date | Patent family member(s) | Publication date |
|---|---|---|---|
| EP 1790772 A1 | 30-05-2007 | DE 102005056618 A1 | 31-05-2007 |
| | | EP 1790772 A1 | 30-05-2007 |
| | | US 2007119513 A1 | 31-05-2007 |
| US 9976254 B2 | 22-05-2018 | CN 205603959 U | 28-09-2016 |
| | | DE 102014223972 A1 | 25-05-2016 |
| | | US 2016145799 A1 | 26-05-2016 |
| WO 9927181 A1 | 03-06-1999 | AU 6775998 A | 15-06-1999 |
| | | CA 2230117 A1 | 24-05-1999 |
| | | US 6079454 A | 27-06-2000 |
| | | WO 9927181 A1 | 03-06-1999 |
| US 4991630 A | 12-02-1991 | NONE | |

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

## REFERENCES CITED IN THE DESCRIPTION

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### Patent documents cited in the description


- IT 102021000007658 **[0001]**
- US 9976254 B2 **[0009] [0039]**