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(54) TISSUE MACHINE

(57) The invention concerns a machine (10) for making tissue, comprising: a forming section (20) with a fabric (24) for dewatering and transporting a nascent tissue web; a through air drying section (20) with at least one through air drying unit (32, 34); and a Yankee section (40) with a Yankee cylinder (40), wherein the through air drying section (30) comprises a TAD fabric (36) for taking over the tissue web from the fabric (24) of the forming section (20), and for transporting the tissue web through the at least one through air drying unit (32, 34) towards the Yankee section (40), and wherein the TAD fabric (36) is constructed as a spiral link fabric (36) which spiral link fabric is free of any coating or the like.

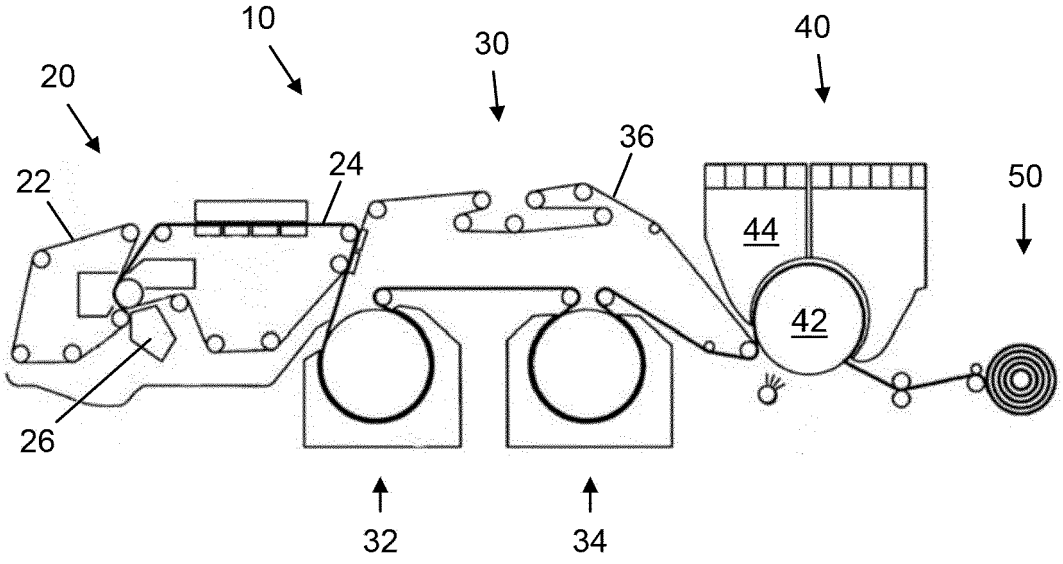

FIG. 1

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Description

[0001] The present invention concerns a machine for making tissue, comprising: a forming section with a fabric for dewatering and transporting a nascent tissue web; a through air drying section with at least one through air drying unit; and a Yankee section with a Yankee cylinder, wherein the through air drying section comprises a TAD fabric for taking over the tissue web from the fabric of the forming section, and for transporting the tissue web through the at least one through air drying unit towards the Yankee section.

[0002] Such machines, also sometimes merely called TAD machines, are generally known in the art. Just as an example, reference is made to patent application WO 93/22498 A1. In such machines the TAD fabric is usually a woven fabric. It may be woven in such a way that its tissue facing side is structured to impart a visible texture into the tissue product. Alternatively, other kinds than woven fabrics can be used as some kind a base fabric which base fabric than has coatings or imprints on its tissue facing side to texture the tissue product. However, the coatings or imprints or the like on the tissue facing side are difficult to apply onto the base fabric in such a manner that it will not detach or deform too much over time. This holds especially true if the tissue web is transported on the TAD fabric also through a pressure nip, e.g. a nip formed by a press roll and the Yankee cylinder.

[0003] Even though the tissue that is produced on such machines is not bad, the market is looking for improved properties in tissue and towel production relating to softness, bulk, handfeel (flexability), absorbency and both wet and dry tensile strength relative to the basis weight of the final sheet and number of plies (layers) in the final product. Moreover, there is a constant demand from tissue makers for unique structures which can give them a benefit against competition and differentiate themselves in the market place, both with appearance of the sheet as well as its final functionality.

[0004] The present invention aims to solve or at least mitigate these problems. This aim is achieved by the teaching of the independent claims. The dependent claims describe advantageous further embodiments of the present invention.

[0005] In particular, these problems are solved or at least mitigated by a generic tissue machine of the kind described above, wherein the TAD fabric is constructed as a spiral link fabric which spiral link fabric is free of any coating or the like.

[0006] It is the merit of the inventor to have found out that such a "pure" spiral link fabric is very good suitable to be used as TAD fabric in a TAD machine. The spiral link fabric provides a unique structure with exceptional pocket depth to form a tissue sheet beyond traditional woven fabric structures. Furthermore, the spiral is an extremely stable structure in both the machine direction and cross machine direction and can be stronger in overall strength relative to woven structures. Last but not least, the spirals can be quickly seamed together enabling a quicker and safer installation and startup of the spiral link fabric.

[0007] Preferably, the forming section comprises a twin-wire former with two converging fabrics forming a gap for receiving fiber suspension ejected from a headbox. However, other known types of forming sections are possible, but less preferred. The two converging fabrics may both be woven fabrics, wherein at least the fabric that transports the nascent tissue web to the TAD fabric may be a structured fabric. Sometimes these fabrics are referred to as forming fabric and as molding fabric.

[0008] In a preferred embodiment of the invention, the through air drying section comprises two through air drying units, more preferably exactly two through air drying units. That way the tissue web can be dried in a very efficient manner.

[0009] Trials have shown that particularly good results can be achieved if the spiral link fabric provides a contact area of between 15% and 25% for the tissue web. To achieve such a high contact area, the tissue facing side of the spiral link fabric may be sanded. Alternatively or additionally, instead of yarns having a basically round cross section to form the coils of the spiral link fabric, flat yarns may be used, having for example a flattened (oval) or even a substantially rectangular cross section.

[0010] Another advantage of using a spiral link fabric as TAD fabric is that a wide range of permeability can be adjusted quite easily. To achieve this, the spiral link fabric can comprise stuffer yarns inserted into the open spaces formed by links of coils. Much higher permeabilities can be achieved with spiral link fabrics compared to most woven fabric structures with a comparable density. The stuffer yarns can be of different numbers and sizes and can either completely or partially fill the space. This stuffer yarn located in the center of the pairs of spiral coils can be customized as a backing surface at which the tissue web is formed inside the spacing of the loops. This can be done with either flat or round monofilaments, and can be either put in every coil or some combination, such as in every other, every third, etc.

[0011] For this kind of application, the spirals are preferably produced out of heat resisting, thermally stable materials. Good results are attainably if the spirals of the spiral link fabric are made from polyphenylene sulfide. This material is also called PPS and traded e.g. under the trade mark "Ryton". Alternatively, the spirals of the spiral link fabric can be made from polyethylenterephthalat, also called PET. Preferably, the PET is hydrolysis-stabilized.

[0012] Depending upon the final demand of the tissue product, different variations as to the diameters of the spiral coils can be chosen. In a first preferred embodiment of the present invention, the spirals of the spiral link fabric comprise a spiral coil diameter of between 0.50mm and 0.60mm, preferably approximately 0.55mm. In a second preferred embodiment of the present invention, the spirals of the spiral link fabric comprise a spiral coil diameter

of between 0.65mm and 0.75mm, preferably approximately 0.70mm. And in a third preferred embodiment of the present invention, the spirals of the spiral link fabric comprise a spiral coil diameter of between 0.85mm and 0.95mm, preferably approximately 0.90mm.

[0013] The basic idea of the present invention may also be formulated slightly differently, namely as using of a spiral link fabric, which spiral link fabric is free of any coating or the like, as a TAD fabric in a TAD machine for making tissue, the TAD machine comprising: a forming section with a fabric for dewatering and transporting a nascent tissue web; a through air drying section with at least one through air drying unit; and a Yankee section with a Yankee cylinder, wherein the through air drying section comprises the TAD fabric for taking over the tissue web from the fabric of the forming section, and for transporting the tissue web through the at least one through air drying unit towards the Yankee section.

[0014] Now, the present invention, or preferred embodiments thereof, are described with reference to the following schematic drawings:

Fig. 1: shows a tissue machine according to the present invention;

Fig. 2: shows a part of a first embodiment of a TAD fabric used in the tissue machine of figure 1;

Fig. 3: is a top view of a part of a second embodiment of the TAD fabric used in the tissue machine of figure 1 ;

Fig. 4: is a side view of the part of the second embodiment of the TAD fabric from figure 3; and

Fig. 5: shows a simulation result of the contact area of the part of the second embodiment of the TAD fabric from figures 3 and 4.

[0015] Figure 1 shows an exemplary embodiment of a tissue machine 10 according to the present invention. The tissue machine comprises a forming section 20, a through air drying section 30 and a Yankee section 40. Furthermore, behind the Yankee section 40 there may be provided a winding section 50 to wind the final tissue web. The further converting of the tissue web can be done offline in a separate machine.

[0016] In the present example, the forming section 20 is provided as a so-called twin wire former. It comprises two fabrics 22 and 24, wherein the first fabric 22 is sometimes also referred to as forming fabric and the second fabric 24 as molding fabric. Usually, these fabrics 22 and 24 are woven fabrics, made from warp yarns and intersecting weft yarns. When the tissue machine 10 is running the first fabric 22 is moving counterclockwise in figure 1, while the second fabric 24 is moving clockwise. Both fabrics 22 and 24 form a converging gap into which a fiber suspension is injected by a headbox 26. The nascent tissue web is further dewatered on the second fabric 24. At the same time it is transported on the second fabric 24 towards the through air drying section 30.

[0017] In this exemplary embodiment the through air drying section 30 comprises two through air dryer units, namely a first through air dryer unit 32 and a second through air drying unit 34. Each of the two through air dryer units 32 and 34 comprises a through air drying cylinder and a through air drying hood to dry the tissue web by blowing hot air therethrough. The tissue web coming from the forming section 20 is transferred from the second fabric 24 to a TAD fabric 36 will be described in more detail below with reference to figures 2-5. In use, the TAD fabric 36 moves counterclockwise in figure 1 transporting the tissue web through the two through air drying units 32 and 34 towards the Yankee section 40. The Yankee section 40 comprises a Yankee cylinder and a Yankee hood. In this exemplary embodiment, the TAD fabric 36 transfers the tissue web directly onto an outer surface of the Yankee cylinder 42. Thus, some kind of pressure nip is formed between a pressing roll inside the loop of the TAD fabric 36 and the Yankee cylinder 42. The pressing roll may be a roll that provides an extended nip, such as a shoe press roll.

[0018] In the Yankee section 40 the tissue web is further dried in a known manner before it is reeled-up in the winder section 50 for further transportation and/or conversion.

[0019] Figure 2 shows a part of a first embodiment of a TAD fabric 36 used in the tissue machine 10 of figure 1. According to the present invention the TAD fabric 36 is a spiral link fabric which spiral link fabric is free of any coating or the like. "The like" is to be understood here in a broad sense also comprising staple fibers, printings, laminations, etc. The TAD fabric 36 is basically made up from yarns in the form of spiral coils 37 and from substantially straight hinge yarns 38 that connect the spiral coils 37. In this first embodiment of figure 2, the TAD fabric 36 additionally comprises stuffer yarns 39. The stuffer yarns 39 are inserted into the open spaces formed by the spiral coils 37. With such stuffer yarns 39 the permeability of the TAD fabric 36 can be adjusted to a given value. In this embodiment, the stuffer yarns 39 are substantially flat, located in the center of each open space and they fill substantially the full space. However, different numbers and sizes can be used and the stuffer yarns also my partially fill the space.

[0020] Figures 3 to 4 refer to a part of a second embodiment of the TAD fabric 36 used in the tissue machine 10 of figure 1, where figure 3 represents a top view thereof, figure 4 represents a side view thereof and figure 5 represents a simulation result of the contact area of the part of the second embodiment of the TAD fabric 36 from figures 3 and 4. In the following, only the differences between the first embodiment of figure 2 and the second embodiment according to figures 3 to 4 are described. The same or similar elements have the same reference signs and it is referred to the above description.

[0021] The main difference between these two embodiments is that the second embodiment does not comprise any stuffer yarns. Therefore, there permeability of the second embodiment is rather high. From the simulation

shown in figure 5 it can be derived that the contact area of the tissue facing side, i.e. the upper side in figure 5, has a contact area of about 19%. Furthermore, in this embodiment the potential caliper is 1.97mm.

Reference signs:

[0022]

10	tissue machine
20	forming section
22	first fabric (forming fabric)
24	second fabric (molding fabric)
26	headbox
30	through air drying section
32	first through air drying unit
34	second through air drying unit
36	TAD fabric
37	spiral coils
38	hinge yarns
39	stuffer yarns
40	Yankee section
42	Yankee cylinder
44	Yankee hood
50	winder section

Claims

1. A machine (10) for making tissue, comprising:

- a forming section (20) with a fabric (24) for dewatering and transporting a nascent tissue web;
- a through air drying section (20) with at least one through air drying unit (32, 34); and
- a Yankee section (40) with a Yankee cylinder (40),

wherein the through air drying section (30) comprises a TAD fabric (36) for taking over the tissue web from the fabric (24) of the forming section (20), and for transporting the tissue web through the at least one through air drying unit (32, 34) towards the Yankee section (40),
characterized in that the TAD fabric (36) is constructed as a spiral link fabric (36) which spiral link fabric is free of any coating or the like.

2. Tissue machine (10) according to claim 1,
characterized in that the forming section (20) comprises a twin-wire former with two converging fabrics (22, 24) forming a gap for receiving fiber suspension ejected from a headbox (26).

3. Tissue machine (10) according to claim 1 or 2,
characterized in that the through air drying section (30) comprises two through air drying units (32, 34).

4. Tissue machine (10) according to any of the preceding claims.
characterized in that the spiral link fabric (36) provides a contact area of between 15% and 25% for the tissue web.

5. Tissue machine (10) according to any of the preceding claims,
characterized in that the spiral link fabric (36) comprises stuffer yarns (39) inserted into the open spaces formed by links of coils (37).

6. Tissue machine (10) according to any of the preceding claims,
characterized in that that the spiral coils (37) of the spiral link fabric (36) are made from polyphenylene sulfide or Polyethylenterephthalat.

7. Tissue machine (10) according to any of the preceding claims,
characterized in that the spiral coils (37) of the spiral link fabric (36) comprise a spiral coil diameter of between 0.50mm and 0.60mm, preferably approximately 0.55mm.

8. Tissue machine (10) according to any of the preceding claims,
characterized in that the spiral coils of the spiral link fabric (36) comprise a spiral coil diameter of between 0.65mm and 0.75mm, preferably approximately 0.70mm.

9. Tissue machine (10) according to any of the preceding claims,
characterized in that the spiral coils (37) of the spiral link fabric (36) comprise a spiral coil diameter of between 0.85mm and 0.95mm, preferably approximately 0.90mm.

10. Use of a spiral link fabric (36), which spiral link fabric (36) is free of any coating or the like, as a TAD fabric in a TAD machine for making tissue, the TAD machine comprising:

- a forming section (20) with a fabric (20) for dewatering and transporting a nascent tissue web;
- a through air drying section (30) with at least one through air drying unit (32, 34); and
- a Yankee section (40) with a Yankee cylinder (42),

wherein the through air drying section (30) comprises the TAD fabric (36) for taking over the tissue web from the fabric (24) of the forming section (20), and for transporting the tissue web through the at least one through air drying unit (32, 34) towards the Yankee section (40).

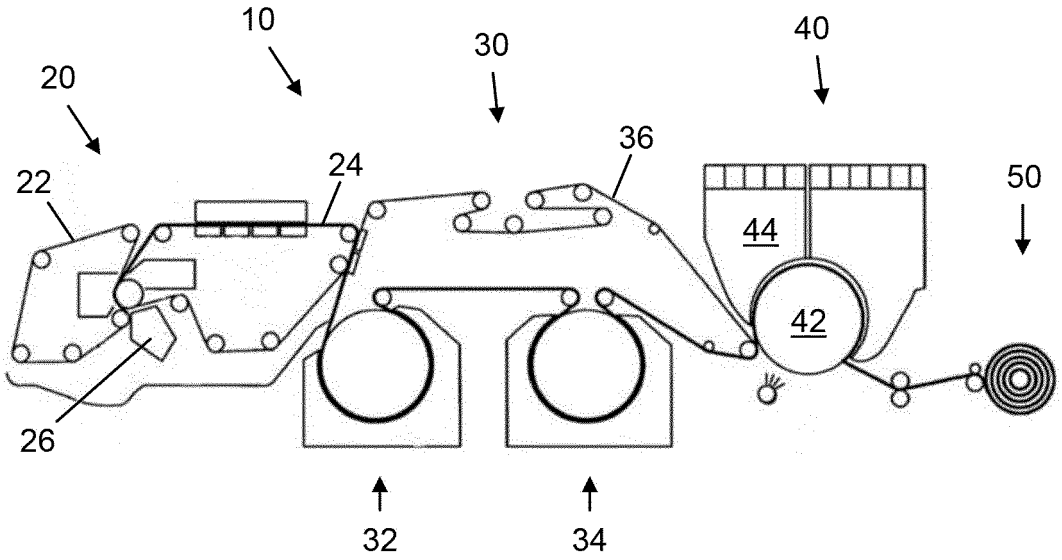

FIG. 1

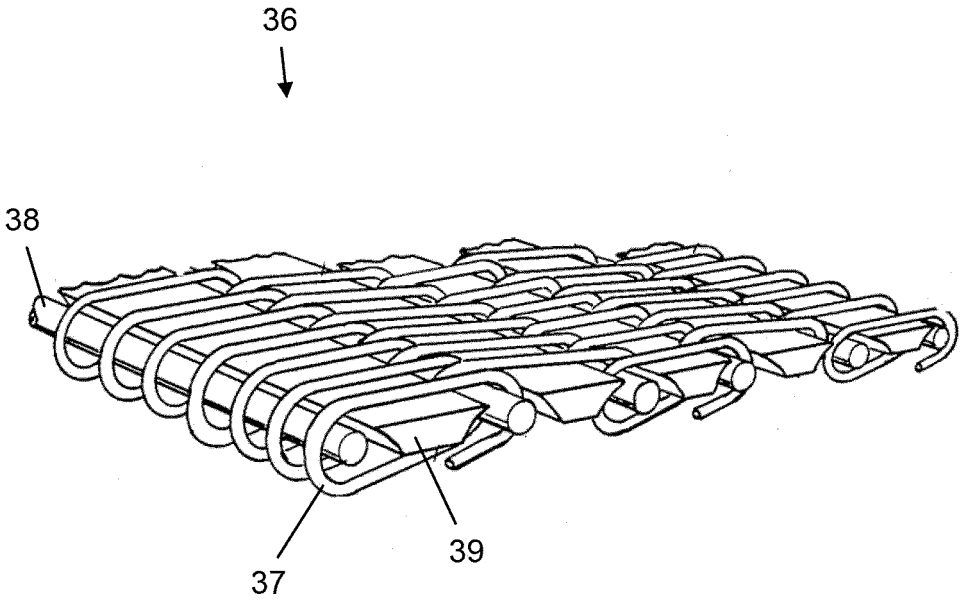

FIG. 2

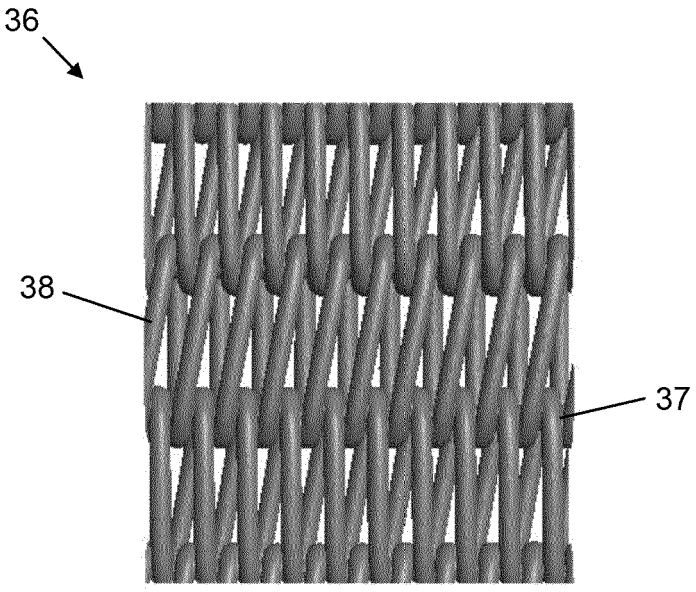

FIG. 3

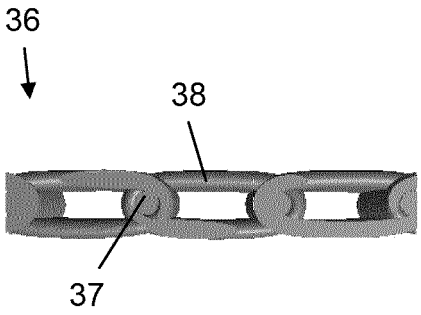

FIG. 4

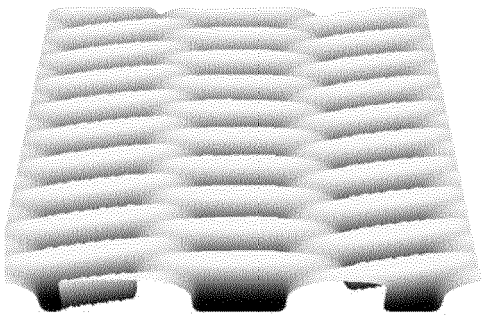

FIG. 5

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EUROPEAN SEARCH REPORT

Application Number
EP 22 19 6454

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A,D	WO 93/22498 A1 (VALMET KARLSTAD AB [SE]) 11 November 1993 (1993-11-11) * page 8, line 1 - page 9, line 3 * * figure 2 *	1-10	INV. D21F5/18 D21F11/14 D21F9/00 D21F1/00
A	US 2007/251660 A1 (WALKENHAUS HUBERT [DE] ET AL) 1 November 2007 (2007-11-01) * paragraphs [0121], [0125] - [0128] * * figures 10,11 *	1-10	
A	US 6 066 390 A (QUIGLEY SCOTT [US]) 23 May 2000 (2000-05-23) * column 2, line 47 - column 3, line 13 * * figures *	1-10	
A	WO 2019/133875 A1 (KIMBERLY CLARK CO [US]) 4 July 2019 (2019-07-04) * page 7, lines 3-7 * * page 9, lines 7-29 * * figures *	1-10	
			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	7 March 2023	Pregetter, Mario

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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REFERENCES CITED IN THE DESCRIPTION

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