

(19)



(11)

EP 2 549 013 B1

(12)

EUROPEAN PATENT SPECIFICATION

(45) Date of publication and mention
of the grant of the patent:
31.01.2018 Bulletin 2018/05

(51) Int Cl.:
D21F 5/00 (2006.01) **D21F 5/04** (2006.01)
D21F 5/18 (2006.01) **D21G 1/00** (2006.01)

(21) Application number: **11174788.7**

(22) Date of filing: **21.07.2011**

(54) Process and arrangement for producing a fiber web

Verfahren und Anordnung zur Herstellung einer Faserstoffbahn

Procédé et agencement pour produire une bande de matériau fibreux

(84) Designated Contracting States:
**AL AT BE BG CH CY CZ DE DK EE ES FI FR GB
GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO
PL PT RO RS SE SI SK SM TR**

(43) Date of publication of application:
23.01.2013 Bulletin 2013/04

(73) Proprietor: **Valmet Technologies, Inc.**
02150 Espoo (FI)

(72) Inventors:
• **Haavisto, Jouni**
00550 Helsinki (FI)
• **Pietikäinen, Reijo**
04420 Järvenpää (FI)
• **Vaittinen, Henri**
04400 Järvenpää (FI)
• **Kekko, Pasi**
41660 Toivakka (FI)
• **Ilomäki, Jari**
00920 Helsinki (FI)

- **Hakola, Jani**
04460 Nummenkylä (FI)
- **Ristola, Petri**
04200 Kerava (FI)
- **Tynkkynen, Topi**
00320 Helsinki (FI)
- **Viljanmaa, Mika**
00760 Helsinki (FI)
- **Havukainen, Robert**
12400 Tervakoski (FI)

(74) Representative: **Berggren Oy, Helsinki & Oulu**
P.O. Box 16
Eteläinen Rautatiekatu 10A
00101 Helsinki (FI)

(56) References cited:
EP-A1- 2 071 076 EP-A1- 2 072 672
EP-A2- 2 022 892 EP-B1- 0 824 618
EP-B1- 1 478 805 WO-A1-2009/129843
WO-A1-2010/136651 DE-A1- 10 318 185
DE-A1-102004 017 807 US-A- 4 112 586

Note: Within nine months of the publication of the mention of the grant of the European patent in the European Patent Bulletin, any person may give notice to the European Patent Office of opposition to that patent, in accordance with the Implementing Regulations. Notice of opposition shall not be deemed to have been filed until the opposition fee has been paid. (Art. 99(1) European Patent Convention).

EP 2 549 013 B1

Description

[0001] In general present invention relates to producing fiber web in a fiber web machine. More especially the present invention relates to a process and an arrangement for producing a fiber web. As known from the prior art in fiber web producing processes typically comprise an assembly formed by a number of apparatuses arranged consecutively in the process line. A typical production and treatment line comprises a head box, a wire section and a press section as well as a subsequent drying section and a reel-up. The production and treatment line can further comprise other devices and sections for finishing the fiber web, for example, a sizer, a calender, a coating section. The production and treatment line also comprises at least one winder for forming customer rolls as well as a roll packaging apparatus. In this description and the following claims by fiber webs are meant for example a paper, board, tissue, pulp and also nanopulp webs.

[0002] Typically in solutions of prior art, the sequential process phases in the fiber web making have been largely independent, consecutive, adjacent, separate and not integrated together. For example, drying section is mainly used to remove water by evaporation, while separate sizing equipment is used to improve web strength and minimize dusting. In similar fashion, a separate precalendering process is used to improve web surface properties suitable for coating.

[0003] Typically in processes and arrangements for producing fiber web, especially paper or board web, in the drying section single-wire draw or twin-wire draw or various combinations of same are employed. In single wire draw, so-called normal groups with single wire draw are used, in which drying cylinders are placed in upper row and reversing cylinders or rolls in lower row. In so-called inverted groups with single-wire draw, the drying cylinders are placed in the lower row and the reversing cylinders or rolls in the upper row. In cylinder drying tightness of the wire is usually relatively low and the surface pressure directed to the web is low. Due to this the cylinder - web contact is insufficient and thus the heat transfer coefficient between the web and the cylinder is rather low.

[0004] Typically the fiber web is sized by separate sizer for improving the strength of the web and to minimize the dusting. Separate sizer might cause a risk of web break; it needs its own drying devices and also takes up space. Typically in prior art arrangements also the pre-calendering is done as a separate process stage, which thus is not integrated to other processes.

[0005] EP patent publication EP 0824618 discloses dryer sections provided with intermediate calendering in a paper machine, in which a dryer section of a paper machine, in which there are several successive wire groups, which primarily or exclusively are groups with single-wire draw, in which the heated drying cylinders are placed in the upper row and the reversing suction

cylinders or the equivalent reversing suction rolls are placed in the lower row and which groups with single-wire draw comprise a drying wire which runs along a meandering path over said dryings cylinders and reversing suction cylinders or rolls so that said reversing suction cylinders or rolls remain inside the loop of the drying wire, in which dryer section, in connection with a drying cylinder of one of said groups with single-wire draw, a free space has been arranged, in which a calender roll is fitted, which is arranged to form a nip of intermediate calendering together with the last-mentioned drying cylinder, through which nip the paper web to be dried is passed and, thus calendered inside the dryer section. This can be considered as an example of an integrated process. The calendering nip has been arranged in connection with a non-lateral drying cylinder of the group with single-wire draw or in connection with the last drying cylinder of the group with single-wire draw and the paper web is arranged to be in contact with said calender roll only in the calendering nip after which the web is separated from said calender roll.

[0006] A drying method called condebelt drying is known from prior art and disclosed for example in patent publication US 4112586 (FI 54514). In this method of drying a board or a paper web by passing the wet web supported by a drying wire between two moving, nonpermeable bands with good heat conducting properties. The band contacting the web is subjected to heating and the band contacting the drying wire is subjected to cooling. Due to the heating of the web the water contained therein is caused to evaporate and the evaporated water is caused to condense into the drying wire due to the cooling of the drying wire. The water is removed from the drying wire after the web and the drying wire have left the surface elements and have been separated from each other. This process is very effective based on transferring water by high temperature difference to one direction and condensation to the drying wire i.e. porous wire of cool side. The wire on the cool side replicates the back side of the web to be rough which limits suitable uses of this kind of product significantly due to printing qualities.

[0007] From prior art also another one-sided concept is known called Boostdryer. This method is disclosed in patent publication DE 102004017807. In this process there is also wire on the cooler side, which wire marks the other surface of the web.

[0008] In patent publication EP 1478805 a method for drying a coated or uncoated fibrous web is disclosed. In patent publication EP1478805 two methods of belt drying are disclosed. The first method is substantially pressure-treating enhanced displacement drying and in this method a paper/board web is dried by pressing it in a processing device, comprising an endless belt adapted to extend around at least one guiding element, at least one counter-element being disposed outside the belt loop to establish a contact area with the belt, such that the belt and the counter element establish there between a web processing zone for passing a web to be processed there through.

The processing device used in the method is provided on both sides of the web with a pore volume that at least on one side of the web, the pore volume is created in a compressible felt or wire in which method the fibrous web to be dried is conveyed in contact with said pore volumes through the processing zone, wherein said pore volumes are subjected to a compressing effect, whereby the felt /wire compresses and at the same time the pressure of a gas present in its pores increases, resulting in a gas flow against the web and, thus, in the penetration of water present in the web towards the pore volume on the other side of the web. The other method presented in publication EP 1478805 relates to condensation drying, comprising a contact zone formed by belt wrap around a roller, where either the belt or roll side is heated and other side is cooled condensing side, including a porous permeable wire on cool side.

[0009] EP 2072672, WO2010/136651, DE 10318185, WO 2009/129843, EP 2071076 and EP 2022892 disclose processes and arrangements, in which a moist fiber web is guided from a press section of a fiber web machine into a drying arrangement that comprises in a process direction at least one device having at least one belt like contact zone that comprises two surfaces, a first surface which is a metal belt, and a second surface which is a roll or a cylinder or a metal belt supported by a roll or by a cylinder or by a support shoe, and in which either the first surface or the second surface or both surfaces are heated, between which surfaces the web is treated and which surfaces pressure-treat the web mechanically for heating the fiber web. Paper and board are available in a wide variety of grades and can be divided according to basis weight in two grades: papers with a single ply and a basis weight of 25 - 300 g/m² and boards manufactured in multi-ply technology and having a basis weight of 150 - 600 g/m². It should be noted that the borderline between paper and board is flexible since board grades with lightest basis weights are lighter than the heaviest paper grades. Generally speaking, paper is used for printing and board for packaging.

[0010] The subsequent descriptions are examples of some values presently applied for fibrous webs, and there may be considerable variations from the disclosed values. The descriptions are mainly based on the source publication Papermaking Science and Technology, section Papermaking Part 3, edited by Jokio, M., published by Fapet Oy, Jyväskylä 1999, 362 pages.

[0011] Mechanical-pulp based, i.e. wood-containing printing papers include newsprint, uncoated magazine and coated magazine paper.

[0012] Newsprint is composed either completely of mechanical pulp or may contain some bleached softwood pulp (0 - 15 %) and/or recycled fiber to replace some of the mechanical pulp. General values for newsprint can be regarded as follows: basis weight 40 - 48,8 g/m², ash content (SCAN-P 5:63) 0 - 20 %, PPS s10 roughness (SCAN-P 76:95) 3,0 - 4,5 µm, Bendtsen roughness (SCAN-P 21:67) 100 - 200 ml/min, density 200 - 750

kg/m³, brightness (ISO 2470:1999) 57 - 63 %, and opacity (ISO 2470:1998) 90 - 96 %.

[0013] Uncoated magazine paper (SC=supercalendered) usually contains mechanical pulp to 50 - 70 %, bleached softwood pulp to 10 - 25 %, and fillers to 15 - 30%. Typical values for calendered SC paper (containing e.g. SC-C, SC-B, SC-A/A+) include basis weight 40 - 60 g/m², ash content (SCAN-P 5:63) 0 - 35 %, Hunter gloss (ISO/DIS 8254/1) < 20 - 50 %, PPS s10 roughness (SCAN-P 76:95) 1,2 - 2,5 µm, Bendtsen roughness (SCAN-P 21:67) 100 - 200 ml/min, density 700 - 1250 kg/m³, brightness (ISO 2470:1999) 62 - 70 %, and opacity (ISO 2470:1998) 90 - 95 %.

[0014] Coated magazine paper (LWC = light weight coated) contains mechanical pulp to 40 - 60 %, bleached softwood pulp to 25 - 40 %, and fillers and coaters to 20 - 35 %. General values for LWC paper can be regarded as follows: basis weight 40 - 70 g/m², Hunter gloss 50 - 65 %, PPS s10 roughness 0,8 - 1,5 µm (offset), 0,6 - 1,0 µm (roto), density 1100 - 1250 kg/m³, brightness 70 - 75 %, and opacity 89 - 94%.

[0015] General values for MFC (machine finished coated) can be regarded as follows: basis weight 50 - 70 g/m², Hunter gloss 25 - 70 %, PPS s10 roughness 2,2 - 2,8 µm, density 900 - 950 kg/m³, brightness 70 - 75 %, and opacity 91 - 95 %.

[0016] General values for FCO (film coated offset) can be regarded as follows: basis weight 40 - 70 g/m², Hunter gloss 45 - 55 %, PPS s10 roughness 1,5 - 2,0 µm, density 1000 - 1050 kg/m³, brightness 70 - 75 %, and opacity 91 - 95 %.

[0017] General values for MWC (medium weight coated) can be regarded as follows: basis weight 70 - 90 g/m², Hunter gloss 65 - 75 %, PPS s10 roughness 0,6 - 1,0 µm, density 1150 - 1250 kg/m³, brightness 70 - 75 %, and opacity 89 - 94 %.

[0018] HWC (heavy weight coated) has a basis weight of 100 - 135 g/m² and can be coated even more than twice.

[0019] Pulp-produced, wood free printing papers or fine papers include uncoated - and coated - pulp-based printing papers, in which the portion of mechanical pulp is less than 10 %.

[0020] Uncoated pulp-based printing papers (WFU) contain bleached birchwood pulp to 55 - 80 %, bleached softwood pulp 0 - 30 %, and fillers to 10 - 30 %. The values with WFU have a large variation: basis weight 50 - 90 g/m², Bendtsen roughness 250 - 400 ml/min, brightness 86 - 92 %, and opacity 83 - 98 %.

[0021] In coated pulp-based printing papers (WFC), the amounts of coating vary widely in accordance with requirements and intended application. the following are typical values for once- and twice-coated, pulp-based printing paper: once-coated basis weight 90 g/m², Hunter gloss 65 - 80 %, PPS s10 roughness 0,75 - 2,2 µm, brightness 80 - 88 %, and opacity 91 - 94 %, and twice-coated basis weight 130 g/m², Hunter gloss 70 - 80 %, PPS s10 roughness 0,65 - 0,95 µm, brightness 83 - 90 %, and

opacity 95 - 97 %.

[0022] Release papers have a basis weight within the range of 25 - 150 g/m².

[0023] Other papers include e.g. sackkraft papers, tissues, and wallpaper bases.

[0024] Board making makes use of chemical pulp, mechanical pulp and/or recycled pulp. Boards can be divided e.g. in the following main groups according to applications thereof: Corrugated board, comprising a liner and fluting; Boxboards, used for making boxes, cases, which boxboards include e.g. liquid packaging boards (FBB = folding boxboard, LPB = liquid packaging board, WLC = white-lined chipboard, SBX = solid bleached sulfite, SUS = solid unbleached sulfite); Graphic boards, used for making e.g. cards, files, folders, cases, covers, etc. and Wallpaper bases. An object of the present invention is to create a new process and a new arrangement for producing fiber webs, especially for drying fiber webs.

[0025] Another object of the present invention is to create a process and an arrangement for producing fiber webs in which possible disadvantages and problems of known methods and devices are eliminated or at least minimized.

[0026] One object of the present invention is to solve at least part of the disadvantages and problems relating to drying processes according to prior art.

[0027] One important object of the present invention is to introduce new integrated fiber web making process.

[0028] To achieve the objects mentioned above and later the process according to the invention exhibits the features defined in claim 1. The arrangement according to the invention exhibits the features defined in claim 7. By the present invention a new integrated fiber web making process is achieved, in which drying, surface finishing and web strength improvements are achieved in one compact process thus providing space and investment cost savings and less complicated process.

[0029] Separate (non-integrated) processes here mean, that they are used for one main purpose only. On the contrary, integrated process here means, that one process (like belt drying) can produce multiple desired effects, like web drying, web densification and web surface smoothening, which have traditionally been done by separate processes. It is also to be understood that terms belt drying / belt contact drying etc. in this description and the following claims also are described the process in which web is heated in belt zone and afterwards evaporation occurs and thus web dries unless differently mentioned. It should also be understood that the term pressure-treating does not mean pressing as it is conventionally done in the press section of fiber web machines, but instead pressure-treating of fiber web according to the invention as in this description and claims explained.

[0030] According to present invention a process and an arrangement for drying a fiber web by belt like contact is achieved. With said invention the web can be dried very effectively with less length and space requiring de-

vice construction and simultaneously the drying solution provides the fiber web with smoothness and strength properties.

[0031] According to one aspect of the present invention, an integrated belt drying and finishing process is introduced, that is capable of drying fiber web very effectively, producing good surface quality and improved strength properties for further process phases, like coating, or final calendering, or even to produce finished end product for end use as such. Another aspect of the invention is to greatly simplify production line and production process further aspects is reduced space requirements, since production line length is shortened remarkably in the most advantageous case; another aspect is to reduce investment costs per produced product quantity.

[0032] According to further aspects of the invention the process and arrangement for producing a fiber web with improved strength and quality is achieved and also the production process is simplified.

[0033] According to the invention the moist web is guided in process direction through one or more devices having belt like contact zones. The contact zone comprises two smooth surfaces, first surface and second surface, between which the web is treated and which surfaces press the web mechanically. The first surface is metal belt or a corresponding flexible element and the second surface is a roll or a cylinder or a corresponding support element or a metal belt supported by a roll or by a cylinder or by a support shoe or by a corresponding support element. Either the first surface or the second surface or both surfaces are heated.

[0034] According to an advantageous embodiment of the invention, the fiber web is guided from the wet press section to downstream to drying section in a process arrangement, that comprises one or more drying devices having belt like contact, comprising two smooth surfaces, the first surface and the second surface, between which surfaces the fiber web is treated and pressed mechanically, and heated at least by the one heated surface. Contact time in the pressure-treating zone is arranged to be sufficiently long, so that web is heated significantly through its thickness, i.e. its average temperature is increased significantly. Heating of fiber web causes the partial vapor pressure to rise in the inner parts of web during the web's stay in the contact. The actual drying starts immediately when web exits the contact zone end and enters the opening gap. The drying process is based on water vapor transport by water vapor diffusion and convective flow generated by partial vapor pressure and total pressure gradients, respectively.

[0035] According to one advantageous embodiment of the invention, the drying rate is improved by applying a ventilation arrangement in conjunction to the contact zone. Advantageously, the ventilation arrangement is placed directly after contact zone, where evaporation from the heated fiber web takes place at highest rate. Mostly the ventilation is exchange of gases neat the fiber

web, so that the moist air and water vapor is removed and transported away and replaced by dry and fresh air at the boundary layer and near vicinity of the said boundary layer of the moving fiber web. Due to ventilation, the fiber web boundary layer vapor concentration remains continuously low and moisture diffusion (transport) is enhanced, thus speeding up drying rate effectively.

[0036] According to one advantageous feature temperature control of the web is used to avoid delamination of web. For example by blowing in addition to exchange of gases effect the internal gas pressure of the web by cooling it slightly, wherein the evaporation speed does not exceed the speed of steam transmission from the web.

[0037] In the process arrangement according to one advantageous example of the invention moist fiber web is guided from press section into drying in an arrangement that comprises in process direction one or more devices having belt like contact zones that comprises two smooth surfaces, first surface and second surface, between which surfaces the web is treated and which surfaces press the web mechanically for heating the web and for removing moisture from the web by at least one heated surface. Advantageously directly after the contact zone effective ventilation is applied to the fiber web either by blowing with a blowing moist air removal unit on metal belt surface or by air borne dryer.

[0038] According to one embodiment of the invention, the drying is enhanced by ventilation arrangement, which is applied directly to the unsupported web, i.e. web is open on both sides. In another arrangement, ventilation is applied to supported web to open side of the web, while the other side of the web is supported either by a roll, a wire or a belt surface.

[0039] The purpose of the ventilation is to transfer the evaporated moisture away from the neighborhood of the web surface, and replace the removed air by a fresh dry air. Continuously ventilating the boundary layer air, the drying rate in the web remains very high as long as sufficient thermal energy reserves remain and generate further evaporation in the fiber web. As soon as the web cools down, evaporation rate drops and it is advantageous to guide the web again into next heating contact zone, after which the process cycle is repeated once more.

[0040] According to one advantageous embodiment of the invention, ventilation is arranged by a ventilation device, for example a impingement hood, airborne dryer unit, like a flotation dryer, a blowing box unit, a suction device, or a simple rows of blow / suction nozzle or bars, or combinations of before mentioned applied to the open side of fiber web.

[0041] According to one embodiment, ventilation blows are applied to a supported web. Advantageously, the web is supported by heated belt of roll surface, or similar, so that while the ventilation is applied on one side of the web, the other side of the web is in simultaneous heating contact. In order to enhance drying efficiently, it

is important to arrange ventilation immediately after the contact zone, as close as possible. As well, it is advantageous to cover by ventilation as much as possible of the open web surface area. According to the invention, the surfaces contacting the fiber web in the contact zone are substantially smooth, producing / replicating a smooth surface to the fiber web. The contacting surface smoothness is in the range 0.4. - 1.0 Ra when no special smoothening effect is desired. When a more smoothening of fiber web is desired, at least one contacting surface is grinded and polished to a smoothness of 0.1 Ra or even better. This might be desired for example in producing high quality printing papers.

[0042] The present invention relates to drying of a fiber web with a method based on belt contact, in which the drying process is improved by removing the evaporated gases by effective ventilation or blowing or suction process in conjunction to belt contact zone.

[0043] In the advantageous arrangement fiber web is dried substantially from beginning (solids content 45-60 % to dry state (solids content 85-95 %)) by using 5-10 belt drying devices in the case of thin fiber webs (dry basis weight roughly below 100 g/m²). This means that 40-100 dryer cylinders prior art can be replaced. This means great savings in machine length. In the case of thicker webs, 5-30 drying contact devices may be needed to dry the web completely, depending on the basis weight and production speed.

[0044] In one arrangement web is partly dried first with traditional dryer cylinders, after which drying is continued with belt contact devices. In another arrangement web is dried first with belt contact devices, after which drying is continued with cylinder drying or other prior art known methods. In order to simplify the construction, final application and the use of belt contact devices, belt contact drying devices are advantageously arranged as modules, each having belt loop with reasonable length, suitable amount of support rolls and contact zones.

[0045] In an advantageous arrangement according to the invention the fiber web is dried substantially from the beginning of the evaporative drying process to the end of the drying process by 1 - 20 devices, advantageously 5 - 10 drying devices, each comprising contact zones using belt heating contact with ventilation. By this even 60 - 100 of drying cylinders according to prior art can be replaced, which means great savings in machine length due to these compact solutions. Moreover solution enables also big space savings because machine hood can be completely redesigned. The upstairs of hood as well as the cellar can be omitted. Important is the arranging of good moisture removal with enhanced ventilation arrangement so the whole process can be maintained in proper temperature.

[0046] According to an embodiment of the invention fiber web is dried in direct metal belt contact i.e. contact without a water absorbing fabric. Through the contact zone of the device the moist fiber web is guided so that it is in contact on both sides between the pressure-treat-

ing substantially nonpermeable surfaces and at least one of the surfaces is heated to temperatures of 30 - 250 degrees Celsius, advantageously of 80 - 130 degrees Celsius, which makes it possible to use low pressure steam as the heat source for heated surfaces. The contact zone transfers heat to the fiber web effectively and water is removed by evaporation and by steam flow directly after the contact zone in supported draw on metal belt or unsupported in an airborne dryer.

[0047] According to one feature of the invention, in the contact zone both sides of the web smoothen and the curl of the web can be controlled in the contact zone by controlling the temperature levels, and particularly the temperature difference of the pressure-treating surfaces.

[0048] According to another feature of the invention blow/suction enhanced drying process is used as a part of belt heating. In connection with the belt heating contact either before the belt contact or after the belt contact in supported or unsupported draw the fiber web is blown by heated/cool and/or dried air with simultaneous removal to enhance the evaporation. Temperature of the blown air is 25 - 400 degrees Celsius and the blowing speed is 50 - 150 m/s.

[0049] According some advantageous features of the invention: The zone time that the web is in the contact zone is advantageously 50 - 200 ms, even to 400 - 500 ms. The belt in the contact zone can be loaded with an extra nip from other side.

[0050] The heating of the belt and/or the other contact surface is advantageously provided by low pressure steam, by which temperature of the belt / surface of about 80 - 130 degrees Celsius can be achieved. Higher temperatures up to 200 (250) degrees Celsius are also possible if thermoroll, induction heater etc means as such known from prior art are used. The heating of the metal belt can be accomplished by a steam heater box, where steam condensates to the belt surface. If higher belt temperatures are needed, the heating can be produced by oil or high pressure steam (water) circulation, for example by heating via belt guide rolls.

[0051] According to one embodiment, when desired, additional loading nip can be used to increase contact pressure, in order to improve heat transfer, increase web densification, and other web properties. Particular use is to have a profiling nip, as known from metal belt calender, to control the CD-directional thickness profiles.

[0052] It is advantageous that directly after the contact zone effective ventilation is arranged either in a supported or unsupported draw by blowing/suction with a suitable blowing unit. The temperature of the blown air does not need to be very high, dry air with temperature of 60 - 100 degrees Celsius is suitable. The low temperature of the blowed air can be provided by steam heat exchanger by using low pressure steam. At this stage primary aim is not to heat the web, but only to ventilate the evaporated steam away. The replacement air is dry and has low water vapor pressure so that the vapour partial pressure gradient remains between the web and the outside

air.

[0053] According to the invention surface pressure in the belt contact effecting the web is controlled as the drying advances in the manner that the bulk and internal strength in web is not lost but smoothness is achieved. This is obtained by using a very light metal belt pressure, for example 5-20 kPa, in the beginning /early stages of drying, and at least in one later process stage / metal belt contact stage using a higher metal belt pressure, for example 20 - 200 kPa, . This can be accomplished by using in one contact zone a counter roll / a thermo roll with smaller diameter than the rolls in the other contact zones. This can also be accomplished by having different, slightly higher belt tightness in one contact zone than in the others. In addition this can be accomplished by using in one contact zone a roll for extra load. This roll can be provided with profiling means. The heating of the belt can be done using different methods, like condensing steam box, contact heating from support roller, etc. Preferred heating methods are low or medium pressure steam heating for low temperatures and water or heat transfer oil circulation based heating systems.

[0054] The process temperatures can be different in different process stages for example a higher temperature is used as the dry solids content rises as the process advances.

[0055] According to further aspects of the invention the heating of the fiber web in the contact zone provides the web with good quality, especially in respect of smoothness, bulk and strength for following finishing processes for example for coating and calendering. In the process and arrangement according to the invention already in the drying required smoothness is achieved and thus the precalendering is no longer needed when producing fiber webs to be coated f. ex. FBB, WLC and WFC. According to one aspect, the sequential treatment of the web in smooth contacts produces good surface quality already in drying phase. As the required smoothness is obtained already in drying phase, separate calendering phase can be in the best case omitted. This is specially case in calendering products with lower surface smoothness, like WFU papers and boards. Since the smoothness achieved already in the drying when utilizing the process and arrangement according to the invention, good the number of coating stations can be reduced for example from three to two. Also blade coating can be changed to curtain coating which provides better covering which further provides for savings in raw material.

[0056] Separate sizing device with drying devices can be omitted since the sizing and drying of the sizing agent can be combined to the belt drying using for example a spray beam and hot belt contact. This is very advantageous when producing liner or fluting, and also when producing WFU. Thus a simpler and more compact production line is achieved and the runnability is better and also costs for investment are reduced. It is also reasonable to expect that the sizing agent will penetrate better in hot belt pressure-treating process than in typical cool

pressure-treating gap. Thus the amount of sizing agent needed is smaller or alternatively the fiber amount needed is smaller, or alternatively, the obtained strength properties of the fiber web are better. As explained, separate sizing equipment, comprising sizing station and redrying section can be omitted. Particularly, a spray application of high solids content sizing agent (for example starch) is very advantageous, since less water is added to fiber web with sizing agent, thus reducing redrying need. Reduced need drying after the sizing is reducing necessary equipment and making process easier and more economic.

[0057] Also the curl and dimension stability properties will be better since the web is not remoistened.

[0058] According to one further application of the invention the process and arrangement is used when producing special paper grade. In processes according to prior art coated special paper grade products typically are coated in an off-machine coater due to the poor runnability properties of the base paper in the coating process, especially in blade coating process, and due to changing trim demands and due to loss of expensive coating agents. On the other hand the final product demands are high in respect of smoothness which is difficult to achieve without blade coating. This example of the invention is based on the idea that the process and the arrangement according to the invention improve the smoothness and absorption of the fiber web and thus provide the possibility of using other coating processes instead of blade coating. In this example the base web is at least partly pressed and heated with metal belt contact zones and then coated in coating stations of which at least one is a curtain coating station, other coating stations can be blade, film, curtain, spray coating stations or combination station.

[0059] Typical special paper grades for production in which this example can be utilized are thermal, label, inkjet and release paper grades. In curl control of the base web coating or moisturizing can be used. The end product does not need calendering or coating off-line. Thus this example provides for an on-line process, better runnability properties of the production line, high production capacity and wider range of grades. In an example a thermal paper grade f. ex. POS or label is produced. POS is intended for use as cashier machine paper and its smoothness requirement is about 1,5 μm . The label grade requires even greater smoothness and its cd/md-ratio is smaller i.e. its requirement also for dimension stability is greater than that of POS grades. In prior art production processes these are never produced in an on-line process to final products. According to the invention the pressure-treating and drying is mainly done by metal belt heating device with ventilation and coating is done by film and curtain coating. An endcalendering with cold soft-calender nip is used for finalizing the product properties.

[0060] According to some further aspects of the invention the process and the arrangement according to the

invention are advantageously combined with curtain coating. According this advantageous feature of the invention the fiber web is dried by pressure-treating by using a heated metal belt and smooth rolls / cylinders in at least one metal belt contact zone in the process direction with ventilation. In the contact zone the temperature of the warmer side is 80 - 250 degrees Celsius, advantageously 110 - 150 degrees Celsius and cooler side 60 - 110 degrees Celsius, and the dwell time advantageously 50 - 300 ms. In a very advantageous example low drying temperature is used and the thermal energy needed for drying is produced by low pressure steam. The drying is accomplished without a wire or the wire is used only in the very beginning of the drying process so that the wire marking is avoided. The drying process is accomplished between two metal surfaces in the dry content of 45 - 95 % dry solids content. During the heating process between the two metal surfaces the smooth surface structure of these replicates to the surfaces of the moist fiber web and provides smooth surface structure to the fiber web. After the drying process the fiber web is coated either in a precoating or in a final coating process using a curtain or a blade coating method (also other coating methods can be used). Sizing can be included in the production process before coating, if needed and at the end the process comprises the calendering, if needed, by typical calendering methods known as such by one skilled in the art. This example of the invention is suitable for example when producing coated printing paper grades (LWC; MWC; WFC), boards (folding box board, liquid pack board, white coated test liner, white liner, white coated kraft liner, white base board, coated white top test liner, coated white top kraft liner, white-lined chipboard) or special paper grades (photographic paper).

[0061] According to some further aspects of the invention the process and the arrangement according to the invention are advantageously combined with impingement/air borne drying that is provided in conjunction to a metal belt. Said drying devices dry the fiber web as it passes unsupported/supported by the metal belt. The drying effect is enhanced by the contact between the web and the metal belt. After drying the fiber web can be calendered in a metal belt calender which is known as such from prior art. The suitable moisture level for calendering is favorably controlled by controlling the impingement/air borne drying. This example can also be realized vice versa i.e. the web is first calendered and then dried. This example is suitable for production of coated paper and board grades when the devices of this example are located in the production line in the precalendering position or in breaker stack position and for all paper and board grades if located in end calendering position or at any location in drying section.

[0062] In laboratory tests made by the applicant it has been noted that one drying device comprising one belt drying contact corresponds to the drying effect of roughly 5 - 10 drying cylinders prior art. It has also been noted that good drying effect is achieved even with rather low

drying temperatures. This is possible due to the good heat transmission of belt contact, especially due to sufficient metal belt contact pressure, even contact and larger effective surface area). The low surface temperature makes it possible to use low pressure steam as the source of thermal energy. It was also noted that sticking was not a problem due to effective heat transmission that causes fast drying of the surface layer of the web and/or due to the steam pressure producing a repelling force that reverses the adhesion force.

[0063] In the following some main advantageous features of the invention are disclosed. According to a basic inventive idea the fiber web is treated in a heating and pressing contact zone in combination with blowing enhancement of drying with cooling/heating control on supporting belt/roll surface. According to one aspect of the invention a process for manufacturing a web is achieved, in which the fiber web is dried by a drying arrangement located downstream from a press section beginning from dry solids content of about 45 - 60 % until dry solids content 85 - 95 % , wherein said drying arrangement comprises at least one belt drying/heating device with belt like contact zones that each comprises two opposite substantially smooth surfaces, into which zones the fiber web is guided for treating and heating and that at least one of the surfaces is accomplished by a metal belt. According to one further feature at least one the surfaces is heated for heating and drying the fiber web. According to one further feature, a beltlike contact zone is defined by contact between an endless belt loop and a counter element located outside this belt loop, wherein the counter element is another belt loop, a roll or a cylinder. In conjunction to at least one contact zone ventilation is arranged in at least one belt drying device for removing moist air and evaporating steam and for enhancing drying. Ventilation can be based on impingement, air borne, blow nozzle, suction nozzle or to corresponding drying based on air circulation. According to one feature sizing equipment is located downstream or upstream of a belt drying device either on-machine or off-machine. Sizing can be based to spray, film transfer, and curtain or corresponding sizing method. According to one feature coating equipment is located downstream or upstream of a belt drying device either on-machine or off-machine, coating can be based to spray, curtain or corresponding coating method. According to one feature calendering device is located downstream or upstream of belt drying device either on-machine or off-machine or in wet-stack position. Calender can be belt, metal belt, soft, machine, multinip or shoe calender. The invention is usable in connection with manufacturing of various fiber web grades, in particularly with FBB, liner, fluting, uncoated and coated fine papers (WFU and WFC), special papers and printing papers. According to further features: in the process the first, or the second, or both surfaces are heated in such way that the fiber web in contact to said surfaces and fiber web is heated in the contact zone and the drying of the web takes place after the contact zone between which sur-

faces the web is treated and which surfaces press the web in order to transfer heat into the fiber web in connection with at least one contact zone effective ventilation is applied in order to enhance moist air removal in the vicinity of the fiber web and to improve drying rate of fiber web. According to some further features the fiber web boundary layer air ventilation is applied for unsupported or supported paper web and/or the fiber web can be guided outside the contact zone in a contact with a supporting metal belt, or like, and that said belt can be heated and transfers heat to the fiber web. Advantageously fiber web is heated in a contact zone, in which at least one of the surfaces is heated to temperatures of 30-250 degrees Celsius, advantageously to 80-130 degrees Celsius. Advantageously contact zone dwell time is 50 - 500 ms, advantageously 50-200 ms. Advantageously at least in one contact zone the temperature either in first surface or second surface is higher than surface temperatures in other contact zones. Further, at least two different contact zones have different pressure. The arrangement for drying may comprise several modules located one after another, one module comprising one belt loop and counter elements and ventilation devices. The invention can also be utilized in connection with modernizations of fiber web production lines by locating belt drying devices instead of drying cylinders. Modules can replace either some or all drying cylinders. Modules can be located at any location in the drying section.

[0064] In the following the invention is discussed in more detail by reference to figures of accompanying drawings.

Figure 1 shows schematically an example of a belt drying device.

Figure 2 shows schematically an example of a belt drying device.

Figure 3 shows schematically an example of an embodiment of a belt drying device.

Figure 4 shows schematically an example of a belt drying device.

Figure 5 shows schematically an example of a belt drying device.

Figure 6 shows schematically comparison between a board machine line according to prior art and a paper machine line utilizing a belt drying device.

Figure 7 shows a schematically comparison between an other board machine line according to prior art and a paper machine line utilizing a belt drying device.

[0065] In the following description same reference signs designate for respective components etc. unless

otherwise mentioned and it should be understood that the examples are susceptible of modification in order to adapt to different usages and conditions within the frames of a belt drying device.

[0066] In figure 1 one example of an arrangement is schematically shown. In this example the arrangement comprises belts 11, 12, 13, 14, 15 which are formed as loops. The belts 11, 13, 14, 15 are heated for example into temperature of 105 degrees Celsius. The belts are heated by steam boxes 30 with overpressure of advantageously 0,5 bar. Belts are of metal. The main properties of the belts are that they can be heated up to temperature of max 250 - 300 degrees C and they are smooth at least on that surface that will be in contact with the fiber web, smoothness is 0,1 - 2,0 Ra or better, advantageously 0,05 - 0,2 Ra at least on one belt surface. Belt loops comprise guide rolls 20, 21 which may also be movable for controlling the tightness of the loop and for example steering loops as shown by arrow 22. In this arrangement the web W to be dried passes process direction through several contact zones comprising two surfaces, first surface and second surface, between which the web is treated and which surfaces press the web W mechanically. In this example, first contact zone is formed by belt loops 11 and 15, while second contact zone is formed by belt loops 13 and 14. In this example the belt loops 11, 13, 14, 15 are heated. Belt 12 in this example is a transfer belt and also it can be heated (or cooled), but this is not shown in the figure 1. The air ventilation units/ blow/suction boxes 31 comprise means for blowing and removing air or other vapor moisture evaporating from fiber web.

[0067] The example of figure 1 is modifiable in various ways. The lower belt loops 11, 13 can be removed and thus the arrangement comprising only upper belts 14, 15 and counter rolls 20a, 20b and transfer belt 12. In this example the counter rolls 20a and 20b can be heated by pressurized water/steam or oil circulation for example into surface temperature 120 - 160 degrees Celsius. Rolls 20a, 20b have preferably a smooth surface with smoothness 0,1 - 2,0 Ra or better, advantageously 0,05 - 0,2 Ra. In this example transfer belt 12 can be replaced by a fabric, or wire, equipped with suitable suction boxes to ensure web pick up.

[0068] According to figure 1 the fiber web is heated in direct metal belt contact. The moist fiber web W is treated through the contact zones between the belts 11, 15 and 13, 14 and alternatively between the belt 15 and roll 20a, and belt 14 and 20b, so that the web is in contact on both sides between substantially smooth nonpermeable surfaces and at least one of the surfaces is heated to temperatures of in range 30 - 250 degrees Celsius, advantageously of 80 - 120 degrees Celsius. The contact zone transfers heat to the fiber web effectively but no water is removed from the web in the contact zone. Instead water is removed by evaporation and by steam flow directly after the contact zone in one-sided supported draw during the time the web travels along the belt 15, 12, 14. In the contact zone both sides of the web smoothen.

[0069] In this example between the contact zones effective ventilation is arranged either in a supported/unsupported by blowing with suitable ventilation unit/units 31. The temperature of the blown air is not very high, dry air with temperature of 60 - 100 degrees Celsius is suitable even unheated dry air may be suitable. The low temperature is provided by steam heat exchanger by using low pressure steam. At this stage the web's ventilation mainly carries evaporated steam away from web surfaces.

[0070] Also the curl of the web can be controlled in the contact zone by controlling the temperature difference of the surfaces by controlling the temperature of the pressure-treating surfaces. Web curling can be controlled by adjusting temperature sidedness between the first and second contact surface (surface 1, surface 2), i.e. belts 15/11 and 14/13. Curling can be adjusted as well by controlling the use of ventilation units 21.

[0071] In the schematic example shown in figure 2 fiber web W is guided into the arrangement of contact zones which are formed between the rolls 20a, 20b, 20c and the belt 11. The fiber web W is also dried by air blows 35. The rolls 20a, 20b, 20c can be heated to temperatures of 30 - 250 degrees Celsius and the rolls 20a, 20b, 20c can have the same temperature or each roll have a temperature of its own. In connection with the belt 11 also heating can be arranged. In this example several contact zones in which the web W is dried are formed. The belt 11 is a metal belt. In connection with the belt drying contact either before the belt contact or after the belt contact in supported or unsupported draw, supported by metal belt in this example, towards the fiber web is blown heated and/or dried air 35 to enhance the evaporation. Temperature of the blown air 35 is 25 - 400 degrees Celsius and the blowing speed is 50 - 150 m/s. Impingement hood or flotation dryer hood or nozzle rows/suction piper can be used.

[0072] In the schematic example of figure 3 the surface pressure in the belt 11 contact effecting the web is controlled as the drying advances in such manner that the bulk is not lost but smoothness is achieved by drying in the beginning early stage with light pressure (5 - 20 kPa) provided by the metal belt 11 and in one later process stage / metal belt 11 contact stage with higher pressure (20 - 200 kPa) provided by the metal belt 11. In the example of figure 3 this is accomplished by using in one contact zone a counter roll / a thermo roll 20c with smaller diameter than the rolls 20a, 20b in the other contact zones of same belt loop 11. This can also be accomplished by having different, slightly higher belt tightness in one contact zone than in the others, for example arranging each roll 20a, 20b, 20c, having their own contrary belt 11 loops which have similar guide rolls 21 that are movable in order to control tightness of the belt 11. Also the process temperatures can be different in different process stages for example a higher temperature is used as the dry solids content rises as the process advances.

[0073] In figure 4 an example of one aspect of the in-

vention is shown schematically. In this example the contact zones are arranged reminding a basic one-wire draw of the prior art. The drying wire is replaced with belt 11, a metal belt and also to improve runnability another belt is arranged as lower belt 16 that may be a wire or a metal belt. The belt 11 of the pressure-treating contact zone is heated by a steam heater 30 or other suitable heating device, e.g. by induction heating device or heated guiding rolls. The fiber web is dried by pressure-treating it in contact zone between two smooth surfaces, belt 11 and cylinder or roll 20 that are heatable. The moisture evaporating is ventilated after each upper row cylinder 20. Also the cylinders or rolls 20 of the lower row are heatable and provide for extra contact zone and thus further provide for heating the web to be dried. This example of the invention is very advantageous in modernization of drying sections of fiber web machines. Rolls are preferably similar in size to typical drying cylinders.

[0074] In the example according to figure 5 impingement drying units 40 are provided above a metal belt 11. The impingement drying devices 40 dry the fiber web W as it passes supported by the metal belt 11. The drying effect is enhanced by the contact between the web W and the heated metal belt 11. After drying the fiber web is calendered in a metal belt calender 50 which is known as such from prior art. The suitable moisture level for calendering is controlled by controlling the impingement drying. The metal belt 11 can be either heated or not. This example can also be realized vice versa i.e. the web is first calendered and then dried. Figure 5 shows integrated calendering and drying unit that can be placed to drying section.

[0075] In figures 6 and 7 two fictitious examples are presented. In this examples in the upper part a fiber web machine according to prior art is presented and in the lower part this prior art machine with the arrangement according to the invention is used. It is easily understood that these examples can be modified in many different variations and in each considerable space savings and/or capacity increases can be achieved.

[0076] The example of figure 6 is for producing folding box board (=FBB) and in this example the drying section of the prior art is replaced with drying arrangement 70 according to the present invention also a profiling nip arrangement 80 and a sizer with a drying arrangement 90 according to the invention is provided. In this example the capacity of the production lines is same but considerable saving of space 84 m (25 %) is achieved. In this example all drying accomplished is according to the process of the invention. The drying arrangement 70 according to the invention has 27 contact zones that replace 95 drying cylinders. Also the calendering unit of the prior art line can be omitted and if needed replaced with the profiling nip arrangement 70, if needed. And in the coating blade coating arrangement of 3 + 2 blade coating units is replaced by 2 + 1 blade coating units. In this modernization example conventional cylinder drying section is replaced with belt drying modules 70 and precalendering

removed and only profiling nip 80 is left and sizer station and redrying is replaced by spray sizer and integrated belt finishing device.

[0077] In example of figure 7 the producing line is for board production, for example for liner of fluting. In this example spray sizing and integrated contact zone drying and smoothing arrangement replaces sizer and its redrying units. The space saved is used to add drying capacity. In this example drying capacity is increased 40 % and the speed of the line is increased from 1200 m/min to 1700 m/min.

[0078] The applicant has done some laboratory tests and good results were achieved. For example when drying WFU paper with contact zone arrangements according to the invention, it was noted that 8 - 10 contact zones resulted the needed dry solids content when temperatures slightly over 100 degrees Celsius were used. Laboratory tests done with WFU paper and liner board have shown that the drying effect is not very much dependent of the temperatures. According to test results of drying between two metal surfaces a roughly 3 - 6 % change of dry solids content is achieved in one contact zone when the heating and/or evaporation of moisture is done after the contact zone. This means that with 5 - 10 contact zones is enough to replace the entire drying section of prior art fiber web machines.

Claims

1. Process for producing a fiber web, in which process the moist fiber web (W) is guided from a press section of a fiber web machine into a drying arrangement that comprises in a process direction one or more devices each having belt like contact zones that each comprises two smooth surfaces, a first surface (11) which is a metal belt, and a second surface (20a, 20b, 20c) which is a roll or a cylinder or a metal belt supported by a roll or by a cylinder or by a support shoe, and in which belt like contact zones the contacting surface smoothness of the surfaces contacting the fiber web is in the range 0.4 - 1.0 Ra when no special smoothening effect is desired and when a more smoothening of fiber web (W) is desired, at least one contacting surface is grinded and polished to a smoothness of 0.1 Ra or lower, wherein either the first surface or the second surface or both surfaces are heated, between which surfaces the web (W) is treated and which surfaces pressure-treat the web (W) mechanically for heating the fiber web (W), wherein the surface pressure in the belt contact affecting the web (W) is adjusted at different values as the drying advances by arranging a different pressure in at least two of the contact zones by drying in an early stage with a light pressure of 5 - 20 kPa and in a later process stage with a higher pressure of 20 - 200 kPa.

2. Process according to claim 1, **characterized in that** directly after at least one contact zone effective ventilation is used for the fiber web in supported/unsupported draw by blowing air with a blowing unit (31) and simultaneous suction for moist air. 5
3. Process according to claim 1, **characterized in that** before and/or after a contact zone the fiber web (W) is dried by an air borne/impingement drying process (40). 10
4. Process according to claim 1, **characterized in that** in the process the fiber web (W) is dried substantially from the beginning of the drying process to the end of the drying process by 5 -10 drying devices each comprising contact zones , in which the web (W) is in belt drying contact. 15
5. Process according to claim 1, **characterized in that** at least one of the surfaces is heated to temperatures of 30-250 degrees Celsius, advantageously to 80-130 degrees Celsius. 20
6. Process according to claim 1 **characterized in that** the web (W) stays in a contact zone 50 - 200 ms. 25
7. Arrangement for producing a fiber web, which arrangement comprises a drying arrangement that comprises in a process direction one or more devices each having belt like contact zones that each comprises two smooth surfaces, a first surface (11) which is a metal belt, and a second surface (20a, 20b, 20c) which is a roll or a metal belt supported by a roll, in which belt like contact zones the contacting surface smoothness is in the range 0.4. -1.0 Ra when no special smoothening effect is desired and when a more smoothening of fiber web (W) is desired, at least one contacting surface is grinded and polished to a smoothness of 0.1 Ra or lower, wherein either the first surface or the second surface or both surfaces are heated, between which surfaces the web (W) is treated and which surfaces pressure-treat the web (W) mechanically for heating the fiber web (W), wherein the surface pressure in the belt contact affecting the web (W) is adjusted at different values as the drying advances by arranging a different pressure in at least two of the contact zones by drying in an early stage with a light pressure of 5 - 20 kPa and in a later process stage with a higher pressure of 20 - 200 kPa by providing at least in one contact zone as the second surface a roll (20c) with a smaller diameter than the rolls (20a, 20b) in the other contact zones. 30 35 40 45 50
8. Arrangement according to claim 7, **characterized in that** in the arrangement ventilation is arranged directly after at least one contact zone either in supported or unsupported draw by blowing air with a

blowing unit (31).

9. Arrangement according to claim 7, **characterized in that** the arrangement comprises an air impingement drying device (40) located either before and/or after a contact zone in supported or unsupported draw of the fiber web (W).
10. Arrangement according to claim 7, **characterized in that** in the arrangement at least one belt in a contact zone is loaded with a nip.

Patentansprüche

1. Verfahren zur Herstellung einer Faserbahn, wobei in dem Verfahren die feuchte Faserbahn (W) von einer Pressenpartie einer Faserbahnmaschine in eine Trocknungseinrichtung geführt wird, die in der Verfahrensrichtung eine oder mehrere Einrichtungen aufweist, die jeweils bandartige Kontaktzonen aufweisen, die jeweils zwei glatte Oberflächen aufweisen, nämlich eine erste Oberfläche (11), die als ein Metallband ausgebildet ist, und eine zweite Oberfläche (20a, 20b, 20c), die als eine Walze oder ein Zylinder oder ein Metallband ausgebildet ist, die von einer Walze oder von einem Zylinder oder von einem Stützschuh gestützt ist, und wobei in den bandartigen Kontaktzonen die Kontaktoberflächenglätte der Oberflächen, welche die Faserbahn berühren, in dem Bereich von 0,4 bis 1,0 Ra liegt, wenn keine spezielle Glättungswirkung erwünscht ist, und wenn eine stärkere Glättung der Faserbahn (W) erwünscht ist, wenigstens eine Kontaktfläche auf eine Glätte von 0,1 Ra oder niedriger geschliffen und poliert wird, wobei entweder die erste Oberfläche oder die zweite Oberfläche oder beide Oberflächen beheizt werden, wobei zwischen den Oberflächen die Bahn (W) behandelt wird, und wobei die Oberflächen die Bahn (W) mechanisch druckbehandeln, um die Faserbahn (W) zu erwärmen, wobei der auf die Bahn (W) wirkende Oberflächendruck in dem Bandkontakt auf unterschiedliche Werte eingestellt wird, wenn die Trocknung voranschreitet, und zwar durch Einrichten eines unterschiedlichen Drucks in wenigstens zwei der Kontaktzonen durch Trocknen in einem frühen Stadium mit einem geringen Druck von 5 bis 20 kPa und in einem späteren Prozessstadium mit einem höheren Druck von 20 bis 200 kPa.
2. Verfahren nach Anspruch 1, **dadurch gekennzeichnet, dass** direkt nach wenigstens einer Kontaktzone eine wirk-same Belüftung für die Faserbahn in einem gestütz-ten bzw. nicht gestützten Zug durch Blasen von Luft mit einer Blaseinheit (31) und gleichzeitigem Absaugen von feuchter Luft eingesetzt wird.

3. Verfahren nach Anspruch 1,
dadurch gekennzeichnet, dass
vor und/oder nach einer Kontaktzone die Faserbahn (W) durch ein luftunterstütztes bzw. Impingement-Trocknungsverfahren (40) getrocknet wird. 5
4. Verfahren nach Anspruch 1,
dadurch gekennzeichnet, dass
in dem Verfahren die Faserbahn (W) im Wesentlichen von dem Beginn des Trocknungsprozesses bis zu dem Ende des Trocknungsprozesses von 5 bis 10 Trocknungseinrichtungen getrocknet wird, die jeweils Kontaktzonen aufweisen, in denen die Bahn (W) sich in einem Bandtrocknungskontakt befindet. 10
5. Verfahren nach Anspruch 1,
dadurch gekennzeichnet, dass
wenigstens eine der Oberflächen auf Temperaturen von 30 bis 250 Grad Celsius, vorzugsweise auf 80 bis 130 Grad Celsius erwärmt wird. 15
6. Verfahren nach Anspruch 1,
dadurch gekennzeichnet, dass
die Bahn (W) für 50 bis 200 ms in einer Kontaktzone bleibt. 20
7. Vorrichtung zur Herstellung einer Faserbahn, wobei die Vorrichtung eine Trocknungseinrichtung aufweist, die in einer Verfahrensrichtung eine oder mehrere Einrichtungen aufweist, die jeweils bandartige Kontaktzonen aufweisen, die jeweils zwei glatte Oberflächen aufweisen, nämlich eine erste Oberfläche (11), die als ein Metallband ausgebildet ist, und eine zweite Oberfläche (20a, 20b, 20c), die als eine Walze oder als ein von einer Walze gestütztes Metallband ausgebildet ist, wobei in den bandartigen Kontaktzonen die Glätte der Kontaktfläche in dem Bereich von 0,4 bis 1,0 Ra liegt, wenn keine spezielle Glättwirkung erwünscht ist, und wenn eine stärkere Glättung der Faserbahn (W) erwünscht ist, wenigstens eine Kontaktfläche auf eine Glätte von 0,1 Ra oder niedriger geschliffen und poliert ist, wobei entweder die erste Oberfläche oder die zweite Oberfläche oder beide Oberflächen beheizt sind, wobei zwischen den Oberflächen die Bahn (W) behandelt wird, und wobei die Oberflächen die Bahn (W) mechanisch druckbehandeln, um die Faserbahn (W) zu erwärmen, wobei der auf die Bahn (W) wirkende Oberflächendruck in dem Bandkontakt auf unterschiedliche Werte eingestellt wird, wenn die Trocknung voranschreitet, und zwar durch Einrichten eines unterschiedlichen Drucks in wenigstens zwei der Kontaktzonen durch Trocknen in einem frühen Stadium mit einem geringen Druck von 5 bis 20 kPa und in einem späteren Prozessstadium mit einem höheren Druck von 20 bis 200 kPa, und zwar dadurch, dass in wenigstens einer Kontaktzone als die zweite Oberfläche eine Walze (20c) mit einem geringeren Durch-

messer als die Walzen (20a, 20b) der anderen Kontaktzonen vorgesehen ist.

8. Vorrichtung nach Anspruch 7,
dadurch gekennzeichnet, dass
in der Vorrichtung die Belüftung direkt nach wenigstens einer Kontaktzone entweder in einem gestützten oder einem ungestützten Zug durch Blasen von Luft mit einer Blaseinheit (31) angeordnet ist.
9. Vorrichtung nach Anspruch 7,
dadurch gekennzeichnet, dass
die Anordnung eine Luft-Impingement-Trocknungseinrichtung (40) aufweist, die entweder vor und/oder nach einer Kontaktzone in einem gestützten oder einem ungestützten Zug der Faserbahn (W) angeordnet ist.
10. Vorrichtung nach Anspruch 7,
dadurch gekennzeichnet, dass
in der Vorrichtung wenigstens ein Band in einer Kontaktzone mittels eines Nips belastet ist.

25 Revendications

1. Procédé pour la production d'une bande fibreuse, dans lequel la bande fibreuse (W) humide est guidée à partir d'une section de presse d'une machine à bande fibreuse vers un système de séchage comprenant un ou plusieurs dispositifs dans une direction de traitement, lesquels comportent respectivement des zones de contact du genre courroies, comprenant deux surfaces lisses, une première surface (11) étant une courroie métallique et une deuxième surface (20a, 20b, 20c) étant une courroie de rouleau ou de cylindre ou métallique supportée par un rouleau ou par un cylindre ou par un patin de support, et lesdites zones de contact du genre courroies présentant un lissé de surface de contact des surfaces touchant la bande fibreuse dans la plage de 0,4 - 1,0 Ra lorsqu'aucun effet de lissage spécial n'est souhaité et, lorsqu'un lissage plus important de la bande fibreuse (W) est souhaité, au moins une surface de contact est poncée et polie jusqu'à un lissé de 0,1 Ra ou inférieur, dans lequel la première surface ou la deuxième surface ou les deux surfaces sont chauffées, la bande (W) étant traitée entre lesdites surfaces et lesdites surfaces traitant la bande (W) sous pression mécaniquement pour chauffer la bande fibreuse (W), dans lequel la pression de surface dans le contact avec la courroie affectant la bande (W) est réglée à différentes valeurs tandis que le séchage se poursuit, en réglant une pression différente dans au moins deux des zones de contact, en séchant avec une pression légère de 5 - 20 kPa au cours d'une étape initiale, puis en séchant avec une pression plus élevée de 20 - 200 kPa au cours d'une

étape de traitement ultérieure.

2. Procédé selon la revendication 1, **caractérisé en ce que** directement après au moins une zone de contact, une ventilation efficace est utilisée pour la bande fibreuse par aspiration supportée/non supportée par soufflage d'air avec une unité de soufflage (31) et par aspiration simultanément pour l'air humide. 5
3. Procédé selon la revendication 1, **caractérisé en ce qu'avant et/ou après** une zone de contact, la bande fibreuse (W) est séchée par un procédé de séchage par impact/à l'air (40). 10
4. Procédé selon la revendication 1, **caractérisé en ce que** dans le procédé, la bande fibreuse (W) est séchée substantiellement dès le début du procédé de séchage jusqu'à la fin du procédé de séchage par 5 - 10 dispositifs de séchage comprenant respectivement des zones de contact, la bande (W) étant en contact de séchage avec la courroie. 15 20
5. Procédé selon la revendication 1, **caractérisé en ce qu'au moins l'une** des surfaces est séchée à des températures de 30 - 250 degrés Celsius, avantageusement de 80 - 130 degrés Celsius. 25
6. Procédé selon la revendication 1, **caractérisé en ce que** la bande (W) demeure dans une zone de contact pendant 50 - 200 ms. 30
7. Système pour la production d'une bande fibreuse, ledit système comprenant un système de séchage comprenant un ou plusieurs dispositifs dans une direction de traitement, lesquels comportent respectivement des zones de contact du genre courroies comprenant respectivement deux surfaces lisses, une première surface (11) étant une courroie métallique et une deuxième surface (20a, 20b, 20c) étant une courroie de rouleau ou de cylindre ou métallique supportée par un rouleau, lesdites zones de contact du genre courroies présentant un lissé des surface de contact est compris entre 0,4 et 1,0 Ra lorsqu'aucun effet de lissage spécial n'est souhaité et, lorsqu'un lissage plus important de la bande fibreuse (W) est souhaité, au moins une surface de contact est poncée et polie jusqu'à un lissé de 0,1 Ra ou inférieur, dans lequel la première surface ou la deuxième surface ou les deux surfaces sont chauffées, la bande (W) étant traitée entre lesdites surfaces et lesdites surfaces traitant la bande (W) sous pression mécaniquement pour chauffer la bande fibreuse (W), dans lequel la pression de surface dans le contact avec la courroie affectant la bande (W) est réglée à différentes valeurs tandis que le séchage se poursuit, en réglant une pression différente dans au moins deux des zones de contact, en séchant avec une pression légère de 5 - 20 kPa au cours 35 40 45 50 55

d'une étape initiale, puis en séchant avec une pression plus élevée de 20 - 200 kPa au cours d'une étape de traitement ultérieure, en prévoyant dans au moins une zone de contact en tant que deuxième surface un rouleau (20c) d'un diamètre inférieur à celui des rouleaux (20a, 20b) dans les autres zones de contact.

8. Système selon la revendication 7, **caractérisé en ce que** dans le système, une ventilation est prévue directement après au moins une zone de contact par aspiration supportée ou non supportée, par soufflage d'air à l'aide d'une unité de soufflage (31).
9. Système selon la revendication 7, **caractérisé en ce que** le système comprend un dispositif de séchage par impact (40) placé avec et/ou après une zone de contact par aspiration supportée ou non supportée de la bande fibreuse (W).
10. Système selon la revendication 7, **caractérisé en ce que** dans le système, au moins une courroie dans une zone de contact est chargée avec un pincement.

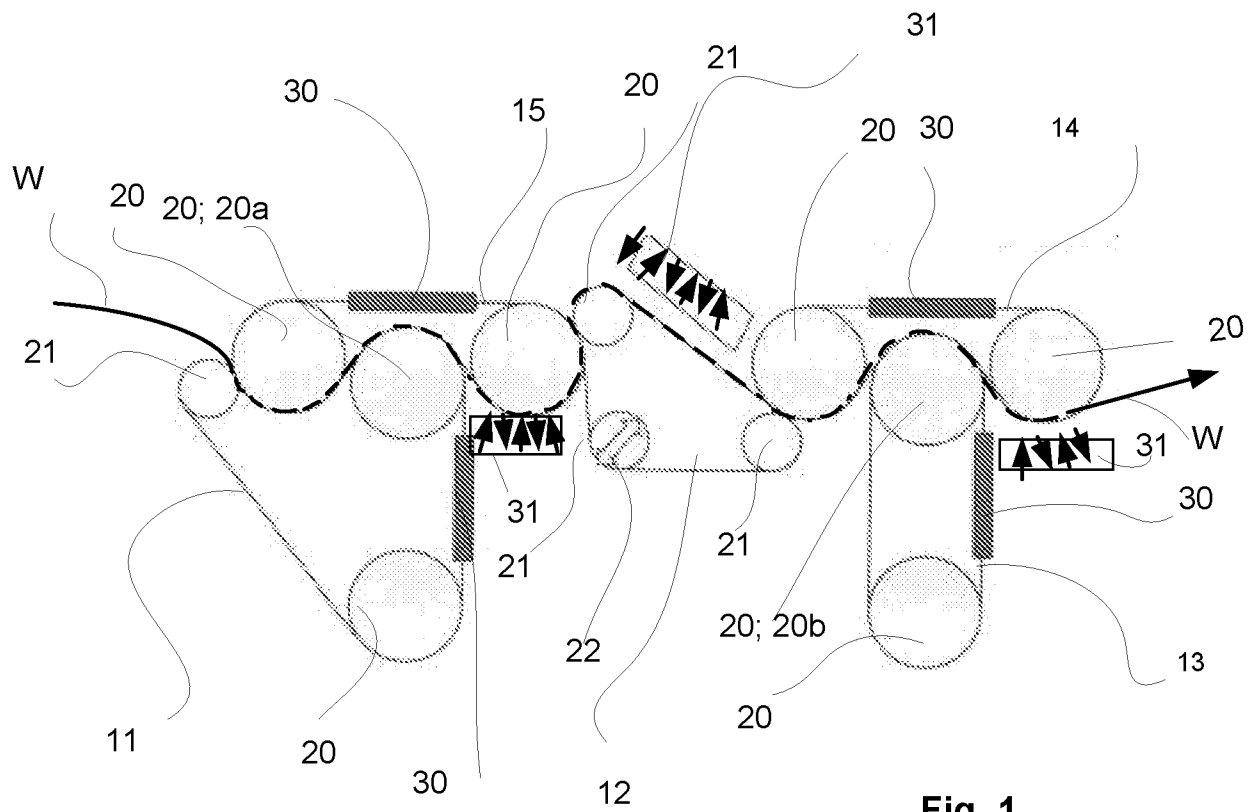


Fig. 1

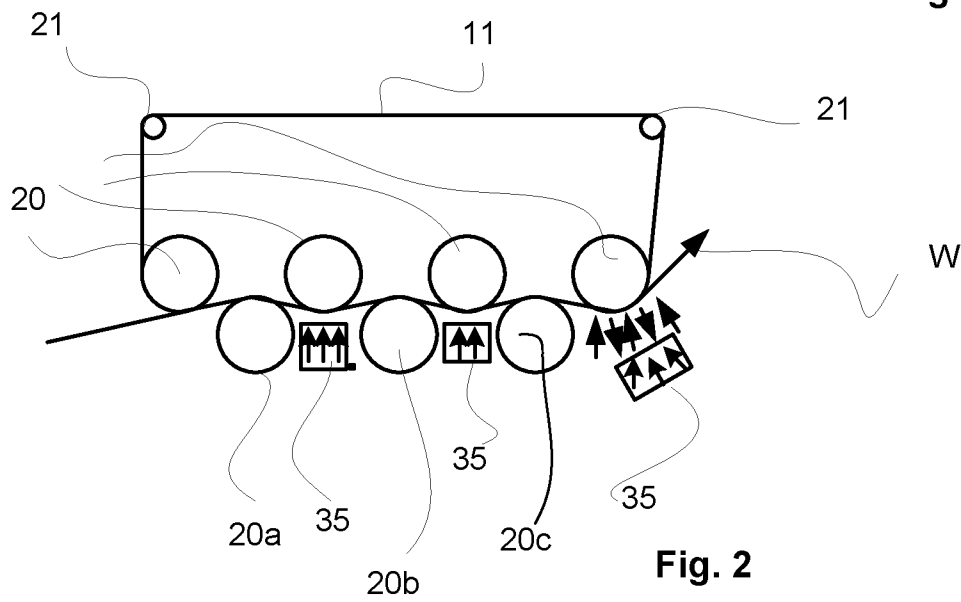


Fig. 2

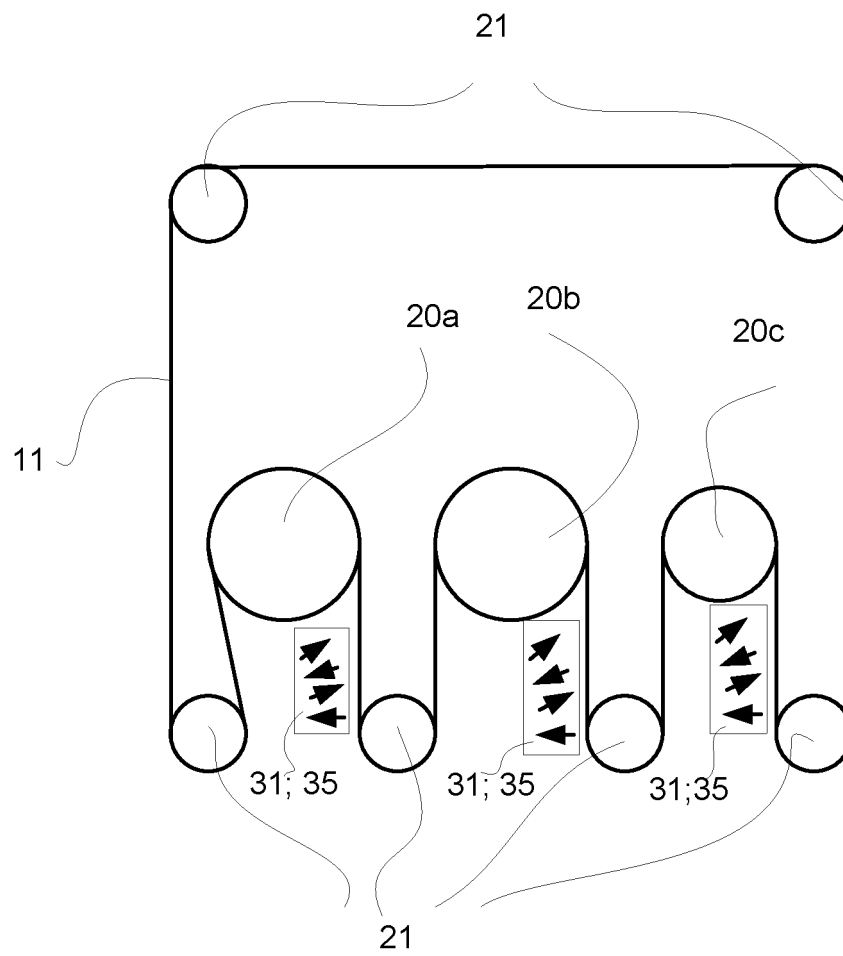


Fig. 3

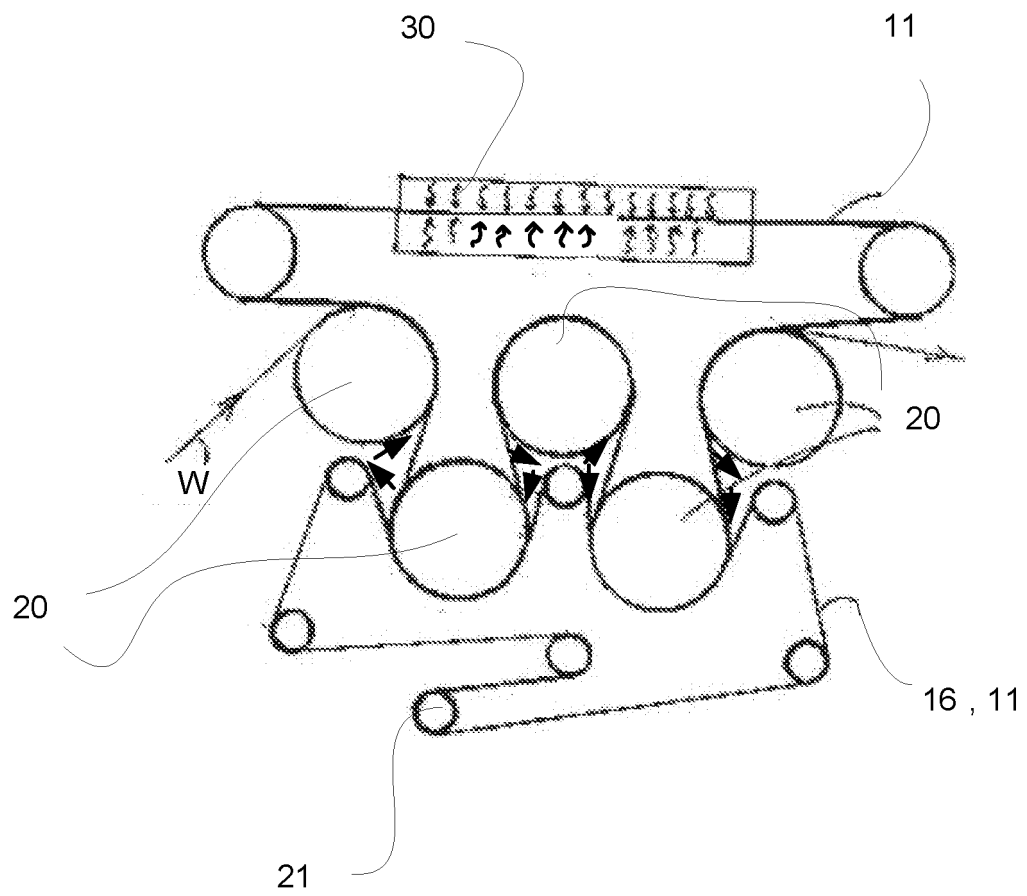


Fig. 4

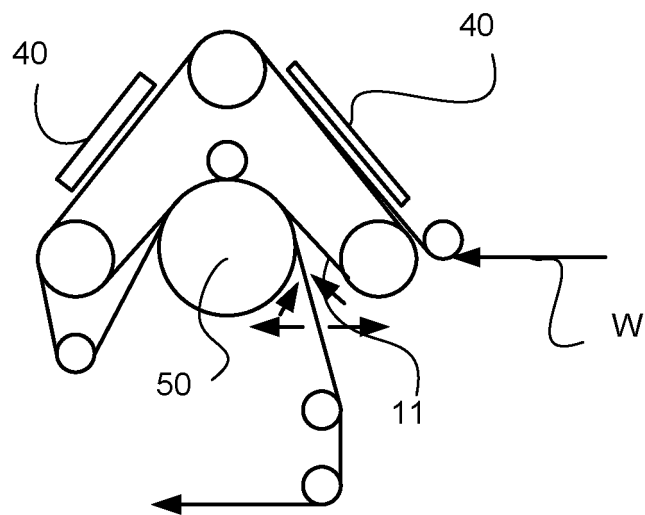


Fig. 5

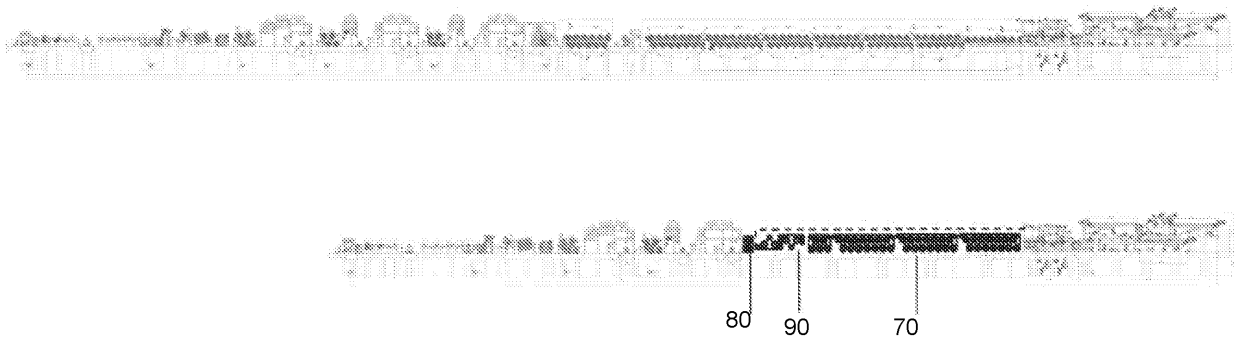


Fig. 6

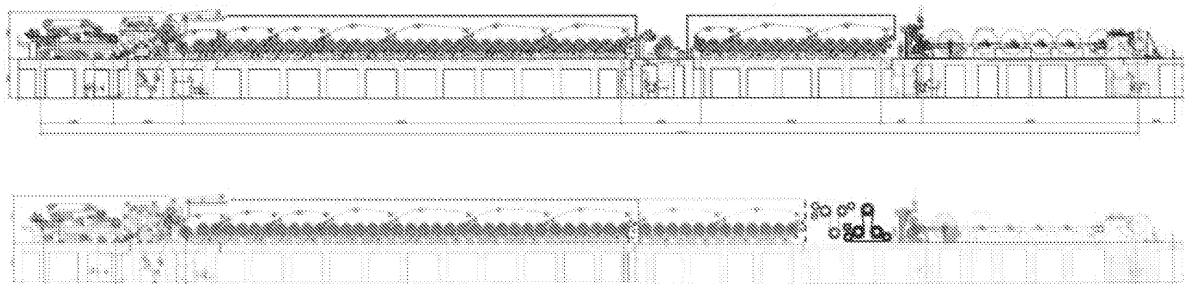


Fig. 7

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- EP 0824618 A [0005]
- US 4112586 A [0006]
- FI 54514 [0006]
- DE 102004017807 [0007]
- EP 1478805 A [0008]
- EP 2072672 A [0009]
- WO 2010136651 A [0009]
- DE 10318185 [0009]
- WO 2009129843 A [0009]
- EP 2071076 A [0009]
- EP 2022892 A [0009]

Non-patent literature cited in the description

- Papermaking Science and Technology. Fapet Oy, 1999, 362 [0010]