(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 0 777 783 B1

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention of the grant of the patent:
01.03.2000 Bulletin 2000/09

(21) Application number: **95927342.6**

(22) Date of filing: **21.07.1995**

(51) Int Cl.[7]: **D21F 11/14**, D21F 11/04

(86) International application number:
PCT/US95/09232

(87) International publication number:
WO 96/06223 (29.02.1996 Gazette 1996/10)

(54) SOFT LAYERED TISSUES HAVING HIGH WET STRENGTH

SANFTES MEHRLAGIGES TISSUE-PAPIER MIT HOHER NASSFESTIGKEIT

TISSUS OUATES EN NAPPES PRESENTANT UNE RESISTANCE ELEVEE AU MOUILLE

(84) Designated Contracting States:
BE DE ES FR GB IT NL SE

(30) Priority: **22.08.1994 US 294153**

(43) Date of publication of application:
11.06.1997 Bulletin 1997/24

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EP 0 777 783 B1

Printed by Jouve, 75001 PARIS (FR)

Description

Background of the Invention

[0001] In the manufacture of tissue paper useful as facial tissue, bath tissue, paper towels and the like, it is well known to use various additives to enhance the properties of the product (see EP-A-0 029 269). Such additives include wet strength agents, which can be permanent or temporary, and debonding agents. As the name implies, wet strength agents impart strength retention to the tissue sheet when it becomes wet by creating or retaining certain fiber-to-fiber bonds that withstand the presence of water or moisture, which is particularly useful for most tissue applications. Temporary wet strength agents are especially useful for bath tissue, where wet strength is needed while the tissue is being used, but is undesirable after the tissue has been flushed into the sewer system. Debonding agents are desirable for the purpose of enhancing the softness of the tissue sheet by reducing the number of papermaking bonds between fibers and enhancing the surface feel of the tissue.

[0002] However, the action of debonding agents inherently is counter to the objective of the wet strength agents, since the debonding agents can prevent the wet strength agents from forming the desired bonds. Hence there is a need for a means of combining wet strength agents and debonders which minimizes the counterproductive interaction of the two classes of chemicals and enables the manufacture of tissue sheets having the beneficial properties of softness and wet strength.

Summary of the Invention

[0003] It has now been discovered that debonding agents and wet strength agents can be added to a tissue sheet in a layer-wise fashion to maximize the effectiveness of each additive while minimizing the interaction of the additives with each other. This enables the papermaker to take full advantage of the properties of the additives and the fibers within the various layers of the tissue, resulting in a soft, yet strong, tissue.

[0004] Hence in one aspect, the invention resides in a method for making a soft tissue sheet comprising (a) forming a layered wet web of papermaking fibers using a layered headbox, said layered wet web having a first outer layer, a second outer layer, and at least one inner layer, wherein the two outer layers comprise predominantly hardwood fibers and said at least one inner layer contains a wet strength agent and comprises predominantly softwood fibers, and wherein at least the first outer layer contains a debonding agent; (b) transferring the layered wet web to a throughdrying fabric wherein said second outer layer is in contact with the throughdrying fabric; and (c) throughdrying the web to form a soft tissue sheet. The resulting throughdried web can be creped or uncreped. In an alternative embodiment, the layered web of step (a) can be dried in accordance with conventional "wet-pressing" processes wherein the web is carried by a papermaking felt, pressed against the surface of a Yankee dryer, dried and creped to produce a soft tissue sheet.

[0005] In another aspect, the invention resides in a soft layered tissue comprising two outer layers and at least one inner layer, wherein said two outer layers contain predominantly hardwood fibers and at least one of the two outer layers, such as the airside layer (hereinafter described), contains a debonding agent, and wherein said at least one inner layer contains predominantly softwood fibers and a wet strength agent. The tissue can be throughdried or wet-pressed and can be creped or uncreped.

[0006] As used herein, a "debonding agent" is an additive that enhances the softness of tissue paper. The debonding agents may accomplish this by a variety of means: a) by interfering with formation of hydrogen bonds, such as with fatty quaternary ammonium compounds (debonder); b) by increasing the lubricity of the fibers and increasing flexibility of the web, such as with fatty acid salts and derivatives (e.g., fatty amine derivatives) and silicones; c) reducing surface tension and thereby reducing Campbell's forces during web formation, resulting in reduced bonded area, such as with surfactants; or d) by other means or combinations of means. Suitable debonding agents include, without limitation, alkyl trimethyl quaternary ammonium compounds, dialkyl dimethyl quaternary ammonium compounds, trialkyl methyl quaternary ammonium compounds, dialkoxy alkyl quaternary ammonium compounds, dialkoxy alkyl quaternary ammonium compounds, diamidoamine quaternary compounds, imidazolinium quaternary ammonium compounds, fatty acid derivatives, nonionic surfactants, ampholytic surfactants, silicones, methyl cellulose, hydroxypropyl cellulose, methyl hydroxyethyl cellulose, methyl hydroxypropyl cellulose, methyl hydroxybutyl cellulose, carboxyethylmethyl cellulose, and mixtures thereof.

[0007] The debonding agents are preferably incorporated into the outer layer(s) by addition into the layer furnish prior to formation of the web. However, the debonding agents can also be applied to the wet web after formation by spraying the debonding agent onto the web, before drying of the web. In such instances the consistency of the wet web can be about 40 percent or less, more specifically about 30 percent or less, and still more specifically about 20 percent or less. The amount of debonding agent applied to the outer layer(s) can be from about 0.125 kg/tonne per layer (0.25 lb./ton per layer) to 25 kg/tonne per layer (50 lb./ton per layer).

[0008] As used herein, a "wet strength agent" is an additive that increases the strength of wet tissue paper. It can provide permanent or temporary wet strength to the tissue. Suitable wet strength agents include, without limitation, urea-formaldehyde resins, melamine-formaldehyde resins, epoxidized polyamide resins, polyaminepolyamide-epichlorohydrin resins, glyoxalat-

ed polyacrylamide resins, polyethylenimine resins, temporary wet strength resins described in U.S. Patent No. 4,981,577 to Bjorkquist issued January 1, 1991, herein incorporated by reference, dialdehyde starch, cationic aldehyde starch, cellulose xanthate, synthetic latexes, vegetable gums, glyoxal, acrylic emulsions and amphoteric starch siloxanes.

[0009] The amount of wet strength agent added to the inner layer of softwood fibers can be from 0.25 kg/tonne/layer (0.5 lb./ton) to 25 kg/tonne/layer (50 lb./ton).

Brief Description of the Drawing

[0010] Figure 1 is a schematic flow diagram of a tissue making process useful for purposes of this invention.

Detailed Description of the Drawing

[0011] Referring to Figure 1, a method of making multi-layered tissues suitable for purposes of this invention will be described. (For simplicity, the various tensioning rolls schematically used to define the several fabric runs are shown but not numbered.) It will be appreciated that variations from the apparatus and method illustrated in Figure 1 can be made without departing from the scope of the invention. Shown is a twin wire former having a layered papermaking headbox 10 which injects or deposits an aqueous suspension of papermaking fibers between outer forming fabric 11 and inner forming fabric 12. Inner forming fabric 12 serves to support and carry the newly-formed wet web 13 downstream in the process as the web is partially dewatered to a consistency of about 10 dry weight percent. Additional dewatering of the wet web can be carried out, such as by vacuum suction 14, while the wet web is supported by the forming fabric. As shown, the dryerside layer of the wet web, which is the outer layer of the web that ultimately faces the dryer surface during drying, is in contact with the forming fabric 12. The airside layer is the outer layer on the opposite side of the web and faces away from the dryer during drying.

[0012] The wet web is then transferred from the inner forming fabric to a transfer fabric 17 traveling at a slower speed than the forming fabric in order to impart increased stretch into the web. Transfer is preferably carried out with the assistance of a vacuum shoe 18 and a kiss transfer to avoid substantial compression of the wet web. Optional vacuum box 19 can be used to further dewater the web and spray applicator 20 can be used to provide controlled addition of additives such as debonders.

[0013] The web is then transferred from the transfer fabric 17 to the throughdrying fabric 25 with the aid of a vacuum transfer roll 26. The throughdrying fabric can be traveling at about the same speed or a different speed relative to the transfer fabric. If desired, the throughdrying fabric can be run at a slower speed to further enhance stretch. Transfer is preferably carried out with vacuum assistance to ensure deformation of the sheet to conform to the throughdrying fabric, thus yielding desired bulk and appearance. Optional vacuum box 27 and spray applicator 28 can be used as described above.

[0014] The level of vacuum used for the web transfers can be from about 3 to about 15 inches of mercury (75 to 380 millimeters of mercury), preferably about 5 inches (125 millimeters) of mercury. The vacuum shoe (negative pressure) can be supplemented or replaced by the use of positive pressure from the opposite side of the web to blow the web onto the next fabric in addition to or as a replacement for sucking it onto the next fabric with vacuum. Also, a vacuum roll or rolls can be used to replace the vacuum shoe(s).

[0015] While supported by the throughdrying fabric 25, the web is dried to a consistency of about 94 percent or greater by the throughdryers 30 and 31. The dried basesheet 35 is transferred to carrier fabric 36 with the aid of vacuum roll 37 and transported to the reel 38 using carrier fabric 36 and an optional additional carrier fabric 39. An optional pressurized turning roll 40 can be used to facilitate removal of the web from the carrier fabric 36. Suitable carrier fabrics for this purpose are Albany International 84M or 94M and Asten 959 or 937. Reel calender 45 or subsequent off-line calendering can be used to improve the smoothness and softness of the basesheet, if desired.

Examples

Example 1.

[0016] A pilot scale twin wire papermaking machine, as described in Figure 1, was used to produce tissues in accordance with this invention. More specifically, the papermaking machine had a layered headbox with a top chamber, two central chambers, and a bottom chamber. A first fibrous slurry composed primarily of short papermaking fibers, namely eucalyptus hardwood kraft (EHWK), was pumped through the top and bottom headbox chambers and, simultaneously, a second fibrous slurry composed primarily of long papermaking fibers, namely northern softwood kraft (NSWK), was pumped through the central headbox chambers and delivered in superposed relation between the inner and outer forming fabrics to form thereon a three-layered embryonic (wet) web. The inner and outer forming fabrics were Asten 866 fabrics. The dry weight ratio of the three layers (outer layer/inner layer/outer layer), referred to as the layer split, was 37.5%/25%/37.5%.

[0017] The EHWK fibers of the first slurry had been previously processed in a Maule shaft disperser with a power input of 80kW at a consistency of about 34% and at a temperature of about 184°F. The resulting EHWK fibers were treated with Berocell 596 debonder in the machine chest at a rate of 5 kg/tonne. Berocell 596 is a dimethyl dialkyl ammonium chloride debonder supplied

by Eka-Nobel. Fiber consistency of the first slurry was about 0.12%.

[0018] The NSWK fibers of the second slurry were treated with Parez 631 NC temporary wet strength resin at a rate of 5.45 kg/tonne. (Parez 631 NC is a glyoxalated cationic polyacrylamide resin supplied by Cytec.) The second fibrous slurry was also mechanically refined to maintain target tensile strengths. Fiber consistency of the second slurry was about 0.04%.

[0019] Partial dewatering of the embryonic web through the forming fabric was assisted by vacuum boxes. The embryonic web was transferred from the inner forming fabric to a Lindsay 3080-CCW transfer fabric with the assistance of a vacuum transfer shoe at a consistency of about 29%. The speed of the forming fabric was about 2285 feet/minute and the speed of the transfer fabric was about 1800 feet/minute, yielding a negative draw (rush transfer) of 27%.

[0020] The web was then transferred from the transfer fabric to the throughdryer fabric (Asten Velostar 800) at a consistency of about 29%. The web was dried by the throughdriers to a consistency of about 94%. The dried web was transferred to the reel between two transfer fabrics (Asten 866 and Lindsay 3070) and wound into a roll on the reel.

[0021] The resulting tissue paper had a basis weight of 29 g/m^2, geometric mean tensile of 710 g/3 inches, wet CD tensile of 123 g/3 inches (7.62 centimeters), wet/dry tensile ratio of 20.3% and a bulk of 12.5 cc/g. The tissue paper had high tactile softness as determined by panel evaluation.

Example 2.

[0022] A three-layer tissue paper sheet was produced in accordance with Example 1, except that the first short fiber slurry did not contain a debonding agent. Instead the outer EHWK layers of the undried web were sprayed with a solution of Berocell 596 debonding agent. The debonding agent solution was applied to the outer layers using spray applicators 20 and 28 and corresponding vacuum boxes 19 and 27 as shown in Figure 1. The debonding agent was applied to the outer layers at a rate of 5 kg. debonding agent/tonne of EHWK fiber. Fiber consistency of the web at the point of spray addition was about 29%. The resulting tissue paper had a basis weight of 28.6 g/m^2, geometric mean tensile of 723 g/3 inches, wet CD tensile of 113 g/3 inches (7.62 centimeters), wet/dry tensile ratio of 19.3% and a bulk of 12.2 cc/g. The tissue paper had high tactile softness as determined by panel evaluation.

Example 3.

[0023] A three-layer tissue paper sheet was produced in accordance with Example 1, except: 1) the first short fiber slurry (EHWK) was treated with 7.5 kg/tonne of Berocell 584 debonding agent (Berocell 584 is a nonionic, cationic surfactant system supplied by Eka-Nobel); 2) the second long fiber slurry (NSWK) was treated with 6.36 kg/tonne of Parez 631 NC temporary wet strength agent; 3) the negative draw between the forming fabric and transfer fabric was 29%; 4) the layer split was 40%/20%/40%; 5) the inner and outer forming fabrics were Lindsay 2164 fabrics, the wet end transfer fabric was an Albany 94-MSS, the TAD fabric was a Lindsay T216-3, and the dry end transfer fabrics were an Albany 94-M and a Lindsay 3070; and 6) the transfer from the inner forming fabric to the transfer fabric occurred at a consistency of about 26% and the transfer to the TAD fabric occurred at a consistency of about 27%.

[0024] The resulting tissue paper had a basis weight of 27.8 g/m^2, geometric mean tensile of 696 g/3 inches, wet CD tensile of 102 g/3 inches (7.62 centimeters), wet/dry tensile ratio of 18.1% and a bulk of 11.31 cc/g. The tissue paper had high tactile softness as determined by panel evaluation.

Example 4.

[0025] A three-layer tissue paper sheet was produced in accordance with Example 3, except: 1) the first short fiber slurry was composed of southern hardwood kraft fibers (SHWK); 2) the second long fiber slurry (NSWK) had been treated with 9.66 kg/tonne of Parez 631 NC temporary wet strength agent; 3) the layer split was 40%/20%/40%; and 4) the transfer from the inner forming fabric to the transfer fabric occurred at a consistency of about 28% and the transfer to the TAD fabric occurred at a consistency of about 29%.

[0026] The resulting tissue paper had a basis weight of 29.4 g/m^2, geometric mean tensile of 726 g/3 inches, wet CD tensile of 107 g/3 inches (7.62 centimeters), wet/dry tensile ratio of 18.1% and a bulk of 9.95 cc/g. The tissue paper had high tactile softness as determined by panel evaluation.

Example 5.

[0027] A three-layer tissue paper sheet was produced in accordance with Example 2, except: 1) the outer layers of the undried web were sprayed with Ucarsil HCP textile softener (debonding agent) at a rate of 10 kg Ucarsil HCP/tonne EHWK (Ucarsil HCP is an organomodified silicone softener obtained from Union Carbide); 2) the second long fiber slurry (NSWK) was treated with 4.33 kg/tonne of Parez 631 NC temporary wet strength agent; 3) the negative draw between the forming fabric and transfer fabric was 30%; 4) the layer split was 35%/30%/35%; 5) the wet end transfer fabric was an Albany 94-M, the TAD fabric was a Lindsay T216-4, and the dry end transfer fabrics were both Lindsay 3070 fabrics; and 6) the dried web was calendered using a reel calender consisting of a 20-inch steel roll and a 20.5-inch rubber roll (110 P&J hardness, 0.75 inch cover thickness) engaged to a nip width of about 32 millime-

ters.

[0028] The resulting tissue paper had a basis weight of 30.1 gm/m^2, geometric mean tensile of 679 g/3 inches, wet CD tensile of 100g/3 inches (7.62 centimeters), wet/dry tensile ratio of 18.1% and a bulk of 8.35 cc/g. The tissue paper had high tactile softness as determined by panel evaluation.

Example 6.

[0029] A pilot scale twin wire through air dried papermaking machine, similar to that described in Figure 1 but having a Yankee dryer between roll 40 and the reel 38, was used to produce a creped, throughdried tissue in accordance with this invention.

[0030] The paper machine had a layered headbox with a top chamber, two central chambers, and a bottom chamber. A first fibrous slurry composed of southern hardwood kraft (SHWK) fibers was pumped through the top and bottom headbox chambers, and, simultaneously, a second fibrous slurry composed of northern softwood kraft fibers (NSWK) was pumped through the central headbox chambers and delivered in superposed relation onto the forming fabric to form thereon a three-layer embryonic web. The layer split was 33.3%/33.3%/33.3%.

[0031] The SHWK fibers pumped through the top chamber of the headbox were treated with 2.5 kg/tonne of Berocell 596 debonding agent. The NSWK fibers of the second long fiber slurry were treated with Parez 631 NC temporary wet strength resin at a rate of 8.15kg/tonne. The second fibrous slurry was also treated with sufficient starch to maintain target tensile strengths. The SHWK fibers pumped through the bottom chamber of the headbox were untreated.

[0032] Dewatering of the embryonic web occurred through the forming fabric and was assisted by vacuum boxes. The embryonic web was transferred from the forming fabric to a transfer fabric with the assistance of a vacuum transfer roll at a consistency of about 29%. The web was then transferred from the transfer fabric to the throughdryer fabric at a consistency of about 29%. The web was dried by the throughdriers to a consistency of about 94%, adhered to a Yankee dryer, creped off the Yankee with a doctor blade, and wound into a roll on the reel.

[0033] The resulting tissue paper had a basis weight of 27.1g/m^2, geometric mean tensile of 768g/3 inches, wet CD tensile of 107 g/3 inches (7.62 centimeters), wet/dry tensile ratio of 20.0% and a bulk of 7.88cc/g. The tissue paper had high tactile softness as determined by panel evaluation.

Example 7.

[0034] A pilot scale crescent former wet-pressed papermaking machine was used to produce a creped tissue in accordance with this invention.

[0035] The paper machine had a layered headbox with a top chamber, a center chamber, and a bottom chamber. A first fibrous slurry composed of EHWK fibers was pumped through the top and bottom headbox chambers, and, simultaneously, a second fibrous slurry composed of NSWK fibers was pumped through the center headbox chamber and delivered in superposed relation onto the felt to form thereon a three-layer embryonic web. The layer split of the embryonic web was 30%/40%/30%.

[0036] The EHWK fibers of the first slurry were processed with 1 kg/tonne of Berocell 584 debonder in a Maule shaft disperser with a power input of 55 kW at a consistency of about 34% and at a temperature of about 178°F.

[0037] The NSWK fibers of the second slurry were treated with Kymene 557 LX permanent wet strength resin at a rate of 2.27 kg/tonne. (Kymene 557 LX is a cationic polyamide-epichlorohydrin resin supplied by Hercules, Incorporated.) Forty percent of the second fibrous slurry was mechanically refined to maintain target tensile strengths.

[0038] The web was carried by the felt to the Yankee dryer, where the web was adhered to the dryer and then creped off the Yankee with a doctor blade and was wound into a roll on the reel.

[0039] The resulting tissue paper had a basis weight of 18.1 lb/2880 ft^2, geometric mean tensile of 1091 g/3 inches (7.62 centimeters), wet CD tensile of 109 g/3", wet/dry tensile ratio of 13% and a bulk of 6.4 cc/g. The tissue paper had high tactile softness as determined by panel evaluation.

[0040] All of the foregoing examples illustrate that a soft tissue having good wet strength can be made by the method of this invention. It will be appreciated that the foregoing examples, given for purposes of illustration, are not to be construed as limiting the scope of this invention, which is defined by the following claims.

Claims

1. A method for making a soft tissue sheet comprising forming a layered wet web of papermaking fibers using a layered headbox, said layered wet web having at least first and second layers, wherein said first layer comprises predominantly hardwood fibers and said second layer comprises predominantly softwood fibers, said first layer containing a debonding agent and said second layer containing a wet strength agent and drying the web.

2. The method according to claim 1 wherein the layered web is adhered to the surface of a Yankee dryer with the first layer in contact with the dryer surface and wherein the web is creped.

3. The method for making a soft tissue sheet accord-

ing to claim 1, comprising: at least one further layer, sandwiching the second layer between the first and third layers wherein both outer layers comprise predominantly hardwood fibers and wherein at least the first outer layer contains a debonding agent.

4. The method according to claim 3 wherein the layered wet web is transfered to a throughdrying fabric and wherein the web is throughdried.

5. The method of claim 3 wherein the second outer layer is in contact with the throughdrying fabric.

6. The method of claim 3 wherein only the first outer layer contains a debonding agent.

7. The method of claim 3 wherein both outer layers contain a debonding agent.

8. The method of claim 3 wherein the web has only one inner layer.

9. The method of claim 3 wherein the web has two inner layers, one of said inner layers substantially containing secondary fibers.

10. The method of claim 3 wherein the dried web is creped.

11. The method of claim 3 wherein the dried web is not creped.

12. The method of claim 3 wherein the debonder is added to the papermaking fibers of the first outer layer prior to forming the wet web.

13. The method of claim 3 wherein the debonder is sprayed onto the wet web before drying the web.

14. The method of claim 13 wherein the consistency of the wet web is about 40 percent or less.

15. The method of claim 13 wherein the consistency of the wet web is about 30 percent or less.

16. The method of claim 13 wherein the consistency of the wet web is about 20 percent or less.

17. The method of claim 1 wherein the creped web is plied together with a like web with the second layers in contact with each other to produce a soft two-ply tissue.

18. The method of claim 1 wherein the layered web comprises a third layer of predominantly hardwood fibers, said third layer being an outer layer.

19. The method of claim 18 wherein the first and third layers contain a debonding agent.

20. A layered tissue comprising at least first and second layers, characterised in that said first layer comprises predominantly hardwood fibers and a debonding agent, and said second layer comprises predominantly softwood fibers and a wet strength agent.

21. A layered tissue according to claim 20, comprising at least one further layer, sandwiching the second layer between the first and third layers, wherein the middle layer comprises predominantly softwood fibers and a wet strength agent and wherein both outer layers comprise predominantly hardwood fibers and wherein at least the first outer layer contains a debonding agent.

22. A layered tissue according to claims 20 to 21, which is furthermore throughdried.

23. A layered tissue according to claims 20 or 21, which is furthermore creped.

24. A layered tissue according to claim 22, which is furthermore creped.

25. A layered tissue according to claim 20, wherein two like webs are plied together with the second layers in contact with each other to produce a soft two-ply tissue.

Patentansprüche

1. Verfahren zur Herstellung eines Weichtissuetuches, umfassend die Bildung einer in Lagen angeordneten nassen Bahn aus Fasern zur Papierherstellung unter Verwendung eines in Lagen angeordneten Stoffauflaufkastens, wobei die in Lagen angeordnete nasse Bahn mindestens eine erste und eine zweite Lage aufweist, wobei die erste Lage vorwiegend Hartholzfasern und die zweite Lage vorwiegend Weichholzfasern aufweist, wobei die erste Lage ein bindungsverminderndes Mittel und die zweite Lage ein Naßfestigkeitsmittel enthält, und Trocknung der Bahn.

2. Verfahren gemäß Anspruch 1, wobei die in Lagen angeordnete Bahn mit der ersten Lage in Kontakt mit der Trockneroberfläche an die Oberfläche eines Yankee-Trockners gehaftet wird, und wobei die Bahn gekreppt wird.

3. Verfahren zur Herstellung eines Weichtissuetuches gemäß Anspruch 1, umfassend: mindestens eine weitere Lage, wodurch die zweite Lage sandwichartig zwischen der ersten und der dritten Lage angeordnet wird, wobei beide äußere Lagen vorwie-

gend Hartholzfasern aufweisen, und wobei mindestens die erste äußere Lage ein bindungsverminderndes Mittel aufweist.

4. Verfahren gemäß Anspruch 3, wobei die in Lagen angeordnete nasse Bahn zu einem Durchtrocknungsstoff übertragen wird, und wobei die Bahn durchgetrocknet wird.

5. Verfahren gemäß Anspruch 3, wobei die zweite äußere Lage mit dem Durchtrocknungsstoff in Kontakt ist.

6. Verfahren gemäß Anspruch 3, wobei nur die erste äußere Lage ein bindungsverminderndes Mittel enthält.

7. Verfahren gemäß Anspruch 3, wobei beide äußere Lagen ein bindungsverminderndes Mittel enthalten.

8. Verfahren gemäß Anspruch 3, wobei die Bahn nur eine innere Lage aufweist.

9. Verfahren gemäß Anspruch 3, wobei die Bahn zwei innere Lagen aufweist, wobei eine der inneren Lagen im wesentlichen Sekundärfasern enthält.

10. Verfahren gemäß Anspruch 3, wobei die getrocknete Bahn gekreppt wird.

11. Verfahren gemäß Anspruch 3, wobei die getrocknete Bahn nicht gekreppt wird.

12. Verfahren gemäß Anspruch 3, wobei der Bindungsverminderer den Fasern zur Papierherstellung der ersten äußeren Lage vor der Bildung der nassen Bahn zugegeben wird.

13. Verfahren gemäß Anspruch 3, wobei der Bindungsverminderer auf die nasse Bahn vor Trocknung der Bahn aufgesprüht wird.

14. Verfahren gemäß Anspruch 13, wobei die Konsistenz der nassen Bahn etwa 40 Prozent oder weniger beträgt.

15. Verfahren gemäß Anspruch 13, wobei die Konsistenz der nassen Bahn etwa 30 Prozent oder weniger beträgt.

16. Verfahren gemäß Anspruch 13, wobei die Konsistenz der nassen Bahn etwa 20 Prozent oder weniger beträgt.

17. Verfahren gemäß Anspruch 1, wobei die gekreppte Bahn mit einer gleichen bzw. ähnlichen Bahn schichtartig verbunden wird, wobei die zweiten Lagen miteinander in Kontakt sind, um ein zweischichtiges Weichtissue herzustellen.

18. Verfahren gemäß Anspruch 1, wobei die in Lagen angeordnete Bahn eine dritte Lage aus vorwiegend Hartholzfasern aufweist, wobei es sich bei der dritten Lage um eine äußere Lage handelt.

19. Verfahren gemäß Anspruch 18, wobei die erste und die dritte Lage ein bindungsverminderndes Mittel enthalten.

20. In Lagen angeordnetes Tissue mit mindestens einer ersten und einer zweiten Lage, dadurch gekennzeichnet, daß die erste Lage vorwiegend Hartholzfasern und ein bindungsverminderndes Mittel und die zweite Lage vorwiegend Weichholzfasern und ein Naßfestigkeitsmittel enthält.

21. In Lagen angeordnetes Tissue gemäß Anspruch 20, umfassend mindestens eine weitere Lage, wodurch die zweite Lage sandwichartig zwischen der ersten und der dritten Lage angeordnet wird, wobei die mittlere Lage vorwiegend Weichholzfasern und ein Naßfestigkeitsmittel enthält, und wobei beide äußere Lagen vorwiegend Hartholzfasern aufweisen, und wobei mindestens die erste äußere Lage ein bindungsverminderndes Mittel aufweist.

22. In Lagen angeordnetes Tissue gemäß Ansprüchen 20 bis 21, das des weiteren durchgetrocknet ist.

23. In Lagen angeordnetes Tissue gemäß Anspruch 20 oder 21, das des weiteren gekreppt ist.

24. In Lagen angeordnetes Tissue gemäß Anspruch 22, das des weiteren gekreppt ist.

25. In Lagen angeordnetes Tissue gemäß Anspruch 20, wobei zwei gleiche bzw. ähnliche Bahnen schichtartig miteinander verbunden sind, wobei die zweiten Lagen miteinander in Kontakt sind, um ein zweischichtiges Weichtissue herzustellen.

Revendications

1. Procédé pour la fabrication d'une feuille de papier absorbant mince et souple consistant, d'une part, à former une nappe humide à jets multiples de fibres papetières utilisant une caisse d'arrivée à jets multiples, ladite nappe humide à jets multiples ayant au moins une première et une seconde couches, procédé dans laquel ladite première couche comprend en majorité des fibres de bois feuillu et ladite seconde couche comprend en majorité des fibres de bois résineux, ladite première couche contenant un agent de déliaison et ladite seconde couche contenant un agent augmentant la résistance à l'état hu-

mide et, d'autre part, à sécher la nappe.

2. Procédé selon la revendication 1, dans lequel la nappe à jets multiples adhère à la surface d'un séchoir-frictionneur avec la première couche en contact avec la surface du séchoir et dans lequel la nappe est crêpée.

3. Procédé de fabrication d'une feuille de papier absorbant mince et souple selon la revendication 1, comprenant : au moins une couche supplémentaire prenant en sandwich la seconde couche entre les première et troisième couches, dans lequel les deux couches externes comprennent en majorité des fibres de bois feuillu et dans lequel au moins la première couche externe comprend un agent de déliaison.

4. Procédé selon la revendication 3, dans lequel la nappe humide à jets multiples est transférée vers une toile pour séchage par soufflage transversal et dans lequel la nappe est séchée par soufflage transversal.

5. Procédé selon la revendication 3, dans lequel la seconde couche externe est en contact avec la toile pour séchage par soufflage transversal.

6. Procédé selon la revendication 3, dans lequel seule la première couche externe contient un agent de déliaison.

7. Procédé selon la revendication 3, dans lequel les deux couches externes contiennent un agent de déliaison.

8. Procédé selon la revendication 3, dans lequel la nappe a seulement une couche interne.

9. Procédé selon la revendication 3, dans lequel la nappe a deux couches internes, l'une desdites couches internes contenant pour l'essentiel des fibres secondaires.

10. Procédé selon la revendication 3, dans lequel la nappe séchée est crêpée.

11. Procédé selon la revendication 3, dans lequel la nappe séchée n'est pas crêpée.

12. Procédé selon la revendication 3, dans lequel le déliant est ajouté aux fibres papetières de la première couche externe avant de former la nappe humide.

13. Procédé selon la revendication 3, dans lequel le déliant est pulvérisé sur la nappe humide avant de sécher la nappe.

14. Procédé selon la revendication 13, dans lequel la concentration en fibres de la nappe humide est d'environ 40 % ou moins.

15. Procédé selon la revendication 13, dans lequel la concentration en fibres de la nappe humide est d'environ 30 % ou moins.

16. Procédé selon la revendication 13, dans lequel la concentration en fibres de la nappe humide est d'environ 20 % ou moins.

17. Procédé selon la revendication 1, dans lequel la nappe crêpée est réunie avec une nappe analogue avec les secondes couches des deux nappes en contact l'une avec l'autre de manière à obtenir un papier absorbant mince et souple à deux jets.

18. Procédé selon la revendication 1, dans lequel la nappe à jets multiples comprend une troisième couche en majorité de fibres de bois feuillu, ladite troisième couche étant une couche externe.

19. Procédé selon la revendication 18, dans lequel les première et troisième couches contiennent un agent de déliaison.

20. Papier absorbant mince à jets multiples comprenant au moins une première et une seconde couches, caractérisé en ce que ladite première couche comprend en majorité des fibres de bois feuillu et un agent de déliaison, et ladite seconde couche comprend en majorité des fibres de bois résineux et un agent augmentant la résistance à l'état humide.

21. Papier absorbant mince à jets multiples selon la revendication 20, comprenant au moins une couche supplémentaire, prenant en sandwich la seconde couche entre les première et troisième couches, dans lequel la couche du milieu comprend en majorité des fibres de bois de résineux et un agent augmentant la résistance à l'état humide et dans lequel les deux couches externes comprennent en majorité des fibres de bois feuillu et dans lequel au moins la première couche externe contient un agent de déliaison.

22. Papier absorbant mince à jets multiples selon les revendications 20 ou 21, qui est de plus séché par soufflage transversal.

23. Papier absorbant mince à jets multiples selon les revendications 20 ou 21, qui est de plus crêpé.

24. Papier absorbant mince à jets multiples selon la revendication 22, qui est de plus crêpé.

25. Papier absorbant mince à jets multiples selon la revendication 20, dans lequel deux nappes analogues sont réunies ensemble avec les secondes couches en contact l'une avec l'autre de manière à obtenir un papier absorbant mince et souple à deux jets.

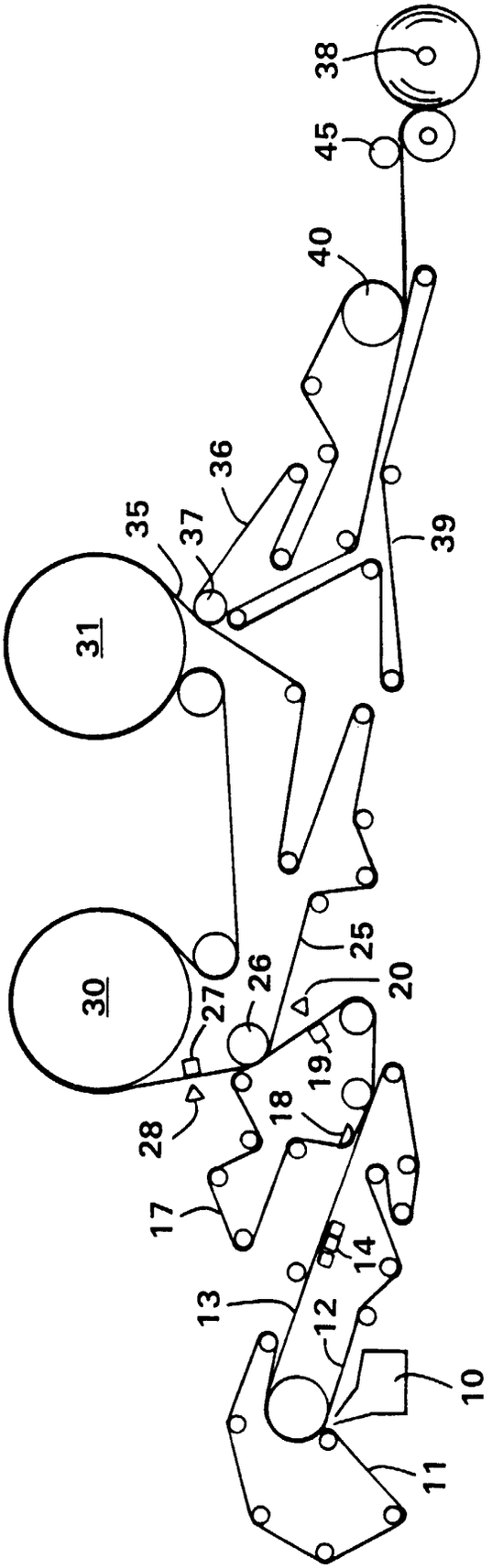

FIG.1