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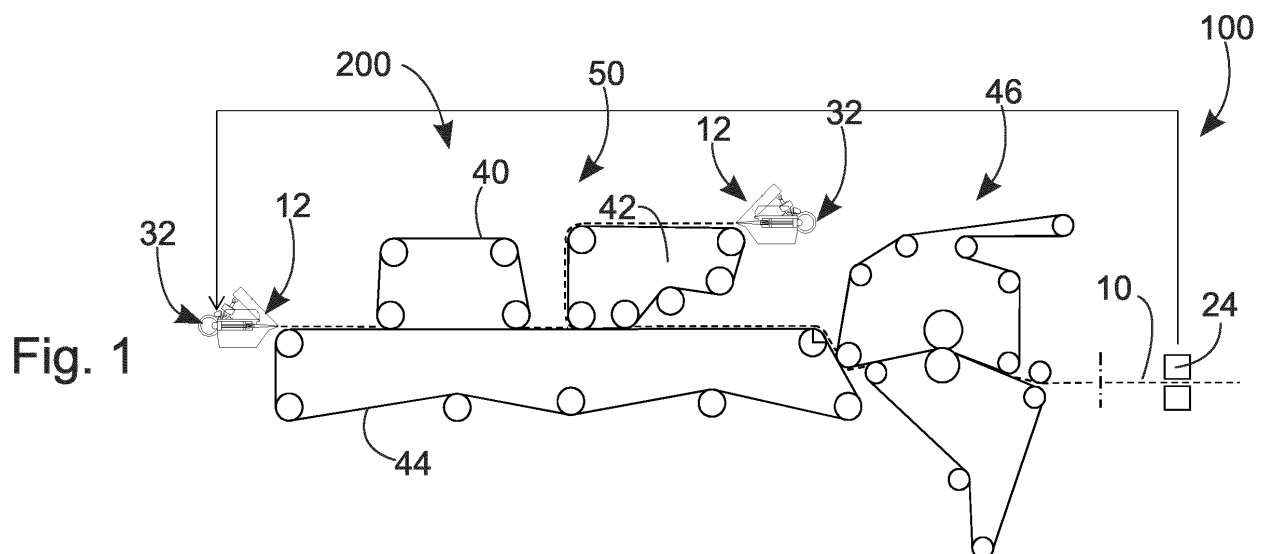
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(54) **METHOD AND SYSTEM FOR THE OPTIMIZATION OF PROPERTIES OF A MULTILAYER FIBER WEB IN FIBER WEB MANUFACTURE**

(57) The invention relates to a method for the optimization of the properties of a multilayer fiber web (10) in the manufacture of a fiber web (10), in which method the multilayer fiber web (10) is formed by feeding at least two stock suspensions that form a layer (16) of the fiber web (10) to a forming section (50) from two or more headboxes (12) divided into parallel feed zones (18), where those properties of said stock suspensions that affect the strength of the finished fiber web differ from each other, and the basis weight profile of said stock suspensions is

adjusted in two or more headboxes (12) by feeding dilution water in zones in the cross direction of the fiber web machine into each stock suspension. In the method, the cross-directional basis weight profile and strength of the formed fiber web (10) are adjusted in the cross direction of the fiber web machine by adjusting the amount of dilution water in zones separately in each stock suspension fed.

The invention also relates to a corresponding system.



Description

[0001] The present invention relates to a method for the optimization of the properties of a multilayer fiber web in the manufacture of a fiber web, in which method the multilayer fiber web is formed by feeding at least two stock suspensions that form a layer of the fiber web to a forming section from two or more headboxes divided into parallel feed zones, where those properties of the stock suspensions that affect the strength of the finished fiber web differ from each other, and the basis weight profile of the stock suspensions is adjusted in two or more headboxes by feeding dilution water in zones in the cross direction of the fiber web machine into each stock suspension.

[0002] The present invention also relates to a corresponding system.

[0003] In multilayer board machines such as liner machines, the cross-directional strength properties of the fiber web are critical in terms of the quality of the product. The objective is to minimize the variation of the cross-directional strength properties of the fiber web in the cross direction of the fiber web. The uneven contraction of the fiber web in the dryer section leads to a deterioration of the cross-directional strength properties on the edges of the fiber web, since there is more contraction on the edges of the fiber web than in the center. Poorer cross-directional strength on the edges of the fiber web may even cause the rejection of edge rolls in quality control, if the edge rolls do not fulfill the strength requirements of the order. The strength problem can be solved by increasing the basis weight of the fiber web on the edges, but in this case expensive raw material is lost when the required basis weight is exceeded in the edge rolls.

[0004] One prior art solution is disclosed in the applicant's patent FI 121888, which presents a method for the optimization of the cross-directional profile of the fiber web. In this method, the headbox of the fiber web machine is divided into several parallel feed zones, and at least two different stock suspensions are fed into each of these feed zones. The different stock suspensions contain fractions with different fiber lengths, advantageously the first stock suspension contains short-fiber fraction and the second stock suspension contains long-fiber fraction. In this way, by feeding a stock suspension that contains more long-fiber fraction to the edges of the fiber web than to the center of the fiber web, it is possible to raise the strengths of the edges after drying to the same level as the strengths in the center part of the fiber web. In other words, an even strength profile can be attained by means of the method.

[0005] However, the problem with the method in accordance with patent FI 121888 is that the different fiber fractions are mixed with each other as late as in the headbox, which makes the design of the headbox complicated and complicates the functioning of the adjustment system of the cross-directional basis weight of the fiber web.

[0006] An object of the present invention is to accom-

plish a method that is more cost effective than the prior art methods for the optimization of the properties of a multilayer fiber web. The characteristic features of the present invention will be more fully understood from claim 1. Another object of the present invention is to accomplish a system for the optimization of the properties of a multilayer fiber web, which system is more advantageous to use than prior art systems. The characteristic features of the present invention will be more fully understood from claim 8.

[0007] This object can be achieved by means of a method for the optimization of the properties of a multilayer fiber web in the manufacture of a fiber web, in which method the multilayer fiber web is formed by feeding at least two stock suspensions that form a layer of the fiber web to a forming section from two or more headboxes divided into parallel feed zones, where those properties of the stock suspensions that affect the strength of the finished fiber web differ from each other. The basis weight profile of the stock suspensions is adjusted in two or more headboxes by feeding dilution water in zones in the cross direction of the fiber web machine into each stock suspension. In the method, the cross-directional basis weight profile and strength of the formed fiber web are adjusted in the cross direction of the fiber web machine by adjusting the amount of dilution water in zones separately in each stock suspension fed. By using the dilution of two different stock suspensions, it is possible to adjust the ratio between two different layers in the basis weight profile of a finished fiber web, and in this way the cross-directional basis weight profile and cross-directional strength properties of the finished fiber web can be made essentially even over the entire width of the fiber web.

[0008] The cross-directional strength of the fiber web can refer to the cross-directional compression strength or flat crush resistance. In the case of a multilayer fiber web, these strengths are usually more important strength indicators than tensile strength, which is naturally high in a product like this.

[0009] One of the two layers in the fiber web is advantageously a core layer and the other layer is a surface layer with better strength properties than in the core layer. The strength properties of the layers of the fiber web differ from each other, which enables a change in the strength properties in the fiber web by changing the mutual ratio of the layers.

[0010] Advantageously, the dilution of the stock suspensions fed can be adjusted independently of each other, in other words the dilution equipment used for the dilutions is not in an adjustment relation with respect to each other. In practice, however, the adjustment of dilution is restricted by a goal to a certain desired basis weight in the fiber web.

[0011] In the method, the basis weight profile of the fiber web is adjusted advantageously to an essentially even profile over the width of the fiber web by means of the dilution of the stock suspension that forms the core layer. In this case, it is possible to make the basis weight

even by using the more advantageous stock suspension of the core layer. The dilution of the stock suspension that forms the thicker core layer also gives a greater adjustment response than the adjustment of the stock suspension that forms the thinner surface layer.

[0012] In the method, the strength profile of the fiber web is adjusted advantageously to an essentially even profile over the width of the fiber web by means of the dilution of the stock suspension that forms the surface layer. By means of the dilution of the surface layer, it is possible to dilute the stock suspension that comes to the center of the fiber web more than the stock suspension that comes to the edges, and in this way savings can be achieved in the raw material costs.

[0013] In this context, an essentially even basis weight profile means that the variation of basis weight in the cross direction of the fiber web is less than $\pm 1 \text{ g/m}^2$. Essentially even strength properties mean that the cross-directional strength properties of the fiber web vary no more than $\pm 2 \%$.

[0014] According to one embodiment, the basis weight profile of the fiber web is measured as an online measurement, and on the basis of the measurement result the dilution of the stock suspension that forms the core layer is adjusted in individual feed zones. In this case, the adjustment works as a feedback control circuit, and the basis weight profile can be adjusted easily in order to change the basis weight of the finished fiber web when shifting over from one grade to another.

[0015] Advantageously, the stock suspension fed to the core layer is diluted more in those feed zones of the headbox that form the edge area of the core layer of the fiber web than in those feed zones that form the center part of the fiber web. In this way, a greater part of the total basis weight of the fiber web on the edges can be composed of a surface layer that has better strength properties than the core layer, which surface layer produces the effect that improves the strength properties of the edges of the fiber web.

[0016] According to one embodiment, two headboxes are used, each adapted to feed one stock suspension. The use of separate headboxes enables a conventional design of the fiber web machine, where the different layers of a finished multilayer fiber web are formed initially on their own forming sections and are combined later into a uniform fiber web on the forming section.

[0017] The object of the system according to the present invention can be accomplished by means of a system for the optimization of the properties of a multilayer fiber web in the manufacture of a fiber web, where the system includes two or more headboxes for the feeding of at least two different stock suspensions to form at least two layers, the strength properties of which differ from each other, to a fiber web to be formed on the forming section, and dilution equipment divided into feed zones in the cross direction of the fiber web machine, adapted in connection with two or more headboxes for the dilution of the stock suspensions in zones in the cross

direction of the fiber web machine in at least some of the feed zones for the optimization of the properties of the fiber web. The dilution equipment is adapted to adjust separately in zones the amount of dilution water in each stock suspension fed for the adjustment of the cross-directional basis weight profile and strength of the formed fiber web in the cross direction of the fiber web machine. The system according to the invention is very advantageous to implement, because the system can be implemented without a complex headbox design and control system.

[0018] According to one embodiment, the system includes two headboxes, each for feeding one stock suspension, in which system the dilution equipment is adapted in connection with both headboxes. This enables the implementation of the system according to the invention in a relatively easy manner also in existing fiber web machines that produce multilayer fiber web.

[0019] The dilution equipment of the different stock suspensions is advantageously independent of each other. In this case, the dilution of the stock suspensions can be adjusted independently of each other, in other words the dilution equipment used for the dilutions is not in an adjustment relation with respect to each other. In practice, however, the adjustment of dilution is restricted by a goal to a certain desired basis weight in the fiber web.

[0020] More specifically, a characteristic feature of the method according to the invention is that the cross-directional basis weight profile and strength of the formed fiber web in the cross direction of the fiber web machine are adjusted in the method by adjusting the amount of dilution water in zones separately in each stock suspension fed.

[0021] More specifically, a characteristic feature of the system according to the invention is that the dilution equipment is adapted to adjust separately in zones the amount of dilution water in each stock suspension fed for the adjustment of the cross-directional basis weight profile and strength of the formed fiber web in the cross direction of the fiber web machine.

[0022] The advantage to be achieved with the method and system according to the invention is an essentially straight basis weight profile in the cross direction of the fiber web and an essentially straight strength profile in the cross direction.

[0023] Essentially straight in this context means that the profile is either completely straight or at least considerably straight with a deviation of only one per cent. This advantage can be achieved without increasing the raw material costs by changing the mutual ratio of layers equipped with different strength properties. At the same time, it is possible to reduce the proportion of fiber web going to broke in manufacture, which decreases the production costs and increases the efficiency of the fiber web machine.

[0024] The invention is described below in detail by making reference to the enclosed drawings that illustrate some embodiments of the invention, in which:

Figure 1 shows the system according to the first embodiment of the invention viewed from the side as a figure in principle,

Figure 2 shows the system according to the second embodiment of the invention viewed from the side as a figure in principle,

Figure 3 shows a headbox of the system according to the invention in the direction of the fiber web as a figure in principle,

Figure 4 shows the cross section of the basis weight profiles of the different layers of the fiber web attainable with the method according to the invention.

[0025] In accordance with Figure 1, a system 100 according to the invention includes at least two headboxes 12 for the feeding of at least two different stock suspensions onto a forming section 50 of a fiber web machine 200 to form a fiber web 10. According to the invention, two or more separate headboxes 12 each have dilution adjustment for one stock suspension. In principle, there can be dilution adjustments in more numerous feeds of stock suspensions fed, but in its simplest configuration the invention can be implemented by means of two dilution adjustments. So that the dilution adjustment gives the desired outcome, in other words even basis weight profile and strength profile in the cross direction of the fiber web, the dilution adjustments must be in stock suspensions where the properties of the stock suspensions differ from each other. In general, the core layer that forms the core of the fiber web in a multilayer fiber web contains a cheaper raw material than the surface layer, which cheaper raw material contains more short fiber than the surface layer and which has a poorer strength than the surface layer. The surface layer, in turn, is composed of a more expensive raw material than the core layer, in which more expensive raw material the proportion of long fibers is greater than in the core layer, and consequently also the strength of the layer of the fiber web formed is better than in the core layer.

[0026] Figure 1 shows the first embodiment of the system according to the invention, in which first embodiment two separate headboxes 12 are used, each equipped with dilution adjustment. In practice, the dilution adjustment is implemented by means of dilution equipment 32 placed in connection with the headboxes 12. The dilution equipment 32 can be, in accordance with Figure 4, feed lines coming to the headbox 12, which feed lines feed into the headbox water or a stock suspension with a considerably higher water content than in the stock suspension fed on the headbox for the dilution of the fed stock suspension in zones in the cross direction of the fiber web.

[0027] The dilution water is typically white water. In the embodiment of Figure 1, each layer of the finished fiber web is formed on its own wire 42 and 44, which combine

the layers into a finished fiber web 10 in a later stage. The fiber web machine can also include a separate top wire cycle 40 in accordance with Figure 1. In the figures, reference number 46 refers to the press section of the fiber web machine.

[0028] Figure 2 shows the second embodiment of the system 100 according to the invention, in which embodiment the multilayer fiber web produced consists of three separate layers. In this case, the system has three headboxes 12, and there is dilution equipment in connection with at least two of these headboxes. In the embodiment of Figure 2, the left-hand side headbox 12 feeds the stock suspension of the core layer, the middle headbox 12 feeds the stock suspension of the intermediate layer, and the right-hand side headbox 12 feeds the stock suspension of the surface layer. In this case, the dilution equipment is advantageously in the headboxes that form the core and surface layers and the intermediate layer can be without dilution, because the cross-directional adjustment of the basis weight profile and strength profile according to the invention can be done by means of two dilution adjustments.

[0029] In accordance with Figure 3, each headbox 12 used in the system according to the invention is divided into several feed zones 18 in the cross-direction of the fiber web. In general, the width of an individual feed zone is 40 - 120 mm, in which case the headbox is divided into dozens, even to more than one hundred feed zones, each of which can be adjusted for dilution independently of each other. In other words, each headbox equipped with dilution adjustment includes dozens, even hundreds of control valves 66 and their control devices (not shown in the figures) for adjusting the dilutions.

[0030] With reference to Figures 1 - 3, in the method according to the invention at least two different stock suspensions are fed from two or more headboxes 12 for the forming of a multilayer fiber web 10. A certain basis weight, such as 100 g/m², has been specified for the produced multilayer fiber web in the order, which basis weight is the minimum basis weight of the fiber web in all reels. The objective is that the basis weight of the fiber web produced comes as close to the target as possible; however, so that the basis weight of the entire fiber web is above the minimum basis weight specified in the order. The feed ratio of the stock suspensions is defined initially and the flows are adapted so that the total basis weight of the layers that form the fiber web exceeds the target. As an example, the basis weight of the core layer can be 75 g/m² and the basis weight of the surface layer can be 25 g/m², in which case the basis weight of the two-layer fiber web is 100 g/m². Initially, the fiber web is formed using rough settings, and the strengths and basis weight of the finished fiber web are measured. The measurement of basis weight can be carried out as an online measurement 24 shown in Figures 1 and 2, but the strengths must be calculated from samples taken from the fiber web using a laboratory analysis. The measurement instrument used for the online measurement of ba-

sis weight can be a basis weight scanner of the type known from prior art. However, the basis weight of the surface layer is advantageously at least 25 g/m² so that a surface layer essential for the appearance and printability of the fiber web is formed on the fiber web.

[0031] The system advantageously includes programmatic equipment for controlling dilution. The programmatic equipment can be a part of a computer or a part integrated into or connected to the control system of the fiber web machine, by means of which programmatic equipment the functioning of the dilution equipment can be controlled. The dilution equipment can include valves for restricting the flow of dilution water or corresponding medium, and valve control equipment, which can advantageously be controlled via a field bus by means of the programmatic equipment. The valve control equipment is advantageously electric actuators. The programmatic equipment can be automatic equipment, which controls, on the basis of pre-set criteria, the valves of the dilution equipment to adjust the dilution flows. The selected criteria can include the difference between the strength measured on the basis of individual feed zones of the headbox and the target, the difference between the measured basis weight and the target, or some other corresponding criterion. In dilution, it is also possible to use the filtrates of wires or other corresponding waters that do not contain much fibers.

[0032] The measurement results of the basis weight and strengths of the fiber web are advantageously fed to the programmatic equipment, which studies how close to the target the evenness of the cross-directional basis weight profile and strength profile of the fiber web are. Initially, the programmatic equipment can be adapted to adjust the basis weight profile on the basis of the measured difference by only adjusting the dilution equipment of the stock suspension that forms the core layer. In this way, the basis weight profile is adjusted by increasing or decreasing the dilution of the core layer with respect to the target. The dilution of the core layer can be adjusted by individual feed zones using the feed zones of the headbox, until an even/straight basis weight profile is achieved in the cross direction of the fiber web.

[0033] After this, the goal is to achieve the set strength target by using the programmatic equipment. At this point, a new strength measurement is carried out in terms of the fiber web that has a straight cross-sectional basis weight profile. In the cross direction of the fiber web, the dilution of the stock suspension coming to the surface layer is decreased on the basis of the differences in the strengths at different points in those zones where the strength of the fiber web is too low. On the other hand, at the same time the decrease in dilution increases the amount of fiber coming to the surface layer in this feed zone of the headbox and increases the basis weight. Dilution can be added by means of the programmatic equipment to compensate for this change in those feed zones of the headbox that form the core layer and that correspond to the adjustable feed zones of the surface layer.

This changes the ratio between the basis weights of the finished core layer and surface layer in the basis weight of the finished fiber web. By increasing the percentual proportion of the surface layer in the basis weight, better strengths are achieved. In the initial situation, at least the stock suspension that is fed to the core layer can be diluted a little, in which case there is an adjustment possibility in terms of dilution in both directions in both stock suspensions fed.

[0034] The fiber web achieved after the change is measured again, and the adjustment of the dilutions is continued on the basis of the difference between the measurement results and the target until even basis weight and strength profiles in the cross direction of the fiber web are achieved. In accordance with Figure 4, the stock suspension fed to the core layer 20 is generally diluted more in those feed zones of the headbox that form the edge area 26 of the core layer 20 of the fiber web 10 than in those feed zones 18, shown in Figure 4, that form the center part 28 of the fiber web 10. In this way, more long-fiber fiber fraction of the surface layer 22 can be brought to the edge areas 26, which long-fiber fiber fraction reinforces the edge areas, which become naturally weaker during the drying of the fiber web. In other words, the mutual relationship of the basis weights of the layers 16 varies in the cross direction of the fiber web 10.

[0035] The cross-directional optimization of the basis weight profile and strength profile of the fiber web can be carried out by means of the method according to the invention by using separate headboxes equipped with dilution adjustment. The dilutions of the stock suspensions fed, forming the various layers, can be adjusted independently of each other.

[0036] Advantageously, the multilayer fiber web manufactured by means of the method and system according to the invention is board used in exterior packaging, where the core layer of the board is formed from a raw material which results in a layer that has a poorer strength and cheaper costs than the surface layer, and the surface layer, in turn, is more expensive and stronger than the core layer.

[0037] The invention relates to a method for the optimization of the properties of a multilayer fiber web (10) in the manufacture of a fiber web (10), in which method the multilayer fiber web (10) is formed by feeding at least two stock suspensions that form a layer (16) of the fiber web (10) to a forming section (50) from two or more headboxes (12) divided into parallel feed zones (18), where those properties of said stock suspensions that affect the strength of the finished fiber web differ from each other, and the basis weight profile of said stock suspensions is adjusted in two or more headboxes (12) by feeding dilution water in zones in the cross direction of the fiber web machine into each stock suspension. In the method, the cross-directional basis weight profile and strength of the formed fiber web (10) are adjusted in the cross direction of the fiber web machine by adjusting the amount of dilution water in zones separately in each stock suspension

fed.

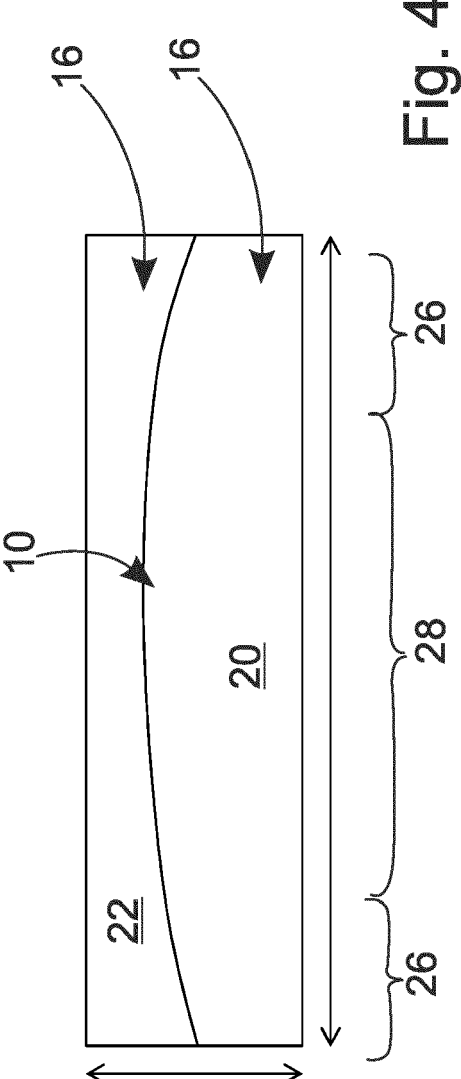
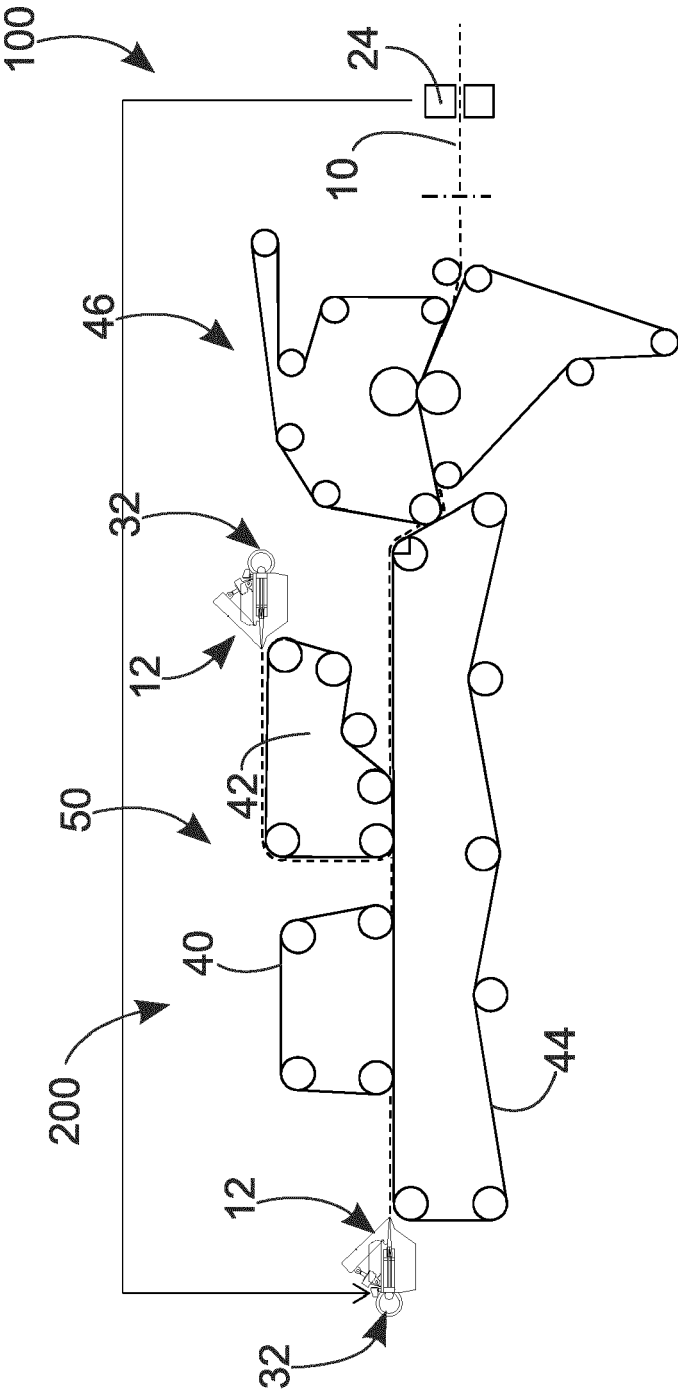
[0038] The invention also relates to a corresponding system.

Claims

1. A method for the optimization of the properties of a multilayer fiber web (10) in the manufacture of a fiber web (10), in which method the multilayer fiber web (10) is formed by feeding at least two stock suspensions that form a layer (16) of the fiber web (10) to a forming section (50) from two or more headboxes (12) divided into parallel feed zones (18), where those properties of said stock suspensions that affect the strength of the finished fiber web differ from each other, and the basis weight profile of said stock suspensions is adjusted in two or more headboxes (12) by feeding dilution water in zones in the cross direction of the fiber web machine into each stock suspension, **characterized in that** in the method the cross-directional basis weight profile and strength of the formed fiber web (10) are adjusted in the cross direction of the fiber web machine by adjusting the amount of dilution water in zones separately in each stock suspension fed.
2. A method according to claim 1, **characterized in that** one of said two layers (16) of the fiber web (10) is a core layer (20) and the other layer is a surface layer (22) with better strength properties than in said core layer (20).
3. A method according to claim 2, **characterized in that** in the method, the basis weight profile of the fiber web (10) is adjusted to an essentially even profile over the width of the fiber web (10) by means of the dilution of the stock suspension that forms said core layer (20).
4. A method according to any one of claims 2 or 3, **characterized in that** in the method, the strength profile of the fiber web (10) is adjusted to an essentially even profile over the width of the fiber web (10) by means of the dilution of the stock suspension that forms said surface layer (22).
5. A method according to any one of claims 2 - 4, **characterized in that** the basis weight profile of the fiber web (10) is measured as an online measurement (24), and on the basis of the measurement result the dilution of the stock suspension that forms the core layer (20) is adjusted in individual feed zones (18).
6. A method according to any one of claims 2 - 5, **characterized in that** the stock suspension fed to said core layer (20) is diluted more in those feed zones (18) of the headbox that form the edge area (26) of

the core layer (20) of the fiber web (10) than in those feed zones (18) that form the center part (28) of said fiber web (10).

7. A method according to any one of claims 1 - 6, **characterized in that** two headboxes (12) are used, each headbox (12) adapted to feed one stock suspension.
8. A system for the optimization of the properties of a multilayer fiber web in the manufacture of a fiber web, where the system (100) includes two or more headboxes (12) for the feeding of at least two different stock suspensions to form at least two layers (16), the strength properties of which differ from each other, to a fiber web (10) to be formed on a forming section (50), and dilution equipment (32) divided into feed zones in the cross direction of the fiber web machine, adapted in connection with two or more headboxes (12) for the dilution of the stock suspensions in zones in the cross direction of the fiber web machine in at least some of said feed zones (18) for the optimization of the properties of the fiber web (10), **characterized in that** said dilution equipment is adapted to adjust separately in zones the amount of dilution water in each stock suspension fed for the adjustment of the cross-directional basis weight profile and strength of the formed fiber web in the cross direction of the fiber web machine.
9. A system according to claim 8, **characterized in that** the system (100) includes two headboxes (12), each for feeding one stock suspension, in which system (100) said dilution equipment (32) is adapted in connection with both headboxes (12).



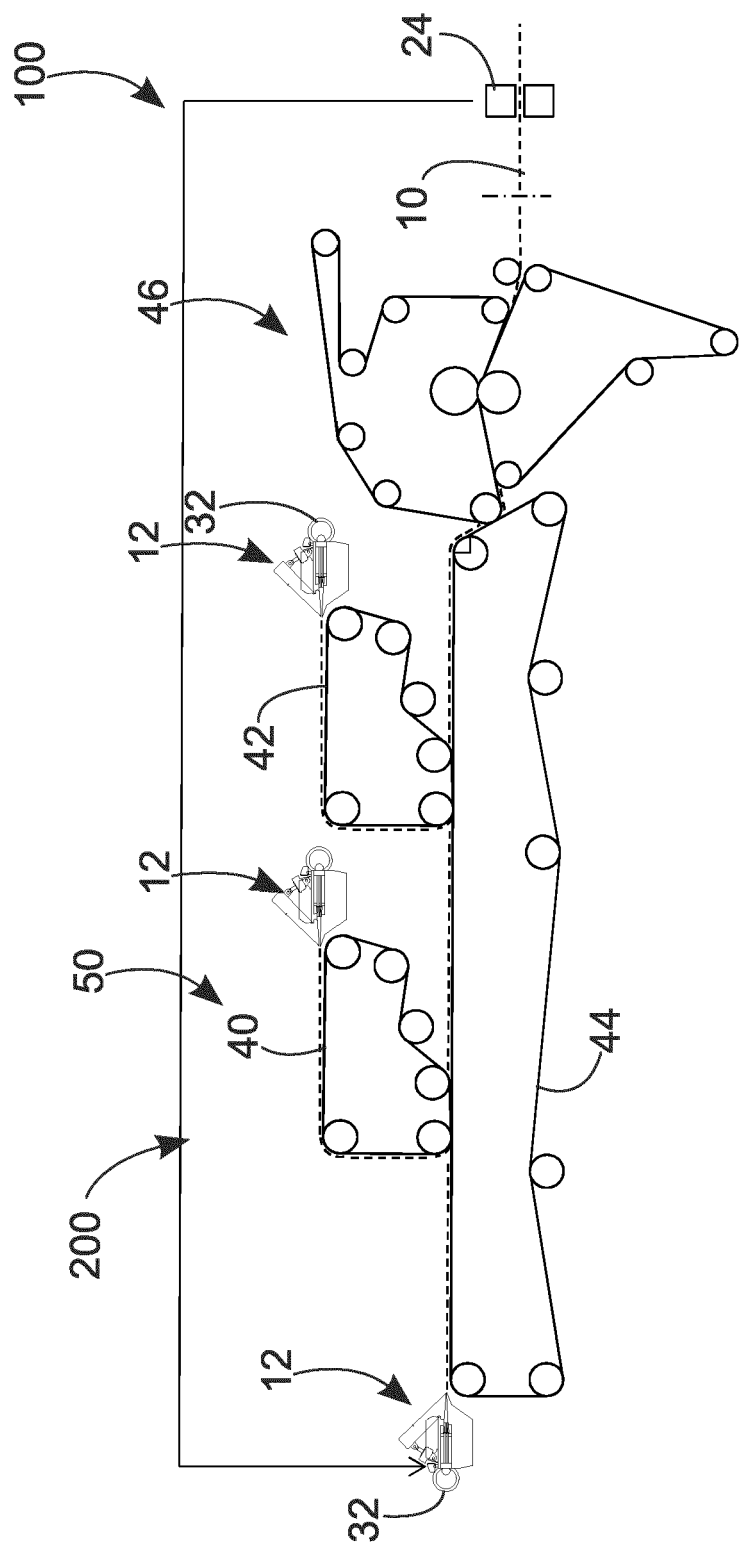


Fig. 2

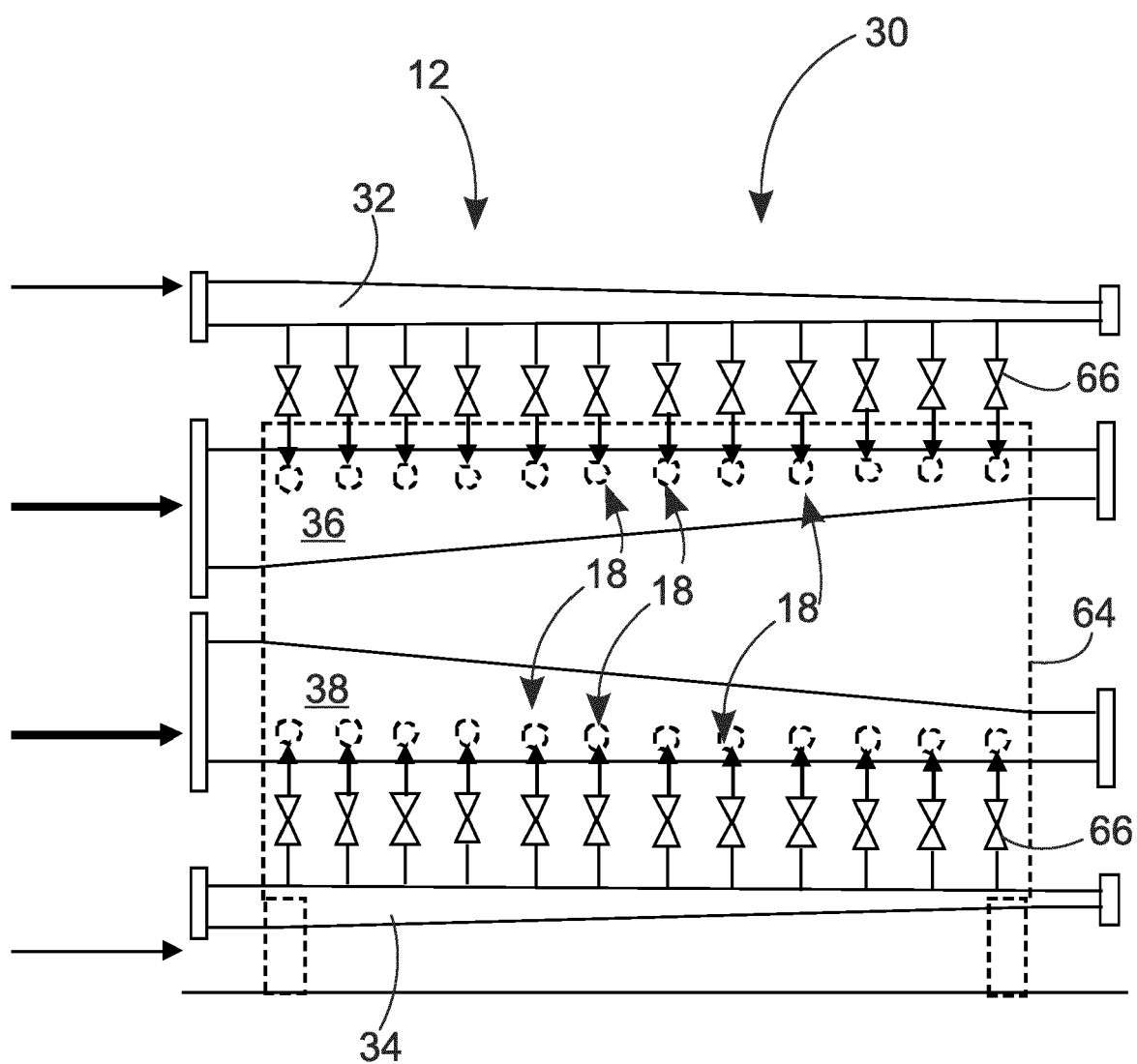


Fig. 3



EUROPEAN SEARCH REPORT

Application Number
EP 16 16 7211

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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 6 284 100 B1 (SHAKESPEARE JOHN FRANCIS [FI] ET AL) 4 September 2001 (2001-09-04)	1,7-9	INV. D21F11/04 D21F1/66 D21F1/08 D21G9/00
Y	* column 5, line 4 - line 40 * * column 12, line 19 - line 64; figure 6 *	2-6	
X	DE 195 14 236 A1 (VOITH SULZER PAPIERMASCH GMBH [DE]) 17 October 1996 (1996-10-17) * column 2, line 1 - column 3, line 50; claims 1,2; figures *	1,7-9	
Y	DE 10 2009 028135 A1 (METSO PAPER INC [FI]) 11 March 2010 (2010-03-11) * paragraph [0028] - paragraph [0046]; figures 2-5 *	2-6	
Y	WO 2004/109010 A1 (METSO PAPER INC [FI]; VAELIKANGAS ARTO [FI]) 16 December 2004 (2004-12-16) * page 5 - page 7; figure 1 *	2-5	
			D21F D21G
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 2 August 2016	Examiner Beckman, Anja
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

EPO FORM 1503 03.82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 16 16 7211

5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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02-08-2016

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 6284100 B1	04-09-2001	US 6284100 B1	04-09-2001
		US 2002011319 A1	31-01-2002
DE 19514236 A1	17-10-1996	NONE	
DE 102009028135 A1	11-03-2010	AT 507115 A2	15-02-2010
		DE 102009028135 A1	11-03-2010
		FI 20085769 A	13-02-2010
WO 2004109010 A1	16-12-2004	AT 502116 A1	15-01-2007
		DE 112004000903 T5	13-04-2006
		WO 2004109010 A1	16-12-2004

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- FI 121888 [0004] [0005]