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(72) Inventors:
• **ANTTILAINEN, Sami**
40740 Jyväskylä (FI)
• **TURPEINEN, Hannu**
40740 Jyväskylä (FI)

(74) Representative: **TBK**
Bavariaring 4-6
80336 München (DE)

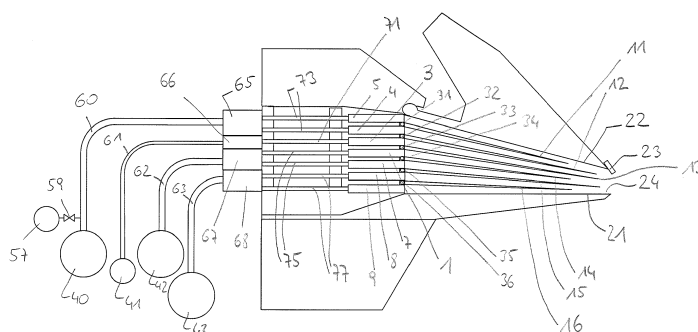
(71) Applicant: **Valmet Technologies Oy**
02150 Espoo (FI)

(54) **MULTILAYER HEADBOX STRUCTURE FOR A FIBER WEB MACHINE FOR FORMING A FIBER WEB AND METHOD FOR FORMING A FIBER WEB IN A FORMING SECTION OF A FIBER WEB MACHINE**

(57) The present invention relates to a multilayer headbox structure for a fiber web machine for forming a fiber web, comprising a multilayer headbox having a turbulence generator and a nozzle chamber having two converging walls (21, 22) forming a nozzle outlet (24). The turbulence generator has a plurality of diffusers (1, 3, 4, 5, 7, 8, 9) creating turbulence in liquids supplied into each respective diffuser via feeding means (65, 66, 67, 68) for feeding the liquids, each of the diffusers having an outlet into the nozzle chamber, wherein central diffusers of the plurality of diffusers comprise a first central diffuser (3) and a second central diffuser (1, 7), the first central diffuser is connected with feeding means (66) feeding fresh water, dilution water, and/or white water into the first central diffuser, the first central diffuser has two blades (12, 13) arranged at its outlet and extending into the nozzle

chamber in a converging manner, the blades separating the fresh water, dilution water, and/or white water as the liquid flowing through the first central diffuser from the liquids flowing through adjacent diffusers, the second central diffuser is connected with feeding means (67) feeding pulp suspension into the second central diffuser, the second central diffuser has an additional blade (14) arranged at the outlet, and the additional blade has a shorter length than the adjacent blade of the first central diffuser, and the central diffusers are arranged between a top ply diffuser (4, 5) and a back ply diffuser (8, 9), in which top ply diffuser top ply pulp suspension as the liquid flows through the top ply diffuser for forming a top ply of the fiber web and in which back ply diffuser back ply pulp suspension as the liquid flows through the back ply diffuser for forming a back ply of the fiber web.

Fig. 1



Description

[0001] The present invention relates to a multilayer headbox structure for a fiber web machine, such as a paper or board making machine, for forming a fiber web, and to a method for forming a fiber web in a forming section of a fiber web machine.

Description of the prior art

[0002] At the beginning of a wet end of a paper or board making machine, a headbox structure basically serves to supply mainly liquid substances such as water and/or a pulp suspension liquid onto a wire of a forming section. Additives such as refined fibers, fillers, cationic polymers such as cationic starch, etc. can be added to the water and/or pulp suspension liquid. These liquid substances are fed to a headbox by means of a water supply or feed water supply. In the forming section, the substances applied onto a forming wire are then dewatered to form a fiber web, such as a paper or board web. Afterward it is then further transferred to a press section for additional dewatering and a dryer section in which the formed fiber web is dried. Further treatment depends on the respective requirements of the product.

[0003] Thus, it is the main task of such a headbox to evenly distribute these liquid substances in the width direction ("cross direction" or "CD") of the paper or board making machine as well as in the running direction of the fiber web to be formed ("machine direction" or "MD") on the wire. In this regard, it is also important to supply the liquid substances in a layered manner in order to ensure the required properties and quality of the later paper or board web.

[0004] A multilayer headbox for a fiber web machine, such as a paper or board making machine, is known from WO 2009/115479 A1. According to this headbox, first supply means serve to supply a fibrous suspension into a guide device which is connected to a nozzle out of which the fibrous suspension emerges via a gap. A dosing device serves to dose at least one additive such as a filler material or a chemical of any type, in particular a paper chemical such as a retention agent. The headbox has two layers comprising a suspension and a central layer comprising water. All of these layers are guided separately in the guide device. In order to improve the formation of different liquid layers, blades are provided in the nozzle to achieve the formation of the liquid layers.

[0005] Nevertheless, there still exists the problem that, because of turbulences in the individual liquid layers, the mixing of the liquid layers largely takes place as soon as the liquid layers have passed the blades. Accordingly, the individual layers do no longer exhibit the required consistency but rather a mixture of respectively adjacent liquid layers. Thus, unwanted interaction as well as a chemical reaction among the additives may take place, so that a degradation of the quality of the fiber web to be formed has to be expected.

Summary of the invention

[0006] Thus, it is an object of the present invention to provide a multilayer headbox structure for a fiber web machine for forming a fiber web and a method for forming a fiber web in a forming section of a fiber web machine, which are capable of enabling formation of individual pure liquid surface side layers having clear boundaries and supplying these pure liquid layers into a forming section of the fiber web machine, such as a paper or board making machine.

[0007] The object of the present invention is achieved by a multilayer headbox structure having the features of claim 1 for a fiber web machine for forming a fiber web and by a method having the features of claim 11 for forming a fiber web in a forming section of a fiber web machine.

[0008] Further advantageous developments of the present invention are defined in the dependent claims.

[0009] According to an advantage of the present invention, it is possible that a three layer fiber web (also called as a "three ply product") can be formed by one headbox structure (one headbox with one forming unit) which dewatering capacity is able to dewater stock which is fed to the forming section of the fiber web machine.

[0010] According to an aspect of the present invention, a multilayer headbox structure for a fiber web machine for forming a fiber web is provided, which comprises a multilayer headbox having a turbulence generator and a nozzle chamber having two converging walls forming a nozzle outlet. The turbulence generator has a plurality of diffusers creating turbulence in liquids supplied into each respective diffuser via feeding means for feeding the liquids, each of the diffusers having an outlet into the nozzle chamber, wherein central diffusers of the plurality of diffusers comprise a first central diffuser and a second central diffuser, the first central diffuser is connected with feeding means feeding fresh water, dilution water, and/or white water into the first central diffuser, the first central diffuser has two blades arranged at its outlet and extending into the nozzle chamber in a converging manner, the blades separating the fresh water, dilution water, and/or white water as the liquid flowing through the first central diffuser from the liquids flowing through adjacent diffusers, the second central diffuser is connected with feeding means feeding pulp suspension into the second central diffuser, the second central diffuser has an additional blade arranged at the outlet, and the additional blade has a shorter length than the adjacent blade of the first central diffuser, and the central diffusers are arranged between a top ply diffuser and a back ply diffuser, in which top ply diffuser top ply pulp suspension as the liquid flows through the top ply diffuser for forming a top ply of the fiber web and in which back ply diffuser back ply pulp suspension as the liquid flows through the back ply diffuser for forming a back ply of the fiber web.

[0011] In the structure of the headbox as described above, the plurality of diffusers at least comprises four diffusers, i.e. the top ply diffuser, the first central diffuser,

the second central diffuser and the back ply diffuser. The top ply diffuser is configured to form the top ply (top surface side) of the fiber web to be formed, and the back ply diffuser is configured to form the back ply (back surface side) to the fiber web to be formed.

[0012] Furthermore, the central diffusers comprise at least the first central diffuser and the second central diffuser, which are arranged between said top ply diffuser and back ply diffuser. According to the aspect of the present invention, the first central diffuser is connected with the feeding means feeding fresh water, dilution water, and/or white water into the first central diffuser, which is either arranged next (adjacent) to the top ply diffuser or the back ply diffuser. Here, the first central diffuser has the two blades which are arranged at its outlet and which extend into the nozzle chamber in a converging manner such that these blades separate the fresh water, dilution water, and/or white water as the liquid flowing through the first central diffuser from the liquids flowing through the adjacent diffusers, i.e. either between the top ply diffuser and the second central diffuser or between the back ply diffuser and the second central diffuser. The second central diffuser is connected with the feeding means for feeding pulp or stock suspension.

[0013] Further, the second central diffuser has the additional blade arranged at the outlet and adjacent to one of the two blades of the first central diffuser, which additional blade of the second central diffuser has a shorter length than said adjacent blade of the first central diffuser. Due to this positioning of the blade tips of the first and second central diffusers, a first central layer of the fiber web to be formed, which layer consists mainly of water (fresh water, dilution water, and/or white water), does not get mixed with the adjacent pulp suspension layers. Accordingly, the first central diffuser is configured to form a boundary layer between the adjacent pulp suspension layers. Thus, while in each of the adjacent diffusers, caused by the generated turbulences, a good distribution of the substances in the respective liquid takes place, the individual liquids stay separated from each other due to the blades of the first central layer. Furthermore, another effect of the blades is to maintain the turbulence in the boundary areas of each liquid layer. The second central layer forms a middle layer, which pulp or stock properties advantageously differs from the top ply suspension and the bottom ply suspension. For example, the second central layer purity can be less or lower than the top ply purity, but it is still good enough to separate stock properties. This helps dewatering capacity in the forming section.

[0014] Accordingly, the different liquids can be supplied to a wire in a forming section in a layered manner, thus maintaining the purity of the individual liquid layers. Since no mixing of the layers can take place, various additives such as filler materials, refined fibers, cationic starch, etc. in the water layer maintain their position in the center of the web to be formed, but are not distributed to the adjacent pulp suspension layers. Accordingly, a

degradation of the additives caused by mixing and a subsequent interaction with materials from an adjacent liquid layer can be avoided. Thus, the desired properties of the additives are maintained. Accordingly, adjusting the required properties of the fiber web to be formed is easily enabled by supplying the respective materials with the respective layer, because a degradation of the individual material properties of the additives due to mixing with the respectively adjacent layer cannot take place.

[0015] Besides, different pulp suspension qualities can be fed via the top ply diffuser, the second central diffuser and the back ply diffuser. Generally, the top ply suspension has the best quality and the second central layer suspension has the worst quality among said pulp suspensions. Thus, raw material and their cost for forming a fiber web can be reduced.

[0016] In case there are more than four diffusers provided in said multilayer headbox structure, a second central diffuser stock (for example, formed of two second central diffusers) is separated from the adjacent top ply diffuser or back ply diffuser by means of a further blade arranged at the outlet, which the further blade has a longer length than the adjacent blade(s) of the second central diffuser and of the top ply diffuser or back ply diffuser. That is, one may say that blade lengths in the slice channel (nozzle chamber) are configured in such a manner that blades between different stock layers (i.e. between the back/top ply layer and the second central layer) are longer than blade(s) which are in the middle of such stock layers. The length of such further blade(s) may be as long as the length of said two blades. Advantageously, further tip blade distance from the nozzle outlet (slice opening) can, for example, be from 1 to 50 mm, wherein the tip of blade is inside the nozzle outlet.

[0017] Furthermore, the multilayer headbox structure for a fiber web machine for forming a fiber web according to the present invention is preferably used for manufacturing (forming) SBS (Solid Bleached Board) or FBB (Folding Boxboard) grades, wherein its middle layer stock is typically hardwood, softwood, CTMP (Chemical Thermo Mechanical Pulp) or broke. Accordingly, a bulky middle layer can be provided.

[0018] Preferably, the top ply diffuser is connected with feeding means feeding the top ply pulp suspension into the top ply diffuser, and the back ply diffuser is connected with feeding means feeding the back ply pulp suspension into the back ply diffuser. Accordingly, different pulp suspensions can be fed to the respective ply diffusers.

[0019] Alternatively, the top ply diffuser and the back ply diffuser can be connected with a single feeding means feeding the same pulp suspension as the top ply pulp suspension and the back ply pulp suspension into the top ply diffuser and into the back ply diffuser. Thus, the same pulp suspension can be used for forming the top ply and the back ply. Besides, the structure of the multilayer headbox and forming section can be simplified and thus its cost can be further reduced.

[0020] Preferably, the top ply diffuser is formed be-

tween an adjacent blade of the first central diffuser and one of the two converging walls of the nozzle chamber, and the back ply diffuser is formed between the additional blade of the second central diffuser and the other of the two converging walls of the nozzle chamber. Thus, a compact and cheap multilayer headbox structure is provided for forming a three layer fiber web.

[0021] Preferably, the blades are arranged in a staggered manner in the above-mentioned headbox structures. Thereby, the accuracy of the different liquid layers can be improved.

[0022] Preferably, at least the blades of the first central diffuser extend beyond the nozzle chamber to an outside of the multilayer headbox. Thereby, the formation of the liquid layers directly on the wire is ensured. Accordingly, no mixing at the boundaries between the first central water layer and the pulp suspension layers takes place.

[0023] This can also be applied in case said further blade(s) is(are) provided. That is, the further blade(s) may also extend beyond the nozzle chamber to the outside of the multilayer headbox. Thus, mixing at the boundaries between the second central pulp suspension layer and the adjacent pulp suspension layers can be further reduced.

[0024] Preferably, tips of the blades of the first central diffuser are arranged inside the nozzle chamber. Thereby, a distance to a nozzle outlet (also referred to as slice opening) can be set to be as small as possible in order to have the central water layer contact the other liquid layers as late as possible. A distance between the tips of the blades of the first central diffuser and the nozzle outlet (slice opening) can, for example, be set from 1 to 50 mm.

[0025] Preferably, the blades are mounted at the respective diffuser outlet in a pivoted manner. Preferably, each blade is arranged in a freely pivotable manner. Thereby, the blade pivots about a hinge or joint provided at the end of the respective diffuser tube. Accordingly, pressure differences between the various liquid layers can be balanced, leading to a further reduction of turbulences at the boundaries of the individual liquid layers.

[0026] Preferably, wall surfaces of each of the diffusers as well as of the blades have a smooth and uniform structure in order to prevent agitation of the respective liquid at its boundary. Thus, while flowing through and along diffuser tubes and then between the blades through the nozzle chamber, the respective liquid layers are calmed down at their boundaries such that an interaction between the different liquid layers after their unification is avoided.

[0027] Preferably, at least one adjustable slice lip is provided at the nozzle outlet. Thus, it is possible to adapt the size of the nozzle outlet, thereby adjusting the output of the liquid layers.

[0028] Preferably, the length of the additional blade is smaller than or equal to 95% of the length of the blades of the first central diffuser. Thus, a compact multilayer headbox structure can be provided.

[0029] According to another aspect of the present invention, a fiber web machine is provided which comprises a forming section having a wire guided around guiding rolls and forming a closed loop, and the multilayer headbox structure as mentioned above which is configured to eject the top ply pulp suspension, back ply pulp suspension, middle ply pulp suspension, and fresh water, dilution water and/or white water in a layered manner onto the wire to form a fiber web having multiple plies.

[0030] According to a further aspect of the present invention, a method for forming a fiber web in a forming section of a fiber web machine is provided, comprising the steps of feeding fresh water, dilution water, and/or white water into a first central diffuser of a multilayer headbox structure, feeding pulp suspension into a second central diffuser of the multilayer headbox structure, which second central diffuser is adjacently arranged to the first central diffuser within a nozzle chamber of a multilayer headbox of the multilayer headbox structure, feeding top ply pulp suspension into a top ply diffuser of the multilayer headbox structure, which top ply diffuser forms a top ply of the fiber web which is adjacently arranged to the first central diffuser within the nozzle chamber, feeding back ply pulp suspension into a back ply diffuser of the multilayer headbox structure, which back ply diffuser forms a back ply of the fiber web which is adjacently arranged to the second central diffuser within the nozzle chamber, guiding the fresh water, dilution water, and/or white water, and the different pulp suspensions through the corresponding diffusers to eject them onto a wire of the forming section as stock plies of liquid substances such that the first central ply consisting of the fresh water, dilution water, and/or white water forms a boundary layer between the top ply or back ply consisting of the pulp suspension and the second central ply pulp consisting of the pulp suspension, and dewatering the liquid substances to form the fiber web.

[0031] Preferably, in the feeding steps of the top ply pulp suspension and the back ply pulp suspension, the same pulp suspension as the top ply pulp suspension and the back ply pulp suspension are fed into the top ply diffuser and into the back ply diffuser. Thus, the same quality for the top ply and the back ply of the fiber web to be formed can be achieved.

[0032] In particular, the above aspects of the present invention provide an advantage in that the first central water layer and the pulp suspension layers (also known as stock layers) can be combined at the nozzle outlet, but can maintain their purity because turbulences in the boundary areas of the respective layers are sufficiently maintained to such an extent that a mixing of the individual layers is prevented. The combination of layers preferably takes place at a short distance upstream of the nozzle outlet. However, in certain cases, the blades may extend beyond the nozzle outlet, so that the individual layers are combined only outside of the nozzle, or the blade lips may be arranged in the slice channel, which is formed by the adjustable slice lip.

Brief description of the drawings

[0033] Further effects, advantages and features of the present invention will become apparent from a disclosure of the enclosed drawings showing preferred embodiments of the present invention, which are discussed below in further detail.

Fig. 1 schematically shows a sectional view of a headbox structure according to a first embodiment of the present invention.

Fig. 2 schematically shows a sectional view of a headbox structure according to a second embodiment of the present invention.

Detailed description of the preferred embodiments

[0034] Figure 1 is a sectional view of a multilayer headbox structure according to the present invention for a fiber web machine, such as a paper or board making machine, for forming a fiber web.

[0035] In Figure 1, from the left to the right, a headbox comprises headers 40, 41, 42, 43 which are arranged in said figure at the bottom of the left side. The liquids, such as pulp suspension liquid and water, are supplied from the headers 40, 41, 42, 43 to intermediate chambers 65, 66, 67, 68 via manifold pipes 60, 61, 62, 63 acting as feeding means, respectively.

[0036] The intermediate chambers 65, 66, 67, 68 acting as equalizing chambers are optionally provided. That is, the headers 40, 41, 42, 43 can be directly or integrally connected to the headbox.

[0037] Further, a diffuser chamber in which diffuser tubes 1, 3, 4, 5, 7, 8, 9 acting as diffusers are provided, and a nozzle chamber having converging walls 21, 22 forming a slice opening (nozzle outlet) 24 are provided. Each of the diffuser tubes 1, 3, 4, 5, 7, 8, 9 consists of several diffuser tubes arranged in the cross machine direction.

[0038] Turbulence generator pipes 71, 73, 75, 77 acting as feeding means establish communication from the headers 40, 41, 42, 43 to the diffuser tubes 1, 3, 4, 5, 7, 8, 9. Blades 11, 12, 13, 14, 15, 16 are respectively attached to outlets of the diffuser tubes 1, 3, 4, 5, 7, 8, 9 via joints 31, 32, 33, 34, 35, 36.

[0039] The blades 11, 12, 13, 14, 15, 16 may have a wedge-shaped cross-section, in which a thick end is attached to the respective diffuser tubes while a thin end projects towards the slice opening 24. The blades 11, 12, 13, 14, 15, 16 are provided in a staggered manner.

[0040] Furthermore, a dilution water header 57 is provided and connected with the manifold pipe 61 via dilution water valves 59 for controlling the web basis weight profile in cross machine direction. The dilution water valves 59 are arranged in 30 to 150 mm intervals in cross machine direction of the headbox.

[0041] From the headers 40, 41, 42, 43, various liquids

are pumped via the manifold pipes 60, 61, 62, 63 and the intermediate chambers 65, 66, 67, 68 to the turbulence generator pipes 71, 73, 75, 77 and thus to the respective diffuser tubes 1, 3, 4, 5, 7, 8, 9.

[0042] According to the present invention, water such as fresh water, dilution water, and/or white water is fed from the header 41 to the diffuser tubes 3 via the manifold pipe 61, the intermediate chamber 66 and the turbulence generator pipes 71, while the other diffuser tubes 1, 4, 5, 7, 8 and 9 are supplied with a stock or pulp suspension. After having entered the respective diffuser tubes, turbulence is generated in the respective liquids in order to achieve a desired distribution of the additives and materials present in the respective liquids. In particular, in the water supplied via the turbulence generator pipe 71 to the diffuser tubes 3 (first central layer liquid), a high amount of filler, here water, is present. The fiber consistency in this first central layer liquid fed from the header 41 is remarkably lower than the fiber consistency of the other liquid layers.

[0043] In the nozzle chamber, the blades 11, 12, 13, 14, 15, 16 maintain the individual liquid layers separate before the liquids are ejected towards a forming section of a fiber web making machine. Each of the blades 11, 12, 13, 14, 15, 16 is attached to a wall portion between the respective diffuser tubes 1, 3, 4, 5, 7, 8, 9 via the joints 31, 33, 35, and 37 in a freely pivotable manner. Thus, apart from the uppermost and lowermost diffuser tubes 5 and 9, each of the diffuser tubes 1, 3, 4, 7 and 8 is respectively continued by two of blades 11, 12, 13, 14, 15, 16. The uppermost and lowermost diffuser tubes 5 and 9 are continued by the blade 15 and a nozzle chamber wall 22 and the blade 16 and a nozzle chamber wall 21, respectively.

[0044] At the right side end of the diffuser tubes 1, 3, 4, 5, 7, 8, 9 in Figure 1, a transition from the diffuser tubes 1, 3, 4, 5, 7, 8, 9 towards the nozzle chamber, i.e. the respective blades 11, 12, 13, 14, 15, 16 and the nozzle chamber walls 21 and 22, is formed in a uniform and smooth manner in order to avoid obstacles agitating the respective flow and liquid. This serves to avoid a further generation of turbulences and a corresponding agitation of the boundaries of the respective liquid layers emerging from the diffuser tubes 1, 3, 4, 5, 7, 8, 9 in between the blades 11, 12, 13, 14, 15, 16 and nozzle chamber walls 21 and 22, respectively.

[0045] Accordingly, the individual liquids flowing towards the slice opening 24 through the nozzle chamber are still separated by the respective blades 11, 12, 13, 14, 15, 16. Surface friction of the blades 11, 12, 13, 14, 15, 16 maintains turbulence in the boundary areas of the individual liquid layers. Therefore, when unifying the stock or pulp suspension liquid flows which are separated by the blades 11, 14 and 16 at their tip ends, an interaction between the individual liquid layers does not take place, since the turbulence in the respective boundary regions is still small-scale. Thus, stock or pulp suspension liquid flows will then merge together downstream of the tip ends

of said blades. The length of the blades 11, 14 and 16 can be chosen such that there is sufficient distance to the tip ends of the blades 12, 13 and 15 for ensuring that individual stock or pulp suspension will merge together. The length of the blades 11, 14 and 16 is preferably up to 95% of the length of the central blades 12, 13 and 15. The blades 12, 13 and 15 and the nozzle chamber walls 21 and 22 maintain turbulence in the water, stock or pulp suspension liquid flows.

[0046] The same effect as described above occurs when unifying the above-described liquid layers consisting of stock or pulp suspension liquid with the water layer flowing between blades 12 and 13 at their tip ends, respectively. As already mentioned above, the tip ends of these blades 12 and 13, respectively, are arranged closer towards the slice opening 24 than the tip ends of the blades 11, 14, 16. That is, the lengths of blades 12 and 13 separating the water layer from the stock or pulp suspension liquid layers exceed the lengths of blades 11, 14 and 16, respectively. In this regard, it also has to be noted that, although the lengths of the blades 12 and 13 correspond to each other in the drawings, blades 12 and 13 can have different lengths, but it is important that their lengths exceed the respective lengths of the other blades 11, 14 and 16. Because the fiber consistency in the water layer is very low, turbulence will remain active in the slice flow from the headbox until the web forming process starts in the forming section.

[0047] Preferably, the length of the blade 15 is equal to one of the lengths of the blades 12 and 13.

[0048] After unifying the water layer with the stock or pulp suspension liquid layers, the liquids are ejected via the slice opening 24 in a layered manner onto a wire or fabric of a forming section for further treatment (not shown), such as dewatering, pressing and drying. The distance from the tip ends of the blades 12, 13 and 15 to the forming section is short for ensuring the layered structure.

[0049] For adjusting the ejected liquid flow, a slice lip 23 is provided at the upper nozzle chamber wall 22. The slice lip 23 can be adjusted in its position, i.e. in particular its reach can be adjusted by known means such as horizontal or vertical slice positioners, micro adjusters, etc. To simplify matters, these are not shown in the drawing.

[0050] Furthermore, due to the layered structure of the liquids, i.e. the water layer being sandwiched between the stock or pulp suspension liquid layers, the additives and other substances present in the respective liquid layers do not interact with each other, because a mixing of the individual liquid layers can be surely excluded. Thus, adjusting the properties of the web, i.e. paper or board web, to be formed by introducing additives or other substances into the stock or pulp suspension liquids/water is facilitated. Furthermore, particularly the amount of filler in the water layer can be increased, thereby achieving a remarkable cost reduction compared to paper or board having a comparably high filler content.

[0051] In other words, as shown in the embodiment of

Figure 1, seven diffusers 1, 3, 4, 5, 7, 8, 9 are provided in said multilayer headbox structure. Here, the central diffusers comprise a first central diffuser 3 and a second central diffuser stack formed by second central diffusers 1 and 7. The first central diffuser 3 is connected with the feeding means for feeding fresh water, dilution water, and/or white water into the first central diffuser 3. The first central diffuser 3 has the two blades 12, 13 arranged at its outlet and extending into the nozzle chamber in a converging manner, the blades separating the fresh water, dilution water, and/or white water as the liquid flowing through the first central diffuser 3 from the liquids flowing through adjacent diffusers 1, 4. The second central diffuser stack is formed by the second central diffusers 1 and 7. This second central diffuser stack is separated from the adjacent back ply diffuser stack formed by the back ply diffusers 8 and 9 by means of the elongated blade 15 (the further blade) arranged at the diffuser outlet, which elongated blade has a longer length than the adjacent blades 14, 16 of the second central diffuser stack and of the back ply diffuser stack. The second central diffuser stack thus has the additional blade 14 arranged at the outlet, and the additional blade 14 has a shorter length than the adjacent blade 13 of the first central diffuser 3. The first central diffuser 3 is arranged between a top ply diffuser stack formed by the top ply diffusers 4, 5 and the second central diffuser stack. In the top ply diffusers 4, 5 top ply pulp suspension as the liquid flows through the top ply diffusers 4, 5 for forming the top ply of the fiber web and in the back ply diffusers 8, 9 back ply pulp suspension as the liquid flows through the back ply diffusers 8, 9 for forming the back ply of the fiber web.

[0052] That is, one may generally say that blade lengths in the slice channel (nozzle chamber) are configured in such a manner that blades between different stock layers (i.e. between the back/top ply layer and the second central layer) are longer than blade(s) which are in the central of such stock layers. The length of such further blade(s) may be as long as the length of said two blades of the first central diffuser 3.

[0053] Figure 2 shows another embodiment of a multilayer headbox structure according to the present invention. In Figure 2, the same and equivalent elements already described above have been assigned the same reference signs; the description thereof will not be repeated.

[0054] Here, the top ply of the web to be formed is arranged at the bottom of the figure, and the back ply of the web to be formed is arranged at the top of the figure. Further, the second central layer is formed from three diffuser tubes 1, 6 and 7 and respective blades 13 to 15 as shown in said figure.

[0055] Furthermore, instead of providing a dilution water header at the top ply side of the multilayer headbox structure as shown in Figure 1, a dilution water header 57 is provided and connected with the manifold pipe 62 via a dilution water valve or valves 59 for controlling the web basis weight profile in cross machine direction. That

is, the second central layer of the web to be formed can be provided with such a dilution water header so that raw material for forming the pulp suspension for the second central layer can be further reduced.

[0056] While the present invention has been described by means of the above-described preferred embodiments, it has to be noted that the present invention is not limited thereto, i.e. the scope of the present invention is defined by the attached claims.

[0057] For example, the headbox itself is not limited to the described structure comprising the turbulence generator pipe, the diffuser chamber and the nozzle chamber, but one may employ a headbox in which the header is directly connected to the diffuser. In such a headbox, there is only one set of tubes (diffuser tubes) present between the header and the diffuser chamber.

[0058] Apart from what has been mentioned above, the present invention may also be applied to other headbox structures, such as a headbox comprising a mixing chamber where dilution water is introduced into the pulp suspension liquids.

[0059] While in the above description the terms "filler" and "additives" have been used as an example of substances added to the stock, pulp suspension or water, it is to be noted that, apart from the ones already mentioned, such additives can be refined fibers, cationic polymers, in particular cationic starch, retention chemicals or retention aid helpers, in particular microparticles or colloidal silica.

[0060] In a paper or board making machine, to which the headbox of the present invention can be applied, the additives can be admixed to the pulp in a machine chest where the stock and the white water are mixed. In this way, the additives will become easily distributed and diluted within the pulp without any additional process elements having to be arranged.

[0061] However, it is desired to further increase the bonding strength of the paper to be produced. That is, if the bonding strength between the stock fibers can be further increased, the percentage of stock within the pulp can be further reduced, for instance. This missing percentage can then be replaced by fillers which are less expensive. An increased bonding strength can, however, certainly also lead to a more resistant paper.

[0062] According to the present invention, the water layer can be formed as the first central layer being adjacently arranged to either the top ply or the back ply of the web to be formed, and the purity of the water layer can be maintained when ejecting the unified liquids out of the slice opening. Further, additives can also be added to the water forming the first central water layer. Such additives can be refined fibers, cationic polymers, in particular cationic starch, fillers (like PCC or GCC), retention chemicals or retention aid helpers, in particular microparticles or colloidal silica. This is advantageous insofar as there is no interaction between the different liquid layers and it is possible to remarkably increase the filler content. Thus, the cost involved in the production of paper

or board can be remarkably reduced while the desired paper or board properties, in particular paper strength, can nevertheless be achieved.

[0063] Furthermore, according to the present invention, the above-mentioned multilayer headbox structure and its forming method for forming a fiber web can be preferably used for manufacturing (forming) SBS (Solid Bleached Board) or FBB (Folding Boxboard) grades, wherein its middle layer stock is typically hardwood, softwood, CTMP (Chemi Thermo Mechanical Pulp) or broke. Thus, a bulky middle layer can be provided.

Claims

1. A multilayer headbox structure for a fiber web machine for forming a fiber web, comprising a multilayer headbox having a turbulence generator and a nozzle chamber having two converging walls forming a nozzle outlet,
the turbulence generator having a plurality of diffusers creating turbulence in liquids supplied into each respective diffuser via feeding means for feeding the liquids, each of the diffusers having an outlet into the nozzle chamber, wherein
central diffusers of the plurality of diffusers comprise a first central diffuser and a second central diffuser, the first central diffuser is connected with feeding means feeding fresh water, dilution water, and/or white water into the first central diffuser,
the first central diffuser has two blades arranged at its outlet and extending into the nozzle chamber in a converging manner, the blades separating the fresh water, dilution water, and/or white water as the liquid flowing through the first central diffuser from the liquids flowing through adjacent diffusers,
the second central diffuser is connected with feeding means feeding pulp suspension into the second central diffuser,
the second central diffuser has an additional blade arranged at the outlet, and the additional blade has a shorter length than the adjacent blade of the first central diffuser, and
the central diffusers are arranged between a top ply diffuser and a back ply diffuser, in which top ply diffuser top ply pulp suspension as the liquid flows through the top ply diffuser for forming a top ply of the fiber web and in which back ply diffuser back ply pulp suspension as the liquid flows through the back ply diffuser for forming a back ply of the fiber web.
2. The multilayer headbox structure for a fiber web machine for forming a fiber web according to claim 1, wherein
the top ply diffuser is connected with feeding means feeding the top ply pulp suspension into the top ply diffuser, and
the back ply diffuser is connected with feeding

means feeding the back ply pulp suspension into the back ply diffuser.

3. The multilayer headbox structure for a fiber web machine for forming a fiber web according to claim 1, wherein the top ply diffuser and the back ply diffuser are connected with a single feeding means feeding the same pulp suspension as the top ply pulp suspension and the back ply pulp suspension into the top ply diffuser and into the back ply diffuser. 5 10
4. The multilayer headbox structure for a fiber web machine for forming a fiber web according to any of claims 1 to 3, wherein the top ply diffuser is formed between an adjacent blade of the first central diffuser and one of the two converging walls of the nozzle chamber, and the back ply diffuser is formed between the additional blade of the second central diffuser and the other of the two converging walls of the nozzle chamber. 15 20
5. The multilayer headbox structure for a fiber web machine for forming a fiber web according to any of claims 1 to 4, wherein the blades are arranged in a staggered manner. 25
6. The multilayer headbox structure for a fiber web machine for forming a fiber web according to any of claims 1 to 5, wherein the blades of the first central diffuser extend beyond the nozzle chamber to an outside of the multilayer headbox. 30
7. The multilayer headbox structure for a fiber web machine for forming a fiber web according to any of claims 1 to 5, wherein tips of the blades of the first central diffuser are arranged inside the nozzle chamber. 35
8. The multilayer headbox structure for a fiber web machine for forming a fiber web according to any of claims 1 to 7, wherein at least one adjustable slice lip is provided at the nozzle outlet. 40
9. The multilayer headbox structure for a fiber web machine for forming a fiber web according to any of claims 1 to 8, wherein the length of the additional blade is smaller than or equal to 95% of the length of the blades of the first central diffuser. 45 50

10. A fiber web machine comprising:

a forming section having a wire guided around guiding rolls and forming a closed loop, and the multilayer headbox structure according to any of claims 1 to 9 configured to eject the top ply pulp suspension, back ply pulp suspension, pulp suspension, and fresh water, dilution water 55

and/or white water in a layered manner onto the wire to form a fiber web having multiple plies.

11. A method for forming a fiber web in a forming section of a fiber web machine, comprising the steps of:

feeding fresh water, dilution water, and/or white water into a first central diffuser of a multilayer headbox structure, feeding pulp suspension into a second central diffuser of the multilayer headbox structure, which second central diffuser being adjacently arranged to the first central diffuser within a nozzle chamber of a multilayer headbox of the multilayer headbox structure, feeding top ply pulp suspension into a top ply diffuser of the multilayer headbox structure, which top ply diffuser forming a top ply of the fiber web being adjacently arranged to the first central diffuser within the nozzle chamber, feeding back ply pulp suspension into a back ply diffuser of the multilayer headbox structure, which back ply diffuser forming a back ply of the fiber web being adjacently arranged to the second central diffuser within the nozzle chamber, guiding the fresh water, dilution water, and/or white water, and the different pulp suspensions through the corresponding diffusers to eject them onto a wire of the forming section as stock plies of liquid substances such that the first central ply consisting of the fresh water, dilution water, and/or white water forms a boundary layer between the top ply or back ply consisting of the pulp suspension and the second central ply pulp consisting of the pulp suspension, and dewatering the liquid substances to form the fiber web.

12. The method for forming a fiber web in a forming section of a fiber web machine, comprising the steps of according to claim 11, wherein in the feeding steps of the top ply pulp suspension and the back ply pulp suspension, the same pulp suspension as the top ply pulp suspension and the back ply pulp suspension are fed into the top ply diffuser and into the back ply diffuser.

Fig. 1

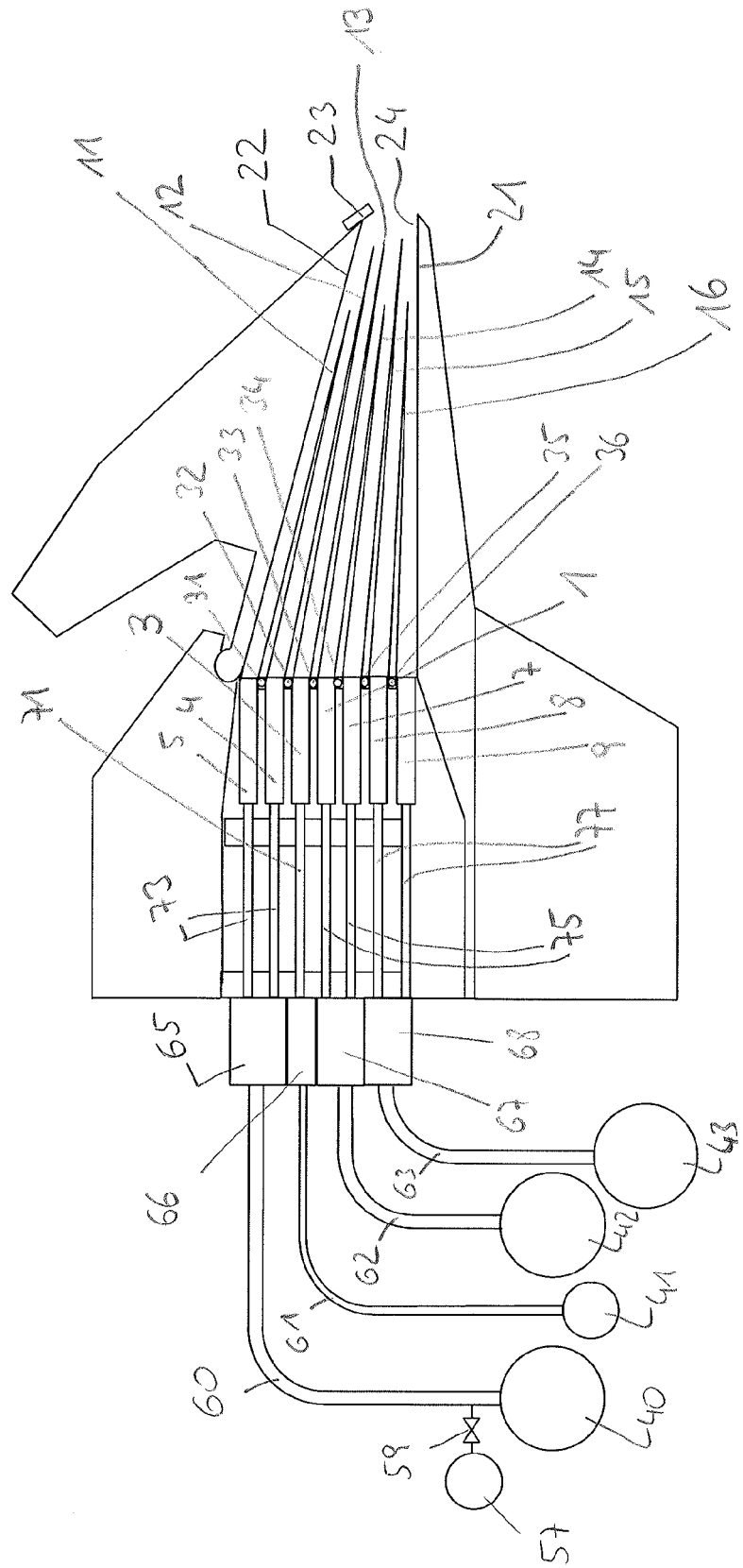
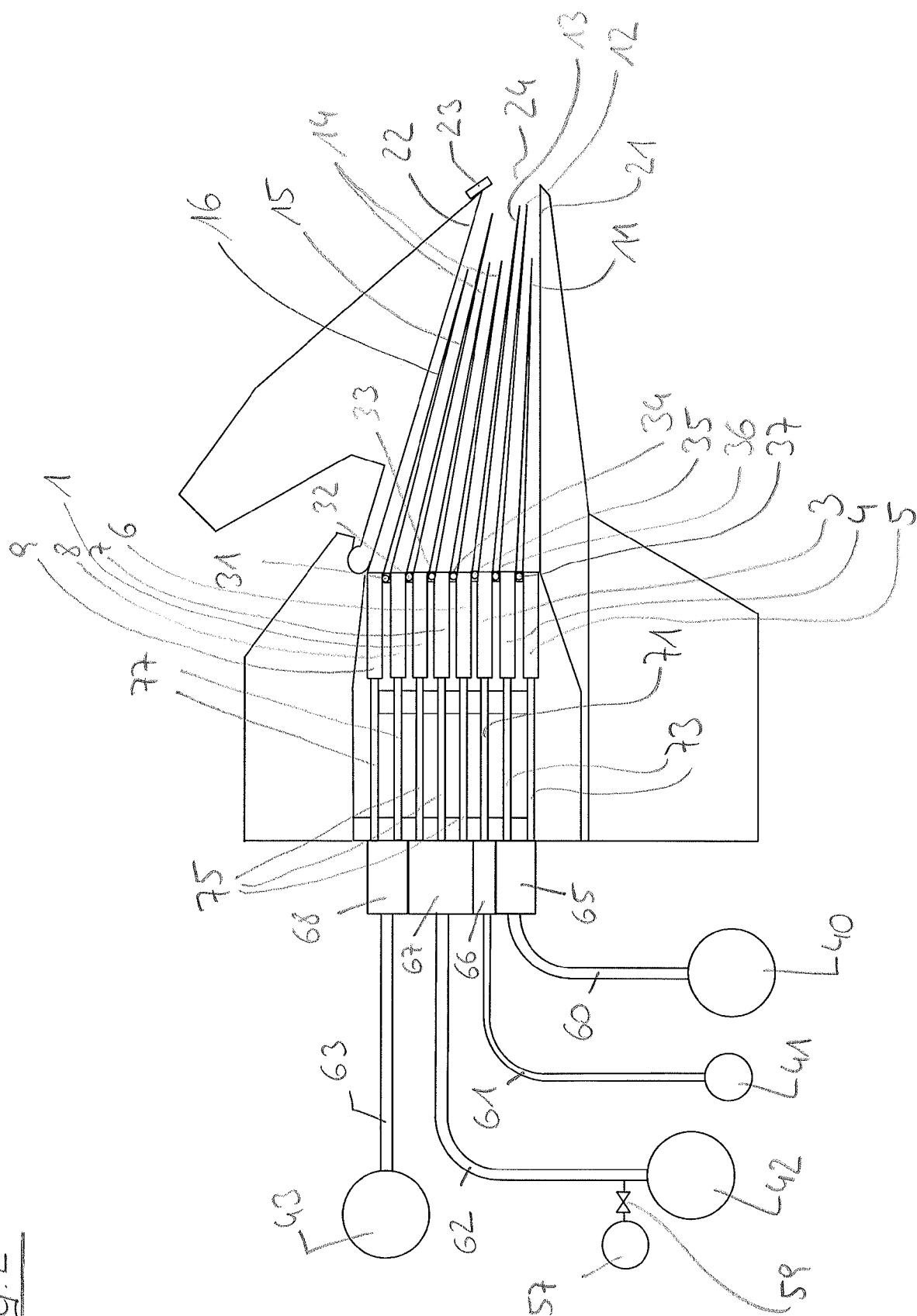


Fig. 2





EUROPEAN SEARCH REPORT

Application Number
EP 18 16 1990

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The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 20 April 2018	Examiner Maisonnier, Claire
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