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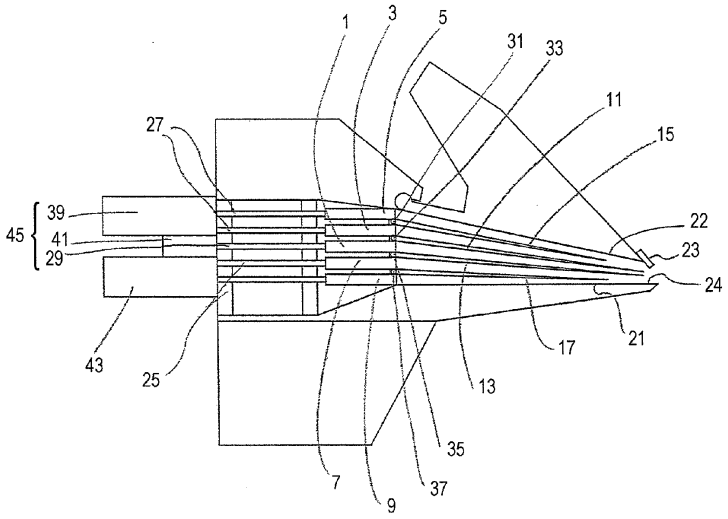
(54) **Headbox structure for a fiber web machine**

(57) The invention pertains to a headbox structure for a fiber web machine. The headbox structure comprises a headbox having a turbulence generator and a nozzle chamber having two converging walls (21, 22) forming a nozzle outlet (24). The turbulence generator has at least three diffusers (1, 3, 5, 7, 9) creating turbulence in liquids supplied into each respective diffuser (1, 3, 5, 7, 9) via feeding means (25, 27, 29) for feeding pulp suspension and/or water as the liquids. Each of the diffusers (1, 3, 5, 7, 9) has an outlet into the nozzle chamber (24). A central diffuser (1) of the at least three diffusers (1, 3, 5, 7, 9) has two blades (11, 13) arranged at its outlet and extending into the nozzle chamber in a converging manner. The blades (11, 13) separate a liquid flowing through the central diffuser (1) from liquids flowing through adjacent diffusers (3, 5, 7, 9). One or more of the adjacent diffusers (3, 5, 7, 9) has an additional blade (15, 17) arranged at the outlet, and the additional blade (15, 17) has a shorter length than the adjacent blade (11, 13) of the central diffuser (1).

FIG. 1



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Description

[0001] The invention pertains to a headbox structure for a fiber web machine such as a paper or board making machine.

[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. are added to the water and/or pulp suspension liquid. These liquid substances are fed to the 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 web. This is then further transferred to a press section for additional dewatering and a dryer section in which the formed web is dried to form a paper or board web. Further treatment depends on the respective requirements of the product.

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

[0004] A multi-layer headbox for a paper or board machine is known from document 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 later paper or board has to be expected. Thus, there is need to provide a headbox structure capable of enabling the formation of individual pure liquid layers having clear boundaries and to supply these pure liquid layers into a forming section of a paper or board making machine.

[0006] According to the invention, a headbox structure for a fiber web machine comprises a headbox having a turbulence generator and a nozzle chamber having two converging walls forming a nozzle outlet. The turbulence generator has at least three diffusers creating turbulence in liquids supplied into each respective diffuser via feeding means for feeding pulp suspension and/or water as these liquids. Furthermore, each of the diffusers has an outlet into the nozzle chamber.

[0007] A central diffuser of the at least three diffusers has two blades arranged at its outlet. The blades extend into the nozzle chamber in a converging manner. Thus, the blades separate a liquid flowing through the central diffuser from liquids flowing through adjacent diffusers. One or more of the adjacent diffusers has an additional blade arranged at the outlet, and the additional blade has a shorter length than the adjacent blade of the central diffuser.

[0008] In the structure of the headbox as described above, the position of the blade tips results in that the central layer consisting mainly of water at its boundaries does not get mixed with the adjacent pulp suspension layers. Thus, while in each of the 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. Furthermore, another effect of the blades is to maintain the turbulence in the boundary areas of each liquid layer.

[0009] 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 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 later paper or cardboard 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.

[0010] In particular, it is possible to achieve an increased filler content in a central water layer with the filler ranging from 30% to 45% in the central layer. Such an increased filler content is preferred, since the filler material itself is comparably cheap.

[0011] Advantageously, the blades can be arranged in a staggered manner in a headbox structure according to the invention.

[0012] Thereby, the accuracy of the liquid layers can be improved.

[0013] Advantageously, in a headbox structure according to the invention, at least the blades of the central diffuser can extend beyond the nozzle chamber to an outside of the headbox.

[0014] Thereby, the formation of the liquid layers di-

rectly on the wire is ensured. Accordingly, no mixing at the boundaries between the central water layer and the pulp suspension layers takes place.

[0015] Advantageously, in a headbox structure according to the invention, the tips of the blades of the central diffuser can be 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 central diffuser (also referred to as central wedges) and the nozzle outlet (slice opening) can be set from 1 to 50 mm.

[0016] Advantageously, in a headbox structure according to the invention, the blades can be mounted at the respective diffuser outlet in a pivoted manner. Preferably, each blade can be arranged in a freely pivotable manner. Thereby, the blade pivots about a hinge or joint provided at the end of the respective diffuser tube.

[0017] Thereby, pressure differences between the various liquid layers can be balanced, this leading to a further reduction of turbulences at the boundaries of the individual liquid layers.

[0018] Advantageously, in a headbox structure according to the invention, the wall surfaces of each of the diffusers as well as of the blades can have a smooth and uniform structure in order to prevent agitation of the respective liquid at its boundary.

[0019] Thus, while flowing through the diffuser tube 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.

[0020] Advantageously, in a headbox structure according to the invention, an adjustable slice lip can be provided at the nozzle outlet. Thus, it is possible to adapt the size of the nozzle outlet (also referred to as slice opening), thereby adjusting the output of the liquid layers.

[0021] Advantageously, in a headbox structure according to the invention, the central diffuser can be connected with feeding means feeding fresh water, dilution water, and/or white water into the central diffuser.

[0022] Advantageously, in a headbox structure according to the invention, each blade can have a wedge shaped cross-section. Because of the wedge shape of the blades, an adaptation of the flowing speed in the nozzle section of the headbox structure is facilitated.

[0023] Advantageously, in a headbox structure according to the invention, a wedge thickness of a blade at the diffuser outlet can correspond to a joint thickness of a joint holding the blade in a pivotable manner. Thus, the flow profile in the individual liquid layers is not affected.

[0024] Advantageously, in a headbox structure according to the invention, the blade tip thickness of each blade can be less than 0.5 mm or even less than 0.3 mm.

[0025] Advantageously, in a headbox structure according to the invention, the headbox can be a multilayer headbox.

[0026] Advantageously, in a headbox structure according to the invention, the central diffuser can contain only one row of diffuser tubes. However, it is to be noted that the central diffuser is not limited to only one row of diffuser tubes.

[0027] Advantageously, in a headbox structure according to the invention, each of the adjacent channels can contain at least two rows of diffuser tubes.

[0028] Advantageously, in a headbox structure according to the invention, the additional blades can be mounted to the outlets of each of the diffuser tubes. That is, each diffuser can have more than two blades assigned thereto.

[0029] In particular, the invention provides an advantage in that the central water layer and the pulp suspension layer (also known as stock layer) 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 an extent preventing a mixing of the individual layers. 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.

[0030] According to the invention, the slice lip reach, which is known as the extent the slice lip is projecting into the liquid flow, is preferably 1 - 10 mm.

[0031] According to the invention, an amount of water flowing between two blades can be more than 30 l/s/m.

[0032] Further advantages of the invention will become apparent from a study of the enclosed drawings showing currently preferred embodiments of the invention.

Fig. 1 is a sectional view of a headbox structure according to a first embodiment of the invention.

Fig. 2 is an enlarged view of a diffuser portion and a nozzle portion of the headbox structure shown in Fig. 1.

Fig. 3 is a sectional view of a headbox structure according to another embodiment of the invention.

Fig. 4 is a sectional view of a headbox structure according to still another embodiment of the invention.

[0033] Fig. 1 is a sectional view of a headbox structure according to the invention and Fig. 2 is an enlarged portion of a diffuser portion and a nozzle portion of the headbox structure shown in Fig. 1.

[0034] In Fig. 1, from the left to the right, a headbox comprises headbox headers 39, 41, and 43, a manifold in which manifold pipes 25, 27, and 29 are provided, a diffuser chamber in which diffuser tubes 1, 3, 5, 7, and 9 are provided, and a nozzle chamber having converging walls 21, 22 forming a slice opening (nozzle outlet) 24.

Manifold pipes 25, 27, and 29 establish communication from the headers 39, 41, and 43 to the diffuser tubes 1, 3, 5, 7, and 9. Blades 11, 13, 15, and 17 are respectively attached to outlets of the diffuser tubes 1, 3, 5, 7, and 9 via joints 31, 33, 35 and 37. Blades 11, 13, 15, and 17 have a wedge shaped cross-section, in which a thick end is attached to the respective diffuser tube while a thin end 11a, 13a, 15a, and 17a projects towards the slice opening. The blades are provided in a staggered manner, i.e. blades 11 and 13 as central blades lengthwise extend beyond blades 15 and 17.

[0035] From headers 39, 41, and 43 various liquids are pumped via the manifold pipes 25, 27, and 29 to the respective diffuser tubes 1, 3, 5, 7, and 9. According to the invention, water such as white water or fresh water is fed from header 41 to diffuser tube 1 via manifold pipe 29, while the other diffuser tubes 3, 5, 7, and 9 are supplied with a stock or pulp suspension. After having entered the respective diffuser tubes 1, 3, 5, 7 or 9, 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 feeding pipe 29 to diffuser tube 1 (middle layer liquid), a high amount of filler is present. The fiber consistency in the middle layer liquid fed from the header 41 is remarkably lower than the fiber consistency of the other liquid layers.

[0036] In the nozzle chamber, the blades 11, 13, 15, and 17 maintain the individual liquid layers separate before the liquids are ejected towards a forming section of a paper or board making machine. Each of the blades 11, 13, 15, and 17 is attached to a wall portion between the respective diffuser tubes 1, 3, 5, 7, and 9 via 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, and 7 is respectively continued by two of blades 11, 13, 15, and 17. The uppermost and lowermost diffuser tubes 5 and 9 are continued by blade 15 and nozzle chamber wall 22 and blade 17 and nozzle chamber wall 21, respectively.

[0037] At the right side end of the diffuser tubes 1, 3, 5, 7 and 9 in Fig. 1, a transition from the diffuser tubes 1, 3, 5, 7, and 9 towards the nozzle chamber, i.e. the respective blades 11, 13, 15, and 17 and 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, 5, 7, and 9 in between the blades 11, 13, 15, and 17 and nozzle chamber walls 21 and 22, respectively.

[0038] Accordingly, the individual liquids flowing towards the slice opening 24 through the nozzle chamber are still separated by the respective blades 11, 13, 15, and 17. Surface friction of blades 11, 13, 15 and 17 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 blade 15 at its tip end 15a or when unifying the stock and pulp liquid flows separated by blade 17 at its tip end 17a, 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 15a, 17a of blades 15, 17. The length of blades 15 and 17 can be chosen such that there is sufficient distance to the tip ends 11a, 13a of blades 11, 13 for ensuring that individual stock or pulp suspension will merge together. The length of the blades 15 and 17 advantageously can be 50% to 95% of the length of the central blades 11 and 13. The blades 11, 13 and the nozzle chamber walls 21 and 22 maintain turbulence in the stock or pulp suspension liquid flows.

[0039] 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 11 and 13 at their tip ends 11a and 13a, respectively. As already mentioned above, the tip ends 11a and 13a of the blades 11 and 13, respectively, are arranged closer towards the slice opening 24 than tip ends 15a and 17a. That is, the lengths of blades 11 and 13 separating the water layer from the stock or pulp suspension liquid layers exceed the lengths of blades 15 and 17, respectively. In this regard, it also has to be noted that, although the lengths of blades 11 and 13 correspond to each other in the drawings, blades 11 and 13 can have different lengths, but it is important that their lengths exceed the respective lengths of the other blades 15 and 17. 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.

[0040] After unifying the water layer with the stock or pulp suspension liquid layers, the liquids are ejected via slice opening 24 in a layered manner onto a wire or fabric of a forming section for further treatment, such as dewatering, pressing and drying. The distance from the tip ends 11a, 13b of blades 11, 13 to the forming section is short for ensuring the layered structure. Since thin blade tip ends 11a, 13a improve a layered structure of the web to a greater extent, the thickness of the blade tip end is less than 0,5 mm, preferably less than 0,3 mm.

[0041] For adjusting the ejected liquid flow, a slice lip 23 is provided at the upper nozzle chamber wall 22. 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. It has to be noted that, due to the layered structure of the liquids ejected, a slice reach R (see Fig. 2) is preferably 1 - 10 mm, thereby advantageously acting on the ejected liquid flow (also referred to as "free jet") without affecting the purity of the individual liquid layers. Accordingly, by means of the headbox structure according to the invention, it is possible to influence the ejected liquid flow to a

much higher degree than is known from the prior art.

[0042] 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 later paper or board 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.

[0043] Fig. 3 shows another embodiment of a headbox structure according to the invention. In Fig. 3, the same and equivalent elements already described above have been assigned the same reference signs; the description thereof will not be repeated.

[0044] According to this embodiment, headers 39, 41 and 43 are arranged in Fig. 3 at the bottom of the left side. The liquids, such as pulp suspension liquid and water, are supplied from the headers 39, 41, 43 to intermediate chambers 67a, 67b, 67c via manifold pipes 61, 63, and 65, respectively. From the intermediate chambers 67a, 67b, 67c, the liquids are then further supplied to the diffuser tubes 1, 3, 5, 7, and 9 via turbulence pipes 71, 73 and 75. After having passed the diffuser tubes, as described above with respect to the preceding embodiments, the liquids are unified at blade tip ends 15a, 17a, 11, and 13a, respectively in the nozzle chamber to be ejected through the slice opening 24.

[0045] Furthermore, a dilution water header 57 is provided and connected with pipe 61 via a valve 59 for controlling the web basis weight profile in cross machine direction. Typically a distance between adjacent pipes 61 and valves 59 is between is 60 to 150 mm in cross machine direction.

[0046] Fig. 4 shows a modification of the embodiment of Fig. 3. According to the modification, a larger header 71 directly connected to respective feeding pipes 25 and 27 is provided at the header position. Header 73 for feeding water is in direct connection with diffuser tube 1 via a pipe 75. Other elements and functions correspond to those already described.

[0047] While the invention has been described by means of currently preferred embodiments, it has to be noted that the invention is not limited thereto, but that the scope of the invention is merely defined by the attached claims.

[0048] In particular, the headbox itself is not limited to the described structure comprising the intermediate chamber, 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.

[0049] Apart from what has been mentioned above, the 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.

[0050] While in the above description the term "additives" has been used as an example of substances added to the stock, pulp suspension or water, it is to be noted that, apart from the already mentioned ones, such additives can be refined fibers, cationic polymers, in particular cationic starch, retention chemicals or retention aid helpers, in particular microparticles or colloidal silica.

[0051] In a paper or board making machine, to which the headbox of the 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.

[0052] 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.

[0053] According to the invention, the water layer can be formed as central layer, and the purity of the water layer can be maintained when ejecting the unified liquids out of the slice opening. In contrast to the known admixing described in the above two paragraphs, the additives can be also added to the water forming the 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.

[0054] While the invention has been described as comprising one central water layer sandwiched between two respective adjacent pulp suspension layers, other arrangements of the layers are possible as long as a water layer is sandwiched between two pulp suspension layers. For instance, a headbox can be structured such that two central water layers separated by one pulp suspension layer and embedded between two further pulp suspension layers are provided. Concerning the number of water layers and pulp suspension layers, any arbitrary number is possible.

Claims

1. A headbox structure for a fiber web machine, com-

prising a headbox having a turbulence generator and a nozzle chamber having two converging walls (21, 22) forming a nozzle outlet (24),
the turbulence generator having at least three diffusers (1, 3, 5, 7, 9) creating turbulence in liquids supplied into each respective diffuser (1, 3, 5, 7, 9) via feeding means (25, 27, 29) for feeding pulp suspension and/or water as the liquids, each of the diffusers (1, 3, 5, 7, 9) having an outlet into the nozzle chamber (24),
a central diffuser (1) of the at least three diffusers (1, 3, 5, 7, 9) having two blades (11, 13) arranged at its outlet and extending into the nozzle chamber in a converging manner, the blades (11, 13) separating a liquid flowing through the central diffuser (1) from liquids flowing through adjacent diffusers (3, 5, 7, 9), wherein
one or more of the adjacent diffusers (3, 5, 7, 9) has an additional blade (15, 17) arranged at the outlet, and the additional blade (15, 17) has a shorter length than the adjacent blade (11, 13) of the central diffuser (1).

2. The headbox structure for a fiber web machine according to claim 1, wherein the blades (11, 13, 15, 17) are arranged in a staggered manner.

3. The headbox structure for a fiber web machine according to any of the preceding claims, wherein at least the blades (11, 13) of the central diffuser extend beyond the nozzle chamber to an outside of the headbox.

4. The headbox structure for a fiber web machine according to any of claims 1 and 2, wherein the tips (11a, 13a) of the blades of the central diffuser (1) are arranged inside the nozzle chamber, and a distance between the tips of the blades (11, 13) and the outlet is set between 1 and 50 mm.

5. The headbox structure for a fiber web machine according to any of the preceding claims, wherein the blades (11, 13, 15, 17) are mounted to the respective diffuser outlet in a pivoted manner.

6. The headbox structure for a fiber web machine according to any of the preceding claims, wherein the wall surfaces of each of the diffusers (1, 3, 5, 7, 9) as well as of the blades (11, 13, 15, 17) have a smooth and uniform structure.

7. The headbox structure for a fiber web machine according to any of the preceding claims, wherein an adjustable slice lip (23) is provided at the nozzle outlet (24).

8. The headbox structure for a fiber web machine according to any of the preceding claims, wherein the central diffuser (1) is connected with feeding means (29) feeding fresh water, dilution water, and/or white water into the central diffuser (1).

9. The headbox structure for a fiber web machine according to any of the preceding claims, wherein each blade (11, 13, 15, 17) has a wedge shaped cross section.

10. The headbox structure for a fiber web machine according to any of the preceding claims, wherein the thickness of the blade tip (11a, 13a, 15a, 17a) of each blade (11, 13, 15, 17) is less than 0.5 mm, preferably less than 0.3 mm.

11. The headbox structure for a fiber web machine according to any of the preceding claims, wherein the headbox is a multi layer headbox.

12. The headbox structure for a fiber web machine according to any of the preceding claims, wherein the central diffuser (1) contains only one row of diffuser tubes.

13. The headbox structure for a fiber web machine according to any of the preceding claims, wherein each of the adjacent diffusers contains at least two rows of diffuser tubes (3, 5, 7, 9).

14. The headbox structure for a fiber web machine according to claim 12, wherein said additional blades (15, 17) are mounted to the outlets of each of the diffuser tubes (3, 5, 7, 9).

15. The headbox structure for a fiber web machine according to any of claims 1 to 14, wherein the length of the additional blade (15, 17) is between 50% to 95% of the length of the blades (11, 13) of the central diffuser.

FIG. 1

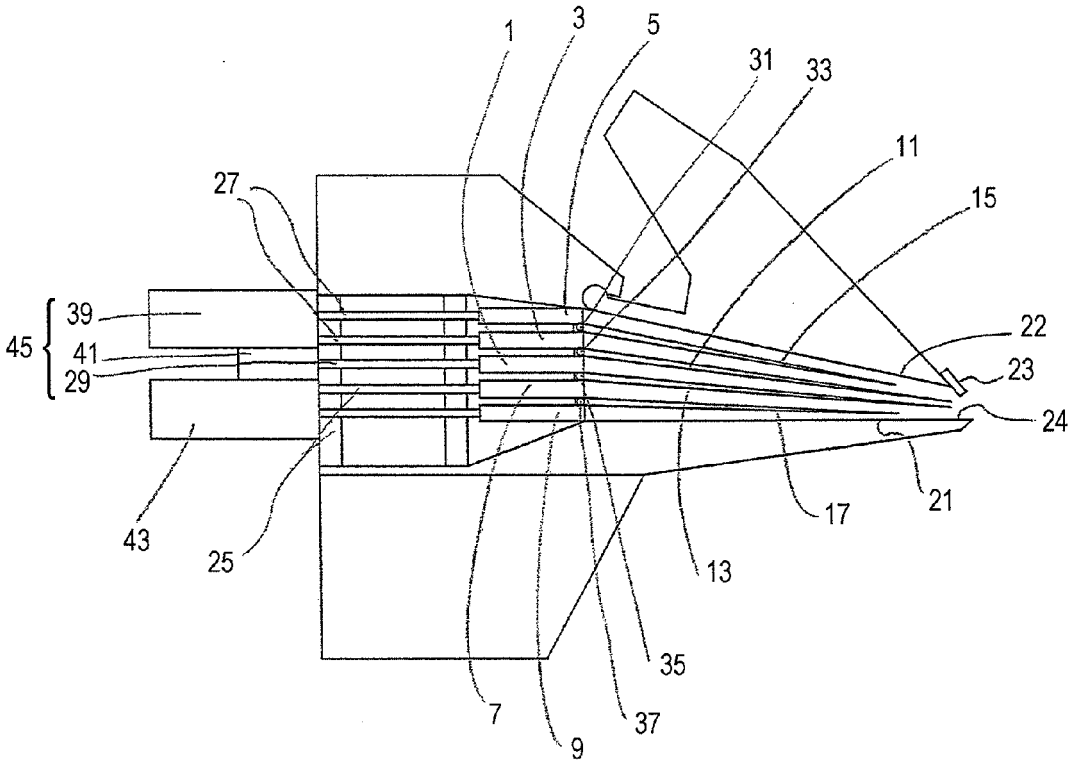

FIG. 2

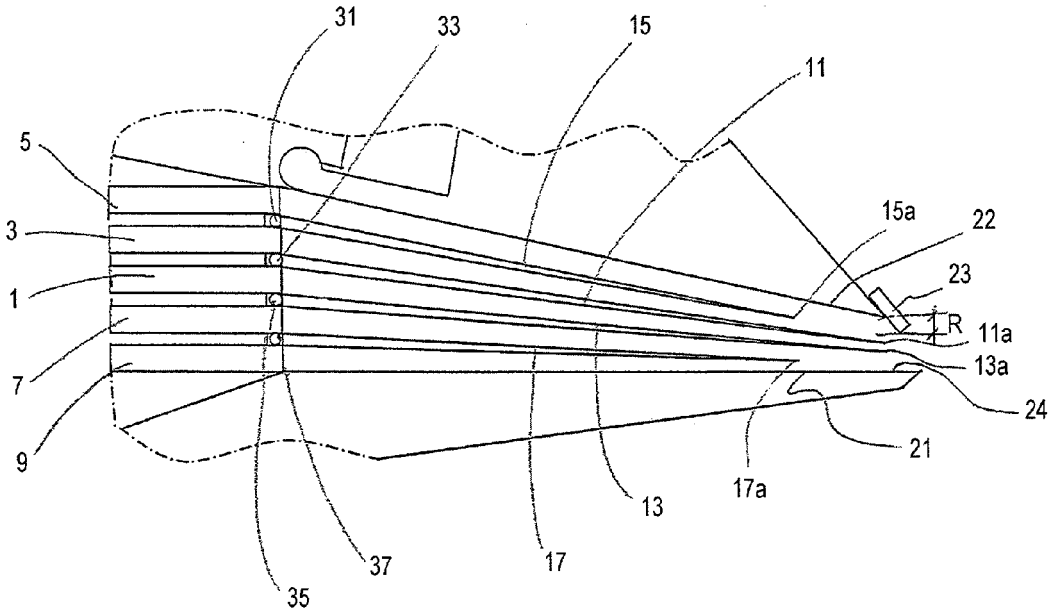

FIG. 3

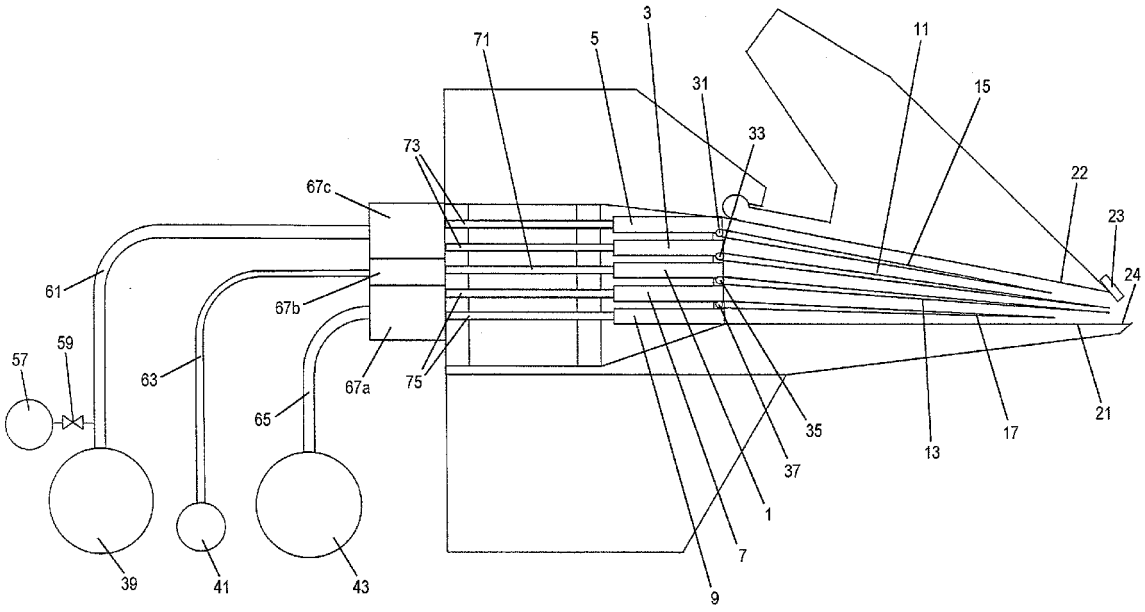
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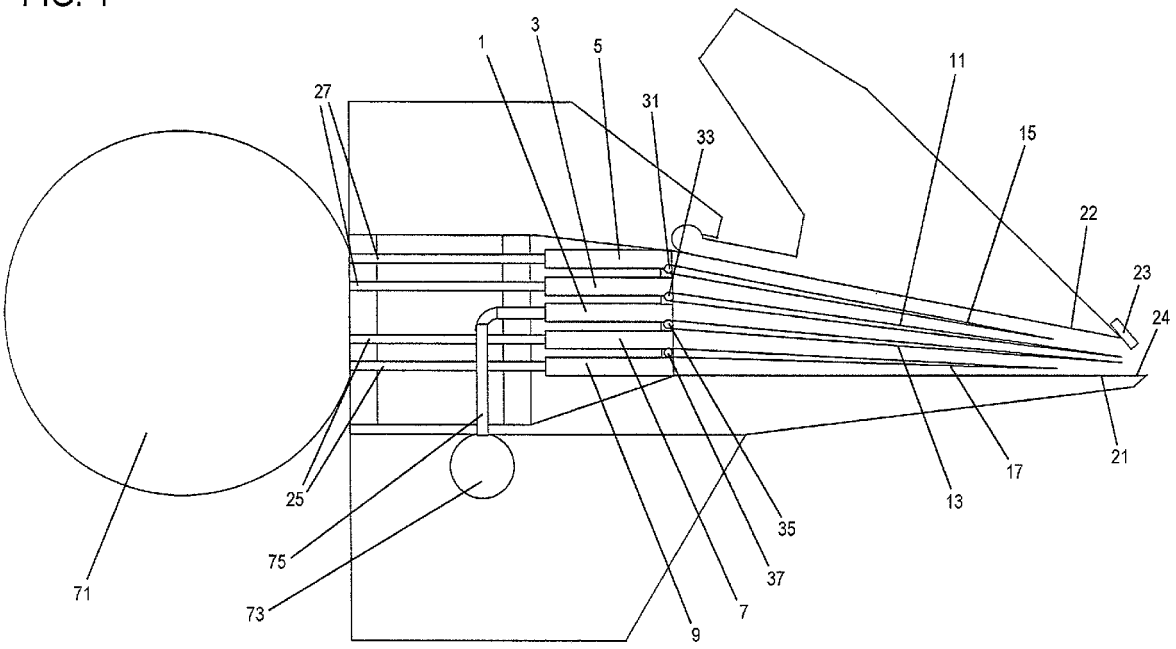
FIG. 4



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EUROPEAN SEARCH REPORT

Application Number
EP 13 16 1554

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 2003/131964 A1 (ERIKSON JAN ANDERS [SE] ET AL) 17 July 2003 (2003-07-17) * paragraph [0043] - paragraph [0047]; figure 1 * -----	1-3,5,6, 9,11,13, 14	INV. D21F1/02
X	US 4 376 014 A (BERGSTROM JAN I) 8 March 1983 (1983-03-08) * column 1, line 11 - column 2, line 17 * * column 2, line 36 - column 5, line 20; figure 3 * -----	1,2,5, 11-14	
X	WO 01/25532 A1 (METSO PAPER INC [FI]; SOINI SAKARI [FI]) 12 April 2001 (2001-04-12) * page 5, line 24 - page 7, line 2; figure 1 * * page 8, line 25 - page 9, line 3; figure 5 * -----	1,2,11, 12,14	
			TECHNICAL FIELDS SEARCHED (IPC) D21F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	20 June 2013	Sabatucci, Arianna

CATEGORY OF CITED DOCUMENTS

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EPO FORM 1503 03.82 (P04C01)

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