



(12) **EUROPEAN PATENT APPLICATION**  
published in accordance with Art. 158(3) EPC

(43) Date of publication:  
**02.06.2004 Bulletin 2004/23**

(51) Int Cl.7: **D21F 9/02**

(21) Application number: **02762948.4**

(86) International application number:  
**PCT/JP2002/008861**

(22) Date of filing: **02.09.2002**

(87) International publication number:  
**WO 2003/023137 (20.03.2003 Gazette 2003/12)**

(84) Designated Contracting States:  
**AT BE BG CH CY CZ DE DK EE ES FI FR GB GR  
IE IT LI LU MC NL PT SE SK TR**  
Designated Extension States:  
**AL LT LV MK RO SI**

(72) Inventor: **SHIMAZU, Hiroto,**  
**c/o Mihara Ryoju Eng. Co., Ltd.**  
**Mihara-shi, Hiroshima729-0 328 (JP)**

(30) Priority: **06.09.2001 JP 2001269837**

(74) Representative: **Henkel, Feiler & Hänzel**  
**Möhlstrasse 37**  
**81675 München (DE)**

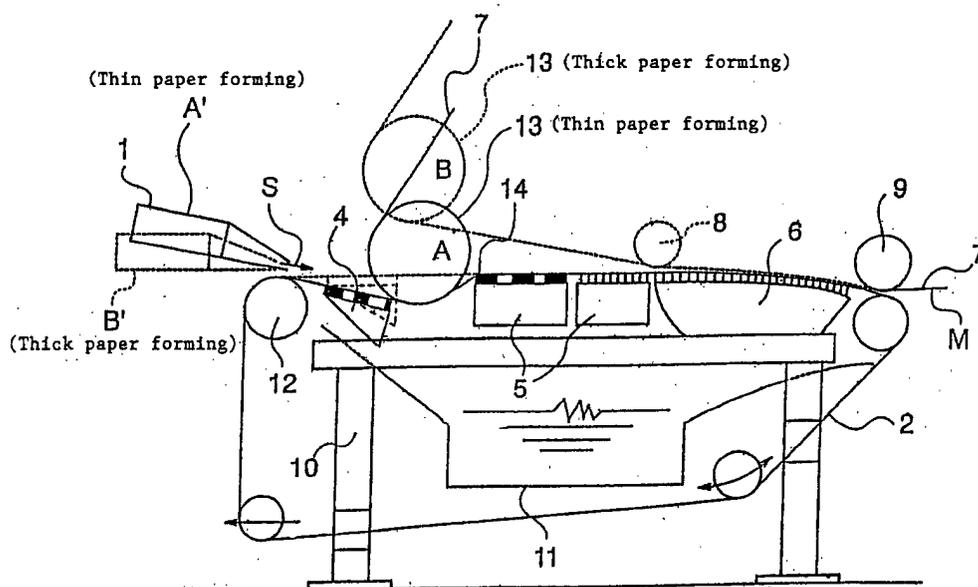
(71) Applicant: **Mihara Ryoju Engineering Co., Ltd.**  
**Mihara-shi, Hiroshima 729-0328 (JP)**

(54) **PAPER FORMING DEVICE OF PAPER<minus>MAKING MACHINE**

(57) A paper forming device of a paper machine enables a change-over between a thin paper high velocity forming and a thick paper forming. In the paper forming device, stock liquor S is discharged from a headbox 1 onto a wire 2 and, while being transferred on the wire 2, is dewatered by a dewatering equipment and further by a suction box 6. A forming roll 13, wound with an ex-

tended felt 7, is arranged movably up and down above the wire 2 near the headbox 1. When a thin paper is to be formed, the forming roll 13 is moved down so that a nip of the stock liquor is formed between the wire 2 and the felt 7. Thereby, the stock liquor S discharged from the headbox 1, can be comparatively immediately nipped between the wire 2 and the felt 7.

Fig. 1



## Description

### TECHNICAL FIELD

**[0001]** The present invention relates to a paper forming device of a paper machine in which stock liquor is discharged from a headbox onto a wire to be dewatered, while being transferred on the wire, by a dewatering equipment and to be further dewatered by a suction box.

### BACKGROUND ART

**[0002]** Fig. 3 shows a prior art example of a paper forming device in which stock liquor of paper is discharged from a headbox onto a forming wire to be dewatered, while being transferred on the wire, for forming a wet sheet.

**[0003]** In Fig. 3, numeral 1 designates a headbox that discharges stock liquor and numeral 2 designates a wire. The wire 2 is made in an endless loop form, as seen in Fig. 3, and has its upper surface portion formed as a horizontal run portion (Fourdrinier table portion) 3 for forming the wet sheet.

**[0004]** Below the wire 2 forming the horizontal run portion 3, in the order from the headbox 1 on the left hand side to the right hand side, a forming board 4, a dewatering equipment 5 and a suction box 6 are arranged.

**[0005]** Above the suction box 6, provided is a felt 7 that is constructed being belted between a felt roll 8 and a pick-up roll 9 so as to run with the wire 2 sandwiched between the felt 7 and an upper surface of the suction box 6.

**[0006]** Numeral 10 designates a frame and numeral 11 designates a save-all that is provided on the frame 10 for receiving water dewatered of the stock liquor on the wire 2. Numeral 12 designates a breast roll that is provided below the headbox 1 for guiding the wire 2.

**[0007]** In the paper forming device shown in Fig. 3 having the construction as mentioned above, stock liquor S is discharged from the headbox 1 onto the forming board 4 portion of the horizontal run portion 3 of the wire 2. While being transferred on the wire 2, the stock liquor is dewatered by the dewatering equipment 5. As the stock is being transferred on the wire 2, it reaches on the suction box 6 and is nipped between the wire 2 and the felt 7. Thus, by a vacuum force acting through the suction box 6 and by a compression force acting due to tension of the felt 7, dewatering is further carried out, so that a wet sheet mat M is formed.

**[0008]** Then, the wet sheet mat M formed on the wire 2, together with the felt 7, is transferred to a press part (not shown) as the next step by the pick-up roll 9.

**[0009]** The prior art paper forming device described above has a comparatively large length of the horizontal run portion 3 and thus, in case of forming a thin paper at a high velocity of 850m/minute or more, scattering or the like of the stock liquor, while being transferred on the wire 2, is caused, so that there arises a problem that

uniformity of the paper forming is obstructed and operation of the machine becomes difficult.

**[0010]** In view of the abovementioned problem of the paper forming device in the prior art paper machine, it is an object of the present invention to provide a paper forming device of a paper machine that has a structure enabling to perform a change-over between a thin paper high velocity forming and a thick paper forming.

### 10 DISCLOSURE OF THE INVENTION

**[0011]** In order to solve the abovementioned problem in the prior art, the present invention provides a paper forming device of a paper machine in which stock liquor is discharged from a headbox onto a wire so that the stock liquor, while being transferred on the wire, is dewatered by a dewatering equipment and is further dewatered by a suction box, characterized in being constructed such that a forming roll, wound with a felt, is arranged movably up and down above the wire near the headbox and, when a thin paper is to be formed, the forming roll is moved down so that a nip of the stock liquor is formed between the wire and the felt.

**[0012]** According to the paper forming device of the present invention constructed as mentioned above, when a thin paper of 35g/m<sup>2</sup> or less, for example, is to be formed, the forming roll is moved down to thereby press down the wire. In this state, forming of a wet sheet is done. In this state, the stock liquor discharged from the headbox onto the wire is immediately nipped between the wire and the felt to receive a centrifugal force and a compression force due to the tension of the wire. Hence, the most part of the water in the stock liquor is dewatered and the wet sheet is rapidly formed.

**[0013]** On the other hand, when a thick paper of 35g/m<sup>2</sup> or more, for example, is to be formed, the forming roll is moved up and a wet sheet is formed by the same construction as the prior art device shown in Fig. 3.

**[0014]** Thus, according to the paper forming device of the present invention, when a thin paper is to be formed, by moving down the forming roll, the stock liquor discharged from the headbox is immediately nipped between the wire and the felt. Thereby, forming of the wet sheet can be done with the open portion being shortened, scattering or the like of the stock liquor on the wire is suppressed and a high velocity forming of the thin paper becomes possible.

**[0015]** Also, according to the paper forming device of the present invention, when the thin paper is to be formed, the stock liquor discharged from the headbox is immediately nipped between the wire and the felt wound around the forming roll, so that a shear force is generated in the stock liquor and fibers are oriented in the running direction of the wire. Thereby, a soft thin paper can be easily formed.

**[0016]** Thus, according to the device of the present invention, not only forming of a thick paper but also a high velocity forming of a thin paper become possible.

**[0017]** In the paper forming device of the present invention, while the wire is pressed down by the forming roll and a running direction of the wire changes, such a construction that, when the forming roll is moved down to thereby press down the wire, the headbox and the forming board arranged under the wire are inclined in the same direction as the running direction of the wire so pressed down is preferably employed. Thus, the position relation between the wire running direction and the headbox and/or the forming board can be maintained.

**[0018]** Also, the paper forming device of the present invention can be constructed such that a wire roll is arranged upwardly movably under the wire downstream of the forming roll and, when the wire roll is moved up to thereby lift up the wire, the forming roll is moved down so that a horizontal running direction of the wire near the headbox is maintained. Thus, even when the forming roll is moved down, the horizontal running direction of the wire between a breast roll and the forming roll can be maintained and, in forming not only a thick paper but also a thin paper, displacement of the headbox and the forming board becomes unnecessary.

#### BRIEF DESCRIPTION OF THE DRAWINGS

##### **[0019]**

Fig. 1 is a side view showing a construction of a paper forming device of a first embodiment according to the present invention.

Fig. 2 is a side view showing a construction of a paper forming device of a second embodiment according to the present invention.

Fig. 3 is a side view showing a construction of a prior art paper forming device.

#### BEST MODE FOR CARRYING OUT THE INVENTION

**[0020]** Herebelow, the paper forming device of the present invention will be described more concretely based on embodiments according to the present invention as shown in Figs. 1 and 2. It is to be noted that, in Figs. 1 and 2, the same parts and components as those shown in Fig. 3 are denoted with the same reference numerals as in Fig. 3 and repeated description thereon will be omitted.

(First Embodiment)

**[0021]** The paper forming device of a first embodiment shown in Fig. 1 will be first described.

**[0022]** In Fig. 1, numeral 13 designates a forming roll that is arranged movably up and down above the wire 2 near the headbox 1. The felt 7 is elongated beyond the length of the prior art felt that extends on the suction box 6, so that the felt 7 is belted between the forming roll 13 and the pick-up roll 9. The forming roll 13 is constructed so as to be supported either in a lower position

A or in an upper position B in Fig. 1 by an appropriate mechanism that is not shown. Numeral 14 designates a curved blade that is formed having a curvature on a surface of No. 1 blade. The No. 1 blade is a blade of the first one of two units of the dewatering equipment 5.

**[0023]** Also, in the paper forming device shown in Fig. 1, the headbox 1 and the forming board 4 are respectively constructed to be inclinedly movable from the horizontal positions shown by dotted lines to the inclined positions shown by solid lines. As the mechanism to support the headbox 1 and the forming board 4 in their horizontal positions and inclined positions may be appropriately selected from the known art, detailed construction thereof is not shown.

**[0024]** Other portions of the structure of the paper forming device shown in Fig. 1 are substantially the same as those portions of the device shown in Fig. 3 and, by denoting them with the same reference numerals, description thereon is omitted.

**[0025]** In the paper forming device of the first embodiment of Fig. 1 constructed as mentioned above, when a thin paper of 35g/m<sup>2</sup> or less, for example, is to be formed, the forming roll 13 is moved down to the lower position A, as shown by solid lines, so that the felt 7 and the wire 2 in this position are pressed down by the forming roll 13.

**[0026]** Thereby, the stock liquor S discharged from the headbox 1 is nipped comparatively immediately by and between the felt 7, that is wound around the forming roll 13, and the wire 2, and the most part of the water contained in the stock liquor S is dewatered by a centrifugal force and a compression force due to the tension of the wire 2 so as to form a wet sheet.

**[0027]** Also, it is so constructed that, when the forming roll 13 is moved down to thereby press down the wire 2 for forming the thin paper, both of the headbox 1 and the forming board 4 are correspondingly inclined, as shown by solid lines in Fig. 1, so that the position relation between the running direction of the wire 2, so pressed down, and the headbox 1 and/or the forming board 4 is maintained in the same way as in the structure in which all of the wire 2, the headbox 1 and the forming board 4 are horizontally arranged.

**[0028]** Further, the curved blade 14 as the No. 1 blade of the first unit of the dewatering equipment 5 has its surface formed in the curvature, the wire 2, the wet sheet and the felt 7 can smoothly run on the curved blade 1.

**[0029]** Thus, according to the paper forming device shown in Fig. 1, even when the thin paper is formed at a high velocity, scattering or the like of the stock liquor is suppressed and a high quality thin paper can be stably formed.

**[0030]** On the other hand, when a thick paper of 35g/m<sup>2</sup> or more, for example, is to be formed, if the forming roll 13 is kept in the abovementioned lower position, a smooth nipping of the stock liquor becomes difficult at the nip portion between the felt 7 and the wire 2 so that so-called a backflow of the stock liquor arises and a se-

rious defect in the paper may be brought about. Hence, the forming roll 13 is moved up to the upper position B, as shown by dotted lines in Fig. 1.

**[0031]** At the same time, the headbox 1 and the forming board 4 are arranged in the horizontal position, as shown by dotted lines in Fig. 1, so as to be in line with the running direction of the wire 2 near the headbox 1. Thus, in case of forming the thick paper, the paper forming device of the first embodiment is operated as a device to form the wet sheet in the same way as the prior art paper forming device shown in Fig. 3.

**[0032]** As mentioned above, the paper forming device of the first embodiment of Fig. 1 enables to stably form a high quality paper both of a thin paper and a thick paper by a single unit of the machine.

(Second embodiment)

**[0033]** The paper forming device of a second embodiment shown in Fig. 2 will be described.

**[0034]** In Fig. 2, numeral 15 designates a wire roll that is arranged under the wire 2 between two units of the dewatering equipment 5 and is constructed so as to be supported either in an upper position A' shown by solid lines in Fig. 2 or in a lower position B' shown by dotted lines. In the paper forming device of the present second embodiment, the headbox 1 and the forming board 4 are arranged in the horizontal positions as shown in Fig. 2 unlike the structure of the first embodiment in which they are inclinedly movable. Other portions of the structure of the second embodiment shown in Fig. 2 are substantially the same as those portions of the paper forming device of the first embodiment shown in Fig. 1 and description thereon will be omitted.

**[0035]** As understood by the above description, in the paper forming device of the second embodiment shown in Fig. 2, it is so constructed that, when the forming roll 13 is moved down to thereby press down the felt 7, in order to maintain the position relation between the running direction of the wire 2 and the headbox 1 and/or the forming board 4, neither the headbox 1 nor the forming board 4 is inclined but the wire roll 15 is moved up to thereby lift up the wire 2.

**[0036]** When a thin paper is to be formed by the paper forming device of the second embodiment of Fig. 2, the forming roll 13 is moved down to position A, as shown by solid lines in Fig. 2, that makes contact with the wire 2 and the wire roll 15 is moved up to the upper position A', so that a predetermined wire holding angle of the forming roll 13 is obtained. Thus, in the present second embodiment, even when the forming roll 13 is moved down, the horizontal position relation between the breast roll 12 and the forming roll 13 is maintained and such a construction as to arrange the headbox 1 and the forming board 4 inclinedly movably is not necessary.

**[0037]** Also, in the present second embodiment, for the reason as mentioned above, such a curved blade as that 14 provided in the paper forming device of the

first embodiment of Fig. 1 is not necessary.

**[0038]** When a thick paper is to be formed by the paper forming device of the second embodiment of Fig. 2, the forming roll 13 is moved up to position B, as shown by dotted lines in Fig. 2, and the wire roll 15 is moved down to the lower position B', as shown by dotted lines, that is, the wire roll 15 is moved down until the horizontal running direction of the wire 2 is realized. In this state, the wire roll 15 is used as a table roll. Otherwise, the wire roll 15 may be constructed so as to be positionable slightly below the wire 2.

**[0039]** In the paper forming device of the present second embodiment, as compared with the first embodiment, there is needed no such a mechanism, that requires a high mounting accuracy, to incline the headbox 1 and the forming board 4 corresponding to the inclination of the running direction of the wire 2. Hence, there is obtained an advantage that no loss time is caused for a position adjustment of the equipment and devices, a change-over of the stock liquor pipings, etc.

**[0040]** In forming the thin paper by the device of the present second embodiment also, stock liquor S discharged from the headbox 1 is nipped comparatively immediately by and between the felt 7 and the wire 2 and occurrence of scattering or the like of the stock liquor S can be suppressed even in the high velocity paper forming. Moreover, in the thin paper forming, contact of the wire 2 to the dewatering equipment 5 and the suction box 6 is minimized. Thereby, the necessary drive force of the wire is reduced and the life of the wire can be elongated.

**[0041]** While the invention has been described concretely based on the embodiments as illustrated, the invention is not limited to the embodiments but, as a matter of course, may be added with various modifications within the scope of the invention as defined by the appended claims.

**[0042]** For example, while the felt 7 wound around the forming roll 13 has been described as the elongated one of the felt on the suction box 6, the felt to be wound around the forming roll 13 may be constructed as a loop of felt that runs between other rolls independently of the felt on the suction box 6.

**[0043]** Also, while the No. 1 blade of the first unit of the dewatering equipment 5 has been described as the curved blade 14, not necessarily the curved blade 14, such one as enables a smooth running of the wire 2, the wet sheet and the felt 7 on the dewatering equipment may be provided. For example, a roll may be provided immediately before the dewatering equipment instead of the curved blade 14.

#### INDUSTRIAL APPLICABILITY

**[0044]** As described above, the present invention provides a paper forming device of a paper machine in which stock liquor is discharged from a headbox onto a wire so that the stock liquor, while being transferred on

the wire, is dewatered by a dewatering equipment and is further dewatered by a suction box, characterized in being constructed such that a forming roll, wound with a felt, is arranged movably up and down above the wire near the headbox and, when a thin paper is to be formed, the forming roll is moved down so that a nip of the stock liquor is formed between the wire and the felt.

**[0045]** According to the paper forming device of the present invention constructed as mentioned above, when a thin paper is to be formed, the forming roll is moved down to thereby press down the wire. In this state, forming of the wet sheet is done. In this state, the stock liquor discharged from the headbox onto the wire is immediately nipped between the wire and the felt to receive a centrifugal force and a compression force due to the tension of the wire. Hence, the most part of the water in the stock liquor is dewatered and the wet sheet is rapidly formed.

**[0046]** Thus, according to the paper forming device of the present invention, when a thin paper is to be formed, by moving down the forming roll, the stock liquor discharged from the headbox is immediately nipped between the wire and the felt. Thereby, scattering or the like of the stock liquor on the wire is suppressed and a high velocity forming of the thin paper becomes possible. Also, a shear force is generated in the stock liquor and fibers are oriented in the running direction of the wire. Thereby, a soft thin paper can be easily formed. Thus, according to the device of the present invention, a high velocity forming of the thin paper becomes possible.

**[0047]** On the other hand, when a thick paper is to be formed, the forming roll is moved up and the wet sheet is formed by the same construction as a prior art device.

**[0048]** In the paper forming device of the present invention that is preferably constructed such that, when the forming roll is moved down to thereby press down the wire, the headbox and the forming board arranged under the wire are inclined in the same direction as the running direction of the wire so pressed down, the position relation between the wire running direction and the headbox and/or the forming board can be maintained.

**[0049]** Also, the paper forming device of the present invention can be constructed such that a wire roll is arranged upwardly movably under the wire downstream of the forming roll and, when the wire roll is moved up to thereby lift up the wire, the forming roll is moved down so that the horizontal running direction of the wire near the headbox is maintained. Then, even when the forming roll is moved down, the horizontal running direction of the wire between the breast roll and the forming roll can be maintained and, in forming not only a thick paper but also a thin paper, displacement of the headbox and the forming board becomes unnecessary.

### Claims

1. A paper forming device of a paper machine in which stock liquor is discharged from a headbox onto a wire so that said stock liquor, while being transferred on said wire, is dewatered by a dewatering equipment and is further dewatered by a suction box, **characterized in** being constructed such that a forming roll, wound with a felt, is arranged movably up and down above said wire near said headbox and, when a thin paper is to be formed, said forming roll is moved down so that a nip of said stock liquor is formed between said wire and said felt.
2. A paper forming device of a paper machine as claimed in Claim 1, **characterized in** being constructed such that, when said forming roll is moved down, said wire is pressed down by said forming roll and said headbox and a forming board, arranged under said wire, are inclined in the same direction as a running direction of said wire.
3. A paper forming device of a paper machine as claimed in Claim 1, **characterized in** being constructed such that a wire roll is arranged upwardly movably under said wire downstream of said forming roll and, when said wire roll is moved up to thereby lift up said wire, said forming roll is moved down so that a horizontal running direction of said wire near said headbox is maintained.



Fig. 2.

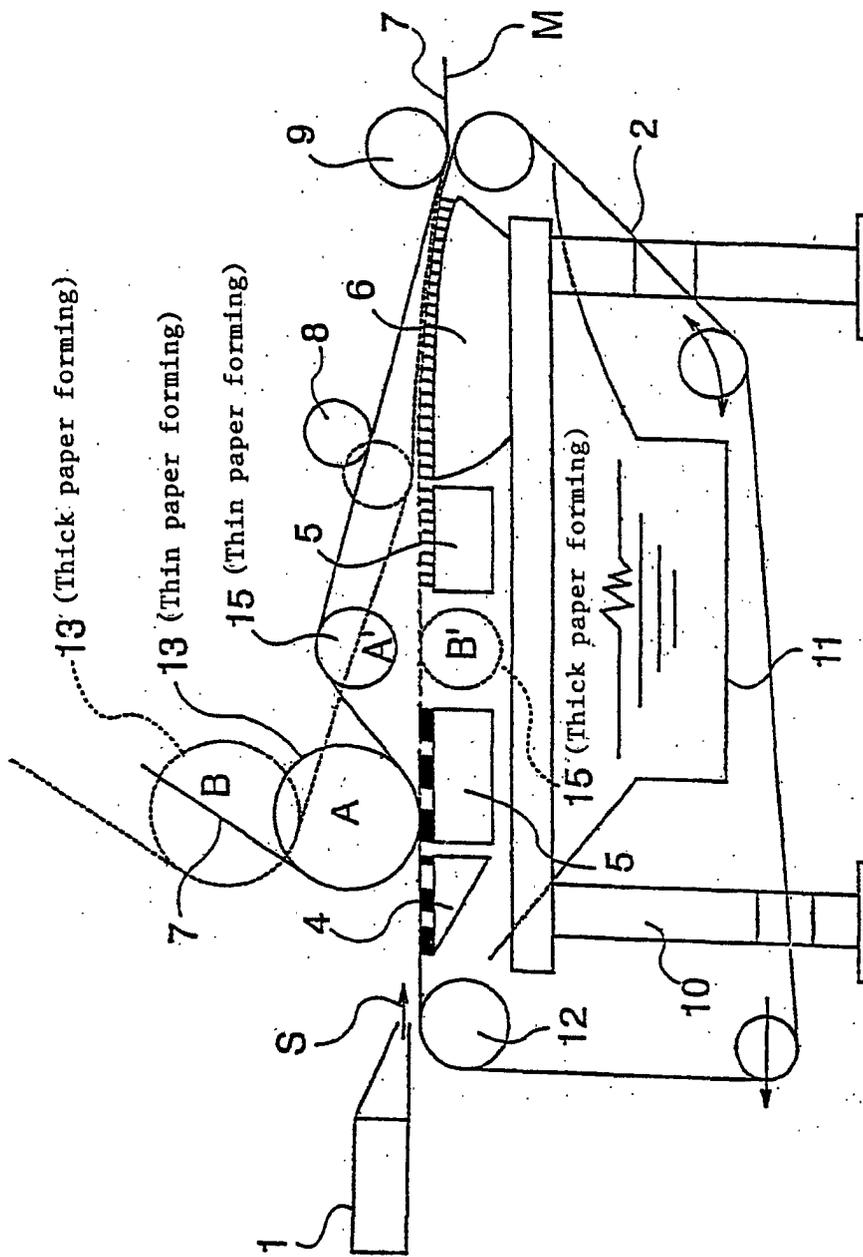
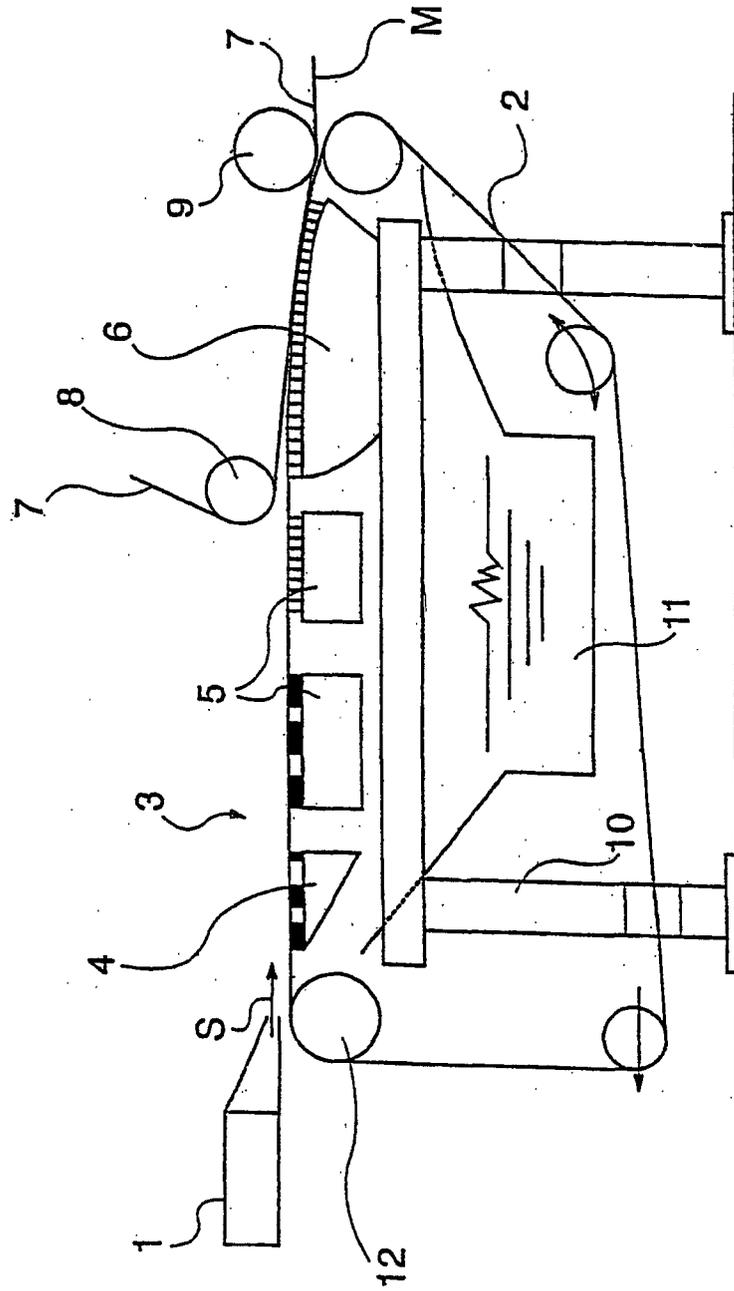


Fig. 3



## INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP02/08861

A. CLASSIFICATION OF SUBJECT MATTER Int.Cl. <sup>7</sup> D21F9/02		
According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED		
Minimum documentation searched (classification system followed by classification symbols) Int.Cl. <sup>7</sup> D21F9/02		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched Jitsuyo Shinan Koho 1926-1996 Toroku Jitsuyo Shinan Koho 1994-2002 Kokai Jitsuyo Shinan Koho 1971-2002 Jitsuyo Shinan Toroku Koho 1996-2002		
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X A	EP 491274 A (Mitsubishi Jukogyo Kabushiki Kaisha), 24 June, 1992 (24.06.92), Full text & DE 69110260 C & FI 916010 A & US 5203967 A & JP 4-222288 A & KR 9506813 B	1 2, 3
A	US 5565064 A (J.M. Voith. GmbH), 15 October, 1996 (15.10.96), Full text & DE 4328997 A & FI 943943 A & CA 2130966 A & JP 7-145590 A	1-3
A	JP 59-53793 A (Mitsubishi Heavy Industries, Ltd.), 28 March, 1984 (28.03.84), Full text (Family: none)	1-3
<input checked="" type="checkbox"/> Further documents are listed in the continuation of Box C. <input type="checkbox"/> See patent family annex.		
* Special categories of cited documents: "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier document but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed	"I" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family	
Date of the actual completion of the international search 22 November, 2002 (22.11.02)	Date of mailing of the international search report 10 December, 2002 (10.12.02)	
Name and mailing address of the ISA/ Japanese Patent Office	Authorized officer	
Facsimile No.	Telephone No.	

Form PCT/ISA/210 (second sheet) (July 1998)

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP02/08861

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 7-138894 A (Mitsubishi Jukogyo Kabushiki Kaisha), 30 May, 1995 (30.05.95), Full text (Family: none)	1-3
A	US 4686004 A (Mitsubishi Jukogyo Kabushiki Kaisha), 11 August, 1987 (11.08.87), Full text & FI 844998 A                      & SE 8406523 A & JP 60-146095 A                  & DE 3447509 A & CA 1242913 A	3

Form PCT/ISA/210 (continuation of second sheet) (July 1998)