

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
21 December 2000 (21.12.2000)

PCT

(10) International Publication Number
WO 00/77298 A1

(51) International Patent Classification⁷: **D21C 9/18,**
D21F 1/48

(21) International Application Number: PCT/FI00/00518

(22) International Filing Date: 9 June 2000 (09.06.2000)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
991356 14 June 1999 (14.06.1999) FI

(71) Applicant (for all designated States except US): **VALMET CORPORATION** [FI/FI]; Fabianinkatu 9 A, FIN-00130 Helsinki (FI).

(81) Designated States (national): AE, AG, AL, AM, AT, AT (utility model), AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CR, CU, CZ, CZ (utility model), DE, DE (utility model), DK, DK (utility model), DM, DZ, EE, EE (utility model), ES, FI, FI (utility model), GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KR (utility model), KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SK (utility model), SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.

(84) Designated States (regional): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

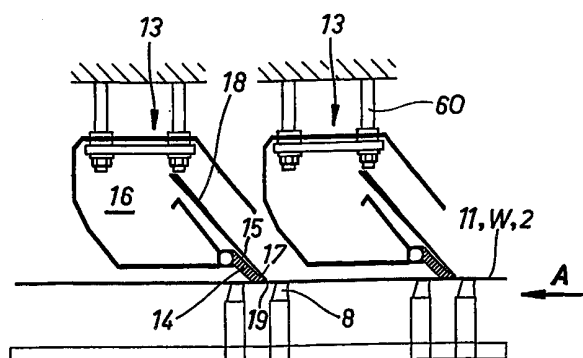
Published:

- With international search report.
- Before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments.

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(72) Inventors; and
(75) Inventors/Applicants (for US only): **LUNDÉN, Leo** [FI/FI]; Ruohotie 20, FIN-48800 Karhula (FI). **KOSKINEN, Jorma** [FI/FI]; Viimakatu 15, FIN-48510 Karhula (FI).
(74) Agent: **LEITZINGER OY**; Ruoholahdenkatu 8, FIN-00180 Helsinki (FI).

(54) Title: METHOD FOR REMOVING WATER ON THE WIRE SECTION OF A PULP DRYER AND A DEWATERING UNIT



(57) Abstract: The invention relates to a method for removing water from a pulp web (W) travelling between the top (11) and bottom wires (2) on the wire section of a pulp dryer. In the method is used at least one non-vacuum dewatering unit (10) arranged inside the top wire (11), the said dewatering unit comprising a dewatering strip (14; 114), the tip part (19; 119) of which can be brought into contact with the surface of the top wire (11) facing away from the web (W) in order to guide the water on the said surface upwards along the rising wall of the dewatering strip (14; 114), and further into a collection space (16; 116) belonging to the dewatering unit. According to the method relating to the invention, the water made to rise upwards along the rising wall by means of the tip part (19; 119) of the dewatering strip (14; 114) is led off the rising wall in such a way that the upwards directed movement of the water takes place substantially as a free jet (18; 118). The invention also relates to a non-vacuum dewatering unit (10) for removing water from a pulp web (W) travelling on the wire section of a pulp dryer.

Method for removing water on the wire section of a pulp dryer and a dewatering unit

The present invention relates to a method for removing water from a pulp web travelling between the top and bottom wires on the wire section of a pulp dryer, in which method is used at least one non-vacuum dewatering unit arranged inside the top wire, the said dewatering unit comprising a dewatering strip, the tip part of which can be brought into contact with the surface of the top wire facing away from the web in order to guide the water on the said surface upwards along the rising wall of the dewatering strip, and further into a collection space belonging to the dewatering unit.

The invention also relates to a non-vacuum dewatering unit for removing water from a pulp web travelling between the top and bottom wires on the wire section of a pulp dryer, the said dewatering unit being arranged inside the top wire and comprising a dewatering strip, the tip part of which can be brought into contact with the surface of the top wire facing away from the web in order to guide the water on the said surface upwards along the rising wall of the dewatering strip, and further into a collection space belonging to the dewatering unit.

The invention further relates to a method for drying chemical pulp in the wire section of a pulp dryer, the wire section comprising a bottom wire onto which is supplied pulp from the headbox, and a top wire, whereby the web being formed is made to travel between the bottom and top wires, this wire unit comprising first dewatering means in conjunction with the bottom wire, the said means being located in the area between the headbox and the top wire, and second dewatering means arranged inside the top wire.

In paper manufacture - with the exception of paper made completely from recycled fibre - chemical pulp is typically used, among other things, for reinforcing the web or for giving it certain desired properties. Typically, a certain desired amount of chemical pulp is mixed with the pulp material.

However, in paper manufacture, chemical pulp is consumed only partially as to the total amount of paper produced. The chemical pulp may be obtained via a pipe system from the paper mill's own pulp mill. A large part of the chemical pulp is, however, used at a paper mill outside the pulp mill as so-called market
5 pulp. In such a case it is obvious that the aim is to dry the chemical pulp, so that water does not have to be transported between the pulp mill and the paper mill. This drying of the chemical pulp is carried out by means of a pulp dryer.

The main purpose of the dryer used for drying the pulp is to render the
10 chemical pulp as dry as desired, as cost-effectively as possible, and it should be remembered that the material being dried is chemical pulp and not a mixture of different fibrous materials and additives, as is the case in paper manufacture. This entails, among other things, that the mechanical removal of water from the pulp should be as efficient as possible without, however,
15 damaging the pulp fibres themselves.

One of the differences between pulp drying and paper manufacture relates to essentially different grammages which are in the case of chemical pulp of the order of 600-1000 g/m², whereas for board, the maximum grammage is about
20 550 g/m² and for paper the maximum is about 150 g/m². Furthermore, the speed of known pulp dryers is typically less than 200 m/min, whereas in a paper machine, the speeds may be of the order of over 1600 m/min. One concrete difference is that paper/board is always an end product, the demands placed on which are completely different from those placed on dried pulp,
25 which is a raw material. The demands made on dried pulp relate mainly to its handling during drying, to the requirements made by the handling of the dried pulp, transport, and pulping at the paper mill. The aim is not to significantly affect the properties of the pulp sheet itself by means of the pulp dryer. In the manufacture of paper and board, on the other hand, the process is defined by
30 the qualities required of the end product, such as smoothness, gloss, opacity, printing quality, etc.

A particular aim of the invention is to provide a novel improved dewatering method and dewatering unit, by means of which the removal of water above the web is rendered more efficient and more economical. To achieve this aim, it is characteristic of the method relating to the invention that, in the method, the

5 water made to rise upwards along the rising wall by means of the tip part of the dewatering strip is led off the rising wall in such a way that the upwards directed movement of the water takes place substantially as a free jet.

The dewatering unit relating to the invention is, on the other hand,

10 characterised in that in the rising wall of the dewatering strip are arranged means for effecting the detachment of the water from the rising wall in such a way that the upwards directed movement of the water takes place substantially as a free jet.

15 Yet another aim of the invention is to provide an improved method for drying chemical pulp in the wire section of the pulp dryer, the said method being characterised in that, in the method, the dry matter content of the chemical pulp is increased by means of the bottom wire and the first dewatering means to a value below approximately 10%, after which the web is guided into the space

20 between the top wire and the bottom wire and its dry matter content is increased to a value of approximately 18-20% by means of two-way dewatering by utilising the said second dewatering means.

The invention is described in greater detail in the following, with reference to

25 the appended drawing, in which:

Figure 1 shows diagrammatically an arrangement for a pulp dryer implemented in accordance with the invention,

30 Figure 2 shows a part of an embodiment of a dewatering unit relating to the invention,

Figure 2a shows an enlarged view of a detail of Figure 2, and

Figure 3 shows an alternative embodiment of a dewatering box belonging to the dewatering unit relating to the invention.

In accordance with Figure 1, the arrangement used in the solution relating to the invention comprises a headbox 1 from which the pulp is supplied to the Fourdrinier wire 2 which circulates via the breast roll 3 and the guide rolls 6 as an endless wire loop. In connection with the bottom wire is arranged a forming board 4 and foil boxes 5 to effect mechanical dewatering. Above the bottom wire is arranged a top wire 11 which circulates via the guide rolls 12 as a closed wire loop, inside which is arranged a non-vacuum dewatering unit 10. The dewatering unit 10 comprises at least one dewatering box 13, described in greater detail below, and roll pairs 9, 20 of which there are two in succession in the embodiment shown. After the two-way dewatering taking place in the space between the top wire and the bottom wire the web is led past the hot-water boxes 30 and further to a so-called combipress 40 which comprises a first nip, a so-called lumb-breaker nip N1, and a second nip N2 and a third nip N3, from where the web is led further, for example, to a shoe press 50, where the next nip N4 is located. From the shoe press 50 the web is led further on, for example, to an evaporation drying unit (not shown).

20

Figures 2 and 2a show in greater detail a preferred structure of the dewatering box 13. The dewatering box 13 is fixed, for example, with support means 60 to the frame structure in such a way that the position of the dewatering box with respect to the top wire is adjustable. To the dewatering box is attached a dewatering strip 14, the tip part 19 of which can be placed against the top surface of the top wire 11 facing away from the web W in order to guide the water on the said surface upwards along the rising wall of the dewatering strip 14. The angle of the strip 14 is adjustable. At point 17 on the rising wall, in the direction of movement (arrow A) of the web W, is formed a forwards directed corner part after which the rising wall continues as a recessed wall part 15. Due to this corner part 17 and the recess part 15, the water travelling upwards along the rising wall detaches from the rising wall and proceeds as a mainly upwards directed water jet 18, travelling further into a water collection space 16 from

where the water can be passed on further, for example, into a wire basin. At the dewatering boxes 13, inside the lower wire loop 2 is arranged a loading table 7 comprising adjustable support strips 8 supported against the surface of the bottom wire facing away from the web, always on either side of the strip 14.

5

The length of the rising wall and the "detachment angle of the jet" and other dimensions are selected in such a way that the location of the detachment angle of the jet, in other words, the length of the rising wall is such that within the operating range of the apparatus (measured values), the rising water has a certain predetermined velocity (> 0 m/s) at the jet detachment angle.

The jet detachment angle refers, among other things, to the type of discontinuing part in the rising wall which prevents the flow from following the surface, that is, it detaches the flow from the surface and forms a substantially free jet. The length of the rising wall is preferably less than about 100 mm, typically less than about 50 mm. The recessed part deviates from the plane defined by the rising wall by about 5 mm, but it may also deviate from the said plane by more or less, for example, by only about 1 mm.

In the embodiment shown in Figure 3, the dewatering box 113 comprises a dewatering strip 114, the tip part 119 of which can be placed against the upper surface of the top wire 11 to guide the water on it upwards along the rising wall of the dewatering strip 114. The dewatering strip 114 is fixed to the T joint means 111 of the support part 112, in which support part 112 there is a surface 115, which is recessed with respect to the plane defined by the rising wall. In this way is formed a jet detachment corner part 117 between the dewatering strip 114 and the support part 112. Due to this corner part 117 and the recessed wall part 115, the water travelling upwards along the rising wall detaches from the rising wall and proceeds as a mainly upwards directed water jet 118, travelling further to the water collection space 116 from which the water can be passed on further, for example, to the wire basin.

By means of the dewatering system relating to the invention, in which the water rises upwards as a jet and does not travel along the surface of the rising wall, the water can be scraped off the wire as a jet already at a speed of about 100 m/min, whereas for the water to rise directly along the surface requires a speed
5 of about 200 m/min. Due to this solution, water can be collected at a lower speed without a vacuum system.

According to the drying method relating to the invention, the dry matter content of the pulp web is increased to a value of approximately 3-10% before feeding
10 the web into the space between the top wire and the bottom wire in which the dry matter content of the web is increased to a value of approximately 18-20% by utilising one or more dewatering boxes 13 relating to the invention and one or more roll nips N. The roll nip N is preferably comprised of, for example, an upper roll 20 with a soft surface and a bored-through lower roll 9. There is
15 preferably at least one roll nip N, but depending on the speed of the pulp dryer and the properties of the pulp and other factors, the number of nips may also be two.

Claims

1. A method for removing water from a pulp web (W) travelling between the top (11) and bottom wires (2) on the wire section of a pulp dryer, in which method
5 is used at least one non-vacuum dewatering unit (10) arranged inside the top wire (11), the said dewatering unit comprising a dewatering strip (14; 114), the tip part (19; 119) of which can be brought into contact with the surface of the top wire (11) facing away from the web (W) in order to guide the water on the said surface upwards along the rising wall of the dewatering strip (14; 114), and
10 further into a collection space (16; 116) belonging to the dewatering unit, **characterised** in that in the method, the water made to rise upwards along the rising wall by means of the tip part (19; 119) of the dewatering strip (14; 114) is led off the rising wall in such a way that the upwards directed movement of the water takes place substantially as a free jet (18; 118).
- 15 2. A method as claimed in claim 1, **characterised** in that the water is led off the rising wall by forming a recessed part (15) in the rising wall after the tip part (19).
- 20 3. A non-vacuum dewatering unit (10) for removing water from a pulp web (W) travelling between the top (11) and bottom wires (2) on the wire section of a pulp dryer, the said dewatering unit being arranged inside the top wire (11) and comprising a dewatering strip (14; 114), the tip part (19; 119) of which can be brought into contact with the surface of the top wire (11) facing away from the
25 web (W) in order to guide the water on the said surface upwards along the rising wall of the dewatering strip (14; 114), and further into a collection space (16; 116) belonging to the dewatering unit, **characterised** in that in the rising wall of the dewatering strip (14; 114) are arranged means for effecting the detachment of the water from the rising wall in such a way that the upwards
30 directed movement of the water takes place substantially as a free jet (18; 118).

4. A dewatering unit as claimed in claim 3, **characterised** in that a corner part (17; 117) is formed after the tip part (19) as a detachment means arranged in the rising wall.
5. A method for drying chemical pulp on the wire section of a pulp dryer, the wire section comprising a bottom wire (2) onto which chemical pulp is supplied from the headbox (1), and a top wire (11), whereby the web (W) being formed is made to travel between the bottom and top wires, the wire section comprising first dewatering means (4, 5) in conjunction with the bottom wire (2), the said means being located in the area between the headbox (1) and the top wire (11), and second dewatering means (13, 20) arranged inside the top wire (11), **characterised** in that in the method, the dry matter content of the chemical pulp is increased by means of the bottom wire (2) and the first dewatering means (4, 5) to a value below approximately 10%, after which the web (W) is guided into the space between the top wire (11) and the bottom wire (2) and its dry matter content is increased to a value of approximately 18-20% by means of two-way dewatering by utilising the said second dewatering means (13, 20).
6. A method as claimed in claim 5, **characterised** in that the dry matter content is increased to a value within the range from approximately 3% to approximately 10% before supplying the web into the space between the top (11) and the bottom wire (2).
7. A method as claimed in claim 5 or 6, **characterised** in that the said second dewatering means comprise at least one non-vacuum dewatering unit (10) which comprises a dewatering strip (14), the tip part (19) of which can be brought into contact with the surface of the top wire (11) facing away from the web in order to guide the water on the said surface upwards along the rising wall of the dewatering strip (14), and further into a collection space (16) belonging to the dewatering unit (10), and in the rising wall of which dewatering strip (14) are arranged means for effecting the detachment of the water from the rising wall in such a way that the upwards directed movement of the water takes place substantially as a free jet (18).

8. A method as claimed in claim 7, **characterised** in that a corner part (17) is formed after the tip part (19) as a detachment means arranged in the rising wall.
- 5 9. A method as claimed in claim 7 or 8, **characterised** in that the second dewatering means in addition comprise at least one roll nip (N) comprised of a roll with a soft surface and a bored-through roll (9).

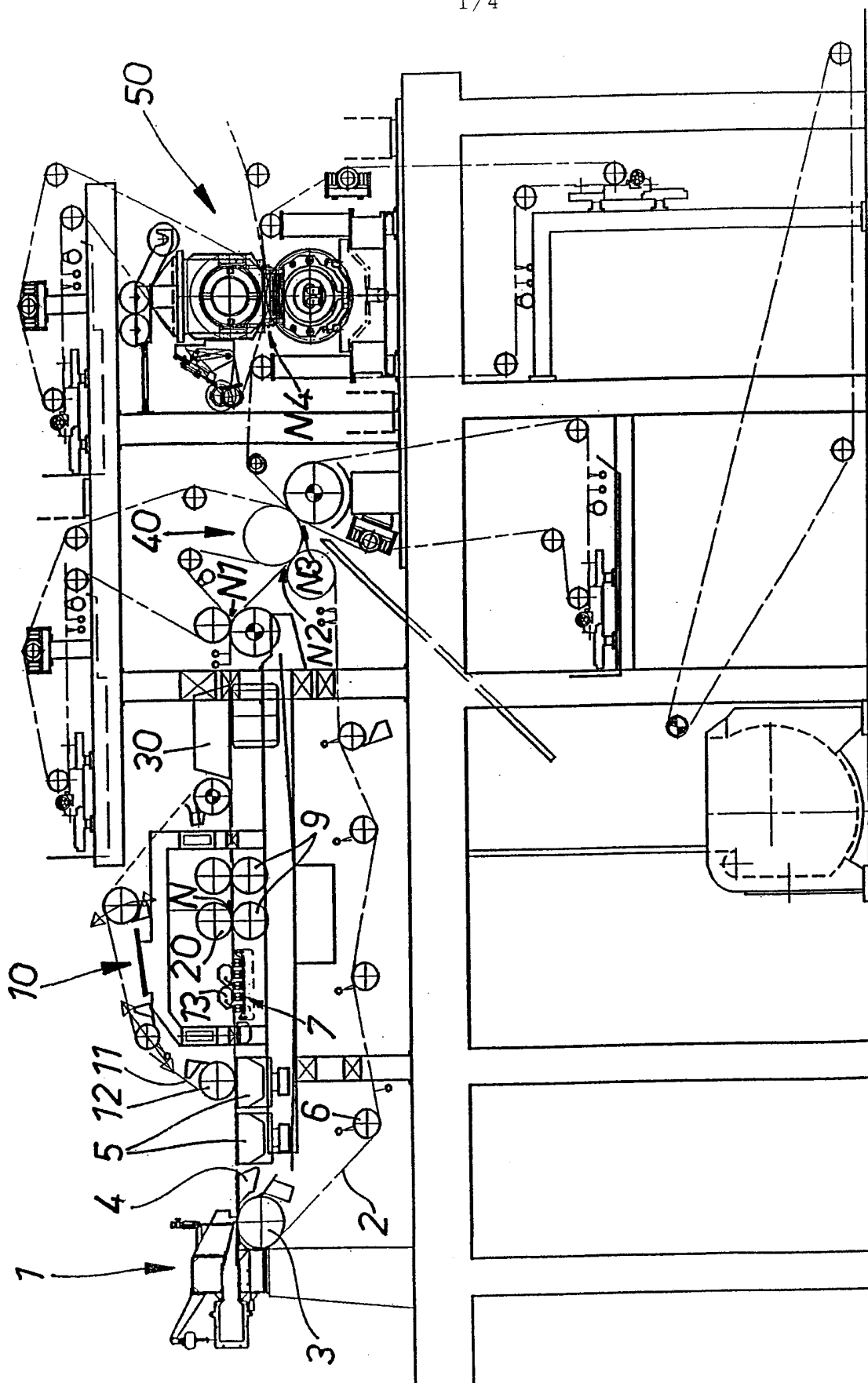


Fig. 1

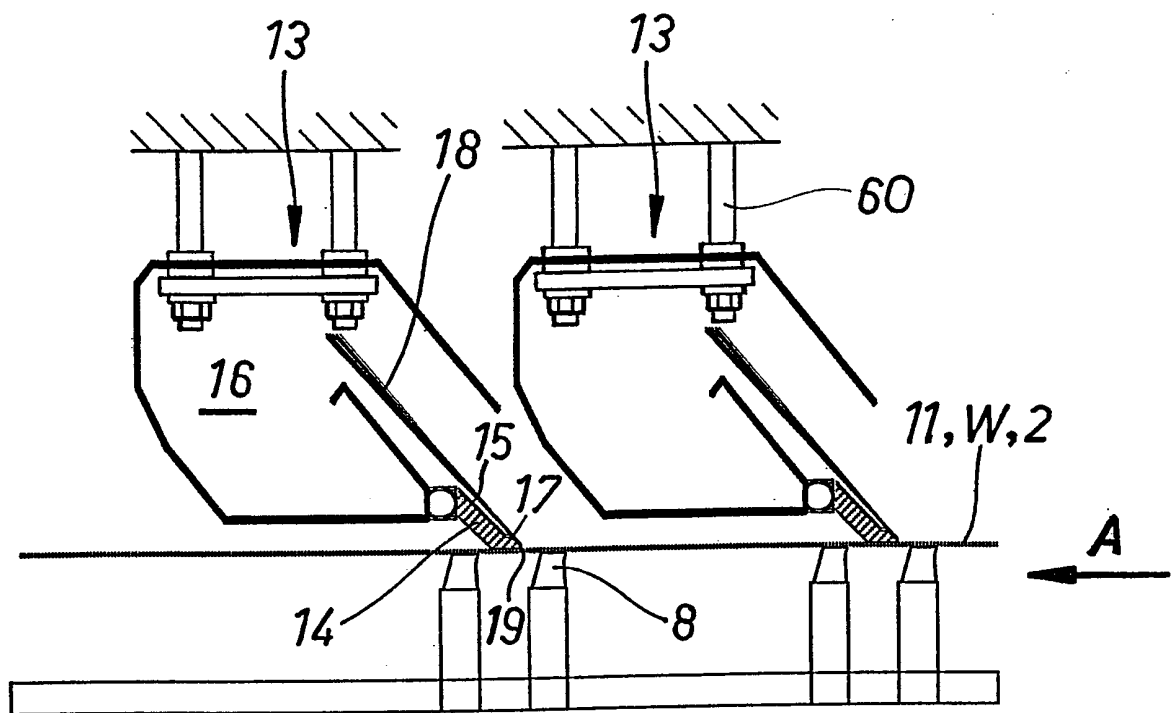
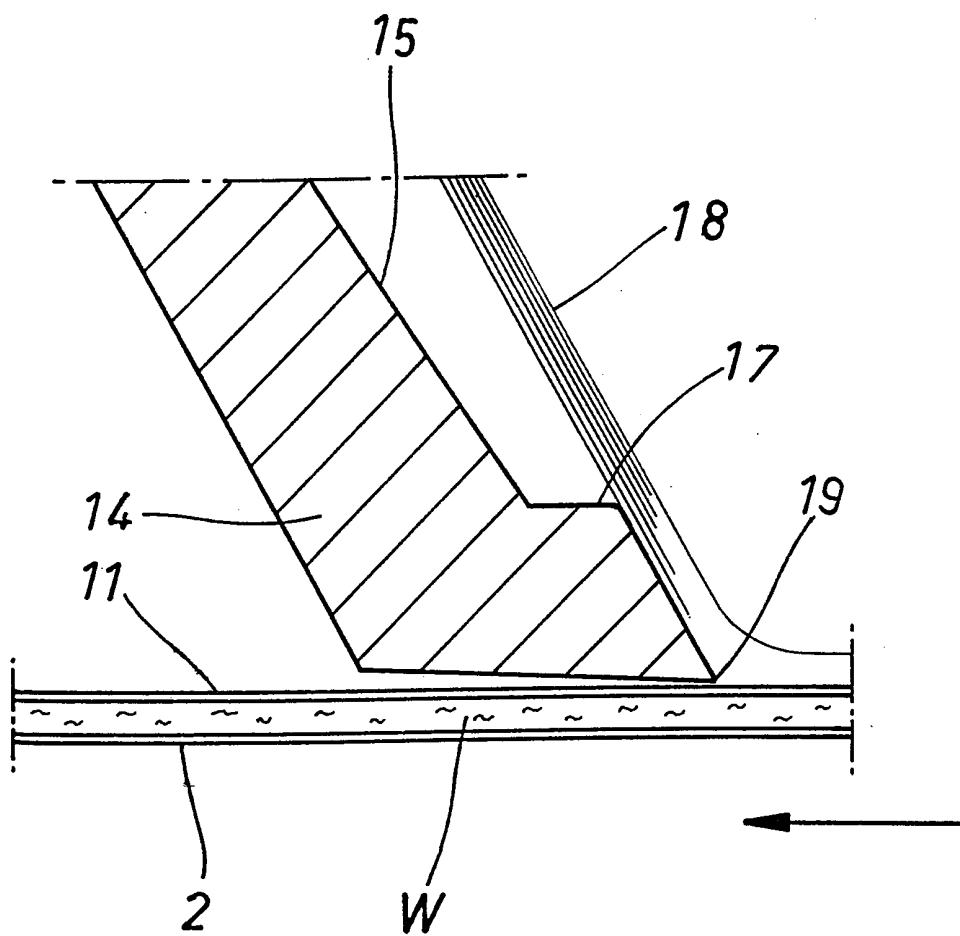
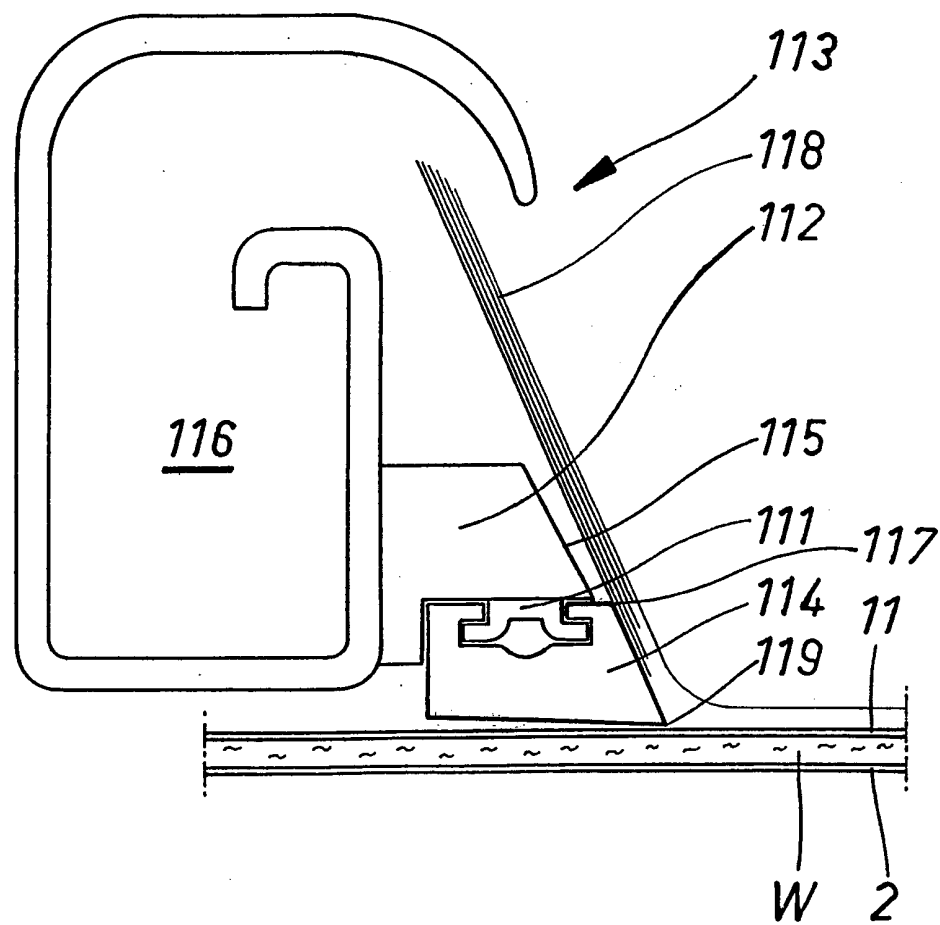


Fig. 2

**Fig. 2a**

**Fig. 3**

INTERNATIONAL SEARCH REPORT

International application No.

PCT/FI 00/00518

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: D21C 9/18, D21F 1/48

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)

IPC7: D21C, D21F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

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.
A	DE 29822590 U1 (VALMET CORP.), 8 April 1999 (08.04.99), claim 1 --	1-9
A	WO 8604368 A1 (VALMET OY), 31 July 1986 (31.07.86), figures 2,3	1-4,7-9
X	figures 2,3, claim 1 --	5-6
A	WO 9204500 A1 (SULZER-ESCHER WYSS GMBH), 19 March 1992 (19.03.92), figure 2 --	1-9
A	US 5116477 A (ALFRED BUBIK ET AL), 26 May 1992 (26.05.92), figures 4, 7 --	1-4,7-9

☒ Further documents are listed in the continuation of Box C.

☒ 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

"T" 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

24 October 2000

Date of mailing of the international search report

27-10-2000

Name and mailing address of the ISA/

Swedish Patent Office

Box 5055, S-102 42 STOCKHOLM

Facsimile No. +46 8 666 02 86

Authorized officer

Marianne Bratsberg/Eö

Telephone No. +46 8 782 25 00

INTERNATIONAL SEARCH REPORT

International application No.

PCT/FI 00/00518

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	FI 96876 B (SUNDS DEFIBRATOR PORI OY), 31 May 1996 (31.05.96), claims 1,8 -- -----	5-6

INTERNATIONAL SEARCH REPORT

International application No.
PCT/FI00/518

Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).:

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see next sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☒ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest.
☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/FI00/00518

- I. Claims 1-4 define a method and an apparatus for removing water from a pulp web, using a non-vacuum dewatering unit characterised by a rising wall arranged for effecting the detachment of water from the rising wall in such a way that the upwards directed movement of the water takes place substantially as a free jet.
- II. Claims 5-6 relate to a method for drying chemical pulp, characterised by the measures of increasing the dry matter content of the pulp by means of the bottom wire and a first dewatering means to a value approximately below 10% and thereafter by means of two-way dewatering by utilising a second dewatering means to a value of approximately 18-20%.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/FI 00/00518

Patent document cited in search report			Publication date	Patent family member(s)	Publication date
DE	29822590	U1	08/04/99	AT 3187 U FI 974583 A SE 9804396 A	25/11/99 20/06/99 20/06/99
WO	8604368	A1	31/07/86	DE 3690026 T FI 82084 B,C FI 850364 A GB 2180273 A,B SE 452997 B,C SE 8604035 A	29/01/87 28/09/90 29/07/86 25/03/87 04/01/88 24/09/86
WO	9204500	A1	19/03/92	AT 134233 T CA 2050647 A DE 4028126 A,C DE 59107409 D EP 0497932 A,B SE 0497932 T3 FI 97306 B,C FI 921813 A	15/02/96 13/03/92 19/03/92 00/00/00 12/08/92 15/08/96 23/04/92
US	5116477	A	26/05/92	DE 3815316 A,C	16/11/89
FI	96876	B	31/05/96	FI 1703 U FI 940395 A,V	16/01/95 27/07/95