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(54) Title: METHOD AND APPARATUS FOR MAKING PAPER

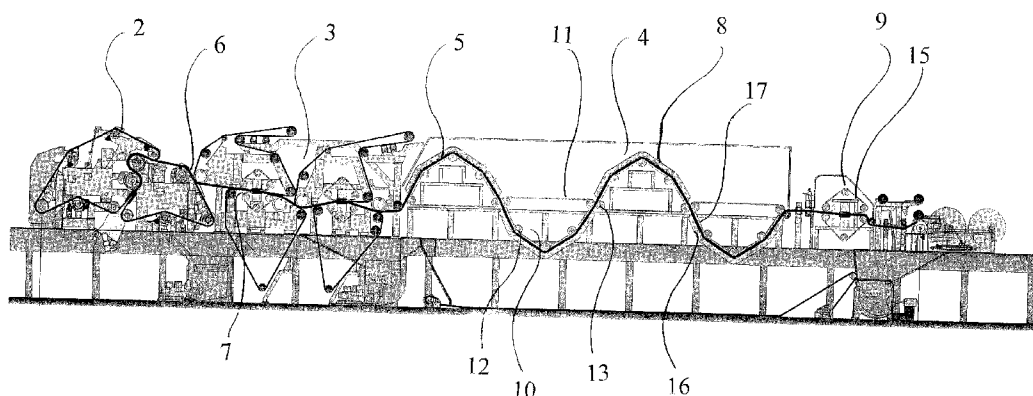


Fig. 1

(57) Abstract: The invention relates to a method and apparatus for removing water in paper-making, wherein paper is formed by feeding pulp to a wire section (2) through a headbox, a web is formed at the wire section, and the web is led from the wire section to a drying section (4) through a press section (3). According to the invention, dewatering the web is enhanced and moisture content of the paper is reduced by removing water from the web (5) the is being formed by at least one dewatering unit (8) comprising a belt circulating member (10) with a belt (11) and at least two rolls (12) over which the belt is arranged to pass.

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METHOD AND APPARATUS FOR MAKING PAPER**FIELD OF THE INVENTION**

The invention relates to a method defined in the preamble of claim 1 for removing water in the papermaking, wherein paper is formed from a fibrous source material by feeding pulp to a wire section through a headbox, a web is formed at the wire section and the web is led from the wire section to a drying section through a press section, and to an apparatus defined in the preamble of claim 2 for making paper.

BACKGROUND OF THE INVENTION

Known from prior art are various methods and apparatuses for making different kinds of papers.

It is known that the web formation section of a paper machine comprises a headbox section a feed piping of a headbox and the headbox, and a wire section. The purpose of the wire section is to form a web from fibre pulp arriving from the headbox and to remove water from the fibre pulp by filtering it through a wire cloth, bringing the web to a sufficiently high dry content. The filtrate flow is produced by the pressure difference acting over the filtered fibre layer and the wire. When the web has a sufficiently high dry content, the transfer of the web from the wire section to the press in easy and good runnability is achieved at the press section. The fibre pulp from the headbox to the wire has a thickness of about 0.2 - 1.2%, and the dry content of the web as it leaves the wire is about 15 - 20%. After the press section, the dry content of the paper web rises to a level of 40 - 55%. However, only a small portion of the initial water content is removed at the press section, in comparison with the wire section. In the press section,

it is important to achieve as high dry content as possible so that the runnability at the drying section would be good and energy would not be consumed too much.

5 At the drying section, the moisture content of the paper web is reduced by cylinders heated with steam. Depending on the further processing of the paper, the purpose of the drying section is to achieve a predetermined moisture level in the paper. It is known
10 to use e.g. drying cylinders and/or suction cylinders at the drying section.

 After the headbox, papermaking is principally dewatering and providing the paper with a desired moisture content e.g. prior to printing or other fur-
15 ther processing.

 The increase of speed in paper machines has contributed to a situation where the desired dry content of the paper web has not been achieved e.g. in the press section, due to a shorter dwell time between
20 the pressing nips. Consequently, the reduced dry content level easily produces problems, e.g. relating to runnability and quality, at the drying section, and later during coating or printing. Due to higher speeds in paper machines, the runnability of the drying sec-
25 tion is a limiting factor in increasing the production. This is why the objective is to achieve as high dry content level as possible already before the drying section.

30 **OBJECTIVE OF THE INVENTION**

 The objective of the invention is to disclose a new, cost-effective method and apparatus for enhancing the removal of water from a paper web. One specific objective of the invention is to disclose a
35 method and apparatus for removing water from a web in conjunction with the drying section.

SUMMARY OF THE INVENTION

The method and apparatus according to the invention are characterized by what has been presented
5 in the claims.

The invention is based on a method for removing water in the papermaking, wherein paper is formed by feeding pulp to a wire section through a headbox, a web is formed at the wire section and the web is led
10 from the wire section to a drying section through a press section. According to the invention, dewatering the web is enhanced and moisture content of the paper is reduced by removing water from the web that is being formed by at least one dewatering unit, the dewatering
15 unit comprising a belt circulating member with a belt and at least two rolls over which the belt is arranged to pass. In one preferred embodiment, the dewatering unit according to the invention is arranged in conjunction with the drying section.

20 Furthermore, the invention is based on a corresponding apparatus for making paper, comprising at least one dewatering unit substantially comprising a belt circulating member. The belt circulating member according to the invention comprises at least two rolls
25 or cylinders over which the belt is arranged to pass and run, thus forming a belt-circulated dewatering member. The belt circulating member may be structurally of any shape, depending on the number of rolls or cylinders and/or their positioning.

30 The invention is specifically based on a method and apparatus for enhancing the drying of the web and reducing the moisture content of the paper that is being formed. The objective of the invention is to raise the dry content of the paper web during paper-
35 making.

In this context, paper refers to any fibre-based paper, board or fibre product or the like. The paper may be made from chemical pulp, mechanical pulp, chemimechanical pulp, recycled pulp, various pulps of
5 plant origin, mixtures thereof and/or the like. The paper may be in the form of a wet web, dried web or sheet, or in other form which is suitable for the purpose. The paper may comprise suitable pigments, fillers and additives.

10 In conjunction with the web formation, water is preferably removed in the wire section with the various dewatering elements of the wire section known per se. In addition to the wire section, water is removed in manners known per se in the press section and
15 the drying section.

The drying section may be structurally completely known per se. The drying section may comprise e.g. a condebelt dryer, a Yankee dryer, a Yankee cylinder, an impingement dryer and/or the like. The drying
20 section may comprise a number of drying devices or drying units.

In one embodiment of the invention, the dewatering unit comprises an opposing cylinder for forming a nip together with the belt circulating member. In one
25 embodiment, the opposing cylinder is selected from the group of: a roll, a cylinder, a slide shoe, a static shoe, another belt circulating member according to the invention or the like. In one embodiment, the belt circulating member may operate as a calender nip with the
30 opposing cylinder.

In one embodiment of the invention, the belt circulating member comprises at least three rolls or cylinders over which the belt is arranged to pass. In one embodiment, the belt circulating member comprises
35 at least four rolls or cylinders over which the belt is arranged to pass.

In one embodiment, the belt-circulated dewatering unit according to the invention may operate as a conventional drying cylinder. In this case, a paper web and a drying fabric may be placed onto the belt of the
5 belt-circulated dewatering unit.

In one embodiment, the belt of the belt circulating member in the dewatering unit is e.g. a metal, steel or a textile fabric belt.

In one embodiment, the paper web may be sucked
10 against the belt e.g. by a suction arranged on the back side of the belt.

In one embodiment of the invention, a perforated area is arranged on at least one edge or both edges of the belt, e.g. a metal or steel belt. Preferably, a suction is arranged through the perforations,
15 e.g. by a suction box, in order to keep the web on top of the belt against the belt. In one embodiment, the perforations and the required suction boxes are arranged onto the belt over such area that the edge areas
20 of the web can be kept against the belt. In one embodiment, the perforations are arranged at a fixed distance from each other or alternatively at other distance from each other. The size and number of the perforations are determined according to the required suction power. In
25 one embodiment, the perforations can be produced into the belt e.g. by laser technology. By perforating the belt at the edges, conditions for controlling the transverse shrink of the web and the machine-direction behaviour of the web are provided. Furthermore, the
30 width and length of the suction box pick-up zone contribute, along with the perforation and the geometry thereof, in providing a desired vacuum level in order to keep the web against the belt in a desired manner. In one embodiment, the required vacuum can be provided
35 by a separate vacuum-producing device. In this manner, the web may also glide according to the running condi-

tions and needs when set against the surface of the belt. This provides conditions for controlling the runnability of the web in the machine and transverse direction of the web. At the same time, the typical runnability-associated problems of the edge zones of the web can be eliminated, such as flapping or detaching of the edge-zones. The required vacuum level in order to attach the web to the belt is mainly determined when the web is drying by the result of the transverse shrink in an individual fibre and forces formed by the fibre through bonds.

In one embodiment of the invention, heating means may be arranged in conjunction with the belt circulating member above and/or below the belt to heat one or both sides of the belt and the web. Warming or heating of the web/belt, and thereby the removal of moisture, are provided e.g. by steam, condensate, recovered heat of the drying section, hot air, high pressure air, by radiation, conventional heat sources, e.g. electricity, oil or bioenergy, or in a similar manner. In one embodiment, in heating the web/belt, the steam and/or condensate system of the drying section, steaming boxes, impingement units, heat pump technology, gas-infrared technology or the like may be used.

In one embodiment, the static shoe press unit arranged in the drying section may be arranged to be part of the dewatering unit according to the invention, e.g. as an opposing cylinder, to form a nip with the belt circulating member of the dewatering unit.

In one embodiment, the drying section may comprise one or more dewatering units. Multiple dewatering units may be arranged structurally in different manners, e.g. successively, two laid one above the other, and/or in a combination of these.

In addition to the dewatering units according to the invention, the web may be dried by the dewater-

ing and drying methods and means known per se in conjunction with the wire section, press section, drying section and/or calendering section and therebetween.

The method and the apparatus according to the invention provide considerable advantages compared to the prior art.

Thanks to the invention, it is possible to remove water and moisture from the web more efficiently and achieve more easily a desired dry content of the paper. The invention enables one to control the transverse shrink of the web. Furthermore, the invention enables one to improve the runnability of the apparatus.

The invention provides a simple and cost-effective manner of making quality paper.

The method and apparatus according to the invention are applicable for making different kinds of papers.

20 DETAILED DESCRIPTION OF THE INVENTION

In the following section, the invention will be described with the aid of a detailed example of an embodiment with reference to the accompanying Fig. 1. Fig. 1 represents an apparatus according to the invention for making paper.

The apparatus for making paper presented in Fig. 1 comprises a hydraulic headbox section and a modified wire section 2 as well as modified press 3, drying 4 and calendering sections 15. Furthermore, the apparatus comprises dewatering units 8 according to the invention for enhancing the removal of water from the web that is being formed and for reducing the moisture content of the paper.

The drying section 4 comprises four dewatering units 8. The dewatering units comprise a belt circulating member 10 with a metal belt 11 and five rolls 12

over which the belt is arranged to pass and run, thus forming the belt-circulated dewatering member 10. In the dewatering unit 8, another belt circulating member 10 operates as an opposing cylinder 13 in order to form a nip. Heating of the metal belt and the web is performed by impingement units 16 and steaming boxes 17 in such manner that in the first and third belt circulating member, the impingement units 16 heat the upper side and the steaming boxes 17 heat the lower side of the web, and in the second and fourth belt circulating member, the impingement units 16 heat the lower side and the steaming boxes 17 heat the upper side of the web.

In this example, paper having a grammage of about 80gsm is formed from a fibre pulp known per se with the method and apparatus according to the invention. Pigment and typically used bonding agents and chemicals are added to the fibrous source material.

The papermaking is performed in a manner known per se and is not described in more detail in this context.

It was observed that with the method and apparatus according to the invention, it is possible efficiently to remove water from the paper to be formed and to optimize the moisture content of the paper. Furthermore, it was observed that the runnability of the apparatus could be improved.

The method and apparatus according to the invention are applicable in different embodiments for making the most different kinds of papers.

The invention is not limited merely to the example referred to above; instead many variations are possible within the scope of the inventive idea defined by the claims.

CLAIMS

1. A method for removing water in the production of paper, wherein paper is formed by feeding pulp to a wire section through a headbox, a web is formed
5 at the wire section, and the web is led from the wire section to a drying section through a press section, characterized in that dewatering of the web is enhanced and moisture content of the paper is reduced by removing water from the web that is being
10 formed by at least one dewatering unit comprising a belt circulating member with a belt and at least two rolls over which the belt is arranged to pass.

2. An apparatus for making paper, the apparatus comprising a headbox section and a wire section (2), a press section (3) and a drying section (4),
15 characterized in that the apparatus comprises at least one dewatering unit (8) for enhancing the removal of water from the web (5) that is being formed and for reducing the moisture content of the paper, the
20 dewatering unit (8) comprising a belt circulating member (10) with a belt (11) and at least two rolls (12) over which the belt is arranged to pass.

3. The apparatus according to claim 2, characterized in that the dewatering unit (8)
25 comprises an opposing cylinder (13) for forming a nip with the belt circulating member (10).

4. The apparatus according to claim 2 or 3, characterized in that the opposing cylinder (13) is selected from the group of: a roll, a cylinder,
30 a slide shoe, a static shoe and another belt circulating member.

5. The apparatus according to any one of claims 2 to 4, characterized in that the belt circulating member (10) comprises at least three rolls
35 (12) over which the belt (11) is arranged to pass.

6. The apparatus according to any one of claims 2 to 5, characterized in that heating means (16, 17) are arranged in conjunction with the belt circulating member (10) above and/or below the belt (11).

7. The apparatus according to any one of claims 2 to 6, characterized in that a perforated area is arranged on at least one edge of the belt (11) in the belt circulating member (10).

8. The apparatus according to any one of claims 2 to 7, characterized in that perforations are arranged to the belt (11) over such area that the edge of the web (5) can be kept against the belt (11) by suction provided through the perforations.

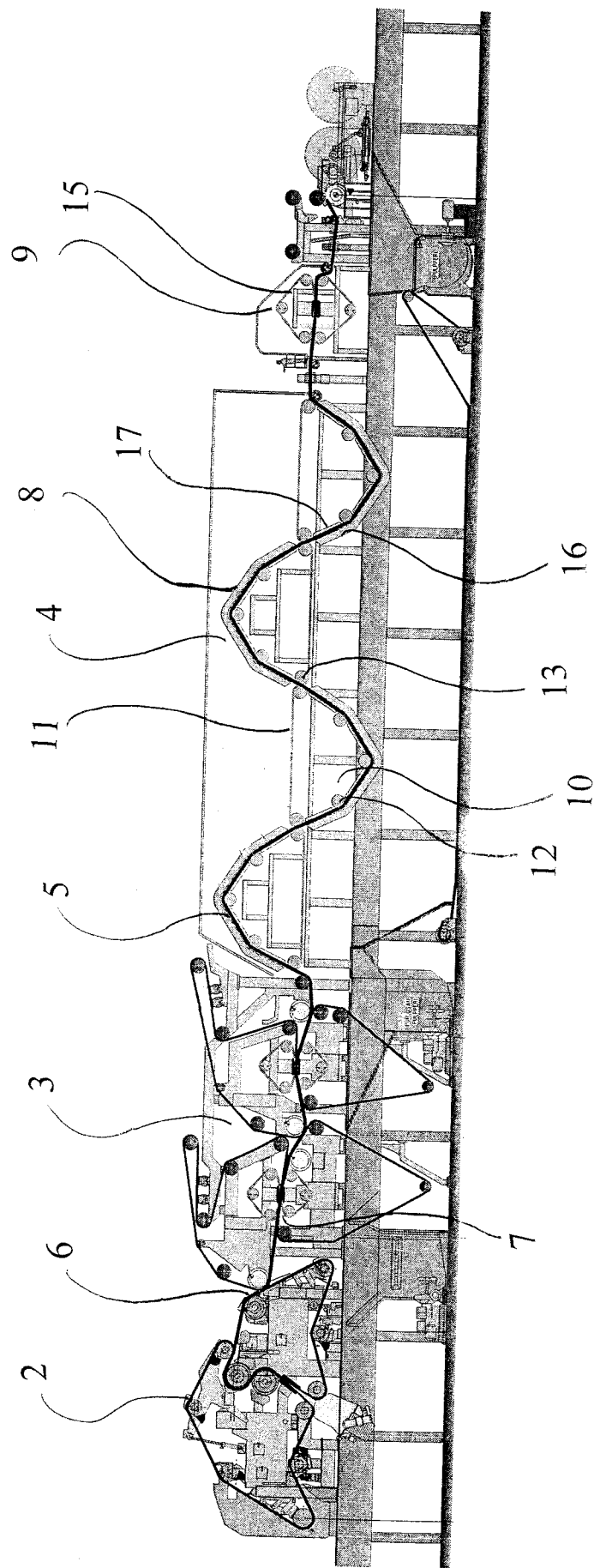


Fig. 1

INTERNATIONAL SEARCH REPORT

International application No.

PCT/FI2008/050325

A. CLASSIFICATION OF SUBJECT MATTER

See extra sheet

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)

IPC8: D21F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
FI, SE, NO, DK

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-internal, WPI, COMPDX

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2007068645 A1 (SILVA LUIZ) 29 March 2007 (29.03.2007) figure 1; paragraphs 1-2, 48-53	1-3, 5
Y	figure 1	4, 6-8
Y	Baumeister, W., Elbert, U., Holle, J. UPM-Kymmene Norland Papier AG. In: XII Valmet Paper Technology Days, Valmet Corporation, Jyväskylä, Finland 2000. Pp. 52-57, pp. 55-57, the Nordland PM 4 Rebuild configuration	4
Y	US 4416730 A (SCHIEL CHRISTIAN) 22 November 1983 (22.11.1983), abstract; figure 1	4
Y	WO 0034570 A1 (VALMET KARLSTAD AB et al.) 15 June 2000 (15.06.2000), figure 1; claim 1	4
Y	WO 0003084 A1 (VALMET CORP et al.) 20 January 2000 (20.01.2000), abstract; figure 1	4, 6
Y	FI 89614 B (VALMET PAPER MACHINERY INC - VALMET PAPER MACINERY INC) 15 July 1993 (15.07.1993), abstract; figure 1; claims 1-2	6



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 application or patent but published on or after the international filing date

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"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

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"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

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INTERNATIONAL SEARCH REPORT

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C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 5851353 A (FISCUS MARK WILSON et al.) 22 December 1998 (22.12.1998), figure 1; column 5, lines 15-47	7-8

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/FI2008/050325

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