



(51) International Patent Classification:

D21C 3/22 (2006.01) D21C 9/00 (2006.01)
D21C 7/00 (2006.01) D21D 5/02 (2006.01)
D21C 7/06 (2006.01) D21D 99/00 (2006.01)

(21) International Application Number:

PCT/SE2019/050473

(22) International Filing Date:

23 May 2019 (23.05.2019)

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data:

1850800-2 27 June 2018 (27.06.2018) SE

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(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JO, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH,

(54) Title: METHOD AND ARRANGEMENT FOR RE-COOKING KNOTS IN BATCH COOKING OF PULP

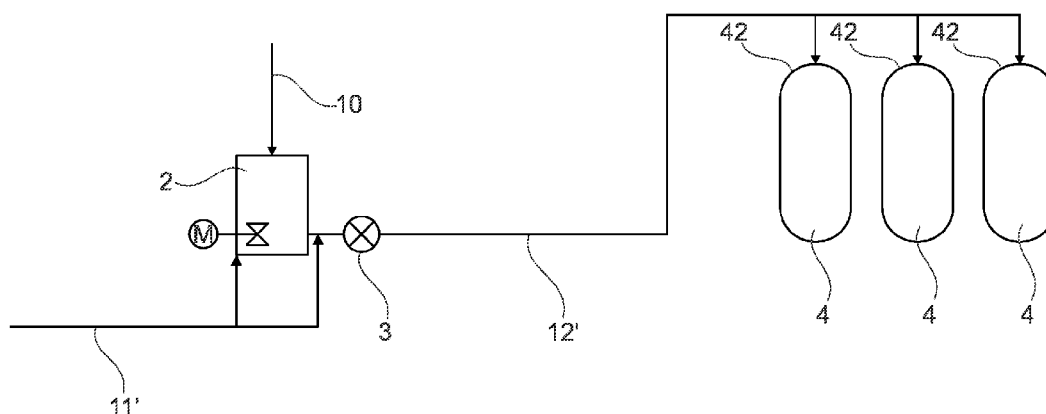


Fig. 3

(57) Abstract: The present invention relates to a knot re-cooking arrangement for batch cooking of pulp, comprising: a batch digester (4) for cooking wood chips in a Kraft process to produce pulp, a knot removal device for removing knots (10) from pulp that has been discharged from the batch digester (4), and a return system for returning knots (10) in a carrying medium (12') to the batch digester (4), wherein the return system is arranged to supply the knots (10) in the carrying medium (12') to an upper portion (42) of the batch digester (4) and wherein the return system is arranged to supply the knots (10) in the carrying media (12') to the batch digester (4) after a prehydrolysis step (107) but before a cooking step (104). The invention also relates to a method for re-cooking knots in batch cooking of pulp.

GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ,
UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ,
TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK,
EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV,
MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM,
TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW,
KM, ML, MR, NE, SN, TD, TG).

Published:

— *with international search report (Art. 21(3))*

METHOD AND ARRANGEMENT FOR RE-COOKING KNOTS IN BATCH COOKING OF PULP

TECHNICAL FIELD

The present invention relates to a method and arrangement for re-cooking knots in batch cooking of pulp, wherein knots previously separated from pulp that has been discharged from a batch digester are re-introduced into the batch digester for repeated cooking.

BACKGROUND

During batch cooking of wood chips to produce pulp incompletely cooked aggregates of wood fibers, known collectively as knots, are generally separated from the pulp after the cooking step to increase quality of the remaining pulp. Knots may comprise dense parts of branches, such as timber knots, but the term can also refer to other collections of fibers such as oversized wood chips for instance. If left in the pulp, the knots could damage washing equipment when the pulp is washed after cooking and they would also require large amounts of bleaching chemicals in subsequent bleaching stages.

Instead, the knots are removed and fed back to the digester in order to be re-cooked together with the next batch of wood chips, and through repeated separation and re-cooking the knots will eventually become part of the pulp so that an even quality is achieved.

The known prior art methods and arrangements within this field are however suffering from drawbacks such as high energy consumption and decreased cooking efficiency. There is therefore a need for improvements that increase efficiency in an energy efficient way.

SUMMARY OF THE INVENTION

The object of the present invention is to eliminate or at least to minimize the problems mentioned above. This is achieved through an arrangement and method for re-cooking knots in batch cooking according to the appended independent claims. Particularly advantageous features of the invention are set out in the dependent claims. The present invention is described with reference to producing a dissolved pulp in a batch cooking process, but it is to be noted that it may also be applied in a Kraft process.

Thus, the re-cooking arrangement for batch cooking of pulp comprises a batch digester for cooking wood chips in a process to produce pulp, a knot removal device for removing knots from pulp that has been discharged from the batch digester, and a return system for returning knots in a carrying medium to the batch digester, wherein the return system is arranged to supply the knots in the carrying medium to an upper portion of the batch digester. Thereby, the cooking of the knots is rendered more efficient without disturbing cooking of the newly introduced wood chips of a new batch. According to the invention, the return system is arranged to supply the knots in the carrying media to the digester after a prehydrolysis step but before a cooking step, preferably after a neutralization step. Thereby, the knots are introduced into the digester just before the cooking, which allows for an efficient re-cooking as well as making efficient use of the carrying medium.

According to an aspect of the invention, the carrying media comprises white liquor. Thereby, distribution of white liquor in the digester is improved and the use of black liquor as carrying medium can be avoided. Preferably, the carrying media also comprises washing filtrate.

5 According to another aspect of the invention the return system comprises a pump, thereby enabling the addition of knots in a carrying medium to the top of the digester.

The present invention also comprises a method for re-cooking knots in batch cooking of pulp, comprising cooking chips in a batch digester to produce pulp, removing knots from the pulp, adding the knots to a carrying media and returning the knots in the carrying media to the batch digester, wherein the knots and the carrying media are returned to an upper portion of the batch digester.

10 Additional benefits and advantages of the invention will become readily apparent to the person skilled in the art in view of the detailed description below.

DRAWINGS

The invention will now be described in more detail with reference to the appended drawings, wherein

15 Fig. 1 discloses a schematic view of an arrangement for re-cooking knots according to the prior art;

Fig. 2 discloses schematically the steps of batch cooking of pulp with addition of knots for re-cooking according to the prior art;

20 Fig. 3 discloses a schematic view of an arrangement for re-cooking knots according to the present invention; and

Fig. 4 discloses schematically the steps of batch cooking of pulp with addition of knots for re-cooking according to the present invention.

DETAILED DESCRIPTION

25 Fig. 1 shows an arrangement according to the prior art for re-cooking knots separated from pulp in a batch cooking process. Knots 10 that have been removed from pulp discharged from a batch digester 4 are delivered to a pumping tank 2 and mixed with a carrying medium 11, generally in the form of weak black liquor and/or washing filtrate. A pump 3 pumps the knots and carrying medium 12 to the batch digesters 4, to be introduced at a lower end 41 of the digesters 4. Such arrangements are generally used both for in a Kraft process and in a dissolving batch cooking. By supplying the knots and carrying medium 12 to the bottom of the digesters 4, disturbances to the cooking process from the carrying medium are kept to a minimum. After cooking, pulp is discharged from the batch digester 4 and a separation of knots from the pulp is repeated, generating a new quantity of knots 10 that are again supplied to the pumping tank 2. The new quantity of knots comprises material that has been cooked only once in the batch digester 4 but often also comprises knots that have already been re-cooked but still requires additional cooking. The removal of the knots 10 from pulp is a well-known process and can be realized in a number of ways, as will be readily understood by the skilled person.

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In Fig. 2, steps of batch cooking for a paper grade kraft are shown. First, a chip filling step 101 is performed where wood chips 13 are introduced into the digester 4, and at this stage the knots and carrying medium 12 are also supplied. Then, contents of the digester 4 are subjected to impregnation 102 wherein a first liquor 14 that is generally a mixture of filtrate and white liquor is supplied. After
5 impregnation, a hot liquor fill 103 is performed where a second liquor 15 comprising hot black liquor and hot white liquor is supplied to the digester 4 before a cooking step 104 is performed. After cooking 104, a wash displacement step 105 is performed and a third liquor 16 comprising filtrate is supplied. Finally, in a discharge step 106 where a fourth liquor 17 also comprising filtrate is supplied, cooked pulp is discharged from the digester 4.

10 Fig. 3 discloses a preferred embodiment of a knot re-cooking arrangement according to the present invention, wherein knots 10 are supplied to the pumping tank 2 as before. However, preferably another carrying medium 11' is used and the knots and carrying medium 12' is supplied to the digesters 4 in an upper portion 42.

By using an upper portion 42 as inlet for the knots and carrying medium 12', the efficiency of cooking
15 the knots is significantly improved, resulting in a lower probability that the knots 10 supplied to the digester 4 will require additional cooking afterwards. This in turn reduces the capacity necessary, so that a smaller quantity of knots and carrying medium 12' is supplied to the digester 4 and the capacity of the pumping tank 2 and pump 3 can consequently be reduced, rendering the arrangement more cost efficient. The carrying medium 11' is preferably white liquor if the re-cooking
20 arrangement is used in dissolving batch cooking but can be a mixture of black liquor and washing filtrate instead if used in a Kraft process.

Fig. 4 shows the steps of batch cooking for dissolving grade kraft, and with the method for re-cooking knots according to the present invention. In the chip filling step 101, wood chips 13 are introduced into the batch digester 4 and in a pre-hydrolysis step 107 the first liquor 14 comprising white liquor and filtrate is added. This is followed by a neutralization step 108 with hot liquor fill in which the
25 second liquor 15 comprising hot white liquor and hot black liquor is added. According to the present invention, the knots and carrying medium 12' are preferably added to the upper portion 42 or the digester 4 in this step. Next, the cooking step 104 is performed, followed by wash displacement 105 with the third liquor 16 comprising filtrate added to the digester 4. Lastly, the discharge step 106 is
30 performed and the fourth liquor 17 also comprising filtrate is added.

It is to be noted that although the prior art method shown in Fig. 2 discloses a batch cooking process for paper grade kraft, the present invention can be used with that process as well as long as the knots in the carrying medium are added in the upper portion 42 of the digester 4. It is also preferable to add the knots and carrying medium during the hot liquor fill just before the cooking step 104,
35 since this avoids the problem of the carrying medium decreasing the efficiency of the impregnation or pre-hydrolysis.

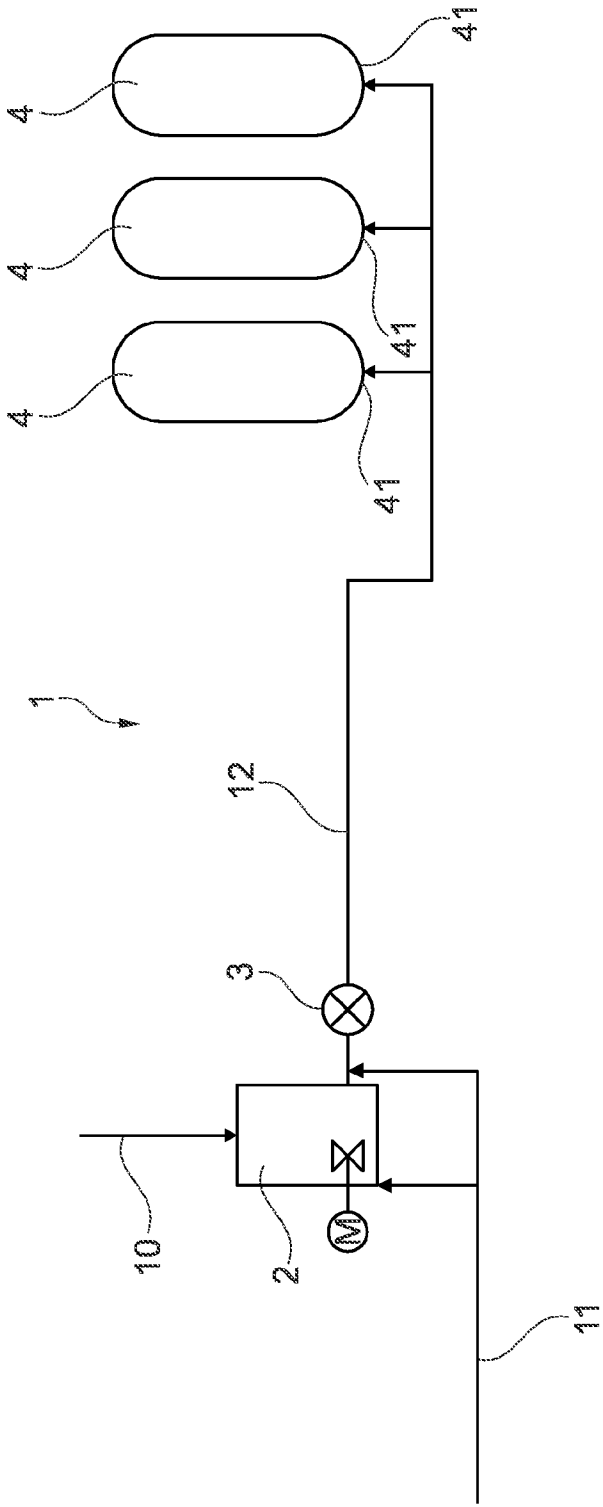
One advantage of the carrying medium 11' being white liquor is that white liquor distribution uniformity is improved and that the upper portion 42 of the digester 4 is cooled down by adding the carrying medium 11' at a time when the digester 4 is heated by reaction heat from the pre-hydrolysis
40 or impregnation. Also, white liquor is able to absorb some carbon dioxide that has been formed in pre-hydrolysis or neutralization.

The pump 3 is preferably configured to pump the knots and carrying medium 12' to a height of at least 20 m and to 7-8 bar pressure in order to be able to supply them to the upper portion 42 of the digester. In some embodiments, two pumps may be arranged in series in order to achieve this in an efficient way

- 5 It is to be noted that features from the various embodiments described herein may freely be combined, unless it is explicitly stated that such a combination would be unsuitable.

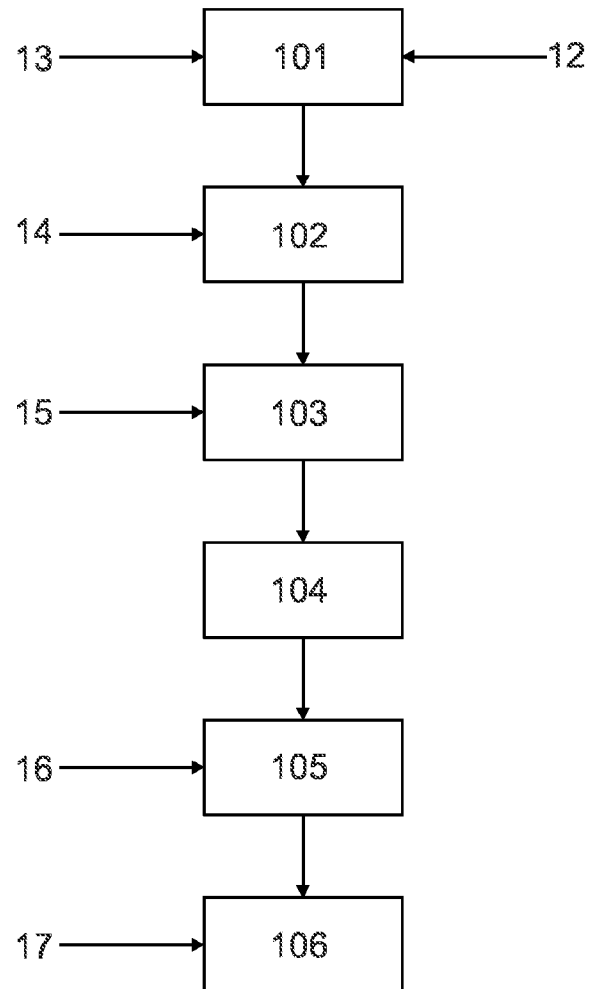
CLAIMS

1. Knot re-cooking arrangement for batch cooking of pulp, comprising:
 - a batch digester (4) for cooking wood chips in a process to produce pulp,
 - a knot removal device for removing knots (10) from pulp that has been discharged from
 - 5 the batch digester (4), and
 - a return system for returning knots in a carrying medium (12') to the batch digester (4),
 - wherein the return system is arranged to supply the knots (10) in the carrying medium (12')
 - to an upper portion (42) of the batch digester (4), **characterized in** that the return system is
 - 10 arranged to supply the knots (10) in the carrying media (12') to the batch digester (4) after a
 - prehydrolysis step (107) but before a cooking step (104).
2. Knot re-cooking arrangement according to claim 1, wherein the carrying media (12') comprises white liquor.
- 15 3. Knot re-cooking arrangement according to claim 1 or 2, wherein the carrying media (12') comprises washing filtrate.
4. Knot re-cooking arrangement according to any of claims 1-3, wherein the return system comprises a pump (3).
- 20 5. Method for re-cooking knots in batch cooking of pulp, comprising:
 - cooking chips in a batch digester (4) to produce pulp,
 - removing knots (10) from the pulp,
 - adding the knots (10) to a carrying media (12'), and
 - 25 returning the knots (10) in the carrying media (12') to the batch digester (4),
 - wherein the knots (10) and the carrying media (12') are returned to an upper portion (42) of
 - the batch digester (4), **characterized in** that the knots (10) and the carrying media (12') are
 - returned to the batch digester (4) after a prehydrolysis step (107) but before a cooking step
 - (104) in the batch digester (4), preferably after a neutralization step (108).
- 30 6. Method according to claim 5, wherein the carrying media (12') comprises white liquor and preferably also comprises washing filtrate.



Prior art
Fig. 1

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Prior art
Fig. 2

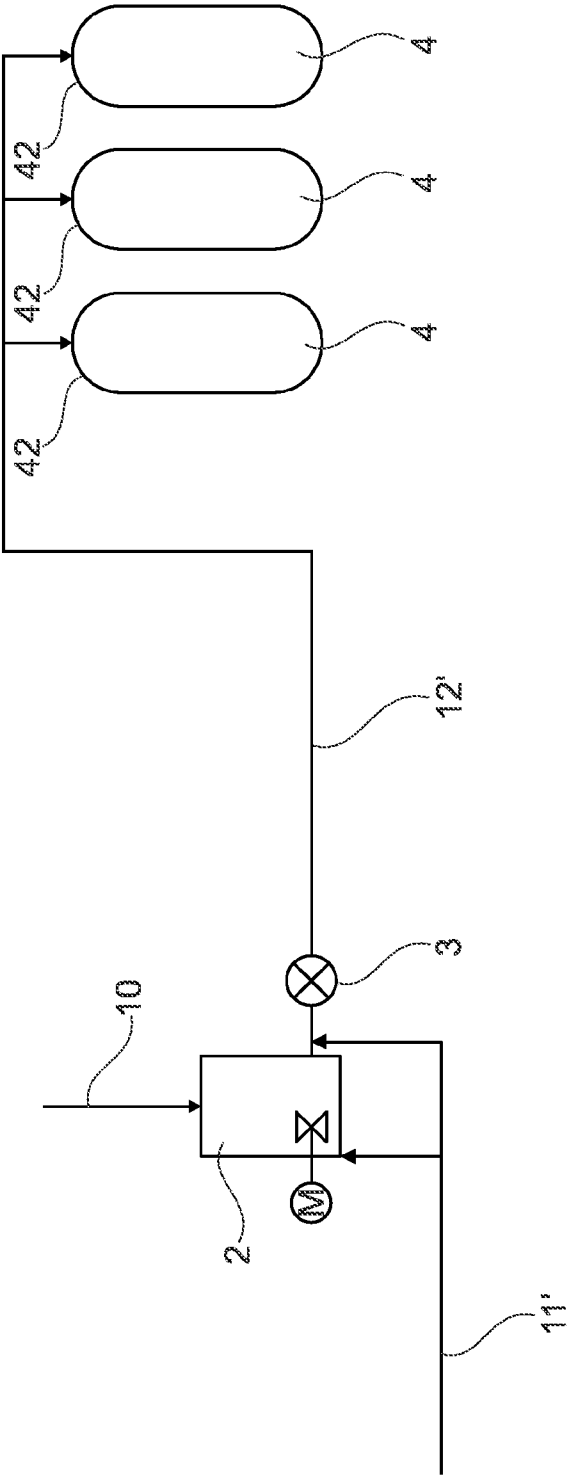


Fig. 3

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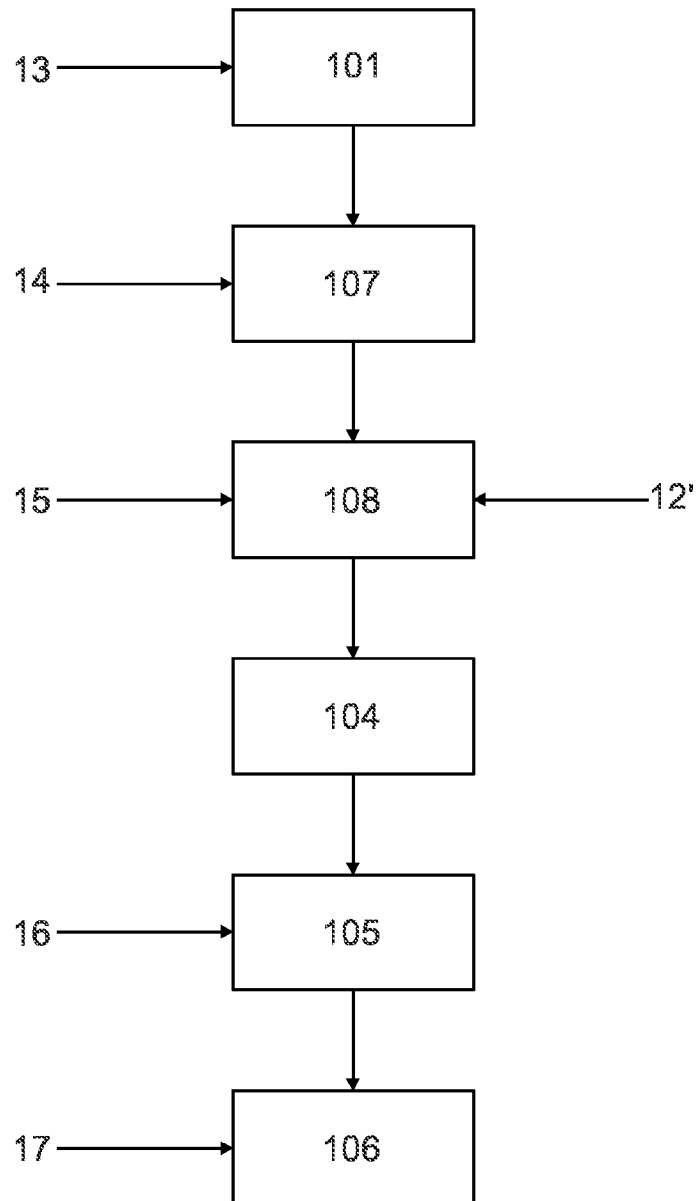


Fig. 4

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE2019/050473

A. CLASSIFICATION OF SUBJECT MATTER IPC: 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) IPC: D21C, D21D		
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) EPO-Internal, PAJ, WPI data		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 20030102093 A1 (STROMBERG C BERTIL), 5 June 2003 (2003-06-05); paragraphs [0002], [0006], [0012], [0017], [0020]-[0022]; figure 1; claims 1-19 --	1-6
A	Krotschek, A.W, 'Batch Cooking Technology and Equipment' In: Handbook of Pulp'. Sixta, H.: Wiley-VCH, 2006, p. 367-376, ISBN 3-527-30997-7, see pages 367-369.; pages 367-369; figures 4.128 --	1-6
A	US 20140053993 A1 (NI YONGHAO ET AL), 27 February 2014 (2014-02-27); paragraphs [0025], [0034], [0037]; figure 1 --	1-6
☒ 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	“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
“D”	document cited by the applicant in the international application	“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
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“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)	“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
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Date of the actual completion of the international search	Date of mailing of the international search report	
20-08-2019	21-08-2019	
Name and mailing address of the ISA/SE Patent- och registreringsverket Box 5055 S-102 42 STOCKHOLM Facsimile No. + 46 8 666 02 86	Authorized officer Adrian Celsi Telephone No. + 46 8 782 28 00	

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE2019/050473

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 2011102760 A1 (METSO PAPER SWEDEN AB ET AL), 25 August 2011 (2011-08-25); whole document -- -----	1-6

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International Patent Classification (IPC)

D21C 3/22 (2006.01)

D21C 7/00 (2006.01)

D21C 7/06 (2006.01)

D21C 9/00 (2006.01)

D21D 5/02 (2006.01)

D21D 99/00 (2006.01)

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/SE2019/050473

US	20030102093 A1	05/06/2003	NONE			
US	20140053993 A1	27/02/2014	CA	2824076 A1	21/02/2014	
			US	8877007 B2	04/11/2014	
WO	2011102760 A1	25/08/2011	NONE			