(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number : **0 518 851 A1**

(12) EUROPEAN PATENT APPLICATION

(21) Application number : **92890138.8**

(22) Date of filing : **09.06.92**

(51) Int. Cl.[5] : **D21C 7/00,** D21C 3/02

(30) Priority : **10.06.91 US 711528**

(43) Date of publication of application :
16.12.92 Bulletin 92/51

(84) Designated Contracting States :
AT BE CH DE DK ES FR GB GR IT LI LU MC NL PT SE

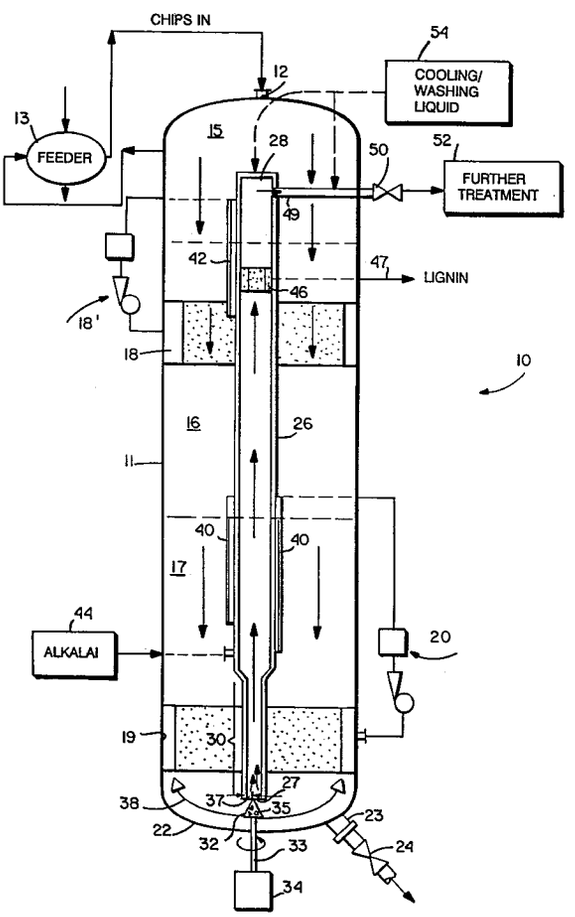
(71) Applicant : **Kamyr, Inc.**
Ridge Center
Glens Falls New York 12801-3686 (US)

(72) Inventor : **Henricson Kaj**
Sentnerlkuja 1, P.O. Box 5
SF-00441 Helsinki (Fi)

(74) Representative : **Haffner, Thomas M., Dr.**
Patentanwaltskanzlei Dipl.-Ing. Adolf Kretschmer Dr. Thomas M. Haffner
Schottengasse 3a
A-1014 Wien (AT)

(54) Reducing chips to fibres in continuous digesters to facilitate lignin extraction.

(57) A conventional continuous digester is modified to effect alkali extraction of lignin after washing. After washing (17) at the bottom of the digester (11), the chips are reduced to fibers and then subjected to alkali extraction. Reduction of fibers takes place by mechanically acting on the chips with a rotating element (32, 35), and/or by causing the chips to mechanically break up by flowing through a high speed, turbulent zone (30) for a short period of time. The extraction zone is provided by an upright conduit (26) within the digester vessel, concentric with it, and having an open bottom (27) spaced above the closed bottom (22) of the digester vessel, and above the rotating element. The diameter of the lowermost portion of the upright conduit is significantly less than the diameter of the main body of the upright conduit. During alkali extraction (44), the fibers are maintained under the same pressure as in the digester, at a temperature of greater than about 100°C, and in an alkaline environment (normally just with alkali remaining from digesting). After alkali extraction the pulp is cooled (with 54) and then passed through a blow valve (50) adjacent the top (12) of the digester.



EP 0 518 851 A1

It has been determined, as disclosed in prior U.S. Patent No. 4,971,658, that the lignin content of a comminuted cellulosic fibrous material suspension, typically during the manufacture of paper pulp, can be decreased by alkali extraction after conventional washing. Particularly, as disclosed in said U.S. Patent No. 4,971,658 it has been found that pulp at a high consistency range, after washing, can be treated with aqueous wash liquor in a hot extraction stage so as to remove the residual lignin. Utilizing some alkali, a temperature of over 100°C (e.g., about 100-150°C), and an extraction time of 1-30 minutes allows removal of lignin in an effective manner if the comminuted cellulosic fibrous material in fiber form rather than chip form.

According to the present invention, the basic teachings of U.S. Patent 4,971,658 are applied to a conventional, continuous digester, in continuous digesting process, so as to allow alkali extraction within the conventional continuous digester vessel. This is accomplished, according to the invention, by -- within the digester vessel itself -- reducing the chips to fibers, so that they may be effectively acted upon by an aqueous solution containing some alkali, at high temperature, so that any residual lignin can be removed. The manner in which the chips are reduced to fibers does not require a pressure reduction, which would not be practical within the continuous digester vessel itself. Rather, one or both of two different techniques may be utilized to reduce the chips to fibers, namely causing the chips to flow in a high speed, turbulent manner for a short period of time, and/or mechanically acting upon the chips after washing thereof has been completed.

According to one aspect of the present invention, there is provided apparatus for treating cellulosic chips in the production of paper pulp. The apparatus comprises: (a) a generally upright continuous digester vessel having a chip inlet at the top thereof, a digesting zone, and a washing zone adjacent the bottom thereof; (b) means for reducing chips within such vessel, in and adjacent the washing zone, into fibers; and (c) means for further treating the fibers, and then for withdrawing the fibers from the vessel. Preferably, the means (c) comprises means within the vessel for extracting lignin from the fibers.

The means (c) also preferably comprises a generally upright conduit substantially concentrically disposed in the vessel and having an open bottom adjacent, but vertically above, the vessel bottom, a closed top, and a withdrawal conduit extending from adjacent the closed top outside the vessel. The means (b) preferably comprises means defining a restriction at the open bottom of the upright conduit for effecting turbulent, high speed, flow of chips into the upright conduit, the turbulent, high speed flow breaking the chips into fibers. The means (b) also may comprise a rotating element disposed below the open bottom of the upright conduit, and rotatable about an axis concentric with the conduit, for mechanically engaging the chips to mechanically break them down into fibers. A bypass outlet may be disposed in the vessel bottom, and a bypass valve in the bypass outlet so that when the bypass valve is opened the chips and/or fibers may pass out of the vessel through the bypass outlet rather than through the upright conduit.

According to another aspect of the present invention, a method of treating cellulosic chips in the production of paper pulp, utilizing an upright vessel having a digesting zone and a washing zone, is provided. The method comprises the following steps, practiced continuously: (a) feeding cellulosic chips into the top of the vessel, (b) digesting the chips in the digesting zone with an alkali digesting liquor; (c) after step (b), washing the chips in the washing zone with an aqueous wash liquid at a temperature of about 120-140°C, (d) after step (c), breaking the chips within the vessel into fibers, and (e) treating the fibers in the vessel with alkali containing liquid, at a temperature of greater than 100°C, to extract lignin therefrom.

Step (d) is preferably practiced by effecting high speed, turbulent flow of the chips and/or by mechanically acting upon the chips within the vessel. Step (e) preferably takes place during up-flow of fibers and liquid, with alkali remaining from step (b), in an upright conduit concentric with the vessel, and at a temperature of above 100°C. Step (d) is practiced by providing a restriction in the open bottom of the upright conduit to provide a zone of high speed, turbulent flow.

According to still another aspect of the present invention, a method of treating cellulosic chips in the production of paper pulp is provided which comprises the steps of continuously: (a) digesting the chips, washing the digested chips at a temperature of about 120-140°C, while maintaining the chips at a pressure substantially greater than one atmosphere; (b) causing the digested and washed chips to break into fibers, while maintaining the pressure substantially the same as in step (a), by causing high speed turbulent, flow of the chips; and (c) effecting alkali extraction of lignin from the fibers. According to this method, step (b) is practiced by causing the chips to flow upwardly into a restricted opening bottom of an upright conduit, and step (c) takes place in a portion of the conduit above its restricted opening bottom, having a much larger diameter than the restricted opening.

According to yet another aspect of the present invention, a continuous digester for producing paper pulp is provided which comprises a generally upright conduit, disposed substantially concentrically within the vessel,and having an open bottom adjacent, but vertically above, the vessel bottom; the upright conduit having a first cross-sectional area portion at the open bottom thereof, and a second cross-sectional area portion above the first portion, the second cross-sectional area being much greater than the first cross-

sectional area; and a rotating element disposed between the conduit open bottom and vessel bottom and rotatable about an axis substantially concentric with the vessel and conduit.

It is the primary object of the present invention to provide an effective method and apparatus for reducing chips to fibers after washing, within a continuous digester itself, with subsequent alkali extraction to remove remaining lignin from the fibers. This and other objects of the invention will become clear from an inspection of the detailed description of the invention and from the appended claims.

BRIEF DESCRIPTION OF THE DRAWING

FIGURE 1 is a schematic side, cross-sectional view of an exemplary continuous digester utilizing the teachings according to the invention, and for practicing a method according to the present invention.

DETAILED DESCRIPTION OF THE DRAWINGS

Exemplary apparatus according to the present invention is shown generally by reference numeral 10 in Figure 1. The apparatus 10 includes a generally upright continuous digester vessel 11, having a conventional chips inlet 12 in the top thereof, with a chip slurry from a high pressure feeder 13 or the like. The basic elements of the digester vessel 11 are conventional. For example, there is an impregnation zone 15, a digesting zone 16, and a washing zone 17. Various extractions, screens and circulations are provided, for example, the conventional withdrawal screens 18 and circulation loop 18′ associated with the digesting zone 16, and wash screens 19 and associated wash loop 20 associated with wash zone 17. The vessel 11 has a closed bottom 22, although optionally a bypass conduit 23, having an associated bypass valve 24, may be provided in the bottom 22. Within the vessel 11, the slurry is maintained at a pressure substantially greater than one atmosphere.

According to the present invention, a generally upright conduit 26 is disposed within the vessel 11 preferably concentric with the vessel. The conduit 26 does not have too large cross-sectional area, so that there can be relatively free flow of the chips column downwardly within the vessel 11, as is conventional. The upright conduit 26 is generally concentric with the vessel 11, and has an open bottom 27, and a top 28. The open bottom 27 is adjacent, but vertically above (spaced from) the closed bottom 22 of the vessel 11.

The generally upright conduit 26, adjacent its open bottom 27 thereof, is configured to provide a means for reducing chips that have been washed in the zone 17 to fibers. By providing a high velocity, turbulent flow zone for the chips, the chips will be broken up into fibers gently without any mechanical device causing damage to fibers, from which lignin may be removed by alkali extraction. The particular configuration of the bottom of the conduit 26 that accomplishes this function is the small cross-sectional area bottom portion 30 thereof. The bottom portion 30 of the conduit 26 has a first cross-sectional area which is substantially less than the cross-sectional area of the main body of the conduit 26. For example, the diameter of the bottom portion 30 may be one-half, or less, than the diameter of the portion 26. The total length of the conduit 26 is preferably designed so that there is a residence time of fibers therein of about 30 minutes, so that effective alkali extraction may be performed.

According to the present invention, additional apparatus may also be provided for facilitating breakup of the chips into fibers at the bottom of the washing zone 17. For this purpose, a rotating element 32 may be provided. The element 32 may comprise a conical hub mounted on a shaft 33 connected to a rotor 34, and surface manifestations -- such as projections -- 35 may be provided on the surface of the conical hub 32 to facilitate de-chipping action. Also, the hub 32 is mounted so that is forms a narrow annular passageway 37 at the open bottom 27 of the conduit bottom portion 30, which will be the area of highest turbulence and velocity. The rotating element 32 typically is rotated slowly within the vessel 11, just fast enough so that it provides mechanical action on the chips which assist, with the high velocity, turbulent flow in conduit portion 30, to effect reduction of the chips to fibers.

Also, in order to facilitate uniform feeding of the chips to the conduit 26, it is desirable to provide a plurality of radially extending arms 38 from the hub 32, which rotate with the hub 32. The axis of rotation of the shaft 33 is substantially concentric with the conduit 26, and the vessel 11.

The hub 32, and the arms 38, or associated components, may be dimensioned and configured to facilitate feeding of the slurry into the open bottom 27 of the conduit 26.

Because the conduit 26 takes up the volume in the middle of the vessel 11 which is typically taken up by pipes for reintroducing extraction flows into the vessel 11, such extraction flow introducing pipes must be placed elsewhere. Preferably--as indicated by the wash circulation reintroduction pipes 40, and the digester recirculation introduction pipes 42 in figure 1, such reintroduction pipes may be mounted on the exterior surface of the upright conduit 26.

The conduit 26 may be supported within the vessel by any mechanism that will provide a minimum of chip hang-up, while at the same time securely supporting it. for example, various spider mechanisms may be provided at the top and/or bottom (such spider mechanism is not shown in the drawing for clarity of illustration) and connected to the vessel 11 sidewall, or closed bottom 22.

Within the conduit 26 is an alkali extraction zone.

By providing a slightly alkali environment and a temperature of greater than 100°C and considering that the fibers are in fiber form, rather than chip form, in the time span of about 30 minutes, lignin will be extracted from the up-flowing fibers in the conduit 26. Normally, there is sufficient alkali remaining in the slurry from the digesting zone 16 so that alkali need not be added to the conduit 26. However, under those circumstances where additional alkali is necessary to properly effect extraction, alkali may be added just above the bottom portion 30 (or even in or at the inlet of the bottom portion 30 so that mixing is quickly effected) from source 44.

As the slurry flows upwardly in the conduit 26, lignin may be removed therefrom, such as by utilizing withdrawal screen 46 and lignin withdrawal conduit 47 adjacent the top 28 of the conduit 26. Adjacent the top 28 is a slurry withdrawal conduit 49 which extends from adjacent the top 28 of the conduit 26 outwardly through the vessel 11 side wall. Preferably a throttling valve 50 or the like (also known as a "pressure reduction" or "blow" valve) is provided at that point, and the pulp, after passing through the conduit 49 and blow valve 50, goes to subsequent treatment stations 52, such as further washing, bleaching or the like stations. Washing or cooling liquor from source 54 can be added before valve 50 to 49 or 28 to cool down the pulp before it passes through the pressure reduction valve 50, to reduce damages to fibers.

Throughout treatment with the apparatus 10, as illustrated in Figure 1, the pressure is maintained substantially the same. Thus, rather than reducing the chips to fibers by reducing the pressure, as in said patent 4,971,658, reduction takes place as a result of intense mechanical action, and/or high velocity, turbulent flow. If it is ever desired to bypass the alkali extraction process in the conduit 26, all that is necessary is for the bypass valve 24 to be open, in which case the pulp will flow out bypass outlet 23 from the bottom 22 of the vessel 11.

Utilizing apparatus 10 it is thus possible to practice a method of treating cellulosic chips in the production of paper pulp which minimizes the amount of lignin remaining after acting on the material in a continuous digester. The method comprises the following steps:

(a) feeding cellulosic chips into the top of the vessel, as is conventional, utilizing a high pressure feeder 13 and the chips inlet 12;

(b) digesting the chips in the digesting zone 16 with an alkali digesting liquid. The conditions in the digesting zone 16 are conventional for continuous (e.g., Kamyr) digesters;

(c) after step (b) washing the chips in a washing zone 17 with aqueous wash liquid, at a temperature of about 120-140°C;

(d) after step (c), breaking the chips within the vessel into fibers. This is preferably accomplished by effecting high speed turbulent flow of the chips for a short period of time, through the restricted diameter portion 30 of the conduit 26, and the annular zone 37 leading into the open bottom 27 of the conduit 26. Also the dechipping action may be practiced by mechanically acting on the chips by rotating the conical hub 32, e.g., having surface manifestations 35 thereon, to engage the chips;

(e) treating the fibers in the vessel 26 with alkali containing liquid, at a temperature greater than 100°C to extract lignin therefrom. Preferably the alkali is merely that remaining from the digesting zone 16, but where necessary alkali can be added at 44. Lignin may be extracted through conduit 47, or may subsequently be removed after treatment in the vessel 11.

Ultimately, the fiber slurry in conduit 26 passes out through the conduit 49 and blow valve 50 to further treatment stations 52. The pulp may be cooled down before passing through the valve 50. The position of valve 50 at the top of the digester 11 reduces pressure drop over the valve 50 compared to normal practice where the valve is at the bottom of the digester 11.

It will thus be seen that according to the present invention a method and apparatus have been provided for the effective removal of lignin from chips. While the invention has been herein shown and described in what is presently conceived to be the most practical and preferred embodiment, it will be apparent to those of ordinary skill in the art that many modifications may be made thereof within the scope of the invention, which scope is to be accorded the broadest interpretation of the appended claims so as to encompass all equivalent structures and procedures.

Claims

1. Apparatus (10) for treating cellulosic chips in the production of paper pulp, comprising:
   (a) a generally upright, continuous digester vessel (11) having a chips inlet (12) at the top thereof, a digesting zone (15), and a washing zone (17) adjacent the bottom (22) thereof; and characterized by:
   (b) means for further treating (44, 46) the fibers, and then for withdrawing (49, 50) the fibers from said vessel; and
   (c) means (30, 32, 35) for mechanically reducing chips within said vessel, in and adjacent the washing zone, into fibers.

2. Apparatus as recited in claim 1 further characterized in that said means (b) comprises means (46, 47) within said vessel for extracting lignin from the fibers.

3. Apparatus as recited in claim 1 or 2 characterized in that said means (b) comprises a generally upright conduit (26) substantially concentrically disposed in said vessel and having an open bottom (27) adjacent, but spaced from, said vessel bottom, a closed top (28), and a withdrawal conduit (49) extending from adjacent said closed top outside said vessel.

4. Apparatus as recited in claim 3 further characterized In that said means (c) comprises means defining a restriction (27) at said open bottom of said upright conduit having a cross-sectional area much smaller than the cross-section at the top of said upright conduit for effecting turbulent, high speed, flow of chips into said upright conduit (26), said turbulent, high speed flow breaking the chips into fibers.

5. Apparatus as recited in any of the claim 1 to 4 characterized in that said means (c) further comprises a rotating element (32, 35) for mechanically engaging the chips to mechanically break them down into fibers.

6. Apparatus as recited in claim 5 further characterized in that said rotating element (32, 35) is disposed below said open bottom (27) of said upright conduit (26), rotatable about an axis (33) concentric with said conduit.

7. Apparatus as recited in any of the claim 1 to 6 characterized in that said means (b) includes a blow valve (50) located adjacent the top of said digester.

8. A method of treating cellulosic chips in the production of paper pulp, utilizing an upright vessel (11), having a digesting zone (15) and a washing zone (17), comprising the steps of continuously:

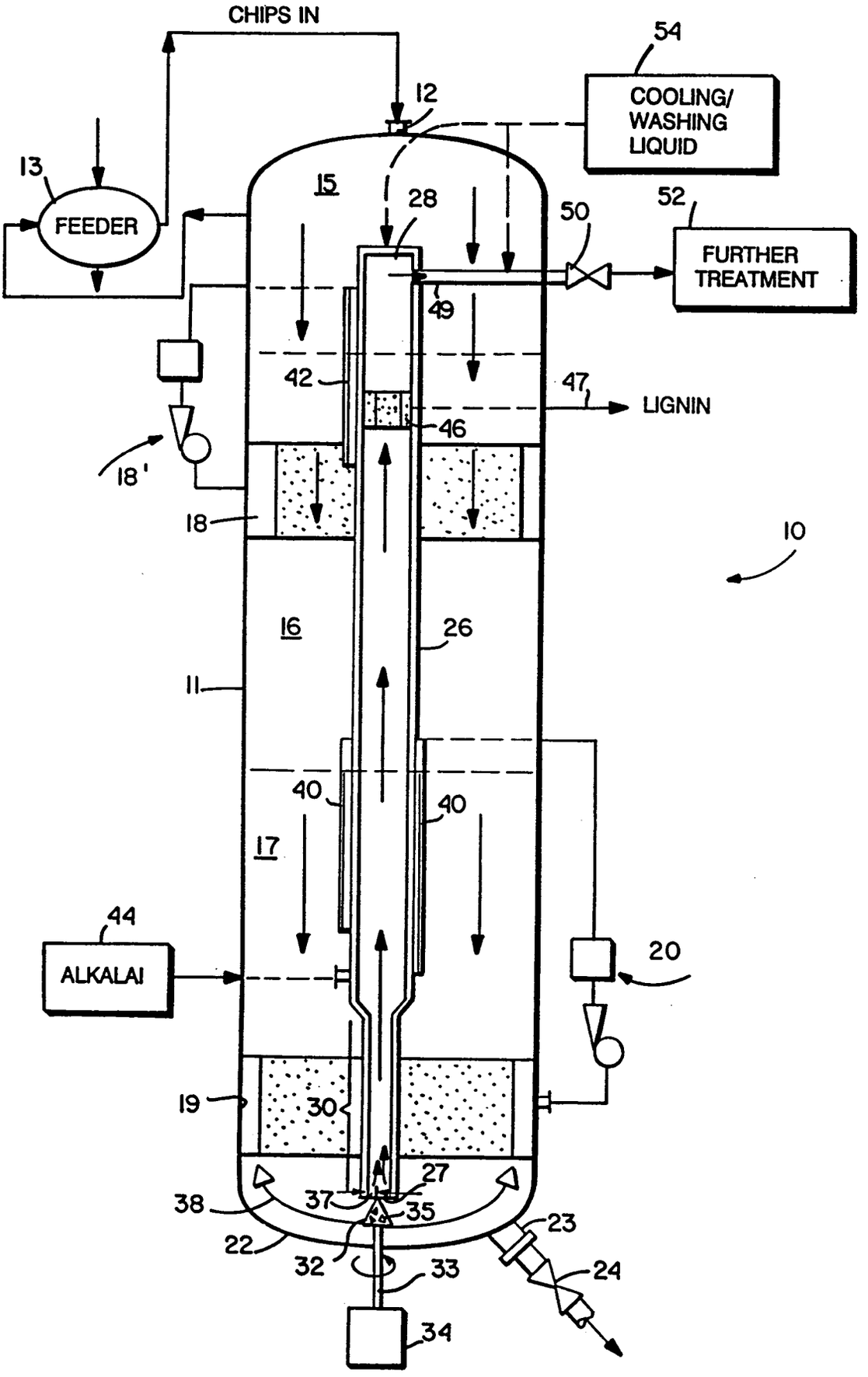
(a) feeding cellulosic chips into the top (12) of the vessel; (b) digesting the chips in the digesting zone with an alkali digesting liquor; and (c) after step (b), washing the chips in the washing zone with an aqueous wash liquid, at a temperature of about 120-140°C; characterized by:

(d) after step (c), mechanically breaking the chips within the vessel into fibers; and

(e) treating the fibers in the vessel with alkali containing liquid, at a temperature of greater than 100°C, to extract lignin therefrom.

9. A method as recited in claim 8 characterized by the further steps, after step (e), of: (f) passing the treated paper pulp through a blow valve (50), and (g) cooling the pulp (via 54) prior to passing it through the blow valve.

10. A method as recited in claim 8 or 9 characterized in that step (d) is practiced by effecting high speed, turbulent, flow of the chips for a short period of time, and by engaging the chips with a slowly rotating element.


CHIPS IN
54
COOLING/
WASHING
LIQUID
12
13
FEEDER
15
28
50
52
FURTHER
TREATMENT
49
42
47
LIGNIN
46
18'
18
10
16
26
11
40
40
17
44
ALKALAI
20
19
30
27
38
37
35
23
22
32
33
24
34

European Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP 92 89 0138

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
Y A	FR-A-2 277 183 (KAMYR INC.) * whole document * ---	1 3-6,10	D21C7/00 D21C3/02
Y A	US-A-4 869 783 (PRUSAS ET AL.) * column 4, line 9 - column 8, line 16 * ---	1 2,8	
A	EP-A-0 153 977 (LAAKSO) * page 1, line 3 - page 12, line 17 * -----	1,3-6,8,10	

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

D21C

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	14 SEPTEMBER 1992	HOPKINS S.C.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P0401)