



Europäisches Patentamt
European Patent Office
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(11) Publication number:

**0 106 609
A1**

(12)

EUROPEAN PATENT APPLICATION

(21) Application number: 83305945.4

(51) Int. Cl.³: D 21 C 9/10

(22) Date of filing: 30.09.83

(30) Priority: 30.09.82 US 431440
06.06.83 US 501682

(43) Date of publication of application:
25.04.84 Bulletin 84/17

(84) Designated Contracting States:
DE FR GB SE

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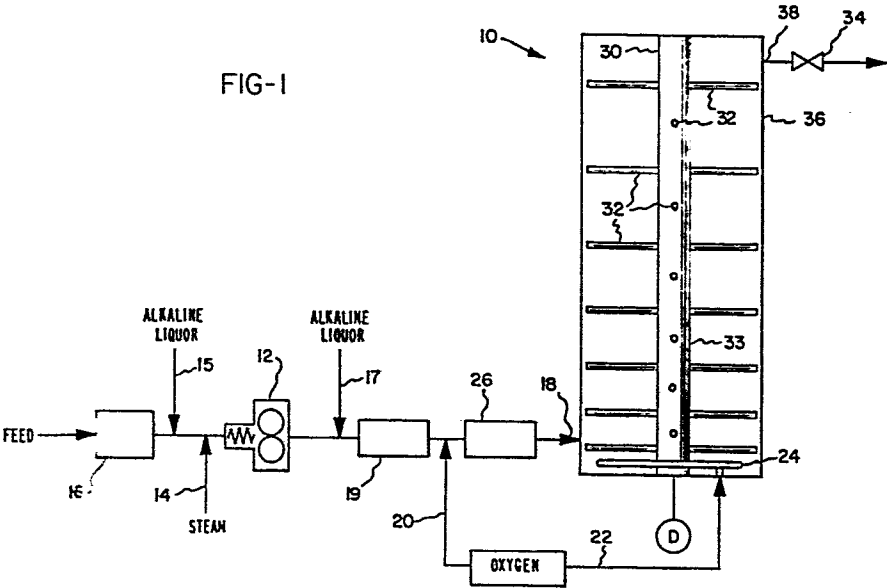
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(54) Apparatus and method for oxygen extraction of lower consistency pulp.

(57) An apparatus and process for oxygen delignification of lower consistency (i.e., 3-20%) pulps wherein pulp and alkaline chemicals are passed through a vertical upflow reaction tower (10) where they are continuously stirred by one or more mixing elements (32) mounted on a centrally positioned rotating shaft (30). Oxygen is added to the pulp either immediately prior to or in the reaction vessel near the base thereof. The oxygen delignification system is typically used as part of a bleaching sequence in which the pulp is preferably first chlorinated.

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FIG-1



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APPARATUS AND METHOD FOR OXYGEN EXTRACTION
OF LOWER CONSISTENCY PULP

This invention relates to a process and apparatus for delignifying pulp in the presence of oxygen and more particularly to a process and apparatus for oxygen extraction of lower consistency pulps using a vertical upflow reactor provided with at least one radially extending mixing element.

Conventional processes for bleaching pulp have utilized chlorine containing compounds. Today, environmental and economic considerations have resulted in a search for non-polluting processes which can offer the desired pulp yields and qualities. Much attention has been devoted to the use of oxygen in combination with alkaline chemicals to delignify pulp as a replacement for conventional processes.

Several workers have investigated oxygen delignification of high consistency pulp (i.e., 20-30% consistency). Verreyne et al, (U.S. Patent No. 3,660,225 of 1972) and Laakso et al, (U.S. Patent No. 4,177,105 of 1979) teach processes wherein the consistency of the pulp is increased to 20-30% and progressively transferred downwardly through successive trays in a reaction vessel where the oxygen contacts the fiber.

Oxygen delignification of high consistency pulp has not been generally accepted as the solution to the pulp industries pollution problems for several reasons. It is known that because the pulp used in these processes does not contain a high

amount of water, it is difficult to control the reaction temperature of the oxygen delignification system. Consequently, overheating of the pulp and pulp degradation can occur, and if conditions are appropriate combustion of the pulp can occur. Furthermore, special equipment is required to carry out the process which is relatively expensive. For example, special dewatering is required to obtain the higher consistencies and an expensive and elaborate reaction vessel is often used to treat the pulp.

Carrying out oxygen delignification of pulp at lower consistencies (e.g., 3-20% consistency) would be advantageous in that much existing mill equipment, including pulp washing and thickening equipment, is designed to operate in that consistency range, and no special equipment would be required to obtain that range. However, several problems are involved in treating lower consistency pulps. They tend to pass through the reaction vessel in channels, leaving dead areas, and they do not retain oxygen sufficiently to achieve a high delignification degree.

Various reactor designs have been suggested for reaction of lower consistency pulp with oxygen. Richter (U.S. Patent No. 3,963,561 of 1976 and U.S. Patent No. 4,093,511 of 1978) discloses an apparatus wherein a pulp-oxygen emulsion is moved upwardly through an open ended funnel-shaped body in a pressurized reactor and then cascades downwardly through a ring-shaped chamber. Sherman (U.S. Patent

No. 4,161,421 of 1979) discloses a pressurized vessel provided with a plurality of vertical tubular reaction columns access to which is selectively controlled to more carefully control the pulp retention time and to prevent channeling.

5 Roymoulik et al (U.S. Patent No. 3,832,276 of 1974) and Phillips (U.S. Patent No. 3,951,733 of 1976) disclose delignification of low consistency pulp (2-10% consistency) by flowing it upwardly through a reaction vessel without agitation wherein the non-dissolved oxygen content of the pulp is minimized to prevent agglomerated bubbles from forming and channeling through the reaction mixture.

In the foregoing upflow oxygen reactors, high shear mixers are used to disperse or emulsify oxygen gas in the pulp prior to its being introduced into the reactors. One example of such a high shear mixer is Bentvelzen et al (U.S. Patent No. 4,295,925). This has several disadvantages. High shear mixers require considerable horsepower to achieve an adequate dispersion of oxygen gas. Furthermore, high shear mixing in the presence of oxygen and alkali at high temperatures can result in damage to the pulp fiber which reduces the pulp strength. A further disadvantage of the foregoing systems is that high intensity dispersion of oxygen gas in the pulp can sometimes result in a foamy condition which reduces washing efficiency as the dissolved solids are washed from the fiber subsequent to delignification.

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On the other hand, if the oxygen gas is not well dispersed in the pulp, the gas bubbles tend to coalesce and this aggravates the channeling problem which many of these vertical tower delignification systems have. When channeling occurs, there is not uniform contact of oxygen with the fiber. Phillips and Roymoulik, noted above, show a complicated venting system to avoid entrapped gas bubbles.

Thus, there is a need for an oxygen extraction system suitable for treating lower consistency (i.e., 3-20%) pulps which avoids the problems of gas channeling, damage to the pulp fiber, high power demand, and the washing problems which have plagued previous systems.

The principal object of the present invention is to provide a process and an apparatus for oxygen extraction of lower consistency pulps, for example, pulps having from approximately 3-20% solids content.

A further object of the present invention is to provide a process and apparatus for the oxygen extraction of lower consistency pulps wherein it is not necessary to subject the pulp to intensive mixing which tends to damage the pulp.

Another object of the present invention is to provide an oxygen extraction system which entails a comparatively low capital outlay.

The foregoing objects and others are attained according to one aspect of the present invention which provides a process and apparatus for the oxygen extraction of lower consistency pulps

wherein the pulp is reacted with oxygen in a vertically oriented reaction vessel provided with at least one mixing element mounted on a rotatable shaft within the pressure vessel. In accordance
5 with the invention, pulp and alkaline chemicals are introduced into the lower portion of the reaction vessel, flow upwardly within the vessel, and are gently stirred by the at least one mixing element as the pulp reacts with an oxygen containing gas. The
10 gas may be directly introduced into the lower portion of the reaction vessel (for example by using a sparger) or the gas may be mixed inline with the pulp prior to its introduction to the reaction vessel.

15 In accordance with the present invention it has been found that low to medium consistency pulps can be effectively reacted with oxygen without the type of intensive mixing which has been known to damage pulps obtained by other processes. The
20 gentle mixing action of the rotating element or elements prevents channeling of either gas or pulp up through the reaction vessel so that uniform delignification is obtained. This continuous mixing also results in very fast reaction rates so that a
25 short retention time is adequate to achieve the desired degree of delignification in many cases.

The oxygen extraction system of the present invention is typically used in combination with other conventional treatments. In particular, the
30 oxygen extraction system of the present invention is preferably used in a bleaching sequence in which the

pulp is previously chlorinated. Chlorinated pulps have been found to be reactive with oxygen under mild conditions so that the lignin is readily extracted from the pulp in the oxygen extraction stage and bleaching to high brightness can be accomplished with relatively small dosages of other bleaching chemicals such as chlorine dioxide or sodium hypochlorite. It has also been found desirable to after-treat the pulp in a caustic extraction tower following the oxygen treatment.

Oxygen may be introduced into the lower portion of the reaction vessel, but it is preferred to mix oxygen or an oxygen-containing gas with the pulp immediately prior to its introduction into the reaction vessel. Thus, in accordance with one embodiment of the invention, the pulp and oxygen containing gas are pre-mixed inline using a low intensity motionless mixer, diffuser, injector, or the like. The oxygen gas may only partially dissolve in the aqueous medium at the bottom of the reaction vessel, but as the gas bubbles and pulp move up through the vessel, the gentle mixing action of the rotating mixing element or elements causes the remaining gas to dissolve. The presence of large gas bubbles of a size up to 1.3cm (0.5 inches) diameter is not detrimental. Thus, intensive mixing to form a gas-pulp emulsion is not required or used in the present invention.

In a preferred embodiment, a plurality of horizontally extending mixing elements are utilized and may be spaced evenly or unevenly along the

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vertical mixing shaft. In some cases it is desirable that there be a higher number of mixing elements per unit length in the lower portions of the reaction vessel near the pulp inlet. The mixing
5 elements may be simply horizontal sections of pipe mounted on the shaft or more sophisticated design
• elements may be used such as paddles of various configurations, ribbon flight screws, modified
10 ribbon flight screws, and the like. The mixing elements need not extend along the entire length of the reaction vessel but may be located adjacent the inlet of the vessel to promote initial mixing of the pulp and oxygen gas.

As the mixing elements rotate in the
15 reaction vessel, the pulp tends to rotate with them. Better mixing and improved contact is achieved if means are provided within the vessel to slow the pulp's rotation. Thus, in accordance with another embodiment of the invention, anti-rotation
20 means such as a plurality of spline bars are vertically mounted on the inside walls of the reaction vessel. To prevent gas channeling along the bars, the bars are interrupted along the length of the vessel.

25 The invention apparatus is useful for oxygen extraction of lower consistency pulps, for example, pulps having from approximately 3 to 20% by weight solids and is preferably used for pulps of about 6 to 15% consistency.

30 In order that the invention may be more readily understood, reference will now be made to the accompanying drawings, in which:

Figures 1, 2 and 3 are schematic flow diagrams illustrating the invention process and apparatus;

5 Fig. 4 is a side cutaway view of the reaction vessel illustrating mixing elements having reinforcing bars extending therebetween; and

Fig. 5 is a top view taken along line 5--5 in Fig. 4.

10 Almost any type of fibrous materials can be treated in the present invention including kraft pulp, sulfite pulp, semi-chemical pulp, chemi-mechanical pulp, and mechanical pulps. Wood pulps or agricultural fiber pulps can be treated in
15 the process. Especially suitable are pulps which have been chlorinated.

Figure 1 illustrates one example of an oxygen extraction system in accordance with the present invention wherein oxidation extraction is
20 carried out in a vertical reaction vessel 10 provided with a rotating shaft 30 which carries a plurality of mixing elements 32. The extraction vessel 10 may be pressurized or the pressure differential established by the height of the vessel
25 may be sufficient for the reaction.

Pulp at from 3-20%, and preferably 6-15%, consistency is introduced into reaction vessel 10 by pump 12. For pulp consistencies up to 6%, a centrifugal pump be utilized. For consistencies
30 greater than 6%, it is preferred that a thick stock pump be utilized. For example, pump 12 may be a

Cloverotor pump available from the Impco Division of Ingersoll-Rand Co., Nashua, New Hampshire, a thick stock pump manufactured by Warren Pumps, Inc., Warren, Massachusetts, or any other type of thick
5 stock or high density pump known in the industry.

Prior to introducing the pulp into thick stock pump 12, steam may be injected into the pulp via line 14. Steam may be mixed by a conventional single shaft or double shaft mixer. The steam aids
10 in expelling excess air from the pulp and also raises the temperature of the pulp somewhat.

Additionally, a portion of the total amount of the charge of alkaline material may be added prior to the introduction of the pulp into the thick stock
15 pump 12 via line 15. A convenient point of addition is at the discharge of the pulp from a washer. The alkaline material serves to lubricate the pulp for easier pumping as well as to insure that the pulp will have an alkaline pH when it enters the reaction
20 vessel 10. To minimize pulp degradation, however, it is sometimes preferred to add part or all of the alkaline charge downstream of pump 12 at line 17. The alkali is added immediately upstream of the inline mixer 19. Various inline mixers can be used
25 in the present invention. However, the use of mixers which generate high shear forces should be avoided. One example of a suitable mixer is a Komax triple action motionless mixer manufactured by Komax Systems, Inc., Long Beach, California.

30 Generally, the total alkaline material charge will amount to approximately 0.5 to 20% by

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weight calculated as Na_2O of the moisture free pulp. Examples of alkaline materials suitable for use in the invention include sodium hydroxide, sodium carbonate, sodium borate compounds, ammonia, kraft white liquor, oxidized kraft white liquor, kraft green liquor, and mixtures thereof although other known alkaline pulping liquors may also be used.

Oxygen may be introduced to the pulp slurry by line 20 upstream of the pulp inlet 18 located near the bottom of the reaction vessel. Alternatively, oxygen may be introduced directly into the bottom of the vessel 10 by line 22 through a sparging device 24. In the former case, an inline motionless mixer 26 may be inserted into the pipe section between line 20 and the vertical reaction vessel 10 to disperse the oxygen in the pulp slurry.

As a further alternative, the oxygen gas may be pre-dispersed in a liquid using a venturi type mixer, motionless mixer, injector, or diffuser, and this dispersion can be added to the pulp through line 20 or 22. A liquid which can be used for this purpose is the filtrate collected downstream upon washing the oxygen treated pulp. As a further alternative, the oxygen may be mixed with an alkaline liquid containing part or all of the alkali requirement for carrying out the delignification reaction.

The reaction vessel 10 is preferably cylindrical having a length to diameter ratio of at least 3 to 1. Lower ratios may result in channeling

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of gas or pulp up through the reactor. A vertical shaft 30 which carries a plurality of horizontally extending mixing elements 32 is coaxially mounted within the vessel 10. The mixing elements may be
5 simply horizontal sections of pipe mounted through the vertical shaft 30 or more sophisticated design elements could be used such as paddles of various configurations and ribbon flight screws. It is not necessary that the mixing elements be evenly spaced
10 along the shaft 30. In some cases, it is desirable to have a larger number of elements per unit length of shaft in the bottom portion of the vessel near the pulp inlet 18 as shown in shaft portion 33.

Shaft 30 is rotated by drive means D. The
15 speed of rotation is generally between 0.5 and 500 rpm, but speeds of 5 to 50 rpm are preferred. This gentle agitation has been found to provide adequate mixing of pulp with oxygen without the deleterious effects that high shear mixers cause. The speed of
20 rotation of the shaft is coordinated with other reaction conditions including the reaction temperature and pressure to provide a suitable retention time to achieve the desired degree of delignification for the particular pulp treated.
25 Generally suitable retention times range from approximately 5 seconds to three hours and preferably between 10 seconds and 30 minutes. The temperature of the delignification reaction can vary over a very wide range but typically ranges from
30 approximately 50 to 160°C. Use of protector chemicals such as magnesium carbonate, magnesium

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hydroxide and magnesium sulfate are generally not required but may be desirable in some instances. These chemicals may be added to the pulp upstream of vessel 10 when they are used.

5 The pressure in the reaction vessel is typically between 1.0 and 20.7 bars (15 and 300 psi (Gauge)) and preferably between 1.4 and 6.9 bars (20 and 100 psi (Gauge)). The solubility of oxygen is higher at higher reaction pressures and, therefore,
10 higher pressures are desired where a high degree of delignification must be achieved. In some cases a valve 34 may be located at the discharge end 36 of the vessel to control the reaction pressure. In other cases, especially where a low degree of
15 delignification is required, the top of the vessel may be open to the atmosphere.

Air is generally not used as the oxygen containing gas because of its relatively low oxygen content and because extraneous gases become
20 entrained in the pulp which is detrimental for washing. Typically oxygen having a purity of 90 to 99.9% is used. The oxygen dosage on the pulp ranges from approximately 0.1 to 15% and preferably 0.4 to 4% by weight oven dry pulp.

25 The vessel 10 is preferably operated so that no separate gas phase exists at the top of the vessel. Rather, it is preferred that the process be carried out with vessel 10 completely filled with the pulp suspension. If any excess gas does exist
30 at the top of vessel 10 it will easily separate from the pulp and will not be in the form of tiny bubbles

which create foam or interfere with subsequent washing of the pulp. The treated pulp is discharged from the reaction vessel through outlet 38. From outlet 38, the pulp may be directed to a storage or retention tank or to additional treatments such as a caustic extraction tower. Alternatively, the pulp may be conveyed to a tank for dilution prior to washing.

Above, the basic elements of the oxygen extraction system of the present invention have been described. Those skilled in the art will understand that this system may be used in combination with a number of bleaching sequences. Some typical sequences are reported by Lindstrom et al, TAPPI Volume 64, pp. 91-94 (June 1981). One example of a bleaching sequence in which the oxygen extraction system of the present invention may be utilized is illustrated in Figure 2.

Figure 2 illustrates an embodiment of the invention wherein the invention apparatus is used in combination with a chlorination tower and a caustic extraction tower. In accordance with this embodiment, a feed pulp is fed by line 40 to a chlorination tower 41 where the pulp is bleached and chlorinated in a conventional manner. The chlorinated pulp product is thereafter washed and fed to the invention apparatus 42 in a manner similar to Figure 1. Steam may be added to the chlorinated pulp by line 14 and the pulp may be pre-treated with an alkaline liquor by line 15, but it is also possible to add the total alkali charge

downstream of pump 12 through line 17 using an inline motionless mixer 19. As in Figure 1, a thick stock pump 12 pumps the pulp to the bottom of the oxygen extraction tower 42. Oxygen gas is added to the pulp by line 44 immediately upstream of a conventional inline mixing device 46 whereafter the pulp is introduced into the bottom of tower 42 at inlet 48.

The oxygen extraction tower 42 is equipped with a vertical shaft 50 having mounted thereon a plurality of radially extending mixing elements 52. The mixing elements may be simply horizontal sections of pipe mounted on shaft 50 or they may be more elaborate configurations as discussed above. In Figure 2, the number of mixing elements 52 in the vicinity of the inlet 48 is greater per unit length than in the upper portion 54 of the tower.

The shaft 50 is rotated by a drive means D at the rotational velocities previously indicated. To slow the tendency of the pulp to rotate around the delignification tower and to improve mixing, a plurality of anti-rotation means 56 are provided on the inside walls of the tower 42. The anti-rotation means illustrated in Fig. 2 are spline bars, typically one-half inch to one inch wide strips of metal, which are mounted vertically on the inside wall of the tower 42. These spline bars act to slow the rotation of the pulp. To prevent the oxygen-containing gas from channeling up the spline bars 56, the bars are interrupted and staggered along the inside surface of the tower. The

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anti-rotation means may take other forms than the illustrated spline bars, for example, horizontal pegs or baffles may be mounted on the inside of the tower.

5 The pulp is discharged through outlet 58 which feeds a valved line 60 from which the pulp is conveyed to a caustic extraction tower 62. Extraction tower 62 is constructed in a conventional manner. The tower may be of the type in which the
10 pulp is introduced from the top and flows downwardly. Following caustic extraction the pulp is washed at 64 and discharged for further treatment or use.

Fig. 3, in which like elements are
15 represented by like reference numerals, illustrates an embodiment of the invention in which shaft 30 extends only partially along the length of vertical reaction vessel 10. Shaft 30 carries on it a ribbon flight mixing screw 70 which provides gentle
20 agitation to the pulp to provide adequate mixing. Of course it will be recognized that other types of mixing elements including mixing screws having modified flights, paddles, and the like may also be utilized in the practice of the present invention.

25 Figs. 4 and 5 illustrate yet another embodiment of the invention in which the generally horizontally extending mixing elements 32 are linked together by vertical reinforcing bars 72 which add mechanical strength to the mixing elements.
30 Vertical spline bars 56 are again provided to slow the rotational movement of the pulp. Reaction

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vessel 10 is also illustrated having a modified base structure extending angularly upward to meet the sidewalls of the vessel. The mixture of pulp and oxygen is fed to the vessel through line 18 as
5 previously described. Oxygen can alternatively be added through line 23.

The present invention will be further understood by reference to the following non-limiting examples.

10 Example I

In the laboratory, a KAPPA 14.2 hardwood kraft pulp was treated with chlorine at 25°C for thirty minutes at a 3.5% pulp consistency by mixing the pulp and water containing chlorine in a
15 container. The chlorine dosage was 3% based on oven dry pulp. The pulp was then washed and treated with a 2.0% sodium hydroxide dosage at 80°C and at a 15% pulp consistency. The treatment with sodium hydroxide was carried out in a reaction vessel
20 equipped with a shaft passing along the length of the vessel. The shaft was equipped with radial mixing paddles.

In a first test, the treatment with sodium hydroxide was for thirty minutes with no oxygen
25 added to the vessel and the shaft was rotated at a speed of 3rpm. The brightness of this pulp after washing was 45.0. In a second test, oxygen gas was added to the reaction vessel to a pressure of 6.9 bar (100psig), and the mixing shaft was rotated at
30 20rpm. After thirty seconds, the oxygen pressure was reduced to zero, and the pulp was held at the

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same temperature of 80°C for thirty minutes without any further mixing. The brightness of this pulp, after washing, was 49.1. This example illustrates the effect of even a very short oxygen treatment
5 using low speed mixing on the brightness of pulp.

Example II

In a laboratory test to determine the effect of low intensity mixing on gas bubbles in a
10 vertical vessel, air was introduced into the bottom of a vertical reaction vessel containing softwood kraft pulp at 10% consistency. The vessel was cylindrical in shape, and the length-to-diameter ratio was 7:1. The vertical vessel was equipped
15 with a vertical shaft having horizontal mixing pegs located at intervals along the shaft. The vessel was constructed of plexiglass, so that the movement of gas bubbles through the pulp could be observed. The size of the gas bubbles at the bottom of the
20 reactor was between 0.3 and 1.3cm (1/8 inch and 1/2 inch) in diameter. When the vertical shaft was not turning, the gas bubbles tended to channel up through the pulp to the top of the vessel. However, when the shaft was turning at a low speed of
25 approximately 20rpm, the mixing pegs on the shaft subdivided the bubbles and prevented the channeling of gas as it rose through the reaction vessel. The laboratory test illustrates the effectiveness of low intensity mixing to prevent channeling and obtain
30 good gas contact with a pulp.

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CLAIMS

1. An apparatus for the oxygen delignification of a fibrous material characterized by:
 - a vertically oriented reaction vessel (10),
 - means (20,22,24) for supplying oxygen to
 - 5 said vessel,
 - means (18) for supplying pulp to a lower portion of said vessel for passage upwardly through said vessel in contact with said oxygen,
 - a centrally mounted shaft (30) rotatable in
 - 10 said vessel,
 - at least one mixing element (32) carried on said shaft and extending outwardly therefrom for stirring said pulp and enhancing the contact between said pulp and said oxygen as they move upwardly
 - 15 through said vessel, and
 - means (38) for removing treated pulp from the upper portions of said vessel.
2. An apparatus as claimed in claim 1, wherein said shaft (30) extends only a portion of the length of said vessel.
3. An apparatus as claimed in claim 1 or 2, wherein a plurality of vertically spaced elements (32) are carried on said shaft (30) and the number of mixing elements carried per unit length of said shaft is
- 5 greater in the lower portion of said vessel (10).

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4. An apparatus as claimed in claim 1, 2 or 3, wherein said apparatus further includes means for slowing the rotation of said pulp by said mixing elements in said vessel comprising spline bars (56) vertically
5 mounted on the inside walls of said vessel (10).

5. A process for the oxygen delignification of fibrous materials characterized by the steps of:
feeding said materials, alkaline chemicals, and oxygen to the lower portion of a vertically
5 oriented reaction vessel (10) equipped with an axially extending shaft (30) carrying at least one horizontally extending mixing element (32),
passing said materials, alkaline chemicals, and oxygen upwardly through said reaction vessel
10 (10),

continuously rotating said shaft (30) and said at least one mixing element (32) to enhance the mixing of said oxygen, alkaline chemicals, and materials, and
15 removing treated materials from the upper portions of said vessel.

6. A process as claimed in claim 5 wherein said materials have a consistency of about 3 to 20%.

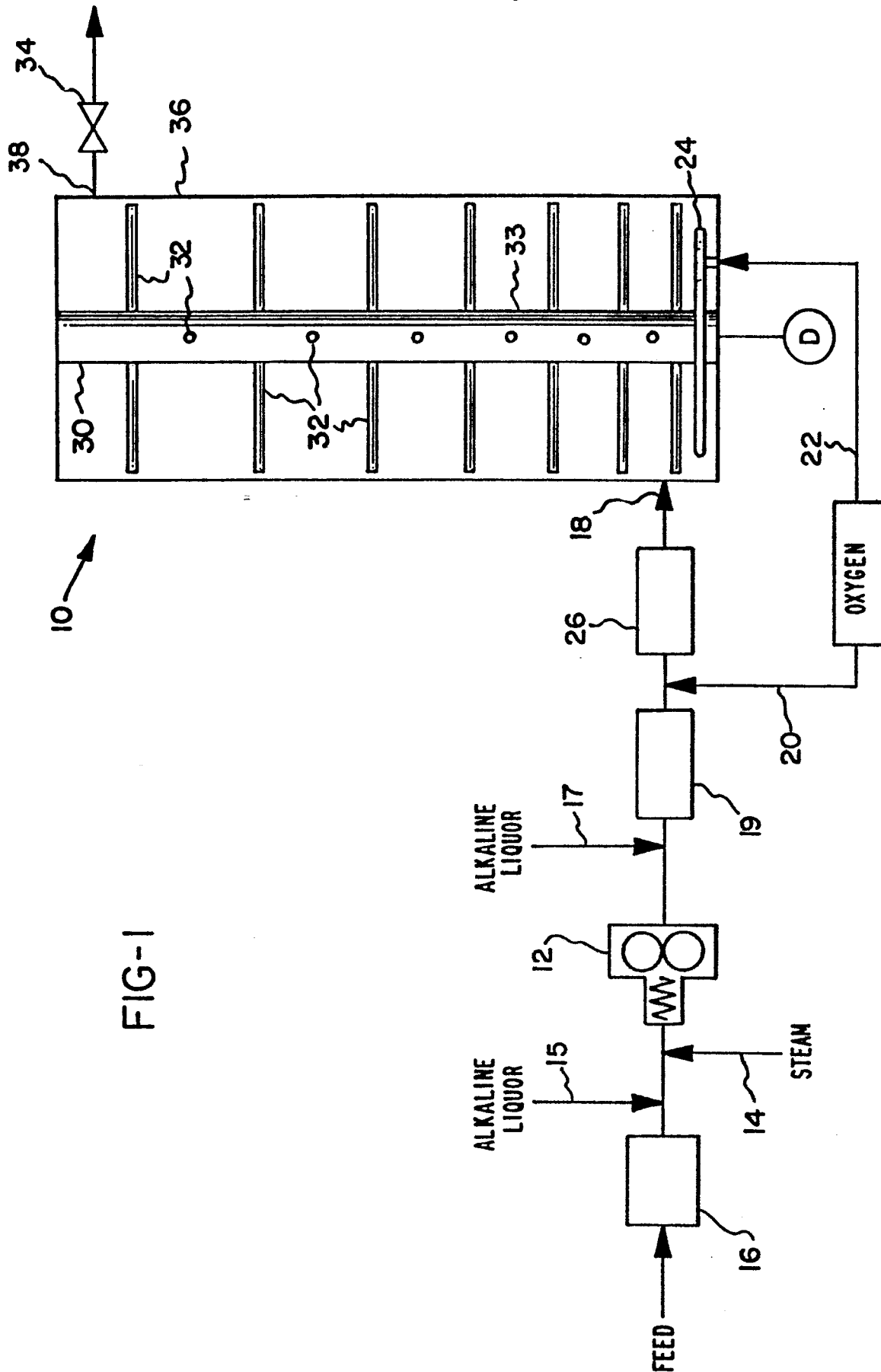
7. A process as claimed in claim 5 or 6, wherein said shaft is rotated at approximately 0.5 to 500 rpm.

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8. A process as claimed in claim 5, 6 or 7, wherein said oxygen is combined with said materials prior to entering into said reaction vessel.

9. A process as claimed in claim 5, 6, 7 or 8, wherein said oxygen is predispersed in a liquid.

10. A process as claimed in claim 8 wherein said oxygen is introduced immediately upstream from an inline mixer.



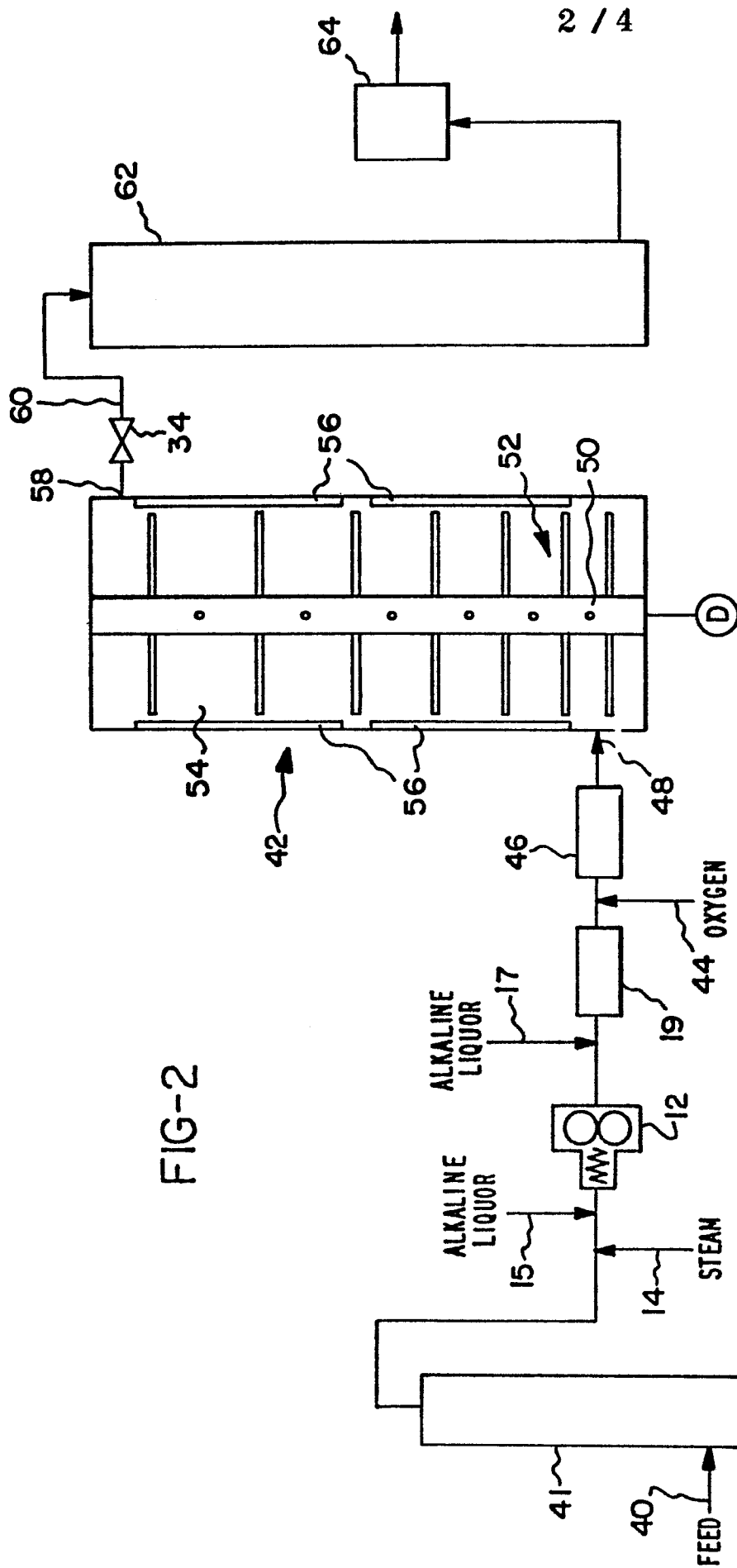


FIG-3

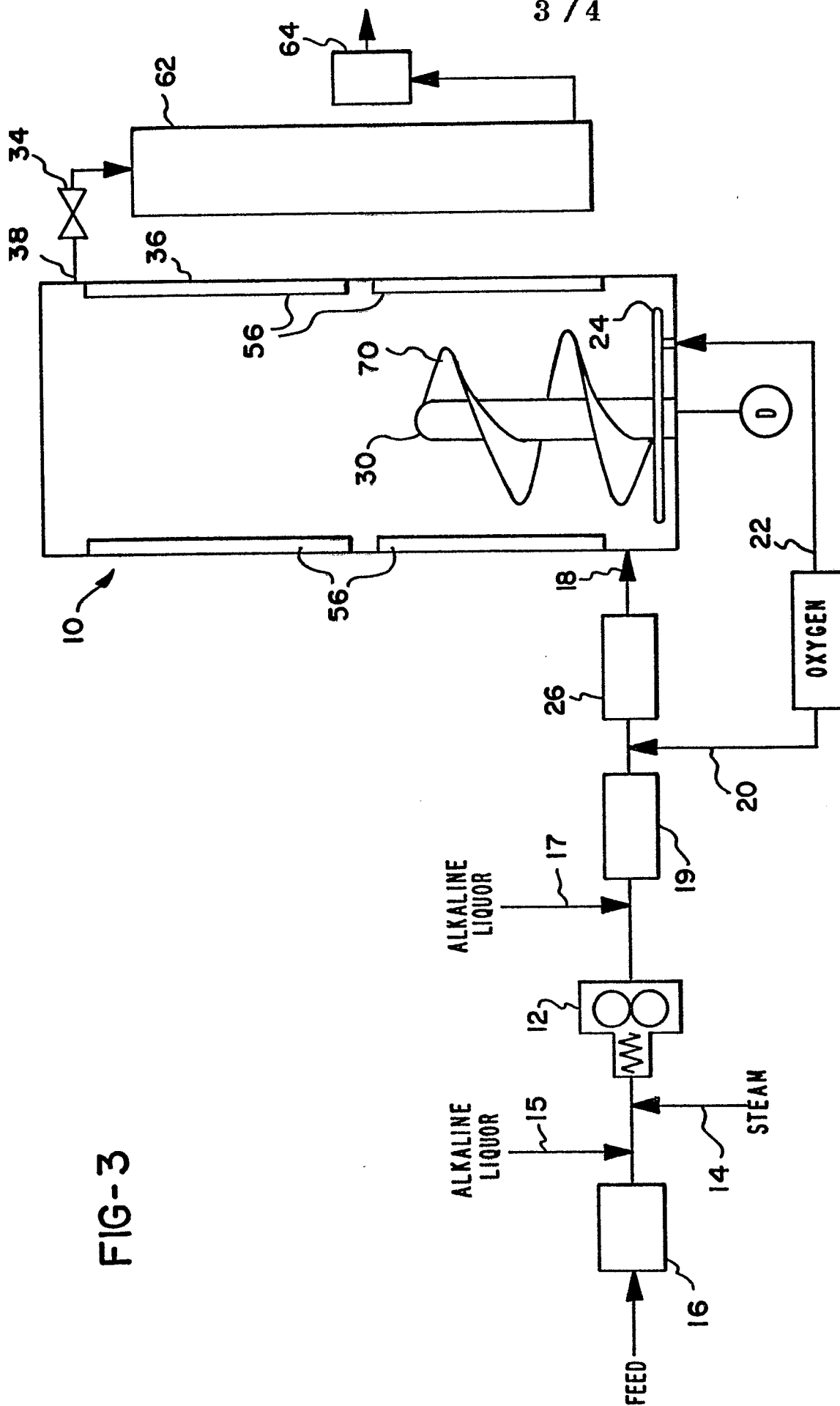


FIG-4

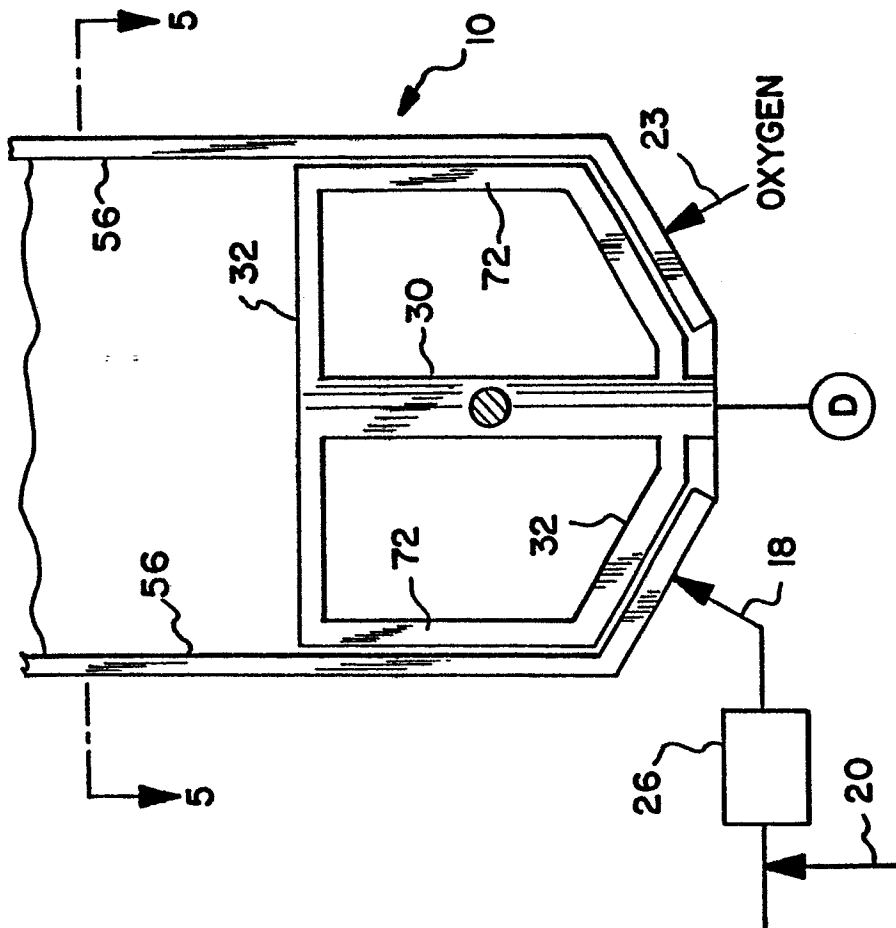
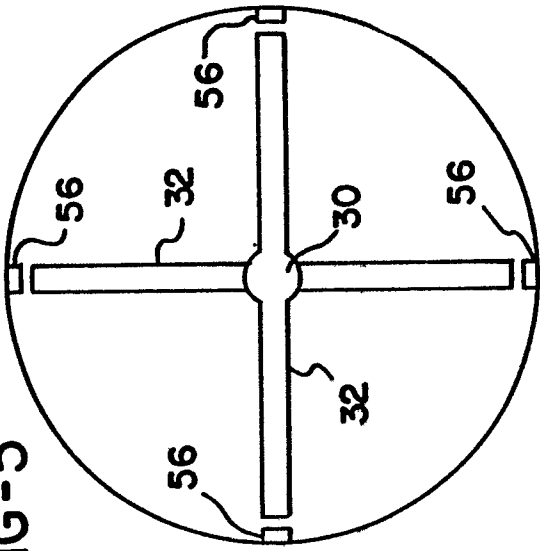


FIG-5





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EUROPEAN SEARCH REPORT

01 06609

Application number

EP 83 30 5945

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. 3)
X	US-A-2 516 447 (E.R. BURLING et al.) * The whole document *	1,5,6,8	D 21 C 9/10
A	--- US-A-4 209 359 (A. SETHY) * Figure 1; column 3, lines 31-48 *	4	
A	--- US-A-3 992 248 (A.M. HURTER) * Figure 1; column 1, lines 10-38,46-65; column 3, lines 12-52; column 4, lines 14-19 *	1,5,6,8	
D,A	--- US-A-3 951 733 (R.B. PHILLIPS)		
A	--- TAPPI J. TECHN. ASS. PULP PAPER IND., vol. 63, no. 4, April 1980, Atlanta, GA (US) L. NASMAN et al.: "Medium-consistency oxygen bleaching", pages 105-109		TECHNICAL FIELDS SEARCHED (Int. Cl. 3)
A	--- TAPPI J. TECHN. ASS. PULP PAPER IND., vol. 64, no. 8, August 1981, Atlanta, GA (US) J.J. RENARD et al.: "New opportunities for in-plant reduction of pollutants through process changes", pages 51-54 --- -/-		D 21 C
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 21-12-1983	Examiner NESTBY K.
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			



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EUROPEAN SEARCH REPORT

01 06609

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DOCUMENTS CONSIDERED TO BE RELEVANT			Page 2
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A	US-A-2 772 138 (F.B. EVANS)		

A	ABSTR. BULL. OF INST. OF PAPER CHEM., vol. 50, no. 3, September 1979, page 309, abstract no. 2848, Appleton, Wisc. (US) & JP - A - 77 132 101 (05-11-1977)		

			TECHNICAL FIELDS SEARCHED (Int. Cl. 3)
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 21-12-1983	Examiner NESTBY K.
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			