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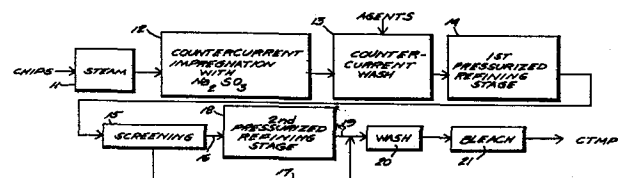
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Mechanical pulping.

Thermomechanical, chemimechanical, and chemithermo-mechanical pulps are produced in a manner such that they have enhanced drainage and strength, and/or can be bleached to enhanced brightness levels and in a simple manner. Chips are impregnated with chemical or thermal treating fluid, such as by passing heated sulfite liquor countercurrent to the flow of the chips (at 12). After impregnation, and where applicable cooking, the chips are washed by a countercurrent flow of wash liquid (at 13, 27) including chelating and surface active agents. Immediately after washing the chips are mechanically refined to produce a mechanical pulp by passing the chips through a first pressurized refiner (14, 38), screening (at 15, 39) the pulp discharge from the first refiner to provide first (16, 40) and second (17, 41) streams, passing the first stream to a second pressurized refiner (18, 43) having a discharge (19, 44), and passing the second stream directly to the discharge of the second refiner. Further treatment of the pulp, including bleaching (at 21, 57) utilizing hydrosulfite and/or peroxide, is effected in order to achieve a mechanical pulp having the desired properties.



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MECHANICAL PULPINGBACKGROUND AND SUMMARY OF THE INVENTION

The production of mechanical pulps is of increasing interest since a higher yield can be obtained from a given amount of raw material utilizing mechanical pulping processes vis-a-vis chemical pulping processes. Mechanical pulping, in general, refers to thermomechanical pulp (TMP), chemimechanical (CMP) and chemithermomechanical pulp (CTMP). While mechanical pulps can be useful for a number of purposes, oftentimes they cannot be made bright enough for many intended end uses, and their brightness tends to degrade over time. Further, the mechanical refining process utilized as the main component of mechanical pulping processes often results in breakdown of fibers having desirable characteristics so that the final pulp produced has relatively poor drainage properties, and relatively poor strength.

According to the present invention, a method is provided for enhancing the brightness and/or drainage and strength properties of mechanical pulp, whether it be TMP, CMP, or CTMP.

According to one aspect of the present invention, TMP, CMP or CTMP is produced by sequentially: (i) Impregnating comminuted fibrous cellulosic material with chemical or thermal treating fluid. (ii) Washing the impregnated material. The washing is preferably accomplished by passing a washing liquid including chelating and surface active agents countercurrent to the flow of material, and is effective to remove a number of materials that subsequently could have an adverse affect on pulp brightness, including residual cooking chemicals,

metals, color bodies, and resins. (iii) The washed material is mechanically refined to produce a mechanical pulp, preferably having a consistency of about 6-15 percent. And, (iv) further treatment, including bleaching with hydrosulfite and/or peroxide, of the mechanical pulp is effected in order to achieve the desired properties.

According to another aspect of the present invention, a CMP or CTMP pulp is produced by effecting a countercurrent flow of sulfite chemical and comminuted fibrous cellulosic material, to effect impregnation of the material. The material may subsequently be cooked, and thereafter is refined and further treated as described above. The countercurrent impregnation provides very effective penetration of the chips, or other material, with sulfite liquor, and ultimately results in more uniform removal of impurities from the chips in such a way as to improve pulp properties and decrease bleach costs.

According to yet another aspect of the present invention, a mechanical pulp is produced by series refining. Chips, or like comminuted cellulosic fibrous material, are pretreated, and then passed to a first pressurized refiner. From the first refiner the mechanical pulp passes to a screen, which screens out pulp portions in need of further refining into a first stream, and pulp fibers already having desired properties into a second stream. The first stream is passed to a second pressurized refiner having a discharge, and the second stream is passed directly to the second refiner discharge.

The mechanical pulp according to the present invention has enhanced strength and drainage, and can be bleached to a higher brightness level than is possible in the prior art, (e.g., 5 Kappa units

higher) and may be bleached to any given brightness level more easily.

It is the primary object of the present invention to provide mechanical pulps having enhanced
5 desired properties. 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 DRAWINGS

10 FIGURE 1 is a block diagram of exemplary apparatus for producing a chemimechanical pulp according to the method of the present invention;

 FIGURE 2 is a block diagram of exemplary apparatus for producing a chemithermomechanical pulp
15 according to the present invention;

 FIGURE 3 is a block diagram illustrating exemplary apparatus for producing a thermomechanical pulp according to the present invention;

 FIGURE 4 is a schematic view illustrating
20 exemplary apparatus useful in the practice of the present invention;

 FIGURE 5 is a schematic view of another exemplary form of apparatus for practicing the present invention; and

25 FIGURE 6 is a partial view of apparatus like that of FIGURE 4, for treating pulp in a wider concentration range (e.g., 5-50%).

DETAILED DESCRIPTION OF THE DRAWINGS

According to the present invention, mechanical pulps, particularly CMP, TMP, and CTMP, are produced so as to maximize drainage and strength properties, enhance brightness, and facilitate ease of bleaching. FIGURE 1 shows the step by step production of CMP according to a method of the present invention, while FIGURES 2 and 3 show methods for the production of CTMP and TMP, respectively, with stages therein identical to those in FIGURE 1 not illustrated.

With respect to FIGURE 1, hardwood or softwood chips, or other comminuted cellulosic fibrous material, are first steamed at station 11. Then they are subjected to countercurrent impregnation with sulfite (e.g. sodium sulfite) chemical at station 12, the countercurrent action properly distributing the chemical in the chips. The chemical facilitates removal of water soluble substances and some of the lignin and polysaccharides, although most of the lignin and polysaccharides remain in the material. After impregnation, the chips are subjected to a countercurrent wash at stage 13. The wash liquid preferably includes chelating and surface active agents, such as EDPA and DPTA. The wash effects removal of residual cooking chemicals, metals, color bodies, and resins. The countercurrent impregnation and countercurrent wash at stations 12, 13, combined, remove impurities very uniformly and in such a way as to improve pulp properties, decrease subsequent bleaching costs, and maximize the brightness to which the pulp may be bleached.

The washed chips are passed from station 13 to a first pressurized refining stage 14, at which a mechanical refiner acts on the chips to form a

mechanical pulp. The pulp at this stage usually has a consistency of about 6-15 percent, and the pulp, at this consistency, is passed to a screening station 15 wherein it is separated into first and second streams 5 16, 17. The first stream comprises pulp components that require further refining, while the second stream 17 contains pulp portions having fibers with desirable properties so that further refining thereof is not necessary. The first stream 16 is passed to a second 10 pressurized refining stage 18 while the second stream 17 is passed directly to the discharge line 19 from the second refiner stage 18. In this way fibers having desired properties are not further broken down, and thus the drainage and strength of the pulp is 15 improved.

The pulp in discharge line 19, with a consistency of 6-15 percent, is further treated in any manner desirable to produce CMP having the necessary properties. Typically this would include a wash 20 station 20 and a bleach station 21. During bleaching, hydrosulfite and/or peroxide would be added to the pulp, and the final product produced would be bleached CMP.

For the CTMP process illustrated in FIGURE 2, 25 the only basic difference between it and the CMP process described in FIGURE 1 is the provision of a cooking stage 23 between the impregnation stage 12 and the washing stage 13. The cook, with sulfite, is at suitable temperature and concentration conditions in order to provide the desired effect on the chips to 30 facilitate subsequent refining thereof. CTMP typically has enhanced strength compared to other mechanical pulps - such as TMP, although the yield is slightly lower - and is particularly suited for 35 pulping of high density hardwoods.

FIGURE 3 shows a typical process for producing TMP. In this embodiment no impregnation stage 12 is provided. Typically, the chips would be steamed for a longer period of time than in the

5 FIGURES 1 or 2 embodiments, and additionally a further vessel may be provided for the addition of heat in the form of steam or hot liquid. After passing through stages 13 through 21, a TMP is produced.

FIGURE 4 illustrates in more detail exemplary

10 apparatus that could be utilized to produce CMP according to the present invention.

The chips are fed to a conventional steaming chips bin 25, and are subsequently metered to the intake for an upright vessel 27. In the vessel 27

15 countercurrent impregnation and countercurrent washing of the chips takes place. Sodium sulfite, or like chemical suitable for the production of CMP, is fed from source 28 through heat exchanger 29 to the vessel 27 and introduced at an appropriate point 30. The

20 chemical flows upwardly in the vessel 27, countercurrent to the downward flow of chips. Pump 31 continuously withdraws chemical from vessel 27 through screens, and reintroduces the chemical adjacent inlet 26 to entrain the chips therein.

25 At the bottom of the vessel 27 the countercurrent wash takes place. Fresh washing liquid and chelating and surface active agents are introduced in line 32, and passed countercurrent to the chips flow, the wash liquid continuously being withdrawn

30 from screens adjacent the bottom of vessel 27 and recirculated by pump 33. Metals, color bodies, and resins displaced by the impregnation and washing steps ultimately find their way to apparatus 34 which effects removal and discharge thereof.

The washed chips pass through line 35 to a conventional drainer 36, and the separated liquid is returned to the vessel 27 under the influence of pump 37. The chips are fed to first pressurized refiner 38, and are mechanically acted on to produce a mechanical pulp. The method is practiced so that the pulp typically would have a consistency of about 6-15 percent. Without depressurization or dilution, the pulp is then screened by a screen 39. The screen 39 separates pulp portions in need of further refining into a first stream 40, while fibers already having desired properties are separated into a second stream 41. First stream 40 may be passed through a cyclone 42, and then to a second pressurized refiner 43, while the second stream 41 is passed directly to the discharge 44 from second refiner 43.

After refining, the mechanical pulp may be passed to a pressurized blow tank 45 for heat recovery and subsequently, again without dilution, pumped by pump 46 to another screen mechanism 47 substantially identical to the screen 39. Rejects from screen 47 pass to rejects chest 48 and subsequently through thickener 49 and into rejects refiner 50, ultimately to be returned via line 51 to the inlet to screen 47. Accepts from screen 47 are pumped by pump 52 to cleaner 53, ultimately are washed in a pressure diffuser 54, and are otherwise subsequently treated. For instance the pulp may pass to a high density storage tank 55, and then may be simultaneously pumped and degassed by pump 56, passed to a mixer 57 at which hydrosulfite bleaching chemical is introduced, and then is subsequently retained in retention vessel 58, with CMP having enhanced brightness and/or drainage and strength characteristics being produced.

Utilizing the apparatus illustrated in FIGURE 5, a CTMP can be produced. In this figure, components with the identical functionality to the components illustrated in FIGURE 4 are indicated by the same reference numeral only preceded by a "1".

The chips are fed to a conventional chips bin 125, and then are steamed in a steaming vessel 60. The chips are entrained with liquid in chute 126 and high pressure feeder 61 feeds them to the top of vessel 62. Sand, and other undesirable components, can be separated out utilizing components 63, 64.

The upright vessel 62 is designed to impregnate the chips, retain them for a "cook", and wash them. The vessel 62 is structurally similar to conventional continuous digesters for producing chemical pulp that have impregnation, cooking, and washing zones. Sulfite cooking chemical may be added at any desired point, such as into line 65, and the heat exchanger 66 heats the chemical to the desired temperature. In the vessel 62 countercurrent impregnation takes place, the chips are retained in a cooking zone for a predetermined period of time, and countercurrent washing takes place at the bottom of the vessel 62, wash liquid being added through line 67.

The chips slurry discharged from the bottom of the vessel 62 passes to drainer 136 and first pressurized refiner 138. Pressurized blow tank 145 is provided after first refiner 138, and the pulp, preferably with a consistency of about 6-15 percent, is pumped by pump 68 to screen 139, with the pulp material in the first stream 140 passing to the second pressurized refiner 143, and the pulp fibers in the second stream 141 being passed directly to the discharge 144 from the second refiner. The pulp is

then introduced into decker 69, is pumped by pump 70 to the top of pressure diffuser 154 in which it is washed, and is discharged from diffuser 154 into up-flow tower 71. Peroxide bleaching chemical may be added to line 72 and introduced to the pulp in diffuser 154, the tower 71 retaining the pulp and bleaching chemical for a predetermined period of time before it is discharged to second decker 73. From there it passes to high density storage tank 155 and is pumped by pump 156 to mixer 157 at which point hydrosulfite bleaching chemical is introduced. After retention in up-flow tower 158, the final CTMP is produced.

The apparatus in FIGURE 6 can also be utilized to produce CTMP, and contemplates refining pulp having a much wider concentration range (e.g., about 5-50%). In this FIGURE, components with substantially the same functionality as components illustrated in FIGURE 4 are indicated by the same reference numeral only preceded by a "2".

After leaving the vessel 227, the suspension of comminuted fibrous cellulosic material may be dewatered utilizing conventional dewatering apparatus 80 (such as a plug screw feeder or screw press) in line 235. Dewatering apparatus 80 may be used in place of or in addition to, conventional drainer 236. The suspension from dewaterer 80 may have a concentration as high as 50% when it is fed to the first refiner 238. The apparatus 80 may be pressurized, or unpressurized, depending upon other apparatus utilized.

Pulp discharged from first refiner 238 - if of high concentration - is diluted utilizing conventional dilution equipment 81 prior to screen 239. The discharge from screen 239 into line 240 is

preferably pressed utilizing conventional press 82 prior to cyclone 242 so that the refiner 243 also acts upon high concentration pulp (e.g., 16-50%). The discharge from a refiner 243 in line 244 is then again
5 diluted utilizing dilution apparatus 83 so that it has substantially the same concentration as the pulp in line 241, before it is passed to the blow tank 245.

By practicing the present invention, it is possible to produce mechanical pulp that can be
10 bleached to a brightness level substantially greater than prior art mechanical pulps produced utilizing similar treatment chemicals, temperatures, etc. Also, the pulp according to the present invention has improved strength and drainage properties compared to
15 conventional mechanical pulps produced under comparable treatment conditions.

While the invention has been herein shown and described in what is presently conceived to be the most practical and preferred embodiment thereof, it
20 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 methods and products.

WHAT IS CLAIMED IS:

1. A method of producing a TMP, CMP, or CTMP comprising the steps of sequentially:
 - 5 (a) impregnating comminuted fibrous cellulosic material with chemical and/or thermal treating fluid;
 - (b) refining the washed comminuted fibrous cellulosic material to produce a mechanical pulp; and
 - (c) effecting further treatment of the mechanical pulp, including bleaching thereof, to achieve desired
 - 10 properties; characterized by: (d) washing the impregnated comminuted fibrous cellulosic material between steps (a) and (b).

2. A method as recited in claim 1 further characterized in that step (a) is practiced by passing
15 the treating fluid countercurrent to the flow of comminuted fibrous cellulosic material, and step (d) is practiced by passing washing liquid countercurrent to the flow of comminuted fibrous cellulosic material.

3. A method as recited in claim 1 further characterized in that step (b) is practiced by:
 - 20 (i) passing the washed fibrous cellulosic comminuted material to a first pressurized refiner;
 - (ii) screening the discharge from the first refiner to separate fibrous material into first and second flow
 - 25 streams; (iii) passing the first flow stream to a second pressurized refiner, having a discharge; and
 - (iv) passing the second stream directly to the discharge from the second refiner.

4. A method as recited in claim 1 further characterized in that the mechanical pulp produced after steps (a), (d) and (b) has a consistency of about 6-15 percent.

5 5. A method as recited in claim 1 further characterized in that step (a) is practiced by passing hot sulfite liquor countercurrent to the flow of the comminuted fibrous cellulosic material, and by heating the comminuted fibrous cellulosic material with steam
10 prior to impregnation.

6. A method as recited in claim 1 further characterized in that step (d) is practiced utilizing a wash liquor including chelating agents and surface active agents to effect removal of metals, color
15 bodies, resins, and the like.

7. A method of producing a chemimechanical or chemithermomechanical pulp, comprising the steps of sequentially: (a) passing hot sulfite chemical into contact with fibrous cellulosic material to impregnate
20 said comminuted fibrous cellulosic material with sulfite chemical; (b) refining the fibrous cellulosic material to produce a mechanical pulp; and (c) effecting further treatment of the mechanical pulp, including bleaching, to achieve desired
25 properties; characterized in that:

step (a) is practiced by passing the comminuted fibrous cellulosic material in a first flow direction, and passing the sulfite chemical in a second flow direction countercurrent to said first
30 direction.

8. A method as recited in claim 7 further characterized in that step (b) is practiced by:

(i) passing the washed fibrous cellulosic comminuted material to a first pressurized refiner;

5 (ii) screening the discharge from the first refiner to separate fibrous material into first and second flow streams; (iii) passing the first flow stream to a second pressurized refiner, having a discharge; and

(iv) passing the second stream directly to the

10 discharge from the second refiner.

9. A method of producing a mechanical pulp comprising the steps of: (a) pretreating comminuted fibrous cellulosic material; (b) refining the comminuted fibrous cellulosic material to produce a

15 mechanical pulp; and (c) effecting further treatment of the mechanical pulp to achieved desired properties; characterized in that step (b) is practiced by:

(i) passing the washed fibrous cellulosic comminuted material to a first pressurized refiner;

20 (ii) screening the discharge from the first refiner to separate fibrous material into first and second flow streams; (iii) passing the first flow stream to a second pressurized refiner, having a discharge; and

(iv) passing the second stream directly to the

25 discharge from the second refiner.

10. A bleached mechanical pulp having enhanced brightness, characterized in that it is produced by the steps of: treating comminuted cellulosic fibrous material with a countercurrent flow

30 of sulfite liquor; effecting countercurrent washing of the sulfite treated material, the wash liquid including chelating agents and surface active agents; refining the washed material to produce a mechanical

pulp; and effecting hydrosulfite and/or peroxide bleaching of the mechanical pulp, to produce a bleached mechanical pulp.

Fig 5

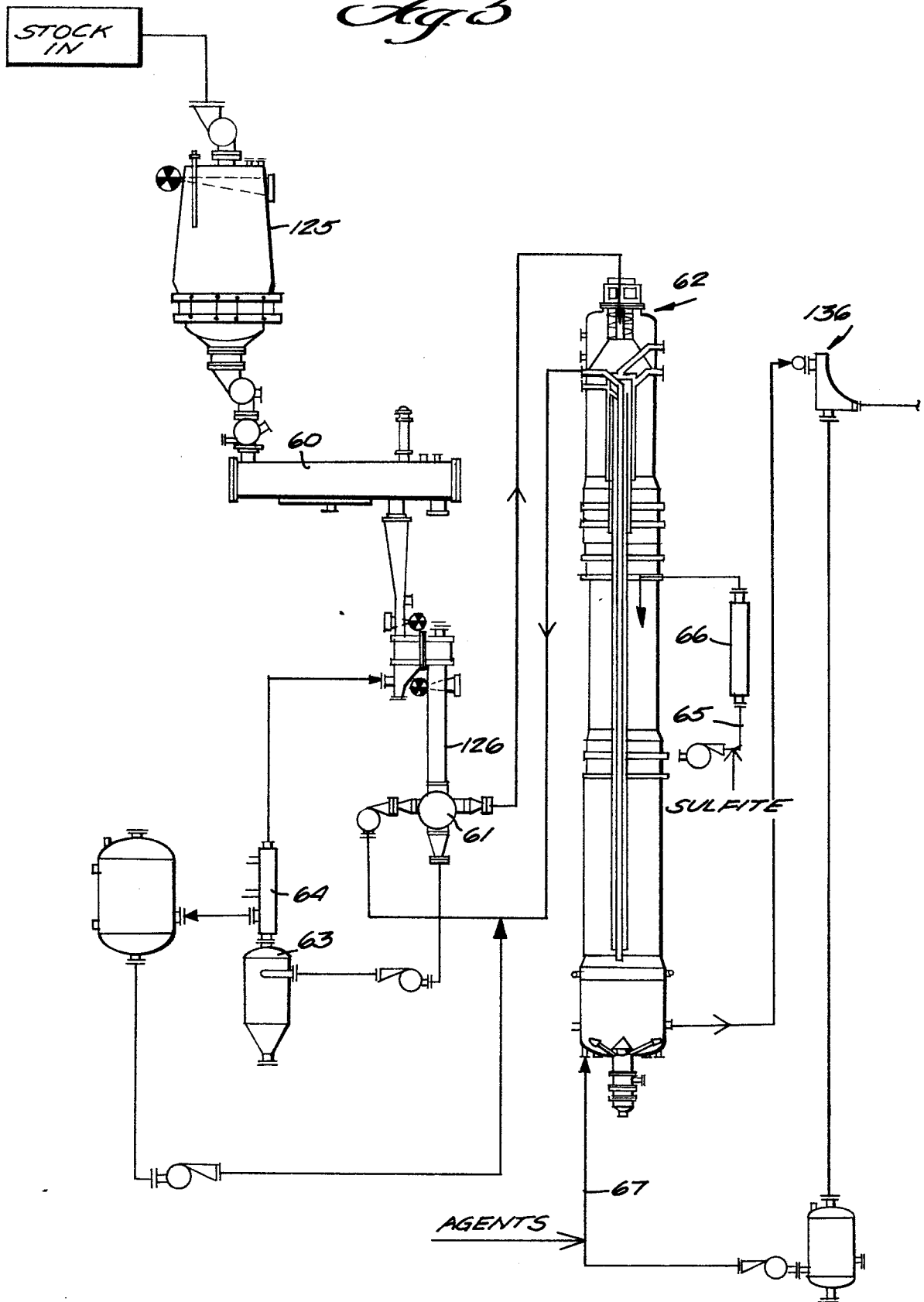


Fig. 5 CONT.

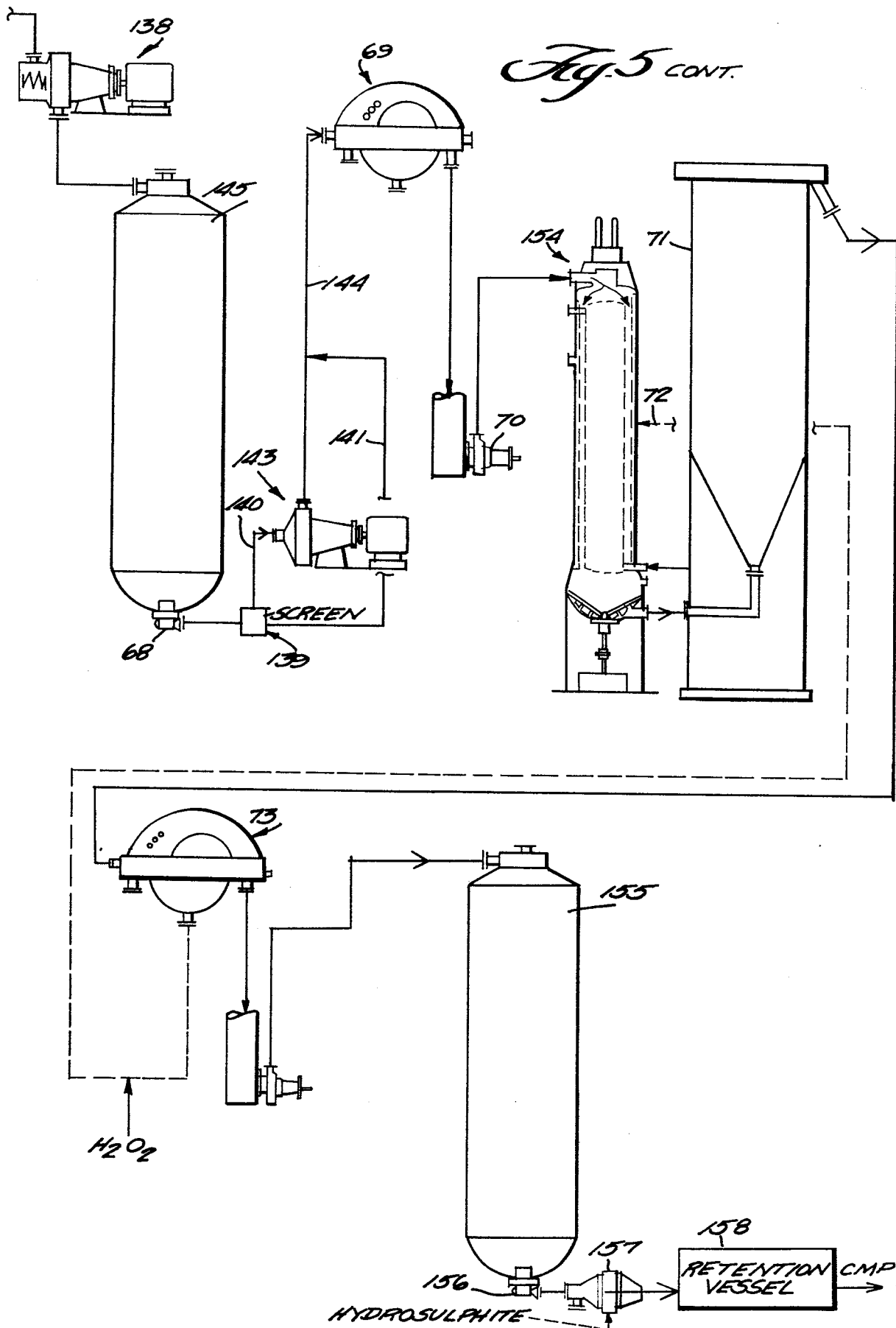


Fig. 6

