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DOWNFEED CONTINUOUS PULPING APPARATUS

Original Filed May 9, 1960

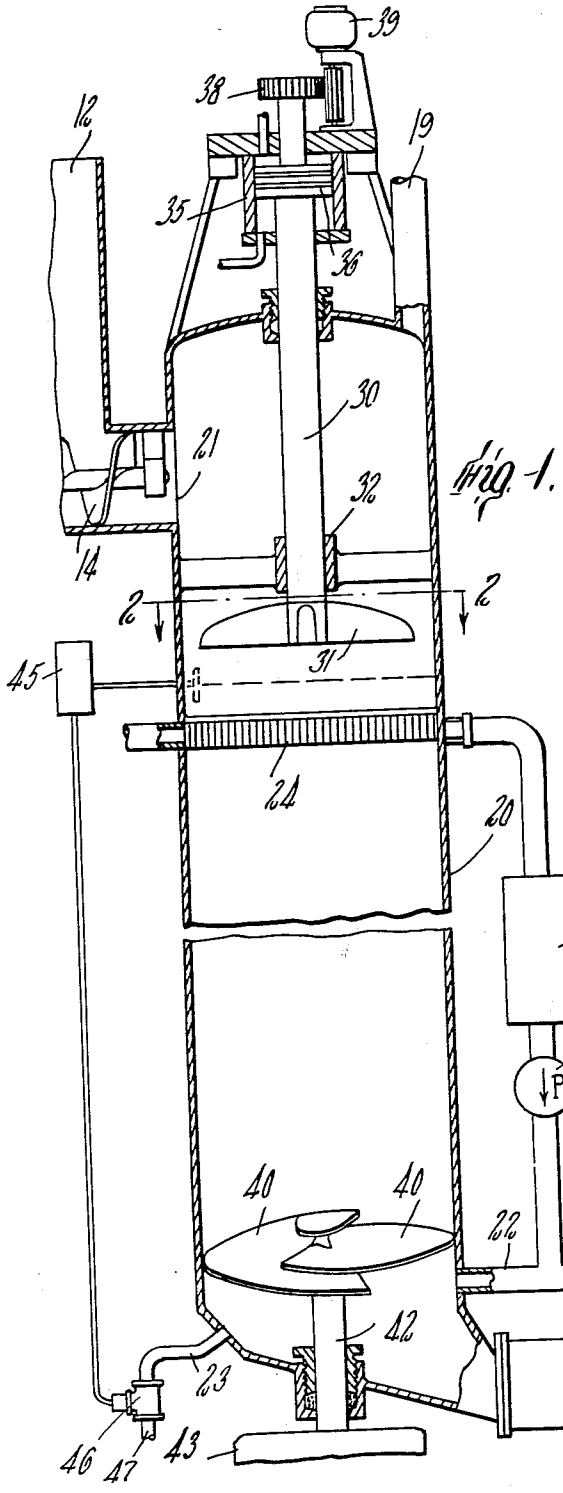


Fig. 1.

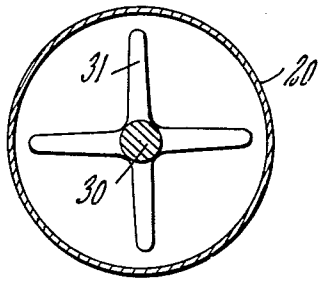


Fig. 2.

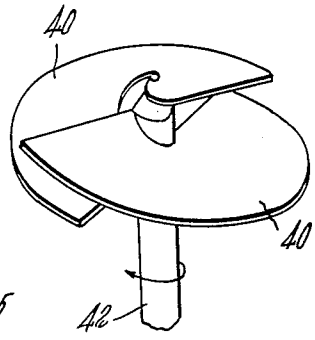


Fig. 3.

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DOWNFEED CONTINUOUS PULPING APPARATUS

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Continuation of application Ser. No. 27,593, May 9, 1960. This application Nov. 29, 1961, Ser. No. 155,681
6 Claims. (Cl. 162—237)

This invention relates to continuous pulping apparatus and systems, and is a continuation of application Serial No. 27,593, filed May 9, 1960. More particularly, it relates to novel apparatus for advancing solid particles through a vessel containing a solid particle liquid mixture, movement of the solid particles being controlled independently of the liquid.

It is a major object of the present invention to provide novel apparatus capable of advancing even dry wood chips through a reaction vessel irrespective of the direction of liquid flow therein. This has been accomplished by providing a single solid-particle feeding means at one end of the vessel, which means exerts force only on wood chips or other particles located adjacent said end of the vessel progressively to advance a mass of wood chips filling the vessel beyond such feeding means throughout the length of the vessel. The intermediate portion of the vessel is thus entirely unobstructed for wood chip advance and for circulation of treating liquids as desired.

For the purpose of explaining further objects and features of the invention, reference is now made to the following detailed description of a preferred embodiment of the invention, taken with the accompanying drawings, wherein:

FIG. 1 is a detailed cross sectional side elevation of downflow apparatus embodying the downfeeding means and discharge means of the invention;

FIG. 2 is a cross sectional plan view showing the downfeeding means of FIG. 1, taken on the line 2—2 thereof; and

FIG. 3 is an isometric detail view of the discharge means of the apparatus of FIG. 1.

In FIGS. 1–3 is shown a pretreatment downflow vessel **20** incorporating the novel downfeeding means of the invention, together with auxiliary apparatus including a chip bin **12** having a screw conveyor means **14** in its bottom for feeding wood chips into the upper end of vessel **20**. In general, the infed wood chips are moved downwardly in the form of a compacted mass through vessel **20** while being treated by a suitable liquid, are diluted by the discharge means thereof, and are then discharged in dilute form, generally to a succeeding process.

Turning now to the specific pretreatment vessel **20** of FIG. 1, the vessel **20** itself is of generally cylindrical form but preferably slightly tapered to expand in a downward direction say of the order of ¼ to ½ inch per foot of length. In the upper end of the vessel is mounted the downfeeding tamping means as is hereinafter described. Thereabove is a chip inlet opening **21** through which chip conveyor means **14** is enabled to feed chips into the vessel **20** above said means. An exhaust opening **19** is also provided in the top of the vessel in order to exhaust volative gases, such as turpentine, which may be evolved from the chip mass within the tower. At the bottom of the tower, defining the lower end of the compacted chip mass, spaced a major portion of the vertical length of the vessel below the downfeeding tamping means of the invention, is a discharge means enabling the feeding of chips from the lower end of the chip mass at the same rate that they enter the top, so that a solid particle-liquid mixture may be established in the bottom portion of vessel **20** for feeding to a subsequent reaction vessel. A

liquid inlet **22** is provided at the bottom of the tower below the discharge means and a liquid outlet in the form of strainer **24** adjacent the upper end, as is hereinafter more fully described.

As best shown in FIGS. 1 and 2, the novel downfeeding means of the invention utilized in vessel **20** to insure the downward advance of chips as a compacted mass, comprises a single web-like member mounted adjacent the upper end of the vessel for generally vertical reciprocatory movement having a stroke of, say, about 3 to 24 inches. Preferably, said member includes a vertically arranged central shaft **30** having a plurality of spoke-like operating elements **31**, herein shown as four in number, mounted on the lower end of shaft **30** and extending radially thereof with uniform angular spacing. These operating elements **31** provide an interrupted operating surface extending in a horizontal plane for free passage of the wood chips or other solid particles therethrough. The operating elements thus provide a downfeeding and tamping means extending generally throughout the horizontal area of the vessel substantially less than the horizontal sectional area of the vessel, with a working area of about 10–80 percent of the total vessel area, preferably about 20%.

The shaft **30** is mounted in a suitable bearing **32** near its lower end above elements **31** and at its upper end it carries a piston **36** which operates in a double acting cylinder **35** having suitable fluid inlet means to each chamber thereof as well as means for supplying fluid to said inlets in a manner to reciprocate the piston at the rate of a few strokes per minute, say 1 to 30, and preferably about 5.

Shaft **30** is also provided with a gear **38** operated by a suitable fluid motor **39**, so that the elements **31** may be rotated bodily around shaft **30** as desired. Such rotation may desirably be accomplished on the up stroke and may be through a small increment say about 10 degrees, so that the elements **31** come down at a different place on the chip pole on each reciprocation.

When chips, either in dry form or as a solid-particle liquid mixture, are fed into the vessel above the elements **31**, they will tend to flow past and under the elements **31** as the elements lift and then are tamped and fed downwardly by the elements as the elements subsequently complete their downward stroke. The reciprocating tamping action of elements **31** compacts the wood chips or other solid particles as they are fed into the vessel and advances them as a compacted mass downwardly through the vessel. This permits the uniform advance of the wood chips throughout the unobstructed horizontal cross-sectional area of the tower for a major portion of the length thereof for fluid treatment irrespective of the effect of the fluid on the buoyancy of the chips, for example. Thus, if a liquid be employed in which the chips are normally buoyant, the downfeeding means of the invention makes possible the downward advance of the chips, even with countercurrent liquid flow or the generating of steam which would also tend to oppose their advance. Furthermore, the uniformly compacted mass of chips extending throughout the effective length of the vessel, as is made possible by the positive downfeed characteristic of the invention, greatly aids in making possible uniform chip treatment, by preventing non-uniform channeling and blockage. This is particularly vital in large diameter vessels.

The discharge means, as is best shown in isometric view in FIG. 3 in addition to being shown in side elevation in FIG. 1, comprises a pair of helical plates **40** having overlapping edges, say, by about 10 to 30 degrees and mounted for rotation at the upper end of a shaft **42**, itself being driven by a motor **43**. Thus, a double lead screw dis-

charger is provided having a pair of leading edges, which at a speed of say 30 r.p.m. will continuously take a thin slice from the bottom of the compacted mass of chips and so remove the chips from the mass as fast as the mass advances downwardly through the tower. The speed of the plates and the pitch of their helical form are so proportioned that the thickness of the slice removed from the bottom of the chip mass never exceeds the pitch and the discharger can always accept material as fast as it is moved downwardly. Below the plates **40** within vessel **20** is a zone of a dilute mixture of chips and liquid, of such consistency that can be easily transferred through a conventional pump and pipes into the bottom of a succeeding pressurized reaction vessel, for example. The excess liquid required to operate this dilute zone is fed to the bottom of vessel **20** through inlet **23**. The overlapping arrangement of plates **40** insures that if the system is stopped long enough for chips to settle by gravity toward the bottom of vessel **20**, the mass will come to rest on plates **40** rather than filling the lower zone below these plates which might cause plugging in the outlet pipes when restarting.

Liquid inlet **22** is positioned below plates **40** and strainer **24** is positioned near the upper end of the tower below tamping members **31**. A pump **27** and heater **25** is provided for recirculating and heating the treating liquid and a valve **26** is connected thereto for adding liquid as it is discharged with the solid particle-liquid mixture. If desired, a level sensing means **45** may be employed to sense the preferred level of the liquid above strainer **24** and below tamping members **31** as shown in FIG. 1, and such level sensing means may be operatively connected to valve **46** to control the balance of fluid into vessel **20** through pipe **47** and inlet **23** so as to maintain a constant level. As shown, the flow of impregnating liquid is countercurrent, as is preferred for countercurrent heating and for deaerating in a wood chip pulping process, but by utilizing a strainer at the lower opening **22** co-current flow may be used.

Thus it will be seen that the invention provides novel apparatus for feeding a vessel. Various modifiactions of the invention within the spirit thereof and the scope of the appended claims will be apparent to those skilled in this art.

What is claimed is:

1. Apparatus for continuously treating the solid particle component of a solid particle-liquid mixture in a generally upright elongated reaction vessel having inlet means for feeding solid particles into said vessel adjacent the upper end thereof and discharge means for discharging said mixture from said vessel adjacent the bottom of said vessel, that improvement which consists of down-feeding means for advancing the solid particle component thereof downwardly through said vessel substantially independently of the movement of liquid in said vessel, including a solid particle downfeeding member mounted adjacent the upper end of said vessel for generally vertical reciprocatory movement, said member having a plurality of spokelike operating elements with relatively flat bottoms providing an interrupted surface extending in a horizontal plane for free passage of said solid particles therethrough, means for feeding said solid particles into said vessel above said elements, hydraulic means including piston and cylinder means for reciprocating said member through a limited

distance relatively to the length of said vessel to advance said particles downwardly by exerting force only on particles located adjacent the upper end of said vessel progressively to compact said particles and to advance the mass of said particles downwardly through said vessel, liquid supply means adjacent the bottom of said vessel for supplying liquid thereto for upward flow thereof through said descending particles, and strainer means spaced upwardly from said liquid supply means and below the said spoke-like operating elements for removing liquid from said vessel.

2. Apparatus as claimed in claim 1, further including means for rotating said downfeeding member about a vertical axis.

3. Apparatus as claimed in claim 1 wherein the horizontal area of said downfeeding member is about 10–80 percent of the total horizontal area of said vessel.

4. Apparatus for continuously treating the solid particle component of a solid particle-liquid mixture in a generally upright vertically elongated vessel having inlet means for feeding solid particles into said vessel adjacent the upper end thereof and discharge means for discharging said mixture from said vessel adjacent the lower end thereof, that improvemnet which consists of downfeeding means for advancing the solid particle component of said mixture through said vessel substantailly independently of the movement of liquid in said vessel, said downfeeding means including a single solid particle downfeeding member having a plurality of spoke-like operating elements with relatively flat bottoms providing an interrupted surface extending in a horizontal plane with a working horizontal sectional area substantially less than the horizontal sectional area of said vessel for free passage of said solid particles through said surface, said member being mounted for generally vertical reciprocatory movement adjacent the upper end of said vessel spaced above said discharge means a major portion of the length of said vessel providing an unobstructed vessel cross sectional area therebetween, means for reciprocating said member through a limited distance relatively to the length of said vessel to advance said particles through said vessel toward the lower end thereof by exerting advancing force only on particles located adjacent the upper end of said vessel below the surface of said member, progressively to compact said particles and to advance the mass of said particles through said vesel toward the lower end thereof and liquid supply means for supplying liquid to said vessel.

5. Apparatus as claimed in claim 4 wherein the working area of said member is about 10 to 80 percent of the area of said vessel.

6. Apparatus as claimed in claim 4, further including means for rotating said member.

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