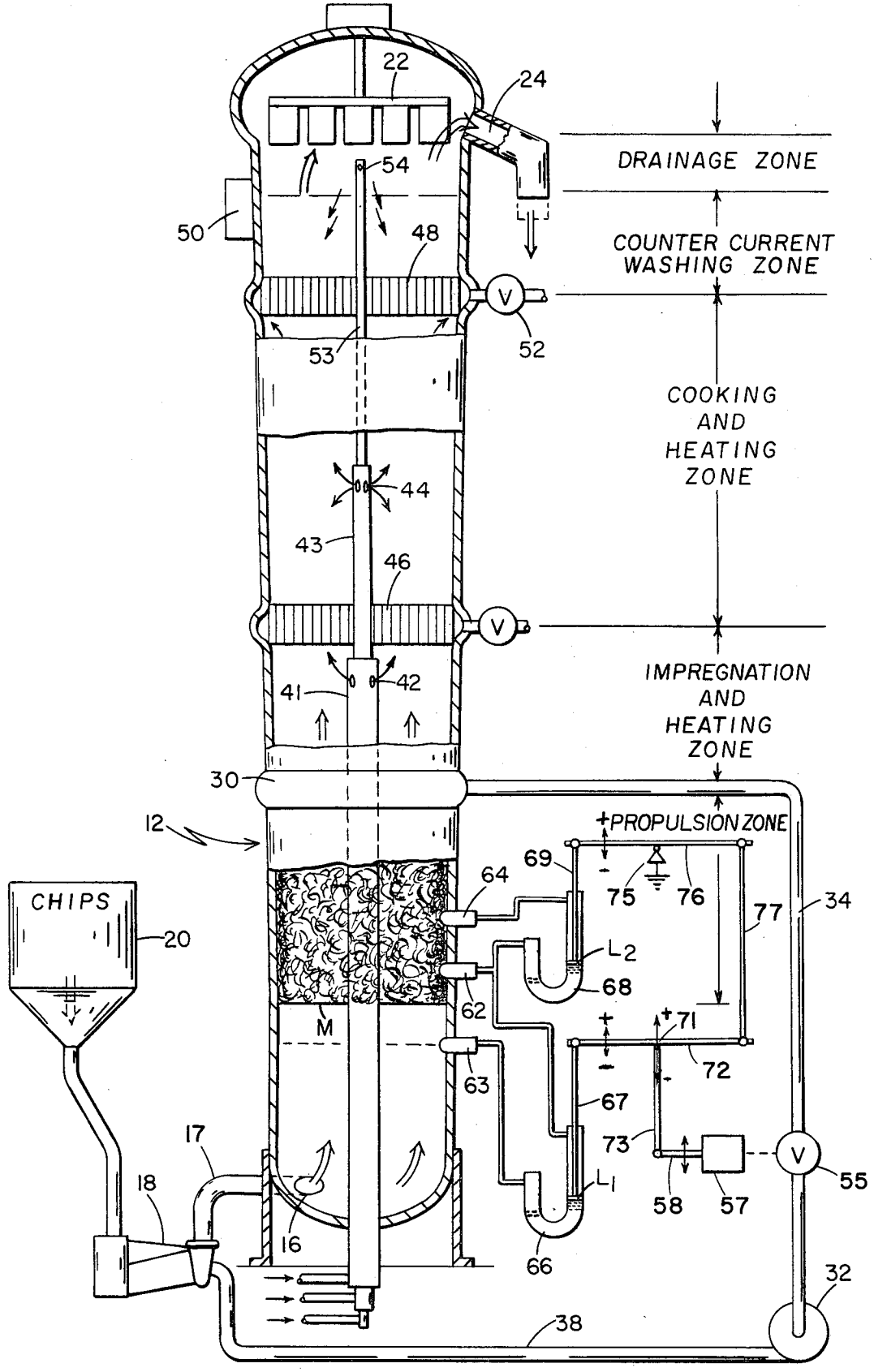
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CONTINUOUS DIGESTER WOOD CHIP LEVEL CONTROL

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CONTINUOUS DIGESTER WOOD CHIP LEVEL CONTROL

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Int. Cl. D21c 3/26
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ABSTRACT OF THE DISCLOSURE

Apparatus and method for continuous pulping in an upright elongated reaction vessel by feeding substantially continuously wood chips and a liquid into the reaction vessel at its lower end to maintain therein a columnar mass of compacted wood chips with its lower end normally spaced upwardly from the lower end of the vessel and advancing the wood chips upwardly throughout the length of said column by advancing liquid upwardly through a liquid propelling zone in the lower portion of the column. The vessel has three vertically spaced pressure sensing means with the lower two of the pressure sensing means spaced respectively above and below the normal position of the lower end of the chip mass and the uppermost one of the pressure sensing means spaced above said lower two to sense said position for control thereof. Comparator means are connected to each of the lower and upper two of the pressure sensing means for comparing the sensed signals therefrom providing output signals resposive to said position and means are provided for comparing the output signal from the lower two of the pressure sensing means with the output signal from the upper two of the pressure sensing means to produce a corrected output signal responsive to the position of the lower end of said chip mass by means of which the propelling liquid flow rate is controlled to control said position.

This application is a continuation of Ser. No. 543,363 filed Apr. 18, 1966, now abandoned.

This invention relates to the continuous digesting of wood chips in an upflow digester, and more particularly to novel apparatus and methods for controlling the continuous advance of a compacted mass of wood chips upwardly throughout the length of such a digester.

In upflow digesters of the type wherein liquid is advanced upwardly through a propelling zone in the lower portion of the submerged columnar mass of compacted wood chips at a liquid flow rate effective to create a force which will propel upwardly the entire columnar mass of wood chips extending throughout the length of the digester, it is necessary to sense the bottom level of the chip mass for control of its position at least in an upward direction in order to maintain a propelling zone of adequate length. It is also desirable to control the position of said lower end in a downward direction to space it above the lower end of the digester so that wood chips may be fed freely into the digester for accretion onto said lower end.

Heretofore, it has been known that such sensing can be accomplished by mechanical devices, similar to that shown in U.S. Pat. No. 2,878,116, but with its resulting mechanical complication, or by suitable radiation devices. Nevertheless, such known expedients are deficient in one or more respects, especially in large digesters operating at high temperatures and pressures, as practical radiation devices are not effective because of the long measurement paths and mechanical devices by reason of the necessary stuffing boxes and the like.

Accordingly, it is major object of the preesnt invention to provide novel apparatus and methods for sensing

in such digesters, the lower end of the chip mass therein, in order that its position may be controlled.

It is also an object of this invention to provide in such digesters control means responsive to said sensing apparatus for controlling automatically the position of the lower end of the chip mass.

In general, the present invention accomplishes such objects by utilizing at least two vertically spaced pressure sensors for sensing a pressure difference caused by liquid flow upwardly through the lower end of the chip mass for control of the position of said lower end, preferably automatically.

For the purpose of fully explaining the above and further objects and features of the invention, reference is now made to the following detailed description of a preferred embodiment thereof, taken together with the accompanying drawing showing a diagrammatic side elevation, partly in section, of apparatus according to the invention.

Referring to the drawing, the pressurized vessel **12** therein shown is generally cylindrical and may be, for example of the order of ten feet or greater in diameter and one hundred feet in length. A wood chip-liquid infeed is provided at the lower entrance end of the vessel **12** in the form of a tangential inlet **16** to which is fed, through pipe **17**, by means of a pump **18**, preferably of the type shown and described in Pat. No. 2,908,226, a wood chip liquid mixture from a supply tank **20**. At the upper end of the vessel **12** is provided a discharger for the pulped wood chips in the form of a scraper **22** which discharges drained pulped wood chips through discharge outlet **24** to discharge mechanism at the lower end of a down-flow pipe (not shown) such as is described in Pat. No. 3,206,356.

Preferably, within vessel **12**, generally along the central vertical axis thereof, are provided a series of three concentric injection pipes **41**, **43** and **53** having outlets **42**, **44** and **54**, respectively, at successively higher levels. Also within vessel **12** are provided strainers **46** and **48**, together with said outlets establishing a plurality of zones within the vessel by advancing liquid for either co-current or countercurrent flow within said zones as desired. For example, there is provided an impregnation and heating zone with superposed heating and cooking zones with co-current and countercurrent flow and a countercurrent washing zone with an uppermost draining zone, the liquid flows being shown by the single arrows and the wood chip movement by the double arrows. A liquid level control **50** is provided near the upper end of vessel **12** to establish the liquid level below scraper **22** as by operating valve **52** in upper strainer **48** to provide the chip drainage zone.

A liquid system is provided for advancing liquid upwardly through a lower portion only of vessel **12** for propelling the entire columnar chip mass upwardly through the vessel by high velocity liquid flow upwardly through said lower portion. Broadly, the apparatus components of such system include a lower propelling liquid strainer **30** spaced a substantial distance above vessel inlet **16** and below scraper **22** defining a propelling zone therebelow and a recirculation pump **32**, together with connecting pipes **34** and **38**, valve **55** and valve operator **57**, for controlled recirculation of liquid to pump **18**.

More specifically as to the operation of the above described apparatus according to the methods of the invention, it has been established in the commercial operation of digesters of the type shown that the wood chips are present therein in the form of a columnar mass of contacting and compacted but discrete wood chips through which liquid can flow more or less independently of the wood chips in the mass but subject to a flow resistance due to the presence of the wood chips. Because the

wood chips are present in the mass in discrete form but in contact with one another, the wood chips within the mass can be advanced upwardly throughout the entire length of the columnar mass maintained within the vessel by advancing liquid upwardly through a lowermost portion only of the chip mass at a suitably high liquid flow rate. However, in order to do so, it is desirable to maintian the lower end of the chip mass in a position spaced above the lower end of the vessel, in order that the clogging and jamming of wood chips within inlet pipe 17 may be avoided.

According to the present invention, the resistance to flow created by the presence of the columnar mass of chips within the propelling zone is utilized to sense and control the position of the lower end M of the chip mass. This is made possible because of the rapid pressure change with distance which occurs within the chip mass. In contrast, no such rapid change occurs in the liquid filled region below the chip mass.

Thus, in a simple form, the invention may consist of a pair of vertically spaced pressure sensors 62, 63, the outputs of which may be compared to locate and so control the position of the lower end M of the chip mass to a location between them. Preferably a comparator in the form of a manometer 66 is connected to the pressure sensors 62, 63 for comparing the pressure signals therefrom, and, if desired, such comparator can be utilized for automatic control of valve 55 through its operator 57 by appropriate means, such as photoelectric or mechanical devices for sensing its level L_1.

In a more elaborate system, a third pressure sensor 64 may be utilized to provide a reference signal which may be sensed by a second manometer 68 connected to the pressure sensors 62, 64 for comparing their pressure signals in order to eliminate the effect of signals due to variations in rate of liquid flow, and so limit the signals presented to valve operator 57 to those due solely to variations in chip level M.

Such a system, as shown in the drawings, includes a float 67, 69 in each of said manometers for sensing their levels L_1, L_2, respectively. Manometer float 67 in manometer 66 is connected to valve operator 57 at one end of a floating tilting lever 72 connected at its center point 71 to push rod 73 so that movement of float 67 swings the actuating arm 58 of valve controller 57, as shown by the arrows thereon, in response to changes in level L_1. Manometer float 69 in manometer 68 is connected to one end of another tilting lever 76 pivoted at its center at fixed pivot 75 and with its other end connected by push rod 77 to the other end of floating tilting lever 72. Thus, movement of floats 67 and 69 in the same direction will cancel without resulting movement of floating pivot point 71, while movement in opposite directions will move pivot point 71 and so operate valve 55.

More specifically as to the operation of the apparatus of the invention, referring first to a simple system omitting manometer 68 and with lever 72 having a fixed pivot at its end normally connected to push rod 77, should the chip level M move upwardly to a position above pressure sensor 62, the pressure drop between the sensors 63, 62 due to the presence of the chip mass will no longer be present and the level L_1 in manometer 66 will decrease until both of its arms are equal in level. In such condition, valve 55 is moved in a direction toward its closed position with the arm 72 moving in the direction of the minus signs in the drawing to reduce the volume of recirculating liquid. Should the chip mass level M move downwardly to a position approaching lower pressure sensor 63, the level in each arm of the manometer 66 will approach a maximum difference and level L_1 will move up in the direction of the plus signs in the drawing. In such condition, valve 55 is moved toward its open position to increase the volume of recirculating liquid. Movement of level L_2 with lever 72 floating as shown, moves floating lever 72 in the opposite sense, so that changes in levels L_1, L_2 in the same direction tend to cancel one another.

In the absence of reference sensor 64, if the chip level moves down below the desired level M, the pressure difference between sensors 63 and 62 increases because of the greater length of the chip mass below sensor 62. By the operation of manometer 66, valve 55 is opened to produce a greater lifting force on the chip mass to move its lower end upwardly towards its desired level M. However, the increased flow also produces a greater pressure drop through the chip mass below sensor 62 which will cause it to rise above the desired level M before the pressure difference between sensors 63, 62 is reduced sufficiently to close valve 55 to its normal opening. But when valve 55 is so closed, the decreased flow through the chip mass below sensor 62 causes a decrease in the pressure sensed between sensors 63 and 62. The reverse correction then takes place. As a result, the two sensor system tends continuously to cycle with the lower end of the chip mass reciprocating, although remaining between sensors 62 and 63.

The addition of reference sensor 64 and manometer 68 prevents this cycling by providing a reference signal, which varies only with liquid flow through the chip mass, since variations in liquid flow will affect both manometers in the same direction and so tend to cancel one another. The reference signal from manometer 68 in effect, then, is opposed only to the portion of the signal provided by manometer 66 due to variations caused by changes in liquid flow rate, so that the desired signal alone, responsive only to the position of the lower end of the chip mass relatively to the desired level M causes movement of the center point 71 of lever 72 to operate valve 55 through its operator 57.

Various modifications of the invention within the spirit thereof and the scope of the appended claims will be apparent to those skilled in the art.

What is claimed is:

1. A method for the continuous pulping of wood chips in an upright elongated reaction vessel by feeding substantially continuously said wood chips and a liquid into said reaction vessel adjacent the lower end thereof to maintain therein a columnar mass of compacted wood chips with the lower end thereof normally spaced upwardly from the lower end of said vessel and advancing the wood chips upwardly throughout the length of said column by advancing liquid upwardly through a liquid propelling zone in the lower portion of said column above the lower end thereof, the steps of:

sensing the pressure in said vessel respectively above and below the normal position of the lower end of said chip mass to sense said position for control thereof;

comparing the sensed pressures to provide a compared pressure; and

controlling the propelling liquid responsive to said compared pressure.

2. In a method as claimed in claim 1, further including the step of recirculating liquid through said propelling zone.

3. A method for the continuous pulping of wood chips in an upright elongated reaction vessel by feeding substantially continuously said wood chips and a liquid into said reaction vessel adjacent the lower end thereof to maintain therein a columnar mass of compacted wood chips with the lower end thereof normally spaced upwardly from the lower end of said vessel and advancing the wood chips upwardly throughout the length of said column by advancing liquid upwardly through a liquid propelling zone in the lower portion of said column above the lower end thereof, the steps of:

sensing the pressure in said vessel at three vertically spaced positions with the lower two of said pressure

sensing positions spaced respectively above and below the normal position of the lower end of said chip mass and the upermost one of said pressure sensing positions spaced above said lower two to sense said position for control thereof;

comparing the sensed pressures to provide compared pressures; and

controlling the propelling liquid means responsive to said compared pressures.

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U.S. Cl. X.R.

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