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CONTINUOUS CELLULOSE DIGESTER WITH CHARGING DEVICE

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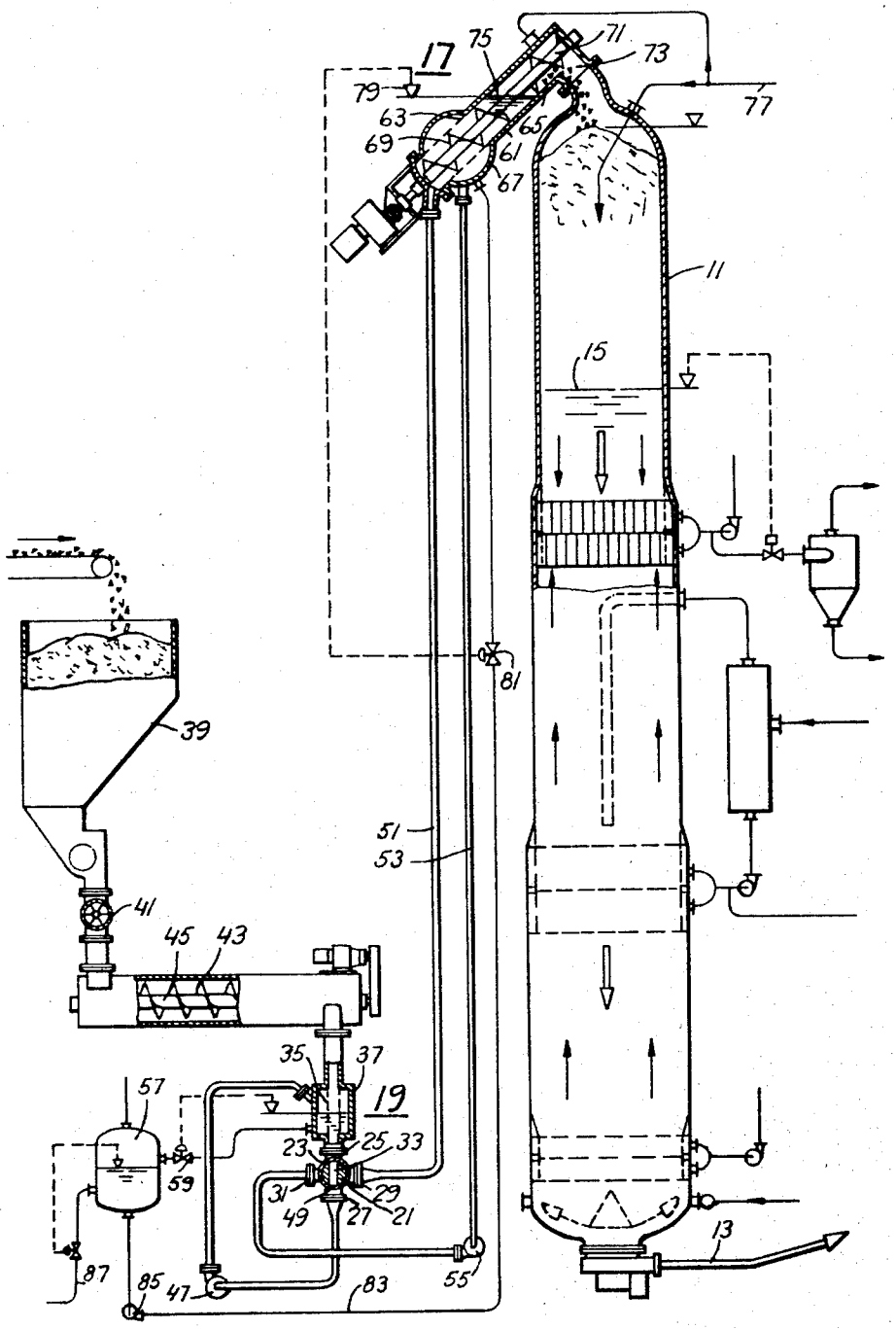

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CONTINUOUS CELLULOSE DIGESTER WITH CHARGING DEVICE

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ABSTRACT OF THE DISCLOSURE

An upright continuous cellulose digester charging device is disclosed, wherein a conduit loop connects a cellulose feeder to a casing containing a screen and a rotary screw conveyor. The casing opens into the area of the top of the digester, and the screen and the conduit loop connections in the casing are located at a level below the level of the casing opening into the area of the top of the digester. The device prevents excessive heat transfer from the digester back to the cellulose feeder.

The invention relates to an upright continuous cellulose digester with a charging device comprising a feeder operating against the digester pressure and a screening device located at a distance therefrom and consisting of a closed pressure-resistant casing, one end of which is steadily in open communication with the top of the digester and which casing encloses a rotary conveyor screw and a screen located along the latter, wherein the ends of a circulation conduit to which the feeder transfers comminuted cellulosic fiber material, such as wood chips, are connected to the casing of the screening device on opposite sides of the screen therein and in which conduit there is inserted a pump for returning to the feeder such liquid as is drawn off through said screen and for pumping a suspension of said fiber material to the screening device.

A drawback which under certain conditions may be present in previously known charging devices of said kind consists in that an excessive amount of heat is transferred from the digester to the circulating liquid and therefore to the feeder. The object of the present invention is to counteract said inconvenient heat transfer. Said object is realized essentially by the characterising feature that the two ends of the circulation conduit are connected to the casing of the screening device at a level located below the lowermost point of the fiber material outlet of the casing directly communicating with the digester top. This involves that heat would have to be transferred in a downward direction from the digester top in order to reach the circulation conduit, which is easier to prevent than the heat transfer in the upward direction encountered earlier and caused e.g. by steam penetrating upwardly and in counter-current to the fiber material charged by the conveyor screw into the digester top, the steam heating the accompanying liquid screened off and pumped back to the feeder. A measure further obstructing such heat transfer consists in that the uppermost part of the screen is located distant from and at a lower level than the fiber material outlet of the casing into the digester. When the digester top is steam-filled, it is then possible to keep the screen completely surrounded by liquid, so that the steam cannot penetrate into the space behind the screen and heat the liquid flowing therefrom back to the feeder.

The invention will now be more closely described with reference to the accompanying drawing which diagrammatically shows a continuous digester equipped with the new charging device.

The drawing shows an upright cylindrical digester **11**, the upper end of which is adapted for being charged continuously with a comminuted cellulosic material, such as wood chips, which during its motion downwardly through the digester is treated in different ways and which is discharged at the lower end of the digester through a conduit **13**. Inserted in the shell of the digester is a number of screen girdles through which various liquids can be drained off the chips column. Various conduits for supply of e.g. steam, digesting liquors, wash water etc. are also connected to the digester. The invention is not restricted to any specific combination of treatments in the digester, but in the shown embodiment there is performed in the uppermost part of the digester a prehydrolyzing digestion in steam phase which at the liquid surface level **15** changes into a prehydrolyzing digestion in liquid phase. Below the level **15** there follows a delignifying digestion by means of liquor flowing in counter-current through the middle part of the digester, and in the lowermost part of the digester there takes place a partial washing-out of the digesting liquor by means of wash water supplied to the lower end of the vessel and driven counter-currently up through the chips column. In the middle delignifying zone a temperature of the order of 170° C. should be maintained and therefore the digester is held under a correspondingly high pressure, e.g. of the order of 150 pounds per square inch.

The objects of the charging device is to charge chips etc. continuously into the upper end of the digester against the action of said high pressure.

The charging device consists of two units connected to each other by means of tube conduits, one unit consisting of a screening device located close to the digester top and in its entirety designated by the numeral **17**, and the other unit consisting of a feeder designated in its entirety by **19** and usually located at a lower level than the screening device.

The feeder **19** which may be of any known type, is shown as a rotary feeder essentially consisting of a cylindrical or conical rotor **21** and a casing **23** therefor, having four connections **25**, **27**, **29** and **31** distributed around the circumference. The rotor is provided with a diametrically through-going pocket **33** which from the shown vertical filling position can be turned into an inclined position in which its two ends are shut off by the casing **23** and from there on into a horizontal emptying position. Attached to the upper connection **25** is a chute **35** having a perforated wall enclosed by a container **37** which is held partly filled with liquid. Through the chute there pass chips emanating from the chips bin **39** and having been fed by the charging device **41** into the steaming vessel **43** which is held under a low pressure, e.g. one atmosphere overpressure, and which chips have been steamed therein while being advanced by a motor-driven screw conveyor **45**. In the lower part of the chute the chips are soaked with liquid, and in the shown position of the rotor **21** the pocket **33** is being filled with the chips-liquid-mixture. By means of a pump **47** liquid is circulated in a conduit extending between the lower connection **27** and the container **37**, which aids in the filling of the pocket **33**. The connection **27** is partly obstructed by a screen **49** attached to the casing **23** and serving to retain the chips in the pocket **33**, whereas the liquid runs through and is returned through said circulation conduit.

When the rotor **21** is turned 90°, so that the pocket **33** is horizontal and its ends are placed opposite to the connections **29**, **31** of the casing, the pocket forms a part of a circulation loop held under digester pressure and formed by two conduit branches **51**, **53** and the screening device **17** at the top of the digester. By means of a pump **55** inserted in the return conduit **53** (which only carries liquid) the chips-liquid-mixture in the pocket **33** is

pumped up through the conduit **51** to the screening device **17** where the chips are delivered, whereas the liquid is recirculated. On account of the pocket **33** being completely filled with liquid when it is returned to chips filling position and also on account of leakage due to the high pressure, the liquid content of the container **37** around the chute **35** increases. However, the level therein is maintained constant by liquid being discharged into a collecting tank **57** under control of a valve **59** and a level feeling means.

The screening device **17** at the digester top comprises a pressure-resistant casing **61** which encloses a cylindrical screen **63**. The casing is composed of a cylindrical part **65** having the same diameter as the screen **63** and forming an axial extension thereof, and a part **67** of a greater diameter surrounding the screen **63** in such a manner that an isolated space is formed on the outside of the screen **63**. The part **67** preferably forms a spherically widened part which is joined to the lower end of the cylindrical part **65** of the casing. Arranged inside the screen **61** and the casing part **65** and concentric thereto is a motor-driven feed screw **69**, the shaft **71** of which extends through the plane or bulging ends of the casing **61** and is sealed thereto.

The conduit **51** through which the chips-liquid-mixture is supplied, opens out in the casing **61** at the lower end and thereof and on the inner side of the screen **63**, whereas the conduit **53** is connected to the widened part **67** surrounding the screen **63** and therefore is capable of returning to the feeder **19** merely such liquid as has drained through the screen **63**. The chips are advanced by the feed screw **69** in the axial direction thereof at first along and past the screen **63** and then through the cylindrical casing part **65** on to a lateral outlet **73** positioned at or near the upper end of the casing and connected by a flange connection to the tapering top part of the digester.

According to the invention the screening device is inverted in comparison to a previously commonly used design, i.e. the feed direction of the chips therein is not downward as in the digester, but is upward, and the screening device has its communication with the digester located at a high level, whereas the chips are supplied to the screening device at a low level. Preferably the screen and the conveyor screw are inclined to the horizontal plane by an angle of between 30 and 60 degrees. Thereby, the chips outlet **73** at the upper end of the casing **61** may be placed substantially straight above the centre of the digester, as shown in the drawing, so that the chips drop down directly into the digester in the shortest possible path. It will be evident that the conduits connected to the lower end of the casing of the screening device are situated on a level which is lower than the lowermost point of the chips outlet **73**, and the screen **63** is also situated in its entirety distant from and on a level lower than said lowermost point of the chips outlet **73**. Preferably, the distance between said outlet **73** and said screen **63** is of the order of the axial length of the screen **63** or at least a third of the axial length of the feed screw **69**.

According to the invention the screening device should preferably be so designed that the length and the inclination of its casing are so chosen relatively to the width measured at right angles to the axis of the feed screw that a free liquid surface can form at a level which is located below the level of the chips outlet of the casing but above the screen **63** and also above the two connection points of the circulation conduit **51**, **53** upon the casing. The embodiment shown in the drawing possesses said feature, and as seen therein the liquid surface **75** forms a border surface which prevents the steam present thereabove and supplied to the digester top through the conduit **77**, from penetrating down to the screen **63** and heating the liquid flowing in the conduit **53** back to the feeder **19**. It is true that steam may condense upon and heat the surface **75** of the liquid in the cylindrical part **65** of the screening device, but as the upper layer of said liquid is steadily renewed by adhering to the chips moving upwardly out of the liquid and as there is also no tendency to the development of convection currents in a liquid column having an upwardly rising temperature, it is evident that the liquid returned through the conduit **53** to the feeder **19** has not been subjected to any significant heating in the screening device **17**.

The surface level **75** is maintained substantially constant in a position coincident with a middle part of the feed screw **69** and the cylindrical casing part **65**. The device used therefor consists of a level feeding means designated by the symbol **79**, which means acts upon a control valve **81** inserted in a conduit **83** through which liquid from the collecting tank **57** is returned by means of a pump **85** to the screening device **17**. The quantity of liquid carried with the chips when rising above the liquid surface level **75** of the screening device is replaced by liquid from the conduit **87**, which liquid is supplied to the tank **57** in such a quantity that the level therein is maintained constant. Said liquid may be either water or some treating liquid, such as digesting liquor, agreeing with the treatment to which the chips are to be subjected immediately after their introduction into the digester.

At the place where it is desired to have the free liquid surface **75**, the thread of the feed screw **69** is left out, so that the chips are lifted up and out of the liquid by the action of the rising lower part of the chips column. Somewhat above the liquid surface **75** the screw feeder **69** again acts directly upon the chips in order to feed them towards the outlet **73**.

The charging device shown may also be used for a digester having no gas or steam filling and the overpressure of which is maintained by hydraulic compression. Then a free liquid surface **75** is not formed and the valve **81** should be controlled otherwise, e.g. by the pressure of the digester. Thus, a digester provided with the new charging device can be operated either with or without a gas phase at the top, and conversion from one to the other kind of operation may easily take place.

Within the scope of the following claims the embodiment shown can be modified also in other respects. For instance, the steaming vessel **43** may be replaced by an upright container in which steaming as well as impregnation of the chips with digesting liquor take place. The feeder may be of the reciprocating or plunger type.

I claim:

1. An upright continuous cellulose digester charging device comprising a feeder operating against the digester pressure and a screening device located at a distance from said feeder, said screening device comprising a closed pressure-resistant casing, one end of which is in steadily open communication with the top of the digester said casing enclosing a rotary conveyor screw and a screen completely surrounding part of said screw, a circulation conduit to which said feeder transfers comminuted cellulosic fiber material, such as wood chips, being connected to said casing on opposite sides of said screen therein, a pump in said circulation conduit for returning to said feeder such liquid as is drawn off through said screen and for pumping a suspension of said fiber material to the screening device, the said circulation conduit being connected to said casing of said screening device at a level located below the lowermost point of the end of said casing directly communicating with the digester top.

2. A digester charging device as claimed in claim **1**, in which the uppermost part of said screen is located distant from and lower than said fiber material outlet of said casing into the digester.

3. A digester charging device as claimed in claim **1**, in which the length and the inclination of said casing are so chosen relatively to the width of the same, measured at right angles to the axis of the conveyor screw, that a free liquid surface can form at a level which is

located below the level of said fiber material outlet of said casing but above said screen and also above the said two points of connection of said circulation conduit to said casing.

4. A digester charging device according to claim **3**, wherein a device controls or maintains constant said liquid surface level in a position coincident with a middle part of said conveyor screw.

5. A digester charging device according to claim **3**, in which the thread of said conveyor screw is left out along a comparatively small portion of the same in the area where said free liquid surface is maintained.

6. A digester charging device according to claim **1**, in which the part of said casing located next to said casing end is cylindrical, in which said screen enclosing said conveyor screw and located next to said fiber material inlet is cylindrical, lies in the extension of and has the same diameter as said first-mentioned cylindrical casing part, and in which said casing has a part of greater diameter enclosing said screen.

7. A digester charging device as claimed in claim **1** wherein the distance between said fiber material outlet and said screen is at least one-third of the axial length of said screw.

8. An upright continuous cellulose digester charging device comprising a feeder, a screening device comprising a closed pressure-resistant casing, one end of which opens into the top of said digester, a screen, a rotary screw conveyor located within said casing and enclosed at its lower end by said screen, and conduit connections opening into said casing, said screen and said conduit

connections located at a level below the lowermost point of said end of said casing opening into the top of said digester, and a conduit loop consisting of a feed conduit and a liquid return conduit and a pump inserted in said return conduit, said conduit loop connecting said conduit connections of said screening device to said feeder.

9. A digester charging device as claimed in claim **1**, in which said screen is an enclosed cylindrical screen and said conveyor screw and said enclosed cylindrical screen are arranged with their axial direction inclined to the horizontal plane, the feed of said screw being directed obliquely upwards, and the upper end of said casing being connected directly to the top part of the digester.

10. A digester charging device as claimed in claim **9**, in which said conveyor screw and said screen are inclined to the horizontal plane by an angle of 30 to 60 degrees.

11. A digester charging device as claimed in claim **9**, in which the upper end of said casing is located substantially straight above the digester top, so that said fiber material departing from said casing drops directly down into the digester.

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