

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
17 January 2008 (17.01.2008)

PCT

(10) International Publication Number
WO 2008/008295 A2

(51) International Patent Classification:
F23B 50/12 (2006.01)

(21) International Application Number:
PCT/US2007/015634

(22) International Filing Date: 9 July 2007 (09.07.2007)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
60/819,646 11 July 2006 (11.07.2006) US
60/908,495 28 March 2007 (28.03.2007) US

(71) Applicant (for all designated States except US): **AN-DRITZ INC.** [US/US]; 13 Pruyn's Island Drive, Glen Falls, NY 12801-3686 (US).

(72) Inventors; and

(75) Inventors/Applicants (for US only): **NEMETH, Lawrence, Joseph** [CA/CA]; 422 King Edward Street, RR#3, Paris, Ontario, N3L 3E3 (CA). **PSCHORN, Thomas** [AT/CA]; 23 Deacon, Lennoxville, Quebec, J1M 2B2 (CA). **STROMBERG, Bertil** [US/US]; 130 South Trout Lake Road, Diamond Point, NY 12824 (US).

(74) Agent: **KAGEN, Alan, M.**; Nixon & Vanderhye P.C., 901 North Glebe Road, 11th Floor, Arlington, VA 22203-1808 (US).

(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, SV, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, LV, MC, MT, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Declaration under Rule 4.17:

— of inventorship (Rule 4.17(iv))

Published:

— without international search report and to be republished upon receipt of that report

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: FEED SYSTEM

(57) Abstract: A feed system includes a buffer assembly that receives material to be fed to a gasifier. The buffer assembly has structure that pre-processes the material for delivery to the gasifier. A rotary valve is positioned relative to the buffer assembly to receive the material from the buffer assembly. A digester receives the material from the first rotary valve, where the rotary valve conveys the material to the digester and includes a gas lock that prevents gas from escaping the digester. The digester is operable as one of a dryer and a gasifier depending on its operating parameters.



WO 2008/008295 A2

TITLE OF THE INVENTION

FEED SYSTEM

CROSS-REFERENCES TO RELATED APPLICATIONS

[0001] This application claims the benefit of U.S. Provisional Patent Application Serial No. 60/819,646, filed July 11, 2006 and U.S. Provisional Patent Application Serial No. 60/908,495, filed March 28, 2007, the entire contents of which are herein incorporated by reference.

STATEMENT REGARDING FEDERALLY
SPONSORED RESEARCH OR DEVELOPMENT

[0002] (NOT APPLICABLE)

BACKGROUND OF THE INVENTION

[0003] The invention relates generally to feed systems and, more particularly, to a feed system for feeding comminuted cellulosic material to a pressurized gasifier.

[0004] The byproducts of an industrial plant process, such as those of a paper mill, can be used to produce fuel and/or electrical power using a gasifier. Feed material introduced into the gasifier is combusted at high temperatures. The contents of the gasifier are explosive and/or corrosive in nature and must be contained within the gasifier during normal operations and during startup and shut down of the gasifier. It is important that contents from the gasifier are prevented from entering upstream components that feed material to the gasifier.

[0005] Existing feed systems require batch feeding arrangements using multiple hatches to contain the gasifier contents or large alternating valve

arrangements combined with pressurized feed-hoppers or the like. Such arrangements are expensive to manufacture and inefficient to operate.

BRIEF SUMMARY OF THE INVENTION

[0006] It would thus be desirable to provide a feed system and method that more efficiently processes cellulosic material and/or other waste products for delivery to a gasifier. The feed system described herein includes structure that feeds the material while preventing the contents of the gasifier from coming in contact with upstream components and from escaping to the atmosphere. Additionally, the feed system advantageously utilizes a digester, such as an M&D digester, for performing a drying function or for serving as the gasifier.

[0007] In an exemplary embodiment, a feed system includes a buffer assembly that receives material to be fed to a gasifier, where the buffer assembly includes structure that pre-processes the material for delivery to the gasifier. A first rotary valve is positioned relative to the buffer assembly to receive the material from the buffer assembly. A digester receives the material from the first rotary valve, where the rotary valve conveys the material to the digester and includes a gas lock that prevents gas from escaping the digester. The digester is operable as one of a dryer and a gasifier depending on operating parameters thereof.

[0008] If the digester is operating as a dryer, the feed system further includes a second rotary valve positioned relative to the digester to receive the material from the digester, where the second rotary valve conveys the material to a gasifier and including a gas lock that prevents gas from escaping the gasifier. The buffer assembly preferably includes a buffer bin positioned to receive the material, a plug screw feeder receiving the material from the buffer

bin and forming a plug of the material, and a screw transfer conveyor providing a buffer volume of the material to the first rotary valve.

[0009] The digester may be disposed at an angle relative to vertical and may include a conveyor, where a speed of the conveyor controls a retention time of the material.

[0010] In another exemplary embodiment, a method of feeding a comminuted cellulosic material includes the steps of (a) receiving the cellulosic material in a buffer bin; (b) feeding the cellulosic material to a plug screw feeder disposed in communication with the buffer bin and forming a plug of the cellulosic material; (c) conveying the material plug to a screw transfer conveyor and providing a buffer volume of the cellulosic material; (d) transferring the cellulosic material to a first rotary valve from the screw transfer conveyor; and (e) conveying with the first rotary valve the cellulosic material to a digester while preventing gas from escaping the digester. The method may further include a step of setting operating parameters of the digester such that the digester operates as a gasifier or setting operating parameters of the digester such that the digester operates as a dryer.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] These and other aspects and advantages of the present invention will be described in detail with reference to the accompanying drawings, in which:

[0012] FIGURE 1 is an exemplary schematic illustration of a gasifier feed system; and

[0013] FIGURE 2 is an exemplary schematic illustration of a gasifier feed system, including a digester.

DETAILED DESCRIPTION OF THE INVENTION

[0014] FIG. 1 is an exemplary schematic illustration of a feed system for feeding comminuted cellulosic material to a pressurized gasifier. Wood chips or other comminuted cellulosic fibrous material are conveyed from a storage silo or pile 1 to a buffer bin 2. The buffer bin 2 may be a chip bin such as the DIAMONDBACK[®] chip bin sold by Andritz Inc. of Glens Falls, New York or other similar chip bin. The chip bin 2 may include a source of steam such that steam may be added to the cellulosic material. The steam source is optional.

[0015] From the buffer bin 2, the cellulosic material is fed to a plug screw feeder 3. Any type of known plug screw feeder may be utilized. Once in the screw feeder 3, a plug of the cellulosic material is formed and is moved toward a discharge end 4 of the screw feeder 3. A back stop or blowback valve (blowback damper) 5 is disposed adjacent the discharge end of the plug screw feeder 3. The back stop 5 serves to close off the plug screw feeder 3 from downstream equipment if the flow of material or density of the plug inside the plug screw feeder 3 is lost. That is, the back stop 5 comprises a preloaded valve or cone that closes the feeder in the event of a pressure drop in the feeder. The back stop 5 serves to prevent the escape of any gas from the gasifier into the atmosphere or other equipment upstream of the gasifier.

[0016] The plug screw feeder 3 may be designed with holes or slots in the screw-housing/basket or the following spool piece to squeeze-out water/moisture (to increase the dry-content of the feed material), extractives and/or other volatile components, thus simplifying the gas cleaning process after the gasifier.

[0017] The plug of cellulosic material formed in the plug screw feeder 3 is discharged into a screw transfer conveyor 6. At the feed end 7 of the screw transfer conveyor 6 where the material plug enters the screw transfer conveyor 6, a continuous flow of inert gas (such as nitrogen, argon, carbon dioxide,

and/or any other non-dangerous gas) is introduced from an inert gas source 8 to the screw transfer conveyor 6. This continuous flow of inert gas 8 is provided at a higher pressure than the pressure in the gasifier, thereby providing a continuous purging of the screw transfer conveyor 6 to keep any dangerous gases from escaping from the gasifier into the atmosphere or to the conveyor 6 or to the plug screw feeder 3. Rather, due to the higher pressure gas supply, in the event of any exposure of the gasifier entrance, the harmless inert gas flows into the gasifier, and the gasifier contents are prevented from escaping. In the screw transfer conveyor 6, the material plug is broken up for further processing.

[0018] The screw transfer conveyor 6 provides a buffer volume of cellulosic material upstream of a rotary valve 9. The rotary valve 9 provides for conveyance of the cellulosic material into the gasifier 10 as well as providing a gas-lock to prevent the escape of gases from the gasifier 10 and mixing with the cellulosic material while it is a plug. Any known rotary valve suitable for this purpose may be used. The rotary valve can be a wet or dry feeder such as a "Bauer Rotary Valve" or a low pressure feeder available from Andritz Inc.

[0019] The inert gas 8 could be used to purge the rotor of the rotary valve 9. The gasses would be purged into the gasifier 10. In light of the high pressure inert gas (i.e., a pressure higher than a pressure in the gasifier), the rotary feeder serves to keep mixing of the gasifier contents and conveyor to a minimum, should the screw transfer conveyor lose its pressure holding capability.

[0020] The cellulosic material is conveyed from the rotary valve 9 and enters the gasifier 10.

[0021] FIG. 2 shows an alternative feed system including a digester 12. Any known digester may be used. One suitable digester is an M&D digester available from Andritz, Inc. The digester is typically used for kraft pulping of

chips or sawdust. In conventional use, the digester vessel is installed at a 45 degree angle, and a midfeather divides the digester into an upper compartment and a lower compartment. A chain conveyor moves the chips or sawdust down the upper compartment and back up the lower compartment. The speed of the conveyor controls the retention time.

[0022] With the feed system of this embodiment, a digester 12 may be disposed downstream of the screw transfer conveyor 6 via a first rotary valve 9A. The first rotary valve 9A operates in a manner similar to that of rotary valve 9 described above and includes a gas lock that prevents gas from escaping the digester 12. The digester 12 is operable as either a dryer or a gasifier, depending on operating parameters thereof. That is, depending on the length of the retention time (and possibly other parameters such as temperature, humidity, etc.), the digester may be operable as a dryer (and/or to de-volatilize the feed material into the gasifier) or as a gasifier.

[0023] If the digester 12 is operating as a dryer, the feed system also includes a second rotary valve 9B positioned relative to the digester 12 to receive the material from the digester 12. The second rotary valve 9B, which functions in a similar manner to the rotary valve 9 described above, conveys the material to the gasifier 10 and includes a gas lock that prevents gas from escaping the gasifier 10.

[0024] If the digester 12 is operating as a gasifier, the gasifier 10 shown in the schematic system drawing in FIG. 2 may be eliminated.

[0025] With this system, comminuted cellulosic material can be fed to a pressurized gasifier while preventing any gases from the gasifier from escaping the gasifier into the atmosphere or other equipment upstream of the gasifier. Additionally, a digester may be incorporated in the system to serve as a dryer or a gasifier.

[0026] While the invention has been described in connection with what is presently considered to be the most practical and preferred embodiments, it

is to be understood that the invention is not to be limited to the disclosed embodiments, but on the contrary, is intended to cover various modifications and equivalent arrangements included within the spirit and scope of the appended claims.

CLAIMS

1. A feed system comprising:
 - a buffer assembly that receives material to be fed to a gasifier, the buffer assembly including structure that pre-processes the material for delivery to the gasifier;
 - a first rotary valve positioned relative to the buffer assembly to receive the material from the buffer assembly; and
 - a digester receiving the material from the first rotary valve, wherein the rotary valve conveys the material to the digester and includes a gas lock that prevents gas from escaping the digester, the digester being operable as one of a dryer and a gasifier depending on operating parameters thereof.
2. A feed system according to claim 1, wherein if the digester is operating as a dryer, the feed system further comprising a second rotary valve positioned relative to the digester to receive the material from the digester, the second rotary valve conveying the material to a gasifier and including a gas lock that prevents gas from escaping the gasifier.
3. A feed system according to claim 1, wherein the buffer assembly comprises a buffer bin positioned to receive the material, a plug screw feeder receiving the material from the buffer bin and forming a plug of the material, and a screw transfer conveyor providing a buffer volume of the material to the first rotary valve.
4. A feed system according to claim 1, wherein the operating parameters of the digester are set such that the digester operates as a gasifier.
5. A feed system according to claim 1, wherein the operating parameters of the digester are set such that the digester operates as a dryer.
6. A feed system according to claim 1, wherein the digester is disposed at an angle relative to vertical and comprises a conveyor, and wherein a speed of the conveyor controls a retention time of the material.

7. A method of feeding a comminuted cellulosic material, the method comprising:
- (a) receiving the cellulosic material in a buffer bin;
 - (b) feeding the cellulosic material to a plug screw feeder disposed in communication with the buffer bin and forming a plug of the cellulosic material;
 - (c) conveying the material plug to a screw transfer conveyor and providing a buffer volume of the cellulosic material;
 - (d) transferring the cellulosic material to a first rotary valve from the screw transfer conveyor; and
 - (e) conveying with the first rotary valve the cellulosic material to a digester while preventing gas from escaping the digester.
8. A method according to claim 7, further comprising setting operating parameters of the digester such that the digester operates as a gasifier.
9. A method according to claim 7, further comprising setting operating parameters of the digester such that the digester operates as a dryer.
10. A method according to claim 9, further comprising, after step (e), transferring the cellulosic material to a second rotary valve from the digester, and conveying with the second rotary valve the cellulosic material to a gasifier while preventing gas from escaping the gasifier.
11. A method according to claim 7, further comprising, prior to step (c), squeezing extractives through the plug screw feeder.

1/2

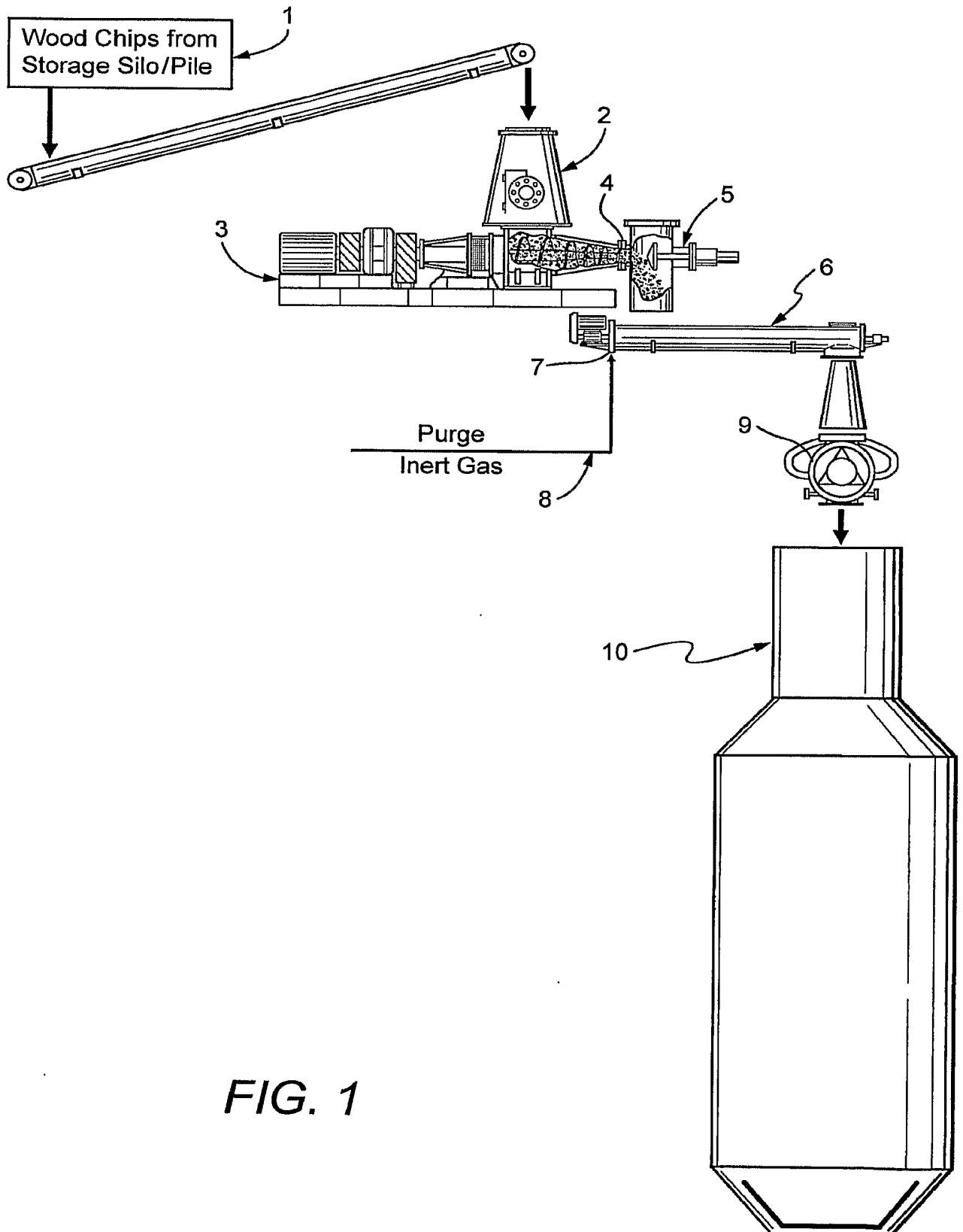


FIG. 1

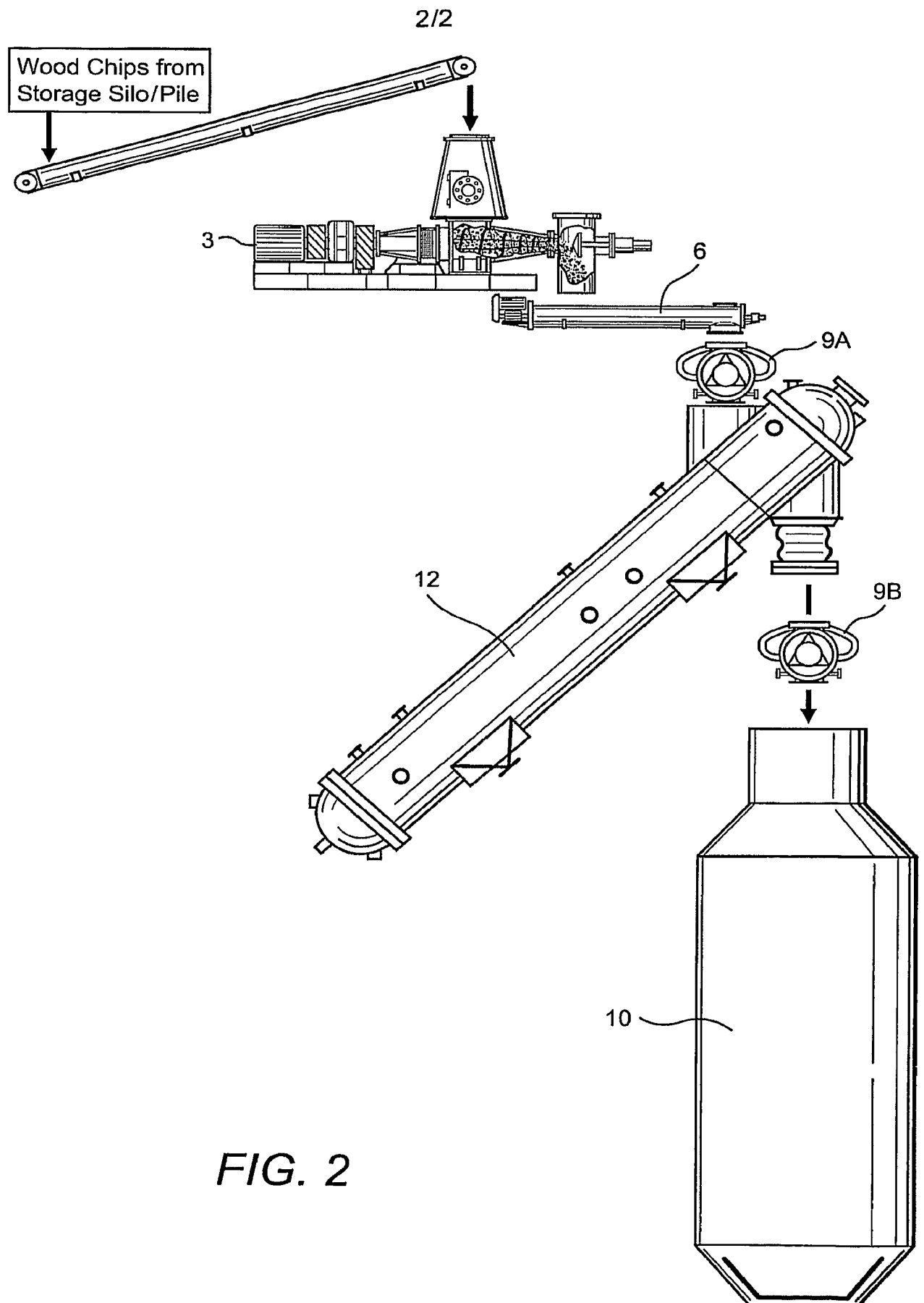


FIG. 2