Nov. 2, 1965 A. P. SCHNYDER 3,215,591

PRESSURE IMPREGNATION APPARATUS FOR IMPREGNATING WOOD CHIPS AND THE LIKE

Filed April 22, 1963 2 Sheets-Sheet 1

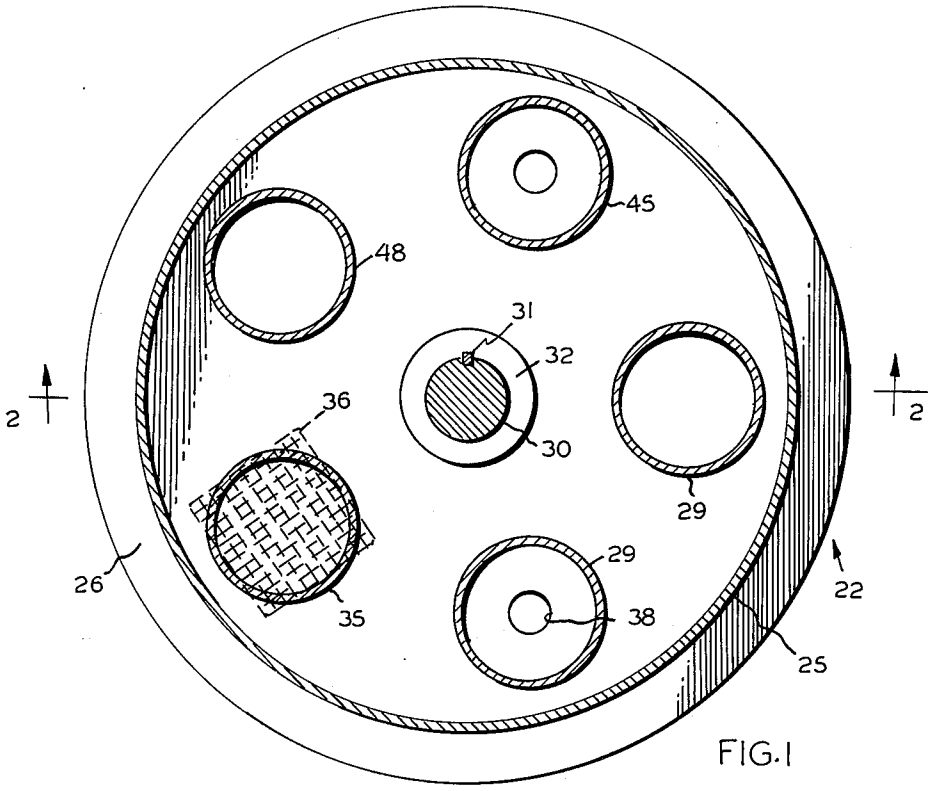


FIG. 1

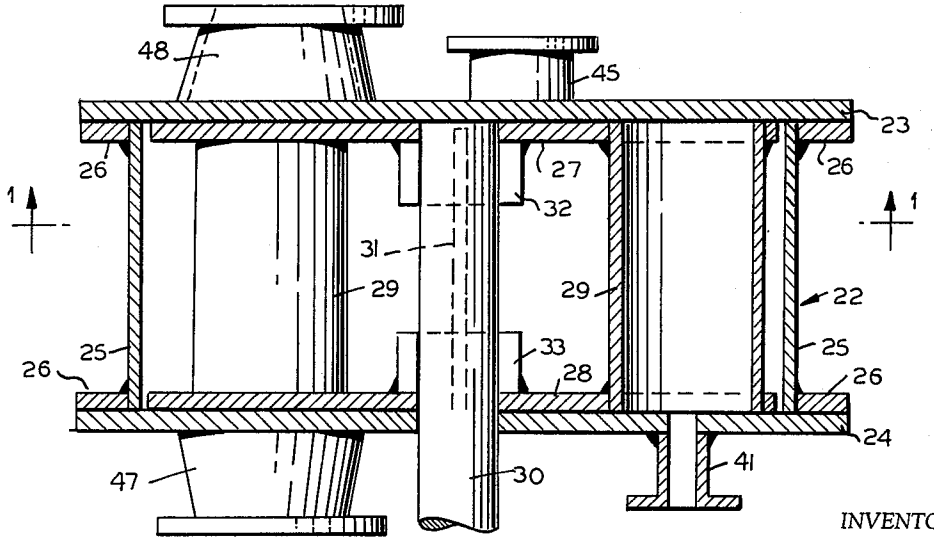


FIG. 2

INVENTOR

AUXILIUS P. SCHNYDER

BY Ross L. Joertmeyer

ATTORNEY

Nov. 2, 1965 A. P. SCHNYDER 3,215,591

PRESSURE IMPREGNATION APPARATUS FOR IMPREGNATING WOOD CHIPS AND THE LIKE

Filed April 22, 1963 2 Sheets-Sheet 2

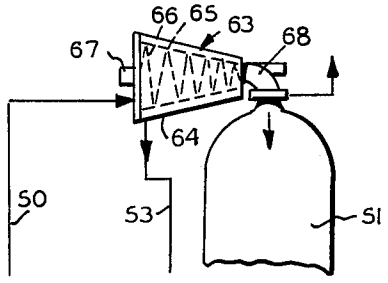


FIG. 4

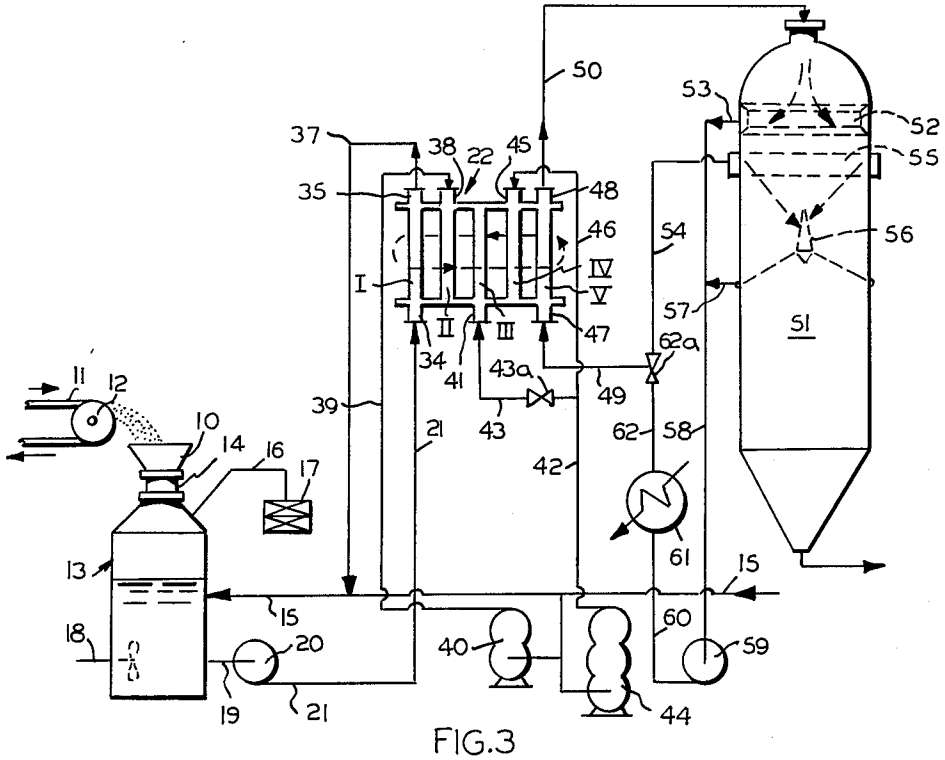


FIG. 3

INVENTOR

AUXILIUS P. SCHNYDER

BY Ross L. Joertmeyer

ATTORNEY

United States Patent Office 3,215,591
Patented Nov. 2, 1965

3,215,591

PRESSURE IMPREGNATION APPARATUS FOR IMPREGNATING WOOD CHIPS AND THE LIKE

Auxilius P. Schnyder, Bogota, N.J., assignor to The Lummus Company, New York, N.Y., a corporation of Delaware

Filed Apr. 22, 1963, Ser. No. 274,422
10 Claims. (Cl. 162—246)

The present invention relates to an improved apparatus for treating wood chips and like cellulosic material in the formation of pulp and, more particularly, to an improved apparatus for the pressure impregnation of wood chips and like cellolosic material with cooking liquor prior to introduction into the digester.

Present practice requires considerable time to effect the impregnation of chips in batch processes, whereas with continuous processes an equivalent extra volume is required in the digester for the chip impregnation at full pressure while raising the temperature to standard delignification temperature ranges.

In accordance with the present invention, the time required to effect the uniform impregnation of wood chips is minimized by subjecting the chips to a high hydraulic pressure several times that of the standard cooking pressure. Rapid impregnation is effected by subjecting a limited volume of chips to successively higher hydraulic pressure stages up to a final pressure in the order of 600 p.s.i.g.

In accordance with a preferred embodiment of the present invention, the chips are initially deaerated in a vessel maintained under vacuum and submerged in cold active cooking liquor. A slurry of the wood chips and liquor is then pumped to a revolver valve impregnator consisting of a revolving barrel assembly having at least three chip receiving tubes and an outer stationary assembly which surrounds and seals the revolving barrel. The outer stationary assembly is provided with openings constituting chip inlet and outlet stations and with pipe connections to high pressure liquor lines constituting intermediate stations where the chips being impregnated are subjected to successive, incrementally increasing hydraulic pressures. Drive means are provided for cyclically rotating the tubes of the revolving barrel assembly from the chip inlet station through the intermediate pressure increasing stations to the chip outlet station, and for maintaining a suitable residence time at the various stations. From the outlet station, the chips in slurry form are passed to a digester, with excess liquor being recycled to the impregnating apparatus.

A primary object of the present invention is to provide apparatus for effecting a uniform impregnation of wood chips thereby obtaining a more uniform pulp product.

Another object of the present invention is to provide apparatus for effecting the uniform impregnation of wood chips whereby the residence time of the chips in the digester is reduced.

A further object of the present invention is to provide apparatus for impregnating chips by incrementally increasing the hydraulic pressure acting upon the chips.

Still another object of the present invention is to provide apparatus capable of effective chip impregnation when the chips and liquor are relatively cold.

These and other objects, features and advantages of the present invention will become more apparent from the following description and the drawings, wherein:

FIGURE 1 is a horizontal sectional view of the revolver valve impregnator of the present invention taken along the line I—I of FIGURE 2,

FIGURE 2 is a vertical sectional view of the revolver valve of FIGURE 1, taken substantially along the line II—II of FIGURE 1,

FIGURE 3 is a schematic overall view illustrating one embodiment of the present invention in which the revolver valve impregnator has been illustrated in a manner to better show the various stations thereof, and

FIGURE 4 is a schematic view of modified chip liquor separator which is positioned externally of the digester.

Referring now to the drawings wherein like reference numerals designate like parts throughout, and more particularly, to FIGURE 3, chips are fed into a hopper **10** from a conveyor belt **11** passing over a pulley **12**. From hopper **10**, the chips are introduced into a tank **13** by means of a suitable chip metering device, such as a star valve **14**. Chips within tank **13** are gradually submerged beneath the level of the liquor introduced through line **15** into tank **13** (as more fully hereinafter described) thereby displacing the free air surrounding the chips. Air is withdrawn from tank **13** through line **16** by a vacuum pump **17**. An agitator **18** is provided to mix the chips and liquor within the tank **13** to form a chip-liquor slurry of suitable consistency. Suitable liquid level control means (not shown) is provided to maintain the liquor level in tank **13** within the desired range. A chip-liquor slurry is withdrawn from tank **13** via line **19** by pump **20**, and is passed through line **21** to the revolver valve impregnator, generally designated by reference numeral **22**.

Referring now to FIGURES 1 and 2, revolver valve impregnator **22** consists of an outer stationary assembly and an inner rotor assembly. The outer stationary assembly comprises an upper flange plate **23**, a lower flange plate **24**, and a cylindrical casing **25** having annular flange portions **26** at each end bolted or otherwise secured to flange plates **23** and **24**. The rotor assembly comprises upper and lower rotatable plates **27** and **28**, and a plurality of tubular members **29** secured, as by welding, at each end thereof within corresponding apertures in upper and lower plates **27** and **28**. Tubular members **29** constitute chip receiving passageways. In the illustrative embodiment, five tubular members **29** are spaced **72°** apart concentrically about a drive shaft **30**. It will be appreciated that the number of tubular members **29** and their spacing around the drive shaft may be varied as desired. Drive shaft **30** extends through aligned apertures in flange plates **23** and **24** and in plates **27** and **28**. Drive shaft **30** is connected to the rotor assembly by means of a key **31**. Suitable stuffing boxes **32** and **33** surround shaft **30** and are mounted on the inner surfaces of plates **27** and **28**.

The surfaces of flange plates **23** and **24**, abutting complementary surfaces of plates **27** and **28**, as well as the ends of tubular members **29** are machined to mirror-like, flat finishes to reduce friction while allowing small clearances to be provided therebetween to minimize excessive internal leakage. During operation, however, internal leakage within revolver valve impregnator **22** from the higher pressure stations to the lower pressure stations, will cause the interior portion of outer stationary assembly to fill up with liquor. As a result of internal leakage, the rotor assembly essentially floats within the stationary outer assembly.

The operation of revolver valve impregnator **22**, and its several chip treating stations, will become apparent from the developed view thereof in FIGURE 3. The chip-liquor slurry in line **21** is passed through an inlet port **34** in lower flange plate **24** and is introduced into a respective one of the tubular members **29** present at inlet station I. A liquor discharge port **35** is secured to upper flange plate **23** in alignment with inlet port **34** and is provided with a screen **36** to prevent the chips introduced into the tubular members **29** to pass through the port **35**. During the period of time in which a tubular member **29** at inlet station I is in alignment with ports **34** and **35**,

the tubular member 29 will be filled with chips. Excess liquor is withdrawn from port 35 through line 37 and is passed through line 15 to tank 13.

The rotor assembly is caused to rotate by means of drive shaft 30 affixed to a driving means (not shown) thereby transferring the filled tubular member 29 to intermediate station II while positioning an empty tubular member 29 (filled only with liquor) at inlet station I. At intermediate station II, the chips in the filled tubular member 29 are subjected to a higher hydraulic pressure applied through a liquor connection 38 secured to upper flange plate 23 which receives additional impregnating liquor from line 39 by pump 40. As indicated diagrammatically in FIGURE 3, pump 40 is capable of achieving a high hydraulic pressure than pump 20. At intermediate station II, as well as at intermediate stations III and IV to be discussed hereinafter, tubular members 29 are closed off at the ends opposite the liquor connections by either flange plate 23 or flange plate 24.

Upon further rotation of the rotor assembly, the tubular member 29 from intermediate station II is moved to intermediate station III whereat the chips in the tubular member 29 are subjected to a further incremental increase in the hydraulic pressure of the liquor through liquor connection 41. The liquor is passed to liquor connection 41 through line 42 and branch line 43 by pump 44. Liquor connection 41 is secured to lower flange plate 24 so that the direction of liquor entry is opposite to that at the previous station II thereby preventing the chips in tubular member 29 from remaining wedged in one position during the cycle of operation.

At intermediate station IV, the chips are similarly subjected to impregnating liquor entering at a liquor connection 45 secured to upper flange plate 23. Liquor connection 45 is supplied with liquor through line 42 and branch line 46 by pump 44. It will, of course, be appreciated that a separate pump may be provided to supply liquor to connection 45. As shown, both intermediate station III and intermediate station IV are supplied with liquor from pump 44. While the hydraulic pressures in stations III and IV may thus be substantially equal, it is preferred, in accordance with the present invention, to provide a suitable valve 43*a* in line 43 of station III, and to dimension lines 42, 43 and 46 so that the hydraulic pressure of the liquor reaching station III is less than the hydraulic pressure of the liquor reaching station IV.

At discharge station V, there is both a liquor connection 47 secured to lower flange plate 24 provided with a screen (not shown), and an unobstructed chip slurry discharge port 48 secured to upper flange 23. Liquor connection 47 is supplied with heated cooking liquor through line 49 from a source to be explained more fully hereinafter to form a slurry with the impregnated chips. The slurry is discharged from the tubular member 29 at station V through discharge port 48 and is passed through line 50 to a digester, generally indicated as 51.

Upon the next cyclical rotation of the rotor assembly, the discharged tubular member 29 filled only with liquor is returned to inlet station I for the start of another cycle. It will, of course, be appreciated that each of tubular members 29 in turn pass through stations I to V. The slurry of impregnated chips and cooking liquor is introduced into the top of digester 51. Since more liquor is required to form the slurry than is required in the delignification of the chips, excess liquor is withdrawn through a circular internal draining ring assembly 52 through line 53.

Since it is not practical to raise the chips to the cooking temperature solely by heating the liquor in line 49 passing to station V and forming the slurry, additional hot liquor is introduced into digester 51 through line 54 and an annular distributor ring 55. Cooking liquor is withdrawn at an intermediate point from the digester 51, such as is schematically indicated in connection with a perforated cone-shaped member 56 mounted within digester 51. The

liquor is withdrawn from member 56 through line 57 and is combined with the liquor in line 53. The combined liquor is passed through lines 58 by pump 59 and thence through line 60 to a heat exchanger 61. In heat exchanger 61, the heat content of the liquor is increased to the extent necessary to maintain the cooking temperature within the digester. From heat exchanger 61, the liquor is passed through line 62 and control valve means 62*a* which proportion the heated liquor between the line 49 leading to discharge station V, and the liquor supply line 54 leading to digester 51 to maintain the proper cooking temperature within the digester 51.

Although only one pump 59 and one heat exchanger 61 have been shown as performing the dual functions of transferring chips from station V to digester 51 and of maintaining the delignification temperature, it is, of course, apparent that the liquor supplied through lines 49 and 54 may come from separate sources, and that additional heat exchangers may be provided as are necessary. After digestion, the pulp in digester 51 is passed to a blow tank.

In FIGURE 4, there is shown a modified chip-liquor separator, generally designated by reference numeral 63, which may be utilized in lieu of the circular draining ring 52 of FIGURE 3. The external chip-liquor separator 63 is supplied with an impregnated chip-liquor slurry from discharge station V through line 50. Separator 63 includes an outer casing 64 tapering in cross section from the inlet end towards the discharge end thereof, and an internal screen 65 spaced from casing 64 to retain the chips therein while allowing liquor to pass through and to drain to the bottom of casing 64 for removal and processing as hereinbefore described. A helical conveyor screw 66 having a drive shaft 67 connected to suitable drive means (not shown) is mounted for rotation within screen 65. By the action of conveyor screw 66, the liquor is squeezed out of the chips and is withdrawn through the screen 65 and line 53. A conduit 68 at the discharge end of separator 63 is provided to pass the chips into digester 51. As a result of the taper of screen 65 and the action of conveyor screw 66, the chips effectively form a plug which effects a pressure sealing for digester 51 from the remainder of the system.

In view of the above, it is apparent that the present invention provides a novel apparatus for achieving a more uniform chip impregnation yielding pulp of more uniform quality while also reducing the overall operating time. It will be appreciated that the present invention is susceptible of many changes and modifications within the spirit and scope of my disclosure. Accordingly, I do not wish to be limited to the particular embodiments shown and described herein, but intend to encompass all modifications and changes within the scope of the appended claims.

I claim:

1. A revolver valve impregnator for treating wood chips and the like, comprising a stationary outer assembly, a rotor assembly rotatable within said outer assembly and including two spaced plates connected by a plurality of open ended tubular members rigidly secured at the ends thereof within apertures provided in said plates, said stationary outer assembly having end plates closely adjacent said rotatable plates and provided with a first pair of aligned apertures constituting an inlet station, one of said apertures providing an inlet for passage of a chip-liquor slurry into an associated one of said tubular members present at said inlet station, the other of said apertures being provided with screen means to prevent chip passage therethrough, said end plates being provided with a second pair of aligned apertures constituting a discharge station, means for subjecting chips in the tubular members to successively higher liquor impregnating pressures during rotation from said inlet station to said outlet station, and conduit means associated with said last-mentioned apertures to supply liquor through one of said

last-mentioned apertures and to discharge a chip-liquor slurry out the other of said last-mentioned apertures.

2. A revolver valve impregnator for treating wood chips and the like, comprising a stationary outer assembly, a rotor assembly rotatable within said outer assembly and including two spaced plates connected by a plurality of open ended tubular members rigidly secured at the ends thereof within apertures provided in said plates, said stationary outer assembly having end plates closely adjacent said rotatable plates and provided with means constituting an inlet station for receiving a chip-liquor slurry and passing the slurry into an associated one of said tubular members present at said inlet station, said end plates being provided with additional means constituting a discharge station, and means for subjecting chips in said tubular members to successively higher impregnating liquor pressures during rotation from said inlet station to said outlet station.

3. A revolver valve impregnator comprising a stationary outer assembly, a rotor assembly rotatable within said outer assembly and including two spaced plates connected by a plurality of open ended tubular members rigidly secured at the ends thereof within apertures provided in said plates, said stationary outer assembly having end plates closely adjacent said rotatable plates and provided with aperture means constituting an inlet station for receiving a chip-liquor slurry and passing the slurry into an associated one of said tubular members present at said inlet station, said end plates being provided with additional aperture means constituting a discharge station, a drive shaft for rotating said rotor assembly passing through said end plates and said rotatable plates, said tubular members being essentially equally spaced circumferentially around said drive shaft, and means for subjecting chips within said tubular members to successively higher liquor pressures during rotation of said rotor assembly.

4. A revolver valve impregnator for treating wood chips and the like, comprising a stationary outer assembly, a rotor assembly rotatable within said outer assembly and including two spaced plates connected by a plurality of open ended tubular members rigidly secured at the ends thereof within apertures provided in said plates, said stationary outer assembly having end plates closely adjacent said rotatable plates and provided with aperture means constituting an inlet station for receiving a chip-liquor slurry and passing the slurry into an associated one of said tubular members present at said inlet station, said end plates being provided with additional aperture means constituting a discharge station, said end plates and said rotatable plates having complementary surfaces machined to a mirror-like finish and having small clearances between adjacent plates, and means for subjecting chips within said tubular members to successively higher liquor pressures during rotation of said rotor assembly.

5. A revolver valve impregnator for subjecting wood chips and the like to successively higher liquor impregnating pressures, comprising a stationary outer assembly, a rotor assembly rotatable within said outer assembly and including two spaced plates connected by a plurality of open ended tubular members rigidly secured at the ends thereof within apertures provided in said plates, said stationary outer assembly having end plates closely adjacent said rotatable plates and provided with a first pair of aligned apertures constituting an inlet station, chip-liquor supply means to feed a chip-liquor slurry to said inlet station through the first of said apertures and into an associated one of said tubular members present at said inlet station, the other of said apertures being provided with screen means to prevent chip passage therethrough and being connected to a liquor discharge line, pressurized liquor supply connections constituting intermediate stations extending through said end plates and positioned to be in alignment with respective ones of said tubular members during a portion of the rotation of said rotor assembly to increase the hydraulic pressure in the tubular members, and said end plates being provided with aperture means constituting a discharge station for discharging the chips.

6. A revolver valve impregnator for subjecting wood chips and the like to successively higher liquor impregnating pressures, comprising a stationary outer assembly, a rotor assembly rotatable within said outer assembly and including two spaced plates connected by a plurality of open ended tubular members rigidly secured at the ends thereof within apertures provided in said plates, said stationary outer assembly having end plates closely adjacent said rotatable plates and provided with a first pair of aligned apertures constituting an inlet station, chip-liquor supply means to feed a chip-liquor slurry to said inlet station through the first of said apertures and into an associated one of said tubular members present at said inlet station, the other of said apertures being provided with screen means to prevent chip passage therethrough and being connected to a liquor discharge line, pressurized liquor supply connections constituting intermediate stations extending through said end plates and positioned to be in alignment with respective ones of said tubular members during a portion of the rotation of said rotor assembly to increase the hydraulic pressure in the tubular members, said end plates being provided with aperture means constituting a discharge station for discharging the chips, and drive means for cyclically rotating said tubular members from one station to another.

7. A revolver valve impregnator for subjecting wood chips and the like to successively higher liquod impregnating pressures, comprising a stationary outer assembly, a rotor assembly rotatable within said outer assembly and including two spaced plates connected by a plurality of open ended tubular members rigidly secured at the ends thereof within apertures provided in said plates, said stationary outer assembly having end plates closely adjacent said rotatable plates and provided with a first pair of aligned apertures constituting an inlet station, one of said apertures providing an inlet for a chip-liquor slurry into an associated one of said tubular members present at said inlet station, the other of said apertures being provided with screen means to prevent chip passage therethrough and being connected to a liquor discharge line, pressurized supply connections constituting intermediate stations extending through said end plates and positioned to be in alignment with respective ones of said tubular members during a portion of the rotation of said rotor assembly to increase the hydraulic pressure within said tubular members, said end plates being provided with aperture means constituting a discharge station for discharging the chips, and a drive shaft passing through said end plates and said rotatable plates for rotating said tubular members from one station to another, said tubular members being essentially equally spaced circumferentially around said drive shaft.

8. A revolver valve impregnator for subjecting wood chips and the like to successively higher liquor impregnating pressures, comprising a stationary outer assembly, a rotor assembly rotatable within said outer assembly and including two spaced plates connected by a plurality of open ended tubular members rigidly secured at the ends thereof within apertures provided in said plates, said stationary outer assembly having end plates closely adjacent said rotatable plates and provided with a first pair of aligned apertures constituting an inlet station, one of said apertures providing an inlet for a chip-liquor slurry into an associated one of said tubular members present at said inlet station, the other of said apertures being provided with screen means to prevent chip passage therethrough and being connected to a liquor discharge line, pressurized liquor supply connections constituting intermediate stations extending through said end plates and positioned to be in alignment with respective ones of said tubular members during a portion of the

rotation of said rotor assembly to increase the hydraulic pressure within said tubular members, said end plates being provided with a second pair of aligned apertures constituting a discharge station, and conduit means being associated with said last-mentioned apertures to supply liquor through one of said last-mentioned apertures for discharging the chips in slurry form from said discharge station out the other of said last-mentioned apertures.

9. A revolver valve impregnator for subjecting wood chips and the like to successively higher liquor impregnating pressures, comprising a stationary outer assembly, a rotor assembly rotatable within said outer assembly and including two spaced plates connected by a plurality of open ended tubular members rigidly secured at the ends thereof within apertures provided in said plates, said stationary outer assembly having end plates closely adjacent said rotatable plates and provided with a first pair of aligned apertures constituting an inlet station, one of said apertures providing an inlet for a chip-liquor slurry into an associated one of said tubular members present at said inlet station, the other of said apertures being provided with screen means to prevent chip passage therethrough and being connected to a liquor discharge line, pressurized liquor supply connections constituting intermediate stations extending through said end plates and positioned to be in alignment with respective ones of said tubular members during a portion of the rotation of said rotor assembly to increase the hydraulic pressure within said tubular members, said end plates being provided with a second pair of aligned apertures constituting a discharge station, conduit means being associated with said last-mentioned apertures to supply liquor through one of said last-mentioned apertures for discharging the chips in slurry form from said discharge station out the other of said last-mentioned apertures, and a drive shaft passing through said end plates and said rotatable plates, said tubular members being essentially equally spaced circumferentially around said drive shaft.

10. A revolver valve impregnator for subjecting wood chips and the like to successively higher liquor impregnating pressures, comprising a stationary outer assembly, a rotor assembly rotatable within said outer assembly and including two spaced plates connected by a plurality of open ended tubular members rigidly secured at the ends thereof within apertures provided in said plates, said stationary outer assembly having end plates closely adjacent said rotatable plates and provided with a first pair of aligned apertures constituting an inlet station, one of said apertures providing an inlet for a chip-liquor slurry into an associated one of said tubular members present at said inlet station, the other of said apertures being provided with screen means to prevent chip passage therethrough and being connected to a liquor discharge line, pressurized liquor supply connections constituting intermediate stations extending through said end plates and positioned to be in alignment with respective ones of said tubular members during a portion of the rotation of said rotor assembly to increase the hydraulic pressure within said tubular members, said end plates being provided with a second pair of aligned apertures constituting a discharge station, said end plates and said rotatable plates having complementary surfaces machined to a mirror-like finish and having small clearances therebetween, conduit means being associated with said last-mentioned apertures to supply liquor through one of said last-mentioned apertures for discharging the chips in slurry form from said discharge station out the other of said last-mentioned apertures, and a drive shaft passing through said end plates and said rotatable plates, said tubular members being essentially equally spaced circumferentially around said drive shaft.

References Cited by the Examiner

UNITED STATES PATENTS

2,680,683	6/54	Obenshain	162—237

FOREIGN PATENTS

25,029	1912	Great Britain.

DONALL H. SYLVESTER, *Primary Examiner.*