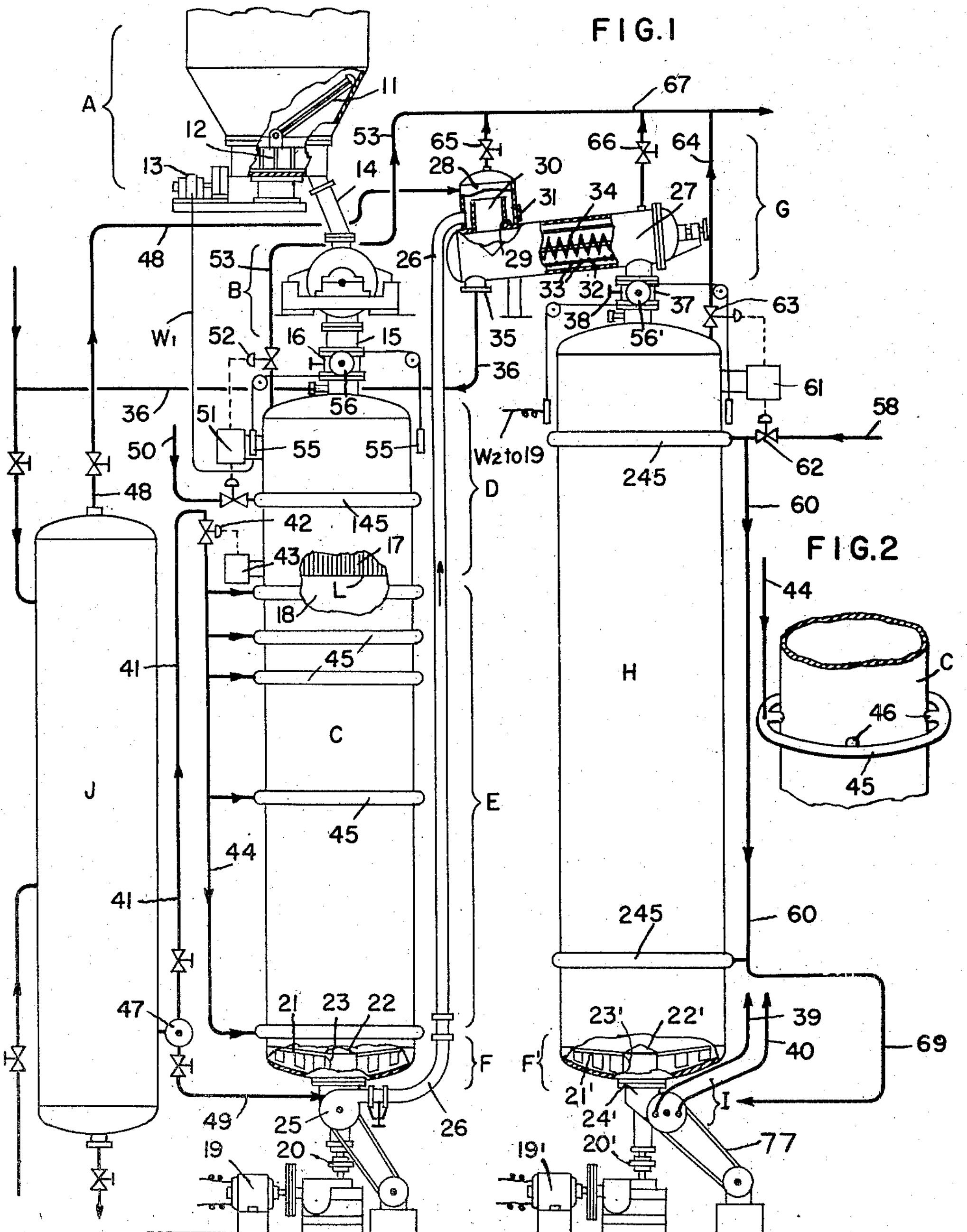
Aug. 20, 1957 L. G. DURANT ET AL 2,803,540

WOOD CHIP DIGESTION

Filed March 6, 1956 3 Sheets-Sheet 1

FIG.1



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WOOD CHIP DIGESTION

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FIG.3

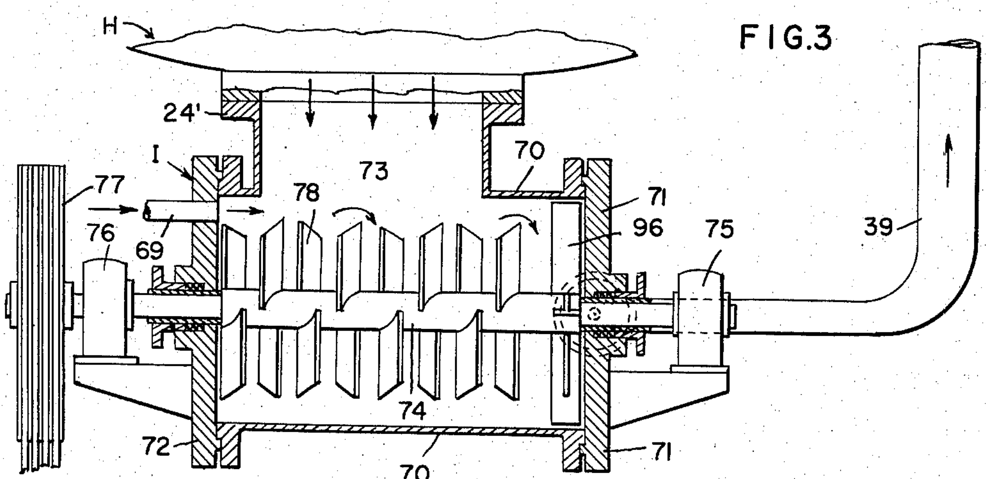


FIG.6

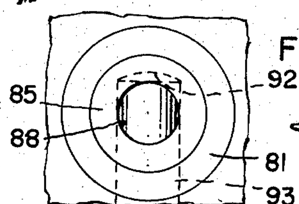


FIG.7

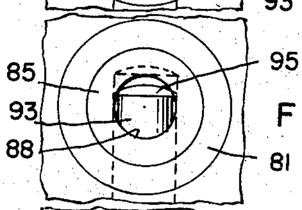


FIG.8

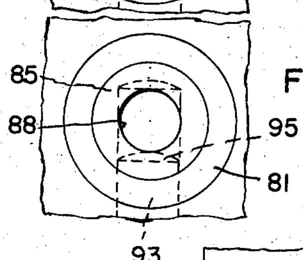


FIG.4

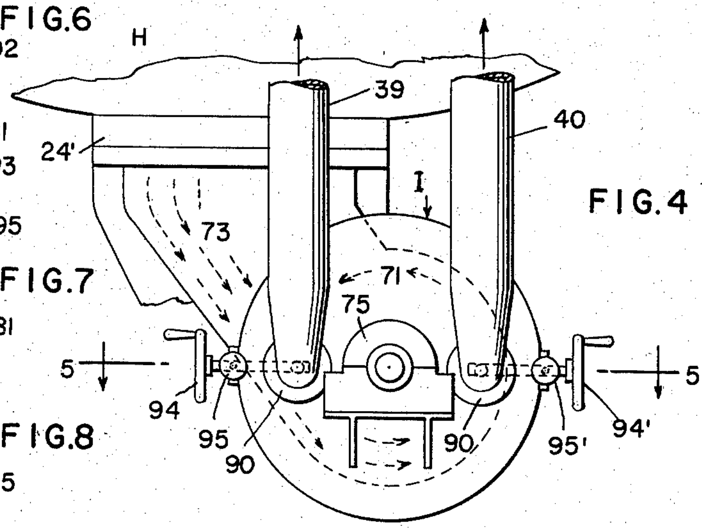
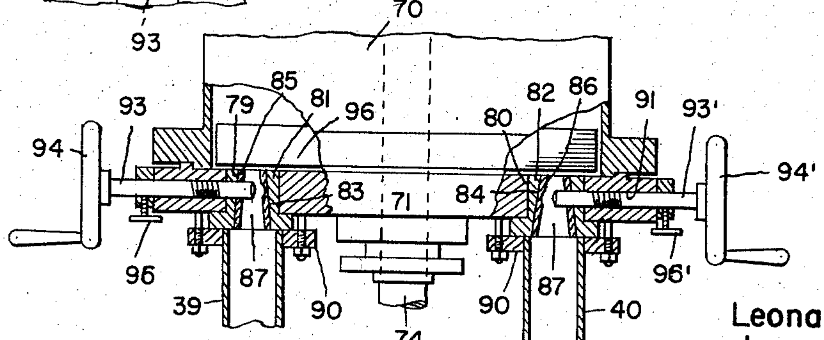


FIG.5



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WOOD CHIP DIGESTION

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FIG. 9

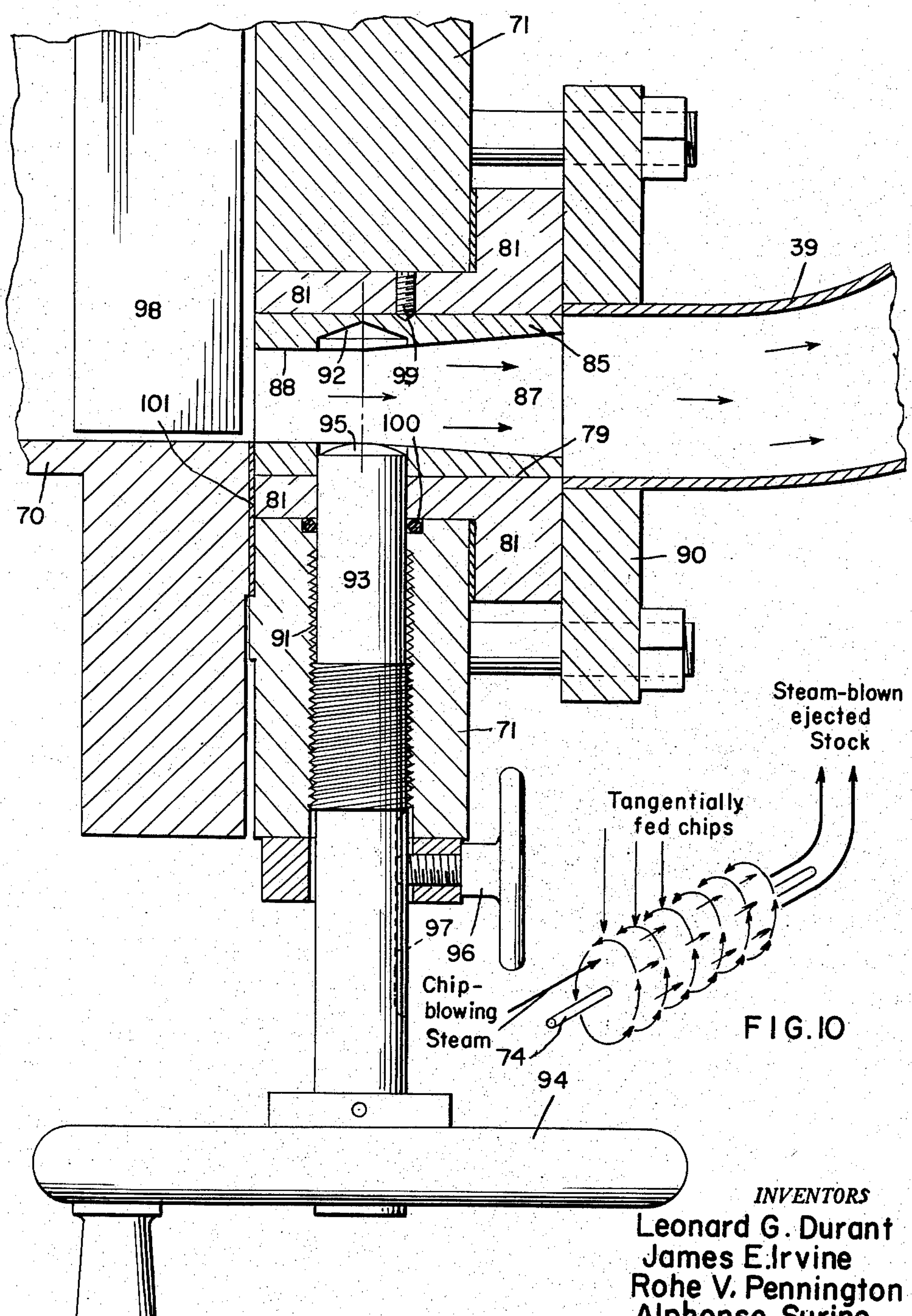

FIG. 10

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WOOD CHIP DIGESTION

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Application March 6, 1956, Serial No. 569,744

7 Claims. (Cl. 92—7)

This invention relates to the continuous digestion of cellulosic material such as wood-chips for making them into pulp. A current new type of such digestion treats the chips in a primary enclosed tank or vessel wherein the chips in columnar formation are first steamed and then immersed in a pond of cooking liquor with which the chips are then impregnated. The chips are then evacuated from the vessel to a pipe where they are diluted with cooking liquor to a pumpable consistency and pumped to a drainage station wherein they are drained of the liquor in which they are immersed, whereupon they are conveyed to a secondary vessel wherein they are digested in an ambient steam atmosphere, again in columnar formation, but in non-submergence and only in their absorbed and adsorbed liquor. When their digestion is completed, they are evacuated with their ambient steam from the digester and blowingly ejected from the system for subsequent treatment. This invention is directed to the construction and operation of such an ejector station. In such a station, the hot digested chips are received from the digester evacuator while they are under pressure.

So it is an object of this invention to devise ways and means for getting out of the system into the atmosphere these hot digested chips while using the stream of steam in which they are surrounded as the expelling force. Since this system operates continuously, it is another object to devise such steam-blown ejection of the chips that it will take place under conditions that result in the loss of steam so minimized in a quantity that it is economical. In other words, there must be a continuously open ejection passageway through which the treated chips are blown to discharge into and through a conduit to the atmosphere and the steam in the system must be used to eject the treated chips through the passageway, yet the loss of steam in the stream thereof that passes out through that passageway with the ejected chips must be minimized whereby the rate of loss does not affect unfavorably the process steps being carried out in advance of the ejector station and does not attain such a volume of lost steam as to be economically unsustainable. More particularly then, it is an object of this invention to devise an ejector station having a chip-ejection passageway with environmental apparatus that does not require change of forward direction of the flow of chips and steam and yet that can be regulated to control the proportion of cellulosic solids to steam blown through the passageway so that the proportion of steam at all times is minor as compared with the solids. Still more particularly, it is an object of this invention to devise such a passageway through which the chips and steam can be ejected that is elongated sufficiently to provide length enough wherein to operate such regulating apparatus, and yet have the passageway offer decreasing resistance of flow therethrough of the ejected chips and the stream of steam in which they are suspended. Another object is to devise an element through which such passageway appears as a bore, and which element is readily replaceable in the event that abrasion causes excessive wear in that bore.

These and other objects that will appear hereinafter, can be realized by associating an ejector station of this invention with such a system as described herein, and particularly with a digester wherein chips are digested in non-submergence and provided with means for supplying a stream of steam to the digester to maintain in it a super-temperature and super-pressure, with means for feeding chips to the digester and evacuator means for removing hot digested chips therefrom while maintaining in the digester a constant-height column of downwardly moving chips. The evacuator means delivers steam and digested chips to the ejector station from which chips are ejectingly blown by along with a stream of steam with which they are associated under regulatable conditions by which the loss of steam is minimized, whereupon the ejected chips go to subsequent treatment. The ejector station has a closed cylinder with a radial inlet into the cylinder for receiving chips from the evacuator means in the digester; with an inlet for a pressured stream of steam; with an exit-providing end; and associated with the exit end of the cylinder is a chip-conducting conduit to the atmosphere. In the cylinder is axially located a rotatable blade-bearing shaft for stirring the chips and impelling them toward the exit end of the cylinder and through an eccentric passageway therein such chips and steam are ejected by being blown into and through the conduit while means are provided for regulating the proportion of chips to steam so ejected for minimizing the volume of steam so blowingly emitted that uses its ejecting force to eject the chips. Details of construction of the passageway and how its size is controllably regulated are also part of this invention.

The invention is illustrated in the accompanying drawings in which Figure 1 is a somewhat diagrammatic side elevation, with parts in section, of a continuous digestion plant or system that forms the environment of the invention. Fig. 2 is a partial isometric view of a detail of the manifold used to inject either steam or liquor or both into the vessels. Fig. 3 is a vertical sectional view through the ejector station. Fig. 4 is an end view. Fig. 5 is a partial plan view with parts in section of the ejector sleeves and blow valves. Figs. 6, 7, and 8 are partial views showing different positions of the plug of the valves while Fig. 9 is an enlarged sectional view of one of the blow-valve arrangements. Fig. 10 is a diagrammatic showing of the action that takes place in the ejector station.

Referring now to Figs. 1 and 2, showing the environmental system, there is a chip-bin A for receiving chips, or other cellulosic material to be treated, having an arch-breaker **11**, and a suitable rotary chip-discharging mechanism **12**, operated by a variable speed motor-driven mechanism **13**, passes chips downwardly through the feed pipe **14** at a regulatable rate to a multivane chip feeding mechanism B for delivering chips through pipe **15**, valved as at **16** to and into a primary cylindrical tank or vessel C divided by a liquid-level L into an upper steaming zone D having a steam atmosphere **17** and a lower impregnating zone E made up of a pond of cooking liquor **18**. In the bottom of tank C (sometimes called the impregnator vessel) there is an evacuator mechanism F for accomplishing continuous discharge of chips from the column thereof in the tank by means of a motor mechanism **19** driving a shaft **20**, that moves in circular paths blades depending at a chip impelling angle from arms **21** extending radially from a shroud **22** comprising a cone-covered vertical cylinder rotating with the blade-bearing arms **21** and having a door-like opening **23** in the vertical cylinder through which blade impelled chips are passed downwardly through pipe **24** into pump **25** that forces the chips while submerged in cooking liquor and under pressure up through delivery conduit 26 to deliver them pressure tangentially to a drainer station G that comprises an outer inclined steam-tight cylindrical tank 27 having a steam dome 28 with an annular bottom 29 from which uprising a stack 30 down which fall chips and liquor fed tangential to the steam dome 28 by the delivery conduit 26. The chips and liquor swirl upwardly to spill over the upper weir-like edge of the stack 30, but meanwhile tramp metal or other detritus gravitates to the annular bottom 29 from which it can be removed through handhole cover such as 31. Above the bottom of the inclined tank 27, there is an inner tank or cylindrical drainer 32 having perforations 33, and rotatable therein is a screw conveyor 34. Thus chips and liquor descending through stack 30 enter drainer 32 up which the screw conveyor 34 moves them meanwhile their liquor drains from them through the perforations 33 and flows from the tank through outlet 35 and pipe 36 for recovery treatment such as in accumulator tank J. The chips that are so drained of the cooking liquor but while retaining their absorbed and adsorbed liquor pass downwardly through pipe 37, valved as at 38, into digestion tank or zone H, where the chips are digested in non-submergence but in the presence of steam and their own adsorbed and absorbed liquor. After being properly digested, they are removed from the entire cross-sectional area of the bottom of the digester tank or zone H by another evacuator mechanism F′ (like station F) by means of a motor mechanism 19′ driving a shaft 20′, that rotates blade-bearing arms 21′ extending radially from a shroud 22′ having an opening 23′ therein through which chips are passed downwardly through pipe 24′. These primed numerals represent parts identical with their unprimed corresponding numerals described in connection with evacuator station F. But here pipe 24′ leads into an axial flow ejector station I, from whence through pipes 39 and 40 digested chips are blown by a steam stream to further treatment such as into a blow tank from which they go to refining or any other desired treatment. Since it usually becomes important to reclaim and otherwise control the cooking liquor used, J indicates an accumulator tank or station. Cooking liquor of controlled strength is pumped by pump 47 from that tank J through suitable valved liquor inlet line 41 to a conventional automatic valve 42 controlled and regulated by a differential pressure type recording controller 43 for regulating the elevation of the liquid-level L of the pond 18 of cooking liquor so that it is maintained constant, or at least as nearly so as possible. So the automatic valve 42 regulates the flow of liquor through pipe 44 and its branches, each of which leads to an annular manifold 45 having injection nozzles such as 46 extending therefrom into the tank C, whereby liquor can be sprayed into the tank in a fairly well dispersed or distributed manner. The manifolds 45 are distributed along the tank C as may seem desirable. Another pipe 49 also leads from the accumulator tank J and goes to and into the pipe 24 leading to pump 25 for giving control of the quantity of liquor mixed with the chips discharged from tank C by evacuator F to make them pumpable (at a consistency of say 10%) by pump 25 up through pipe 26 to the drainage station G. Still another pipe 48 is used to lead from the top of the accumulator tank J upwardly to the steam dome 28 of the drainage station G. Other valved pipes leading into the accumulator tank J are for conducting certain incoming chemical-bearing liquids thereinto.

From any suitable source, steam under pressure is supplied through steam inlet line 50 to the steaming zone D in the primary tank C by means of an annular manifold 145 in all respects like manifold 45 and having the same kind of injection nozzles 46 to supply steam into the tank, in a well distributed manner. The inlet of steam into the manifold 145 is controlled and regulated by conventional pressure-temperature recording controller 51, that also controls and regulates valve 52 in vapor-outflow line 53. And a final control is indicated generally at 55 that is a chip level gauge and controller that consists of a transmitter containing a radio-active material, and a receiver is connected electrically by connection W_1 to the motor-drive 13 of chip bin discharger 12, to automatically regulate the chip level to be substantially constant. The instrument is so mounted that the "set point" can be raised or lowered such as by pulley 56 by the operator. These radiation measuring and monitoring devices are made by The Ohmart Corporation of Cincinnati, Ohio. A similar chip-level sensing gauge and controller 55′ is applied to the digester zone or tank H, with its raising and lowering pulley 56′ but in this case the controller 55′ is connected by a connection W_2 to, and regulates the motor drive 19 on, the evacuator station F on the primary vessel C.

Digester zone or station H is provided with a steam-inlet line 58, for delivering steam under pressure to the branch lines 59 and 60, each respectively feeding steam to an annular manifold 245 having injection nozzles, patterned after manifold 45 and its nozzles 46. Inlet of steam through line 58 is controlled and regulated by a conventional pressure-temperature recording controller 61 (similar to controller 51) operating on automatic valve 62 and also on automatic valve 63 included in vapor outflow line 64. Valved vapor outlet or gas-off pipe 65 from the steam dome 28 of the drainage station G, and also from valved vapor outlet or gas-off pipe 66 from the high point of the inclined tank 27 of that station, can all join into a common exhaust or gas-off line 67 leading to further treatment of the vapors, if desired, such as for turpentine recovery.

The continuous digestion of cellulosic material such as wood chips carried out by this system in successive treatment zones may be said to comprise feeding chips continuously to the steaming zone where, while in columnar formation, they are prepared for the ready acceptance of the cooking liquor by appropriate steaming, thus releasing non-condensable gases and otherwise preparing the chips for ready acceptance of the cooking liquor; next submerging the thus conditioned chips in hot cooking liquor under controlled conditions of time and temperature that assure complete penetration and diffusion of the liquor into the chips but limit the chemical reaction therebetween so that in this zone of impregnating treatment, there is minimized any fiber-degrading action; the chips themselves now contain an amount of absorbed and adsorbed liquor of controlled chemical concentration sufficient to be cooked rapidly but insufficient to cause cellulose degradation, so they are transferred while in submergence and still under pressure from the impregnation zone to a drainage zone where they are relieved of their excess liquor which drains freely therefrom during their uphill conveyance along the perforated cylindrical drainer therein; the drained chips are then cooked also while in columnar formation in only their retained liquor and in non-submergence in a gaseous environment enclosed in a digester; after being cooked, the chips are evacuated from the digester into an ejection zone having a receiver for the digested chips, from whence digested chips are ejected while in suspension in stream of chip-blowing steam and projected or blown to a place of subsequent treatment. All of the action steps are carefully controlled as to pressure, temperature, and the rate of downward movement or the time of transit of the chips through each treatment zone and between such zones, which is a reason why the chip level is maintained substantially constant in each of the vessels C and H; the liquid-level L in vessel C is also so maintained; and the temperature and pressure of the steam is also carefully automatically controlled.

Now that the environment of this invention has been described, it may be said that the ejector zone or station I is comprised of a horizontal cylinder 70 closed at its ends by end plates 71 and 72 respectively, with a radial inlet

73 for hot digested chips and steam coming from the evacuator station F' in the bottom section of digester tank H. A stream of pressured steam is provided for the cylinder by suitably valved steam pipe **69**, that leads from the steam pipe **60** controlled by automatic valve **62**, for maintaining in the ejector a pressure equal to that in the digester. In the cylinder is axially mounted a rotatable shaft **74** journalled as at **75** and **76** and suitably driven through pulley **77**. The shaft has blades or paddles **78** angled to stir and to impel the chips to the right in Fig. 3 toward and to the end plate **71** that is eccentrically apertured as at **79** and **80**, into which respectively is fitted a reducer fitting **81** and **82**, each with a flared or tapered bore **83** and **84** respectively, into which is fitted a replaceable sleeve **85** and **86** respectively, each provided with a bore **87** that is flared or tapered outwardly away from the exit end plate **71**. The bore **87** of sleeve **85** leads to the pipe or conduit **39** to and through which chips are blown to a blow tank for subsequent treatment. The bore **87** of sleeve **86** similarly leads to the pipe or conduit **40** for the same purpose. From Fig. 9 is can be seen from the enlarged view that the bore **87** while flared at its outlet end is straight and non-flared at its inlet portion **88**. The pipes **39** and **40** are held in place and in alignment with the bores **87** by means of clamping plate **90**.

From Fig. 9 the blow-valve arrangement can also be seen in enlargement, and thus more clearly than in Fig. 5, that the exit end plate **71** on the cylinder **70** has a radial screw-threaded bore **91**, passing not only through it but through sleeve **85** on one side. In sleeve **85** there is aligned with bore **91** a seat **92**. Screw-threaded into the bore **91** is a threaded plug **93**, having a handwheel **94** at one end and a domed end **95** at the other, with the latter adapted to fit into the seat **92**. The diameter of the plug **93** is as large as, if not slightly larger than the diameter of the straight bore **88** so when the plug is seated, as in Fig. 6, that bore is closed. When the plug is entirely retracted, as in Fig. 8, that bore is wide opening, and an intermediate position of partly open and partly closed is shown in Fig. 7. Set-screw **96** is provided by engagement with elongated slot **97** in the plug for holding the plug in any adjusted position. Since these parts are duplicated for sleeve **86**, the numerals **91'**, **93'**, **94'** and **96'** have been used to indicate corresponding duplicated parts. Coming back for a moment to the radial shaft **74** and its blades **78**, it has a particular end blade **98**, for keeping the entrances to sleeves **85** and **86** wiped clean. The sleeves **85** and **86** are removable from and replaceable in their respective reducer fittings **81** and **82**, wherein they are held in place by set screw **99**. So the plugs and the bore-bearing sleeves with which they cooperate comprise blow-valves to be referred to later herein. **100** represents an O-ring type of packing around the plug **93**. **101** represents a gasket for contributing to the steam-tight fit of the parts that abut it.

In the operation of the ejector station I, the chips digested in the digester station H, are evacuated therefrom in evacuator station F', and delivered along with their ambient steam, through tangential inlet **73** into the lower portion of the cylinder **70**, wherein they catch up with the blades **78** rotating with shaft **74**, for swirlingly moving the chips toward the exit end plate **71**. The chips, by means of the forward impulses given them by the rotating blades **78**, plus the forward flowing stream of steam coming into the cylinder through steam pipe **69**, are impelled and carried forward without change in their general direction of movement to and through the bore **87** of the tapered sleeves **85** and **86**, parallel axially to the cylinder **70**, to exit into the conduits or pipes **39** and **40** respectively that convey the chips to and into a blow tank for subsequent treatment. The extent of the opening in the bore **87** of the sleeves **85** and **86** is controlled by the regulatable rotatable screw threaded plugs **93** and **93'**, by which the bores can be made wide open as shown in Fig. 8, completely closed as shown in Fig. 6, and partly open as shown in Fig. 7, and they can be held in any such adjusted position by set-screws **96** and **96'**. The purpose of this regulatability of the opening of the bores **87** is to control the proportion of steam to chips being blown through the bores of the blow-valves so that the quantity of steam is minimized while that of the chips is maximized. It is essential to have a stream of steam emitted throug the bores **87** because it is used to blow the chips therethrough and to impel the ejected chips up the conduits or pipe **39** and **40** to a blow tank wherein they are received at atmospheric pressure. And since they are to be received at atmospheric pressure, it is desirable to have the conduits **39** and **40** increase in diameter as they lead to the blow tank whereby the chips and the stream of steam in which they are suspended, will lose its pressure more or less gradually. It is to be understood, therefore, that the chips carried by the forwardly moving stream of steam in the ejector I to and through the ejection bores **87** are aided or given a spiralized boost in their forward direction by the bladed shaft **74** normally rotating at about 350 R. P. M., but it is the pressure of the stream of steam that is the major cause of the ejection of the chips through the bores **87**. There may be some tendency of the chips to clog the entrance to the bores **87**, but this is avoided or minimized by the blade **98** on the shaft **74** that has a wiper effect in keeping the bores unclogged.

Fig. 10 illustrates the action steps that take place in the ejector cylinder **70**, namely, the digested chips are fed to the cylinder tangentially toward the bottom thereof where they are picked up by the swirling and stirred-up mass of previously delivered chips that are being impelled by the blades or paddles **78** on the rotating shaft **74**, toward the exit end of the cylinder. Superimposed on this forward movement of the chips stirred to prevent their settling, is the stream of steam coming in through steam pipe **69** that blows the stirred chips to and through the blow-valve or blow-valves, without departing substantially from their generally linearly forward direction of movement.

The steam streaming to ejection in the ejector cylinder **70** comes from two sources, of which one is the ambient steam that flows with the chips from the digester evacuator F' through the inlet **73** into the cylinder, and the other is the stream of steam under pressure that enters the cylinder **70** through steam inlet pipe **69**. This pipe draws its steam from branch steam line **60** that is under the automatic control of the digester steam control valve **61** whereby there is maintained a pressure in the ejector cylinder **70** that is equalized with that in the digester H. This equalizing additionally may be a safety feature because if all the blow steam came from the digester, there could be some channelling of steam and digested chips therein. Also, if there should be a brief hang-up of digested chips, and especially if the pulp is in the lower yield range, as the chips pass through the discharge bore in the evacuator, there is a chance of their plugging this opening.

It is expected that most of the steam stream required for blowing chips from the ejector will come from the steam pipe **69** although some ambient steam will be carried into the ejector along with the digested chips. Thus the action of the digester evacuator F' is to withdraw digested chips from the digester and drop them into a stream of steam moving forwardly from the steam inlet pipe **69** toward the blow valve, which is a term given to the construction shown in Fig. 9. The stream of steam moves slowly through the fore-body of the ejector—say 2 to 6 feet per minute—but increases in velocity rapidly as it approaches the blow-valve until it attains a velocity of 6,000 to 9,000 feet per minute in passing through the bore **87** in the sleeve **85** of the blow-valve.

The steam pressure used varies widely depending on several conditions such as type of pulp being made, length of cook, liquor strength, and so on, but it could be said that the pressure used can lie in a range of from 30 pounds per square inch gauge pressure, hereinafter referred to as p. s. i. g. to 250 p. s. i. g., while a representative example would be 250 p. s. i. g. at 405°. So far as blowing from the ejector is concerned, when low pressure is used say under 30 p. s. i. g., it is difficult to blow chips or pulp to any height or even to blow at all without running into the difficulty of plugging, so in this respect, pressure becomes important.

The shape of the bores 87 is important, particularly as to the straight section 88 of the bore, followed by the tapered section 97. This is due partly because it makes for a closer control of the closing operation or perhaps it should be said the partial closing operation by the plug 93, and partly to reduce the abrasive wear on the bore as the chips are ejected therethrough. The tapered section begins the reduction of pressure on the chips and their ejecting stream of steam. Also, as abrasive wear on the sleeves 85 and 86 is unavoidable, they must be removable and replaceable, for which this construction shown provides.

In the design of the bore 87 in the sleeve 85, it is also desired to keep the valve plug 93 as close to the interior face of the ejector as possible so that a minimum of stock can lodge in the cylindrical portion 88 of the bore 87 against the valve plug when it is closed. The inner portion of the bore of the sleeve is flared so that when the valve plug is opened, the plug of pulp or digested chips formed by the stock lodging between the plug and the interior face of the ejector may be blown clear by the steam pressure, since the flared portion offers no side wall resistance to the passage therethrough of the plug of pulp. The diameter of the bore of the cylindrical portion 88 in the sleeve 85 will be from ¾ inch upward. It will be 1 in. for a 150 ton per day production. A 300 ton per day production would make use of two such blow-valves. Such a valve would be 3¼ in. long whose cylindrical portion is 1¼ in. long and whose flared portion is 2 in. long. An ejector therefor, would be 24 in. in diameter and 38 in. long.

For carrying out the process for which this apparatus is designed, there will be used about 2,000 lbs. of steam per ton of high yield (say 65% to 70%) pulp produced, and about 3,000 to 3,500 lbs. per ton of low yield (say 50%) pulp. This steam heats the chips; their concomitant moisture; the cooking liquor; and provides for radiant losses from the equipment as well as digesting the chips. In addition there will be used a fairly constant quantity, namely, 200 lbs. of steam per ton of pulp produced for blowing the digested chips from the ejector station. Conventional blow heat recovery equipment will recover about 50% of the heat in the blown stock and steam. So for a high yield system, the net steam requirement would be 50% of 2,000 plus 200, or 1,100 to 1,200 lbs. per ton of pulp. When we cook prime grade pulp (45% to 50% yield) we must use 50% of 3,400 plus 200, or 1,600 to 1,700 lbs. per ton.

In high yield (low grade) pulps wherein the chips are not digested so much, that is, given a short cooking time, the chips retain much of their toughness and when they are blown to ejection through the bores 87, they are very little disintegrated. On the other hand, in low yield (high grade) pulps for which the chips are digested much more thoroughly and have been given a long cooking time with the result that most of their lignin has been dissolved and they have little and no mechanical bond with which to retain their form against the pressure they encounter from the chip-raking blades on arms 21′ in the evacuator station F′ in the bottom of the digester. So much chips may well be dispersed or distintegrated by the motor-driven mechanical chip-expelling action of that evacuator so as to be received tangentially into the ejector cylinder 70 in the form of fibre bundles or even pulp. As blown to ejection through the bores 87, the moisture content of the ejected mass is from 70% to 80%, with the remainder being chips or chip fragments in the form of discharging stock.

It is very important to make use of the stream of steam as the ejecting force for causing the digested chips to be continuously blown from the digester system, yet the loss of such blow steam so used must be controlled to be economically feasible. So even though the chip-ejection apertures or bores are continuously open, by the use of this invention, the proportion of chips to exiting steam can be kept down to a minimum by regulatably keeping the quantity of the ejected chips high and the quantity of emitted steam low, yet without sacrificing any substantially chip-ejecting effect of the steam.

As this invention may be embodied in several forms without departing from the spirit or essential characteristics thereof, the present embodiment is therefore illustrative and not restrictive, since the scope of the invention is defined by the appended claims and all changes that fall within the metes and bounds of the claims or that form their functional as well as conjointly co-operative equivalents, are therefore intended to be embraced by those claims. For instance, whereas treatment of wood chips has been described, other ligno-cellulosic particles could be so treated.

We claim:

1. Continuously operable wood-chip digesting apparatus which comprises a vertically-extending closed chip digester under pressure enclosing a steam atmosphere, means for passing drained hot chips into the digester, means for supplying steam to the digester for controlling its temperature, a chip-ejector station, and means for evacuating digested chips from the digester to the ejector; wherein the ejector station comprises a steam-tight substantially horizontal cylinder closed at each end but with one end including an exit, a motivated chip-impeller axially located in the cylinder with sets of substantially radial blades, a chip-inlet for the cylinder, means for supplying a stream of steam to the cylinder, a chip ejection conduit leading eccentrically from the exit end of the cylinder, and a size-adjustable passageway through that end of the cylinder to the ejection conduit through which chips small enough to pass through the adjusted passageway are blown by the stream of steam exiting from the cylinder therethrough, which said passageway is tapered outwardly from the cylinder end, and there is an adjustable plug traversing that passageway for regulating the effective size thereof for controlling the ratio of chips to steam passing through that passageway.

2. Apparatus according to claim 1, wherein one set of the radial blades is sufficiently near the entrance to the passageway for continually wiping it clean to avoid plugging thereof.

3. In a wood-chip digesting system having a digester continuously supplied with chips to be digested under super-pressure and steam for supplying heat and pressure with means for evacuating digested chips and steam from the digester, an ejection station for ejecting digested chips in a stream of steam to the atmosphere comprising a closed horizontal cylinder with an exit-providing end, an inlet through which chips are received into the cylinder from the evacuating means, a rotatable shaft axially located in the cylinder, bladed means on the shaft for rotatably stirring chips therein and impelling them toward the eixt end of the cylinder, means for supplying to the cylinder a pressure stream of steam for blowing the stirred chips toward the exit end of the cylinder, a bore-bearing ejection sleeve eccentrically located in the exit end of the cylinder paralleling the shaft through which chips and steam are blowingly ejected without substantial change of forward direction, and means for regulating the proportion of chips to steam so ejected for minimizing the volume of steam so ejected while using its blowing force to eject the chips.

4. Apparatus according to claim 3, wherein the bore

through the ejection sleeve has a cylindrical entrance section followed by an outwardly flared exit section.

5. Apparatus according to claim 3, wherein the bore through the ejection sleeve is flared to be larger at its outlet end than at its inlet end with a threaded plug for traversing that bore for regulating the effective size thereof for controlling the ratio of chips to steam being ejected therethrough.

6. Apparatus according to claim 5, wherein the bore through the ejection sleeve has a cylindrical entrance section followed by an outwardly flared exit section, with the former shorter than the latter, and with the plug traversing the cylindrical section.

7. In a digester system having a digester continuously supplied with chips to be digested under super-pressure and steam for supplying the heat and pressure with means for evacuating digested chips and steam from the digester, an ejector station for ejecting digested chips in a stream of steam to the atmosphere comprising a closed horizontal cylinder with an exit-providing end, an inlet through which chips are received into the cylinder from the evacuation means, a rotatable shaft axially located in the cylinder, bladed means on the shaft for rotatably stirring the chips and directing them toward the exit end of the cylinder,

a bore-bearing ejection sleeve eccentrically located in the exit end of the cylinder parallelling the shaft through which chips and steam are ejected without substantial change of forward direction, means for regulating the proportion of chips to steam so ejected for maximizing the quantity of chips and minimizing the quantity of steam so ejected, and means for supplying to the other end of the cylinder a stream of steam under pressure for blowing the stirred chips toward and through the bore-bearing ejection sleeve, said evacuation means being in the bottom of the digester which has a central discharge outlet and the means include motor-driven angled blades moving in circular paths over the entire cross-sectional area of the digester bottom for impelling chips thereon to discharge through the central outlet to the ejection means whereby chip-disintegrating pressure is applied to the chips prior to their transfer to the ejection means.

References Cited in the file of this patent

UNITED STATES PATENTS

850,384	Mallam	Apr. 16, 1907
1,932,885	Dunbar	Oct. 31, 1933
2,616,802	Kehoe et al.	Nov. 4, 1952