Oct. 28, 1958 L. G. DURANT ET AL 2,858,211

APPARATUS FOR WOOD CHIP DIGESTION

Filed Feb. 13, 1956

2 Sheets-Sheet 1

FIG. 1.

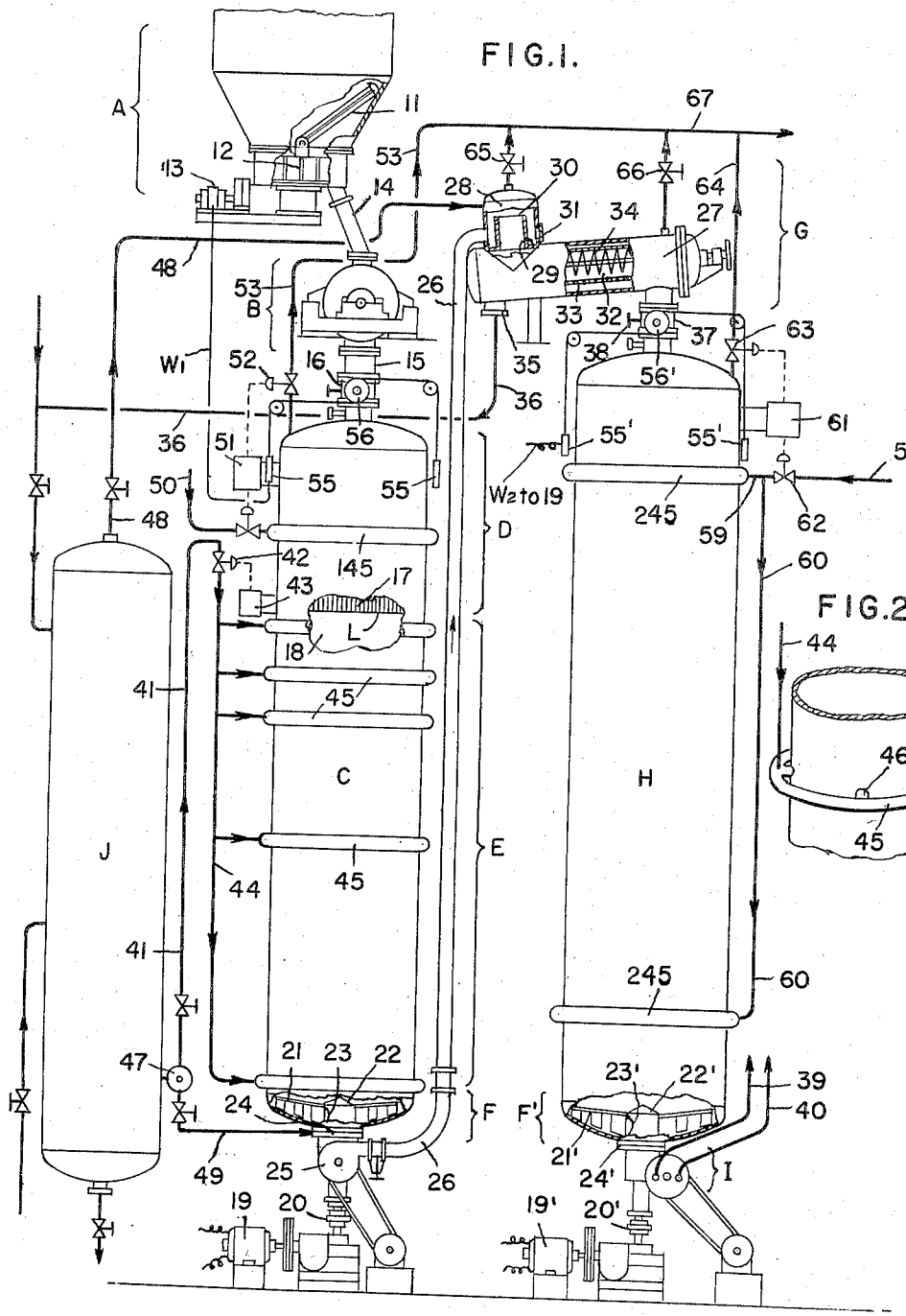


FIG. 2.

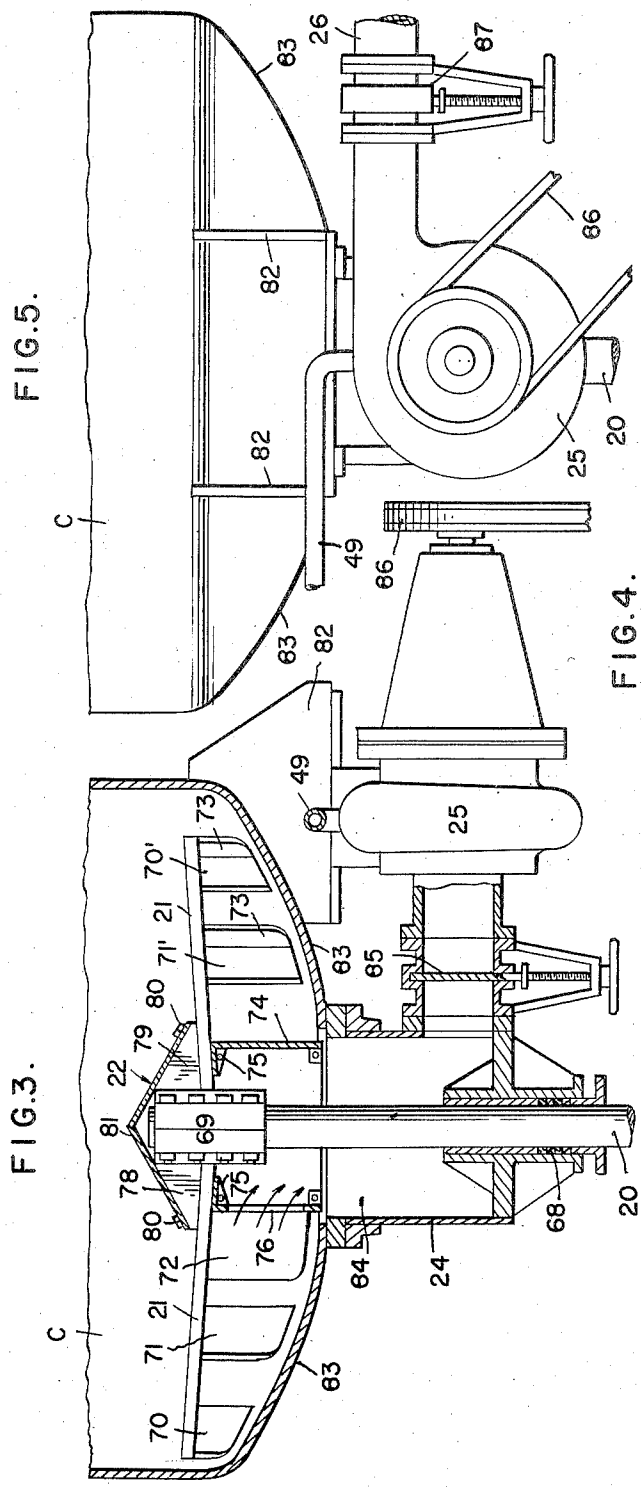
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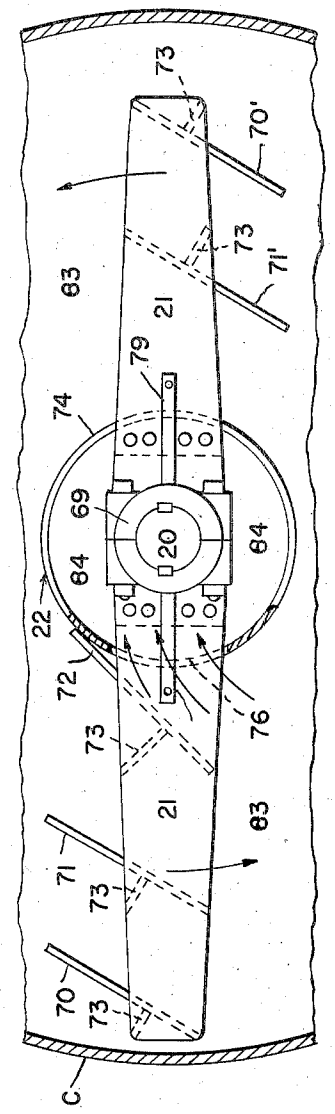
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APPARATUS FOR WOOD CHIP DIGESTION

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4 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 a downwardly moving column of chips in a primary enclosed vessel or tank wherein the chips are first steamed and then immersed in a pond of cooking liquor with which the chips are then impregnated. The chips are next evacuated from the vessel to a pipe wherein they are diluted with cooking liquor to a controllable pumpable consistency and are immediately pumped to a drainer station wherein they are passed to a secondary vessel wherein again as a downwardly moving column of chips they are digested in non-submergence only in their absorbed and adsorbed liquor. When their digestion is completed, chips are evacuated from the digester and ejected from the system for subsequent treatment. This invention is directed to the construction and operation of the evacuator means usable both to evacuate impregnated chips from the bottom of the column thereof in the primary vessel and from the bottom of the column thereof in the secondary vessel or digester.

The time of transit of the chips as a column thereof in through each vessel must be carefully controlled automatically, and to that end the level of the column of chips in each vessel must be maintained substantially constant. In other words, the chips at the bottom of the column thereof in the vessel must be continually removed from the vessel while an equal amount of new chips is supplied to the top of the column thereof. It is not easy to remove chips from the bottom of such a massive column thereof, especially when they are under pressure and high temperature as they are in this system, so it is an object of this invention to devise ways and means for so doing that are highly dependable, simple, cheap, and substantially trouble-free. There must be no tendency for the chips to arch and there must be no possibility for them to channel to the outlet whereby some chips are discharged from the column thereof while others are not. In other words, there must be strictly sequential and uniform discharge of the chips from the column thereof.

To that end, there is provided a central vertical chip-evacuation outlet in the bottom of the tank or vessel, upwardly through which rises a motor-driven shaft on which upper end is carried substantially radially extending arms from which depend blades inclined to their path of travel so that as the blades are moved in circular paths by movement of the arms, the blades rake or plow or sweep chips with which they come into contact, toward the central discharge outlet, while the arms carry a shroud greater in diameter than the discharge outlet, and aligned therewith. The shroud is secured to the arms to move therewith. It has a conical top cover and a depending skirt, but the skirt has at least one port-like opening through which can pass chips plowed toward the skirt by the moving blades. Chips that pass through the port then fall down the central chip discharge outlet. The chips in the column thereof with which the blades contact offer significant resistance, so the blades may

have to be properly reinforced. The blade-bearing shaft can be operated by a variable speed motor so that a chip-level controller in either a precedent or in a subsequent station may regulate the rate of discharge of chips by the evacuator mechanism.

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 partial vertical sectional view through the bottom of vessel C in Fig. 1, showing details of the evacuator mechanism of this invention. Fig. 4, is a partial plan view of the showing of Fig. 3, while Fig. 5, is a side elevational view looking toward the left of Fig. 3.

Referring now to Figs. 1 and 2 showing the 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 downward 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 rotates blade-bearing arms **21** extending radially from a skirt-bearing shroud **22** whose skirt has a port or opening **23** therein through which chips are passed downwardly through pipe **24** into pump **25** that forces the chips while submerged in cooking liquor up through delivery conduit **26** to deliver them tangentially to a drainer station G that comprises an inclined enclosed 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 tangentially 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 hand-hole cover **31**. Above the bottom of the inclined tank **27**, there is a tubular trough **32** having perforations **33**, and rotatable in the trough **32** is a screw conveyor **34**. Thus chips and liquor descending through stack **30** enter trough **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 digester tank or zone H by another evacuator mechanism 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'**. 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 suitably 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 lead 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 dispersed or distributed manner. The manifolds 45 are distributed along the tank C as may seem desirable. Anther pipe **49** also leads from the accumulator tank J and goes to and into the pipe **24** 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 drainer 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 drainer 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 a 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 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. 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 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 an automatic valve **63** included in vapor outflow line **64**. Valved vapor outlet pipe **65** from the steam dome **28** of the drainer station G, and also from valved vapor outlet pipe **66** from the high point of the inclined tank **27** of that station, can all join into a common exhaust 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 conditionsd 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; 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 they are ejected while in suspension in 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.

In Fig. 3, the bottom portion of the primary vessel C is shown having a bottom **83** provided with a chip discharge bottom central outlet **84**, delivering to a pipe **24** that leads past a valve **85** to a centrifugal pump **25** suitably driven from a motor through a belt **86**. The pump forcibly delivers chips immersed in their liquor post valve **87** into pipe through which the chips are pumped up and into the drainer station G. To facilitate this by having sufficient liquor associated with the chips, liquor from the accumulator J is or can be pumped through pipe **49** into the pipe **24**. Shaft **20** driven by motor **19** rises upwardly in pipe **24** through an appropriate packing gland **68** to be liquid and steam tight, whereupon the upper end of the shaft reaches into the vessel C sufficient to have bolted to its end a separable coupling **69** from which radially extends two arms **21**, from one of which depend a plurality of chip-raking or plowing blades **70**, **71** and **72**, while from the other depends similar blades **70'** and **71'**. These blades are inclined toward their path of movement so that they rake or plow or push chips toward the central outlet **84**. Since the chips at the bottom of the column thereof offer considerable resistance, the blades each have a reinforcing strip or rib **73**. Depending from the arms **21**, in alignment with the outlet **84** is a cylindrical skirt or skirted member **74**, slightly less in diameter than the outlet, and secured to the underside of the arms **21** by brackets **75**. The skirt has an opening or port **76** in its periphery through which chips can pass, as shown by the arrows in Figs. 3 and 4, which opening or port **76** corresponds to **23** in Fig. 1, except here is shown in greater detail. Above the skirt are two triangular plates **78** and **79** secured to the upper side of the arms **21** and also to the coupling **69**, to the top of which is bolted by bolts **80**, a conical canopy or cover **81**, which combination of canopy and skirt is referred to generally herein as shroud **22** that shields the chip-discharge outlet pipe **24**. **82** indicates generally the bracket members used for the support of the various elements. Blade **72** is peculiarly disposed, as can be seen from Fig. 4, so that it guides chips directed into the port-like opening **76** through the skirt **74**. The construction of the evacuator station F just described applies with equal force to the evacuator station F' in the bottom of the digester vessel H, wherein the evacuator elements have been given primed numerals.

In the evacuator mechanism F shown at the bottom

of impregnator vessel C has its motor mechanism 19 a variable speed one, whose speed is regulatably controlled by or from the chip-level sensing and control mechanism 55, which also regulatably controls the speed of the variable speed motor drive 13 for feeding the chips. This is so that that control mechanism can also maintain the column of chips being treated in the digester vessel H at constant height. In other words, if the column of chips in the digester gets too high, the motor 19 of the evacuator mechanism F in the impregnator vessel C will be slowed down until the desired or normal height of the column of chips has been restored. On the other hand, if the top of the column gets too low, the evacuator motor 19 will be speeded up.

So in such an assembly or system, a problem to be solved was to devise an evacuator mechanism that would meet all these requirements, and especially to evacuate chips while in columnar formation within a tall tank longitudinally through which the column moved from top to bottom yet which column was fed by individual chips at the top and from the bottom of which individual chips were discharged.

In operation, therefore, rotation of the shaft 20 by the motor mechanism 19, through coupling 69 moves the radial arms 21 through a circular path, and this in turn carries the depending blades 70, 70', 71, 71', and 72 through circular paths. Movement of these blades dislodges individual chips from the bottom region of the column thereof in the treatment vessel, and movement of the angularly disposed blades pushes or slides the chips inwardly toward the port-like opening 76 in the skirt 74 of the shroud 22. The specially angled blade 72 finally squeezes the chips through that opening whereupon they fall down pipe 24 to discharge into pump 25 if the evacuator is in impregnator vessel C or into the ejector station I, if the evacuator is in digester vessel H. The shroud prevents channelling of chips to the outlet since the cover 81 prevents channelling from above while the skirt 74 prevents channelling from a lateral direction. Since the shroud 22 with its canopy 81 and skirt 74 rotates unitarily with the bladed arms 21, chips enter through the moving door 76 in an orderly and sequential manner.

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 cooperative equivalents, are therefore intended to be embraced by those claims.

We claim:

1. Continuously operable wood-chip digesting apparatus which comprises a system having a combined steaming and impregnating tank enclosed for holding a pond of cooking liquor overlain by a steam atmosphere and having a central bottom outlet, means for regulatably supplying steam to the tank, means for regulatably feeding chips to the steam atmosphere, means for feeding such liquor to the pond, means for maintaining a constant liquid-level on the pond, means for evacuating chips from the tank, a chip drainer, means for regulating the passing to the drainer of evacuated impregnated chips immersed in liquor, a chip digester under pressure enclosing a steam atmosphere and having a central bottom outlet, means for regulatably passing chips from the drainer to the digester, means for supplying steam to the digester for controlling its temperature, means for evacuating chips from the digester, and means for ejecting evacuated digested chips from the system; wherein the evacuating means comprises a motor-driven rotatable shaft extending upwardly through the central bottom outlet, radial arms extending from the shaft movable in a circular path, blades depending from the arms angled to their paths of movement for pushing chips toward the outlet, and channelling-preventing shroud means supported from the arms and having a port through which chips pushed thereto by the blades can pass to the outlet.

2. Apparatus according to claim 1, wherein the shroud means comprise a conical canopy surrounding a cylindrical skirted member having a port in its periphery.

3. Apparatus according to claim 2, wherein the canopy is supported from the arms by means of two triangular plates.

4. Apparatus for the continuous digestion of wood chips under heat and pressure, including an enclosed tank having a central bottom outlet, means for feeding chips to the top of the tank to establish a column of such chips extending in the tank from bottom to top, means for supplying chip-treatment substances to the tank, and means for evacuating chips from the bottom of the column therein in the tank through the central bottom outlet of the tank including a motor-driven rotatable shaft extending upwardly through the central bottom outlet, arms extending laterally from the shaft movable in a circular path within the tank, blades depending from the arms angled to their paths of movement for pushing chips in the bottom of the column thereof toward the outlet, and means for minimizing channeling of the chips for shielding the bottom outlet while rotated by and with the blade-bearing arms having a canopy-covered skirt provided with a moving port for radial passage of the blade-pushed chips therethrough to the outlet.

References Cited in the file of this patent

UNITED STATES PATENTS

1,521,232	Daae	Dec. 30, 1924
2,072,086	De la Roza	Mar. 2, 1937
2,200,034	Merrill	May 7, 1940
2,289,612	Wells	July 14, 1942
2,342,225	Schnyder	Feb. 22, 1944
2,474,862	Richter	July 5, 1949
2,680,683	Obenshain	June 8, 1954
2,717,536	Clark et al.	Sept. 13, 1955

FOREIGN PATENTS

458,863	Great Britain	Dec. 29, 1936
134,809	Switzerland	Nov. 1, 1929