

June 22, 1926.

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MCGARVEY CLINE

APPARATUS FOR EXTRACTING ROSIN AND TURPENTINE FROM WOOD

Filed August 25, 1922

3 Sheets-Sheet 1

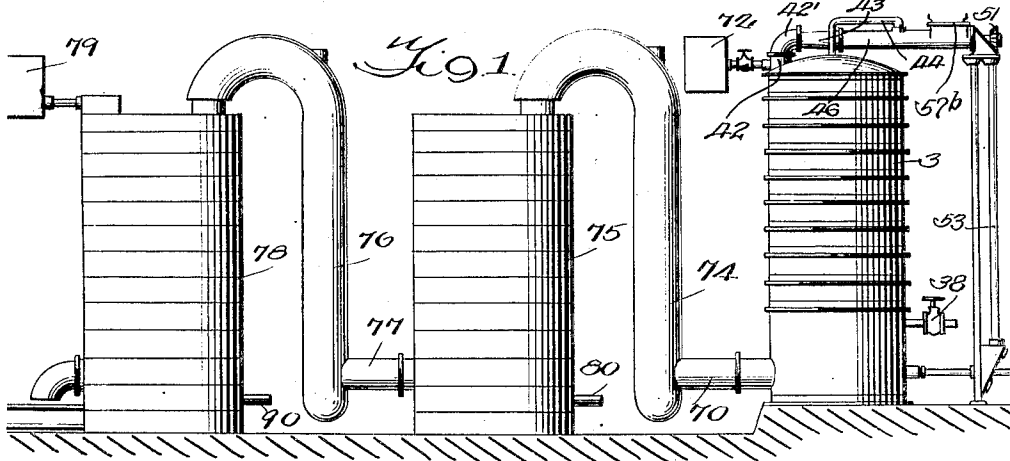
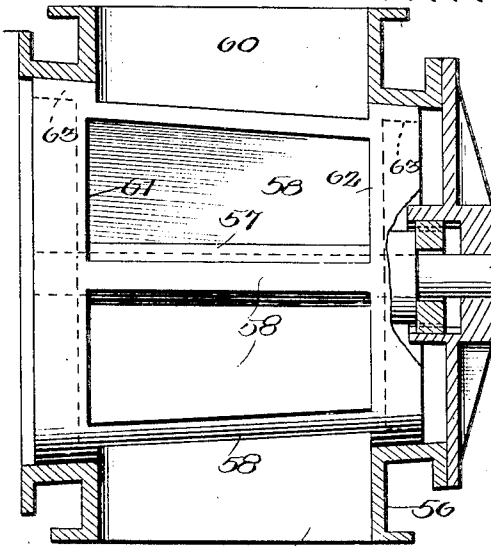
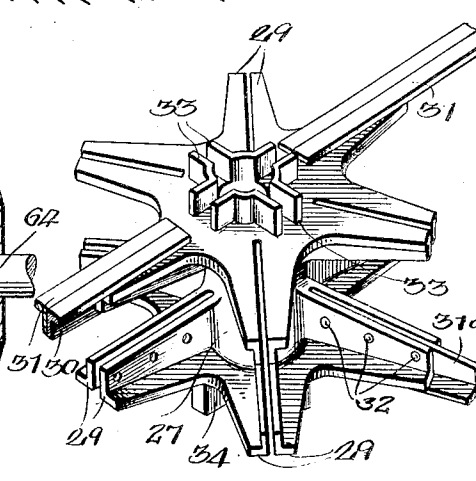


Fig. 7.

Fig. 5.

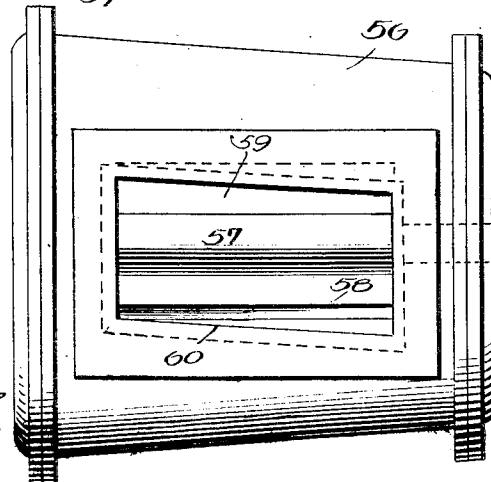


Fig. 8.

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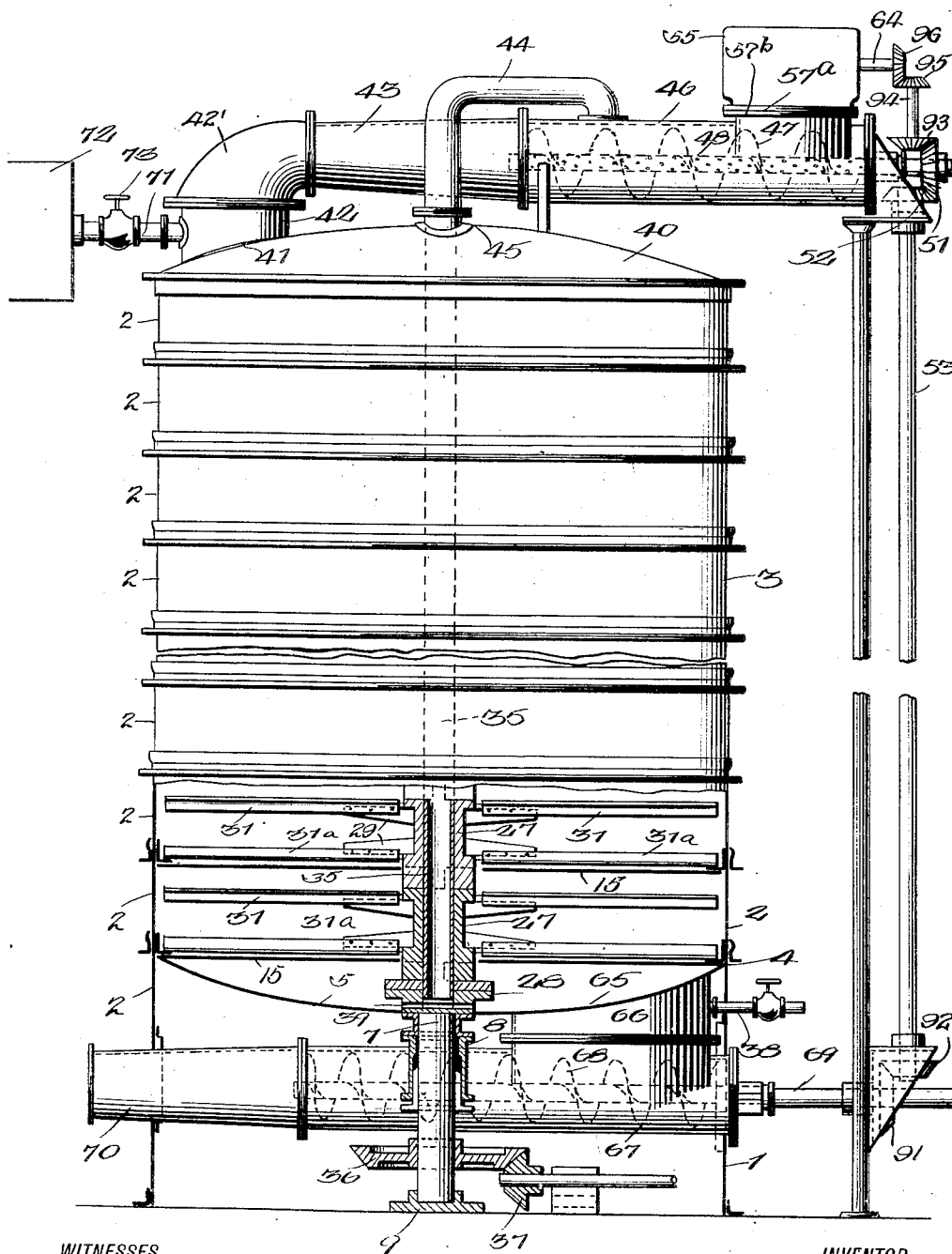
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3 Sheets-Sheet 2



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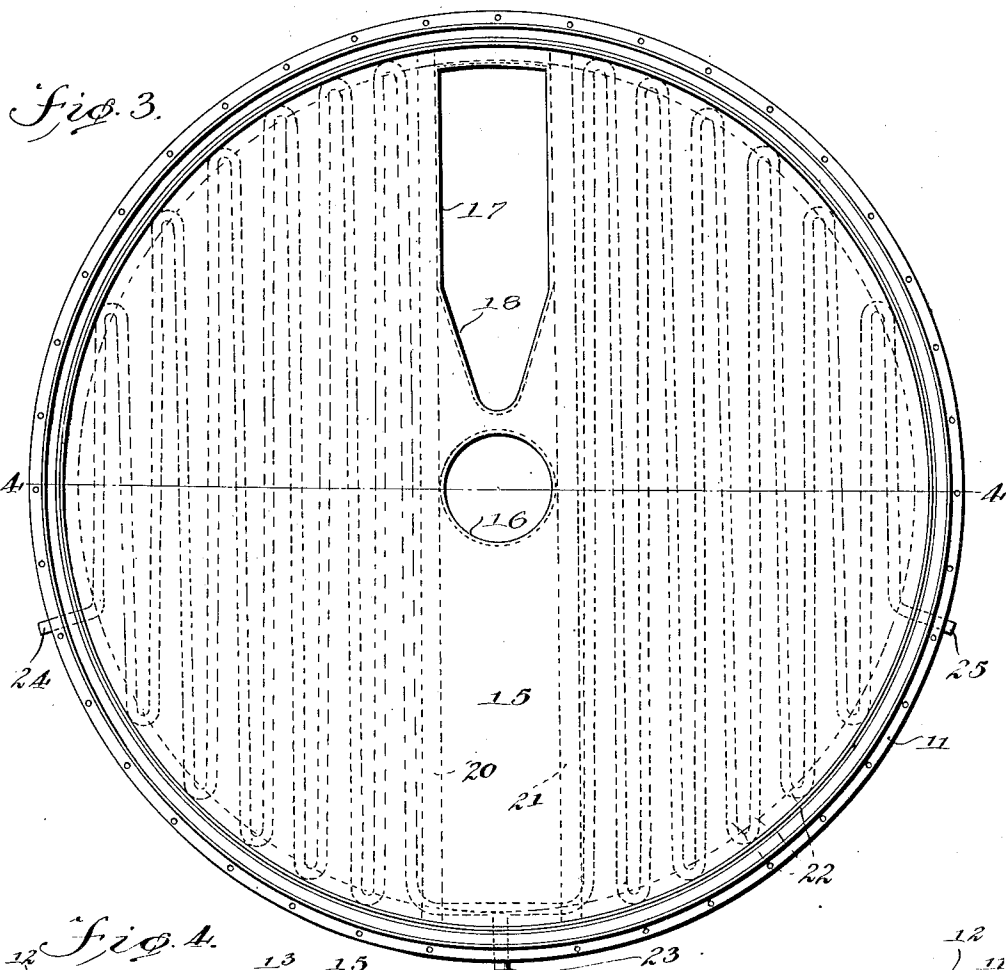
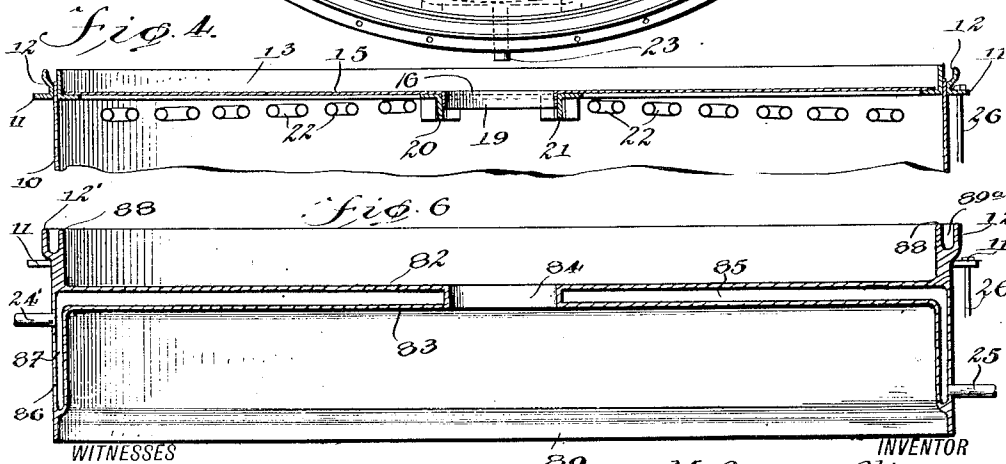
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3 Sheets-Sheet 3



WITNESSES

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APPARATUS FOR EXTRACTING ROSIN AND TURPENTINE FROM WOOD.

Application filed August 25, 1922. Serial No. 584,261.

This invention relates to an apparatus for extracting turpentine and resinous contents from sawdust and finely divided conifer woods which are more or less rich in these substances. In many large sawmills and lumber yards, particularly those of the South, where pine and other conifer woods are cut and sawed into lumber it is a common practice to use the waste in the form of sawdust, chips, and the like, as fuel to in part furnish the power for the mill. This fuel is rich in turpentine and rosin, both of which are more valuable as commercial products than as fuel; and of late years methods of recovering these substances from the waste have been proposed and to some extent practiced; and the general object and aim of the present invention is to provide an improved and efficient process of and apparatus for treating this waste for the extraction of the resinous content therefrom, prior to its final consumption as fuel.

More specific objects of the invention are, to provide an apparatus wherein the substances to be recovered from the waste wood may be more thoroughly and completely extracted therefrom than has heretofore been possible; to provide such an apparatus which shall be continuous in its operation and may well constitute a link of a conveyor by which the waste is transmitted from the mill to the boiler house without involving manual handling of the same en route; to provide an apparatus wherein the resinous content may be extracted with a minimum wetting and soaking of the material which, of course, tends to lessen its fuel value; to provide an apparatus wherein the turpentine may be volatilized from the material mainly through the agency of dry heat, and wherein the volatilized product may be absorbed and carried to a condenser through the agency of low pressure steam; and to provide an apparatus wherein the stock shall be preheated by direct contact with steam before it is admitted to the distilling retort, for the double purpose of reducing the distilling heat required within the retort and preventing condensation of the distillate through contact with cold material entering the retort.

Other objects and attendant advantages

of the invention will be readily apparent to persons familiar with distilling processes and devices of this general character from the following detailed description, taken in connection with the accompanying drawings wherein I have illustrated one practical and workable embodiment of the invention, and in which—

Fig. 1 is a view in elevation of a battery for extracting resinous matter from finely divided particles of wood;

Fig. 2 is an elevation, partly in vertical section of a single unit for extracting turpentine and pine oil from finely divided particles of wood;

Fig. 3 is a plan view of one of the horizontal hot plate partitions or division plates of the sectional retort or drum shown in Fig. 2;

Fig. 4 is a central vertical section taken on the line 4—4 of Fig. 3;

Fig. 5 is a perspective view of one of the hubs of the retort and its attached spreader and scraper blades;

Fig. 6 is a central vertical section of a modified form of a hot plate or division plate shown in Fig. 4;

Fig. 7 is a vertical section of the rotary feed valve; and

Fig. 8 is a top plan view of the rotary feed valve showing the diagonally disposed opening in the top of the valve casing.

Referring to the drawings, 1 designates a base member preferably cylindrical in form and constituting a support for a series of superposed cylinder sections each designated as an entirety by 2, said several sections unitedly constituting a steam drum 3. In the top of the base member 1 is mounted a concave or dished plate 5 which constitutes the bottom end wall or cover of the steam drum 3; and above the concave end wall 5 is a flat circular hot plate 15, of which there is also one provided for each of the several cylindrical sections 2, as hereinafter more particularly described.

The concave bottom 5 of the retort is centrally apertured to admit a vertical drive shaft 7 provided with a stuffing box 8 and mounted at its lower end in a step bearing 9.

Describing now in detail the sections 2 of the drum, which are best shown in Figs.

3 and 4, each of these comprises a cylinder section 10 having at its upper end a ring riveted or welded to its outer wall. This ring comprises a horizontally extending flange 11 and an upwardly and outwardly extending flange 12 extending above the upper edge of the section 10. To the inner wall of the section 10 at its upper end is riveted or welded an internal angle ring comprising a vertically extending flange 13 spaced from the flange 12 of the outer ring and an inwardly extending horizontal flange 14, upon which is mounted a hot plate 15 formed with a central opening 16 and a radial opening 17 having its inner end adjacent to the opening 16 of reduced width, as shown at 18 in Fig. 3.

The metal surrounding the opening 16 is turned downwardly at 19 and lies between and in tangential contact with a pair of angle iron beams 20 and 21 which extend transversely across the bottom of the plate 15 and are attached at their ends to the inner wall of the cylinder section 10.

The metal surrounding the opening 17 is also bent downwardly to form depending flanges, the parallel portions of which lie in contact with the beams 20 and 21, whereby the plate 15 is locked against rotation.

Mounted directly beneath the plate 15 and supported by any suitable means is a steam pipe line bent to form coils 22 lying in close parallel juxtaposition and spaced sufficiently at the center of the plate to straddle the openings 16 and 17. The coils on each side of the plate communicate with a steam supply pipe 23, while the outer ends of said coils are connected to steam lines 24 and 25 for exhausting the steam from the coils. As shown in Fig. 4, the successive coils extending laterally outwardly from the center of the plate 15 are located at gradually lower levels, so that any water condensed in the coils will be readily drained off through the pipes 24 and 25.

The several sections 2 of the drum are superposed upon each other, the lower edge of each section 10 being seated in the annular groove formed between the upstanding flanges 12 and 13 of the next underlying section and suitably calked therein, and the sections are bonded together by tie bolts 26 connecting their respective external flanges 11. All of the steam inlets 23 are, of course, connected to a single supply pipe which leads from a source of steam under pressure. The exhaust conduits 24 and 25 are likewise connected to a common conduit for draining condensed steam away from the drum, this latter conduit preferably being connected into any well-known form of steam trap.

Rotatably mounted within the opening 16 of the plate 15 are a series of superposed hub sections designated generally by 27 interconnected as hereinafter described to be

driven in unison and constituting the drivers for spreader and scraper arms by which the material treated is spread or tumbled and caused to travel over the hot plate of each of the several heating chambers or compartments of the retort. Referring to Fig. 5, radiating from the hub 27 are two series (upper and lower) of ribs or fins 29 having radial sockets, the upper of which receive the depending flanges 30 of spreader arms 31, while the lower receive the upstanding flanges of scraper arms 31^a; both series of arms being secured in the sockets by rivets or bolts 32.

Upon the upper face of the hub 27 are formed four pairs of spaced ears 33 ninety degrees apart; and upon the bottom face of the hub are formed a corresponding series of depending lugs 34 adapted to be received between the ears 33 of the several spaced pairs for locking the hubs together, with the central openings or bores of the hubs in alignment. In and through these central openings is tightly fitted a rotary centrally disposed pipe 35, which extends from the top of the retort to a point adjacent to the bottom of the latter, and serves as a steam supply pipe as hereinafter described. A flange 28 on the upper end of the shaft 7 is preferably provided with pairs of spaced ears such as 33 receiving depending lugs 34 of the lowermost hub 27, so that as the shaft 7 is rotated it will cause a rotation of all the hubs 27 and likewise their attached scraper and spreader arms.

Fast on the shaft 7 is a bevel gear 36 in mesh with and driven by a pinion 37 driven from any suitable or convenient source of power.

38 designates a pipe for the supply of steam to the interior of the retort at the bottom of the latter, this pipe being shown in Fig. 1 as entering through the wall of the base member 1 and the adjacent wall of a discharge hopper 66 hereinafter referred to.

The plates 15 are so located within the drum 3 that the radial openings 17 of successive plates are laterally offset around the axis of the drum; the opening in the top plate being just to one side of the feed opening hereinafter described, and the opening in the bottom plate being directly over the discharge hopper 66, so that steam entering at the bottom of the retort is caused to take a spiral course upwardly through the drum since it has to travel through these openings to reach the upper end of the drum.

The centrally disposed steam pipe 35 communicates at its lower end with radial openings 39 formed through the hub of the flange 28, these openings communicating with the lowermost steam compartment of the drum.

The top of the drum is closed by a cover 40 which is provided adjacent to its periphery with a feed opening 41 surrounded by a

neck 42. This latter is connected by an elbow 42' to a tapered conduit 43 which is offset from the center of the cover 40 in order to provide space for a steam pipe 44 that is connected at one end by a swivel joint 45 to the centrally disposed steam supply pipe 35 and at its other end to a conveyor tube or cylinder 46. This latter is connected to and continuous with the conduit 43 and is equipped with a screw conveyor 47 having a hollow shaft 48 that is perforated at intervals along its length to admit steam entering through said hollow shaft into the conveyor cylinder 46. The outer end of the screw shaft 48 is connected by a suitably packed swivel joint (not shown) to a steam supply pipe connected with a source of steam under pressure. The screw 47 may be driven from a vertical shaft 53 through co-operating miter gears 52 and 51; the ratio of the gearing being such as to rotate the shaft 48 at a predetermined speed in order to properly feed finely divided wood through the conduit 43, elbow 42', neck 42 and opening 41 into the top section of the drum 3. The conveyor cylinder 46 forms a preheating chamber for the chips of wood before the latter is delivered to the retort or drum 3.

In order to seal the preheating chamber 46 from the atmosphere I have provided thereon a rotary valve designated as an entirety by 55 in Fig. 2, and the details of which are best shown in Figs. 7 and 8. This valve comprises a casing 56 which is attached by a base flange 57^a to a flanged opening 57^b located in the top and at one end of the preheating chamber 46. The valve proper comprises a hub 57 having webs 58 radiating from the hub 57 and forming pockets 59 which are adapted to be filled with chips of wood from a hopper (not shown) mounted on the upper flanged opening 60 of the valve casing 56. Formed integral with the ends of the hub 57 and the blades or webs 58 are annular discs 61 and 62, the discs 61 being of larger diameter than the discs 62 so that the valve is in the shape of the frustum of a cone with one end of the blades or webs of greater width than the opposite end. The end discs 61 and 62 are formed with annular flanges 63 which provide bearings for the rotary valve in the tapered wall of the valve casing 56. A shaft 64 is connected with the hub 57 to drive the valve at a suitable speed for delivering proper quantities of wood to the preheating chamber 46.

As shown in Fig. 8, the flanged feed opening 60 at the top of the valve casing is in the shape of a rhomboid, its longer sides being oblique or inclined to a median plane extending longitudinally through the center of the valve casing, or, in other words, the longitudinal side of the opening is disposed

at an angle to the outer edge of the valve blade instead of being parallel with said blade, whereby the longitudinal edge of the opening, co-operating with the blade, provides a cutting means for chips of wood that tend to clog the valve as the blades of the valve rotate within the casing.

Were it not for the annular disposition of the longitudinal side edges of the opening, chips of wood would jam between the blades and the opening instead of being sheared by the same, and would thus injure the combined valve and feeder.

In the concave bottom 5 of the retort is formed an opening 65 embraced by a discharge hopper 66 which leads into the upper side of a discharge conveyor tube 67. In this latter a screw conveyor 68 is mounted for rotation on a shaft 69 that extends through a suitable stuffing box in one side of the base 1 of the retort. The screw 68 forces all the chips of wood exhausted through the opening 65 outwardly through a discharge pipe 70, whence the chips may be delivered by a conveyor to a second retort in which the rosin is extracted by a suitable solvent, as hereinafter described.

As shown in Fig. 2, the conduit 43 is slightly tapered and narrowed in the direction of travel of the material toward the retort, so that the chips of wood or sawdust forced through the preheating chamber 46 and into the retort will choke the conduit 42 42' and 43 sufficiently to prevent the steam from the retort escaping into the preheating chamber 46, while at the same time the finely divided particles of wood crowding in the tapered conduit 42 tend to prevent the steam from the preheating chamber flowing into the top of the retort with the wood and cause it to flow for the most part through the conduits 44 and 35 into the bottom of the retort.

A pipe 71 connected with the neck 42 leads to a condenser 72 for condensing the steam carrying the distilled turpentine and pine oil. A valve 73 controls the rate of discharge through the pipe 71.

Describing more in detail the functions of the two sets of spreader and scraper arms previously described, the upper series of arms or blades 31, which I term spreader arms serve to distribute the finely divided particles of wood on and over the hot plates 15 and are adapted to prevent the wood from piling up at one place which would be adjacent the opening 17 where the wood falls from one plate onto the next lower plate. The arms or blades 31^a which I term scraper blades, are adapted to maintain the finely divided particles of wood in a constant state of agitation in order that the steam may come into surface contact with all particles of the wood and thoroughly saturate the same, and these arms also serve to ad-

vance the wood over the plates and force it to drop through the radial openings 17 so that the wood will be caused to travel entirely around the axis of each chamber of the retort from top to bottom of the latter.

Referring to Fig. 1, I have therein shown a battery which comprises an initial retort 3 embodying the structure thus far described, and in which the chips of wood are maintained in a constant flow through the retort and heated both indirectly through the coils and hot plates and directly by the steam admitted through the pipe 38 and central conduit 35. To the discharge end of the retort 3, consisting as herein shown of the discharge section 70, is connected a vertical conveyor 74 which receives the partially distilled chips and carries them to a second retort 75 which is filled with some form of solvent for extracting the rosin from the chips which have been discharged from the retort 3. A second vertical conveyor 76 is connected to the discharge end 77 of the retort 75 for carrying the chips, which have been saturated with the solvent, to a third retort 78 in which live steam is admitted at 90 for removing the solvent from the chips. A condenser 79 is connected to the top of the retort 78 whereby the steam and solvent are condensed.

A pipe 80 is connected to the lower end of the retort 75 for draining off the rosin-saturated solvent, which is then treated for the removal and recovery of the rosin.

In Fig. 6 I have illustrated a modified form of a section of the drum and integrally formed hot plate. The section comprises two parallel circular plates 82 and 83 connected by a central short collar 84 which affords a central opening to receive the vertical steam conduit 35. Radial passages 17, like that shown in Fig. 3, are likewise formed in these plates with an annular flange bordering the openings and connecting the same together to form an internal narrow steam chamber 85. In a cylindrical ring 86 integral with the outer edges of the plates 82 and 83 is formed a circular steam chamber 87 communicating with the horizontal flat steam chamber 85. An inlet steam pipe 24' and drain pipe 25' are connected respectively with the upper and lower ends of the annular steam chamber 87. An integral annular flange 12' spaced from and co-operating with the upper end 88 of the annular ring 86 forms an annular socket 89* to receive and fit the lower end 89 of the next superposed annular ring 86. Flanges 11, similar to those shown in Fig. 4, extending around the outer side of the ring 86 provide a means whereby the several sections may be connected together by the tie bolts 26 to form the complete retort as above described.

Briefly describing the driving mechanism

shown in Fig. 2, on the lower feed shaft 69 is mounted a bevel gear 91 meshing with and driving a bevel gear 92 on the lower end of the vertical shaft 53, whereby the upper feed conveyor is driven through the gears 70 52 and 51. The valve shaft 64 may be driven from the bevel gear 51 by a bevel gear 93, vertical shaft 94 and meshing bevel gears 95 and 96.

The operation of the above-described apparatus is substantially as follows. Finely divided particles of wood, such as shavings, sawdust, chips and wood shredded in a hogging machine are fed into a hopper mounted on top of the valve casing 56. 80 Power having been applied to the drive shaft 69, the feed valve 55 is started in operation and from the pockets thereof the wood drops into the preheating chamber 46 through which it is carried by the screw 85 47. At the same time steam is admitted to the bottom of the retort through pipe 38, and also to the hollow shaft 48 and flows through the perforations thereof into the body of wood filling the heating chamber 46, 90 preheating said body of wood and absorbing the more volatile vapors from the latter, and flowing thence through the pipes 44 and 35 into the bottom of the retort, where it commingles with the steam admitted 95 through pipe 38. As the finely divided particles of wood leave the preheating chamber 46 in a heated condition they are crowded by the screw conveyor 47 into and through the narrow end of the tube 43, filling and choking this tube to such an extent 100 as to maintain a constant seal against the escape of vapor-laden steam from the retort 3.

From the tube 43 the wood passes through 105 conduits 42' and 42 and opening 47 into the top of the retort, falling onto the topmost hot plate in the latter. By the spreader and scraper arms 31 and 31^a the wood is carried around the hot plate and 110 evenly distributed thereover until it is pushed over the opening 17, whence it falls onto the next underlying hot plate and is carried around and spread over the latter in the same manner. In this manner the 115 wood is passed from the top to the bottom of the retort being temporarily arrested in and caused to travel around each of the successive heating chambers. From the lowermost heating plate the wood is dropped 120 through the discharge hopper 66 into the lower delivery chamber 67, whence it is discharged by the screw 68 into and through the discharge pipe 70.

Prior to the admission of the material 125 to be treated, live steam is turned on through the pipes 23 to the several heating coils of the hot plates, whereby the latter are heated to a temperature sufficient to effect the volatilizing of the turpentine contained 130

in the wood, and this turpentine is picked up and absorbed by the steam entering from the pre-heating chamber and the supply pipe 38 into the bottom of the retort and flowing upwardly spirally through the latter; this body of steam coming into direct and intimate contact with the wood and being in sufficient volume to absorb and carry turpentine vapors from the wood in both the preheating chamber and the retort without reaching the point of saturation.

The indirect heat supplied through the steam coils and hot plates is sufficient to volatilize and drive off the turpentine from the wood, and it also has the effect of superheating the low pressure steam entering the bottom of the retort through the pipes 35 and 38, whereby the capacity of the said steam to absorb and carry off the volatilized turpentine is increased. This superheating of the steam from pipes 35 and 38 is a valuable auxiliary to the successful operation of the apparatus for the further reason that it tends to reduce the moisture content of the chips, facilitates the extraction of the turpentine and pine oil from the latter, and renders the waste chips more available for subsequent use as fuel. The discharge of the steam from the preheating chamber 46 through pipes 44 and 35 into the bottom of the retort also prevents the preheating chamber from being overcharged with steam. This steam from the preheating chamber is, of course, partially charged with the more volatile turpentine and pine oils when it enters the retort and mingles with the pure steam entering through pipe 38; but the mixture, especially when superheated by the heating coils and hot plates, is amply sufficient, both in volume and in condition, to readily absorb and conduct off all of the distilled oil vapors without reaching the point of saturation. Moreover, the steam treatment of the chips in the chamber 46 heats the chips sufficiently when entering the top of the retort to prevent condensation of the turpentine and steam through contact therewith before the turpentine and steam pass to the condenser 72.

The further treatment of the exhausted chips in the retorts 75 and 78 for the removal and recovery of rosin and solvent has already been described. Substantially the same structural features are embodied in the retorts 75 and 78 as have been specifically shown and described in connection with the main retort 3, with the exception that the preheating chamber 46 of retort 3 is absent in retorts 75 and 78, and the conveyors 74 and 76 replace the feed conveyor 47 of retort 3. All steam conduits used in retorts 75 and 78 are preferably connected to a common steam conduit which supplies steam to retort 3.

I claim—

1. A device for extracting the resinous content from finely divided wood, comprising a retort, means for charging the retort with finely divided wood, means for progressively forcing the wood through the retort, means for admitting steam into contact with the wood in said charging means, means for admitting steam at the bottom of the retort into contact with the wood passing through the latter, means for discharging the wood from the retort, means for conducting steam from said charging means directly into the bottom of the retort, and means for conducting the resinous-laden steam from the retort.

2. A device for extracting the resinous content from finely divided wood, comprising a retort, means for charging the retort with the wood, means for charging the retort with steam, spaced superposed plates in the retort dividing the latter into a plurality of compartments, said plates having openings to permit the wood to fall from each plate above the bottom plate to the next underlying plate, means in each compartment for spreading the wood over the plate, other means in each compartment for causing the wood to travel over the plate and drop through the opening thereof, steam coils underlying each plate to heat the latter, means for discharging the wood from the retort, and means for conducting the steam charged with resinous matter from the retort.

3. A device for extracting the resinous content from finely divided wood, comprising a retort, means dividing the latter interiorly into a plurality of superposed compartments, means for charging the retort with the wood, vertically aligned hubs coaxial with the respective compartments and provided with pairs of radiating fins, blades at their inner ends secured to pairs of radiating fins, coupling means on opposite faces of the hubs adapted to engage complementary coupling means on the contiguous faces of adjacent hubs, a shaft connected to the lowermost hub for driving all the hubs, means for discharging the wood from the retort, and means for conducting the resinous-laden steam from the retort.

4. A device for extracting the resinous content from finely divided wood, comprising a retort, means for charging the retort with the wood, means for charging the retort with steam, spaced superposed plates dividing the retort into a plurality of compartments, said plates each provided with an opening through which the wood may be dropped from each plate onto the next underlying plate, a plurality of vertically aligned hubs coaxial with the respective compartments and coupled together for rota-

tion, a plurality of pairs of spaced fins radiating from an upper end of each hub, a plurality of pairs of spaced fins radiating from the lower end of each hub, spreader blades secured between upper pairs of fins, scraper blades secured between lower pairs of fins, means for rotating the hubs and blades with the spreader blades sweeping over the openings in the plates lying thereabove and the scraper blades sweeping over the openings in the plates therebelow, means for discharging the wood from the retort, and means for conducting the resinous-laden steam from the retort.

5. In a device for extracting the resinous content from finely divided wood, the combination of a retort, a preheating chamber connected with the retort, a feed device in said preheating chamber, means for admitting steam into the presence of the wood in said preheating chamber, means for conducting steam from said preheating chamber directly into the bottom of the retort, means for admitting a separate supply of steam to the bottom of the retort, a supply valve serving to charge the preheating chamber with wood and also prevent the escape of steam from said preheating chamber, means for

continuously discharging the wood from the retort, and means for conducting the resinous-laden steam from the retort.

6. In a device for extracting the resinous content from finely divided wood, the combination of a retort, means for charging the retort with finely divided wood, means for supplying the charging means with steam for preheating the wood, a valve casing connected with the charging means, a valve in the casing adapted to prevent the escape of steam from said charging means, said valve comprising a hub, annular discs mounted at opposite ends on the hub and engaged with bearings in said casing, webs radiating from the hub and joined at their opposite ends to said annular discs to form V-shaped pockets for receiving wood, said valve casing being provided with an opening in its top in the shape of a rhomboid for admitting wood to the pockets in the valve with the longitudinal edges of said opening inclined to the longitudinal edges of the webs whereby the peripheral edge of each web of the valve is moved progressively into engagement with the longitudinal edge of said opening, and means for rotating said valve.

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