No. 807,925. PATENTED DEC. 19, 1905.

A. W. HANDFORD.

WOOD FIBER DIGESTER.

APPLICATION FILED DEC. 27, 1904

3 SHEETS—SHEET 1.

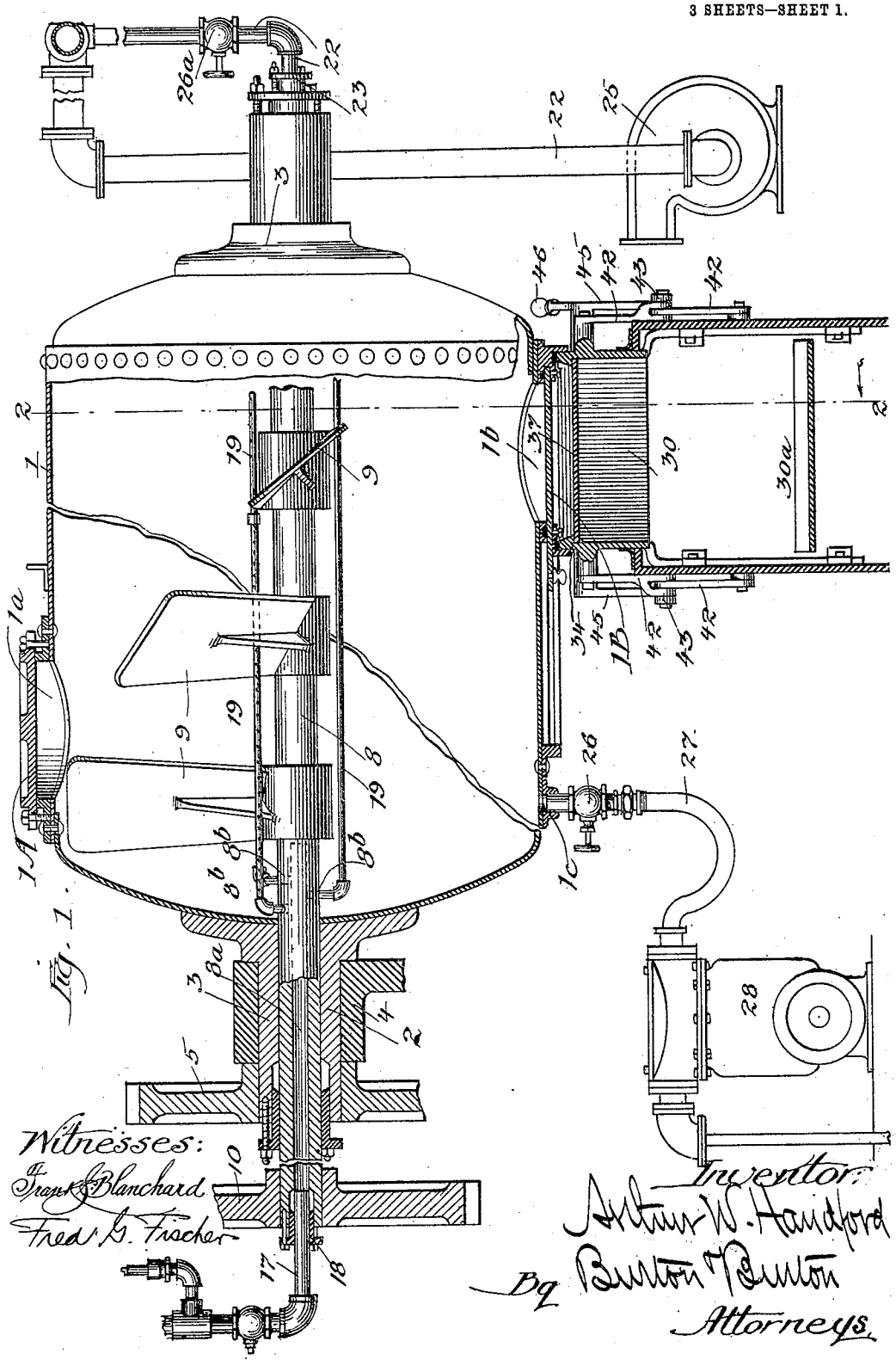


Fig. 1.

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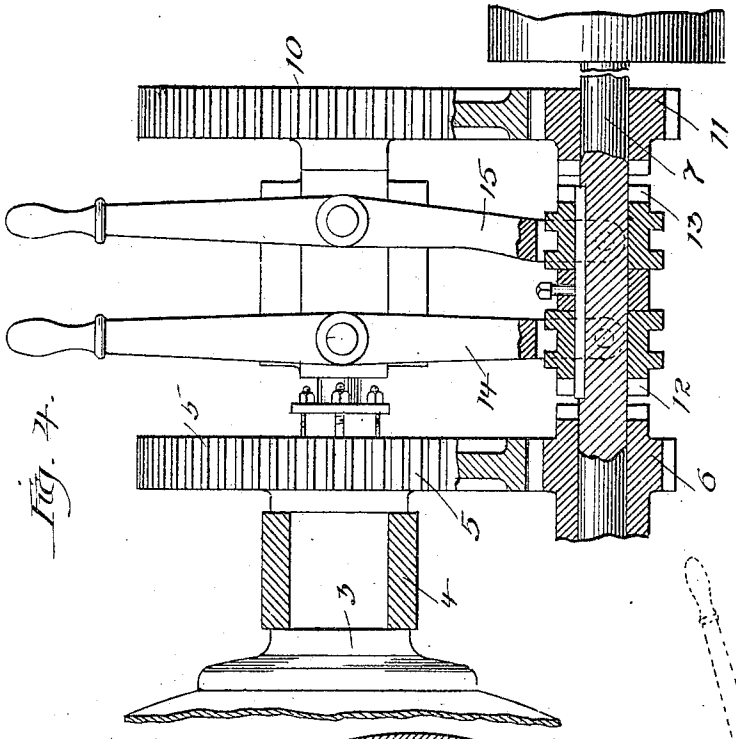


Fig. 1.

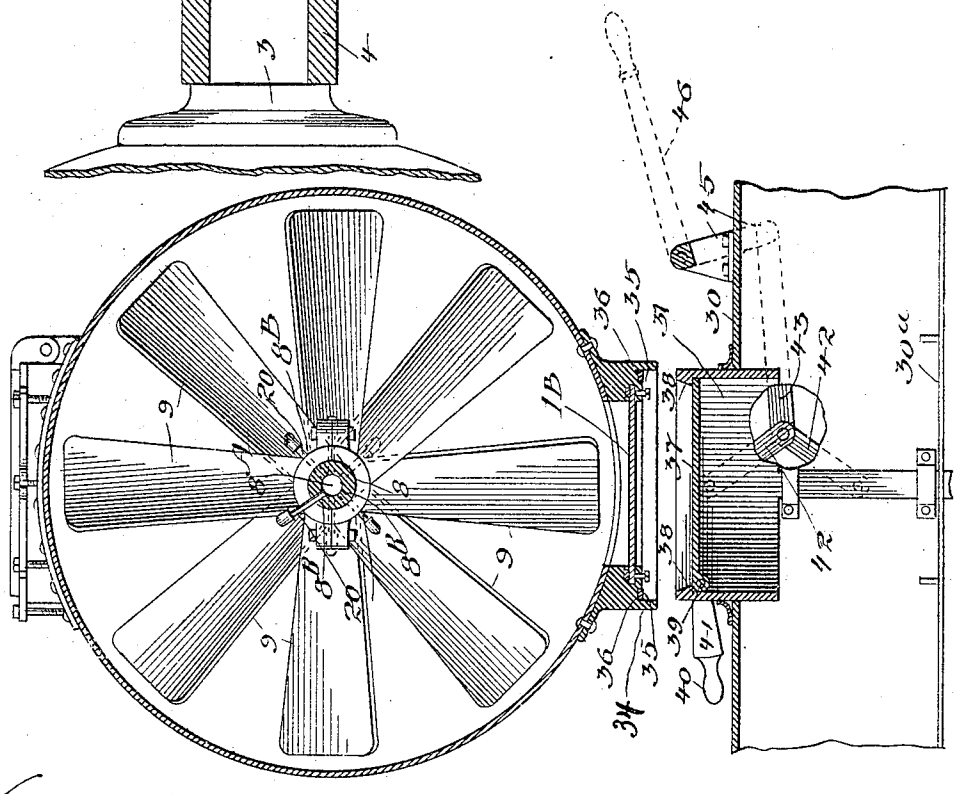


Fig. 2.

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3 SHEETS—SHEET 3.

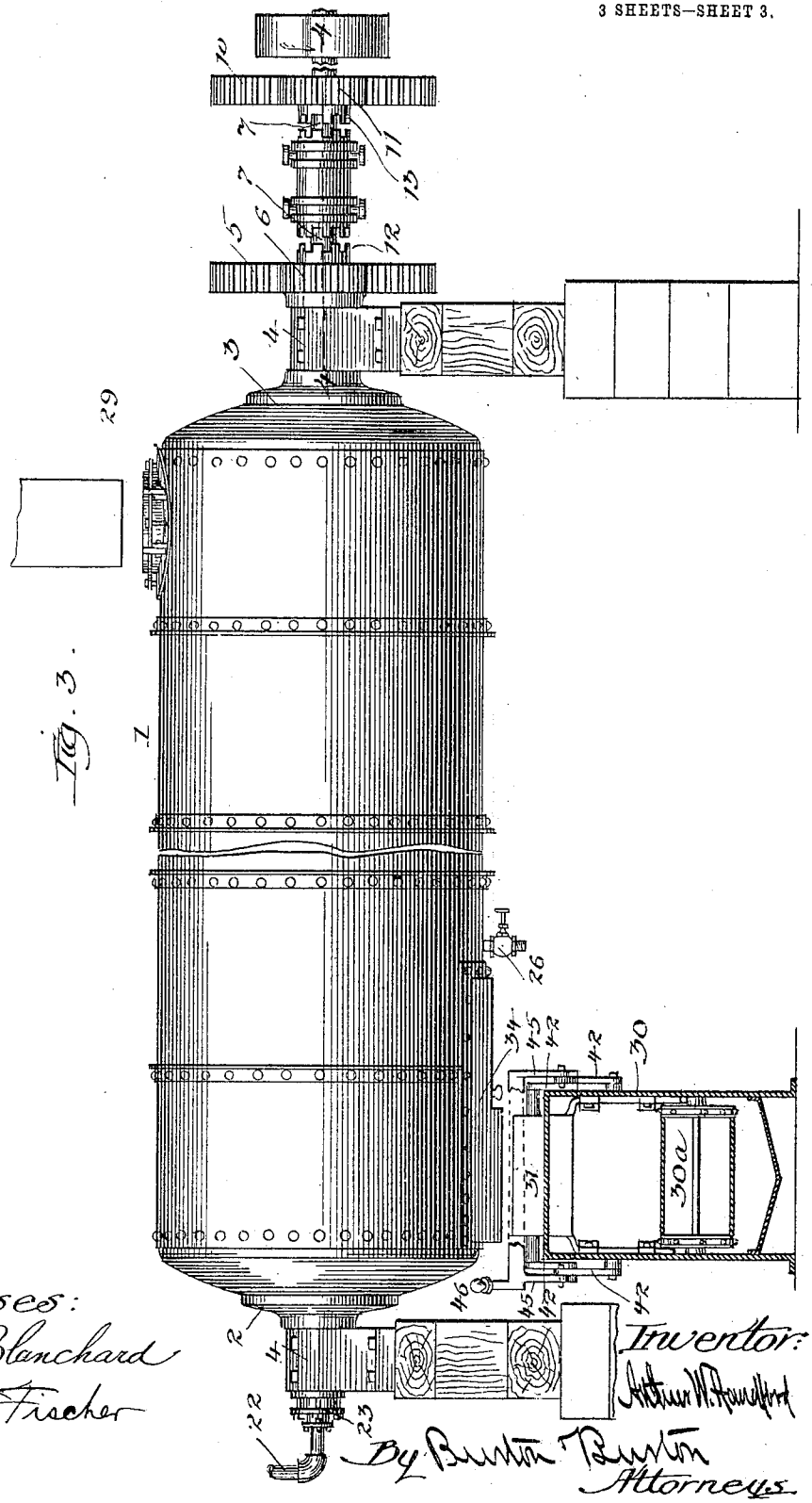


Fig. 3.

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UNITED STATES PATENT OFFICE.

ARTHUR W. HANDFORD, OF EVANSTON, ILLINOIS, ASSIGNOR TO WOOD DISTILLATES AND FIBRE COMPANY, OF CHICAGO, ILLINOIS, A CORPORATION OF ILLINOIS.

WOOD-FIBER DIGESTER.

No. 807,925. Specification of Letters Patent. Patented Dec. 19, 1905.

Application filed December 27, 1904. Serial No. 238,307.

To all whom it may concern:

Be it known that I, ARTHUR W. HANDFORD, a citizen of the United States, residing at Evanston, in the county of Cook and State of Illinois, have invented new and useful Improvements in Wood-Fiber Digesters, of which the following is a specification, reference being made to the accompanying drawings, forming a part thereof.

This invention relates to apparatus for treating wood fiber for the purpose of deriving therefrom by heat and moisture the soluble products and juices after the wood has been shredded or in any manner reduced to a comparatively fine or filamentary condition.

The invention consists in the features of construction set out in the claims.

In the drawings, Figure 1 is a longitudinal axial section of a structure embodying this invention, a portion intermediate the ends being broken away to condense the view. Fig. 2 is a transverse section at the line 2 2 on Fig. 1. Fig. 3 is a partly-sectional view showing the main element in side elevation, section being made vertically across the conduit into which the main element discharges. Fig. 4 is a detail section at the line 4 4 on Fig. 3.

This digester comprises a substantially horizontal cylinder 1, permanently mounted for rotation by means of the trunnions 2 and 3 at its opposite heads, respectively, said trunnions being journaled in suitable bearings 4 4, mounted upon suitable permanent supports of metal or masonry. For rotating this cylinder about its longitudinal axis the trunnion 3 at one end has rigid with it a gear 5, which meshes with and is driven by a gear 6 on a counter-shaft 7, to which power is communicated for rotating it in any convenient manner. A shaft 8 extends axially through the cylinder, penetrating both trunnions, which are bored for that purpose, and this shaft carries within the cylinder paddles or feeding vanes or arms 9, which are preferably constructed, as shown, with a half hub or collar at the root of each arm, so that two of the arms having such half-hubs may be clamped together about the shaft, and thereby made rigid with it for rotation. Each of the arms or paddles 9 is set at an oblique angle to a directly transaxial plane and the successive pairs of arms thus clamped together on the shaft are arranged so that the arms or paddles together amount to wings trending spirally about the shaft from one end to the other of the cylinder. The purpose of these paddles, and particularly of their oblique and spiral arrangement, is to feed the material longitudinally through the cylinder for charging and discharging it, as hereinafter more particularly explained. The shaft 8 has rigid with it outside the trunnion 3 a gear 10, rotating the shaft, said gear meshing with and being driven by a gear 11 on the counter-shaft 7. The gears 6 and 11 on said counter-shaft 7 are disengageably clutched to said shaft by clutches 12 and 13, respectively, which are operated by shipping-levers 14 and 15 to engage either of said gears at will with the shaft or to leave them both disengaged when desired, so that either the cylinder 1 or the shaft 8, with its paddles, may be rotated, according to the operation to be performed, as hereinafter explained. The shaft 8 is in a sense tubular, being bored axially from both ends inward toward the middle, the two bores, however, not meeting nor communicating directly. The bore 8^a at one end receives the end of a steam-pipe 17 through a suitable stuffing-box 18, permitting the shaft to revolve notwithstanding its connection in this manner with a fixed steam-pipe. Said bore 8^a communicates with the interior of the cylinder through a plurality of short radial bores 8^b 8^b 8^b and with these radial bores, which are threaded, perforated pipes 19 19 19 are connected by short elbow, so that the pipes extend parallel with the shaft within the cylinder at a distance from the shaft sufficient to permit the pipes to clear the hubs of the paddles 9, the pipes passing between said paddles as they extend longitudinally. The radial bores for connecting these perforated pipes are near the end of the cylinder at which the steam enters. The shaft and the pipes may extend any desired distance toward the other end, some of the pipes preferably nearly reaching the other end. One of the pipes is perforated to a point about one-third of the length of the cylinder from the end, another is perforated for a distance corresponding to the middle one-third of the cylinder's length, and the third pipe is perforated for a distance corresponding to the final one-third, so that the steam entering through the axial bore 8^a is distributed throughout

the whole length of the cylinder by means of the pipes perforated at said different portions of the length thereof. The ends of the pipes remote from their connection to the shaft at the radial bores 8^b may be supported on the shaft in any convenient way to insure steadiness of position. The axial bore 8^A at the opposite end of the shaft is similarly connected by radial bores 8^B 8^B 8^B with perforated pipes 20 20 20, which are extended similarly to the pipes 19 19 19, longitudinally through the cylinder between the paddles-arm, one of said pipes being perforated at a portion corresponding to the middle third of the length of the cylinder and the other two being perforated at portions corresponding, respectively, to the two end thirds of the length. The steam-pipe 17 is connected with a source of live steam for supplying the cylinder with such steam for the purpose of heat and moisture to dissolve the soluble substances from the shredded wood with which the cylinder is to be charged.

A pipe 22 extends through a stuffing-box 23 into the axial bore 8^A, and this pipe extends to an exhauster, as the exhaust-fan conventionally shown at 25, and the purpose of this connection is to draw out from the cylinder through the perforated pipes 20, axial bore 8^A, and pipe 22 the vapors which may be generated in the cylinder from the soluble elements of the wood and to conduct and deliver them to suitable apparatus for distillation in order to derive in liquid form the soluble values of the wood.

The cylinder 1 is provided with two manholes 1^a and 1^b at opposite sides and opposite ends, so that one of said manholes may be at the top at one end, while the other is at the bottom at the other end of the cylinder, the former being for the purpose of delivering the shredded wood into the cylinder and the latter for permitting its withdrawal. These manholes are provided with covers 1^A and 1^B, designed to be held tightly in place when the digester is being operated, as hereinafter described. At any convenient position, preferably about midway of the length of the cylinder and at the same side as the discharge-manhole, it is provided with a liquid-discharge aperture 1^c, fitted with a valve 26, adapted at the discharge side to be coupled to a pipe 27 when the cylinder is in proper position for the valve to register with the pipe, said pipe 27 being connected with a pump 28 for pumping out the liquid from the cylinder and delivering it to any receptacle or conduit for further treatment. Above the cylinder, in position to register with the receiving-manhole when said manhole is at the top, there is located a feeding-hopper 29, through which the cylinder may be charged with shredded wood to be treated therein, and at the lower side of the cylinder, in position to register with the discharge-manhole at the proper position of the cylinder, there is located an intake of a conduit 30, in which there is a conveyer 30^a for conducting the shredded wood after treatment in the digester to any other apparatus for further treatment. In view of the fact that the treatment of the wood by heat and moisture in the cylinder tends to vaporize some of the hydrocarbon or other inflammable elements of the wood it is highly important that when the discharge-manhole is opened for the discharge of the fiber there is to be no opportunity for the escape of such hydrocarbon vapors into the air, both because there would thereby be the loss of some of the material which it is the purpose of the process to derive from the wood and because of the danger of fire and explosion by reason of the inflammability of such vapors. For this purpose the cover 1^B of the discharge-manhole is mounted in slideways 34 on the manhole-fitting, so that it slides longitudinally with respect to the cylinder for covering and uncovering the manhole. The manhole-fitting has a flange 34 extending around the manhole-opening, which projects beyond the plane of the slide-cover 1^B, and the conduit 30 has a telescoping or adjustable mouthpiece 31, which makes a close sliding fitting at its telescopic junction with the said conduit and which is adapted to telescope also within the flange 34 of the manhole-fitting up to a shoulder or seat 35, provided on the inner side of the flange, and the upper edge of the mouthpiece 31 impinges against packing 36 in the shoulder 35 for making a tight seat against said shoulder. The mouthpiece 31 is also provided with a valve or gate 37, adapted to be swung up against the under side of a stop-shoulder 38 on the inner side of the mouthpiece for closing the latter and to be dropped to vertical position for opening the same. The rock-shaft 39 of this gate or valve 37 extends to the exterior of the mouthpiece, where it is provided with a suitable handle 40 for rocking the valve to open and close it, and the handle is preferably provided with a weight 41 to hold the gate normally closed against the shoulder 38. For raising and lowering the telescoping mouthpiece 31 said mouthpiece is connected at two opposite sides by a pair of links 42 42, one link of each pair being pivoted to the conduit 30 and the other to the mouthpiece 31, the two links of the pair being pivoted together. From the pivots of one of the two pairs of links a link 43 extends off at one side of the conduit and is pivotally connected to one arm of the bell-crank lever 45, which is fulcrumed on the conduit, and has the other arm 46 extending in position to operate as a handle for rocking the lever to force the links 42 of each pair into line, whereby they uphold the mouthpiece, or to fold them to allow the mouthpiece to descend. The exhauster may

be kept in operation while the manhole-cover is being closed after the shredded wood has been discharged, thus entirely preventing danger of escape of inflammable vapors from the cylinder.

In operating this digester, the cylinder being brought to rest at receiving position—that is, with the manhole at the receiving end at the top in registration with the hopper—the shredded wood is delivered into the hopper, and the shaft 8 being rotated the material is fed by the paddles 9 longitudinally through the cylinder from the receiving to the delivery end, and thus accumulated therein until the cylinder is as full as may be desired. The shaft being now thrown out of gear and allowed to come to rest, the receiving-manhole being closed, the cylinder itself is thrown in gear and rotated while steam is admitted through the shaft and connected perforated pipes 19. This process is continued until by heat and moisture the soluble elements of the wood are to a large extent dissolved therefrom, the length of time necessary for this first step in the process varying according to the character of the wood from fifteen minutes to an hour. When the device has thus been operated long enough to cause the cylinder to become as hot as it can be maintained with a given pressure of steam, the cylinder is thrown out of gear and brought to rest with the valve 26 at the lower side, and connections being made with the pipe 27 the valve is opened and the liquid and water of condensation derived from the steam will be forced out, first, by the steam and vapor pressure within the cylinder, and when that pressure is exhausted or reduced to atmospheric pressure the pump 28 is brought into action and the remaining liquid is pumped out, thereby producing a partial vacuum in the cylinder, and this process is continued until the cylinder is substantially drained of liquid. Meanwhile—that is, during the pumping—the exhauster 25 is operated to draw off the vapors from above the liquid until the degree of rarefaction produced in the cylinder exceeds the capacity of the exhauster, which is then cut off by closing the valve 26^a, while the pumping continues for the purpose of further reducing the vacuum while drawing off the remaining liquid. When the liquid is all drawn off and such degree of partial vacuum produced as will result from exhausting the liquid, the valve 26 is closed, the steam is again admitted, the pipe 27 uncoupled, and the cylinder again thrown in gear and rotated for further continuing the process of "cooking" or digesting the material—that is to say, resolve therefrom such remainder of the soluble elements of the wood as may be extracted by heat and moisture. When this process has continued to such degree as experience with each particular kind of wood may show to be advisable, varying from fifteen minutes to an hour, the cylinder is brought to rest at the same position as before and connected as before for drawing off the liquid and vapors, the pump and exhauster being operated as before for that purpose until the cylinder is exhausted of both liquid and vapor as nearly as may be, leaving the fiber substantially dry, because at the temperature to which it will have been brought the comparatively slight vacuum which will be produced by the pump and exhauster will evaporate all the superficial moisture from the shredded material. If the valve 26 is at the same side as the discharge-manhole, the cylinder at the position last stated will be in position for registering the discharge-manhole with the intake 30, and the telescoping mouthpiece being thrust up to close connection with the manhole, the cut-off valve 37 being opened and the manhole-cover withdrawn, the shredded-wood contents of the cylinder may be discharged through said manhole into the hopper by throwing the shaft 8 in gear and causing it to be rotated to feed the material longitudinally through the cylinder by means of the spirally-arranged paddles in the same manner as said material was advanced longitudinally through the cylinder from receiving toward discharge end in accumulating it to fill the cylinder. The shaft being thus rotated until the shredded wood is all discharged, the valve 37 being closed, and the telescoping mouthpiece being withdrawn from the discharge-manhole of the cylinder, said manhole-cover may be closed and the receiving-manhole may be opened and the cylinder recharged with a new quantity of shredded wood by the continued rotation of the shaft as before, and the process will be repeated in all its steps.

I claim—

1. An apparatus for the purpose indicated consisting of a shell mounted for rotation about its axis, a shaft extending axially through such shell and also mounted for rotation about its axis and having arms or paddles arranged for advancing the material through the shell longitudinally by the rotation of the shaft; means for rotating the shaft; means for rotating the shell independently of the shaft and means for disconnecting either the shaft or the shell at will from the driving power.

2. An apparatus for the purpose indicated consisting of a shell mounted for rotation about its axis; a shaft extending axially through such shell and also mounted for rotation about its axis and having means within the shell for advancing the contents of the latter longitudinally therethrough by the rotation of the shaft while the shell is at rest; means for rotating the shaft; means engageable and disengageable at will for rotating the shell, the shaft having an axial bore from one end opening within the shell and a steam-sup-

ply pipe telescoping with such axial bore of the shaft for supplying steam to the shell.

3. An apparatus for the purpose indicated consisting of a shell mounted for rotation about its axis, a shaft extending axially through such shell, such shaft being axially bored from both ends inward, such bores opening for communication with the interior of the shell; a steam-supply pipe telescoping with one of said bores and a vapor-exhaust pipe telescoping with the other.

4. An apparatus for the purpose indicated consisting of a shell, a shaft extending axially therethrough and mounted for rotation about its axis and means for rotating it, said shaft being axially bored from both ends, such bores being opened within the shell for communication with the cavity thereof; a steam-supply pipe telescoping with one of said bores and a vapor-exhaust pipe telescoping with the other.

5. An apparatus for the purpose indicated consisting of a shell mounted for rotation about its axis; a shaft extending axially through the shell also mounted for rotation and means for rotating the shaft and the shell independently of each other, the shaft having axial cavities extending in from the two ends and opening within the shell for communication with the cavity thereof; a steam-supply pipe communicating with one of said cavities and a stuffing-box through which it protrudes for such communication, and a vapor-exhaust pipe communicating with the other cavity and a stuffing-box protecting such communication.

6. An apparatus for the purpose indicated consisting of a shell mounted for rotation about its axis and disengageable means for rotating it; a shaft extending axially through such shell also mounted for rotation about its axis and disengageable means for rotating it independently of the shell; a shaft having arms or wings arranged for advancing the material through the shell longitudinally by rotation of the shaft and having an axial cavity leading in from one end and communicating with the interior cavity of the shell; a steam-pipe communicating with said cavity of the shaft and a stuffing-box which protects such communication.

7. In an apparatus for the purpose indicated, in combination with a shell mounted for rotation about its axis, a shaft extending axially therethrough journaled in the heads of the shell and also mounted for rotation independently of the shell, said shaft having an axial cavity leading in from one end and pipes connected with said axial cavity within the shell and extending longitudinally thereof; an aperture for discharge within the shell and a steam-supply pipe connected with the axial cavity of the shaft outside the shell for delivering steam into the latter through said axial cavity and interior pipe.

8. In an apparatus for the purpose indicated, in combination with the shell, a shaft extending axially therethrough having an axial cavity leading in from one end for supplying steam to the shell; a plurality of pipes connected with said axial cavity within the shell extending longitudinally thereof, said pipes being severally opened at different points in the length of the shell for distributing steam therethrough, and a steam-supply pipe connected with said axial cavity of the shaft outside the shell.

9. In an apparatus for the purpose indicated, in combination with a shell, a shaft extending axially therethrough mounted for rotation in the heads of the shell and having within the latter arms or paddles for advancing material through the shell by the rotation of the shaft, said shaft having an axial cavity leading in from the end, and a plurality of pipes connected with said cavity within the shell and extending longitudinally thereof, said pipes being perforated respectively at different portions of the length of the shell for distributing the discharge of the pipe through the shell, and a pipe for supplying the heating medium connected with the axial cavity of the shaft outside the shell and a stuffing-box guarding such connection.

10. In an apparatus for the purpose indicated, in combination with a shell, a shaft extending axially therethrough mounted for rotaion in the heads of the shell and means for rotating it, said shaft having an axial aperture leading in from each end; a plurality of pipes connected with each of said axial cavities within the shell and extending longitudinally thereof, the several pipes leading from each of said cavities being open for discharge within the shell at different points in the length thereof; a pipe for supplying the heating medium connected with one of said axial cavities of the shaft outside the shell and an exhaust-pipe connected with the outer of said cavities outside the shell.

11. In an apparatus for the purpose indicated, in combination with a shell mounted for rotation about its axis, a shaft extending axially therethrough, said shaft having an axial cavity leading in from one end and communicating with the cavity of the shell; a pipe for supplying the heating medium connected with said cavity of the shaft outside the shell, said shaft having also an axial cavity extending in from the other end communicating with the cavity of the shell, and an exhaust-pipe connected with said axial cavity of the shaft outside the shell.

12. In an apparatus for the purpose indicated, in combination with the shell mounted for rotation about its axis and means for rotating it; a steam-pipe communicating axially with said shell at one end; an exhaust-pipe communicating axially with the shell at the other end, said shell having at one side

a valve connection for a drain-pipe; a drain-pipe mounted in position to be connected therewith at one position of the shell; a pump connected with said drain-pipe for exhausting liquid from the shell and an exhauster connected with the axial exhaust-pipe for exhausting vapors therefrom.

13. In an apparatus for the purpose indicated, in combination with a shell having a discharge-manhole, a manhole-fitting having parallel flanged guideways for a manhole-cover and a flange encompassing the manhole projecting away from the shell outside the manhole-cover guideways.

14. In an apparatus for the purpose indicated in combination with a cylindrical shell having, a manhole, a manhole-fitting having a plain seat for the manhole-cover and parallel flanged guideways projecting from said seat for the cover, said fitting having also a flange projecting off from the cylinder encompassing the manhole-opening and standing outside the cover-guideways.

15. In an apparatus for the purpose indicated, in combination with a cylindrical shell having a discharge-manhole, a manhole-fitting mounted on the shell having parallel flanged guideways for the manhole-cover; a flange encompassing the manhole projecting off from the cylinder outside the manhole-guideways, and a ledge or shoulder at the inner side of said manhole-encompassing flange having an outwardly-facing shoulder.

16. An apparatus for the purpose indicated, consisting of a shell mounted for rotation about its axis; a shaft extending axially through such shell also mounted for rotation about its axis; means operated by the shaft for advancing material longitudinally through the shell as the shaft rotates; means for rotating the shaft; means for rotating the shell, and means for disconnecting either the shaft or the shell at will from their respective rotating means.

17. An apparatus for the purpose indicated, consisting of a shell mounted for rotation about its axis; disengageable means for rotating it; a shaft extending axially through such shell also mounted for rotation about its axis and disengageable means for rotating it independently of the shell; means operated by the shaft within the shell for advancing material through the shell longitudinally by the rotation of the shaft, the shaft having an axial cavity extending from one end part way through its length and communicating with the interior cavity of the shoulder; a fixed steam-pipe communicating with said cavity of the shaft, and a stuffing-box which protects such communication.

In testimony whereof I have hereunto set my hand, in the presence of two witnesses, at Chicago, Illinois, this 29th day of November, A. D. 1904.

ARTHUR W. HANDFORD.

In presence of—

FREDK. G. FISCHER,

M. GERTRUDE ADY.