Nov. 21, 1933. W. H. SWANSON 1,936,341

DEVICE FOR DISTRIBUTING WOOD CHIPS IN PULP DIGESTERS

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Fig. 3

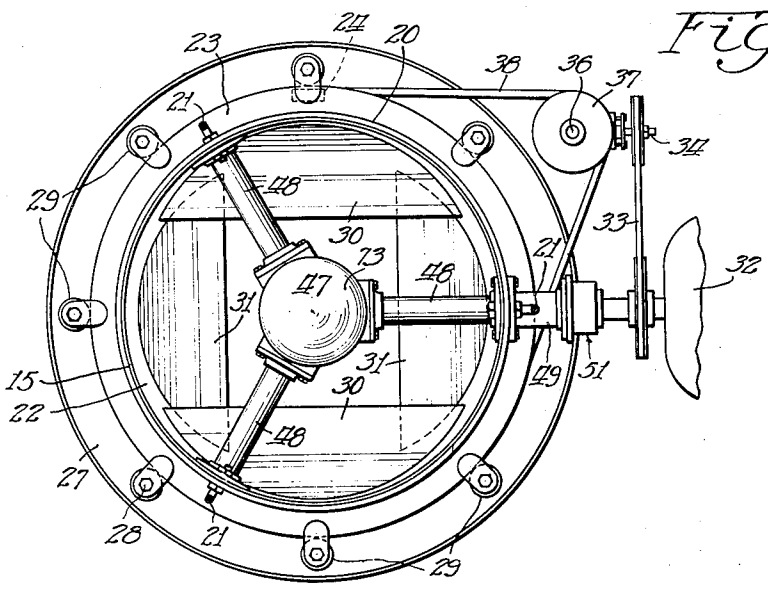


Fig. 1

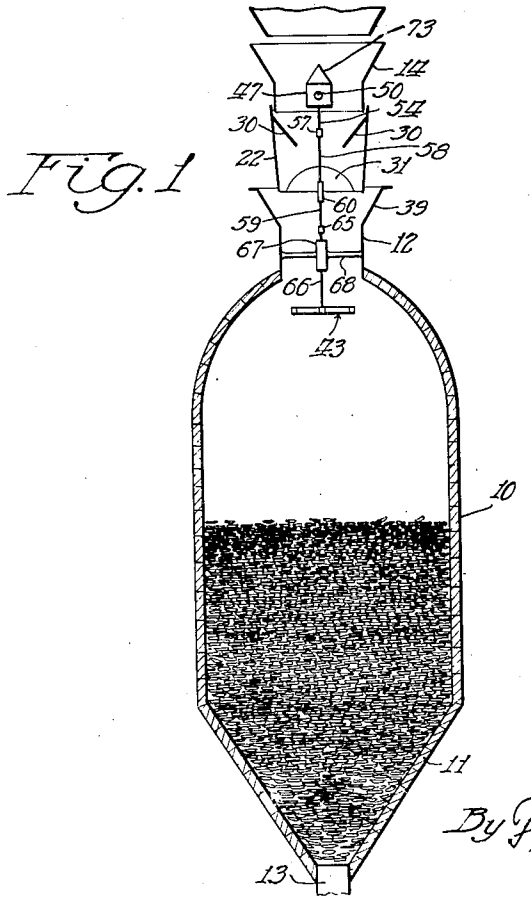
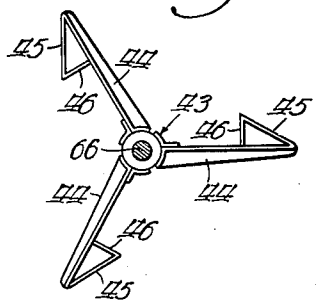


Fig. 4



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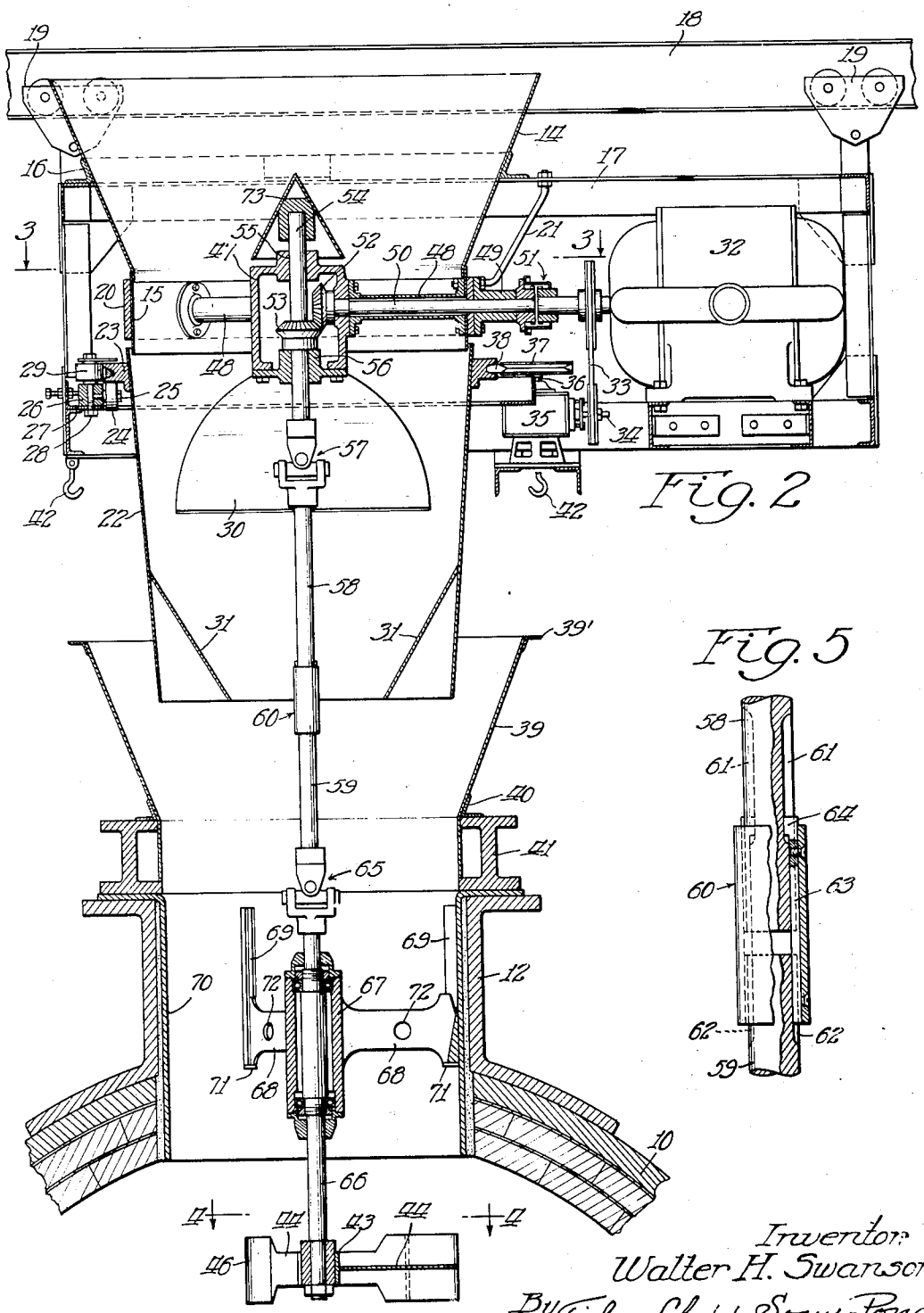


Fig. 2

Fig. 5

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DEVICE FOR DISTRIBUTING WOOD CHIPS IN PULP DIGESTERS

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14 Claims. (Cl. 92—7)

This invention relates to the general art of paper making, and has reference more particularly to an improved mechanism for distributing wood chips in pulp digesters.

The general object of the invention is to provide an apparatus whereby the chips may be so distributed in the digester as to effect, in the first place, more uniform cooking conditions through a more uniform temperature distribution within the digester, thereby improving the yield and quality of the pulp; and, in the second place, to secure a larger charge of chips being introduced into the digester than is possible by the procedure heretofore practiced, by reason of a closer piling of the chips, thus considerably increasing the capacity of the cooking equipment.

In the present customary method of filling digesters with chips, a spout is placed over the top nozzle of the digester, and the sliding gate in the chip bin bottom immediately above the spout is opened. The chips fall by gravity through the spout and into the digester. As is the case with all materials in small pieces, a cone-shaped pile is formed in the digester, the entering chips dropping on the apex and sliding down to a position of rest somewhere along the sides of the pile. The chips, having a slab-like form or shape, tend to take a position of most stable equilibrium, which means that they will rest on one of the faces having the greatest surface area, rather than on one of the edges. They slide down the cone in this position, with the result that a charge of chips is formed in the digester having a stratification corresponding to the angle of repose of the material. Not infrequently a stream of chips dropping from the bin enters the top of the digester eccentrically, and this leads to a stratification apex line somewhat eccentric to the vertical center line of the digester. However, the angularity of the stratification still exists.

Considering now the effect of this peculiar stratification upon the cooking process, after the digester is filled with chips the cooking liquor is introduced, the vessel being usually filled to the top with the re-agent and sealed by a top nozzle cover or cap, whereupon the heating of the contents is begun. Two methods of heating the contents are employed. That one which is almost universal in practice consists of introducing steam at sufficient pressure to overcome the back pressure of the contents into the bottom of the digester, either through a bottom T or through nozzles spaced at regular intervals in one horizontal plane of the surface of the bottom cone. The steam is quickly condensed to water by the cooking liquor and gives up its latent heat, as well as a portion of its sensible heat, to the latter. This warm liquor rises by convection through the digester contents, displacing colder liquor above, which falls to the bottom of the digester, is heated and, in turn, rises. Thus a convection current of circulation develops in the liquor portion of the digester contents. As the contents warm up the vapor pressure of the liquid, and also gas pressure of the dissolved sulphur dioxide in case of sulphite cooking liquor, causes a development of pressure in the digester. Further, the condensed steam increases the liquid content of the digester, causing it to fill up and develop a hydrostatic pressure, which is usually allowed to reach a predetermined maximum and is then maintained at this point by relief of excess water vapor sulphur dioxide gas and liquor through suitable outlets in the top nozzle. The relief of sulphur dioxide gas, in the sulphite process particularly, aids also in maintaining a circulation of the liquid contents. The gas is released in the form of bubbles, and these rise through the digester, causing upward motion of the liquid surrounding them.

Now, the liquid must naturally flow in channels formed by the interstices between the chips. And if the chips have an angular stratification, such as results from the usual method of filling, the channels or interstices must be somewhat continuous in the direction of the angular alignment or stratification. Since these channels lead upward and away from the walls of the digester to its axis, the liquid stream in rising tends toward the axis or center of the digester, and in descending it follows the outside walls of the vessel because of the cooling effect resulting from radiation of heat from these walls. Hence, the center of the digester contents is always found to be considerably hotter during the most of the cooking time than the outside portions, and the course of circulation can be followed very definitely by the temperature variations. While this condition is good from the standpoint of liquor circulation, it has an adverse effect upon the pulp quality and yield. It leads to non-uniformity in the product, inasmuch as part of the wood is exposed to the cooking re-agent at a higher temperature for a much longer time than other parts. Naturally, the cooking process is not completed until all the wood has been converted into pulp, and by the time the contents of the colder zones are completely converted, the contents of the warmer central zones will be considerably overcooked, resulting in a

very appreciable yield and strength loss which, of course, is undesirable.

A more modern system of cooking involves the forced circulation of hot cooking liquor through the digester, accomplished by withdrawing the liquor from the top or bottom of the digester, passing it through a pump, and forcing it back into the digester at the bottom or top, as the case may be. This modification is less productive of zones of unequal temperatures in the digester, but its efficiency in this respect is not complete. The angular stratification of the chips causes most of the liquor to flow through the central zone of the digester if the liquor is forced in at the bottom, or along the walls if delivered at the top, and this leads to somewhat inactive zones in the digester contents which are not pulped as rapidly as the main body of the contents.

The present invention aims to eliminate the undesirable conditions in the digester outlined above, and employs, as one feature of the invention, a device for insuring a central or axial introduction of the charge of chips into the receiving nozzle or spout of the digester, and, as another feature of the invention, a device for insuring a substantially horizontal stratification of the chips in the digester and a closer packing of the same by which a considerable increase in the pulp obtained from each charge is secured.

A still further object of the invention has been to provide a charging and chip-distributing mechanism which, when the digester has been fully charged, may be readily withdrawn and shifted to one side to permit the sealing of the digester nozzle by the usual cap or cover.

The invention, its mode of operation, and the benefits and advantages inherent therein will all be readily understood and appreciated by persons familiar with this branch of the paper making art from the following detailed description, taken in connection with the accompanying drawings, wherein I have illustrated one practical and simple form in which the invention may be embodied, and in which—

Fig. 1 is a partly diagrammatic view in vertical axial section of a pulp digester and its chip charging and distributing mechanism, illustrating the horizontal stratification of the charge obtained by the use of the present distributor.

Fig. 2 is a vertical section on an enlarged scale through the upper portion of the digester and its nozzle and the charging mechanism, showing both the device for securing an axial or concentric inflow of the chips to the digester and the device for distributing the inflowing stream and effecting the horizontal stratification of the charge.

Fig. 3 is a plan section on the line 3—3 of Fig. 2.

Fig. 4 is a plan view of the beater or distributor, in section through its operating shaft on line 4—4 of Fig. 2.

Fig. 5 is a fragmentary view, partly in elevation and partly in longitudinal section, of a shaft coupling which permits removal of the overhead charging device.

Referring to the drawings, 10 designates a digester of the usual form having a conical bottom portion 11, a receiving nozzle 12; and at 13 is indicated in Fig. 1 a pipe for steam or hot cooking liquor entering the lower end of the digester.

Referring now more particularly to Figs. 2 and 3, and first describing the filling device, 14 designates as a whole a collecting spout, the upper portion of which is enlarged to prevent spillage of chips from the overhead bins. This spout tapers down to a short cylindrical neck section 15 which concentrates the chip flow into the next underlying part of the machine. This collecting spout is supported by means of a collar 16 on a carrying frame 17, which is suspended from trolley beams 18 by trolleys 19. The trolley beams lie beneath the chip bins and permit of the filling machine being placed above the digester being filled, as needed.

Encircling the lower section 15 of the collecting spout is a ring 20 suspended from the frame 17 by braces 21 and serving to center and steady the lower end of the collecting spout.

Immediately below and registering with the fixed collecting spout is a revolving spout section 22 preferably of slightly tapered form as shown, that is suspended by a large ring sheave 23 mounted on its upper end. The sheave 23 rests and revolves on a series of spaced rollers 24 journaled on studs 25 that are mounted in blocks 26 that, in turn, are mounted on an angle ring 27 attached to the frame 17, the blocks 26 being secured to said ring by bolts 28. The bolts 28 extend above the blocks 26 and form bearings for a group of rollers 29 that surround the periphery of the sheave 23 and prevent any lateral displacement of the sheave and spout section 22.

Attached to the internal wall of the revolving spout section 22 are two pairs of downwardly and inwardly inclined baffles,—an upper pair 30, and a lower pair 31, disposed at right angles to each other, as best shown in Fig. 3. These baffles serve the very important purpose of breaking up any eccentric flow of the chip stream, which would result in eccentric and irregular piling of chips in the digester. The chip stream emerges from the lower set of baffles in a sheet, the width of which is the diameter of the spout at this point and the thickness of which is the distance between the lower edges of the lower baffles. Observations of the device in operation indicate that the chip stream is of uniform density throughout.

In practice the spout 22 is turned at a rate of about 20 R. P. M. A simple and convenient drive for the spout comprises an electric motor 32 mounted in the frame 17, the armature shaft of which is connected by a belt and pulley drive 33 to the horizontal shaft 34 of an ordinary speed reducer conventionally shown at 35. On a vertical shaft 36 of the speed reducer is mounted a pulley 37 that, through a cord 38, drives the large ring sheave 23.

The chip stream from the revolving spout section 22 is directed into the digester nozzle 12 by means of an auxiliary tapered spout 39, which is supported by a collar 40 on the strainer ring holder 41 when the machine is operating. Means, not shown, are provided for raising the auxiliary spout 39 up around the spout 22 when the digester has been filled with chips and the filling mechanism is to be moved from above the digester. Any convenient means for supporting the auxiliary spout 39 in elevated position may be employed, a plurality of hooks 42 suspended from the frame 17 being herein indicated for engagement with a flange ring 39' on the upper end of the spout section 39.

The chip stream passes through the digester nozzle 12 into the path of a rapidly rotating flail-type beater or distributing impeller of slightly less diameter than the internal diameter of the nozzle 12 and designated as an entirety by 43.

A plan view of this beater shown in Fig. 4 indicates the preferred shape of its blades, three of which are preferably employed. Each blade 44 is formed with a deflecting face 45 at its outer end which lies at an angle of approximately 30° to the main radial arm of the blade. This face 45 of the blade serves to deflect the chips it strikes toward the outer zones of the digester. Each blade is also formed at the inner edge of the face 45 with a face 46 that lies at a right angle to the main arm and is fixed to it. The action of this face 46 is to prevent the outward deflection of chips falling between it and the hub of the impeller, causing them to fall more in the central zones of the digester. Thus, a uniform level piling of the chips in the digester is realized.

In practice, the distributing impeller 43 is rotated at a rate approximating 700 R. P. M. It is equipped with a separable flexible drive from the motor 32 consisting, in the instance shown, of the following.

Mounted centrally of the cylindrical section 15 of the collecting spout 14, is a gear case 47 that, in the instance shown, is supported from the spout section 15 by three tubular radial arms 48 having flanged ends attached to the gear case and to the spout section 15. Journaled in one of the arms 48, and in an auxiliary bearing sleeve 49 attached to the ring 20, is a shaft 50 connected by a flexible coupling 51 to the motor shaft. On the inner end of shaft 50, within the gear case 47, is a miter gear 52 driving a miter gear 53 fast on a vertical shaft section 54 journaled in upper and lower bearings 55 and 56 in the gear case. The lower end of shaft 54 is connected by a universal joint coupling 57 to an underlying shaft section 58. The lower end of shaft section 58 is separably coupled to the upper end of a shaft section 59 by means of a coupling sleeve 60, shown in detail in Fig. 4. Shaft 58, slightly above its lower end, is formed with longitudinal keyways 61, and shaft 59 is formed with somewhat shallower keyways 62 in line with the keyways 61 and opening through the upper end of shaft 59. Secured to the inner wall of the sleeve 60 are cooperating keys each formed with a narrow main portion 63 of a depth corresponding to the keyways 62 and engaging the latter, and a deeper end portion 64 of a depth corresponding to the keyways 61 and engaging the latter. The lower end of shaft section 59 is connected by a universal joint coupling 65 to the upper end of a shaft 66 on the lower end of which the distributing impeller 43 is mounted. Shaft 66 is journaled, preferably by anti-friction bearings, as shown, in the hub 67 of a supporting spider removably mounted in the nozzle 12 of the digester. As herein shown, this spider is formed with a plurality of radial arms 68, which at their outer ends slidingly engage grooved guides 69 on the digester nozzle lining 70, these guides 69 being formed with stops 71 at their lower ends to support the spider and its shaft bearing. Of course, the nozzle liner and guides are made of a metal which will resist the corrosive action of the digesting liquor and are naturally permanently fixed in the digester. The arms 68 may be formed with holes 72, for engagement by hooks suspended from an overhead winch, by which, when the shaft sections 58 and 59 have been uncoupled by raising the coupling sleeve 60, and the filling mechanism has been moved to one side, the impeller and its supporting spider may be bodily removed.

The universal joints 57 and 65 take care of any mis-alignment in set up between the spout and distributing sections of the machine.

Fixed to the upper end of shaft 54 is a metallic cone 73, which, in its rotation, breaks up any chip arch that may form in the collecting spout 14 tending to plug the machine.

As has been previously indicated, the use of the chip charging and distributing apparatus hereinabove described results in more uniform cooking conditions, particularly temperature distribution, within the digester, due mainly to the horizontal stratification and uniform piling of the chips, which improves the yield and quality of the pulp, and, in addition, permits of a larger charge of chips being introduced into the digester than by the usual procedure, because of the closer piling of the chips, thus increasing materially the capacity of the cooking equipment.

I have herein set forth one simple and practical embodiment of the principle of the invention, by the use of which, as has been demonstrated in practice, the stated purposes and objects of the invention are effectively secured. Manifestly, however, the described apparatus may be varied in details in matters of structure and arrangement without departing from the principle of the invention or sacrificing any of the benefits and advantages secured thereby. Hence, I reserve all such variations, modifications and mechanical equivalents as fall within the spirit and purview of the appended claims.

I claim:

1. In a device for charging wood chips into pulp digesters, the combination of a revoluble spout, and means for supporting the same above and coaxial with the receiving nozzle of a pulp digester, downwardly and inwardly directed baffles mounted on and grouped around the inner wall of said spout, and means for rotating said spout during the passage of the chip stream therethrough.

2. In a device for charging wood chips into pulp digesters, the combination of a revoluble spout, and means for supporting the same above and coaxial with the receiving nozzle of a pulp digester, a pair of opposed downwardly and inwardly directed baffles in the upper portion of said spout, a similar pair of downwardly and inwardly directed baffles in the lower portion of said spout disposed at right angles to said first-named baffles, and means for rotating said spout during the passage of the chip stream therethrough.

3. In a movable device for charging wood chips into pulp digesters, the combination of a trolley-suspended frame, a revoluble spout, and means for suspending the same from said frame above and coaxial with the receiving nozzle of a pulp digester, upper and lower pairs of downwardly and inwardly inclined baffle plates mounted on the inner wall of said spout, said pairs of baffle plates being disposed at right angles to each other, and means mounted on said frame for rotating said spout during the passage of the chip stream therethrough.

4. In a device for charging wood chips into pulp digesters, the combination of a frame, a horizontal ring mounted in said frame equipped with a circular row of rollers, a revoluble spout, a ring sheave mounted on the upper end of said spout and rotatably supported on said rollers, upper and lower pairs of downwardly and inwardly inclined baffle plates mounted on the inner wall of said spout, said pairs of baffle plates being disposed at right angles to each other, a

motor mounted on said frame, and driving connections from said motor to said sheave.

5. In a device for charging wood chips into pulp digesters, the combination of a frame, a stationary collecting spout mounted on said frame, a revoluble spout and means for suspending the same beneath and in register with the discharge end of said collecting spout, downwardly and inwardly directed baffle plates mounted on and grouped around the inner wall of said revoluble spout, and means for rotating said revoluble spout during the passage of the chip stream therethrough.

6. In a device for charging wood chips into pulp digesters, the combination of a frame, a stationary tapered collecting spout mounted on said frame, a revoluble spout and means for suspending the same beneath and in register with the discharge end of said collecting spout, upper and lower pairs of downwardly and inwardly directed baffle plates in said revoluble spout, means for rotating said revoluble spout during the passage of the chip stream therethrough, and a revoluble member located in said collecting spout adapted to prevent arching of the chips in the latter.

7. In a movable device for charging wood chips into pulp digesters, the combination of a trolley-suspended frame, a stationary tapered collecting spout mounted on said frame and terminating in a cylindrical neck portion, a revoluble spout and means for suspending the same beneath and in register with said neck portion, upper and lower pairs of downwardly and inwardly directed baffle plates disposed at right angles to each other in said revoluble spout, a motor mounted on said frame, and means for effecting a slow rotation of said revoluble spout from said motor during the passage of the chip stream through said revoluble spout.

8. The combination with a pulp digester, of removable mechanism for effecting a substantially horizontal stratification of the chips therein, comprising grooved guides on the internal wall of the digester nozzle formed with stops at the lower ends of the grooves, a spider formed with arms engageable with said grooves and having a central bearing, a drive shaft journaled in said bearing and extending into the upper portion of the digester, a chip-distributing impeller insertible through said nozzle mounted on the lower end of said shaft, and means for effecting rapid rotation of said shaft.

9. As a new article of manufacture, a beater or impeller for distributing a falling stream of chips throughout the cross sectional area of a pulp digester, comprising a hub and a plurality of substantially radial blades, each of said blades formed at its outer end with a face disposed at an angle of approximately 30° to the radial arm of the blade.

10. As a new article of manufacture, a beater or impeller for distributing a falling stream of chips throughout the cross sectional area of a pulp digester, comprising a hub and a plurality of substantially radial blades, each of said blades formed at its outer end with a face disposed at an angle of approximately 30° to the radial arm of the blade, and a second face inwardly of said first-named face disposed substantially at right angles to the radial arm of the blade.

11. Apparatus for charging a pulp digester with chips, comprising, in combination, a trolley-suspended frame, mechanism mounted on said frame for centering a stream of chips falling from the chip bin with reference to the nozzle of a pulp digester, a tapered spout underlying and registering with said centering mechanism adapted to be seated on the nozzle of the digester, means for suspending said spout from said frame and above said nozzle when out of use, and a rotary beater within the pulp digester disposed across the path of the falling stream of chips for distributing the latter in horizontal strata throughout the cross sectional area of the digester.

12. Apparatus for charging a pulp digester with chips, comprising, in combination, a trolley-suspended frame, a rotatable device mounted on said frame for centering a stream of chips falling from the chip bin with reference to the nozzle of a pulp digester, a rotary beater within the pulp digester disposed across the path of the falling stream of chips for distributing the latter in horizontal strata throughout the cross sectional area of the digester, a motor on said frame, and driving connections from said motor to said centering device and beater serving to impart relatively slow and rapid rotary movements to said centering device and beater, respectively.

13. Apparatus for charging a pulp digester with chips, comprising, in combination, a trolley-suspended frame, a rotatable chip stream centering device mounted on said frame, a rotary beater within the pulp digester disposed across the path of the falling stream of chips for distributing the latter in horizontal strata throughout the cross sectional area of the digester, a separable drive shaft for said beater extending through the digester nozzle and said centering device, a motor on said frame geared to said shaft, and speed reducing transmission mechanism intermediate said motor and centering device.

14. Apparatus for charging a pulp digester with chips, comprising, in combination, a trolley-suspended frame, a rotatable chip stream centering device mounted on said frame, a stationary collecting spout mounted on said frame above and registering with said centering device, a rotary beater within the pulp digester disposed across the path of the falling stream of chips for distributing the latter in horizontal strata throughout the cross sectional area of the digester, a flexible and separable drive shaft for said beater extending through the digester nozzle and said centering device into said collecting spout, bearings for said shaft in said nozzle and collecting spout, respectively, a motor on said frame geared to said shaft, and speed reducing transmission mechanism intermediate said motor and centering device.

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