July 11, 1933. C. O. BACHMAN 1,917,420

APPARATUS FOR GRINDING WOOD

Filed Sept. 24, 1927 3 Sheets-Sheet 1

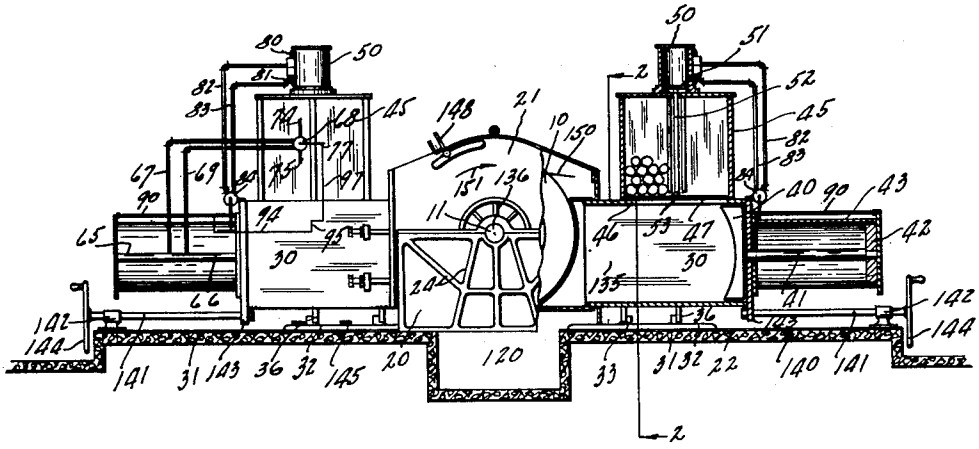


Fig. 1

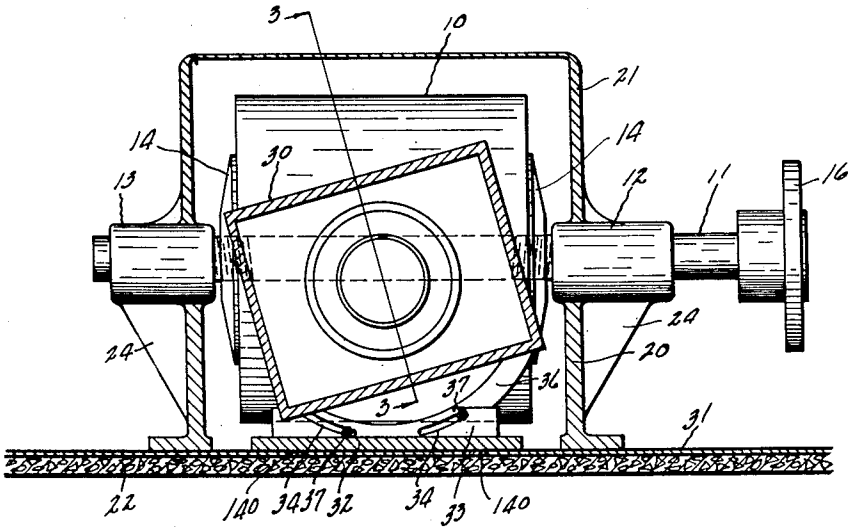


Fig. 2

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APPARATUS FOR GRINDING WOOD

Filed Sept. 24, 1927 3 Sheets-Sheet 2

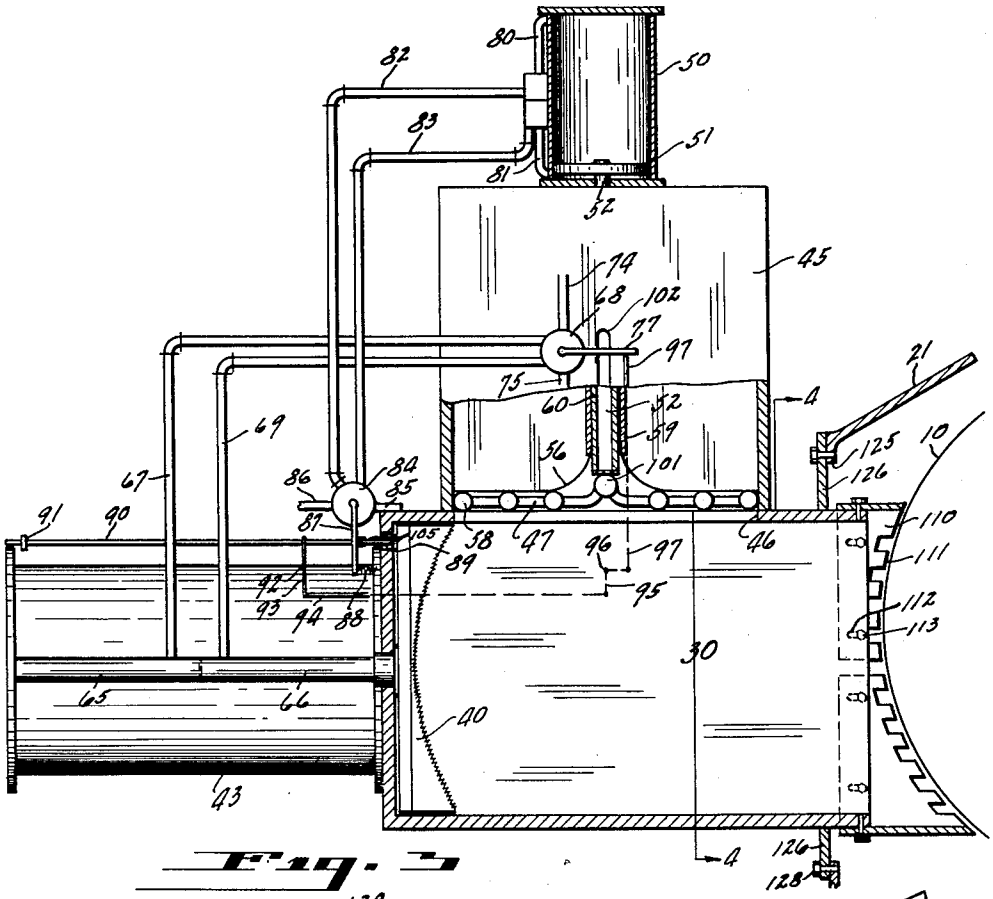


Fig. 3

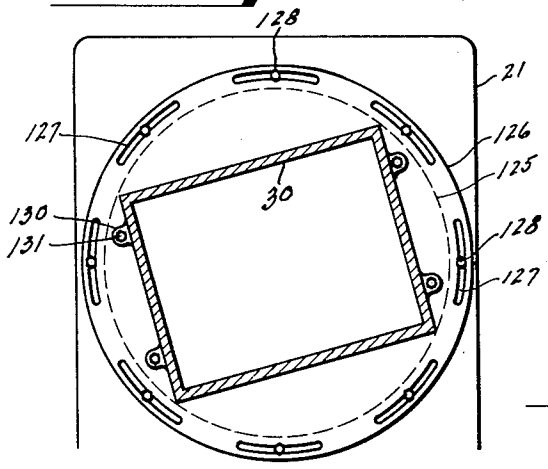


Fig. 4

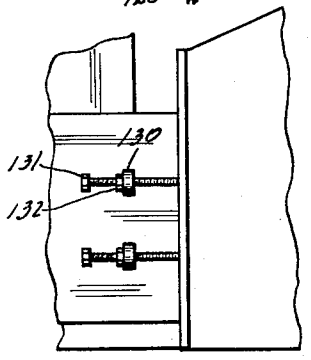


Fig. 5

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APPARATUS FOR GRINDING WOOD

Filed Sept. 24, 1927 3 Sheets-Sheet 3

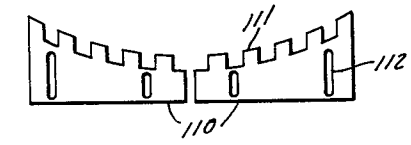


Fig. 6

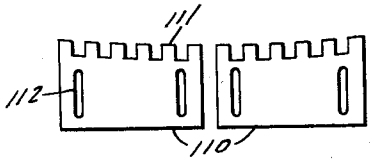


Fig. 7

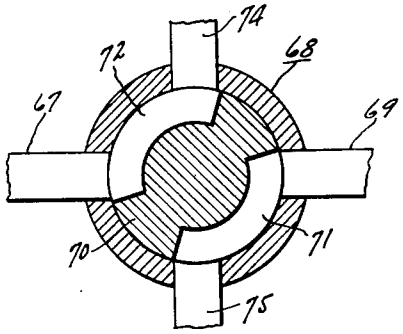


Fig. 8

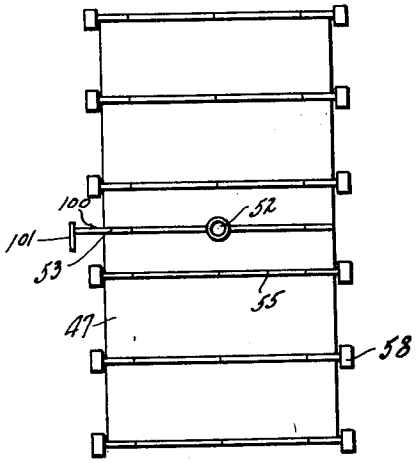


Fig. 9

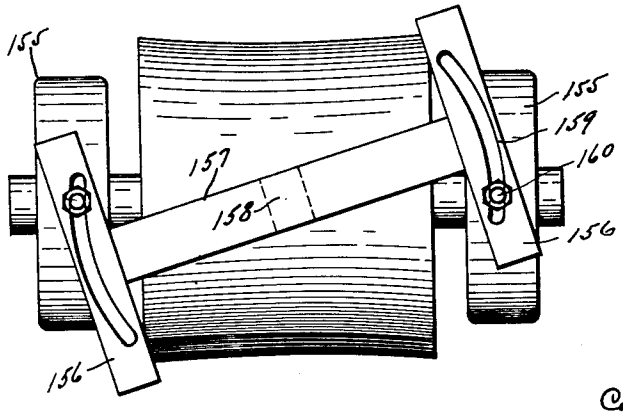


Fig. 10

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UNITED STATES PATENT OFFICE

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APPARATUS FOR GRINDING WOOD

Application filed September 24, 1927. Serial No. 221,741.

This invention relates to the manufacture of ground wood, or mechanical, pulp to be used in the manufacture of paper, or the like.

One of the principal objects of this invention is to provide a method of grinding wood to form a superior ground wood-pulp.

Another object of the invention is to provide apparatus for carrying out this method, which apparatus is economical in operation, requiring low power consumption.

Still another object of the invention is to provide apparatus of this character in which the parts may be readily assembled or disassembled and adjustment of the parts may be easily and quickly made, and which has longer operating life, having provisions for lessening the weight upon the supporting bearings of the grinding stone during operation.

Still another object of the invention is to provide an automatically controlled pulp grinder of this character.

Other objects and advantages of the invention will be apparent from the following description when taken in connection with the accompanying drawings and appended claims.

In the drawings in which like characters of reference designate like parts throughout the several views thereof;

Fig. 1 is a side elevation of a pocket grinder constructed in accordance with this invention, a portion thereof being broken away and in section to more clearly illustrate the construction;

Fig. 2 is a vertical sectional view taken on the plane of the line 2—2 of Fig. 1, the adjacent side of the cover casing of the grinding stone being broken away and the attaching means for fastening the pocket to the casing being removed for purposes of illustration;

Fig. 3 is an enlarged vertical sectional view on the plane of the line 3—3 of Fig. 2 through one of the pockets and associated feeding magazine illustrating the automatic control mechanism;

Fig. 4 is a partial vertical sectional view on the plane of the line 4—4 of Fig. 3;

Fig. 5 is a fragmentary side elevation further illustrating the attaching and adjustable connections between the pocket and the casing;

Fig. 6 is a detail view of the teeth-bearing sections for one side of a pocket;

Fig. 7 is a similar detail view of the teeth-bearing sections for the top or bottom of a pocket;

Fig. 8 is a sectional detail view of the valve controlling the fluid connection to the fluid pressure cylinders of the automatic control mechanism;

Fig. 9 is a plan view of the movable plates controlling the feeding of a charge from a feeding magazine into a pocket; and

Fig. 10 is a diagrammatic plan view of a grinding stone and jigging attachment adapted particularly for angular grinding.

Heretofore in the making of ground wood for pulp, the wood has been cut into pieces or logs of suitable length, which have been pressed against the surface of a rapidly rotating grinding stone, being held with the axis of the log parallel with the longitudinal axis of the stone. The grain of the wood is thus disposed parallel to the surface of the stone, so that the grinding or shearing operation of the rough particles of the stone during rotation takes place substantially at right angles to the grain of the wood. This grinding at right angles to the grain of the wood is objectionable in that considerable "wood flour",—or particles of wood so finely ground as to have no "fiber" characteristics such as are needed for the interlacing which give strength to paper—, is produced. Also, the action of the stone grinding at right angles to the grain of the wood tears off quite large splinters or slivers which are not only useless, but highly objectionable, in the subsequent forming of the paper sheet, and must be removed by screening.

During grinding operation the irregularities of the surface of the stone fill up rather rapidly and it is therefore necessary to resurface or sharpen the stone at frequent intervals. In doing so the stone is "jigged"—that is, a tool or jig is placed in a suitable mounting, and the surface of the stone worked or sharpened by the jig. In some cases of jigging of the stone, a spiral-shaped tool is held against the rotating surface of the stone and moved along the stone as the stone rotates, so as to cut a spiral groove. With such an arrangement the lead of the spiral must be quite small, as the jigging can not be controlled if a large lead spiral is attempted. Consequently sharpening or burring at only a slight angle could be at-

tained. Such sharpening or burring, while it restores the cutting effectiveness of the stone, does not alter the objectionable operating characteristics set out above. In addition it is impossible to burr the stone with a spiral jig uniformly with repeated jiggings, inasmuch as the lines or grooves of a subsequent jigging can not in actual practice be made to correspond with the lines formed by a previous jigging.

In accordance with the present invention, the wood is ground by forcing it against a relatively moving abrasive surface, moving at an angle to the grain of the wood. When ground at a suitable angle, that is when the wood is held against the stone with its grain at a suitable angle to the axis of rotation of the stone, the quantity of wood flour or splinters which results is very much less than is the case where previous methods of grinding are used. In practice the production of flour and splinters may not be completely eliminated—partly because of inherent irregularities in the wood itself, and partly because of the preliminary barking treatment that is sometimes used. However, under all operating conditions the quantities of both flour and splinters which are produced during the practising of the invention are very much less than is the case with the previously used methods. In addition the angle of grind should not be too great for if the wood is held against the stone with the grain at an angle materially greater than the desired angular range, then the asperities or grinding projections of the stone tend to pull out long threads, like excelsior, from the wood. For satisfactory production of ground wood for making pulp, then, the wood is ground aslant the grain at an angle which is intermediate the range giving excessive wood splinters and the range giving excessive excelsior-like long threads. While the most effective angle varies somewhat with varying operating conditions, such as the condition and inherent characteristics of the wood, the speed of rotation of the stone, the coarseness of the stone, and other factors, generally the angle of grind is more dependent upon the character of product desired. And a large variation in angle of grind may be necessary for securing a given product from woods of varying characteristics, as compared with the angular variation made because of the varying wood characteristics themselves. The operating range of angular setting for a given wood and a desired product may be predicted; but minor variations of angular setting within such predicted range will ordinarily be determined from actual results. For example, in the grinding of native spruce to produce ground wood for news print, using a 54″ diameter stone of ordinary roughness, rotating at 240 R. P. M., the angular range will be ordinarily from 7°–12°, and very satisfactory results have been secured with an actual angular setting of 8°–10°. Again, where the product desired is to be used in the manufacture of what is known as catalog paper, which is superior to news print, the angular range is from 15°–20°, and very satisfactory results have been attained with an angular setting of 17°–19°. With the woods ordinarily used in the manufacture of ground wood in this country the angular range, for any operating conditions normally encountered, will fall between 5° and 30°, with respect to the direction of the grain. It may be stated generally, that the harder the wood the larger the angle that should be used. Also, the sharper the stone the smaller the angle that should be used.

It has been found in actual operation that grinding wood in accordance with this method gives a ground wood-pulp which is quite superior to that being now generally produced by the old method, longer fibers being produced, the fiber bundles being more completely disintegrated and reduced to ultimate fibers, and the proportion of splinters and wood flour being greatly reduced. This gives greater strength to the paper, or the like, which is made from such pulp. At the same time a material decrease in power consumption results. Also since the ground wood is of such superior character and capable of producing a sheet of greater strength, the percentage of chemical pulp which is added to mechanical pulp to increase the strength with certain grades of paper, may be materially reduced, thereby effecting additional economy in manufacture of the finished product.

In the drawings is shown a form of apparatus which lends itself very satisfactorily to this angular grinding. In the mechanism therein illustrated the grinding stone is indicated at 10, and has a horizontally disposed shaft 11 supported by bearings 12 and 13. Conventional roller bearings are preferably used, though any other suitable type of anti-friction bearing will do. The shaft 11 preferably extends through the grinding stone 10, and is oppositely threaded at each end thereof to threadedly receive metal plates 14, between which the stone is securely clamped and held in proper operating position. The shaft 11 is extended and provided with a driving pulley or gear as indicated at 16 which may be driven from any suitable source of power, or the shaft 11 may be directly connected to a driving motor. The grinding stone 10 is rotated during operation in a direction which tends to tighten the clamping plates 14 against the stone, so that the stone is at all times securely held therebetween.

The grinding stone may be of conventional construction, being a massive sandstone or

other natural or artificial stone roll, usually varying from four to five feet in diameter, and from two and one-half to four and one-half feet in length. The stone is rotated at a suitable rate of speed, usually about 200 to 240 R. P. M., and the wood to be ground is forced against the surface of the stone under suitable pressure, generally varying from 40 to 80 pounds per square inch.

The grinding stone is provided with an enclosing casing comprising lower frame sections 20 and an upper cover section 21, the lower sections and the cover section being preferably separable along the longitudinal axis of the shaft 11 to facilitate the disassembly of the parts and inspection and replacement of the stone and bearings. The lower frame sections 20 are supported upon a suitable foundation 22. These sections 20 are provided with strengthening ribs 24 and are shown as carrying the bearings 12 and 13 and thus receive the weight imposed upon the bearings.

In order to support charges of wood to be ground, against the surface of the grinding stone, with the desired pressure and at the desired angle, charge receiving pockets indicated at 30 are provided. These pockets are angularly adjustable. Each pocket comprises a built-up structure of substantially rectangular cross-section having closed side walls and a rear end wall, the end of the pocket adjacent the grinding stone 10 being open. As is illustrated particularly in Fig. 2, the pocket is supported at an angle to the longitudinal axis of the grinding stone. The foundation 22 which is preferably of concrete, is provided with foundation plates 31 which receive a supporting base 32 which in turn supports the pocket. The supporting base 32 is provided with upstanding lugs or flange members 33 having arcuate shaped slots 34 therein, and the pocket is in turn provided with arcuate shaped cradles 36 which are bolted to the upstanding lugs 33 by means of bolts 37. The bolts pass through the arcuate slots 34 and receive threaded nuts thereon by means of which the parts are held in adjusted position. The nuts of the bolts 37 are loosened when adjusting the angular position of the pocket, the bolts traveling during the adjustment within the arcuate slots 34.

Operating within each pocket is a plunger 40 connected by a rod 41 to a piston 42 operating within a pressure fluid cylinder 43 mounted in horizontal alignment with the pocket, this cylinder being bolted to the end wall of the pocket. Suitable compressed fluid connections are provided for the hydraulic cylinder, the compressed fluid, generally water, serving to force the plunger 40 against the charge of wood within the pocket 30 to hold the wood against the surface of the grinding stone 10 with a definite predetermined pressure.

For supplying a fresh charge of wood to be ground, a feeding magazine 45 is provided for each pocket. Each magazine is constructed of a size adapted to receive a charge for its associated pocket, and upon the completion of the grinding of one charge in the pocket 30 and the return of the plunger 40 to the outer end of the pocket, the mechanism is operated so that the fresh charge passes from the feeding magazine 45 into the pocket 30. The feeding magazine 45 is mounted upon the top of the pocket 30, in alignment with an opening 46 formed through the upper wall of the pocket. The magazine, which is of substantially rectangular cross-section, is provided with an open side to permit feeding of a charge of wood thereto, the wood or logs being piled within the magazine transverse to the longitudinal axis of the pocket therebeneath, as is clearly illustrated in Fig. 1. Communication between the feeding magazine and the pocket is ordinarily closed by means of movable plates or gates 47.

Fluid pressure operated means are provided for opening and closing the movable plates 47 and for maintaining these plates closed with a predetermined pressure during the grinding operation within the pocket 30 to resist the pressure therein. This means comprises a fluid pressure cylinder 50 mounted upon the top of the feeding magazine 45, said cylinder having a piston 51 operating therein with suitable fluid pressure connections for effecting the operation of the piston. The piston carries a piston rod 52 which extends downwardly, through the top and into the magazine 45, and is connected at its lower end to a cross rod 53 pivotally connecting the adjacent edges of the two inside sections of the plates 47.

Each of the plates 47 is formed of a plurality of sections, shown as three in number, pivotally connected together. This is conveniently accomplished by providing a cross rod or pintle 55 between each two adjacent sections, the two sections being hingedly connected to the cross rod. To insure proper movement of the plates 47, tracks or grooves 56 are formed in the end walls of the feeding magazine 45, and the ends of the rods 55 are extended and carry rollers 58 which roll within the tracks 56. Within the magazine 45 are spaced guides 59 and 60, which serve as a dividing partition, between which the piston rod 52 extends, the guides dividing the magazine into two compartments, and each compartment being controlled by one of the movable plates 47.

In accordance with this invention the grinding of the wood within the pocket 30, the operation of the plunger 40 therein, as well as the feeding of a fresh charge of wood

from the feeding magazine 45 into the pocket 30, are automatically controlled. Further, the automatic control of the feeding magazine and the movable plates therein is coordinated with the automatic control of the pocket mechanism so that a fresh charge of wood is supplied at the proper time to the pocket 30.

To accomplish this control and operation, the cylinder 43 is provided with fluid passages 65 and 66 leading respectively to the opposite ends of said cylinder. A pipe connection 67 extends from the passage 65 to a valve casing 68, and a similar pipe connection 69 extends from the passage 66 to the valve casing 68. As shown clearly in Fig. 7, the valve casing comprises a cylindrical outer casing member having a turn plug valve 70 therein. The turn plug 70 is cut away on opposite sides thereof to form two arcuate chambers or passages 71 and 72 respectively. A fluid pressure inlet pipe 74 and a fluid pressure exhaust pipe 75 are connected to the casing on opposite sides thereof, the ends of the pipes 67 and 69 being connected intermediate the pipe connections 74 and 75. The construction is such that when one of the pipes 67–69 is in communication with the inlet passage, the other pipe is in communication with the exhaust passage. As shown in Fig. 7 the pipe 67 is in communication with the inlet passage 74 and pipe 69 is in communication with the exhaust passage 75, the plunger 40 then being actuated by the piston within the cylinder 43 on its pressure stroke against a fresh charge of wood within the pocket 30. The turn plug 70 is provided with an extension passing through the end of the casing 68, which extension is provided with an operating lever 77.

The fluid pressure cylinder 50 of the feeding magazine 45 is provided with fluid pressure passages 80 and 81 which lead respectively to the top and bottom ends of the cylinder, these passages being connected respectively by pipes 82 and 83 with a valve casing 84 similar in construction to that shown in Fig. 7 and described above, the valve casing having a fluid pressure inlet passage 85 and an exhaust passage 86. The turn plug of the valve casing 85 is provided with an operating lever 87, which in turn is urged by a spring 88, one end of which is fastened to any stationary part of the apparatus, and the other end to the lever 87, to a position which opens communication between the inlet pipe 85 and the pipe 82 to supply pressure fluid above the piston 51 to maintain the gates 47 closed with a definite pressure, the pipe 83 at this time being in communication with the exhaust pipe 86.

Attached to the plunger 40 and movable therewith is a tripper rod 90 which extends through an opening 89 in the end wall of the pocket 30. Carried by the tripper rod 90 is an adjustable stop 91. Pivotally mounted at 92 upon the exterior wall of the cylinder 43 is a lever 93, one arm of which extends into the path of movement of the adjustable stop 91 carried by the tripper rod 90. The other arm of the lever 93 is connected by a link 94 to one end of a bell-crank lever 95 pivoted at 96 to any fixed part of the apparatus on the exterior of the pocket 30, as shown diagrammatically in Fig. 3. The other arm of the bell-crank lever 95 is pivotally connected to a link 97, which in turn is pivotally connected to the operating lever 77 of the valve casing 68. Carried by an extended end 100 of the cross rod 53, to which the sliding plates 47 are pivotally attached, is an adjustable trip 101. The side wall of the magazine 45 is provided with a longitudinal slot 102 through which the extended end 100 of the rod 53 extends, the construction being such that during actuation of the sliding plates 47 the adjustable trip 101 comes into contact with the operating lever 77 to actuate the same. The inner end of the tripper rod 90 is provided with an enlarged portion 105 which is adapted to engage the arm 87 as the plunger 40 approaches the outer end of its outward stroke. Preferably the arm 87 is formed as a yoke about the tripper rod 90, the yoke being engaged by the abrupt shoulder at the end of the enlarged portion 105.

In operation, assuming the parts to be in the position shown in Fig. 3 and the plunger 40 starting on its pressure stroke within the pocket 30, the valve plug of the valve casing 68 is then in such position as to connect the pipe 67 to the inlet pipe 74 to supply pressure fluid to the outer end of the cylinder 43 and thus urge the plunger 40 toward the grinding stone 10 with a constant predetermined pressure. As the charge within the pocket 30 is ground, the plunger 40 gradually moves toward the inner end of the cylinder, when as it approaches the end of its stroke, the adjustable stop 91 finally comes in contact with the lever arm 93, rocking this lever and acting through the link 94, bell-crank 95, and link 97, to pull down the operating arm 77 of the valve plug in the valve casing 68. This movement of the operating arm 77 is such as to shift the plug 70 in a clockwise direction to connect the pipe 67 to the exhaust pipe 75, and at the same time connect the pipe 69 to the inlet pipe 74. The outward stroke of the plunger 40 then takes place, and as there is little resistance to this outward movement, this stroke takes place quite rapidly. During these operations, the spring 88 holds the operating arm 87 of the valve plug in the valve casing 85 in such position as to connect the upper end of the cylinder 50 to fluid pressure and the lower end to exhaust to thereby maintain a closing pressure upon the closed movable plates 47.

During the grinding of one charge within the pocket 30, the feeding magazine 45 is filled by the operator, who only has to attend to the refilling of the magazines as needed, inasmuch as the operation is otherwise automatic.

As the plunger 40 approaches the end of its outward stroke, and the inner edge of the plunger has about cleared the edge of the opening 46, the shoulder of the enlarged portion 105 on the tripper rod 90 comes in contact with the arm 87 and further outward movement of the plunger 40 effects actuation of the arm 87 to shift the valve plug in the valve casing 85 to connect the pipe 83 to the inlet pipe 85 and to connect the pipe 82 to the exhaust pipe 86. This actuates the piston 51 to open the movable plates 47 and permit the fresh charge of wood to drop within the pocket 30. As the movable plates 47 move upwardly between the guides 59 and 60, the adjustable trip 101 extending through the slot 102 finally comes in contact with the operating arm 77 to again shift the valve plug in the valve casing 68 to connect the fluid pressure to the outer end of the cylinder 43 and to connect the inner end of the cylinder to exhaust. The plunger 40 then begins another pressure stroke forcing the wood now within the pocket against the stone. After only a slight movement of the plunger 40 toward the grinding stone 10, the enlarged portion 105 of the tripper rod 90 moves out of the path of the arm 87 which is shifted by the spring 88 to again connect the upper end of the cylinder 50 to fluid pressure and the lower end of the cylinder to exhaust to thereby close the sliding plates 47 and to maintain them closed with a closing pressure during the pressure stroke. This sequence of operations is repeated for each charge.

The inner end of the pocket 30 is provided with removable teeth-bearing sections 110, each section carrying a plurality of teeth 111 positioned in closely spaced relation to the surface of the grinding stone 10. Each side of the pocket is provided with teeth-bearing sections, the outer ends of the teeth of these sections being given a curvature at the various sides to approximate the curvature of the surface of the stone from which they are slightly spaced. These teeth function to prevent the escape of slivers and thin pieces of wood during the grinding, the ground wood passing through the slots between the teeth.

In order to permit the angular adjustment of the pocket 30, and still maintain the teeth of the teeth-bearing sections at the various sides of the pocket in desired spaced relation to the grinding stone, each side of the pocket is provided with a plurality of separable teeth-bearing sections, shown herein as being two in number. As is readily evident, when the pocket 30 is positioned at an angle with respect to the longitudinal axis of the grinding stone 10 each side of the pocket, or rather the ends of the teeth-bearing sections at that side of the pocket, should have a curve to conform to the adjacent surface of the grinding stone 10 from which it is spaced. And of course for various angular positions, these curves vary. However, satisfactory results are obtained with the construction as shown, by providing a plurality of teeth-bearing sections at each side of the pocket, and making each section independently adjustable with respect to the surface of the grinding stone. As shown, each section 110 is provided with adjusting slots 112 through which pass adjusting bolts 113, which bolts fasten the removable sections to the exterior of the pocket.

Each section 110 at the sides of the pocket is preferably given a curvature which corresponds to the curvature of the surface of the grinding stone adjacent that side of the pocket when the pocket is positioned at some angle within the working angular range. Thus, the side sections, as shown in Fig. 5, may be given a curvature for an angular setting of 15° for the pocket 30, that is, with the pocket disposed at an angle of 15° with the longitudinal axis of the grinding stone. Similarly the top and bottom sections, as shown in Fig. 6 are given a curvature which corresponds with this same angular setting of 15°, the curvature of the top and bottom sections of course approaching more closely a straight line than that of the side sections. With an angular setting of 15° for the pocket 30, the teeth-bearing sections will then exactly conform to the surface of the grinding stone. For angular setting less or greater than 15°, the various sections at each side of the pocket are independently adjusted in order to conform closely to the surface of the grinding stone. Any discrepancy in curvature in the angular range used is quite slight, and satisfactory results are obtained throughout the range mentioned with the construction shown. In actual practice satisfactory results are obtained with the ends of the teeth 111 spaced about one-eighth of an inch from the surface of the stone 10, although, of course, the less the spacing the less the escape of slivers.

The grinding stone 10, as previously described, is completely enclosed within a surrounding casing in order to confine the ground wood therein to prevent it from being thrown off the stone into the surrounding space. The enclosing casing is open at the bottom beneath the grinding stone 10, a slush pit 120 being formed in the foundation therebeneath. The ground wood is discharged therein during the grinding operation and is slushed out with water, the stock overflowing into a stock spout (not shown), from where it is pumped to further treating apparatus in the conventional manner. Where water is

used for operation of the fluid-pressure cylinders, the exhaust water may be discharged into the pit 120 to assist in the slushing out of the pulp.

An opening 125 is provided in each side wall of the enclosing casing to receive therethrough a pocket 30. In order to permit the angular adjustment of the pocket 30, this opening is preferably made circular in shape and given a diameter which is at least as large as the diameter of the circumscribing circle of the rectangular pocket. Means are provided for closing the space between this opening and the pocket, and at the same time readily permitting the angular adjustment of the pocket. As shown, a circular metal plate 126 is provided which has a rectangular opening to snugly but slidably receive the outer surface of the pocket 30. The outer periphery of the plate 126 overlaps the casing wall about the opening 125, and this overlapping portion of the plate 126 is provided with a plurality of arcuate slots 127. From the casing about the opening 125 extend a plurality of adjusting bolts 128 which pass through the slots 127, these bolts being provided with nuts which are tightened when the adjustment of the pocket is completed. When it is desired to change the angular adjustment of the pocket 30, the nuts on the bolts 128 are loosened, and the nuts on the bolts 37 passing through the arcuate slots in the pocket supporting base 32 are also loosened. The pocket is then rotated, the bolts sliding within the arcuate slots. Or if this adjustment is not sufficient, the slots are removed entirely from the bolts and the pocket turned to bring the bolts into alignment with a different set of slots. The bolts being in place, the nuts are then tightened in the adjusted position.

In actual operation, the surface of the grinding stone 10 gradually wears away. In order to maintain the pockets 30 in desired spaced relation with the surface of the stone 10, these pockets are preferably made adjustable to or from the surface of the grinding stone, thus enabling the pocket to be adjusted toward the stone as the stone wears away, or in the opposite direction upon replacement of the stone. As shown, the outer wall of the pocket 30 is provided with lugs 130 through which pass adjusting bolts 131. These bolts are preferably threaded through the lugs 130 the ends of the bolts extending through and being rotatably mounted in the circular plate 126. Suitable locking nuts 132 are also provided for holding them in desired adjusted position. When it is desired to adjust the pocket toward or away from the grinding stone the locking nuts 132 are loosened and the bolts then turned in a direction to effect the desired adjustment, the plate 126 sliding along the outer surface of the pocket during the adjustment. The illustrated construction permits this adjustment to be made without in any way disturbing the angular setting or adjustment of the pocket.

As will be readily evident when considering the enormous size and weight of the grinding stone a considerable strain is imposed upon the supporting bearings 12 and 13. To the weight of the grinding stone is added the weight of the shaft 11 and the metal plates 14. The weight of such a stone usually varies from three to seven tons or more, and the weight of the shaft and associated parts add several tons to this. To the strain imposed upon the bearings from this weight is added the strain resulting from the pressure of the wood within the grinding pockets against the surface of the stone.

In accordance with this invention, the pockets associated with the grinding stone are so positioned with respect to the stone as to greatly reduce during operation the strain imposed upon the supporting bearings. As shown, particularly in Fig. 1, the pockets are positioned in such a manner as to balance the horizontal components of the forces resulting from the pressure of the respective pockets, two pockets being shown disposed in horizontal alignment. Also, the pockets are so positioned as to produce an upward vertical force component tending to balance the weight of the grinding stone. As is clearly evident in Figs. 1 and 2, each of the pockets is positioned with its effective center 135 below the horizontal axis 136 of the grinding stone, so that a preponderance of effective grinding area of the pocket face is disposed below the longitudinal axis of the supporting shaft of the stone. An upward force component thereby results from the pressure at each pocket, the combined upward force components tending very materially to balance the weight of the grinding stone during the grinding operation. This construction very materially lessens the wear upon the bearings and insures longer life of the apparatus.

In order to facilitate the disassembly or inspection of the parts, each pocket and magazine with their associated parts are mounted for ready removal from their position adjacent the surface of the grinding stone. As shown particularly in Fig. 2, tracks or rails 140 are carried by the foundation plates, the supporting base 32 carrying the pocket 30, magazine 45 and related parts being adapted to slide upon the tracks 140. For effecting easy removal of these parts, a threaded shaft 141 is provided, which shaft is received within a threaded socket 142 bolted to the foundation 22. One end of the shaft 141 is rotatably mounted within a depending flange 143 of the pocket 30, and the other end of the shaft is provided with a hand-wheel 144. Upon rotation of

the hand-wheel 144, longitudinal movement of the shaft relative to the threaded socket 142 results, thereby drawing the pocket and magazine and related parts away from or toward the surface of the grinding stone depending upon the direction of rotation of the hand-wheel. The supporting base 32 is preferably bolted to the foundation in its operative position by means of removable bolts 145 to insure against accidental movement.

A conventional jigging attachment for the grinding stone is indicated in Fig. 1 at 148, this attachment being supported by brackets attached to the cover casing 21.

A doctor 150 is preferably provided for scraping and removing the ground wood from the surface of the grinding stone 10 intermediate the pockets 30. Thus, as shown clearly in Fig. 1, with a direction of rotation of the grinding stone 10 as indicated by the arrow 151, the ground wood-pulp emanating from the pocket 30 at the left-hand side of the figure is removed from the grinding stone and discharged at the ends of the doctor into the pit 120, this ground wood-pulp being thereby prevented from passing through the grinding area of the second pocket at the right-hand side of the figure. In this manner, the ground wood-pulp is uniformly treated, and regrinding of pulp produced in one pocket in the grinding area of another pocket is prevented. The quality of the ground wood-pulp is thereby materially improved.

When using a cylindrical grinding stone and a pocket disposed at an angle to the axis of the stone, the wood within this pocket which is held at an angle to the axis of the stone is ground down upon a curve, that is, the face of the wood contacting with the grinding surface of the stone will assume a curved shape as the wood is ground. A grinding stone such as illustrated in Fig. 10, may be used to grind the wood substantially on a plane, the wood being thereby uniformly ground down throughout its length. This is accomplished by providing a grinding stone having a varying diameter to form a concave grinding surface, the curve or concavity of the grinding surface being so related to the angular disposition of the wood with respect to the axis of the stone that the wood rests against the grinding surface of the stone substantially throughout its length. This results in even grinding of the wood within an angularly disposed pocket.

A grinding stone may be prepared originally with such a concaved grinding surface, or a cylindrical grinding stone may be ground down by a jig attachment arranged as illustrated in Fig. 10. As shown, the mounting of the jig comprises brackets 155 which may be attached to the cover casing of the grinding stone, and a jig frame including end pieces 156 and a transverse beam or bar 157 which serves to support the traveling carriage indicated at 158 of a conventional jig. Any suitable jig and operating means therefor may be used, and as these parts are well known, further illustration is thought unnecessary. The jig frame is disposed at an angle to and is symmetrical with the axis of the stone. When thus mounted, the tool or burr which is carried by the traveling carriage 158 of the jig, will take a deeper cut at the center of the stone and a cut of progressively decreasing depth towards the ends. In order to provide a concavity in the grinding surface of the stone which is adapted to effect uniform grinding of the wood disposed at a predetermined angle to the axis of the stone, the jig frame is set at substantially the same angle with respect to the axis of the stone as the angle at which the wood is positioned. For this purpose, the jig frame is provided with an adjustable mounting. As shown, the frame end pieces 156 are provided with arcuate slots 159 through which pass clamping bolts 160 carried by the brackets 155. The bolts 160 receive nuts thereon which may be tightened to clamp the adjustable jig frame in any desired position.

When using a grinding stone having a concaved grinding surface, the adjustable teeth sections are correspondingly curved. In this case, it is preferable to provide two or more teeth-bearing sections for each side of the pocket and provide independent adjustment of these sections to permit sufficiently close positioning of the teeth of each section with respect to the grinding surface of the stone throughout the angular range of adjustment.

While the method herein described, and the form of apparatus for carrying this method into effect, constitute preferred embodiments of the invention, it is to be understood that the invention is not limited to this precise method and form of apparatus, and that changes may be made in either without departing from the scope of the invention which is defined in the appended claims.

What is claimed is:

1. Apparatus of the character described, comprising a grinding stone, and a charge-receiving pocket associated with said stone mounted for angular adjustment about a longitudinal axis of said pocket relative to the longitudinal axis of said grinding stone.

2. Apparatus of the character described, comprising a grinding stone, a pocket for receiving a charge of material to be ground by said stone, a feeding magazine associated with said pocket, a movable plate normally closing off communication between said pocket and said feeding magazine, and means

for opening and closing said plate to control the feeding of a fresh charge to said pocket, said plate being formed of a plurality of flexibly connected sections.

3. Apparatus of the character described, comprising a grinding stone, an enclosing casing therefor having an opening therein, a substantially rectangular pocket received within said opening for receiving a charge of material to be ground by said stone, means for angularly adjusting said pocket, and adjustable connections between said pocket and said casing to permit said angular adjustment and maintain said opening receiving said pocket closed.

4. Apparatus of the character described, comprising a grinding stone, an enclosing casing therefor having an opening therein, a substantially rectangular pocket received within said opening for receiving a charge of material to be ground by said stone, means for angularly adjusting said pocket, adjustable connections between said pocket and said casing to permit said angular adjustment and maintain said opening receiving said pocket closed, and additional adjustable connections for said pocket for adjusting said pocket toward or away from said grinding stone.

5. Apparatus of the character described, comprising a grinding stone, a pocket for receiving a charge of material to be ground by said stone, means for angularly adjusting said pocket, separable teeth-bearing members for said pocket, and adjustable connections between said teeth-bearing members and said pocket to permit adjustment of said teeth-bearing members relative to the surface of the grinding stone for various angular positions of said pocket.

6. Apparatus of the character described, comprising a grinding stone, a pocket for receiving a charge of material to be ground by said stone, means for angularly adjusting said pocket, a plurality of separable teeth-bearing sections for each side of said pocket, and adjustable connections between each of said teeth-bearing sections and said pocket to permit independent adjustment of each of the plurality of teeth-bearing sections on each side of said pocket, to effect substantial conformity of the teeth of said members with the surface of the grinding stone for various angular positions of said pocket.

7. Apparatus of the character described, comprising a supporting foundation, a grinding stone, normally stationary means for receiving a charge of material to be ground by said stone, and connections between said charge receiving means and said foundation for bodily moving said charge-receiving means laterally away from or toward said grinding stone to permit access to or replacement of said grinding stone.

8. Apparatus of the character described, comprising a grinding stone, a foundation therefor, tracks in said foundation extending laterally away from said stone, a supporting base resting on said tracks, a normally stationary pocket adapted to receive a charge of material to be ground by said stone carried by said supporting base, and means for bodily moving said supporting base and pocket carried thereby along said tracks laterally away from or toward said stone to permit access to or replacement of said grinding stone.

9. Apparatus of the character described, comprising a grinding stone, a pocket for receiving a charge of material to be ground by said stone, a plunger for pressing said material in said pocket against said stone, means for returning said plunger to a position to receive a fresh charge of material within said pocket, and automatic means brought into operation on the return movement of said plunger for promptly effecting reversal of the direction of movement of said plunger.

10. Apparatus of the character described, comprising a grinding stone, a pocket for receiving a charge of material to be ground by said stone, a plunger for pressing said material in said pocket against said stone, means for automatically reversing the direction of the movement of said plunger as the plunger approaches the end of its grinding movement, and means automatically brought into operation on the return movement of said plunger for immediately reversing the direction of movement of the plunger as it approaches the end of its return movement.

11. Apparatus of the character described, comprising a grinding stone, a pocket for receiving a charge of material to be ground by said stone, a feeding magazine associated with said pocket, movable means for normally closing off said magazine from said pocket, a plunger for forcing the material in said pocket against said stone, means for returning said plunger to a position to receive a fresh charge of material within said pocket, and automatic means brought into operation after the said plunger has largely completed its return movement for opening said movable means to supply a fresh charge of material to said pocket.

12. Apparatus of the character described, comprising a grinding stone, and a charge receiving pocket angularly tilted about its own longitudinal axis with respect to the longitudinal axis of said stone, said grinding stone having a varying diameter to provide a concave grinding surface opposite said charge receiving pocket, the concavity of said stone being coordinated with the angular positioning of said pocket.

13. Apparatus of the character described, comprising a grinding stone, a supporting

foundation for said stone, a pocket for receiving a charge of material to be ground by said stone, a supporting base for said pocket, and adjustable connections between said pocket and said supporting base for positioning said pocket at various angular positions about its own longitudinal axis with respect to the longitudinal axis of said stone.

14. Apparatus of the character described, comprising a grinding stone, a pocket for receiving a charge of material to be ground by said stone, a feeding magazine associated with said pocket, movable means for normally closing off said magazine from said pocket, a plunger for forcing the material in said pocket against said stone, means for returning said plunger to a position to receive a fresh charge of material within said pocket, automatic means brought into operation after said plunger has largely completed its return movement for opening said movable means to supply a fresh charge of material to said pocket, and automatic means for promptly effecting reversal of direction of movement of said plunger as the plunger approaches the end of its return movement.

15. Apparatus of the character described, comprising, a grinding stone, a pocket for receiving a charge of material to be ground by said stone, a feeding magazine associated with said pocket, a movable member normally closing off communication between said pocket and said feeding magazine means for opening and closing said movable member to control the feeding of a fresh charge to said pocket, the opposite end walls of said feeding magazine having recessed guideways therein and means carried by said movable member and movable within said guideways.

16. Apparatus of the character described, comprising a grinding stone, a pocket for receiving a charge of material to be ground by said stone, a feeding magazine associated with said pocket, a movable plate normally closing off communication between said pocket and said feeding magazine, means for opening and closing said plate to control the feeding of a fresh charge to said pocket, the opposite end walls of said feeding magazine having guideways, and rollers carried on opposite sides of said movable plate and movable within said guideways.

17. Apparatus of the character described, comprising a grinding stone, a pocket for receiving a charge of material to be ground by said stone, a feeding magazine associated with said pocket, a partition dividing said magazine into two compartments having feeding openings, movable plates normally closing said openings, and means extending within said partition for effecting movement of said plates.

18. Apparatus of the character described, comprising a grinding stone, a pocket for receiving a charge of material to be ground by said stone, a feeding magazine associated with said pocket, spaced transverse guides dividing said magazine into two compartments having bottom feeding openings, movable plates normally closing said openings and adapted to move in curved paths to open positions within said spaced guides, each plate being flexible to permit said movement from closed position to open position within said spaced guides.

19. Apparatus of the character described, comprising a grinding stone, an enclosing casing therefor having an opening therein, a substantially rectangular pocket received within said opening for receiving a charge of material to be ground by said stone, the diameter of said opening being at least as large as the diameter of the circumscribing circle of said rectangular pocket, means for angularly adjusting said pocket about its own longtudinal axis, a plate having a rectangular opening slidably receiving said pocket, said plate overlying the opening in said casing, adjustable connections between said plate and said casing to permit said angular adjustment of the pocket, and adjustable connections between said pocket and said casing to permit adjustment of said pocket toward said grinding stone as the stone wears down without disturbing said first-mentioned adjustable connections.

20. For use with a pocket grinder of the character described, comprising a grinding stone, and a pocket for receiving material to be ground by said stone, said pocket having means for effecting angular adjustment thereof; teeth bearing means adapted for removable connection to said pocket to confine the material therein and prevent undesirable escape of said material between the end of said pocket and said grinding stone, said teeth bearing means comprising a plurality of teeth bearing sections for each side of the said pocket, each said section having means for effecting adjustable connection with said pocket adapted to permit independent adjustment of each said section relative to the surface of the grinding stone.

21. Apparatus of the character described, comprising a grinding stone having a concave grinding surface, a charge receiving pocket angularly disposed with respect to the longitudinal axis of said stone, and means for adjusting the angular positioning of said pocket about a longitudinal axis of said pocket, whereby the angular positioning of said pocket can be coordinated with the concavity of said stone so that pieces of wood within the pocket lies substantially flat against the concave surface of said stone along the length thereof.

In testimony whereof I hereto affix my signature.

CARL OTTO BACHMAN.