Jan. 28, 1936. A. N. RUSSELL ET AL 2,029,125

WOOD GRINDING MACHINE

Filed May 18, 1932 6 Sheets-Sheet 1

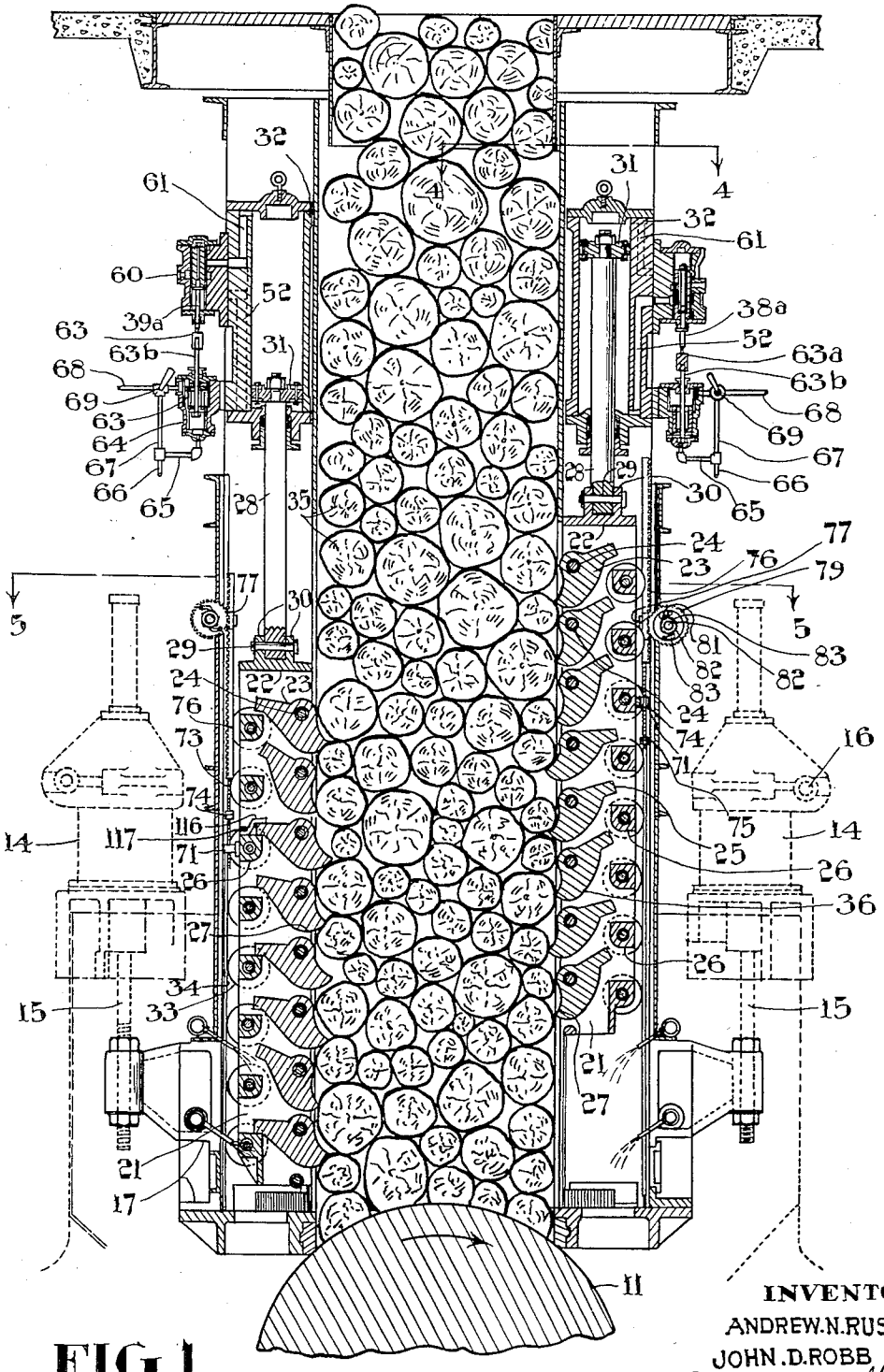


FIG. 1

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Filed May 18, 1932 6 Sheets-Sheet 2

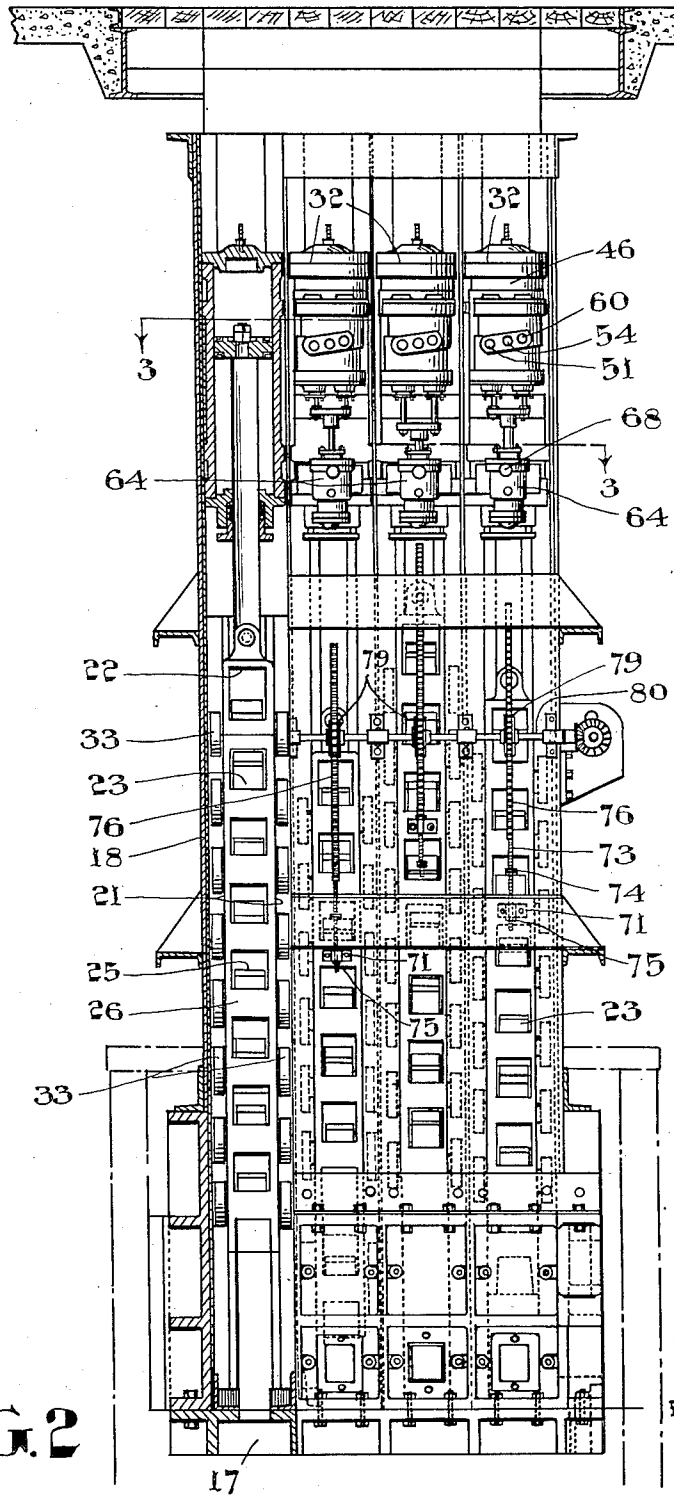


FIG. 2

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WOOD GRINDING MACHINE

Filed May 18, 1932 6 Sheets-Sheet 3

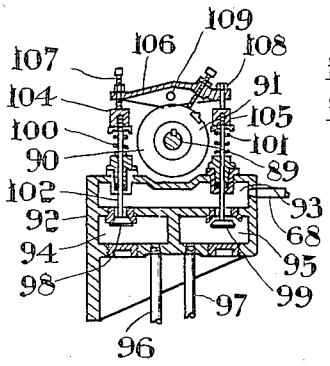


FIG.6

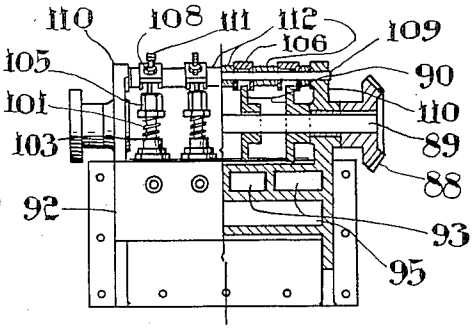


FIG.7

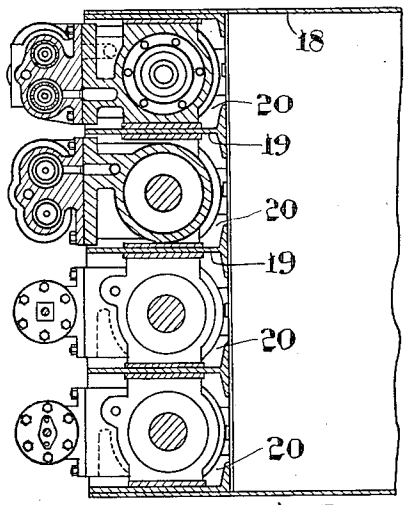


FIG.3

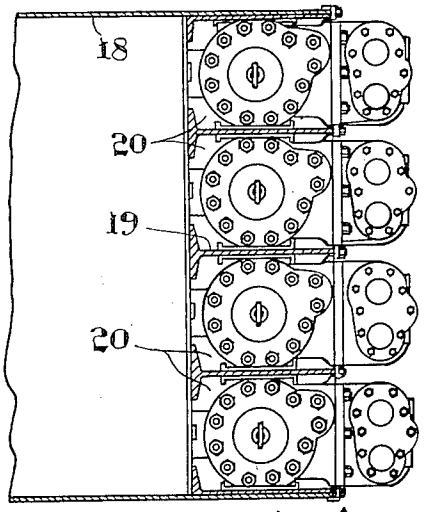


FIG.4

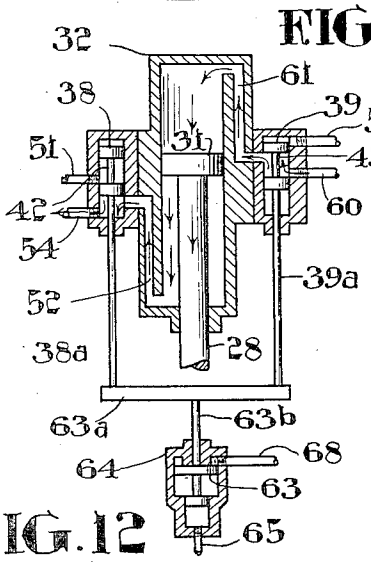


FIG.12

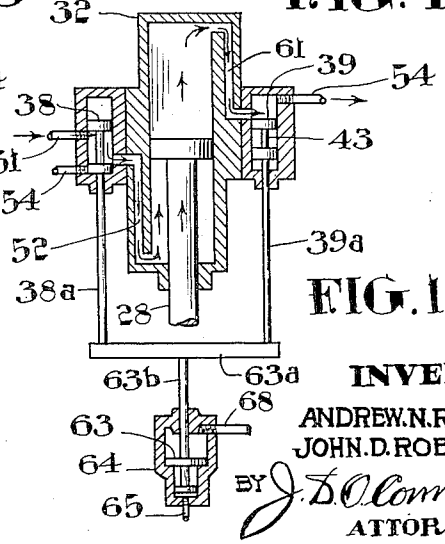


FIG.13

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WOOD GRINDING MACHINE

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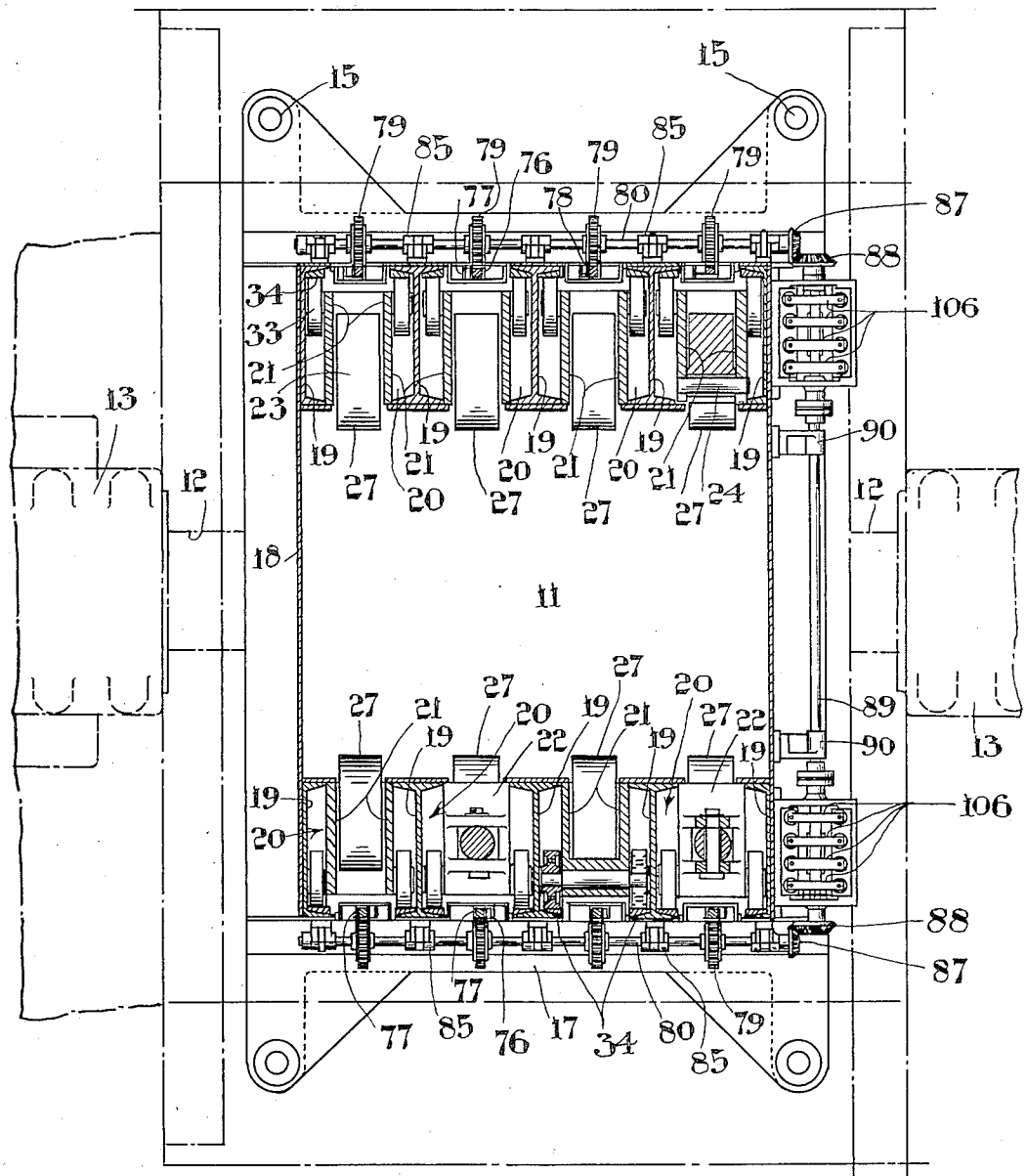


FIG. 5

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WOOD GRINDING MACHINE

Filed May 18, 1932 6 Sheets-Sheet 5

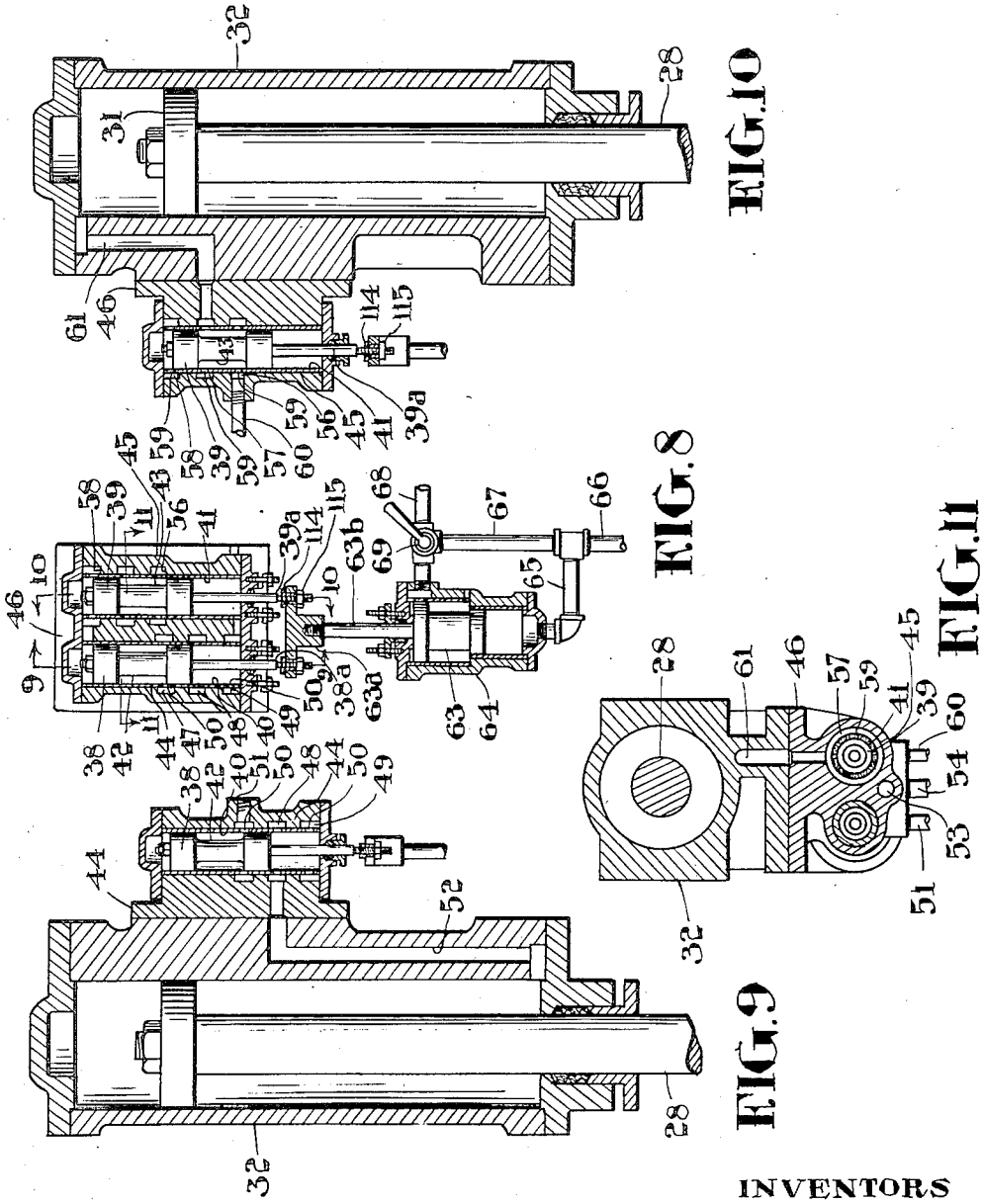


FIG. 10

FIG. 8

FIG. 11

FIG. 9

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WOOD GRINDING MACHINE

Filed May 18, 1932 6 Sheets-Sheet 6

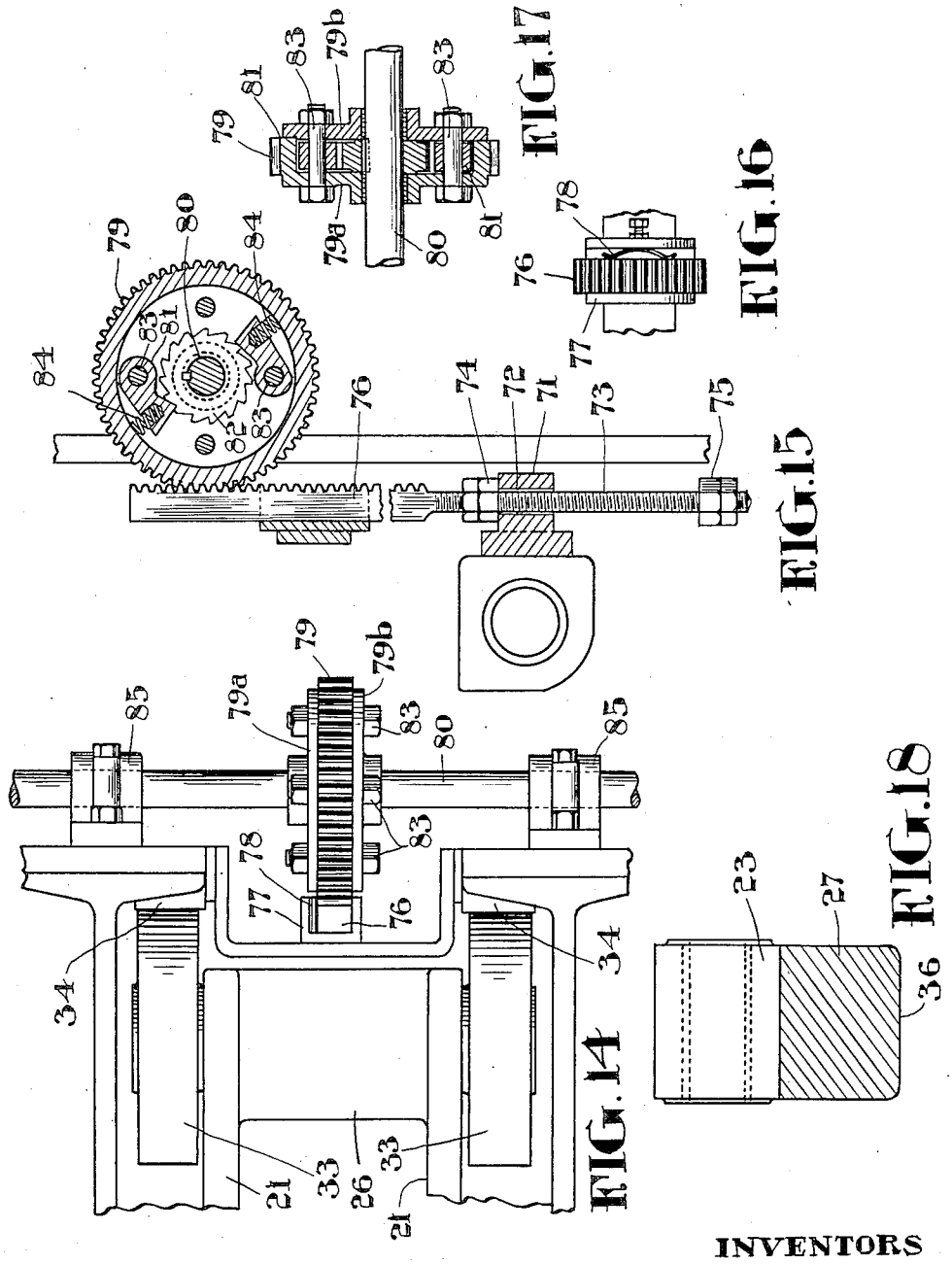


FIG. 17

FIG. 16

FIG. 15

FIG. 18

FIG. 14

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Patented Jan. 28, 1936 2,029,125

UNITED STATES PATENT OFFICE

2,029,125

WOOD GRINDING MACHINE

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Application May 18, 1932, Serial No. 612,125
In Great Britain August 11, 1931

8 Claims. (Cl. 83—75)

This invention relates to pulp wood grinders of the continuous feed or magazine type and is a continuation, in part, of my prior U. S. application Serial No. 431,908, filed February 27, 1930, Patent No. 1,948,189 issued February 20, 1934.

The pocket type of grinder in general use before the advent of the magazine grinder consisted of a plurality of wood receiving pockets equipped with hydraulic pressure plates or followers functioning to feed the wood to the working surface of the grinding element. This type of grinder has certain advantages incident to the direct application of hydraulic or elastic operating fluid, but the disadvantages, such as high operating cost with comparatively low output, led to the development of the magazine grinder.

Magazine grinders are usually equipped with endless belts having specially formed links or other devices for engaging and feeding the wood to the working surface of the grinding element. These chains are operated at a very slow constant speed from either an oil or an electric motor through the intermediary of a complicated reduction gearing. This arrangement, as compared with the pocket type grinder, provides for continuous feeding of the wood to the grinding element and has certain other advantages, such as low labor costs incident to magazine charging and general operation. The principal disadvantage of the magazine grinder resides in the fact that the chains or other devices employed for feeding the wood to the grinding element are operated by a driving mechanism which lacks the elasticity of the direct hydraulic feed employed in the pocket type grinder and it is well recognized that, from a grinding standpoint, the best results are obtained when the wood is pressed to the grinding surface by the direct application of fluid pressure.

The purpose of the present invention is to provide an improved type of magazine grinder in which the wood is continuously fed to the working surface of the grinding element by the direct application of fluid pressure.

According to this invention, the wood charge placed in the magazine is continuously fed to the working surface of a rotary grindstone by means of two groups of reciprocable feed members arranged at opposite sides of the magazine and actuated by the direct application of fluid pressure. These feed members are each provided with a plurality of pivotally mounted pawls normally arranged to apply feeding pressure to the wood charge only during movement of the members in the direction of the grindstone. During reverse movement of said members, the pressure applying pawls are automatically retracted from engagement with the wood charge so that the feeding members are permitted to slide freely past the wood during such return movement. Each feed member is connected to a piston operating in a cylinder equipped with a valve mechanism controlling the flow of operating fluid in such manner that the piston and the feed member connected therewith are alternately moved towards and away from the grindstone. The valves controlling the various cylinders may be operated either manually or automatically in order to reverse the movement of the pistons and the feed members connected therewith, but it is preferred that these valves be operated in such a manner that when one of the feed members is moving away from the grindstone, the remaining feed members will all be moving in the opposite direction, so that the mass of wood contained in the magazine will be continuously subjected to a substantial and uniform feeding pressure. For example, assuming that four feeding members are provided at each side of the magazine, the flow of fluid to and from the cylinders controlling said feed members will preferably be controlled in such manner that when one of the feed members is moving away from the grindstone the remaining feed members will be moving in the direction of said stone, so that the charge of wood is, at all times, subjected to the pressure of seven of the operating cylinders. As the rate at which the feed members move, during the working strokes, is retarded by the grinding operation and is considerably slower than the rate at which the feed members move during the return strokes, it will be seen that the period of time when only seven of the eight cylinders are applying pressure to the wood will be comparatively short and that, during the greater part of the grinding operation, the wood is subjected to the pressure of all of said cylinders. When it is desired to remove the load from the grindstone, the feeding members may be employed as lifting devices for lifting the wood charge away from the working surface of the stone. In order to accomplish this, suitable means are provided for securing the pawls of certain feed members against pivotal movement so that, during the return stroke of said members the pawls will apply pressure to move the wood charge in a direction away from the working surface of the stone.

Proceeding now to a more detailed description of this invention, reference will be had to the accompanying drawings, in which,

Figure 1 is a vertical sectional view through the grinder in a plane at right angles to the axis of the grindstone.

Figure 2 is a view partly in vertical section and partly in side elevation in a plane parallel with the axis of the grindstone.

Figure 3 is a transverse sectional view along the line 3—3 of Fig. 2.

Figure 4 is a transverse sectional view along the line 4—4 of Fig. 1.

Figure 5 is a transverse sectional view along the line 5—5 of Fig. 1.

Figure 6 is a transverse sectional view of a timing valve mechanism.

Figure 7 is a view partly in side elevation and partly in longitudinal section of the timing valve mechanism appearing in Fig. 6.

Figure 8 is a vertical sectional view through a duplex valve mechanism controlling the flow of fluid to and from opposite sides of the power piston associated with each feed member.

Figure 9 is a vertical sectional view taken along the line 9—9 of Fig. 8. In this view a portion of the power piston and cylinder controlling the operation of one of the feed members also appears in vertical section.

Figure 10 is a view similar to Fig. 9 but taken along the line 10—10 of Fig. 8.

Figure 11 is a transverse sectional view taken along the line 11—11 of Fig. 8.

Figures 12 and 13 are diagrammatic views illustrating the action of the duplex valve mechanism appearing in Figs. 8 to 11 inclusive.

Figures 14, 15, 16 and 17 are enlarged detail views of the drive connection provided between each feed member and the timing shaft controlling the operation of the timing valves appearing in Figs. 6 and 7.

Figure 18 is a transverse sectional view through one of the pawls carried by the reciprocable feed members.

Referring more particularly to the drawings, 11 designates a rotary grindstone carried by a shaft 12 (see Figs. 1 and 5) journalled in suitable bearings 13. Casings 14, mounted at opposite sides of the grindstone, carry vertically moveable screws 15 adapted to be raised and lowered by the encased worm or other gearing generally indicated at 16. The lower ends of screws 15 are fixed to a casting 17 forming the lower end of the magazine 18. The casting 17 is of well known construction and is adapted to have its lower face maintained in proper relation to the working surface of the grindstone by suitable adjustment of the screws 15.

The magazine structure includes a series of flanged beams 19 arranged at opposite sides of the magazine and spaced apart, as shown in Figures 3 and 5, to provide a series of vertical guideways 20. Mounted in each guideway is a reciprocable feed member comprising side plates 21 having their upper ends joined together by a cross member 22. Each feed member carries a series of vertically spaced pawls 23 mounted between the side plates 21 on suitable pivots 24. The pawls are normally balanced on the pivots so that the heel portions 25 rest on cross bars 26 connecting the side plates 21 while the toe portions 27 project beyond the side plates into the wood receiving space of the magazine. Each feed member is connected to the lower end of a piston rod 28 by a pin 29 passing through suitable lugs 30 carried by the upper cross member 22. The upper end of each piston rod 28 is connected to a power piston 31 operating in a power cylinder 32. Each power cylinder is equipped as hereinafter described with suitable valve mechanism for controlling the flow of operating fluid to and from opposite sides of the power piston 31.

From the foregoing description it will be evident that the feed members, operating in the guideways 20, are raised and lowered as the operating fluid is alternately admitted into the upper and lower ends of the power cylinders 32 to raise and lower the power pistons 31. The side plates 21 of the feed members are arranged to travel in the guideways 20 free of contact with the wood charge and are preferably equipped with rollers 33 travelling on suitable tracks 34 carried by the beams 19. During downward movement of the feed members the pawls 23 assume a position with their projecting toe portions 27 engaging the wood charge 35 and their heel portions 25 resting on the cross bars 26 so that pressure is applied through the pawls to force the wood charge in the direction of the grindstone. It will be noted here that the pawls are provided with longitudinally curved lower edges 36 for engagement with the wood charge. This curvature is predetermined so that the pressure of the pawls is applied to the wood charge in a direction at such an angle to the direction of movement of the feed members that the applied pressure is properly distributed throughout the entire mass of the wood charge. The edges 36 of the pawls are also formed with a slight transverse curvature as shown to advantage in Figure 18. This transverse curvature is such as to eliminate sharp corners at the sides of the pawls which would tend to shear or break the fibres of the wood. During upward movement of the feed members the toe portions of the pawls swing downwardly about the pivots 24 and out of engagement with the wood charge with the result that substantially no resistance is offered to this movement of feed members since there is no direct contact between the wood charge and the side plates 21.

In the present instance the feed members are arranged in two groups (of four each) located at opposite sides of the magazine. The actuation of the feed members by the power pistons 31 is preferably controlled so that when one feed member is on its upward or return stroke the remaining feed members are on their downward or working strokes. With this method of control the wood charge is at all times subjected to the pressure of at least seven of the feed members. Moreover, since the return stroke of each feed member is completed in a fraction of the time required to complete the working stroke, the pressure of the eight feed members is simultaneously applied to the wood charge during 60% of the time the grinder is in operation.

As herein illustrated the control mechanism for the power pistons 31 is designed to provide a working stroke at slow speed with considerable power and a rapid return stroke with comparatively little power. To this end each power cylinder 32 is equipped with low and high pressure valves; the low pressure valve controlling the flow of low pressure fluid to and from the lower end of the cylinder and the high pressure valve controlling the flow of high pressure fluid to and from the upper end of the cylinder. These valves are shown in detail in Figs. 8 to 11 inclusive and the action thereof is diagrammatically illustrated in Figs. 12 and 13.

As shown to advantage in Fig. 8, the low pressure valve 38 and the high pressure valve 39

operate in suitable valve sleeves 40 and 41 and have their intermediate portions reduced in diameter to provide the annular grooves indicated at 42 and 43. The valve sleeves are arranged in parallel cylinders 44 and 45 formed in a single casting 46 attached to one of the power cylinders 32.

The low pressure valve cylinder 44 is provided with three annular passages 47, 48 and 49. These passages are separate from one another and communicate with the interior of the valve sleeve 40 through suitable openings 50. Passage 47 also communicates with the low pressure inlet 51 to which fluid at comparatively low pressure (80 to 100 lbs. per sq. in.) is supplied from any suitable source. Passage 48 communicates with a port 52 leading to the lower end of cylinder 32. Passage 49 communicates with a port 53 (see Fig. 11) leading to an exhaust connection 54.

The high pressure valve cylinder 45 is also provided with three separate annular passages 56, 57 and 58 communicating with the interior of the valve sleeve 41 through openings 59. The lower passage 56 communicates with the high pressure inlet 60 to which fluid at comparatively high pressure (200 to 300 lbs. per sq. in.) is supplied from a suitable source. The intermediate passage 57 communicates with a port 61 leading to the upper end of power cylinder 32. The upper passage 58 communicates with the previously mentioned port 53 leading to the common discharge connection 54.

The valves 38 and 39 are actuated in unison by a differential piston 63 to which the valves are connected by the valve stems 38*a* and 39*a*; yoke 63*a*, and piston rod 63*b*. Piston 63 operates in a differential cylinder 64 and its lower end is continuously subjected to water pressure supplied to the lower end of cylinder 64 through a branch 65 of the water supply main 66. Provision is also made for supplying water pressure to the upper end of cylinder 64 through a branch 67 of the supply main 66 or through a further supply main 68. The flow of water into cylinder 64 through the branch 67 is controlled by a manually operable three way valve 69. This valve is only used occasionally and is normally positioned to close off the flow through the branch 67 without interfering with the flow through the main 68. The flow through the main 68 is controlled by an automatic timing valve mechanism which, as hereinafter described, functions to alternately connect the main 68 with a source of water pressure and with a drain pipe.

For the downward or power stroke of the power piston 31 the valves 38 and 39 and the differential piston 63 are positioned as indicated in Figs. 8 to 12 inclusive. In this position the high pressure valve 39 permits the high pressure fluid to flow into the upper end of cylinder 32 via the high pressure inlet 60, passage 56, valve sleeve 41, passage 57 and cylinder port 61. At the same time valve 38 permits the low pressure fluid, previously supplied to the lower end of cylinder 32, to escape, via cylinder port 52, passage 48, valve sleeve 40, passage 48, and exhaust port 53, to the common exhaust connection 54.

For the return stroke of the power piston the valves 38 and 39 and the differential piston 63 are positioned as shown in Figure 13. In this position valve 38 permits low pressure fluid to flow into the lower end of cylinder 32 via low pressure inlet 51, passage 47, valve sleeve 41, passage 48 and cylinder port 52. At the same time valve 39 permits the high pressure fluid, previously supplied to the upper end of cylinder 32, to escape, via cylinder port 61, passage 57, valve sleeve 41, passage 58 and exhaust port 53, to the common exhaust connection 54. The high and low pressure fluid alternately escaping through the exhaust connection 54 is conducted to a suitable sump or storage tank (not shown).

As previously stated the valve 69 is normally positioned to close the delivery end of the branch 67 without interfering with the flow through the water main 68. During the working stroke of the power piston 31 the valves 38 and 39 and the differential piston 63 are held in the position shown in Figs. 8 to 12 inclusive by the pressure of the water entering the lower end of cylinder 64 via the branch 65 and acting against the lower end of piston 63. At this time the main 68 is connected to drain through the timing valve mechanism and functions as a discharge pipe for the water pressure previously admitted to the upper end of cylinder 64. For the return stroke of the power piston 31 the timing valve mechanism operates to connect the main 68 with a source of water supply so that water under pressure flows through the main 68 into the upper end of the cylinder 64 where it acts on the upper surface of the piston 63 and serves to shift said piston and the valves 38 and 39 to the position shown in Fig. 13. As the differential piston 63 is shifted to the last mentioned position the water previously supplied to the lower end of cylinder 64 is forced back into the branch 65.

In the normal operation of the grinder the shifting of the various valves 38 and 39 from the position shown in Fig. 12 to that shown in Fig. 13, and vice versa, is repeated indefinitely under the control of the valve timing mechanism governing the operation of the differential pistons 63. The manually operable control valve 69, associated with each differential piston 63, is usually operated only when the feed member controlled by said piston is to be actuated out of its proper sequence. The necessity for this arises, for example, when one of the feed members becomes jammed before completing its working stroke. In such an emergency the feed member may be immediately returned to its starting point by turning the valve 69 to a position closing the main 68 and placing the upper end of the cylinder 64 in communication with the branch connection 67. When the valve 69 is returned to its normal position this feed member immediately resumes its proper place in the normal operating sequence of the feed members as determined by the timing valve mechanism.

The timing valve mechanism controlling the differential pistons 63 is shown in Figs. 1 to 7 inclusive and also appears, in detail, in Figs. 14 to 17 inclusive. The purpose of this timing mechanism is to govern the operation and reversal of the power pistons 31 to maintain the proper sequence of motion among the several feed members throughout the operation of the grinder. To this end each feed member carries a bracket 71 having an opening 72 loosely receiving a threaded rod 73 therethrough. The feed member and the rod 73 are capable of relative movement within the limits set by a pair of stop nuts 74 and 75 carried by the rod and positioned above and below the bracket 71. At its upper end the rod 73 carries a rack 76 which slides vertically in a guide shoe 77, against one side of which the rack is held by a spring 78 with sufficient pressure to prevent the rack and rod falling by their own weight. During the working

stroke of the feed member the rod 73 and rack 76 are forced downwardly by engagement of the bracket 71 with the lower stop nut 75. On the upward stroke of the feed member the rod 73 and rack 76 are lifted by engagement of the bracket 71 with the upper stop nut 74. When the feed member is at the top of its upward stroke the clearance between the bracket 71 and the lower nut 75 permits the feed member to move downwardly a limited distance at the start of the power stroke before exerting a downward pull on the rod 73. This takes care of any slip which may occur at the start of the downward stroke of the feed member before the pawls engage the wood charge and prevents the control mechanism, which is actuated by the racks 76, being adversely affected by such slippage.

Each rack 76 meshes with a gear 79 carried by a shaft 80 on which the gear is free to turn. Gear 79 carries a plurality of pivoted pawls 81 engaging a ratchet wheel 82 keyed to the shaft 80. As shown to advantage in Figs. 14 and 17 each gear 79 is made in two parts 79a and 79b held together by bolts 83. The pawls 81 are mounted on certain of the bolts 83 and are held to the ratchet by suitably arranged springs 84. As shown more particularly in Figs. 1 and 5 there are two shafts 80 arranged at opposite sides of the magazine in suitable bearings 85 and each shaft carries four gears 79 meshing with the racks 76 driven by the adjacent group of feed members. During the upstroke of the racks 76 the pawls 81 slip freely over the ratchets 82 and permit the gears 79 to turn freely on the shafts 80 without imparting motion thereto. During the downstroke of the racks the rack of each group which happens to be descending at the greatest rate of speed serves to drive its associated shaft 80 through the medium of the engaging drive gear 79.

The shafts 80 are provided with bevelled pinions 87 in driving engagement with similar pinons 88 fixed to the ends of a valve timing shaft 89 journalled in suitable bearings 90. The shaft 89 carries the valve operating cams 91 which are equal in number to the number of feed members operating in the magazine 18. In the present instance there are eight cams arranged in two groups of four each located at opposite ends of the shaft 89. The relative angular displacement of the cams is such that the cam lifts 91 are equally spaced radially of the shaft 89 so that the sum of the spaces equals one revolution. In other words the shaft 89 and the cams 90 make a complete revolution in the time required for one of the feed members to complete its working and return strokes. Each group of cams is positioned above a valve box 92 having its upper portion partitioned off to provide four separate transverse chambers 93, each chamber being located directly below one of the cams 90. Below the transverse chambers 93 the valve box is partitioned off to provide two separate longitudinal chambers 94 and 95, the chamber 94 being connected to a water supply pipe 96 and the chamber 95 being connected to a drain pipe 97. Each chamber 93 is equipped with a pair of valves including an inlet valve 98 opening into the supply chamber 94 and an outlet valve 99 opening into the drain chamber 95. The valves 98 and 99 normally tend to close under the influence of the springs 100 and 101 encircling the valve stems 102 and 103 and acting against the abutments 104 and 105 at the upper ends of the valve stems. Mounted directly above each pair of valves 98 and 99 is a rocker 106 equipped with adjustable tappet screws 107 and 108 bearing, respectively, on the valve abutments 104 and 105. The rockers (four in number) are pivotally mounted on a common shaft 109 having its ends supported in bearings 110 projecting upwardly from the valve box 92. Each rocker is located directly over one of the cams 90 and carries a set screw 111 for engagement with the cam lift 91, the several rockers being properly positioned on the shaft 109 by suitable spacers 112.

Each transverse chamber 93 is connected to the upper end of one of the differential cylinders 64 by one of the previously mentioned mains 68. When the valves 98 and 99, controlling said chamber, are in the position shown in Fig. 3 it will be evident that the upper end of the cylinder 64 is connected to the drain pipe 97. Consequently the pressure supplied to the lower end of said cylinder 64 is effective to shift the differential piston 63 and the associated power cylinder control valves 38 and 39 to the position shown in Fig. 8 so that the piston operating in the power cylinder is forced downwardly on its working stroke. At each complete revolution of the shaft 89 the valve 99 is closed and the valve 98 opened by movement of the controlling rocker 106 in response to engagement of the cam lift 91 with the set screw 111. During the brief period that the valves 99 and 98 are in the last mentioned position the main 68 is connected to the supply pipe 96 through the chambers 93 and 94 and serves as a pressure supply main for the upper end of cylinder 64 with the result that the differential piston and the power cylinder control valves 38 and 39 are positioned as shown in Figure 13 so that the power piston is returned to its starting position. When the cam lift 91 passes out of engagement with the set screw 111 the timing valves 98 and 99 are immediately returned to the position shown in Fig. 6, since the pressure exerted against the rocker 106 by the valve spring 100 is greater than that exerted by the spring 101.

The foregoing description of the timing valve mechanism applies with respect to the operation of each pair of timing valves 98 and 99 and it will be understood that the operating sequence of the power piston and feed member controlled by each pair of timing valves is determined by the angular displacement of the associated operating cam 90, the several cams being so arranged on the shaft 89 that when one of the eight feed members is on its upward stroke the remaining feed members are all descending and applying pressure to the wood charge.

A particular advantage of the valve timing mechanism herein described is that the feed members are automatically moved upwardly on the return stroke at predetermined intervals of time, regardless of whether or not the said feed members have completed or only partially completed their pressure applying strokes. The merit of this arrangement resides in the fact that when one of the feed members becomes jammed during the working stroke it will remain inactive only during the interval of time required for the timing valve mechanism to reverse the flow of fluid to the power cylinder connected with the feed member. As soon as this occurs the feed member is quickly raised to the end of its return or non-working stroke and then begins to move downwardly on the working stroke. It will also be evident that, since the feed members move freely past the wood charge during the return or non-

working strokes, these members will not become permanently jammed by arching or bridging of the wood within the magazine. When such arching or bridging does occur the pressure applying strokes of the feed members will, of course, be retarded or arrested but, at predetermined intervals controlled by the timing valves, each feed member will move freely on its return stroke and will then immediately move in the reverse direction to apply pressure to the wood charge at a somewhat different point. In other words whenever there is arching or bridging of the wood within the magazine the limited reciprocating movement which the feed members are permitted to have results in the pawls 27 constantly changing their positions to apply pressure to different portions of the wood charge until the arch or bridge is broken down.

When it is desired to remove all load from the grindstone 11, certain of the feed members may be employed as lifting devices for moving the wood charge away from the working surface of the stone. To this end the heel portions of two opposing feed members are temporarily secured to the cross bars 26 by clamps 116 held in place by suitable screws 117. The pawls are thus tied down to maintain a horizontal position during upward movement of the feed members. The feed members employed as lifting devices are preferably operated manually by actuation of the valves 69.

Referring again to the power cylinder control valves 38 and 39 it will be noted that, in all positions of the valves, the grooves 42 and 43 are in communication with the pressure inlets 51 and 60 and that the upper and lower ends of the valve cylinders 44 and 45 are open to the exhaust port. The advantage of this arrangement is that the valve mechanism is relieved of all loads due to pressure and any leakage occurring is free to drain away through the exhaust. Adjustment of these valves is provided for through the medium of suitable thimbles 114 which are threaded on the valve stems 38*a* and 39*a* and secured to the yoke 63*a* by lock nuts 115. Any slight misalignment of the valves is compensated by loose fitting of the thimbles in the receiving openings of the yoke.

Having thus described our invention, what we claim is:—

1. A pulp wood grinder comprising a magazine, a plurality of reciprocable feed members arranged therein, a piston connected to each feed member, a separate cylinder for each of said pistons, high and low pressure fluid supply lines, a valve mechanism for each cylinder operable to periodically connect one end of said cylinder with the high pressure fluid supply line to effect a working stroke of the feed member and to periodically connect the remaining end of the cylinder with the low pressure fluid supply line to effect a return stroke of the feed member, said valve mechanism also serving to connect each end of the cylinder with an exhaust line during admission of fluid to the opposite end of the cylinder, a differential piston connected to operate said mechanism to positions alternately connecting each end of the cylinder with its respective fluid supply line, a differential cylinder containing said differential piston, one end of said differential cylinder being in constant communication with a pressure line, and means functioning periodically to alternately connect the remaining end of the differential cylinder with a pressure line and with an exhaust line.

2. A pulp wood grinder comprising a magazine, a plurality of reciprocable feed members arranged therein, a piston connected to each feed member, a separate cylinder for each of said pistons, high and low pressure fluid supply lines, a valve mechanism for each cylinder operable to a position connecting one end of the cylinder with the high pressure fluid supply line or to a position connecting the remaining end of the cylinder with the low pressure fluid supply line, said valve mechanism also serving to connect each end of the cylinder to an exhaust line when positioned to connect the opposite end of the cylinder with its respective fluid supply line, a differential piston connected to operate said valve mechanism, a differential cylinder containing said differential piston, a fluid supply line connected to one end of the differential cylinder so as to be in continuous communication therewith, a valve mechanism functioning to alternately connect the remaining end of the differential cylinder with a pressure line and an exhaust line and means actuated by the feed members for controlling said last mentioned valve mechanism.

3. A pulp wood grinder comprising a magazine, a plurality of reciprocable feed members arranged therein, a piston connected to each feed member, a separate cylinder for each of said pistons, a valve mechanism associated with each cylinder to control the flow of fluid to and from opposite ends of the cylinder, racks movable in opposite directions in response to corresponding movement of the feed members, pinions meshing with said racks and means actuated by rotation of the pinions during the working strokes of the feed members for operating the valve mechanisms of the different cylinders in a definite sequence.

4. A pulp wood grinder comprising a magazine, a plurality of reciprocable feed members arranged therein, a piston connected to each feed member, a separate cylinder for each of said pistons, a valve mechanism associated with each cylinder to control the flow of fluid to and from opposite ends of the cylinder, a rack slidably mounted in proximity to each feed member, means on each feed member adapted to move the rack in one direction or the other depending upon the direction of movement of the feed member, a pinion meshing with and adapted to be rotated by each rack, a timing shaft, drive connections between the pinions and timing shaft including pawl and ratchet devices functioning to drive the timing shaft only during the working strokes of the feed members and means controlled by rotation of the timing shaft for operating the valve mechanisms of the different cylinders in a definite sequence.

5. A pulp wood grinder comprising a magazine, a plurality of reciprocable feed members arranged therein, a piston connected to each feed member, a separate cylinder for each of said pistons, a valve mechanism associated with each cylinder to control the flow of motive fluid to and from opposite ends of the cylinder, a timing shaft, means controlled by rotation of the timing shaft for operating the valve mechanisms of the different cylinders in a definite sequence, and means actuated by the feed members for rotating the timing shaft only during the working strokes of said feed members, said last mentioned means comprising drive shafts geared to the timing shaft, pinions rotatably mounted on each of said drive shafts, a rack movable with each feed member and meshing with one of said pinions, said pinions being provided with pawls engaging

ratchets on their respective drive shafts so that said drive shafts are rotated in response to rotation of said pinions only when the feed members are moving on their working strokes.

6. A pulp wood grinder comprising a magazine, a plurality of reciprocable feed members arranged therein, a piston connected to each feed member, a separate cylinder for each of said pistons, a valve mechanism associated with each cylinder and controlling flow of motive fluid to and from opposite ends of the cylinder, an auxiliary pressure responsive device connected with each valve mechanism for operating the same, valves for controlling the flow of fluid to and from said auxiliary pressure responsive devices, a timing shaft, means actuated by said timing shaft for operating said last mentioned valves in predetermined sequence and means controlled by the movement of the feed members for actuating said timing shaft, said last mentioned means including racks movable with the feed members, pinions meshing with said racks and drive connections between the pinions and the timing shaft including pawl and ratchet devices arranged so that the timing shaft is driven by the feed members only during the working strokes of the said members.

7. A pulp wood grinder comprising a magazine, a plurality of reciprocable feed members arranged therein, a piston connected to each feed member, a separate cylinder for each piston, a valve mechanism associated with each cylinder to control the flow of motive fluid to and from opposite ends of the cylinder, an auxiliary pressure responsive device associated with each valve mechanism for operating the same, means for controlling the operation of said auxiliary pressure responsive devices comprising a series of chambers each connected with one of said auxiliary pressure responsive devices, valves associated with each chamber and operable to a position connecting said chamber with a pressure line or with an exhaust line, a timing shaft, means actuated by rotation of said timing shaft for operating the valves of each chamber in a predetermined sequence with respect to each other and with respect to the valves of the companion chambers, and means actuated by the feed members for rotating the timing shaft only during the working strokes of said members.

8. A pulp wood grinder comprising a magazine, reciprocable feed members arranged therein, a piston connected to each feed member, a separate cylinder for each of said pistons, a valve mechanism associated with each cylinder and controlling the flow of motive fluid to and from opposite ends of the cylinder, an auxiliary fluid actuated pressure responsive device controlling the operation of each valve mechanism, a series of chambers, a conduit connecting each chamber with one of said pressure responsive devices, common pressure and exhaust chambers adapted to be alternately placed in communication with each of said first mentioned chambers, a valve controlling communication between said pressure chamber and each of said first mentioned chambers, a second valve controlling communication between said exhaust chamber and each of said first mentioned chambers, a timing shaft, means actuated by said timing shaft for operating the valves associated with each of the first mentioned chambers in a predetermined sequence, and means actuated by the feed members for operating the said timing shaft during the working strokes of the feed members.

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