Dec. 20, 1960 J. D. LYALL 2,965,315

WOOD GRINDER AND MEANS FOR OPERATING THE SAME

Filed March 22, 1957

Fig. 1

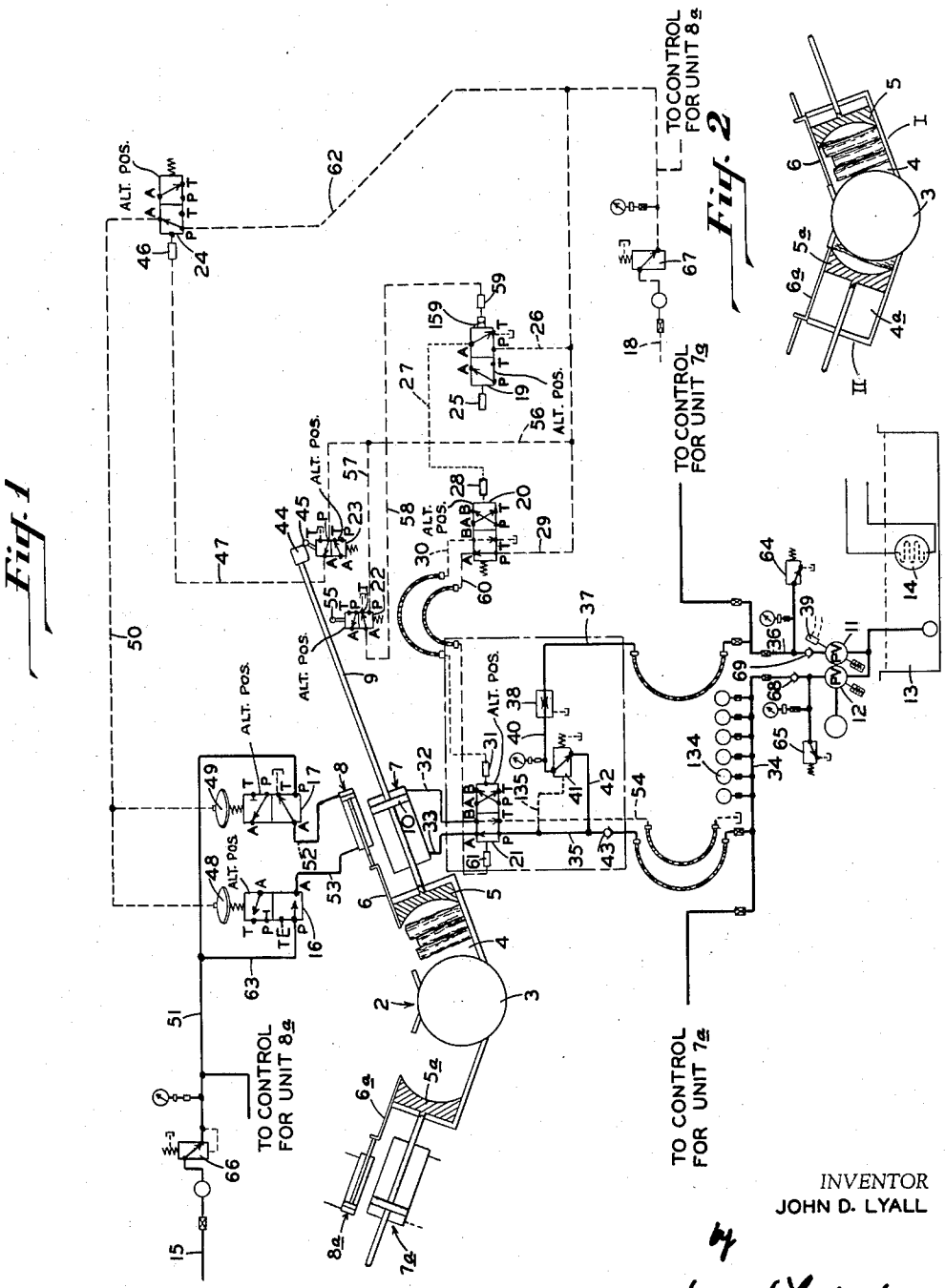


Fig. 2

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WOOD GRINDER AND MEANS FOR OPERATING THE SAME

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7 Claims. (Cl. 241—34)

This invention relates to a wood grinder and means of operating the same. It is concerned more particularly with a multiple pocket type wood grinder.

In grinding wood for use in the manufacture of fiberboard as disclosed in Scott Patent 2,642,359, multiple pocket grinders such as Great Northern grinders may be employed. A group of these grinders may be required in a large fiberboard mill. Multiple pocket grinders, particularly when operated in tandem, have heretofore required elaborate control equipment to compensate for power lost during the grinding cycle when one or more of the pockets of the grinder are being recharged. Conventionally, this control has been accomplished by increasing the pressure applied to the wood being ground in the active pocket or pockets of the grinder while the inactive pocket is being recharged and made ready for grinding. This has been done in an effort to provide a more nearly constant load on the motor which drives the stone and thereby to effect more economical operation of the grinding unit as a whole.

An object of the invention is to provide for such rapid transition from a no-load grinding condition in any pocket of the grinder to a full-load condition in such pocket that adjustment of the pressure on the wood in another pocket or pockets need not be effected to obtain economical operation of the grinding unit.

In conventional multi-pocket grinders, the wood is pressed into engagement with the grinding stone at a pressure which varies in accordance with the load on the motor which drives the grinding wheel. This is most frequently accomplished by provision of sensing equipment on the motor control which translates variations in the load into corresponding variations in the pressure applied to the wood in the various pockets. With this system, it is not possible to move the wood into engagement with the grinding stone at a constant rate. As a consequence, the characteristics of the pulp produced vary widely, the pulp produced under low pressure conditions being different from the pulp produced under high pressure conditions with the different rates of feed which are inevitable in a pressure responsive system.

Another object of the present invention, therefore, is to provide a unit for grinding wood in which the wood will be forced into the grinding stone at a constant rate to produce a more uniform pulp.

Other objects of the invention will be clear from consideration of the following description of an embodiment of the invention which will be described in conjunction with the attached drawing in which:

Figure 1 is a diagrammatic and schematic view of a two-pocket wood grinder and control equipment for semi-automatic operation of the unit; and

Figure 2 is a diagram showing a two-pocket grinder with one of the units in wood grinding position and the other in wood charging position.

The symbols used in the drawings are the standard graphcial symbols of the Joint Industry Conferences, known as J.I.C. Hydraulic Standards.

The general arrangement

The grinder is indicated diagrammatically at **2**. It includes a grinding stone **3**, a wood pocket **4**, and a pressure foot **5** which is arranged to press bolts of wood received in the pocket **4** against the stone **3** for grinding. A retractable cover plate or gate **6** is provided to close the top of the wood pocket **4** and to support bolts of wood positioned thereon for charging of the pocket upon movement of the gate to its open position, as shown in Figure 1. There are two such pockets for a single grinding stone, as has been diagrammatically shown in Figure 1. Since each unit is essentially the same, only one unit will be described.

A double acting hydraulic cylinder and piston pressure unit **7** is provided for actuation of the pressure foot **5**. A double acting pneumatic cylinder and piston pressure unit **8** is provided for moving the gate **6**. This pressure unit **8** preferably is equipped with cushioning devices at each end of its stroke to absorb the shock of stopping the motion of the gate **6**. Similar cushions may be provided on unit **7**. A control actuator rod **9** is mounted for movement with the piston **10** of pressure unit **7**.

The pressure unit **7** is connected to a two-pressure source of power so that the piston **10** which carries the pressure foot **5** may be retracted quickly with low pressure, may be advanced quickly with low pressure to bring the wood in the pocket **4** into engagement with the grinding stone **3**—to provide a "grip" on the wood—and then may be advanced at a constant rate of speed with high pressure during the wood grinding phase of the operation. This two-pressure source of power includes pumps **11** and **12** which may be mounted on top of a welded metal reservoir **13**. A conventional heat exchanger **14** may be provided for maintaining the oil or other hydraulic fluid within the reservoir **13** at a desired operating temperature.

Pressure unit **8** is operated by air from a source **15** and is controlled by diaphragm type air actuated control valves **16** and **17** supplied with control air from a source **18**. The pressure unit **8** preferably is arranged for rapid retraction of the gate **8** to discharge a load of wood to be ground from a position on the gate directly into the pocket by gravity, as disclosed in my Patent No. 2,703,206.

The control system

The control system for the hydraulic pressure unit **7** for the grinder includes a two-position, three-connection valve **19** which is arranged for manual control and also for automatic air pilot control. In accordance with J.I.C. standards, valve **19** is shown in its two positions of operation, with the alternate position being indicated by the abbreviation Alt. Pos. The other valves described below are similarly designated. The system also includes automatic air pilot controlled valves **20** and **21** which are directional two-position, four-connection valves, valve **21** being air controlled for movement to each of its two positions. There is also included in the system a pair of mechanically controlled valves **22** and **23** which are directional two-position, three-connection valves actuated automatically by control rod **9** attached to piston **10** of the pressure unit **7**. Valve **22** serves to control the delivery of air to pilot control cylinder on valve **19**.

The air control system for the pressure unit **8** which actuates the gate **6** includes diaphragm controlled valves **16** and **17** and mechanically controlled valve **23** previously mentioned. Valve **23** controls the delivery of air to a pilot control cylinder on valve **24** which is an air pilot controlled, directional two-position, three-connection valve.

The actuation and control of the pressure units

Figure 1 shows the system in an at rest position with bolts of wood charged into the pocket 4 for engagement by the pressure foot 5 for movement into grinding position.

To start the operation, the operator moves the manual control handle 25 of valve 19 to a "start" position. This reverses the position of valve 19 from the position shown in Figure 1 to the alternate position, and control air from source 18 passes through line 26, through valve 19 from pressure port P (ports P in all instances are pressure ports, in accordance with J.I.C. specifications) to port A, then through line 27 to air pilot control cylinder 28 of valve 20, reversing the position of that valve from the position shown in Figure 1 to the alternate position and connecting ports P and B and ports A and T. (Ports T in all instances are exhaust or "tank" ports, in accordance with J.I.C. specifications.)

With valve 20 in this reversed or alternate position, control air from source 18 flows through line 29, through valve 20 from its port P to port B, to line 30 which leads to air pilot control cylinder 31 of valve 21. This reverses the position of valve 21 to its alternate position and joins ports P and B and A and T. With valve 21 in this reversed or alternate position, hydraulic fluid for actuation of the present unit 7 will be inletted into the unit above the piston 10 through line 32, and hydraulic fluid will be exhausted from below the piston 10 through line 33.

As previously mentioned, the system is so arranged that the pressure foot 5 will be advanced quickly with low pressure to bring the wood in the pocket into engagement with the grinding stone 3 to produce a grip on the wood, and then high pressure will be applied to the wood during the grinding phase of the operation to move the wood into the grinding stone at a constant rate. This sequence of operations is accomplished in the following manner:

Fluid under pressure is supplied by pump 12 through line 34 into a group of six, ten-gallon capacity, rubber bag accumulators 134 and then through line 35 to valve 21. With this arrangement, the pump 12 may have a relatively small capacity, say 25 gallons per minute; and by the use of connecting lines of appropriate size from the accumulators, the flow may be increased to say 180 gallons per minute to effect rapid movement of the piston 10, as will be more fully hereinafter described.

The fluid from line 35 flows into valve 21 and through valve 21 which is in its alternate position from port P to port B to the line 32 supplying fluid to the pressure unit 7 above the head of piston 10. Pump 12 may be provided with a governor to permit the pump to be set for a constant pressure output which may vary over a desired range, say 200 to 500 pounds per square inch. The governor may be provided with a suitable hand wheel adjustment to permit such variation of the output pressure as required. With rapid flow of fluid through lines 34, 35, and 32 into pressure unit 7 above piston 10, the movement of the piston to bring the pressure foot into gripping engagement with the wood in the pocket 4 will be quite rapid. Actually, this initial advance of the piston in the "gripping phase" in a 54" Great Northern grinder may be equal to about 50% of its full stroke, and it may be accomplished in about one second.

Simultaneously, hydraulic fluid from the pump 11 will be supplied under high pressure through lines 36 and 37 to a constant volume, pressure-compensated metering valve 38. This valve which operates in accordance with the pressure drop across it to alter the size of its delivery orifice and thus provide for a constant rate of flow through the valve delivers hydraulic fluid to the unit 7 at a constant rate, as will be detailed below. The high pressure pump 11 preferably is equipped with a pressure controlled governor. The governor may be adjusted by a pneumatic cylinder 39, and a hand wheel manual adjustment may be provided also to permit operating the governor manually in case of air failure. The capacity of the high pressure pump 11 may be relatively small, say 12 gallons per minute at 2000 pounds per square inch, and the governor may permit adjustment of pressure from say 800 to 2000 pounds per square inch.

The constant volume metering valve 38 is adjustable to provide for the desired flow, up to 4 gallons per minute, for example, and may be set at any fixed rate of flow within its operating range, say two gallons per minute.

As shown in Figure 1, line 40 which leads from the valve 38 may be equipped with a conventional dial gauge and a graduated scale and pointer. A manual adjustment with a locking arrangement is preferably provided on the valve 38 so that it may be set for the desired rate of flow and locked in adjusted position. The desired pressure on the inlet side of the valve 38 will be controlled by the governor on the pump 11.

Metering valve 38 delivers hydraulic fluid to line 40 which leads to a sequence valve 41. The valve 41 is arranged so that the pressure at which it opens may be varied. This may be adjusted from say 200 to 500 pounds per square inch pressure in line 35 through connecting line 135. Thus, when hydraulic fluid from pump 12 acting against the top of piston 10 in the pressure unit 7 brings the wood in the pocket 4 into engagement with the grinding stone 3 and the pressure on the foot 5 builds up, the forward motion of the piston is arrested and pressure from pump 12 builds up in lines 34, 35, and 135 until the opening pressure of sequence valve 41 is reached, whereupon it opens and permits hydraulic fluid to flow through metering valve 38 and line 40 and through sequence valve 41 into line 42. A check valve 43 is provided in the line 35 to prevent back flow of the hydraulic fluid into line 34. Thus, the high pressure fluid from pump 11 flows from line 42 into line 35, through valve 21 which is in its alternate position from port P to port B and into line 32 to the upper end of the pressure cylinder 7 above piston 10. The supply of hydraulic fluid to the cylinder above piston 10 is metered by valve 38 to advance the wood into the grinding stone at a constant rate. Since the valve 38 is responsive to the pressure drop across it, it is self-compensating for increases and decreases in pressure required to force the wood into the stone at the desired rate. Such changes in the pressure result from operation on bolts of wood of different sizes, densities, etc.; and, of course, the area of interfacial contact between the wood and the stone will vary.

As piston 10 in pressure unit 7 moves downwardly to bring the pressure foot 5 into engagement with the bolts of wood, actuator cam 44 on control rod 9 is moved away from the mechanical controller 45 of air control valve 23. This moves valve 23 to its alternate position, and port A is now connected to port T. With the valve in this position, air is exhausted from air pilot control cylinder 46 of valve 24 through line 47.

Upon exhausting of air from air pilot control cylinder 46, valve 24 moves to its alternate position, and ports A and T are connected. This permits air to be exhausted from the diaphragms 48 and 49 which control actuation of the valves 16 and 17. Exhausted air flows through line 50 to valve 24 and through the valve from ports A to T for exhausting.

When air is exhausted from above diaphragms 48 and 49, spring loaded valves 16 and 17 are reversed to their alternate positions, and ports A and T of valve 16 are connected, and ports P and A of valve 17 are connected. With valves 16 and 17 in their alternate positions, air from source 15 flows through line 51 into valve 17 and through port P to port A and then through line 52 to the top of pressure unit 8 above the piston therein, and air below the piston is exhausted from the pressure unit 8 through a line 53 and through valve 16 from port A to port T to the atmosphere. Movement of piston in unit 8 in this downward direction moves gate 6 to a closed position, covering the open top of the wood pocket 4, and the gate may be restacked with wood while the pocket grinds out.

As grinding continues, the piston 10 in pressure unit 7 forces the wood into grinding contact with the grinding stone 3 at a constant rate, as previously mentioned, and hydraulic fluid below the piston 10 is exhausted through line 33, through valve 21 which is in its alternate or "grinding position", with ports A and T connected together. The exhaust fluid passing through valve 21 is received in discharge line 54 through which it is delivered back to the tank 13.

Movement of the piston 10 continues until the actuator cam 44 on control rod 9 engages the mechanical controller 55 of valve 22. When this occurs, the position of the valve 22 is reversed to its alternate position, and ports P and A are connected. With the valve 22 in this alternate position, control air from the source 18 is delivered through lines 56 and 57 to valve 22 and passes through the valve from port P to port A to line 58 to air pilot control cylinder 59 of valve 19. When this occurs, valve 19 is reversed to the normal position shown in Figure 1 with ports A and T again connected. (It will be remembered that the valve was reversed to its alternate position upon manual operation of the control handle 25 to "start" position at the beginning of the operation.) This exhausts air from air pilot control cylinder 28 of valve 20, through line 27, and through ports A and T of valve 19.

Thereupon, valve 20 returns to the normal position shown in Figure 1, and control air now flows from source 18 through line 29 into valve 20 and through its ports P and A to line 60 which supplies air to air pilot control cylinder 61 of valve 21. This returns valve 21 to the normal position shown in Figure 1. (Air pilot control cylinders 31 and 61 operate in opposition to one another; cylinder 61 moves the valve 21 to the normal position shown in Figure 1, and the cylinder 31 moves the valve to its alternate position.) When the valve 21 is in the normal position shown in Figure 1, fluid is supplied by pump 12 through lines 34 and 35 through check valve 43. Fluid supplied through line 35 passes through valve 21, ports P to A, and then through line 33 into the lower end of pressure unit 7, below piston 10. As previously mentioned, pump 12 supplies fluid to the accumulators 134 which are connected to lines of such size that the fluid may be delivered to pressure unit 7 at a relatively high rate, 180 gallons per minute, for example, and this effects very rapid retraction of the piston 10 carrying with it the pressure foot 5. Actually, retraction can be accomplished in about two seconds. Hydraulic fluid above piston 10 is exhausted through line 32 into valve 21 through ports B to T and then through line 54 back to the tank 13.

As soon as piston 10 moves toward its retracted position, actuator cam 44 moves away from mechanical controller 55 of air control valve 22, and air is exhausted from air pilot valve cylinder 59 which controls valve 19. The air is exhausted through line 58 and through valve 22 from ports A to T which are connected together when mechanical controller 55 is in its normal position, as shown in Figure 1. Air pilot control cylinder 59 is provided with a mechanical holding pawl and detent arrangement 159 which is only overcome by manual operation of control handle 25 of valve 19. Thus, valve 19 remains in its alternate position with ports A and T connected, and the piston 10 continues to move to its fully retracted position. When this occurs, mechanical actuator 45 of valve 23 is engaged, valve 23 is returned to the position shown in Figure 1, and ports P and A are connected, and air pilot control cylinder 46 of valve 24 is actuated. Air now flows from source 18 through line 62 to port P of valve 24, through valve 24 to port A, and then through line 50 to diaphragms 48 and 49 of valves 16 and 17. This moves valve 16 to its normal position where its ports P and A are connected and valve 17 to its normal position where its ports A and T are connected, both as shown in Figure 1. In these positions, air for retraction of the piston in pressure unit 8 which carries the gate 6 flows from source 15 through line 51, line 63, and through valve 16 from ports P to A and through line 53 to the lower end of pressure unit 8. The air above the piston in pressure unit 8 is exhausted through line 52 and through valve 17 from ports A to T. Gate 6 is retracted which permits a charge of bolts of wood positioned on the gate to fall by gravity into the pocket 4 for grinding.

The gate 6 remains open, and the pressure foot 5 remains in its retracted position until the operator reverses the hand lever 25 of valve 19, whereupon the operation is repeated.

It will be clear from the foregoing that, should the operator desire to interrupt the automatic operation of the grinder for any reason after the gate closes and the pressure foot is in motion toward the grinding stone, all he needs to do is reverse the manual control handle 25 of valve 19 to its normal or "stop" position which connects ports A and T, and the gate will automatically open, and the pressure foot will automatically retract, and the controls will assume their normal at rest position until put into operation by movement of the manual control handle 25 to its "start" position by the operator.

Conventional equipment such as adjustable maximum pressure blow-off valves 64 and 65 for the pumps 11 and 12 and similar valves 66 and 67 for air lines 15 and 18 are provided. Check valves 68 and 69 are provided to protect pumps 11 and 12 against reverse rotation in the event of power failure. Suitable strainers, gauges, etc., are provided as indicated in the drawing.

Operation of the system

The operation of the system as applied to one grinding pocket will be clear from the foregoing description. As mentioned previously, the hydraulic and pneumatic actuating and control units are duplicated on other pockets, such as the pressure foot 5*a* and the gate 6*a* of the drawing. Where there are a number of grinders arranged in tandem for simultaneous operation, as two two-pocket grinders, for instance, they may all be supplied with hydraulic fluid under pressure from a single pumping station, such as pumps 11 and 12 of the drawing and from a single source of operating air, as source 15, and a single source of control air, as source 18.

Referring to Figure 2 and assuming unit I to be charged with wood and ready for starting of a grinding cycle and unit II to be at the end of a grinding cycle, while the wood in pocket 4 is being placed under gripping pressure between grinding stone 3 and pressure foot 5 (a short time interval, not more than a second or so), pressure foot 5*a* is being automatically retracted and gate 6*a* is being opened to discharge a load of wood into pocket 4*a*. This may require a time interval of say two seconds. As soon as movement of pressure foot 5 is arrested by contact between the wood in pocket 4 and the grinding stone 3, building up back pressure in the hydraulic system, full hydraulic pressure is immediately applied to the piston which moves pressure foot 5, and it is moved at a constant rate to force the wood in pocket 4 into grinding relationship with grinding stone 3. The grinding interval will vary with the rate of movement of the pressure foot and the depth of the charge of wood in the pocket. The rate of movement of the pressure foot may be varied depending upon the kind of pulp to be ground. With loblolly pine, coarse ground for fiberboard use, the system may be adjusted to move the wood into the stone at a rate of say 3" per minute. With a charge of wood 15" thick (measured from the face of the grinding stone to the face of the pressure foot at the start of the grinding phase), the grinding cycle will require 300 seconds, at a 3" per minute rate of feed.

After the operator "starts" the cycle for unit I, he may "start" the cycle for unit II as soon as the gate 6*a* opens and wood is automatically charged into pocket 4*a*. Normally, the operator will be stationed at a position where he may readily observe both pockets. As soon as he notes the opening of gate 6*a*, for instance, and sees

that the charge of wood is properly deposited in pocket 4*a* so that gate 6*a* may close, he will immediately start the cycle for unit II. Then within a second or so, the motor which drives stone 3 will be under full load from both units I and II.

From this, it will be clear that, under normal operating conditions, there will be only an interval of a few seconds when the motor is not under full load—the interval from the end of the grinding cycle of one unit, I or II, (the instant when the pressure foot starts its upward retracting movement) to the beginning of the grinding cycle of the other unit, II or I, (when full grinding pressure is applied to the new charge of wood by the pressure foot). Assuming the units I and II to be operating in a cycle where unit I is beginning its grinding cycle at the instant unit II is ending its cycle, the "no-load" interval on the grinding stone motor drive will be zero and the half-load interval will be but a few seconds, depending upon the speed with which the operator observes the position of the wood in the pocket and starts the cycle for unit II. This interval will be less than a total of 30 seconds under normal operating conditions. In most instances, there will be no significant no-load period and only a short period when the motor drive is operating at a half of its normal full load, for the operator will be alerted upon opening of each of the gates 6 and 6*a* to observe the position of the wood and immediately to press the manual control which starts the cycle for that unit and will arrange to have each unit complete its cycle during the grinding interval of the second unit.

It will also be clear from the foregoing that actual grinding will be accomplished with an essentially uniform rate of feed of the wood into the stone regardless of the load on the motor drive. The wood fiber thus produced is quite uniform and of excellent quality. By advancing the wood into the stone at a constant rate, the variations in fiber size and structure which normally occur in conventional multi-pocket grinders are minimized. This is particularly significant in producing coarse pulps for fiberboard products and the like.

I claim:

1. In a wood grinder having a rotatable grinding stone, a pocket to receive wood to be ground, and a pressure foot for pressing said wood into grinding contact with said grinding stone, the combination of a fluid actuated power unit for actuating said pressure foot, a first source of fluid under pressure connected to said power unit, a second source of fluid under lower pressure and higher flow than said first source connected to said power unit, a valve for controlling the supply of said fluid under pressure from said second source to said power unit to move said pressure foot into gripping engagement with said wood, and means for advancing said pressure foot at a constant rate during wood grinding, comprising a valve which regulates the flow of pressure from said first source to said power unit to a constant volume per unit of time.

2. In a wood grinder having a rotatable grinding stone, a pocket to receive wood to be ground, and a pressure foot for pressing said wood into grinding contact with said grinding stone, the combination of a fluid actuated power unit for actuating said pressure foot, a first source of fluid under pressure connected to said power unit, a second source of fluid under lower pressure and higher flow than said first source connected to said power unit, a valve for controlling the supply of said fluid under pressure from said second source to said power unit to move said pressure foot into gripping engagement with said wood, and means for advancing said pressure foot at a constant rate during wood grinding, comprising a constant volume, pressure-compensated metering valve which regulates the flow of fluid under pressure from said first source to said power unit to a constant rate and means for controlling said metering valve to open the same upon gripping engagement of said pressure foot with the wood to be ground.

3. In a wood grinder having a rotatable grinding stone, a pocket to receive wood to be ground, and a pressure foot for pressing said wood into grinding contact with said grinding stone, the combination of a fluid actuated power unit for actuating said pressure foot, a first source of fluid under pressure connected to said power unit, a second source of fluid under lower pressure and higher flow than said first source connected to said power unit, a valve for controlling the supply of said fluid under pressure from said second source to said power unit to move said pressure foot into gripping engagement with said wood, a pressure-compensated metering valve for controlling the supply of said fluid under pressure from said first source to said power unit to advance said pressure foot at a constant rate, and a sequence valve responsive to pressure of fluid from said second source upon said gripping engagement of said pressure foot for controlling the supply of fluid under pressure from said pressure-compensated metering valve to said power unit.

4. In a wood grinder having a rotatable grinding stone, a pocket to receive wood to be ground, and a pressure foot for pressing said wood into grinding contact with said grinding stone, the combination of a fluid actuated power unit for actuating said pressure foot, a first source of fluid under pressure connected to said power unit, a second source of fluid under lower pressure and higher flow than said first source connected to said power unit, a valve for controlling the supply of said fluid under pressure from said second source to said power unit to move said pressure foot into gripping engagement with said wood, a pressure-compensated metering valve for controlling the supply of said fluid under pressure from said first source to said power unit to advance said pressure foot at a constant rate, a sequence valve responsive to pressure of fluid from said second source upon said gripping engagement of said pressure foot for controlling the supply of fluid under pressure from said pressure-compensated metering valve to said power unit, and a check valve in the supply line from said second source to said power unit below said sequence valve for directing the flow from said first source to said power unit.

5. In a wood grinder having a rotatable grinding stone, a pocket to receive wood to be ground, and a pressure foot for pressing said wood into grinding contact with said grinding stone, the combination of a fluid actuated cylinder and piston power unit for actuating said pressure foot, a first source of fluid under pressure connected to said power unit, a second source of fluid under lower pressure and higher flow connected to said power unit, a valve controlling the supply of fluid under pressure from said second source to said cylinder below said piston to retract said pressure foot and for controlling the supply of fluid under pressure from said first and second sources to said cylinder above said piston to move said pressure foot toward said grinding stone, a pressure-compensated metering valve for controlling the supply of said fluid under pressure from said first source to said power unit to advance said pressure foot at a constant rate, and a sequence valve responsive to pressure of fluid from said second source upon gripping engagement of said pressure foot for controlling the supply of fluid under pressure from said pressure-compensated metering valve to said cylinder above said piston whereby said piston is retracted at a rapid rate, is moved at a rapid rate to bring said pressure foot into gripping engagement with the wood to be ground, and is then moved at a constant but slower rate to press the wood into grinding relationship with said grinding stone.

6. In a wood grinder having a rotatable grinding stone, a pocket to receive wood to be ground, and a pressure foot for pressing said wood into grinding contact with said grinding stone, the combination of a double acting hydraulic cylinder and piston power unit, a first hydraulic pump for supplying fluid under pressure to the said cylinder, a supply line connecting said first pump to said

cylinder above said piston, a second hydraulic pump for supplying fluid under pressure to said cylinder, a supply line connecting said second pump to said cylinder below said piston and to said supply line from said first pump to said cylinder above said piston, an accumulator in said line from said second pump to said cylinder, a two-position, four-connection valve for controlling the flow of fluid from said pumps to said cylinder to move said piston toward and away from said grinding stone, said valve in its first position connecting said supply line from said accumulator to said cylinder below said piston and in its second position connecting the supply line from said first and second pumps to said cylinder above said piston, a pressure-compensated metering valve for controlling the supply of fluid under pressure from said first pump to said common supply line to advance said piston at a constant rate, and a sequence valve responsive to pressure in said common supply line for controlling the supply of fluid under pressure from said first pump through said metering valve to said supply line to said cylinder above said piston.

7. In a wood grinder having a rotatable grinding stone, a pocket to receive wood to be ground, and a pressure foot for pressing said wood into grinding contact with said grinding stone, the combination of a double acting hydraulic cylinder and piston power unit for actuating said pressure foot, a first hydraulic pump for supplying fluid under pressure to the said cylinder, a supply line connecting said first pump to said cylinder above said piston, a second hydraulic pump for supplying fluid under pressure to said cylinder, a supply line connecting said second pump to said cylinder below said piston and to said supply line from said first pump to said cylinder above said piston, an accumulator in said line from said second pump to said cylinder, a two-position, four-connection valve for controlling the flow of fluid from said pumps to said cylinder to move said piston toward and away from said grinding stone, said valve in its first position connecting said supply line from said accumulator to said cylinder below said piston and in its second position connecting the supply line from said first and second pumps to said cylinder above said piston, a pressure-compensated metering valve for controlling the supply of fluid under pressure from said first pump to said common supply line to advance said piston at a constant rate, a sequence valve responsive to pressure in said common supply line for controlling the supply of fluid under pressure from said first pump through said metering valve to said supply line to said cylinder above said piston, and means responsive to movement of said piston toward said grinding stone for actuating said control valve.

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UNITED STATES PATENT OFFICE

CERTIFICATION OF CORRECTION

Patent No. 2,965,315 December 20, 1960

John D. Lyall

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 2, line 1, for "graphcial" read -- graphical --; column 3, line 26, for "present" read -- pressure --; line 60, for "54"" read -- 54" --.

Signed and sealed this 9th day of May 1961.

(SEAL)
Attest:

ERNEST W. SWIDER
Attesting Officer

DAVID L. LADD
Commissioner of Patents