No. 780,213. PATENTED JAN. 17, 1905.

E. F. MILLARD.

WOOD GRINDING APPARATUS.

APPLICATION FILED APR. 22, 1904.

2 SHEETS—SHEET 1.

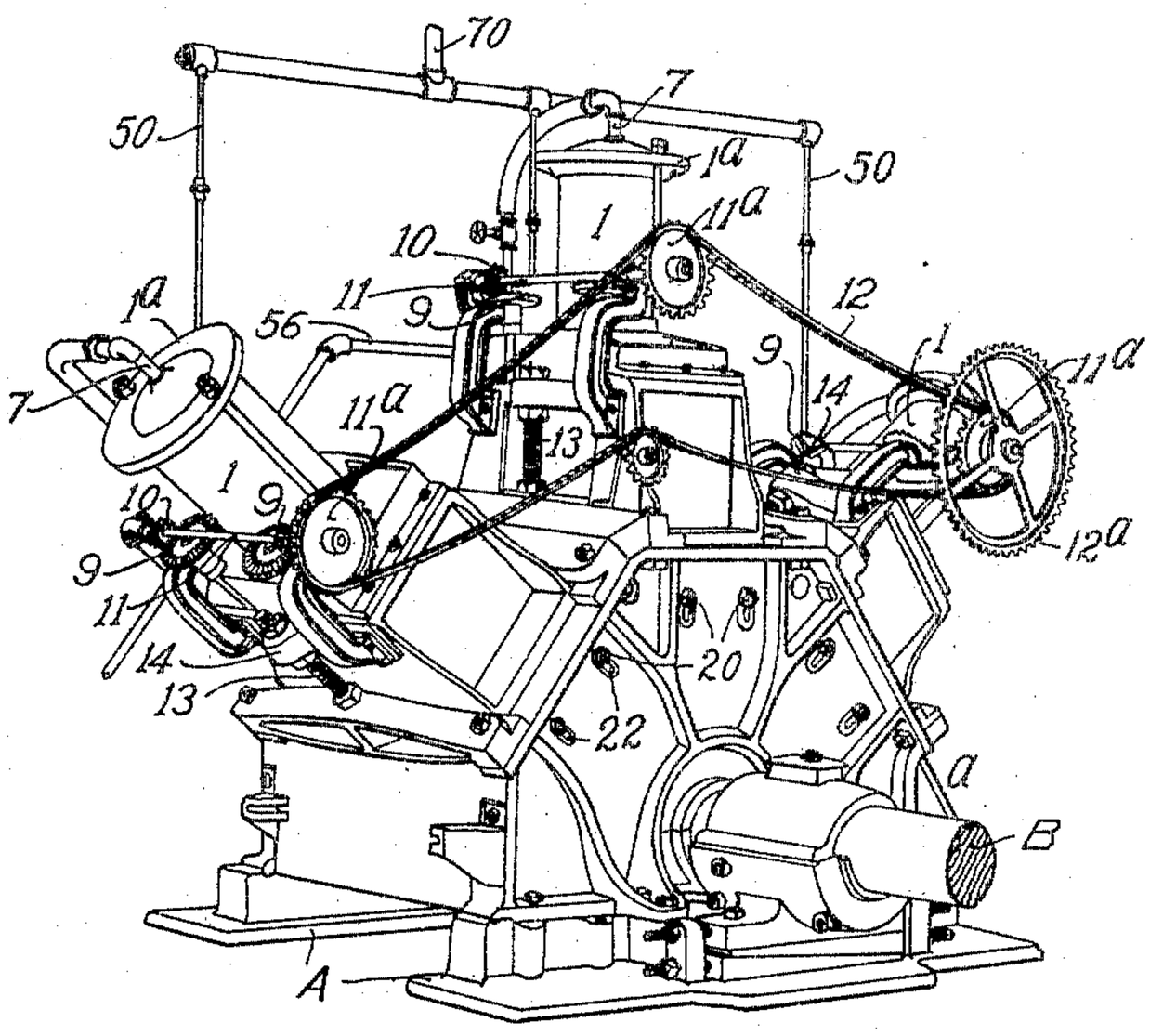

FIG. 1.

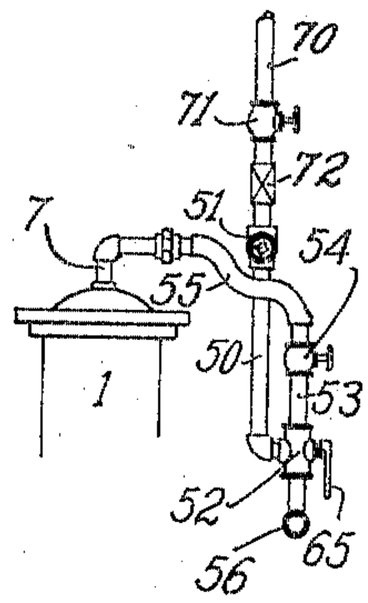

FIG. 3.

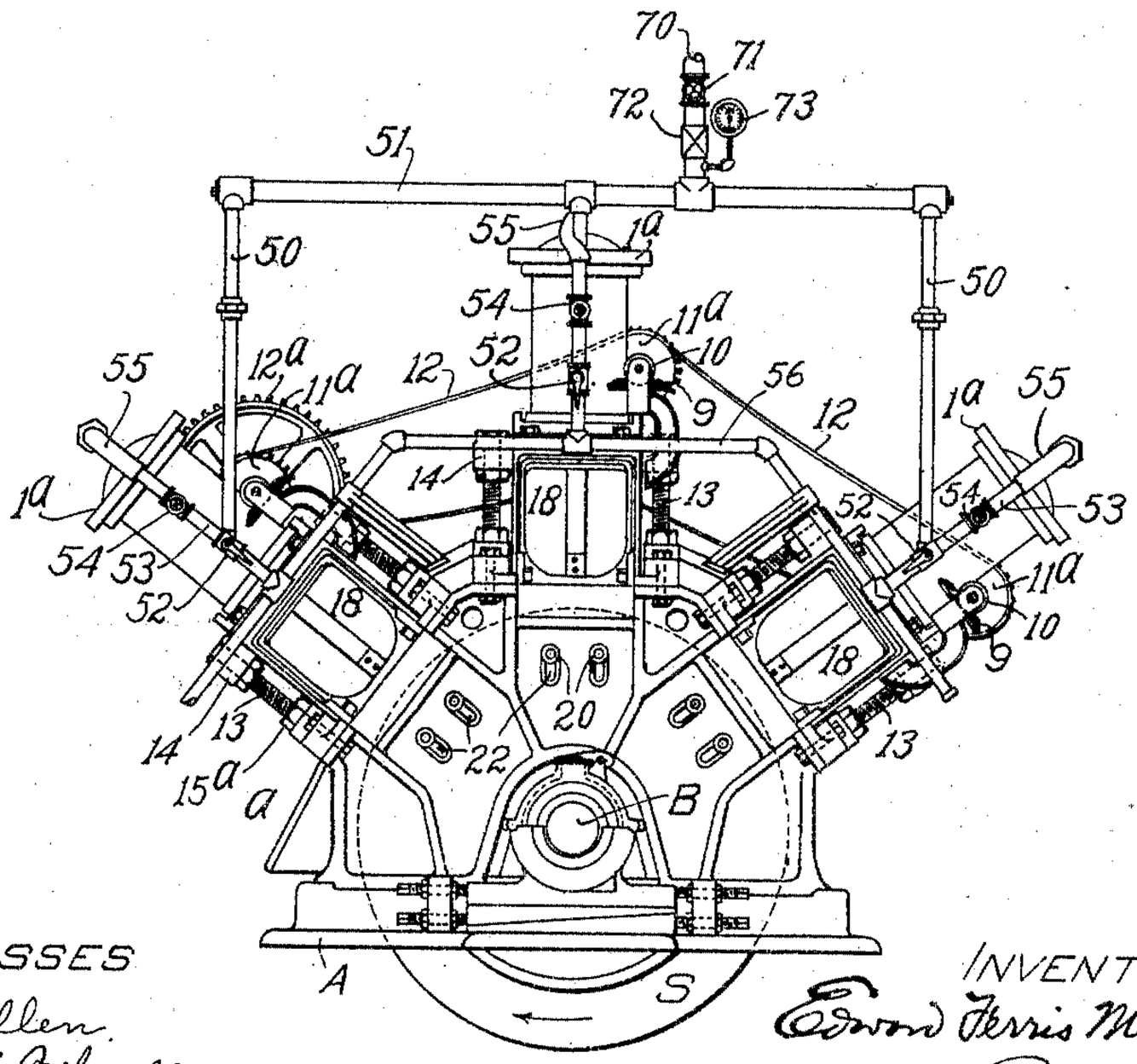

FIG. 2.

WITNESSES

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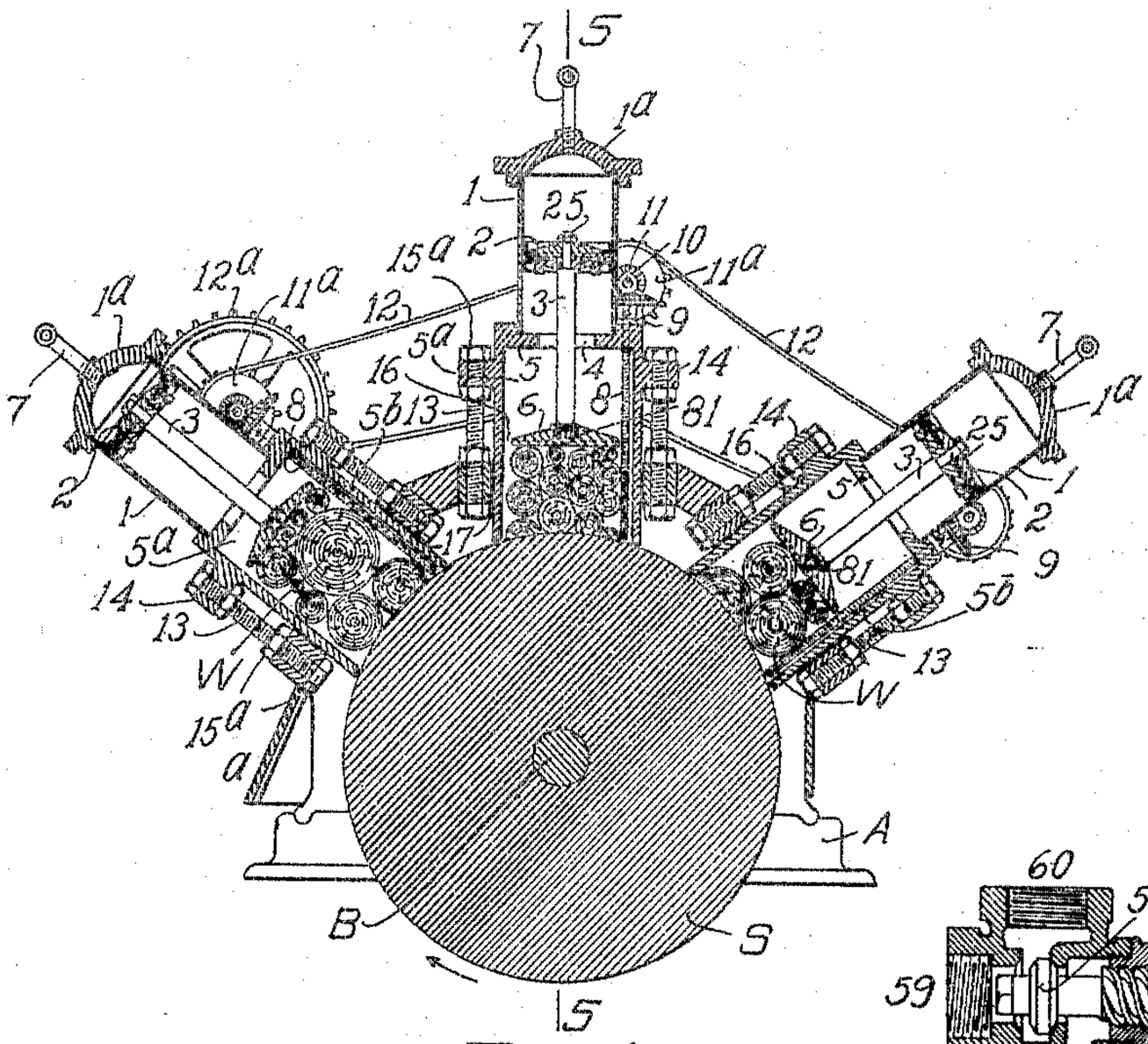

FIG. 4.

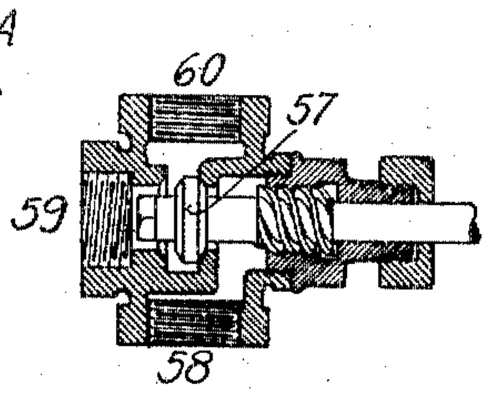

FIG. 6.

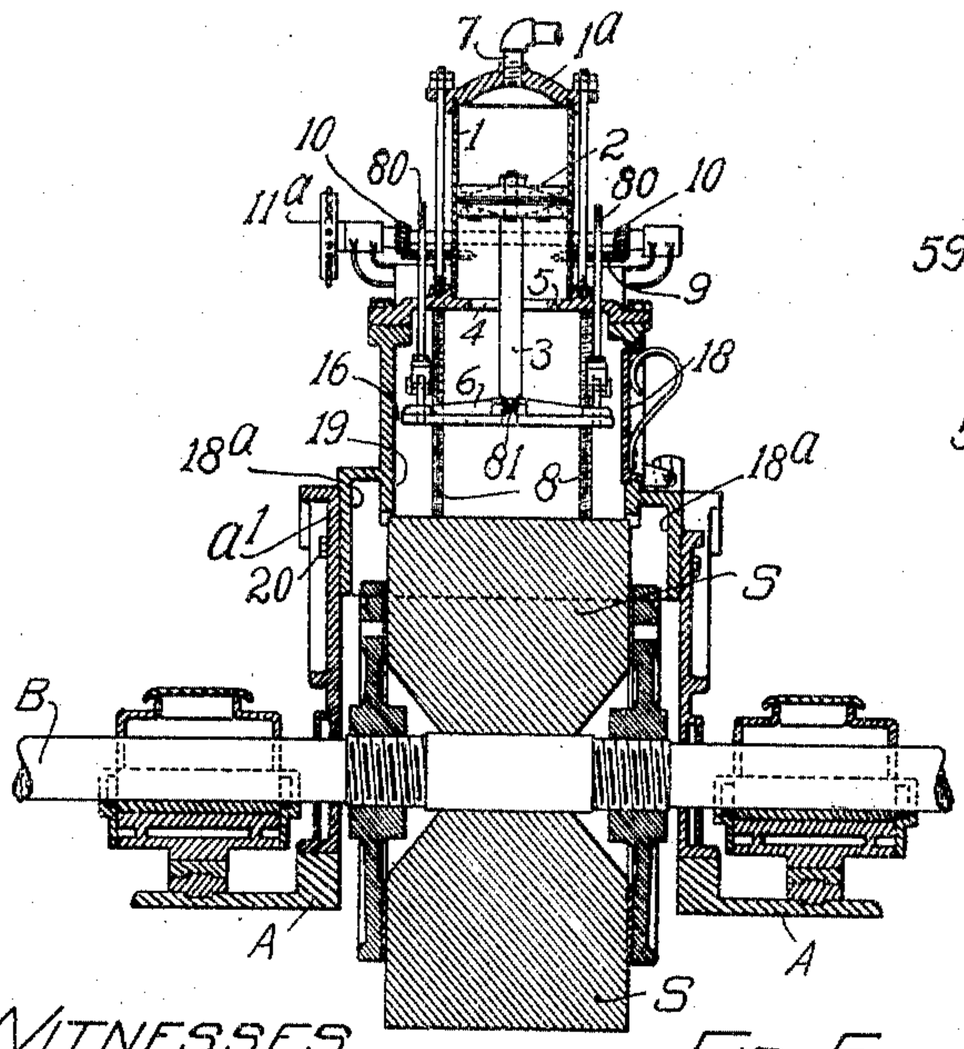

FIG. 5.

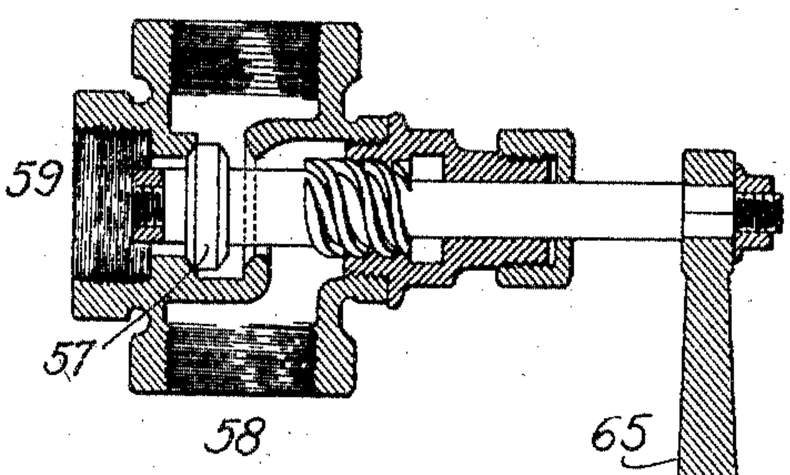

FIG. 7.

WITNESSES

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No. 780,213. Patented January 17, 1905.

UNITED STATES PATENT OFFICE.

EDWARD FERRIS MILLARD, OF WATERTOWN, MASSACHUSETTS.

WOOD-GRINDING APPARATUS.

SPECIFICATION forming part of Letters Patent No. 780,213, dated January 17, 1905.

Application filed April 22 1904. Serial No. 204,320.

To all whom it may concern:

Be it known that I, EDWARD FERRIS MILLARD, a citizen of the United States, residing at Watertown, in the county of Middlesex and State of Massachusetts, have invented certain new and useful Improvements in Wood-Grinding Apparatus, of which the following is a specification, reference being had therein to the accompanying drawings.

Figure 1 is a perspective view of my new wood-grinding apparatus. Fig. 2 is a side elevation thereof. Fig. 3 is an elevation showing part of a piston-cylinder and pipe and valve connections thereof with the vacuum-pipe and fluid-supply pipe. Fig. 4 is a central vertical section at right angles to the axis of the stone. Fig. 5 is a transverse vertical section at a line corresponding to line 5 5 of Fig. 4. Figs. 6 and 7 are sectional sections of a three-way valve forming part of the pipe and valve connections shown in Fig. 3.

This invention relates to apparatus for grinding or reducing blocks of wood into their fibrous constituents, commonly termed "mechanical wood-pulp."

An object of my invention is to produce wood-pulp which is substantially uniform in composition and is made up as nearly as possible of fibrous filaments which taper from the middle toward each end and which can be formed into paper equal in strength and finish to other ground wood-pulp paper in which from fifteen to twenty-five per cent. of sulfite is used. In order to produce such wood-pulp to the best advantage and with a maximum economy of cost, it is desirable to regulate the pressure on the wood being ground to suit the varying condition of the grinding-stone, to distribute the pressure as equally as possible on each square inch of the wood coming into contact with the stone, and to deliver said pressure of the wood on the stone with a minimum variation in order that the wear on the stone may be minimized, whereby the stone will be kept with its grinding-surface in the best condition for grinding the pulp into a substantially uniform composition and whereby the quality of the product is directly governed by controlling the pressure of the wood against the stone instead of, as generally heretofore, by directly controlling the condition of the stone by a dressing of its grinding-surface.

It is my purpose by regulating the pressure of the wood against the stone to keep the grinding-surface of the stone in a more uniform proper grinding condition, so that I can use always sharp stones the points of which catch the fibers of the wood and draw them from the sticks in pieces of considerable length as compared with their thickness without cutting or breaking them into sawdust or slivers, as is the case where many machines in common use are used with sharp stones under heavy pressures.

In many of the prior machines using stones under heavy pressure when the stones are first sharpened they are too sharp to make the right quality of pulp, tearing the wood into slivers and forming sawdust instead of pulp. In my apparatus the pressure of the wood against the stone is a relatively light pressure—that is to say, about one-third of what is commonly used in the heavy-pressure machines. It is difficult to state with precision the exact amount of pressure of the wood against the stone, as that must depend to a considerable extent upon the character of the wood under treatment and also upon that of the stone; but it may be approximately given as from two or three pounds to ten pounds to the square inch of the wood surface exposed to the action of the stone. By using a relatively light pressure with always sharp stones I produce an improved quality of pulp, making fewer slivers and less dust, and therefore produce an increased quantity of pulp from each cord of wood.

The apparatus herein shown may be used, if desired, under what are considered heavy pressures in this art; but it is highly useful in subjecting sticks of suitable wood under light pressures to the disintegrating action of a sharp stone, as set forth in my United States Letters Patent No. 449,586, granted March 31, 1891.

In the drawings, A is the main frame, and *a* a pulp-escape hood, the purpose of which is explained later and which is a feature of minor novelty.

B is the shaft of the grinding-stone S, mount-

ed within the chamber of casing A, with its grinding periphery passing the open lower ends of the wood-containing box. Any other suitable form may be used, if preferred.

I illustrate three pockets and coöperating mechanical parts; but the number may be decreased or increased as desired. Their constructions are substantially identical, and description of one will suffice for all.

1 is a piston-cylinder having a tight upper head 1^a.

2 is a piston of any suitable construction fast on the piston-rod 3, which plays freely through an opening 4 in the bridge-piece 5, which forms a wall between the lower end of cylinder 1 and the upper end of the wood-holding pocket 5^a.

The lower end of cylinder 1 is made fast to bridge-piece 5 in any suitable manner, and 5 forms a part of the wood-pocket 5^a, so that cylinder 1 and wood-pocket 5^a may be adjusted from and toward a stone simultaneously. Piston-rod 3 is provided at its lower end with a plunger 6, which is of smaller diameter than the diameter of the wood-pocket 5^a. A conduit 7 opens into cylinder 1 on the upper side of piston 2 and is both a pressure and suction conduit. Stone S rotates in the direction shown by the arrow, and contiguous to the back plate 5^b of the wood-pocket there is a vertical antifriction-screw 8, against which wood W between plunger 6 and stone S is pressed by the rotation of the stone. In practice I prefer to use in each pocket a pair of antifriction-screws 8, these antifriction-screws being rights and lefts, so that they permit the plunger 6 to press the wood downwardly against the stone without frictional resistance. Wood W, as stated, is pressed against the back plate by the rotation of the stones; but as the plunger is advanced radially to meet the grinder friction must necessarily ensue between the wood and the back plate, and the purpose of the screws is to minimize such friction. Screws 8 are not to be considered as feed-screws; but if they have any effect at all in feeding the wood it is of little practical importance. The feed of the wood to the stone is due to the pressure exerted by the plunger on the wood, and the purpose of the screws 8 is to form at or near the inner surface of the back plate an antifriction mechanism. Any suitable antifriction mechanism may be substituted for screws 8 without departure from my invention most broadly considered.

Each screw 8 is provided at its upper end with a beveled gear 9, which meshes with a beveled pinion 10 on a counter-shaft 11, which is provided with a sprocket-wheel 11^a. In the present form of apparatus three sprocket-wheels 11^a are shown, one for each set of antifriction-screws 8, and a sprocket-chain 12 is provided for the sprocket-wheels. One of the counter-shafts 11 is provided with a driving-wheel 12^a, so that all three sets of antifriction devices are driven simultaneously.

A pocket-adjusting screw 13 is provided at each side of each pocket 5^a. The upper portions of these screws are mounted in lugs 14 of the pocket. Their lower portions are socketed in the main frame A, and nuts 15^a are provided for screws 13 in order to adjust the pockets endwise and radially in relation to the stone as the stone is worn away.

As stated, piston 3 passes loosely through the opening 4, and the diameter of plunger 6 is less than the diameter of pocket 5^a. Thus a space (indicated at 16) is left between the ends of the plunger and the opposed wall of the pocket, within which the plunger reciprocates in order that the piston-rod and plunger may be moved sidewise in any direction. Opening 4 is of much greater area than the cross-sectional area of the piston-rod 3, so that when the plunger 6 is carried against a wall of the wood-pocket and the piston-rod is thereby canted the piston-rod does not strike against the wall of opening 4. This is important, as it prevents friction, which otherwise would be due to friction between the piston-rod pressing against the opposed surface. The piston-rod must, in a word, be free to move laterally in any direction. Each pocket is provided with a suitable door 18 in the usual way. The pockets 5^a reciprocate through holes (indicated at 17, Fig. 4) and have side flanges 18^a depending below their lower ends 19, these flanges sliding on the inner walls a' of frame A. Bolts 20 pass through flanges 18^a and frame-walls a' and are provided with suitable ends 21, whereby the wood-pockets and frame are clamped together. To permit ready adjustment of the wood-pockets in relation to the frame A, bolts 20 pass through slots 22, which are elongated in the direction of the lengthwise axis of the wood-pocket.

In order to lighten the construction of the piston, piston-rod, and plunger, I make the piston-rod 3 of tubing, connecting the piston and plunger with opposite ends of the tubular piston-rod by means of a suitable plug 25. It is desirable that the piston, its rod, and the plunger should be as light in weight as possible in order that the same may be readily drawn back by the vacuum created, as required, in the chamber between head 1^a and the piston.

My apparatus is operated usually by water-pressure, and 7 is a fluid-supply and alternately a vacuum for each cylinder 1. Each conduit 7 is connected with a branch 50 of a fluid-supply pipe 51 through a three-way valve 52 (best seen in Fig. 3) and a pipe-section 53, provided with a shut-off valve 54. Between pipe-section 53 and conduit 7 there is a flexible non-collapsible pipe-section 55, which is usually of so-called "suction-hose." The purpose of this flexible connection 55 is

to permit the system of piping now being described to remain stationary while the wood pockets and cylinders are being adjusted endwise. The lower end of the pipe-section 53 is connected with a vacuum-pipe 56, which goes to any suitable apparatus for exhausting water or other fluid from the upper side of the piston 2. Each three-way valve 52 connects what may be called "pressure-pipe" 50 with cylinder 1, so that pressure fluid may be introduced through pipe 50, valve 52, pipe-sections 53 and 55, and conduit 7 into the upper end of cylinder 1. To accomplish this, the valve is open to pipes 50 and 53 and closed to the vacuum-pipe 56, (see Fig. 6,) where the valve-plug 57 is seated to close the vacuum going-way 58 and is open to the ways 59 and 60, which lead, respectively, to the pipes 50 and 53. When it is desired to produce a vacuum in the cylinders 1, the valve-plug is moved to close the way 59, leaving the way to the cylinder open and opening the vacuum-way, as shown in Fig. 7. Consequently suction on the vacuum-pipe draws out the fluid from cylinders 1 and forms vacuums therein, whereupon the plungers 6 are moved upwardly by atmospheric pressure on their under sides. Of course the wood in one or more pockets may be ground before the grinding operation at another pocket is accomplished. Therefore a three-way valve 52 is provided for each cylinder, so that by regulating the valve 52 the plunger and the cylinder corresponding to that valve may be lifted and a new supply of wood put into this pocket. A handle 65 is provided for each valve 57. The valves 54 are only closed to take off the caps 1^a for some purpose or another. Pipe 51 is supplied commonly with water or with any other proper fluid through a main supply-pipe 70, which is commonly provided with a shut-off valve 71 and pressure-regulator 72 and a pressure-gage 73.

Shaft B may be driven by any suitable power, and any suitable fluid may be used for pressure on the plunger. Steam, however. is not desirable for effecting this pressure, because it is too elastic, and water is the medium commonly used for this purpose. It will be observed in the apparatus described that the pressure effected by the water or other pressure-fluid is communicated to the stone without loss due to friction between the piston-rod and any part opposed to it or between the plunger and any part opposed to it.

The doors 18 being in the wood-pockets and not, as heretofore, in the frame of the machine reduces the number of adjustments heretofore required and makes my new apparatus much more compact and simple to adjust. In my apparatus the cylinders are attached to and carried by the wood-pockets, and this is an advantage over other types of machines in which the cylinders have been attached to the frame and were always stationary with the frame. In earlier forms of machines when the wood-pockets were adjusted to the stone the antifriction-screws and their driving mechanisms had to be adjusted with relation to the adjustment of the wood-pockets.

It is very important to prevent a plunger from coming into actual contact with the grinding-surface of the stone, for if it does the grinding-surface is apt to be so injured that two or three days' time will be required to put it into proper condition. Therefore I provide for each wood-pocket one or more telltales 80, usually one near each end of each pocket. Each telltale consists of a rod the lower end of which is connected with the plunger and an upper portion of which passes loosely through a top wall of the wood-pocket. This is unnecessary in my present construction. The plunger is free to move in all directions within the wood-pocket, the lower end of the rod being connected with the plunger by a universal joint 81, whereby the lower end portion of the rod is prevented from becoming crystallized and breaking off.

What I claim is—

1. In wood-grinding apparatus, the combination of a main frame; a rotatable stone; a plurality of radially-disposed wood-pockets, each open at its lower end to the stone; a piston-cylinder rigidly attached to each wood-pocket; means for adjusting each rigidly-connected wood-pocket and piston-cylinder endwise from and toward the stone; a piston in the piston-cylinder and piston-rod attached thereto; a plunger attached to the piston-rod and free to move in all directions within the wood-pocket, the piston-rod reciprocating without frictional contact with any opposed part; a fluid-pressure-supply pipe; a branch pipe from said pressure-supply pipe to the upper portion of each cylinder; a vacuum-pipe common to each cylinder; for each cylinder a three-way valve, which in one position connects the pressure branch with the cylinder to admit pressure thereto, the valve in this position disconnecting the vacuum-pipe with the cylinder, and which in another position disconnects the pressure-pipe with the cylinder and connects the vacuum-pipe therewith, the connection between said valve and the cylinder comprising a flexible non-collapsible pipe-section; and, in each wood-pocket, an antifriction mechanism projecting from the inner surface of the back plate.

2. The combination of a wood-pocket; a piston-cylinder attached to the pocket and opening therein; a piston sliding in the cylinder; a piston-rod therefor, and a plunger carried thereby; the plunger reciprocating in the pocket, and both piston-rod and plunger having free lateral movement, the opening between the cylinder and pocket being of greater area than the cross-section of the piston-rod, and the plunger being of a diameter less than

the interior diameter of the pocket; and an antifriction mechanism in the pocket.

3. The combination of a wood-pocket; a cylinder fixed thereto; a piston; piston-rod; plunger; and a telltale loosely attached to the plunger; the piston-rod, plunger and telltale having free lateral movement.

4. The combination of a frame; a stone therein; a plurality of piston-cylinders; a plurality of wood-pockets open toward the stone; a piston, piston-rod and plunger for each cylinder and pocket; a vacuum-forming system common to the cylinders; a pressure-forming system common to the cylinders; and means (such as a three-way valve, for example) which connects either the vacuum system or the pressure system with each cylinder, as required.

5. The combination of a frame; a stone therein; a plurality of piston-cylinders; a plurality of wood-pockets open toward the stone; a piston, piston-rod and plunger, one for each cylinder and pocket; a vacuum-forming system common to the cylinders; a pressure-forming system common to the cylinders; means for connecting either system with a cylinder, as required; means for adjusting the pockets in relation to the stone; and non-collapsible, flexible pressure-pipe sections in the pressure system.

In testimony whereof I affix my signature in presence of two witnesses.

EDWARD FERRIS MILLARD.

Witnesses:
EDWARD S. BEACH,
E. A. ALLEN.