July 3, 1923.

1,460,874

A. WHITE

WOODCUTTING MACHINE

Filed Sept. 6, 1921

8 Sheets-Sheet 1

Fig.1

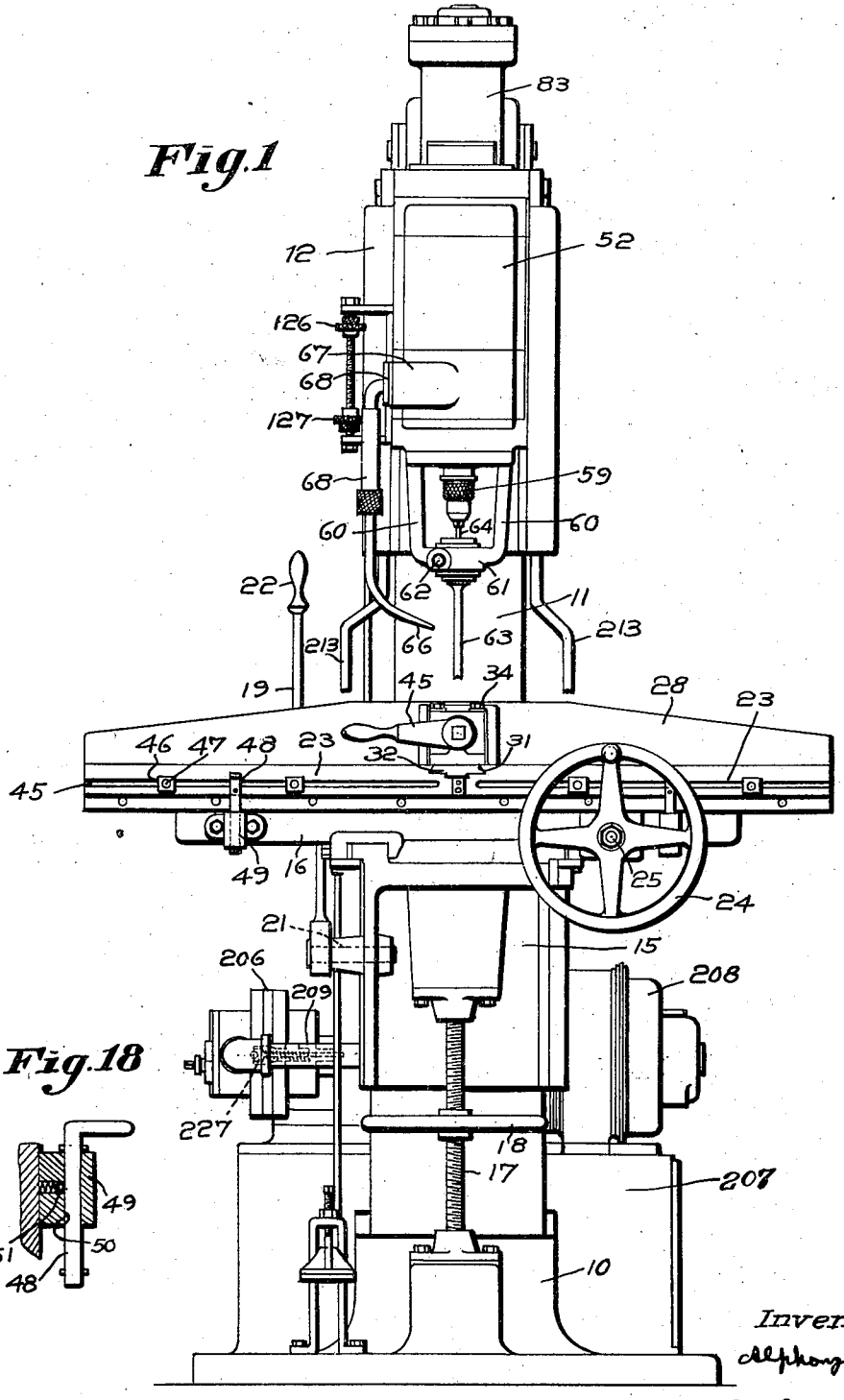


Fig.18

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A. WHITE

WOODCUTTING MACHINE

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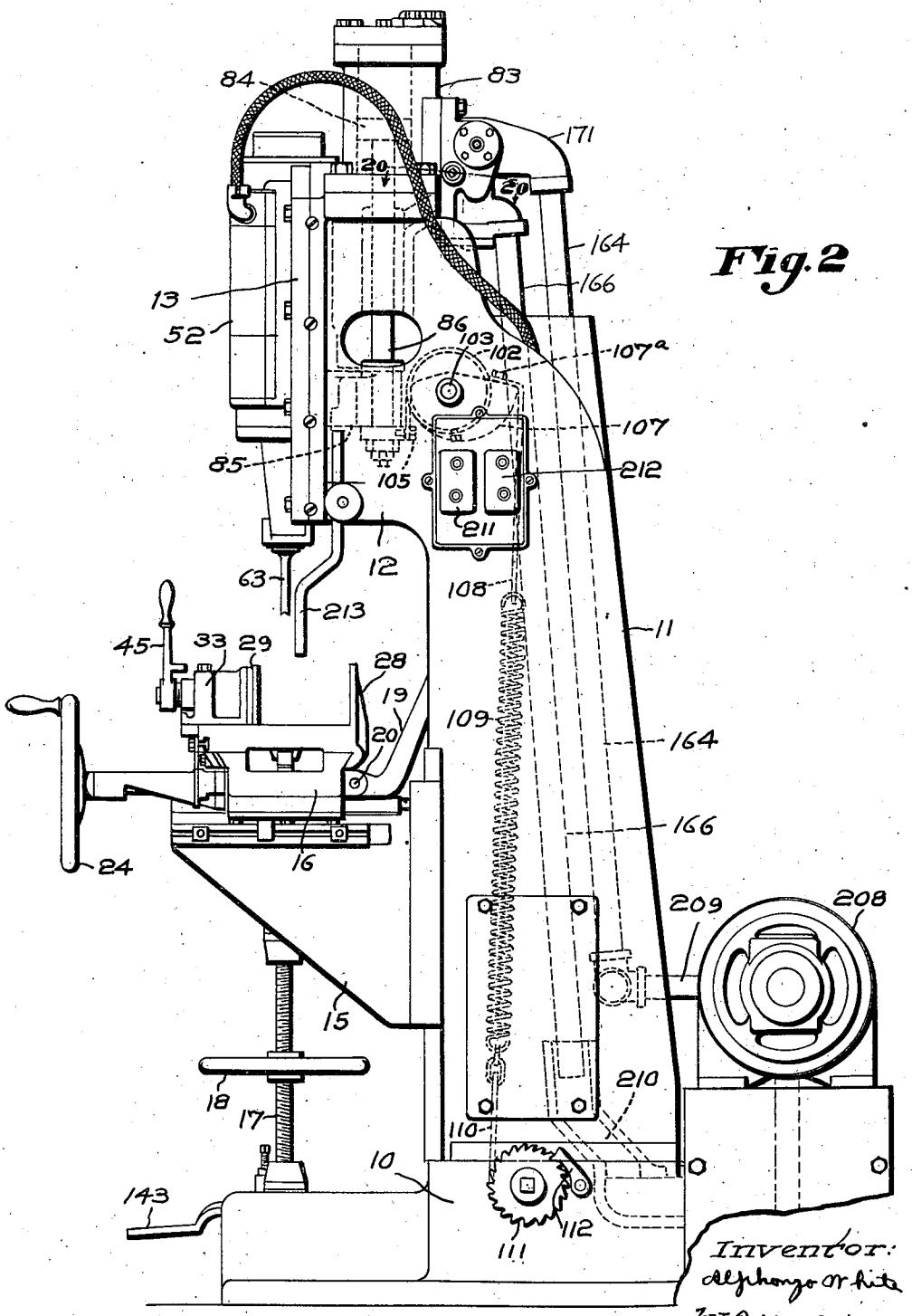


Fig. 2

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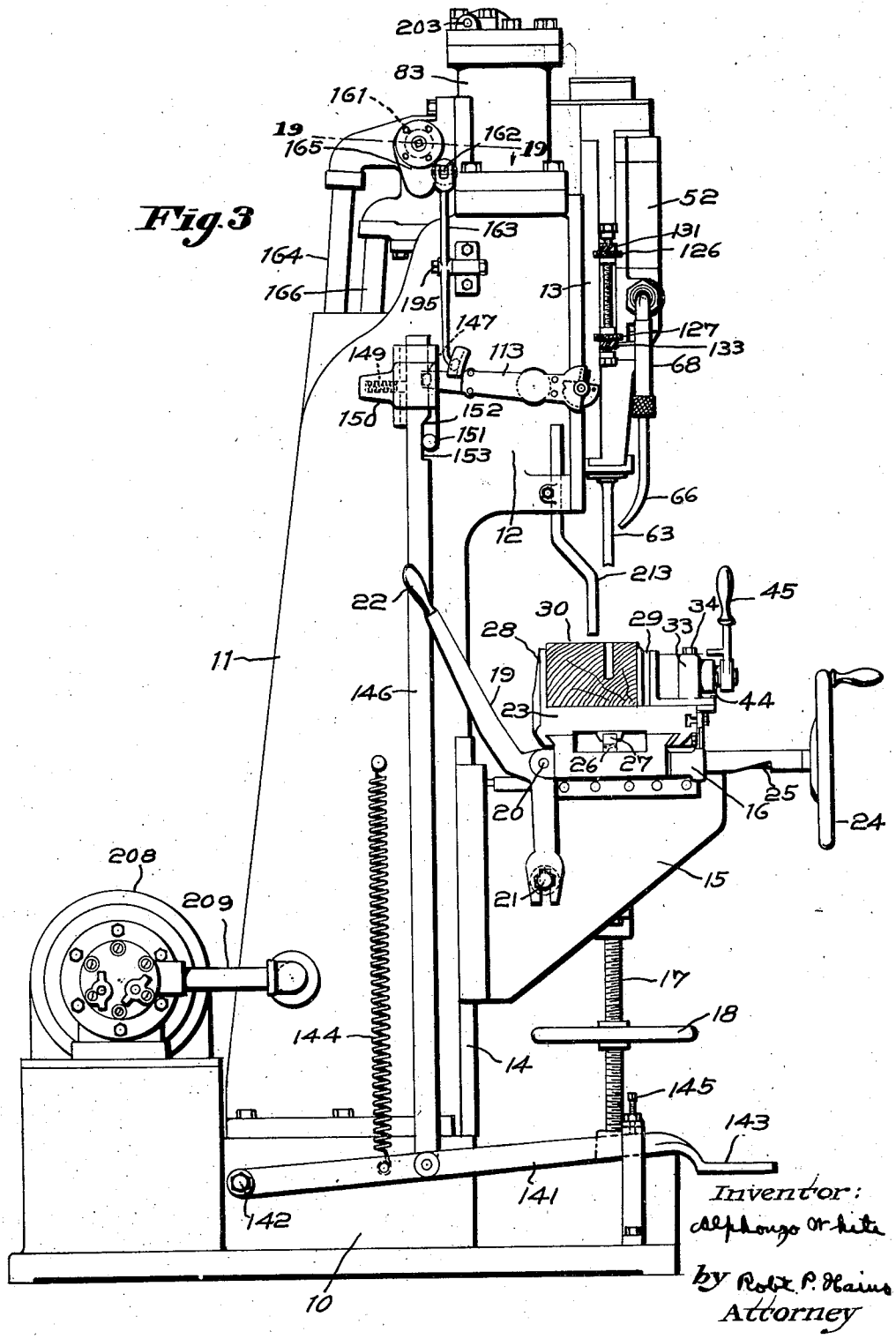
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A. WHITE

WOODCUTTING MACHINE

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Fig. 3



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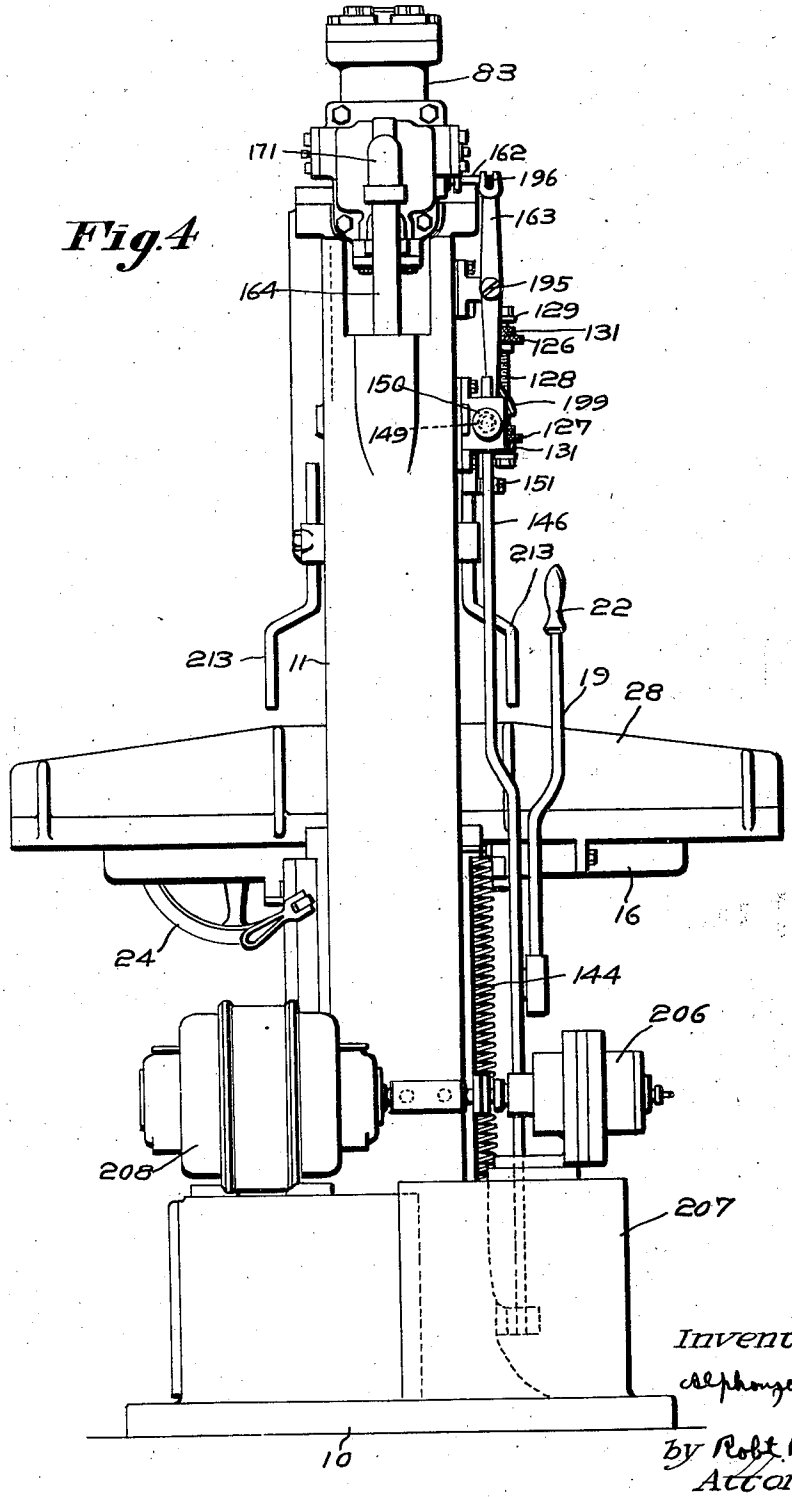
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A. WHITE

WOODCUTTING MACHINE

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Fig. 4



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WOODCUTTING MACHINE

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Fig. 6

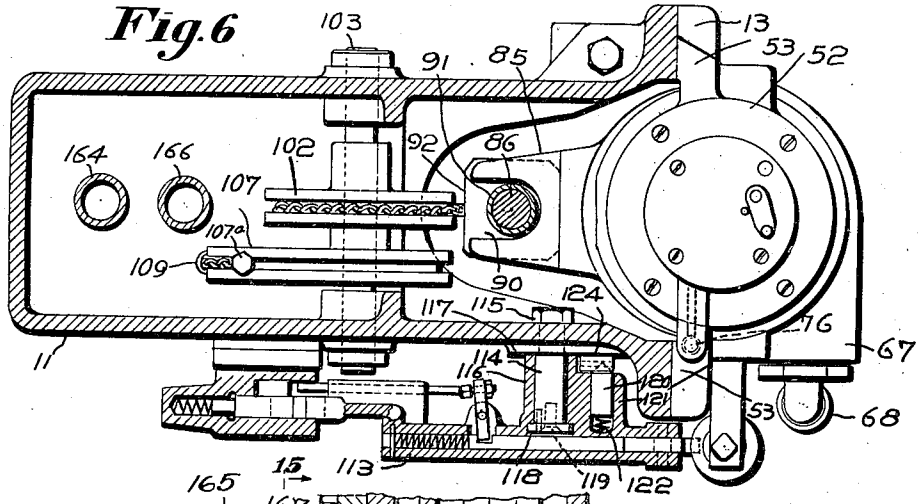
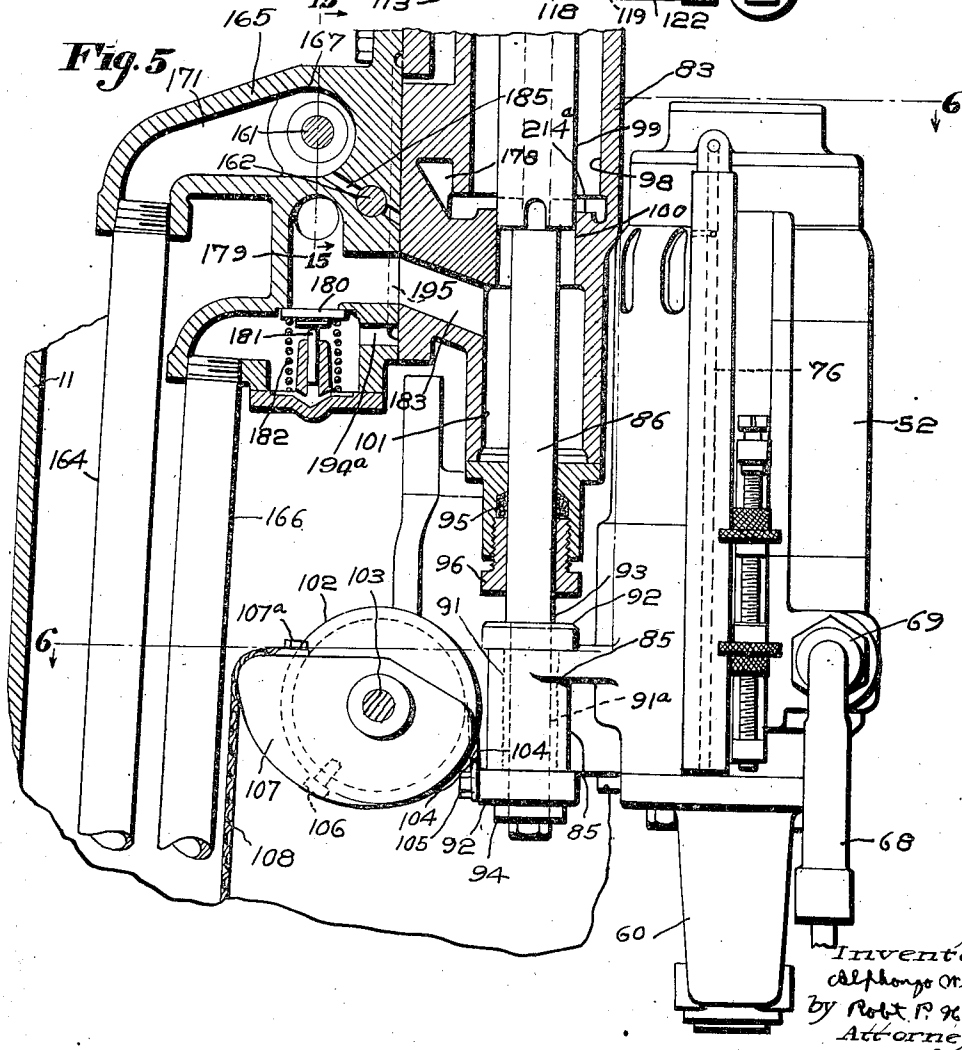


Fig. 5



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A. WHITE

WOODCUTTING MACHINE

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Fig. 7

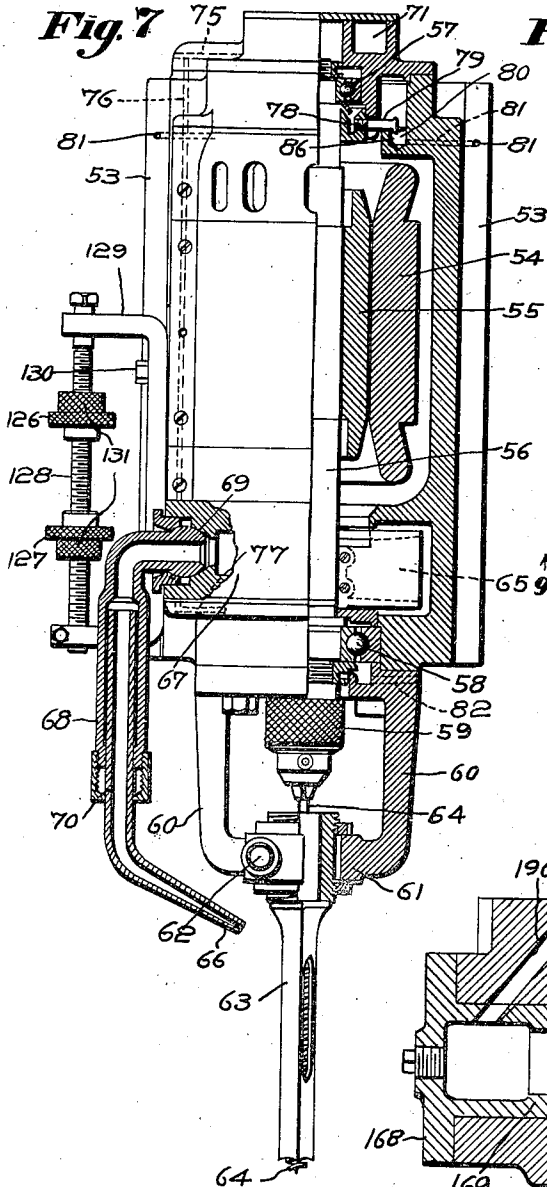


Fig. 9

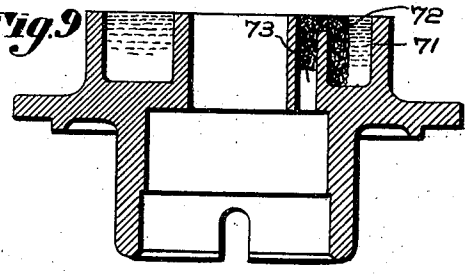


Fig. 8

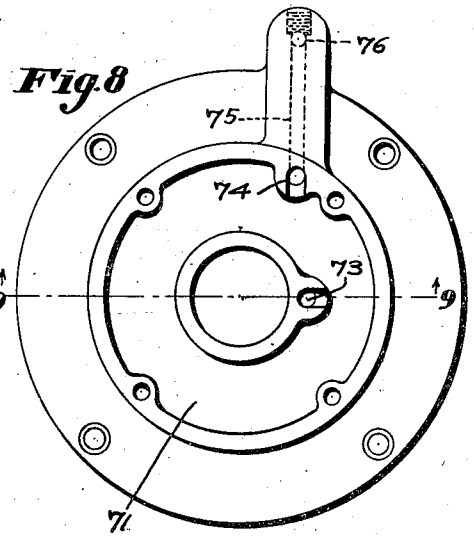


Fig. 19

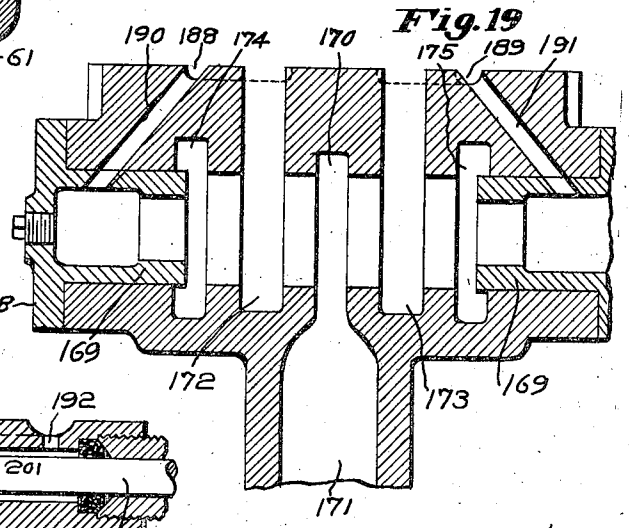
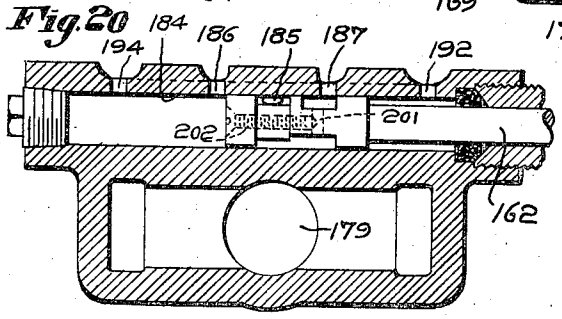


Fig. 20



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A. WHITE

WOODCUTTING MACHINE

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Fig.11

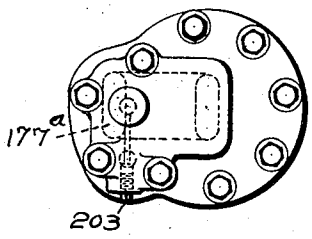


Fig.12

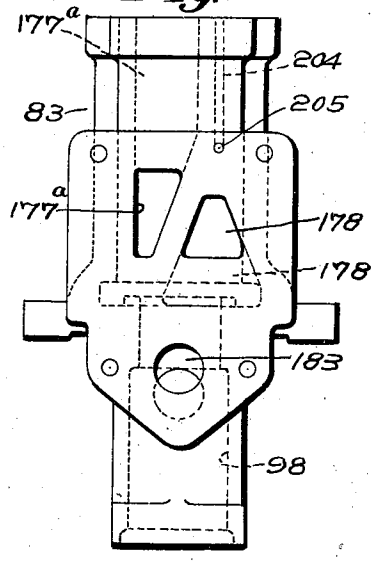


Fig.10

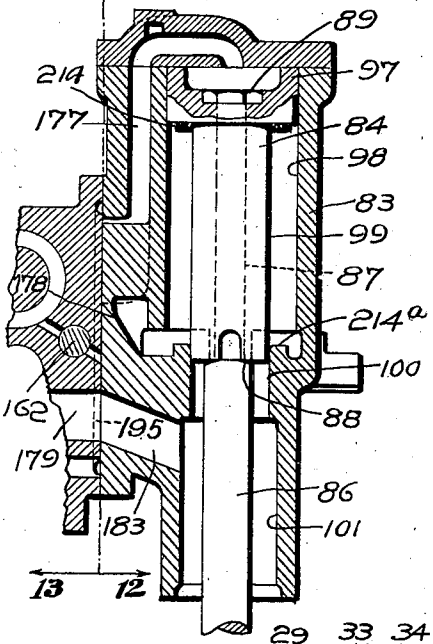


Fig.13

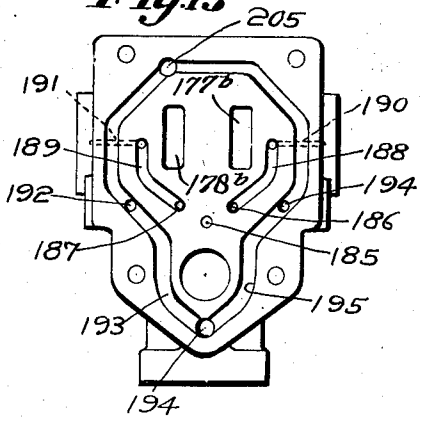
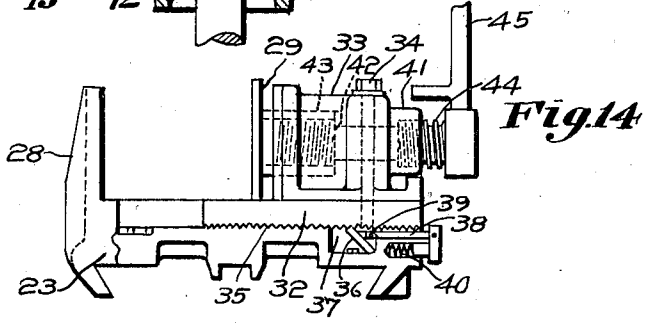


Fig.14



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July 3, 1923.

1,460,874

A. WHITE

WOODCUTTING MACHINE

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Fig. 17

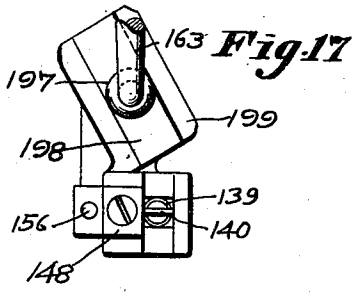


Fig. 16

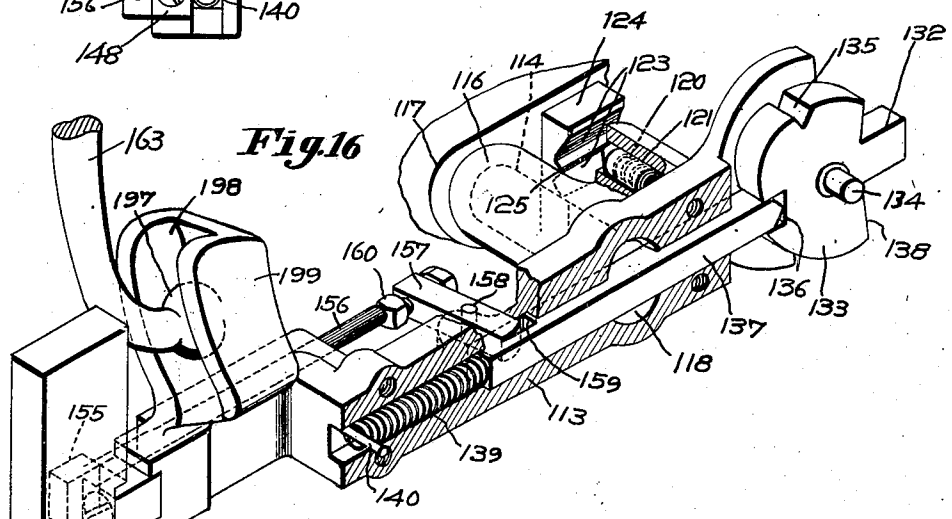
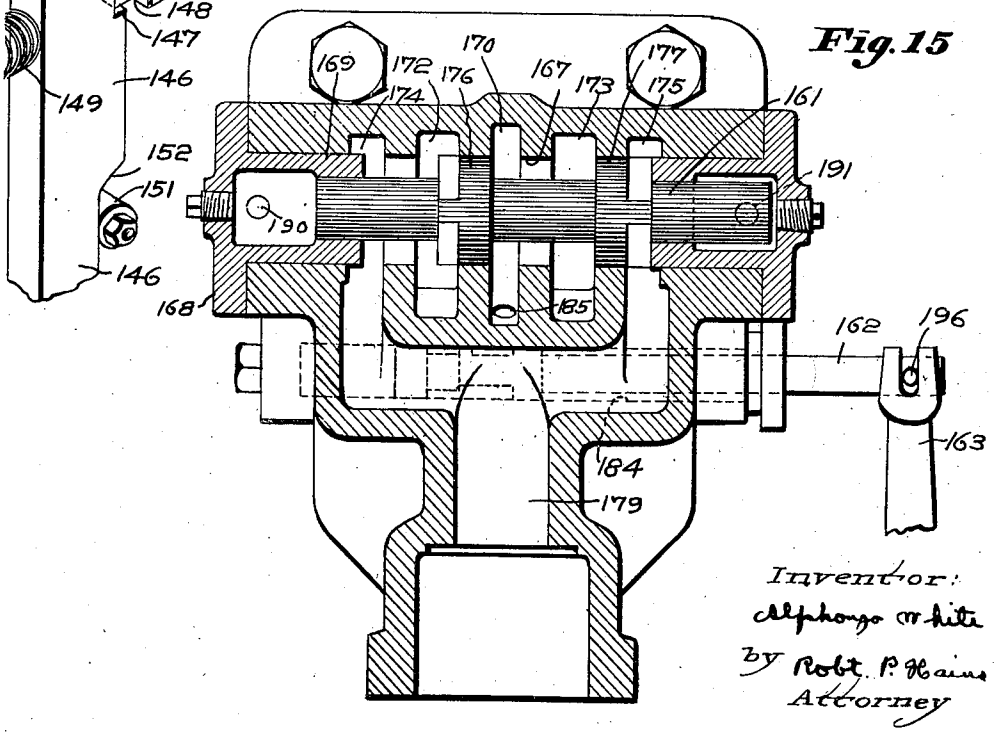


Fig. 15



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Attorney

Patented July 3, 1923. 1,460,874

UNITED STATES PATENT OFFICE.

ALPHONZO WHITE, OF WINCHENDON, MASSACHUSETTS, ASSIGNOR TO BAXTER D. WHITNEY & SON, INC., OF WINCHENDON, MASSACHUSETTS, A CORPORATION OF MASSACHUSETTS.

WOODCUTTING MACHINE.

Application filed September 6, 1921. Serial No. 498,811.

To all whom it may concern:

Be it known that I, ALPHONZO WHITE, a citizen of the United States, residing at Winchendon, in the county of Worcester and State of Massachusetts, have invented an Improvement in Woodcutting Machines, of which the following description, in connection with the accompanying drawings, is a specification, like characters on the drawings representing like parts.

This invention relates to woodworking machines in which a cutting tool is moved toward and from the work, and more particularly to a bit and hollow chisel mortising machine. However, various features of the present invention are well adapted for various applications.

An important requirement of woodworking machines is that they shall perform their functions rapidly, and to this end it is desirable to provide power means for rapidly moving the cutting tool to and from the work.

Under different conditions the tool is required to enter the work to different depths, and under different conditions it is necessary to retract the tool to different distances from the work. It is therefore desirable to provide means that may be quickly and easily adjusted to vary the movement of the tool either toward or from the work.

While it is desirable to provide power means for moving the tool quickly to and from the work, it is important that the tool at all times be under complete control of the person attending the machine; and to this end it is desirable to provide means operable by the operative for quickly starting or stopping the reciprocating movement of the tool, and the control should be such that movement of the tool toward the work may be checked by the operative before the stroke toward the work is completed.

Important features of the present invention, therefore, consist in hydraulic means for moving the tool into engagement with the work; in means that may be readily adjusted to cause the tool to be reciprocated hydraulically between various different points lying within the limits of the path of travel of the hydraulically-operated means; in means for imparting a slow working stroke and quick return stroke to the tool; in means under the control of the operative for promptly starting and stopping the hydraulic movement of the tool; and in means for automatically bringing the tool to rest in its uppermost position upon operation of the stopping means.

In woodworking it is often desirable to form mortises, slots, and cavities with square corners. This cannot be done with a rotating bit or drill, and it is therefore customary to provide a hollow mortise chisel and bit in which the bit rotates within the hollow chisel. In this construction the bit forms a round hole as it enters the work and the mortise chisel cuts the walls of the round hole away to form a mortise or cavity having square corners.

In using a bit and hollow mortise chisel, it is necessary to rotate the bit and to force the bit and chisel into cutting engagement with the work, and after a mortise or cavity of the desired depth is formed, it is desirable to withdraw the bit and chisel.

Another important feature of the present invention, therefore, consists in novel means for rotating the bit and for supporting the bit and hollow chisel for movement toward and from the work.

In the present instance of the invention the bit or tool is rotated by a small electric motor mounted for movement toward and from the work. It is desirable to provide means for cooling the motor and also to provide means for removing the chips formed by the rotating bit or tool.

Another important feature of the invention, therefore, consists in means including a fan for producing a cooling air current about the motor and for directing the air current in the form of a blast toward the bit or tool to remove the chips.

As above mentioned, the hydraulic means for moving the tool toward and from the work is provided with adjustable means for causing the reciprocation of the tool between selected points, and with means under the control of the operative for quickly bringing the tool to rest in its uppermost position.

Another important feature of the inven-

tion, therefore, consists in means operable by adjustable, stops to effect reciprocation of the tool between selected points, and also operable by the operative to stop or start the reciprocating movement of the tool.

Another important feature of the invention consists in novel means for counterbalancing the weight of the tool and its driving means.

Still another feature of the invention resides in a relief valve by which the hydraulic feeding pressure upon the bit and chisel is prevented from exceeding a predetermined maximum pressure.

The above and other features of the invention and novel combination of parts will be herein described in connection with the accompanying drawings which show one good, practical form of the invention.

In the drawings:—

Figure 1 is a front elevation of a woodworking machine embodying the invention;

Fig. 2 is a side elevation of the machine viewed from the right side thereof;

Fig. 3 is a side elevation of the machine viewed from the left side thereof;

Fig. 4 is a rear elevation of the machine;

Fig. 5 is a central vertical sectional view through the upper portion of the machine frame;

Fig. 6 is a horizontal sectional view taken on the line 6—6 of Fig. 5;

Fig. 7 is a view partly in section, and partly in side elevation, of the motor casing and associated parts;

Fig. 8 is a top plan view of the motor casing cap shown in Fig. 7;

Fig. 9 is a sectional view on line 9—9 of Fig. 8;

Fig. 10 is a vertical sectional view through the hydraulic cylinder;

Fig. 11 is a top plan view of Fig. 10;

Fig. 12 is a face view of the hydraulic cylinder looking in the direction of the arrows 12—12, Fig. 10;

Fig. 13 is a face view of the valve chest for the hydraulic cylinder looking in the direction of the arrows 13, Fig. 10;

Fig. 14 is a sectional view taken transversely through the table and showing the vise in side elevation;

Fig. 15 is an enlarged sectional view taken on the line 15—15 of Fig. 5;

Fig. 16 is an enlarged perspective view of the reverse lever;

Fig. 17 is an end view of the lever shown in Fig. 16;

Fig. 18 is a side view of a detail to be described;

Fig. 19 is an enlarged sectional view taken on line 19—19 of Fig. 3; and

Fig. 20 is a sectional view through the auxiliary valve chamber looking down, and taken on the line 20—20, Fig. 2.

Referring to the drawings: The machine shown therein as one good form of the invention has a suitable base 10 upon which the column 11 is mounted, and at the upper portion of the column is formed a head 12. The head 12 has a slide-way 13 and below the head a slide-way 14 is formed upon the column 11.

The cutting tool or tools are supported from the slide-way 13 in a manner to be described, and it is desirable to provide means for adjustably supporting the work below the tool or tools. Satisfactory means to this end comprises a knee 15 secured to the slide-way 14 for movement in a vertical direction, and upon the knee 15 a saddle 16 is mounted for sliding movement toward and from the column 11. The knee 15 may be raised or lowered by an adjusting screw 17 rotated by a handwheel 18, and the saddle may be slid upon the upper face of the knee toward and from the column by a rocking lever 19, which in the present instance has an intermediate portion pivotally secured to the saddle as at 20 while its lower end has sliding engagement with a fixed pin 21 secured to the knee. At the upper end of the lever is a handle 22, and the arrangement is such that a pull upon the lever handle will slide the saddle outwardly while a push upon the handle will move the saddle inwardly. Upon the saddle 16 is slidably mounted a table 23, and sliding movement may be imparted to the table by rotating the handwheel 24 secured to a shaft 25 having a gear 26 that meshes with a rack 27 secured to the table. The table 23 is provided with a work-holding vise comprising the wide fixed jaw 28 and the adjustable jaw 29 adapted to grip the work 30.

It is desirable to mount the adjustable jaw 29 so that it may be easily and quickly adjusted relative to the fixed jaw to receive the size of work to be operated upon; and it is also desirable to provide additional means for forcing the adjustable jaw into clamping engagement with the work. To this end, in the present instance, the table 23 has a dovetail slide-way 31 (see Fig. 1) formed transversely across its upper face to receive a sliding plate 32 (see Fig. 14) mounted to slide toward and from the fixed jaw 28. Upon the plate 32 is mounted a head 33 which may be secured to the plate by bolts 34. The sliding plate 32 is mounted to slide freely toward the fixed jaw and has means for automatically holding it from moving from the fixed jaw. The holding means consists of a series of ratchet teeth 35, Fig. 14, upon the sliding plate 32 with which a dog 36 cooperates. The dog 36 in the present instance is mounted in an inclined position within a recess 37 of the table, and the upper end of the dog is normally held by spring means in position to engage the ratchet teeth 35. The dog 36 is yieldingly held in

its active position by a sliding pin 38 secured to the dog at 39 and urged outwardly by a coiled spring 40. The arrangement is such that pressure upon the sliding plate 32 will move it toward the fixed jaw while movement of this plate in the opposite direction is prevented by the dog 36, and when it is desired to release the dog this is done by pushing inwardly upon the end of the pin 38 to move the upper end of the dog out of engagement with the ratchet teeth.

It is desirable to provide means upon the sliding plate 32 to force the adjustable jaw toward the fixed jaw, and to this end the head 33 has a threaded portion 41 and a recessed portion 42 (see Fig. 14) which slidably receives a projection 43 on the adjustable jaw 29. The jaw 29 is adjusted relative to the head by a screw 44 provided with right and left hand threads. One type of thread is received by the correspondingly threaded portion 41 while the other type of thread is received by a cooperating thread within the projection 43. The screw 44 may be rotated by the handle 45, and the arrangement is such that as the screw is rotated it is moved bodily by the threaded portion 41, and the jaw 29 is moved by this bodily movement, and also relatively to the screw by the threads within the projection. As a result the jaw 29 is adjusted a distance equal to the combined pitch of the two types of thread. In this manner a rapid movement is imparted to the jaw while the use of a thread having a steep pitch is avoided.

It is desirable to provide means for stopping the sliding movement of the table at desired points, and to this end the table 23 has a slot 45 to which stops 46 are adjustably secured by bolts 47 (see Fig. 1). In the present instance the stops 46 cooperate with stop abutments 48 mounted upon the saddle to be moved into and out of the path of the stops. The stop abutments may be slidably mounted within the brackets 49 and preferably are provided with notches 50 (see Fig. 18) engaged by friction means 51 to hold the abutments in their stop-engaging position. The arrangement is such that if it is desired to move the table beyond the position for which a stop is set, it is merely necessary to slide the abutment 48 down out of the path of the stop.

As stated, the cutting tool or tools are supported by the head 12 of the machine frame above the work-supporting table and are mounted for movement toward and from the table. The means for supporting and operating the tools will now be described.

Upon the head 12, in the embodiment of the invention illustrated, is slidably mounted a casing 52 provided with dove-tailed bearing plates 53 (see Fig. 6) engaging the slideway 13 for sliding movement in a vertical direction. The bit or cutting tool, in the present instance, is rotated by an electric motor mounted within the casing 52. The motor may be of any well-known construction and consists of a stator 54 mounted within the casing 52, and a rotor 55 secured to the motor shaft 56 to rotate with the shaft. The shaft 56 has an upper bearing 57 and a lower bearing 58, and to the lower end of the shaft is secured a tool-holding chuck 59.

In operating a bit and hollow mortise chisel, which are the type of tools the machine illustrated is designed to operate, it is necessary to provide means for holding a hollow mortise chisel with its cutting end adjacent the cutting end of the bit, and to this end the casing 52 is provided with a forked bracket 60 having a collar 61, and clamping means including a bolt 62 for clamping the upper end of a hollow chisel 63 within the collar 61. The chuck 59 and collar 61 are in axial alignment and the chuck serves to rotate the bit 64 within the hollow chisel. The arrangement is such that as the bit and chisel are forced against the work, the rotating bit forms a round hole while the end of the chisel adjacent the cutting end of the bit cuts the walls of the hole away to form square corners.

It is desirable to provide means for cooling the electric motor that drives the bit 64, and to this end a fan 65 is provided within the casing 52, near the lower end thereof, which is driven by the motor to produce an air current passing through the casing about the motor. The cooling air current produced by the fan, in the present instance, is further utilized to blow chips away from the cutting tool. To this end a nozzle 66 is provided which is connected to the fan chamber 67 by a conduit 68, and the conduit is preferably connected to the fan chamber by a ball and socket joint 69 which permits the nozzle to be swung upwardly out of the way. The conduit may have one part telescopically mounted within the other as at 70, to permit sliding and rotative adjustment of the nozzle 66.

The upper and lower bearings of the motor shaft, and the bearing surfaces of the slide-way 13 should at all times be properly lubricated, and to this end, an oil chamber 71 is provided adjacent the upper bearing 57 and contains a wick 72. From the oil chamber 71 oil is led to the upper bearing 57 through the port 73, and is led to the lower bearing 58 through the port 74, laterally extending conduit 75, vertical conduit 76 and lower laterally-extending conduit 77. The oil which passes through the upper bearing 57 collects in a chamber 78 and is led from this chamber through a tube 79 to a second chamber 80. From the chamber 80 the used oil passes through the conduits 81 to the bearing faces of the bearing plates 53

to lubricate the slide-way 13. The used oil from the lower bearing 58 escapes through the port 82.

As stated, an important feature of the present invention consists in hydraulic means for moving the bit and hollow chisel toward and from the work. Satisfactory means to this end will now be described.

At the upper end of the column 11 is mounted a cylinder 83 containing a sliding piston 84 mounted to slide vertically within the cylinder. Below the cylinder 83 is a bracket 85 rigidly connected to the sliding motor casing 52 and which serves to impart the reciprocating movement of the piston 84 to the motor casing and tools carried thereby. The piston 84 is connected to the bracket 85 by a piston rod 86 having at its upper end a reduced portion 87, (see Fig. 10) which extends through the piston and is rigidly secured thereto, the arrangement being such that the lower end of the piston engages a shoulder 88 upon the piston rod, and a nut 89 upon the upper end of the piston rod clamps the piston against said shoulder. The bracket 85 has a recessed portion 90 (see Figs. 5 and 6) adapted to receive the body portion of a spool 91 while the flanges 92 of the spool snugly engage the upper and lower faces of the bracket 85. The spool 91 is rigidly secured upon a reduced portion 91^a at the lower end of the piston rod by a shoulder 93 upon the piston rod engaging the upper face of the spool and a nut 94 engaging the lower face of the spool. The spool forms a satisfactory connection between the piston rod and the bracket 85 as it is free to move laterally within the bracket 85 into proper alignment with the piston rod. The piston rod enters the lower end of the cylinder 83 through a stuffing-box having packing 95 and a gland nut 96.

Since the cutting tools do not cut while they are moved away from the work, and should not be fed against the work at a speed greater than that at which the rotating bit will cut, it is desirable to move the tools slowly toward the work and rapidly from the work, and to this end, in the present instance, the piston 84 has a head 97 that slidably fits the inner wall 98 of the piston chamber, and extending downwardly from the piston head is a reduced cylindrical portion 99 that fits a neck 100. This neck lies between the piston chamber 98 and an auxiliary chamber 101 that receives the reduced portion 99 as the piston moves downwardly. The arrangement is such that more fluid is required to fill the cylinder above the piston head than is required to fill the cylinder below the piston head, and as a result the piston will move upwardly more rapidly than it will move downwardly, but will exert a greater force downwardly than it will upwardly.

It is desirable to provide means for counterbalancing the weight of the sliding motor casing 52 and parts carried thereby; satisfactory means to this end will now be described.

Rearwardly of the bracket 85, in the present instance, is mounted a pulley 102 upon a shaft 103 supported by the columns 11 (see Figs. 2, 4 and 5). The pulley 102 is connected to the casing 52 so that as the casing moves downwardly, it will rotate the pulley, and in the construction shown, the connection comprises a chain or flexible member 104 having one end secured to the spool flange 92 by a bolt 105, and its other end secured to the pulley by a bolt 106. Upon the shaft 103 is mounted a rocking cam pulley 107, which is rigidly connected to the pulley 102 and a chain or flexible member 108 is secured to the cam pulley 107 by a bolt 107^a so that as the cam pulley rotates clockwise, viewing Fig. 5, the flexible member 104 will unwind from the periphery of the pulley 102 and the flexible member 108 will wind on the cam pulley. The lower end of the flexible member 108 is secured to a coiled spring 109 and the lower end of the coiled spring is secured to a flexible member 110 connected to a take-up spool 111 that (see Fig. 2) may be rotated to adjust the tension of the spring 109, and the spool 111 may be held from rotation by a dog 112. The construction is such that as the motor casing 52 moves downwardly, the flexible member 104 will unwind from its pulley by rotating the pulley in a direction to wind the flexible connection 108 about the cam-pulley 107, and as the flexible member 108 winds about the cam pulley it will stretch the coiled spring. The cam-pulley is so constructed that it compensates for variations in the force exerted by the spring 109 as it is extended, so that practically a uniform lifting force is exerted upon the sliding casing 52 by the counterbalancing means.

In operating the present machine, it may be desirable to cause the cutting tool, in its movement toward and from the work, to reciprocate through a distance less than the maximum travel of the sliding casing 52; and under different conditions it may be desirable to cause the sliding casing to complete its stroke at different distances from either end of its maximum path of travel. Furthermore, the construction should be such that the means for controlling the length of stroke of the sliding casing 52 may be easily and quickly adjusted. Satisfactory means to this end will now be described.

Movement of the piston 84 and the sliding casing 52 operated by the piston is con-

trolled by valve means, to be described, which control the fluid pressure upon the opposite ends of the piston, and the position of the valve means is controlled by a reverse lever 113 (see Figs. 3, 6 and 16) rockingly mounted upon one side of the column 11. The lever 113 is pivotally secured to the column 11 by a stud pin 114 (Fig. 6) rigidly secured to a wall of the column 11 by a nut 115, and the lever 113 has a collar portion 116 that fits the pin 114. The inner end of the collar portion 116 abuts against a boss 117 of the column, and the lever is prevented from moving on the pin 114 away from the boss 117 by a disk 118 seated in a recess of the lever and secured to the pin 114 by a screw 119.

The lever 113, in the present instance, when moved to one position adjusts the valve means to admit pressure above the piston, and when moved to a second position, adjusts the valve means to admit pressure below the piston. It is therefore desirable to provide means for maintaining the lever 113 in either one or the other of these positions, and to this end the lever is provided with a plunger 120 mounted in a socket 121 and urged outwardly by a spring 122, the outer end of this plunger being adapted to enter either of the adjacent notches 123 formed in a block 124 secured to the column 11, see Fig. 16. The arrangement is such that a small projection 125 between the two notches 123 prevents the lever from coming to rest in an intermediate position.

It is desirable that the lever 113 shall be shifted from one position to the other by movement of the tool toward or from the work, and to this end, adjustable stops are carried by the sliding casing 52 to operate the lever. These stops, in the preesnt instance, comprise adjustable nuts 126 and 127 (see Fig. 7) mounted upon a threaded bolt 128 carried by a U-shaped bracket 129 secured by bolts 130 to the sliding casing 52. Each adjustable nut may be locked in its adjusted position by a lock nut 131.

It is desirable to provide the reverse lever 113 with means for placing the lever under the control of the adjustable stops 126, 127, or for releasing it from the control of the stops at the will of the operative; and to this end, a finger 132 is pivotally secured to the lever 113 in position to project into the path of movement of said stops. The finger 132 has a head 133 rotatably secured to the lever by a pin 134, and the head has a shallow notch 135 and a deep notch 136. When it is desired that the lever 113 be shifted by the traveling stops, the finger 132 is locked in the position shown in Fig. 16 by a sliding bolt 137 that enters the deep notch 136. As long as the finger is locked in this position it will be engaged by the stops 126 and 127 and the lever 113 will be shifted to effect movement of the piston 84 in first one direction and then the other. When it is desired to stop the reciprocating movement of the cutting tool, the bolt 137 is retracted, in a manner to be described, by the operative, whereupon as the stop 127 moves upwardly it will strike the finger 132, but instead of rocking the lever 113 it will rotate the finger upwardly out of the path of the stop, and the finger will be frictionally held in this new position by engagement of the bolt 137 with the shallow notch 135. The finger 132 will remain in the inactive position until the lever 113 is rocked by the operative, to effect a downward movement of the cutting tool, whereupon the lower face of the stop 127 will strike a surface 138 of the head 133, which surface was moved into the path of the stop by the upwardly rocking movement of the finger 132, as will be apparent from Fig. 3. Engagement of the stop 127 with the surface 138 rocks the finger 132 downwardly into position to bring the deep notch 136 into position to be engaged by the bolt 137. As the downward movement of the tool continues after the lower stop has engaged the surface 138, the upper stop 126 will strike the finger which is now locked in its active position and the lever 113 will be shifted to effect an upward movement of the tool. Whereupon, the tool will be reciprocated up and down through a distance defined by the adjustable stops until the bolt 137 is again retracted. The bolt 137 is projected by a spring 139 positioned between the pin 140 and an end of the bolt.

The mechanism just described effects automatic reciprocation of the tool and the length of stroke either toward or from the work may be controlled by adjusting the stops 126, 127, but it is desirable to provide means under the control of the operative to stop the reciprocating movement of the tool, and to bring the tool to rest in its uppermost position. Means to this end will now be described.

In the present instance, the control lever 113 is shifted by a treadle 141 although other means adapted to be controlled by the operative might be provided. The treadle 141 is pivoted at 142 to swing in a vertical plane and has a part 143 to be engaged by the foot of the operative. The lever is urged upwardly by a spring 144 and its upward movement may be limited by an adjustable bolt 145. Connected to the treadle 141 is an upwardly-extending bar 146, the upper end of which has a notch 147 adapted to receive a block 148 secured to the rear end of the lever 113 (see Figs. 3, 6 and 16). The bar 146 is urged toward the block 148 by a spring 149 within the hood 150 secured

to the column 11, and as the treadle is depressed the notch 147 of the bar is moved away from the block 148 by a fixed pin 151 that engages an inclined surface 152 of the bar 146. The arrangement is such that as long as the treadle 141 is in its uppermost position, the bar 146 will remain in the position shown in Fig. 3, in which the cut-away portion 153 of the bar permits the notch 147 to engage the rear end of the lever 113 and hold the lever in the upper position as shown in Fig. 3. This is the position of lever 113 that effects movement of the piston 84 to the upper end of its stroke.

As stated, the sliding bolt 37 that locks the finger 132 in its operative position may be retracted by the operative. This is accomplished in the present instance by lateral movement of the bar 146. As the operative removes his foot from the treadle, the bar 146 moves upwardly and is moved toward the block 148 under pressure of the spring 149, and this movement serves to retract the bolt 137 to release the finger 132. The bar 146 carries a block 155 positioned to abut the rear end of the sliding pin 156 to move this pin frontwardly. A rocking lever 157 is pivotally mounted at 158 upon the reverse lever 113 adjacent the forward end of the sliding pin 156. One end of the lever 157 fits in a notch 159 of the bolt 137 while an adjustable bolt 160 carried by the other end of the lever 157 engages the pin 156. The arrangement is such that frontward movement of the sliding pin 156 retracts the bolt 137.

From the mechanism just described, it will be seen that the lever 113 normally remains in the upper position shown in Fig. 3, with the piston at the top of its stroke, and with the bolt 137 retracted so that the finger may be rotated to its inactive position. As the treadle 141 is depressed it pulls the bar 146 downwardly and this bar, due to the engagement of the notch 147 with the reverse lever, moves this lever to the lower position. Further downward movement of the treadle causes the bar 146 to be moved rearwardly by the cam 151 and this rearward movement releases the reverse lever from the bar and permits the bolt 137 to be projected.

As stated, the reverse lever 113 serves to operate the valve mechanism which controls the pressure in the piston chamber 83; and the valve mechanism and the means for operating the same from the lever 113 will now be described.

In the embodiment of the invention illustrated, the pressure of the fluid in the piston chamber is controlled by a main valve 161 and the main valve in turn is controlled by an auxiliary valve 162 operated from the reverse lever 113 by a rocking lever 163. Various liquids may be used as the hydraulic pressure fluid, and it is found that oil is well adapted for the present purpose. Non-elastic fluids or liquids are preferred to elastic fluids as the operating medium, because the feeding movement imparted to the tool may be controlled more accurately by a non-elastic fluid than by an elastic fluid, and the former will exert the maximum feeding pressure promptly upon the tool while the latter will exert a pressure that increases due to expansion. The oil is supplied by a pipe 164 to the valve casing 165 (see Figs. 3 and 5) under pressure from a pump or other pressure-establishing means, and is led from the valve casing 165 by the pipe 166. Within the casing 165 is formed the main valve chamber 167 (see Figs. 5 and 15). This chamber is cylindrical in form and extends transversely of the valve casing. The ends of the chamber 167 are closed by cap plates 168 having hollow inwardly-extending bosses 169. About the central portion of the chamber 167 is formed an annular pocket 170 communicating with the high pressure chamber 171 (see Fig. 5), and to either side of the pocket 170 are formed annular pockets 172 and 173 arranged to be placed by the main valve 161 in communication with either the high pressure pocket 170 or the lower pressure pockets 174 and 175 surrounding the main valve. The ends of the valve 161 are slidably received in the hollow bosses 169, and about the valve are formed annular flanges 176 and 177. The arrangement is such that when the main valve is moved to the position shown in Fig. 15, the oil from the high pressure chamber 171 will pass from the pocket 170 into the valve chamber between the flanges 176 and 177 and then out through the pocket 173 to a conduit 177^a (Fig. 10) leading to the upper end of the cylinder; and while the valve 161 remains in the position shown in Fig. 15, communication is established between the lower end of the cylinder 98 and the low pressure pocket 174 by the conduit 178 leading from the bottom of the cylinder chamber to the pocket 172. If the valve 161 is moved to the opposite end of its chamber, communication will be established between high pressure pocket 170 and pocket 172, and between low pressure pocket 175 and pocket 173. The lower pressure pockets 174 and 175 open into the low pressure chamber 179 (Fig. 5).

As stated the reduced cylindrical portion 99 of the piston 84 slides in the neck 100, and moves downward in the auxiliary chamber 101. The liquid in the chamber 101 displaced by the downward movement of the reduced cylindrical portion 99 of the piston, escapes through the conduit 183 into the low pressure chamber 179, and the lower end of the reduced cylindrical portion 99 is notched as shown in Figs. 5 and 10 to permit liquid to pass from the chamber 98 to the chamber 101 when the piston 84 is in the uppermost

position. This permits the liquid that continues to enter the cylinder 98 below the piston 84, after the latter has completed its up stroke, to pass through these notches into the chamber 101 and out through the port 183. It is desirable to maintain the cylinders 98 and 101 full of liquid while the piston is in its uppermost position so that the piston will rest upon liquid as it moves downward and will not drop slightly. This is accomplished by providing a spring valve 180 (Fig. 5) which is slidably supported by its stem 181 and is urged upwardly against its valve seat by a spring 182.

It is found desirable to operate the main valve through an auxiliary valve rather than by mechanical connections between the main valve and reverse lever 113. In the present instance the main valve is shifted by establishing an oil pressure at first one end of the valve, then the other. This is accomplished by providing an auxiliary valve chamber 184 communicating with the high pressure pocket 170 through a port 185, Fig. 15, and upon each side of the port 185 are provided ports 186 and 187 leading from the chamber 184 to conduits 188 and 189 (see Figs. 13 and 19). The conduit 188 communicates with the chamber at one end of the main valve through an inclined port 190, and the conduit 189 communicates with the opposite end of the main valve through an inclined port 191. The arrangement is such that when the auxiliary valve 162 occupies the position shown in Fig. 15, oil passes from the high pressure port 185 to the port 186 and from there to the left-hand end of the main valve, while at the same time oil is permitted to escape from the right-hand end of the main valve through port 191, conduit 189, port 187, into the chamber 184, and from this chamber through port 192 to the curved conduit 193 (Fig. 13) which discharges into the oil space below the pressure valve 180 through port 194a. If the auxiliary valve is shifted from the position shown in Fig. 15 to that shown in Fig. 20, the oil will pass from port 185 to 187 and then to one end of the valve 161 and will escape from the other end of the valve through port 190, conduit 188, port 186, valve chamber 184, port 194, curved conduit 195 into port 194a. The curved conduits 193 and 195 it should be noted extend entirely around the face of the valve chest shown in Fig. 13 and serve to collect any liquid that may escape from the ports they surround.

The main valve 161 and auxiliary valve 162 are mounted in the casting of Fig. 13, and the flat face of this casting shown fits tightly against the flat face of the cylinder casting of Fig. 12 so that the ports 177a and 178 of Fig. 12 align with the parts 177b and 178b of Fig. 13 to conduct oil from the main valve chamber to the opposite ends of the cylinder 98.

As stated, the rocking lever 163 serves to impart movement of the reverse lever 113 to the auxiliary valve 162, and to this end the lever 163 is pivotally mounted at 195 upon the column 11 (see Fig. 3) and the upper end of the lever 163 straddles the valve 162 and has a slotted end that receives a pin 196 secured to the valve. The lower end of the lever 163 is bent and has a ball head 197 that enters an inclined slot 198 formed in a block 199 secured to the reverse lever 113. The arrangement is such that movement of the lever 113 moves the block 199 up or down relative to the ball head 197 and this rocks the lever 163 laterally to move the auxiliary valve either to the position shown in Fig. 15 or that shown in Fig. 20.

Under some conditions it may be desirable to vary the rate of speed at which oil is permitted to pass from the high pressure port 185 of the auxiliary valve to an end of the main valve. In the present instance this is accomplished by providing the auxiliary valve 162 with a wall 200 that blocks the flow of oil between ports 185 and 186. Communication between these ports is afforded by port 201 in the valve 162 having an adjustable screw 202 to control the flow of oil through this port.

It may happen that a small amount of air will find its way into the upper part of the piston chamber 83; to permit the escape of this air a valve 203 (Fig. 11) is provided at the upper end of the piston chamber and conduits 204 and 205 (Fig. 12) form a communication between this valve and the conduit 193.

In the present instance the oil pressure required to operate the hydraulic means is produced by a rotary pump 206 (see Fig. 1) mounted on an oil tank 207 and driven by an electric motor 208. The pressure pipe 164 leading to the valve chamber is connected to the pump by a pipe 209 and the return pipe 166 discharges into the tank 207 through a conduit 210. The pump motor and the bit-driving motor may be controlled by push-button-switches 211 and 212 (see Fig. 2).

It sometimes happens that as the tool is moved upwardly it pulls the work 30 upwardly in the vise, and to prevent the work from being carried upwardly by the tool, adjustable stops 213 may be provided.

In certain types of work it may be desirable to have the cutting tools "bottom" with a high degree of accuracy, that is, it may be desired that each downward stroke of the tool shall stop at a predetermined point with a higher degree of accuracy than can be obtained by adjusting the stop 126. To this end the lower face of the piston head may be

provided with a washer 214 of fibre or other suitable material, adapted to strike against the surface 214ª at the lower end of the piston chamber. When it is desired that the downward movement of the tool shall be stopped by the washer 214 striking against the surface 214ª, the stop 126 is positioned to permit this to occur.

It is important that the bit and chisel shall not be fed against the work by a force great enough to injure them. It sometimes happens that the bit-driving motor is unable to rotate the bit against the work, in which case the bit will be injured if the feeding means continues to force it against the work after it has stopped cutting. The hydraulic feeding means described is admirably adapted to prevent the bit and chisel from being fed against the work with an excessive force, because the force with which the bit and chisel are fed against the work depends upon the pressure of the hydraulic operating fluid, and this pressure may readily be controlled by an adjustable relief valve. In the present instance the pump 206 is provided with an adjustable relief valve 227 (see Fig. 1) which may be adjusted to control the maximum pressure exerted upon the piston 84 by the oil. The speed at which the tool-carrying means will be reciprocated toward and from the work will depend on the velocity with which oil is supplied to the cylinder 84 and this may be controlled by varying the velocity with which oil is delivered from the pump 206.

The operation of the mechanism for reciprocating the tool supporting head is briefly as follows:

The reverse lever 113 is normally held by the bar 146 in the position shown in Fig. 3, and reciprocating movement is imparted to the tool 63 upon depressing the foot treadle 143. This rocks the lever 113 downward and places the same under the control of the traveling stops 126 and 127 which shift the lever back and forth to reverse the vertical movement of the tool 63. Movement of the lever 113 shifts the auxiliary valve 162 to admit liquid to one end or the other of the main valve 161, to thereby shift the main valve to admit liquid under pressure to one end of the cylinder 98 or the other. As soon as the operator removes his foot from the treadle 143 the lever 113 is automatically rocked upwardly to admit liquid to the under side of the piston 84 so that the tool 63 will be carried to its uppermost position and the piston 84 is held in this position by the counter balancing spring 109, but it may be also supported by the liquid that continues to enter the cylinder 98 below the piston and which escapes through the notches at the lower end of the reduced piston 99 and into the lower cylinder 101 to escape through the port 183 toward the spring operated valve 180.

An important requirement of mortising machines of the type to which the present invention relates, is that the machine be constructed to feed the tools rapidly into the work and to withdraw the tools rapidly from the work. This is necessary to economize in time, and also because a wood cutting bit works best when fed forward at a speed sufficiently high to keep the cutting lips in new wood, and if the bit is fed at a slower speed it is likely to be heated and burnt by friction. The hydraulic means of the present invention is constructed with these requirements in mind. The primary and secondary valves are constructed so that they will operate promptly, and the ports leading to the opposite ends of the cylinder are relatively large as compared to the area of the cylinder so that the latter may fill and empty quickly. Furthermore by using a non-elastic fluid as the operating medium the feeding movement imparted to the tool may be controlled with a high degree of accuracy.

From the foregoing description when read in connection with the drawings, it will be apparent that the hydraulic means for moving the tool toward and from its work may be adjusted to vary the length of stroke and the point at which the reverse movement will be effected; that the tool will automatically return to its uppermost position when the operative removes his foot from the treadle; that the parts will operate smoothly and may be operated at any desired speed by varying the speed at which the operating fluid is delivered to the hydraulic cylinder; that the maximum pressure of feed upon the tool may be accurately controlled by controlling the maximum pressure of the operating liquid; and that the present construction possesses various other advantages.

What is claim is:—

1. In a wood working machine for operating a bit and hollow mortising chisel, in combination, means for non-rotatably supporting a hollow mortising chisel, means for rotating a bit within the hollow chisel, and hydraulically operated means for exerting a predetermined feeding pressure upon the bit and chisel so that if either the bit or chisel strikes a hard spot in the work the feeding movement of both will be arrested.

2. In a wood working machine for operating a bit and hollow mortising chisel, in combination, means for non-rotatably supporting a hollow mortising chisel, means for rotating a bit within the hollow chisel, and hydraulically operated means for moving the bit and chisel toward and from the work and adapted to exert a predetermined feeding pressure upon the bit and chisel so that if either the bit or chisel strikes a hard spot in the

work the feeding movement of both will be arrested.

3. In a wood working machine for operating a bit and hollow mortising chisel, in combination, means for non-rotatably supporting a hollow mortising chisel, means for rotating a bit within the hollow chisel, hydraulically operated means for exerting a predetermined feeding pressure upon the bit and chisel so that if either the bit or chisel strikes a hard spot in the work the feeding movement of both will be arrested, and adjustable stops positioned to operate the hydraulic means to effect repeated up and down movement of the bit and chisel.

4. In a wood working machine for operating a bit and hollow mortising chisel, in combination, means for non-rotatably supporting a hollow mortising chisel, means for rotating a bit within the hollow chisel, non-elastic fluid-operated means for moving the bit and chisel toward and from the work, and constructed and arranged to control with a high degree of accuracy the range of feeding movement imparted to the bit and chisel.

5. In a wood working machine for operating a chisel, in combination, means for supporting a chisel, and hydraulic means operated by a non-elastic fluid to force the chisel into the wood and constructed and arranged to control with a high degree of accuracy the range of cutting movement imparted to the chisel.

6. In a wood working machine, in combination, means for supporting a chisel of the type in which the entire cutting surface is formed at the end of the chisel, non-elastic fluid-operated means for forcing the chisel into the wood, and valve means for controlling the flow of the actuating fluid to the operating means to thereby control with a high degree of accuracy the range of cutting movement imparted to the chisel.

7. In a wood working machine, in combination, means for supporting a chisel of the type in which the entire cutting surface is formed at the end of the chisel, hydraulic means operated by a non-elastic fluid to force the chisel into wood, and automatically controlled valve means for arresting the feeding movement imparted to the chisel.

8. In a wood working machine, in combination, means for supporting a chisel of the type in which the entire cutting surface is formed at the end of the chisel, and hydraulic means operated by a non-elastic fluid to force the chisel into cutting engagement with the work and for withdrawing it from the work.

9. In a wood working machine, in combination, means for supporting a chisel, and hydraulic means operated by a non-elastic fluid to move the chisel to and from the work with a slow working stroke and a quick return.

10. In a wood working machine, in combination, a hollow mortise chisel, and hydraulically operated means for supporting the chisel and operated by a non-elastic fluid to impart a cutting movement to the chisel.

11. In a wood working machine, in combination, a bit and hollow chisel, means for rotating the bit, and hydraulic means operated by a non-elastic fluid to move the bit and chisel to and from the work with a slow working stroke and a quick return.

12. In a wood working machine, in combination, a bit and hollow chisel, means for rotating the bit, hydraulic means operated by a non-elastic fluid to move the bit and chisel to and from the work, and adjustable stops for reversing the direction of movement of the bit and chisel.

13. In a wood working machine, in combination, a bit and a hollow chisel, means for rotating the bit, non-elastic fluid-actuated means for repeatedly reciprocating the bit and chisel to feed them into the work and withdraw them therefrom, and operative-controlled means for starting and stopping the reciprocatory operation.

14. In a wood working machine, in combination, chisel supporting means, non-elastic fluid-operated means for moving the chisel into and out of cutting engagement with the work, adjustable stops for controlling the extent of movement of the chisel to and from the work, and operative-controlled means for effecting movement of the chisel by it fluid-operated means beyond the control of said stops.

15. In a wood working machine, in combination, a bit and hollow chisel, means for rotating the bit, hydraulic means for moving the bit and chisel into and out of cutting engagement with the work, and shiftable means operated by the hydraulic means to reverse the direction of movement of the bit and chisel as they travel in either direction.

16. In a wood working machine, in combination, a bit and hollow chisel, means for rotating the bit, hydraulic means for moving the bit and chisel into and out of cutting engagement with the work, adjustable stops for causing the bit and chisel to reciprocate between selected points, operative-controlled means operable independently of said stops to arrest the movement of the bit and chisel toward the work and for automatically bringing the bit and chisel to rest in their uppermost position.

17. In a wood working machine, in combination, a bit and hollow chisel, means for rotating the bit, hydraulic means for moving the bit and chisel along a path of predetermined length, and adjustable means for effecting reciprocation of the bit and

chisel by the hydraulic means between any two points along said path.

18. In a wood working machine, in combination, chisel supporting means, hydraulic means for moving the chisel along a path of predetermined length to force the chisel into engagement with the work and to withdrawing it therefrom, and adjustable stops for effecting reciprocation of the chisel by the hydraulic means between any two points along said path.

19. In a wood working machine, in combination, a bit and hollow chisel, means for rotating the bit, hydraulic means for moving the bit and chisel along a path of predetermined length, adjustable stops for effecting reciprocation of the bit and chisel by the hydraulic means between any two points along said path, and operative-controlled means for effecting movement of the bit and chisel by the hydraulic means to a position beyond the control of said stops.

20. In a woodworking machine, in combination, a bit, and hollow chisel, means for rotating the bit, hydraulic means for reciproting the bit and chisel to move them into and out of cutting engagement with the work, and operative-controlled means operable to arrest in any position the movement of the bit and chisel toward the work and adapted to cause them to move away from the work.

21. In a machine of the class described, in combination, means for supporting a tool for movement toward and from the work, hydraulic means for moving the tool into cutting engagement with the work and for withdrawing it therefrom, a lever for controlling the operation of the hydraulic means and mounted to be rocked to one position to move the tool into the work and rocked in the opposite direction to withdraw the tool, stops for shifting said lever, and operative-controlled means for shifting said lever independently of the stops to relieve the lever from the control of the stops and to withdraw the tool to a position beyond its path of travel as determined by the stops.

22. In a machine of the class described, in combination, means for supporting a tool for movement toward and from the work, hydraulic means for moving the tool into cutting engagement with the work and for withdrawing it therefrom, a lever for controlling the hydraulic movement of the tool and mounted to be held frictionally in one position that effects movement of the tool toward the work and to be held frictionally in a second position that effects movement of the tool from the work, traveling stops for shifting said lever, and operative-controlled means for shifting said lever independently of the stops and adapted to relieve the lever from the control of said stops.

23. In a machine of the class described, in combination, means for supporting a tool for movement toward and from the work, hydraulic means for moving the tool into cutting engagement with the work and for withdrawing it therefrom, a lever for controlling the hydraulic movement of the tool, stops for shifting said lever, and an extension upon the lever for imparting the shifting movement of the stops to the lever, a lock for said extension, and means controlled by an operative to release said lock so that the stops may move the extension into and out of its locked position to thereby release the lever from the control of the stops and restore it to the control of the stops respectively.

24. In a wood working machine, in combination, means for supporting a chisel for movement toward and from the work, hydraulic means for moving the chisel into the work and for withdrawing it therefrom, and adjustable means for controlling the pressure of the fluid upon the hydraulic means so that the cutting pressure upon the chisel may be prevented from exceeding a predetermined pressure.

25. In a machine of the class described, in combination, a cutting tool, hydraulic means for moving the tool to and from the work, a movable lever operable when moved in one position to effect movement of the tool toward the work and when moved to a second position to effect movement of the tool from the work, adjustable stops mounted to travel with said tool for shifting the lever from one position to the other, operative-controlled means for shifting the lever independently of the stops, and means operable by one of said stops for releasing the lever from the control of said stops.

26. In a machine of the class described, in combination, a bit and hollow chisel, means for rotating the bit, hydraulic means for moving the bit and chisel to and from the work, a reverse lever operable when moved in one position to effect movement of the bit and chisel toward the work, and when moved to a second position to effect movement of the bit and chisel from the work, adjustable stops mounted to travel with the bit and chisel and adapted to shift the lever from one position to the other, and operative-controlled means for releasing the lever from the control of said stops, and means actuated by the bit and chisel moving means for restoring the lever to the control of said stops.

27. In a machine of the class described, in combination, a cutting tool, hydraulic means for moving the tool to and from the work, a reverse lever operable to reverse the direction of movement of the tool by the hydraulic means, adjustable stops mounted to travel with the tool to operate the reverse lever, a finger mounted upon the reverse

lever to impart movement from the stops to the lever and movable to and from the stop-engaging position, means for normally holding said finger in position to cause the stops to shift the lever, means for moving the finger out of stop engaging position, and means actuated by the hydraulic means for moving the finger into the stop engaging position.

28. In a machine of the class described, in combination, a cutting tool, hydraulic means for moving the tool into and out of cutting engagement with the work, a reverse lever for reversing the direction of movement of the tool as it moves toward and from the work, adjustable means operable by the hydraulic means to shift the reverse lever in either direction, and treadle controlled means for holding the reverse lever in one position and operable to move the lever to a second position and then release the lever for movement independent of the treadle means.

29. In a machine of the class described, in combination, a cutting tool, hydraulic means for moving the tool into and out of cutting engagement with the work, a reverse lever movable to one position to effect movement of the tool in one direction and movable to a second position to effect movement of the tool in an opposite direction, adjustable stops mounted to travel with the tool to shift the reverse lever, a finger mounted upon the reverse lever in position to be moved to and from the stop engaging position by the stops, and means for normally holding said finger in the stop engaging position to cause the stops to shift the lever.

30. In a machine of the class described, in combination, means for supporting a tool for movement toward and from the work, fluid actuated means for forcing the tool into engagement with the work and for withdrawing it from the work, a lever for controlling the operation of the fluid means and mounted to be rocked to one position to move the tool toward the work and rocked to a second position to move the tool from the work, traveling stops for shifting the lever back and forth from one position to the other, a finger movably mounted upon the lever and adapted to impart movement from the stops to the lever, and locking means for securing the finger in its active position and adapted to be moved to a second position to release the finger for movement of the finger to an inactive position by one of said stops.

31. In a machine of the class described, in combination, means for supporting a tool for movement toward and from the work, fluid actuated means for forcing the tool into engagement with the work and for withdrawing it from the work, a lever for controlling the operation of the fluid means and mounted to be rocked to one position to move the tool toward the work and rocked to a second position to move the tool from the work, traveling stops for shifting the lever back and forth from one position to the other, a finger movably mounted upon the lever and adapted to impart movement from the stops to the lever, locking means movable to and from locking position for holding the finger in its active position, and means operable by the movement of a stop in one direction to move the unlocked finger to its inactive position and operable by the movement of a stop in the opposite direction to move the finger to its active position.

32. A chisel and bit mortising machine comprising the combination with the chisel and bit and means for rotating the bit and hydraulic operated means and controls for automatically repeatedly reciprocating the chisel and bit, of means controlled by the operator so governing the control of the hydraulic operated means at any stage of the reciprocating movement as, according to the position of the chisel and bit, to cause it to move and stop at its uppermost position, or to remain there if it be there.

33. In a chisel and bit mortising machine, in combination, means for rotating a bit, hydraulic operated means for moving the bit and chisel to and from the work, mechanism for controlling the hydraulic means to effect automatically repeated reciprocation of the chisel and bit, and means controlled by the operator for governing said control mechanism and constructed and arranged to actuate the latter to arrest movement of the chisel and bit toward the work at any stage and move them to the maximum withdrawal position to remain there until the operator controlled means is again actuated.

34. In a wood working machine for operating a bit and hollow mortising chisel, in combination, a motor for rotating a bit at a high speed, inelastic fluid feed means for moving the bit and hollow chisel toward and from the work, adjustable stops for varying the length of the operative strokes imparted to the bit and chisel by the fluid feed means, and pressure responsive means for relieving the operating fluid pressure to relieve the bit and chisel from excessive feeding pressure.

In testimony whereof, I have signed my name to this specification.

ALPHONZO WHITE.