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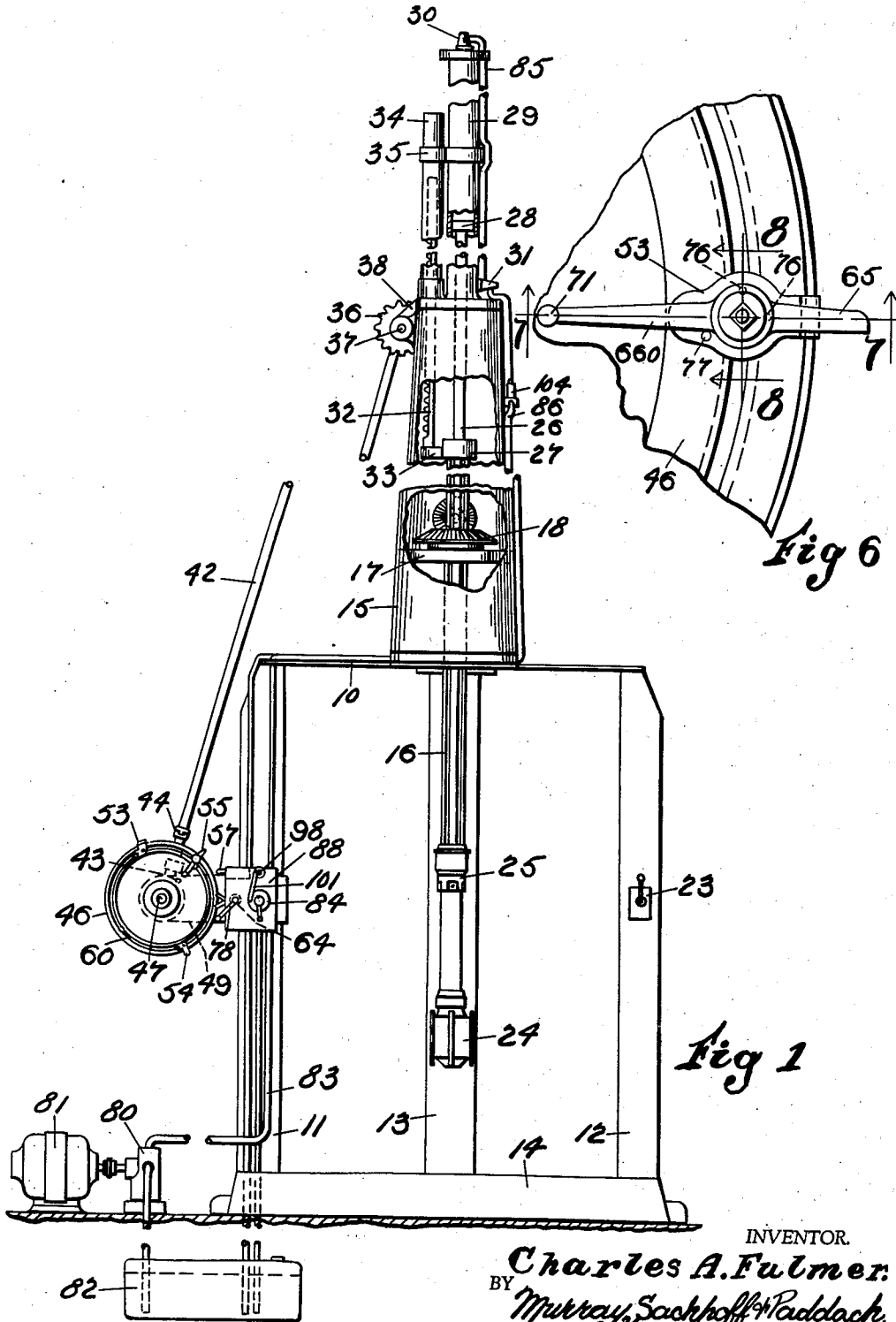
C. A. FULMER

2,297,953

HONING MACHINE

Filed Feb. 25, 1941

4 Sheets-Sheet 1



**Oct. 6, 1942.**

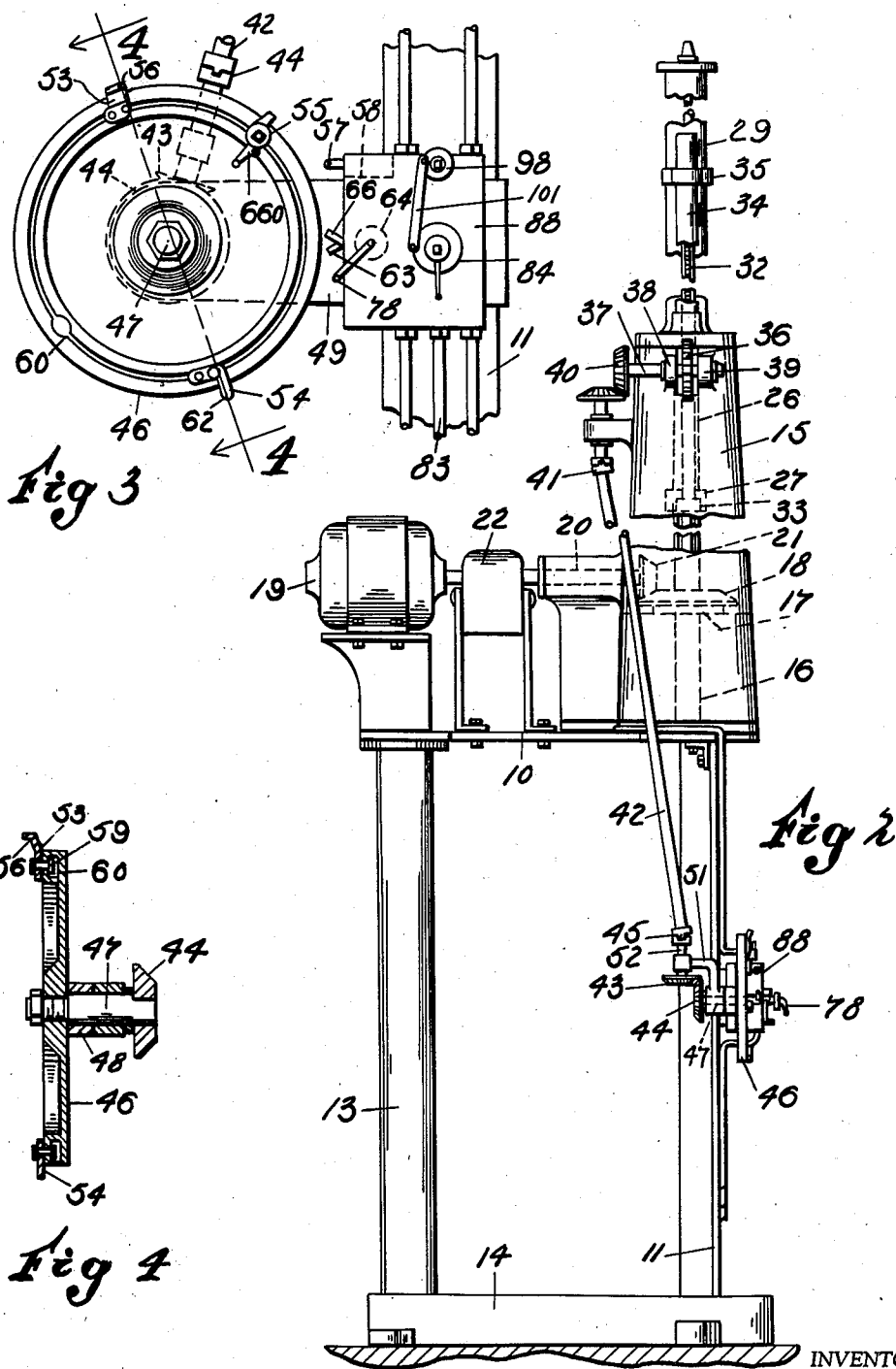
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## HONING MACHINE

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4 Sheets-Sheet 2



INVENTOR.

Charles A. Fulmer  
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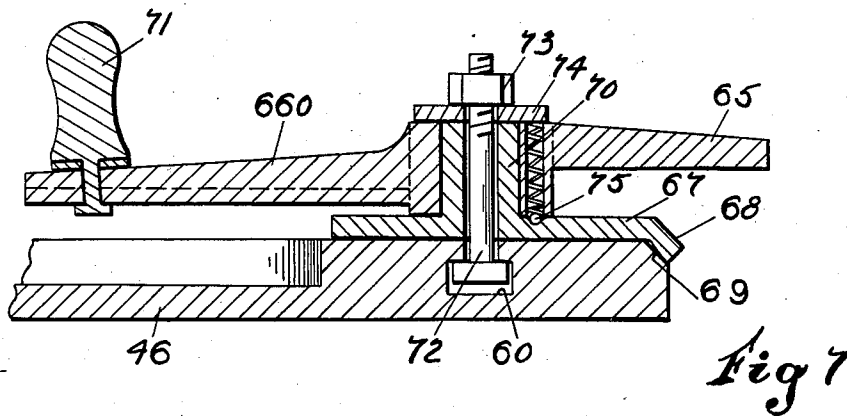
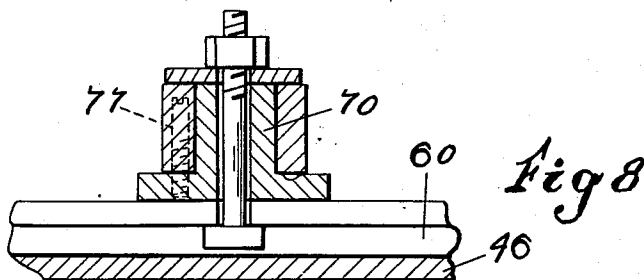
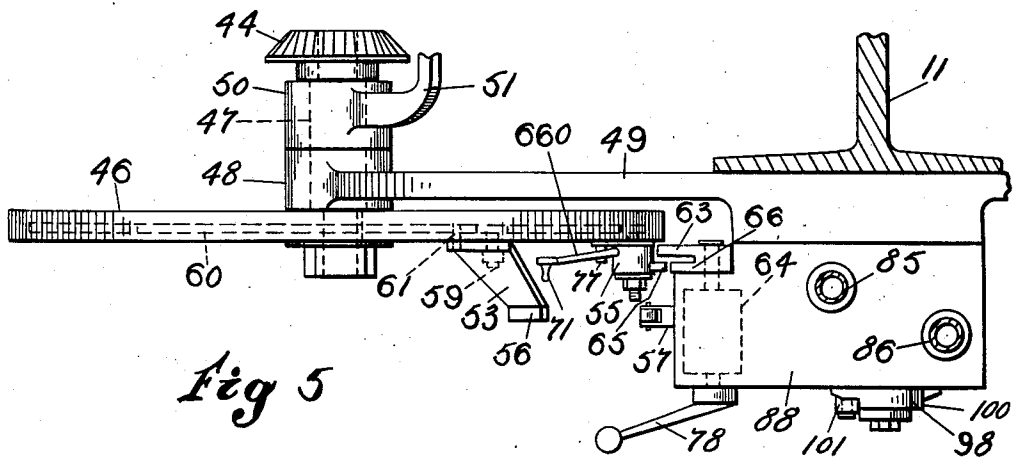
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HONING MACHINE

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4 Sheets-Sheet 3



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4 Sheets-Sheet 4

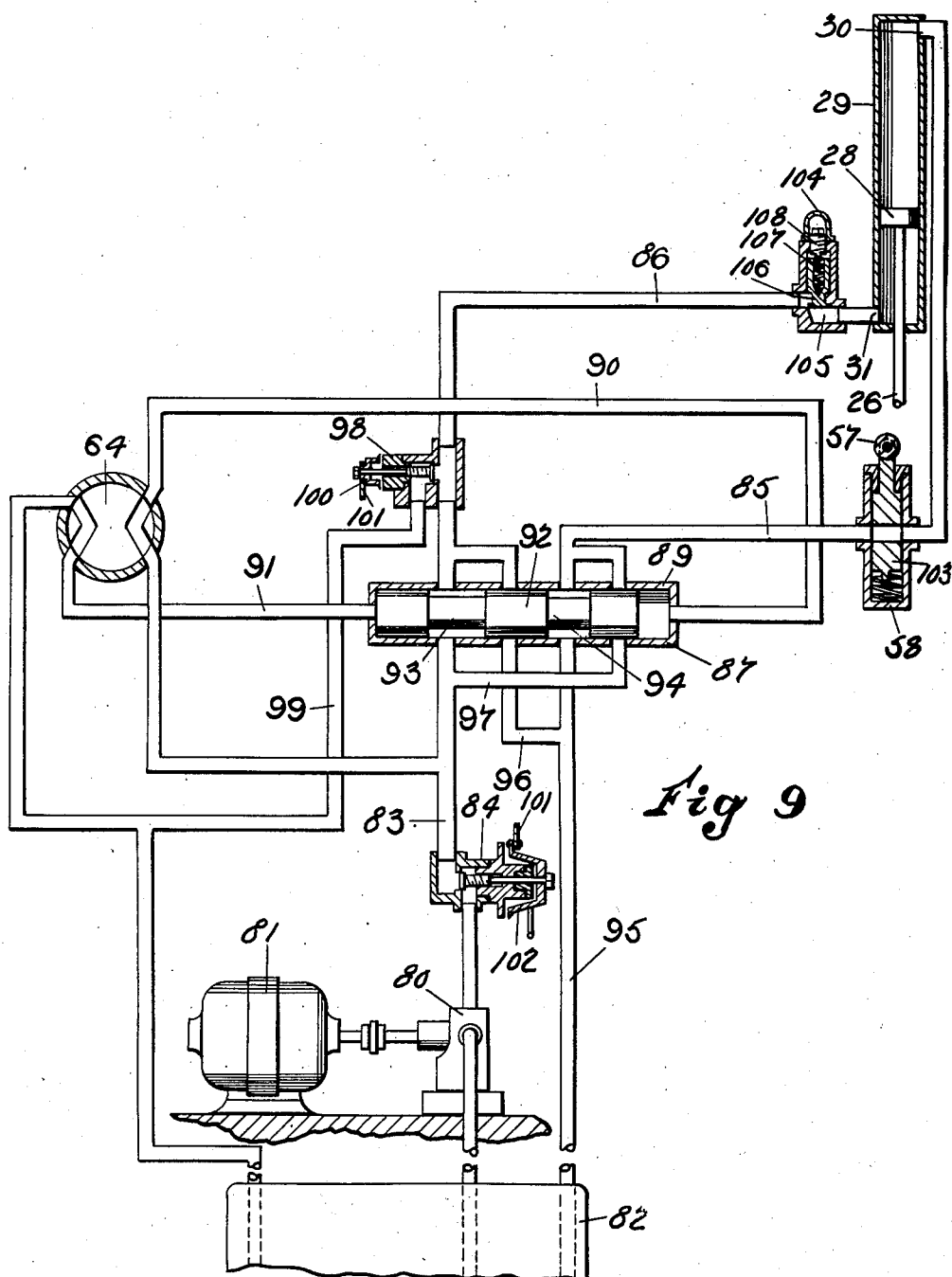


Fig 9

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## UNITED STATES PATENT OFFICE

2,297,953

## HONING MACHINE

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Application February 25, 1941, Serial No. 380,513

6 Claims. (Cl. 51—34)

The present invention relates to improvements in cylinder honing or grinding machines and is particularly directed to controls for this type of machine.

An object of the invention is to provide a means particularly adapted to vertical honing machines which will conveniently position all the controls for reciprocating the tool-carrying part for said machine within reach of an operator occupying his usual station beside the machine in proximity to the work operated upon.

Another object of the invention is to provide a means for disposing the adjustable mechanism for controlling the working stroke and the in-operative position of the reciprocating tool-carrying part of a honing machine in a place on the machine accessible to the operator thereof located at his machine station.

A still further object of the invention is to provide a simple and efficient means of reducing the time now required for performing a certain cylinder honing job and to further facilitate adjusting the machine to operate on cylinders of varying lengths.

Another object of the invention is to provide a means of synchronizing controls for a vertical honing machine with the moving tool-carrying part, said controls being located adjacent the tool of said machine.

Another object of the invention is to provide hydraulic means for actuating the tool-carrying part controlled by my novel synchronizing and adjustment mechanism having the following novel functions: the reciprocating tool may be positively stopped in any desired position; the limit stops on an oscillating control disk are positioned in individual planes for directly operating the control means for the hydraulic operated tool-carrying part; and the tool may be held stationary in any position by a counterbalance valve which will hydraulically equalize the weight of the reciprocated mass whether the machine is operative or entirely shut down.

Other objects of the invention will be apparent from the following specification and drawings, in which:

Fig. 1 is a fragmental front elevational view of a honing machine fitted with my control mechanism.

Fig. 2 is a fragmental side elevational view of the machine shown in Fig. 1.

Fig. 3 is a front elevational view of the oscillating member comprising a part of the control mechanism.

Fig. 4 is a cross-sectional view taken on line 4—4 of Fig. 3.

Fig. 5 is an enlarged detail plan view of the control mechanism shown in Fig. 3, parts thereof being broken away or shown in cross-section.

Fig. 6 is a fragmental enlarged plan view of the intermediate stop for my oscillating member.

Fig. 7 is an enlarged cross-sectional view taken on line 7—7 of Fig. 6.

Fig. 8 is an enlarged cross-sectional view taken on line 8—8 of Fig. 6.

Fig. 9 is a diagrammatical view of the hydraulic system employed in connection with my controls for actuating the tool-carrying part of a honing machine.

The accompanying drawings illustrate the preferred form of my invention associated with a conventional honing machine of the vertical type. The machine consists of a raised platform 10 supported at its front edge by two spaced legs 11 and 12 and by a rear leg 13; the lower ends of said legs being rigidly fastened to a base member 14. Extending upwardly from the front central portion of the platform is a conical housing 15 in which a rotating and reciprocating part, which takes the form of a splined spindle 16, is positioned. The housing has a web 17 upon which is journaled a bevel gear 18 having a splined connection with the spindle 16. The means for driving the bevel gear 18, thereby rotating the spindle, comprises a motor 19 for driving a shaft 20 connected to a bevel 21 meshed with the bevel gear 18. A variable speed drive and clutch mechanism 22 is interposed between the shaft 20 and the motor for rotating the spindle at any desirable speed by means of a gear shift mechanism 23 mounted on the front of the machine at the operator's station (Fig. 1). A honing tool 24 is fastened to the lower end of the spindle by means of a universal joint 25 and is disposed in axial alignment with said spindle. The upper end of the spindle is connected to a piston rod 26 by a coupling 27 which permits rotation of said spindle relative to the rod. The upper end of the piston rod is connected to piston 28 which is adapted for reciprocation in a cylinder 29, the latter being in axial alignment with the spindle and positioned on the housing 15. Reciprocation of the piston is accomplished within the cylinder by the alternate introduction of fluid under pressure into the upper duct 30 and the lower duct 31 communicating with the interior of the cylinder ends.

Mechanism for controlling the hydraulic means which actuates the spindle by means of the piston

arrangement described consists of a rack 32 rigidly connected at its lower end to the coupling 27 by an arm 33. The lower end of the rack is enclosed in the housing 15 while its upper part moves in a sleeve and guide 34, the upper end of said guide being fastened to the cylinder by a clamp 35. A pinion 36 is rigidly fastened to a stud shaft 37, the latter being rotatably mounted in spaced extensions 38 and 39 formed on the housing 15, said pinion being held thereon in position to engage the teeth formed in the rack 32. The free end of the stud shaft drives a pair of bevel gears 40 which are connected by means of a universal joint 41 to an elongated drive shaft 42. The lower end of the drive shaft rotates a pair of bevel gears 43 and 44 through a universal joint 45. The gear 44 is adapted to actuate an oscillating member 46 which takes the form of a disk pinned to a shaft 47 which, in turn, is rigidly connected to the gear 44. The shaft is journaled in a sleeve 48 which is mounted on a leg 11 of the machine frame by means of an arm 49 (Fig. 5). The bevel gear 43 is supported by means of a rotatable sleeve 50 having an extension 51 through which its stud shaft 52 extends and is rotatably mounted. It will therefore be understood that the rectilinear reciprocating motion of the tool-carrying spindle is translated into oscillating circular motion of the member 46 through the mechanism described, the gear ratio of the mechanism being such that one stroke of the spindle will produce one oscillation of the member 46.

The oscillating member, as shown in Figs. 1 and 2, is positioned at the operator's station and has adjustably positioned thereon an upper limit stop 53, a lower limit stop 54, and an intermediate stop 55 which predetermine the working cycle of the tool-carrying part and also its upper inoperative position.

The upper limit stop 53 has an extended portion 56 (Figs. 3, 4 and 5) which projects beyond the periphery of the disk and also forwardly into a parallel plane outside the plane of the disk. The extended portion 56 is adapted to engage a finger 57 for operating a locking valve 58. This valve automatically controls the hydraulic means for holding the piston in its uppermost inoperative position. In this position the honing tool may be outside and above the work being operated upon depending upon the relative location of the stop 53 on the disk. The upper limit stop 56 is positioned on the disk by means of a bolt 59 having the head thereof engaged in an annular T-slot 60 formed in the disk, the stop being held in a radial position relative to said disk by means of a pin 61 fastened to the stop and extending into said slot. Adjustment of the stop may be had by loosening the bolt 59 and moving it to the desired position in the slot. The lower limit stop 54 is radially held in position on the disk in a manner similar to the means for holding the upper limit stop in position, said lower limit stop having an extension 62 extending from the periphery of the disk and in a plane adapted to engage a finger 63. As shown in Fig. 5, the finger 63 is adapted to actuate a pilot valve 64 for reversing the tool-carrying part of the machine from a downward direction to an upward one at its lower limit of travel. The intermediate stop 55, as shown in Figs. 6, 7 and 8, having an extension 65 thereon for engaging a finger 66 on the pilot valve, is rotatable from an operative to an inoperative position. This stop comprises a plate 67 having a down-turned portion 68 for

engaging a bevel edge 69 on the disk to thereby hold the plate in a radial position regardless of its adjusted peripheral position. The plate has an upstanding annular portion 70 thereon for rotatably receiving the extension 65 which has an integral lever portion 660 attached thereto, said lever being provided at its outer end with a handle 71. The plate and stop are adjustably mounted on the disk by means of a bolt 72, the head thereof being positioned in the T-slot 60 and the nut 73 therefor being adapted when tightened to hold a washer 74 against the portion 70 to rotatably hold the stop relative to the plate. A ball detent 75, when registered with two spaced holes 76 in the plate, is adapted to hold the stop in an operative or an inoperative position. A pin 77 (Figs. 6 and 8) is positioned on the plate to engage the lever 660 and hold the stop in operative position to engage the finger 66 on the pilot valve. As shown in Fig. 5, the pilot valve may also be operated manually by means of a hand lever 78. As clearly shown in Fig. 5, the two fingers for controlling the pilot valve and the finger for operating the locking valve are in different planes and are adapted for engagement with their respective limit stops and the intermediate stop on the disk when the latter member is oscillated. The positions of the lower limit stop 54 and the intermediate stop 55 are adapted to determine the upper and lower limits of motion of the tool-carrying part during its reciprocating working motion, said stops being adapted to operate the pilot valve 64 to reverse the hydraulically controlled piston fastened to said part. When the intermediate stop is moved to inoperative position with its extension 65 within the periphery of the disk so that said extension will not engage the finger 66 on the pilot valve, the hydraulic means will continue to move the tool-carrying part upwardly until the disk has been rotated to bring the upper limit stop 53 into engagement with the finger 57 which will automatically stop the part in its upper inoperative position.

The valve means or system for controlling the hydraulic means is shown diagrammatically in Fig. 9 and consists of a pump 80 driven by a motor 81 for creating the necessary fluid pressure for the system. The pump has a conventional spring-loaded valve therein which returns fluid to the sump tank 82 when the pressure in the main line 83 exceeds a definite maximum pressure. Interposed in the main line 83 is a manually operated volume control valve 84 for maintaining any desired volume in the system between the maximum pump capacity and zero. The piston 28 is reciprocated within the cylinder 29 by alternately introducing fluid under pressure into the branch pressure line 85 communicating with the upper duct 30 in the cylinder and the branch pressure line 86 connected to the lower duct 31 which is the cylinder side through which the piston rod 26 passes. The branch lines are alternately and simultaneously pressure and drain lines for the pressure-transmitting medium, it being understood that when branch line 86 is introducing fluid under pressure to the lower end of the cylinder, branch line 85 will be draining fluid to the sump tank and vice versa.

The means for alternately introducing pressure fluid to either side of the cylinder to reciprocate the tool-carrying part of the machine consists of a direction control valve 87 operated by the pilot valve 64. Both of these valves are housed in a valve box 88, the latter being posi-

tioned on the honing machine at the operator's station and having the oscillating disk 46 mounted thereon (Fig. 1). By turning the pilot valve 64 either manually by lever 78 (Fig. 5) or automatically by means of stops on the disk which engage fingers 63 or 66, the direction control valve may be reversed, thus reversing the direction of the piston 28. As shown in Fig. 9, the pilot valve is in position to admit fluid pressure from the main pressure line 83 to the right hand side of cylinder 89 through line 90. When the pilot valve is moved 90°, pressure fluid from the main line 83 will be admitted to the left side of the cylinder 89 by line 91, thus moving the piston 92 to the right. It will be noted that when line 90 is carrying pressure fluid to the direction control valve, line 91 is draining fluid to the sump tank 82 and vice versa. The piston 92 has two reduced portions 93 and 94 therein which act as passageways for the ports with which they are aligned. Thus in Fig. 9 the portion 93 has opened the main pressure line 83 to branch line 86 to introduce pressure to the lower side of the cylinder 29 while portion 94 has opened the drain line 95 to branch line 85. When the piston 92 is in the right side of the cylinder 89, portion 93 opens branch line 86 to auxiliary line 96 of drain line 95 while portion 94 opens branch line 85 to auxiliary line 97 communicating with main pressure line 83, thus changing branch line 85 from a drain to a pressure line and branch line 86 from a pressure line to a drain line.

The means for equalizing the speed of the piston 28 in either its upward or downward direction is similar to the apparatus in my co-pending application Serial No. 428,910 and consists of a proportioning valve 98 which is adjusted to constantly bleed a certain volume of fluid from branch line 86 into drain line 99 when pressure fluid is being introduced by line 86 into the lower part of cylinder 29, through which piston rod 26 passes. The adjustment means 100 on the proportioning valve is connected by link 101 to the adjustment means 102 on the main control valve 84 so that under varying speeds of the piston 28 made by adjusting valve 84, the proportioning valve will bleed off enough volume of fluid to equalize the piston motion under all speeds of piston travel.

The means for stopping the piston 28 in its upper inoperative position consists of the locking valve 58 having a finger 57 which is actuated by the upper limit stop 53 on the oscillating disk 46. As shown in Fig. 9, the locking valve has a piston 103 therein which is spring-urged to open position thereby permitting flow of fluid in either direction through branch line 85. When the operator wishes to place the tool-carrying part in upper inoperative position while the machine is operating within its working cycle, determined by the lower limit stop 54 and the intermediate stop 55, it is only necessary to turn the intermediate stop to inoperative position and the upper limit stop will be brought into engagement with the finger 57 to depress it thus closing the line 85. This precludes further draining of oil from the pipe and upper portion of the cylinder 29. As pressure fluid continues to be introduced at the bottom of the cylinder 29 a head of pressure will be built up in the upper part of the cylinder and in the line 85 between the locking valve and port 30 and also in the lower part of the cylinder which is equal to the maximum pressure at which the control valve 84 has been set to deliver fluid to the system 75

and thereafter, the piston 28 will be held rigid until the pilot valve is manually actuated for the next operation on the work. When the pilot valve is manually actuated to the position to move the piston 28 downwardly (the reverse position to that illustrated in Fig. 9) the line 86 will drain fluid from the lower end of the cylinder which had built up therein a head of pressure equal to the maximum pressure for the system. The release of this pressure fluid unbalances the pressure on the cylinder and permits the head of pressure in the upper part of the cylinder to move said piston downwardly a distance sufficient to permit a slight rotation of the control disk which moves the limit stop 53 off the finger 57 thereby permitting fluid pressure to enter the top of the cylinder through line 85 to continue the downward motion of said piston to its working cycle. It will be noted that the motors 19 and 81 continue running while the reciprocating tool is in its upper inoperative position and in the event complete shutdown of the machine is desired electric circuits to said motors may be opened. A counterbalance valve 104 interposed in line 86 will then hold sufficient fluid pressure in the lower part of cylinder 29 to sustain the weight of the reciprocated mass.

A means for holding the reciprocated part of the machine and its associated parts in equilibrium regardless of the position at which said parts come to rest consists of a counterbalance valve 104 interposed in the lower cylinder branch line 86. The valve has a passageway 105 there-through in which a plunger 106 is seated; said plunger having enlarged disk-like heads of unequal diameter (Fig. 9). The upper head of the plunger has the greatest diameter so that pressure fluid in line 86 will unseat the plunger and allow said fluid to enter the cylinder 29. The plunger is urged to seated position by spring 107 which can be adjustably compressed by threaded boss 108. The pressure exerted by said spring should be just great enough to retain fluid in the lower side of the cylinder when branch line 86 acts as a drain line, thus sustaining the reciprocated mass in equilibrium.

What is claimed is:

1. In a honing machine having a rotating and reciprocating spindle connected at its lower end to an axially disposed tool and rotatable at its upper end in a coupling connecting it to an hydraulic means, the combination of a valve means for controlling the hydraulic means, an oscillating disk mounted adjacent the valve means, stops on the disk for directly engaging the valve means, a rack fastened to the coupling, a pinion meshed with the rack, an elongated drive shaft, a geared connection between the pinion and the shaft, and a geared connection between the lower end of the shaft and the oscillating disk.

2. In a honing machine having a rotating and reciprocating spindle connected at its lower end to an axially disposed tool, and connected at its upper end to an hydraulic means, the combination of a valve means for controlling the hydraulic means and comprising a pilot valve for reversing the direction of travel of the spindle during its working cycle, and a limit valve for locking the spindle in its upper inoperative position, arms for the valve means disposed in different parallel planes, an oscillating disk mounted adjacent the valve means, a circular guide-way for the member positioned concentrically

with its axis, a number of stops adjustably mounted in the guideway and each extending into the plane of one of the arms to engage it at a predetermined position of the oscillating member, means for rotatably mounting one of said stops for manually moving it to operative or inoperative positions relative to the valve means, and means associated with the spindle for oscillating the disk.

3. In a honing machine having a rotating and reciprocating spindle connected at its lower end to an axially disposed tool and connected at its upper end to an hydraulic means in axial alignment therewith, the combination of a valve means for controlling the hydraulic means, arms for the valve means disposed in different parallel planes, an oscillating member mounted adjacent the valve means, a circular guideway for the member positioned concentrically with its axis, a number of stops adjustably mounted in the guideway, each stop extending into the plane of one of the arms controlling the valve means and each stop adapted to engage one of said arms at a predetermined position of the oscillating member, means for rotatably mounting one of said stops for moving it to operative or inoperative positions relative to the valve means, and means associated with the spindle for oscillating the member.

4. In a honing machine the combination of a base having a raised platform supported by elongated legs, a housing upon the base, a rotating and vertically reciprocating spindle movable within the housing and having its lower extremity depending below the platform, an axially disposed tool connected to the lower end of the spindle, a coupling device at the upper end of the spindle, an hydraulic cylinder mounted upon the housing in axial alignment with the spindle, a piston movable in the cylinder, a piston rod fastened to the piston and extending into the housing and having a driving connection with the coupling, a rack in parallelism with the cylinder and mounted at its lower end to the coupling, said rack extending upwardly through an aperture formed in the housing, a sleeve positioned on the housing and adapted to enclose the rack, an elongated drive shaft, a pinion meshed with

the rack, a geared connection between the upper end of the shaft and the pinion, an hydraulic system communicating with both ends of the cylinder, an oscillating control member for the system and adapted to alternately introduce pressure fluid into the ends of the cylinder, and a geared connection between the lower end of the shaft and the oscillating member.

5. In a honing machine the combination of a vertically reciprocating and a rotating tool actuating means, an hydraulic cylinder connected with said means, an hydraulic system communicating with the upper and lower ends of the cylinder, an oscillating disk having a geared connection with said means, a pilot valve in the system and positioned adjacent the periphery of the disk, stops on the disk for actuating the pilot valve to alternately introduce pressure fluid into the upper and lower ends of the cylinder during the working cycle of the means, an upper limit valve in the system mounted adjacent the periphery of the disk and adapted on actuation to close the upper end of the cylinder while pressure fluid is being introduced in the lower end thereof and a stop on the disk for actuating the limit valve.

6. In a honing machine the combination of a reciprocating and rotating spindle, an axially disposed tool connected to the lower end of the spindle, a vertical cylinder positioned coaxially above the spindle, a piston in the cylinder, a rod connecting the piston to the spindle, an hydraulic system communicating with the upper and lower ends of the cylinder, an oscillating disk having a driving connection with the spindle, a pilot valve in the system disposed adjacent the periphery of the disk and adapted upon actuation to alternately introduce pressure fluid to the ends of the cylinder and reciprocate the tool during its working cycle, a pair of stops on the disk for actuating the pilot valve, an upper limit valve interposed in the system and positioned adjacent the periphery of the disk and adapted upon actuation to close the upper end of the cylinder while pressure fluid is being introduced to the lower end thereof by the pilot valve, and a stop on the disk for engaging the limit valve.

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