Dec. 12, 1933. C. BOOTH 1,938,756

GRINDING MACHINE

Filed March 19, 1930 2 Sheets-Sheet 1

Fig. 1

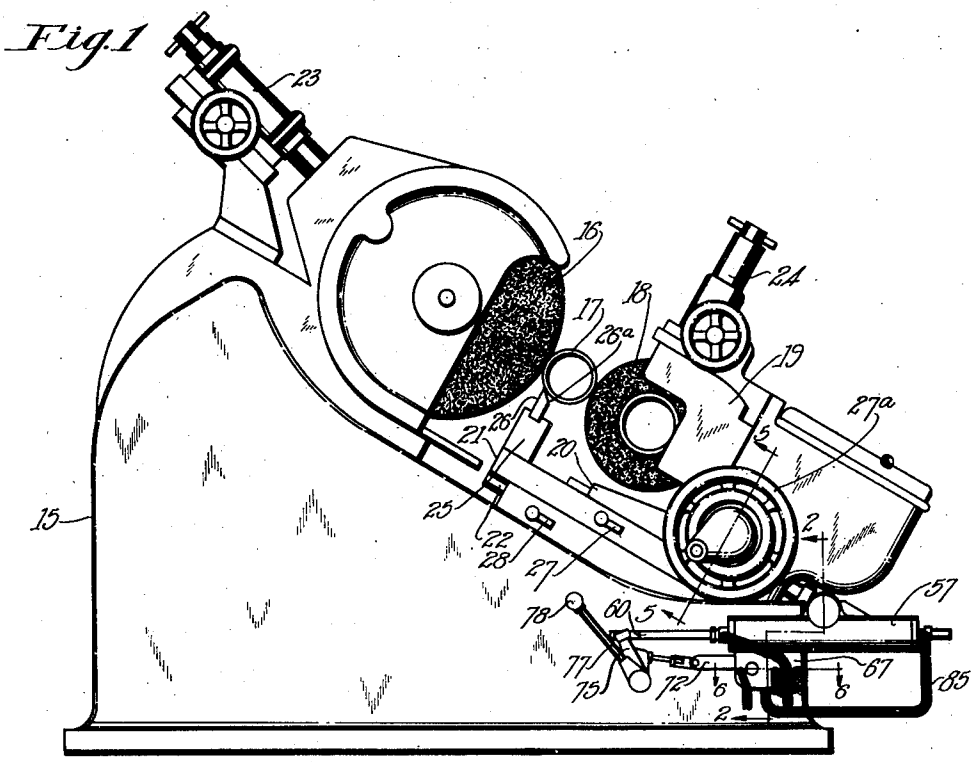


Fig. 6

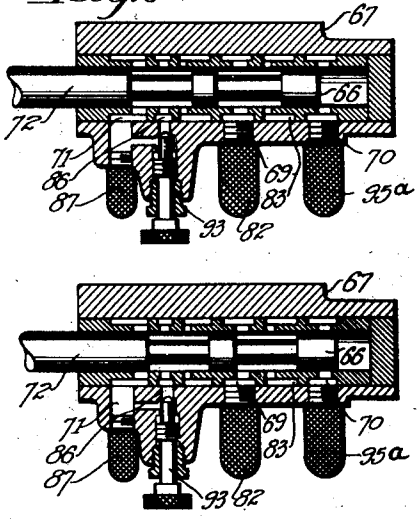


Fig. 7

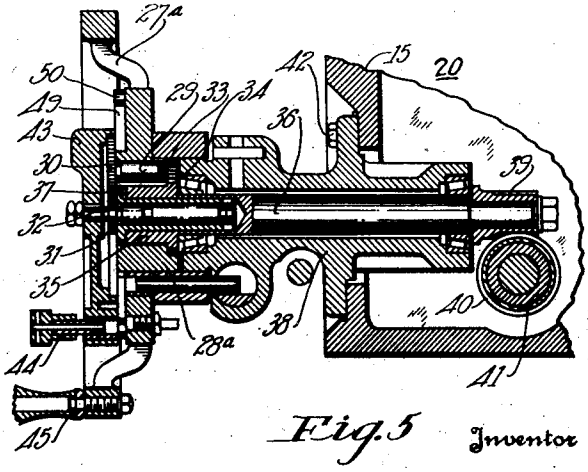


Fig. 5

Inventor

CLEMENT BOOTH

By H. K. Parsons

Attorney

Dec. 12, 1933. C. BOOTH 1,938,756

GRINDING MACHINE

Filed March 19, 1930 2 Sheets-Sheet 2

Fig. 4

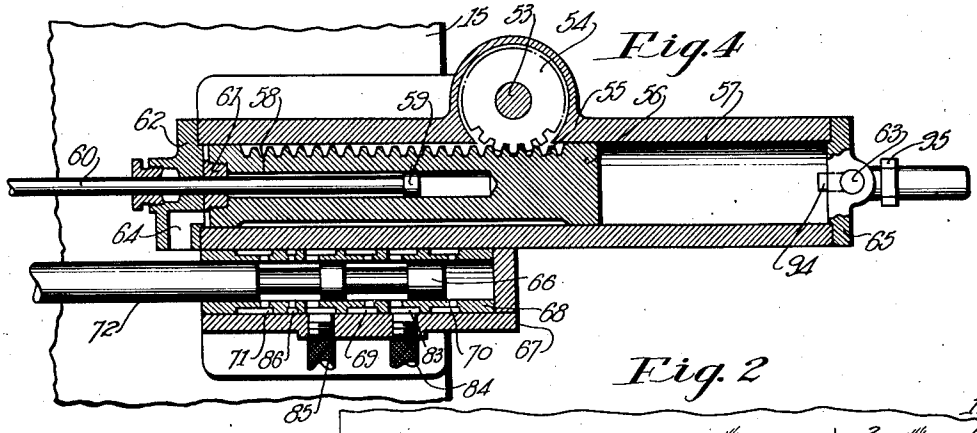


Fig. 2

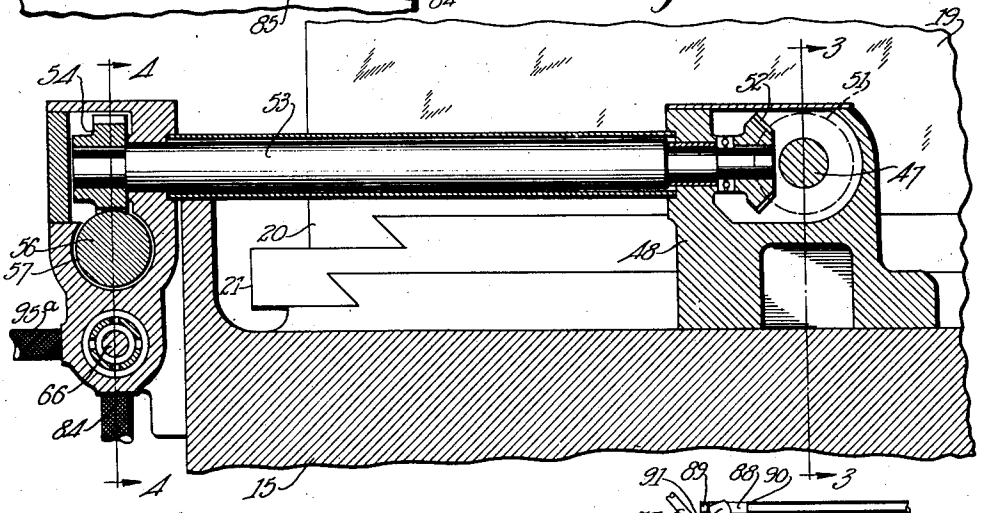


Fig. 6

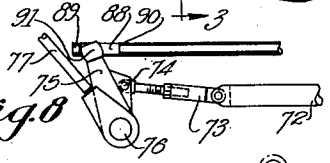


Fig. 3

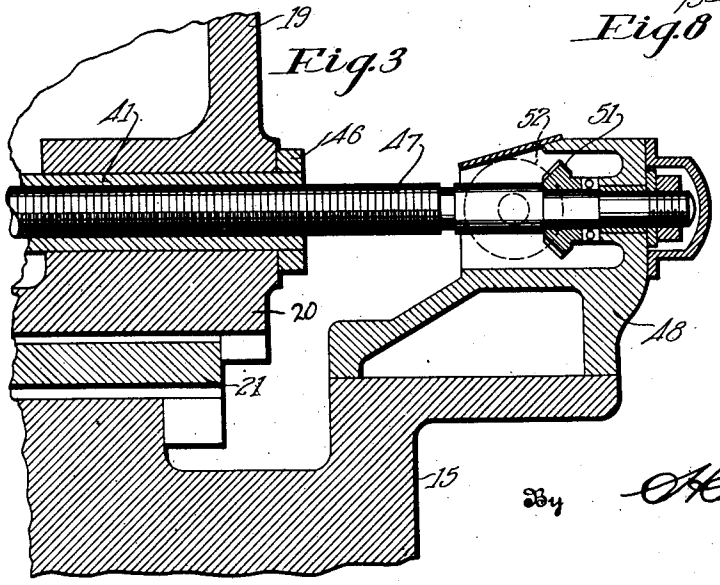
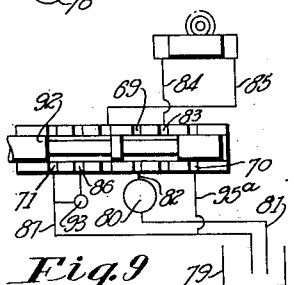


Fig. 9



Inventor

CLEMENT BOOTH

By H K Parsons

Attorney

Patented Dec. 12, 1933 1,938,756

UNITED STATES PATENT OFFICE

1,938,756

GRINDING MACHINE

Clement Booth, Cincinnati, Ohio, assignor to Cincinnati Grinders Incorporated, Cincinnati, Ohio, a corporation of Ohio

Application March 19, 1930. Serial No. 437,181

19 Claims. (Cl. 51—103)

This invention relates to improvements in machine tools and especially to improvements in grinding machines of the centerless type.

An object of the invention is to provide improved means for effecting movement of a translatable member of a machine tool organization.

Another object of the invention is to provide a combination hydraulic and mechanical means for shifting a movable member of the machine tool organization at differential rates to rapidly bring the said member into operative relation, slowly adjust the member and rapidly return same to its normal position and for adjusting the zone through which this cycle takes place.

Other objects and advantages of the present invention should be readily apparent by reference to the following specification considered in conjunction with the accompanying drawings forming a part thereof and it is to be understood that any modifications may be made in the exact structural details without departing from or exceeding the spirit of the invention.

Figure 1 is an elevational view of a grinding machine embodying the improvements of this invention.

Figure 2 is a sectional view taken on line 2—2 of Figure 1.

Figure 3 is a sectional view taken on line 3—3 of Figure 2.

Figure 4 is a sectional view taken on line 4—4 of Figure 2.

Figure 5 is a sectional view taken on line 5—5 of Figure 1.

Figure 6 is a sectional view on line 6—6 of Figure 1.

Figure 7 is a view similar to Figure 6 showing the parts in a further relationship.

Figure 8 is an enlarged detail of operating and controlling mechanism for the hydraulic valve.

Figure 9 is a diagrammatic illustration of the hydraulic circuit involved in the invention.

Throughout the several views of the drawings similar reference characters are employed to denote the same or similar parts.

A device embodying this invention may comprise a bed 15 having mounted fixedly thereon a grinding wheel 16 rotatable at a high grinding rate of speed in a clockwise direction to effect a stock-removal from a work piece 17. Mounted on the other side of the work piece 17 is a regulating wheel 18 rotatable at a slow work controlling rate of speed likewise in a clockwise direction. The spindle of the regulating wheel 18 is carried by a movable housing 19 supported on a slide 20 which in turn is supported by a lower slide 21 carried on suitable ways 22 formed on the bed 15. Suitable tool dressing means 23 and 24 are provided for respectively truing the active faces of the wheels 16 and 18. To support the work piece 17 within the grinding throat formed between the wheels 16 and 18, the lower slide 21 has secured to the inner end thereof a block 25 supporting a work rest blade 26. The blade 26 is provided on the upper end thereof with an inclined active supporting surface 26a inclining toward the regulating wheel forming a trough between itself and the surface of the regulating wheel in which the work piece is placed. This inclination of the blade co-operates with the inclination of the bed of the machine, which is about thirty degrees from the horizontal, so that the work pieces under the influence of gravity are at all times in engagement with the regulating wheel surface and are rotated thereby before engagement with the grinding wheel. Clamps 27 and 28 are provided for respectively securing the lower slide 21 to the bed 15 and the upper slide 20 to the lower slide 21.

The foregoing description deals with a standard centerless grinder as heretofore known and utilized. It has been the practice to actuate the slides 20 and 21 relative to one another and as a unit relative to the bed 15 by suitable mechanical means. By this invention it is proposed to combine the mechanical means with suitable hydraulic means which may be utilized jointly or independently.

The mechanical means is used primarily to adjust the wheels relative to one another to take up wheel wear and to set up the machine for different kinds or sizes of work and comprises a hand wheel 27a rotatably mounted about a bearing 28a having pinion shaft 29 journaled therein. Pinion shaft 29 has formed on one end a gear 30 meshing with a pinion 31 secured to stub shaft 32. A pinion 33 is mounted on the other end of pinion shaft 29 meshing with gear 34 having a hub 35 forming a part of drive shaft 36. The hub 35 is bored to receive sleeve 37 which forms a bearing for the stub shaft 32. Shaft 36 extends through a housing 38 and has secured to its inner end a spiral gear 39 meshing with a similar spiral gear 40 secured to sleeve nut 41. The housing 38 is secured by cap screws 42 or the like to the slide 20. The hand wheel 27a may also be rotated by a crank 43 secured to stub shaft 32 and terminating in spring pressed plunger 44. The plunger 44 locks the crank 43 to the hand wheel 27a so that in normal operation they are actuated

as a unit by handle 45 carried by the wheel 27*a*. The sleeve nut 41 is rotatably but nontranslatably journaled in the housing 19 by means of a nut 46 as shown in Figure 3.

The threads of the sleeve nut 41 mesh with feed screw 47 rotatably journaled in a bracket 48 carried by an extension of the bed 15. From the foregoing it will be noted that rotation of the hand wheel 27*a* will rotate the spiral gear 39 correspondingly to rotate spiral gear 40 and sleeve nut 41, thereby effecting a translation of the regulating wheel unit 19 relative to the bed 15 or the slide 21. This manual actuation of the slide may be used when initially setting up the machine for operation on a supply of work pieces to initially set or adjust the grinding throat. As the wheels wear or after re-truing the surface of the wheels 16 and 18 and to effect a very slow measured amount of adjustment of the wheels the crank 43 is employed. The locking plunger 44 is pulled outwardly to disengage the crank from the hand wheel 27*a* and the crank is rotated in a clockwise or counter-clockwise direction to correspondingly rotate the stub shaft 32. This causes a rotation of pinion 31 and through the engagement of the teeth thereof a rotation of planetary gear 30 and pinion 33 which in turn rotates gear 34 formed integral with or secured to the shaft 36 to rotate the same at a slow rate and correspondingly rotating spiral gears 39 and 40 and sleeve nut 41. Cooperating with the spring pressed plunger 44 of the crank 43 is a plate 49 having a series of perforations or the like 50 therein which perforations are spaced a predetermined amount and as the plunger is advanced from one perforation to the other the surface of the regulating wheel 18 is advanced a predetermined measured amount, such as a fractional part of a thousandth of an inch.

As was noted above the mechanism just described is used for setting up the machine and taking up wheel wear and the like which mechanism cooperates with an automatic hydraulic mechanism for actuating the slide 21 and the regulating wheel 18 carried thereby toward and from the grinding wheel. This mechanism comprises a bevelled gear 51 keyed or otherwise secured to the end of feed screw 47 and the gear has meshing therewith a similar bevelled gear 52 secured to the inner end of transversely extending shaft 53. A pinion 54 is secured to the opposite end of the shaft 53 and has the teeth thereof meshing with rack teeth 55 formed on hydraulic piston 56. The piston 56 is adapted to be actuated through a cylinder 57 secured in any desired manner to the bed 15. A bore 58 is formed interiorly of the piston 56 and receives therein a head 59 formed on one end of supplementary valve shift rod 60. The bore 58 is closed by a plug 61 forming a guide for the rod 60 supplementing the guide formed in cylinder head 62.

The piston 56 is adapted to be actuated by an hydraulic medium entering the cylinder 57 through one of a pair of ports 63 and 64 and exhausting through the other port. The port 63 is formed in rear cylinder head 65 while the port 64 is formed in cylinder head 62.

The flow of the medium into and through the cylinder 57 is controlled by a valve 66 enclosed within a housing 67 that may be integral with or independent of the cylinder 57. The valve housing 67 has interiorly thereof a sleeve 68 surrounding the valve 66 and is provided with inlet port 69 and exhaust ports 70 and 71. A valve rod 72 extends from the valve 66 and has pivotally secured to its outer end an adjustable link 73 which in turn is pivoted at 74 to an arm 75 secured to pivot 76 extending from the bed. A manually actuable lever 77 having a knob 78 is secured to the shaft for rocking same and the arm 75 to adjust the valve 66.

As shown diagrammatically in Figure 9 a suitable tank or sump 79 is provided containing the hydraulic medium which is drawn therefrom by a pump 80 through suction pipe 81 and discharged through conduit 82 through inlet port 69 into the interior of the valve casing 67. As shown in Figures 9, 4 and 1 the medium passes through port 83 and conduit 84 to the left hand end of cylinder 57 to actuate piston 56 to the right, as seen in Figure 4. Piston 56 forces the medium ahead of it out through port 63 conduit 85 into the valve casing 67 from which it passes through exhaust port 71, conduit 87, back to the sump.

By reference to Figures 6 and 7 it will be noted that port 71 is unrestricted and permits a free flow of fluid therethrough permitting the piston 56 to be rapidly actuated to correspondingly shift regulating wheel unit 19. As the unit 19 approaches the work the speed thereof is cut down to a normal work feeding rate. This change in rate of movement of the regulating wheel unit 19 is accomplished automatically by providing a notch 88 in the free end of slide rod 60 to provide shoulders 89 and 90. Received within the notch 88 between shoulders 89 and 90 is a head or knob 91 formed on the end of arm 75. At the time the regulating wheel unit is in position to feed the work into the grinding wheel to effect a stock removal therefrom the nut 61 carried by the piston engages the head 59 on slide rod 60 carrying the said rod with it. This movement of the rod causes shoulder 89 through the engagement thereof with the head or knob 91 to oscillate arm 75 and shift valve 66. Shoulder 92 on the valve now closes off port 71 as shown in Figure 7 causing the medium discharging from the cylinder 57 to pass through the port 86 which is controlled by needle valve 93 retarding the flow of the fluid therefrom, thereby causing a slow infeed movement of the unit 19 to feed the work piece into the grinding wheel. Piston 56 continues to travel to the right as seen in Figure 4 until the end thereof engages the end of adjustable stop 94 held in position by nut 95. The lever 77 is then actuated in a clockwise direction or to the right as seen in Figure 1 to shift valve 66 to connect the inlet port 69 with the other end of the cylinder through conduit 85 to retract the piston 56 and cause a movement of the regulating wheel unit to the right, Figure 1. At this time the hydraulic medium is being exhausted from cylinder 57 through conduit 95*a* to the sump 79.

From the foregoing description it will be noted that there has been provided improved automatic hydraulic means for effecting the reciprocation and translation of a movable member of a machine tool organization such as the regulating wheel unit of a centerless grinder. The operation of the machine is as follows: After a work piece has been placed on the work rest blade and in engagement with the regulating wheel the handle 77 is actuated in a counter-clockwise direction or the left to shift valve 66 connecting the hydraulic pump with the end of the piston to cause the hydraulic medium to actuate the piston for effecting a rapid movement of the regulating wheel unit toward the left or up the bed toward the grinding wheel. As soon as the regulating wheel unit has been advanced to

the position to feed a work piece into the grinding wheel the speed thereof is automatically reduced to the proper desired speed for feeding the work piece into the wheel. This slow movement of the regulating wheel unit continues until the work piece has been reduced to the desired size at which time the movement stops and the parts are allowed to remain stationary to permit a sparking out or until the desired finish has been secured on the work piece. At this time the operator actuates the lever 77 in a clockwise direction or to the right to correspondingly actuate or retract the regulating wheel unit and the work piece is replaced by a new one.

What is claimed is:

1. In a centerless grinder, the combination of a bed or support, a pair of grinding and regulating wheels carried thereby and forming a grinding throat therebetween, means within the throat for supporting a work piece during grinding and hydraulic means for actuating one of the wheels toward and from the other including a screw, a piston for rotating the screw, a cylinder for the piston, an hydraulic medium for actuating the piston, a valve controlling the exhaust of the medium from the cylinder at a rapid and slow rate and means operated by the piston to adjust the valve from one position to the other to thereby automatically control the rate of movement of one of the wheels.

2. In a centerless grinder, the combination of a pair of opposed grinding and regulating wheels forming a grinding throat therebetween, means within the throat for supporting a work piece during grinding, means for actuating one of the wheels toward the other at a slow and a rapid rate including a feed screw, an hydraulic piston for rotating the screw, an hydraulic medium for actuating the piston, an inlet and an exhaust port for the medium leading to and from the cylinder, and a valve controlling the flow of the medium through the exhaust port and having two operative positions so that in one position of the valve an unrestricted flow is permitted through the exhaust port while in the other position a restricted flow only is permitted whereby the movable wheel is actuated at a rapid and a slow rate.

3. In a centerless grinder, the combination of a pair of opposed grinding and regulating wheels forming a grinding throat therebetween, means within the throat for supporting a work piece during grinding, means for actuating one of the wheels toward and from the other at a slow and a rapid rate including a feed screw, an hydraulic piston for rotating the screw, an hydraulic medium for actuating the piston, an inlet and an exhaust port for the medium leading to and from the cylinder, a valve controlling the flow of the medium through the exhaust port and having two operative positions, in one position of the valve an unrestricted flow is permitted through the exhaust conduit while in the other position a restricted flow only is permitted whereby the movable wheel is actuated at a rapid and a slow rate, and means for automatically shifting the valve to automatically change the rate of movement of the wheel.

4. In a centerless grinder, the combination of a pair of opposed grinding and regulating wheels forming a grinding throat therebetween, means within the throat for supporting a work piece during grinding, means for actuating one of the wheels toward and from the other at a slow and a rapid rate including a feed screw, an hydraulic medium for actuating the piston, an inlet and an exhaust port for the medium leading to and from the cylinder, a valve controlling the flow of the medium through the exhaust port and having two operative positions, in one position of the valve an unrestricted flow is permitted through the exhaust conduit while in the other position a restricted flow only is permitted whereby the movable wheel is actuated at a rapid and a slow rate, means for automatically shifting the valve to automatically change the rate of movement of the wheel, and manual means for adjusting the position of the movable wheel supplementing the reciprocation thereof by the hydraulic means.

5. In a centerless grinder, the combination of a bed or support, a grinding wheel carried thereby and rotatable at a high grinding rate of speed, a regulating wheel rotatable at a slow work controlling rate of speed in opposition to the grinding wheel, a support for the regulating wheel carried by the bed and slidable relative thereto, manual means for actuating the slide to adjust the regulating wheel relative to the grinding wheel, hydraulic means supplementing the manual means to effect a translation of the slide at a rapid and a slow rate and automatic means operable by the slide for effecting the change of movement of the slide.

6. In a centerless grinder the combination of a pair of opposed grinding and regulating wheels forming a grinding throat therebetween, a slide supporting one of the wheels for translation toward and from the other wheel, means for translating the slide through a predetermined zone comprising a screw, a nut carried by the slide meshing with the screw, a piston, gear means between the piston and screw for rotating same, and means for actuating the piston at different speeds to correspondingly rotate the screw and translate the slide.

7. In a centerless grinder the combination of a pair of opposed grinding and regulating wheels forming a grinding throat therebetween, a slide supporting one of the wheels for translation toward and from the other wheel, means for translating the slide through a predetermined zone comprising a screw, a nut carried by the slide meshing with the screw, a piston, gear means between the piston and screw for rotating same, means for actuating the piston at different speeds to correspondingly rotate the screw and translate the slide, and means for changing the zone through which the slide reciprocates under said hydraulic means.

8. In a centerless grinder the combination of a pair of opposed grinding and regulating wheels forming a grinding throat therebetween, a slide supporting one of the wheels for translation toward and from the other wheel, means for translating the slide through a predetermined zone comprising a screw, a nut carried by the slide meshing with the screw, a piston, gear means between the piston and screw for rotating same, means for actuating the piston at different speeds to correspondingly rotate the screw and translate the slide, and means for changing the zone through which the slide reciprocates under said hydraulic means said means comprising a manually controlled hand wheel, and means operatively connecting the hand wheel with the nut for rotating same thereby.

9. In a centerless grinder the combination with a bed or support, of a pair of opposed rotating members carried thereby, one for effecting a stock

removal from a work piece and the other for controlling the rotation of said work piece, means for supporting one of the members for translation toward and from the other member, and means for effecting said translation at differential rates including a feed screw, a piston for rotating same, an hydraulic medium, a conduit for the medium extending from the piston and means for effecting an unrestricted or a restricted flow through the conduit to thereby actuate the member at a fast and slow rate.

10. In a centerless grinder the combination of a bed, a grinding wheel carried thereby and operable at a high grinding rate of speed, a regulating wheel in opposition to the grinding wheel rotatable at a slow work controlling rate of speed, the wheels being spaced apart to form a grinding throat between them, means within the throat to support a work piece during grinding, means for supporting one of the wheels for movement toward and from the other comprising a slide, a nut carried by the slide, a feed screw having threaded connection with the nut, and hydraulic means for rotating screw to effect a movement of the slide.

11. In a machine tool organization the combination with a bed, of a member carried thereby and translatable relative thereto, means for translating the member including a rotatable screw, an hydraulic piston for rotating the screw, a cylinder for the piston, an hydraulic medium for actuating the piston through the cylinder, conduits for the medium and means controlling the rate of flow of the medium to correspondingly control the movement of the piston and rotation of the screw said means comprising a valve, a valve rod, a casing for the valve, a restricted and an unrestricted port in the casing controlled by the valve, and means connecting the valve and piston whereby to automatically change the porting through the valve from the unrestricted to the restricted port.

12. In a machine tool organization the combination of a bed or support, a tool carried by the bed, the bed further having ways thereon extending upwardly at an angle as respects the base of the bed, a slide on the ways and supporting a work piece adapted to be operated upon by the tool, means for cyclically shifting the slide on the bed ways including an adjusting screw for raising the slide up the ways toward the tool, and hydraulically actuated power means for rotating the screw at differential speeds during each cycle of movement of the slide to actuate the slide at rapid traverse and feed rates.

13. In a machine tool organization the combination of a bed, a slide carried thereby and movable relative thereto, and means for translating the slide including a pump, a motor actuated by the pump, a screw driven in opposite directions by the motor and operatively connected with the slide for moving same forward and backward in a given zone, means for variably determining the rate and direction of actuation of the motor, and means for varying the operative relation between the screw and translatable slide to change the zone of reciprocation of said slide.

14. In a machine tool organization the combination of a bed or support, a slide carried thereby for movement relative thereto, hydraulic means for effecting the translation of the slide including a piston, an hydraulic circuit, a valve in the circuit, a lever for the valve, and an operative connection between the lever and piston whereby said lever is progressively advanceable in one direction by the piston for determining the rate and direction of movement of the slide and the lever being further advanceable in another direction for reversing the movement of the slide.

15. In a machine tool organization the combination of a bed or support, a slide carried thereby for movement relative thereto, hydraulic means for effecting the translation of the slide including a motor, an hydraulic circuit for actuating the motor, a valve in the circuit for controlling the motor, a lever for the valve progressively advanceable in one direction for determining the rate and indicating the direction of movement of the slide and advanceable in another direction for reversing and indicating the movement of the slide, and means for coupling the valve and lever with the motor for actuating same whereby at a predetermined point in the motor stroke the rate of movement thereof is changed.

16. In a machine tool organization the combination of a bed, a slide thereon for movement relative thereto, a screw in operative engagement with the slide, a nut threaded on the screw and held against axial movement relative to the slide, means for rotating the nut and advancing same together with the slide relative to the screw and bed, and hydraulic means for oscillating the screw in opposite directions for advancing and retracting the slide relative to the bed.

17. In a machine tool organization the combination of a bed, a slide thereon for movement relative thereto, a screw in operative engagement with the slide, a nut threaded on the screw and held against axial movement relative to the slide, means for rotating the nut and advancing same together with the slide relative to the screw and bed, hydraulic means for oscillating the screw in opposite directions for advancing and retracting the slide relative to the bed, said means including an hydraulically operated piston, and means for actuating the piston at differential rates to correspondingly actuate the slide.

18. In a machine tool organization the combination of a bed, a slide carried thereby for movement relative thereto, a screw rotatably journaled and having an operative connection with the slide, an hydraulic motor for oscillating the screw to effect a backward and forward movement of the slide, an hydraulic medium for actuating the motor, a valve for controlling the rate and direction of flow of the medium, and means operatively connecting the motor and valve for automatically shifting the valve by the motor and for changing the rate of movement of the motor at a definite point in its stroke.

19. In a machine tool organization the combination of a bed, a slide carried thereby and movable relative thereto, hydraulic means for effecting said movement including a piston, a piston rod telescoping with the piston, abutment means on the piston and rod for engagement with one another, a shiftable valve for controlling the rate and direction of flow of the medium, and an operative connection between the piston rod and valve whereby upon engagement of the cooperating abutments the valve will be automatically shifted to vary the rate of flow of the medium and the rate of movement of the slide.

CLEMENT BOOTH.