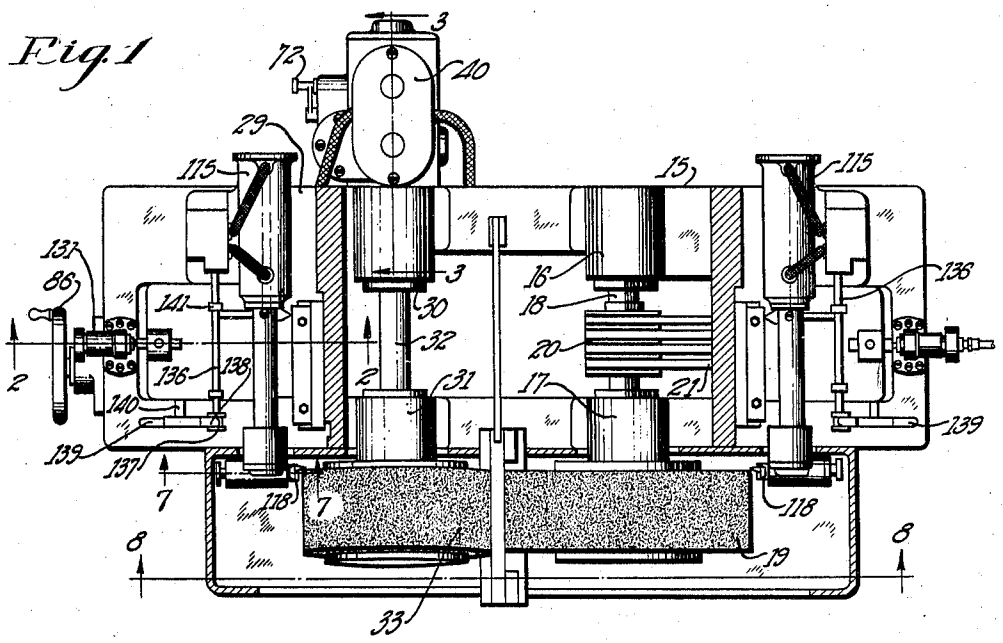
June 11, 1935. C. BOOTH ET AL 2,004,426

GRINDING MACHINE

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Fig. 1



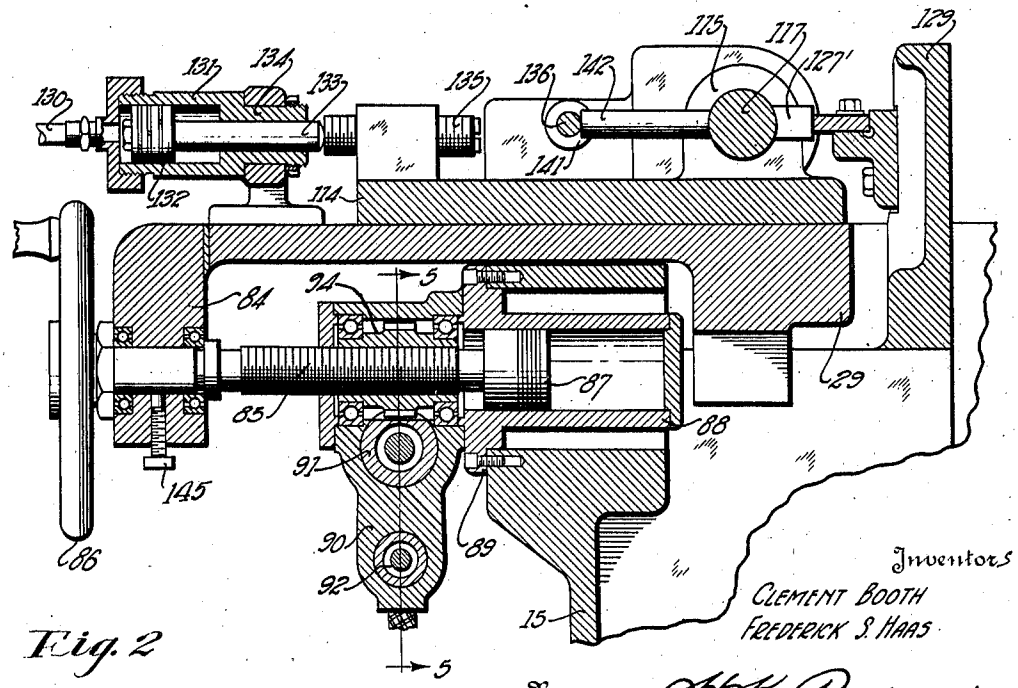


Fig. 2

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GRINDING MACHINE

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Fig. 3

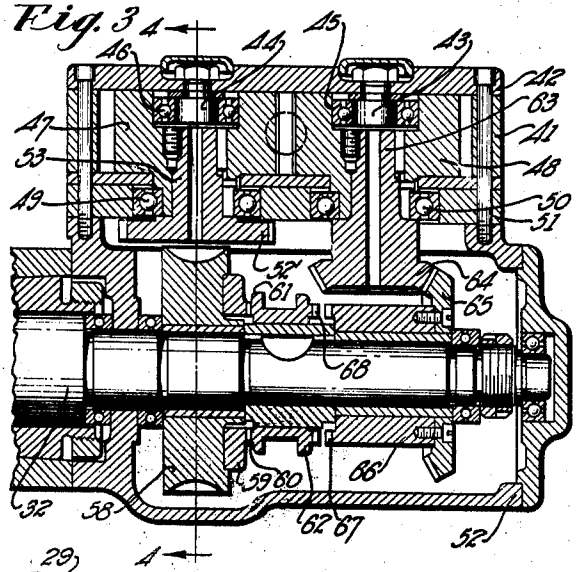
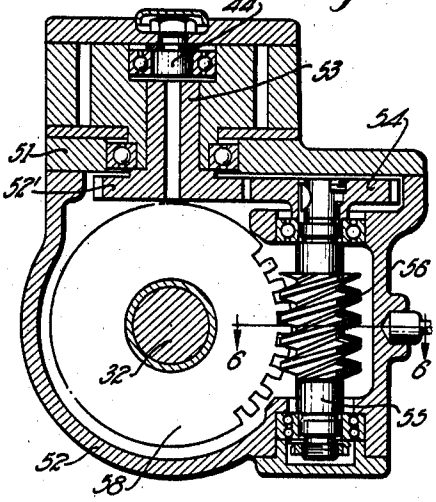


Fig. 4



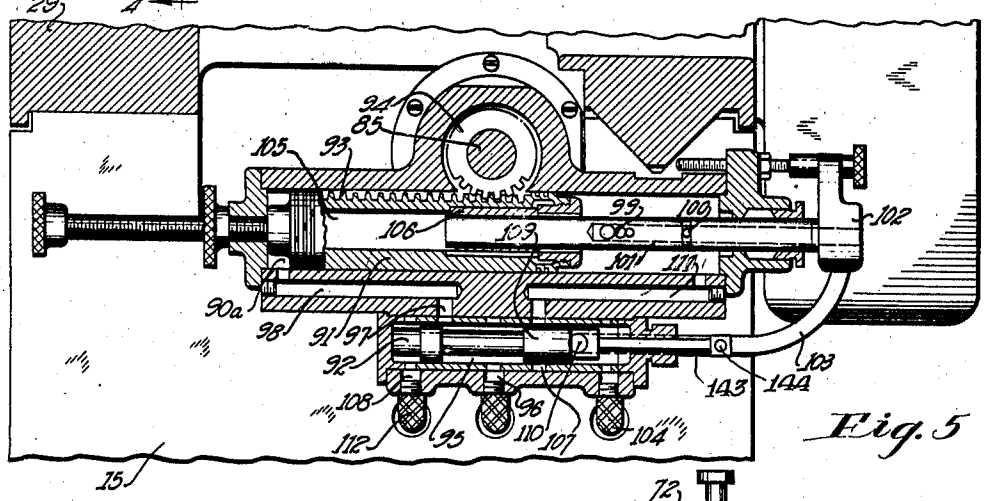


Fig. 5

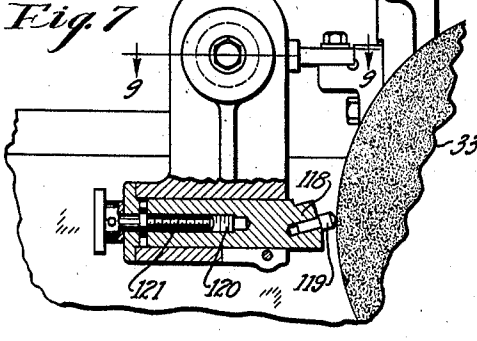


Fig. 7

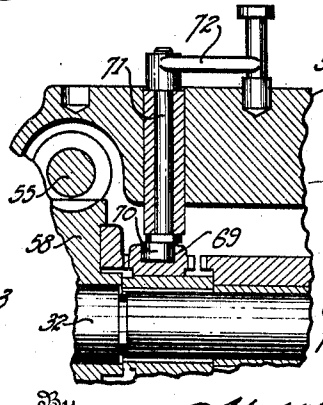


Fig. 6

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GRINDING MACHINE

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Fig. 8

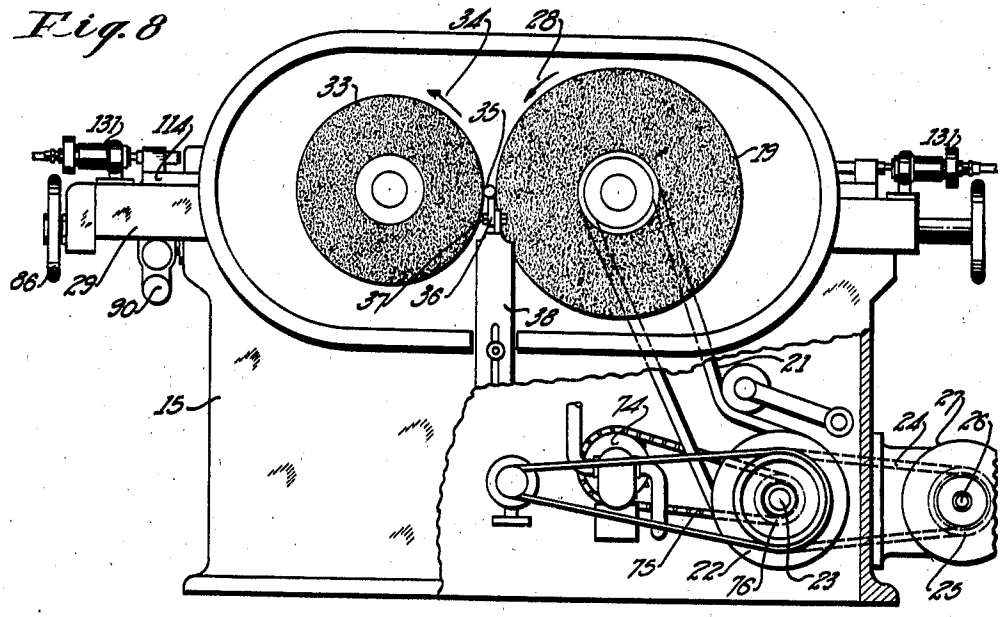
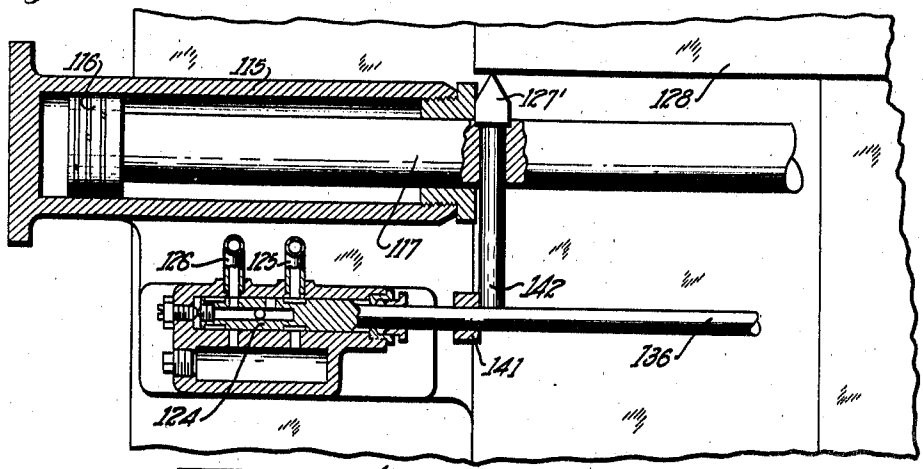


Fig. 9



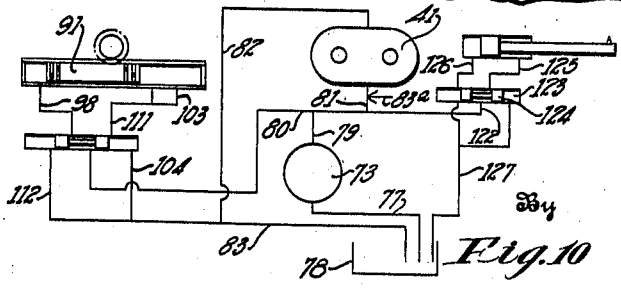


Fig. 10

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UNITED STATES PATENT OFFICE

2,004,426

GRINDING MACHINE

Clement Booth and Frederick S. Haas, Cincinnati, Ohio, assignors to Cincinnati Grinders Incorporated, Cincinnati, Ohio, a corporation of Ohio

Application March 28, 1930, Serial No. 439,778

18 Claims. (Cl. 51—103)

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

An object of this invention is the provision of improved means for effecting the drive of the regulating wheel, of a centerless grinder.

Another object of the invention is to provide an improved mechanism for controlling the movements of a movable member of a machine tool organization such as the regulating wheel unit, of a centerless grinder.

Another object of the invention is to provide improved truing structure for dressing or truing the active face of the wheel of a precision grinding machine.

A further object of the invention is to provide a common source of power for controlling and rotating the various members and movements of a machine tool organization.

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 within the structural details without departing from or exceeding the spirit of the invention.

Figure 1 is a view of a device embodying this invention having certain parts thereof shown in section to more clearly illustrate the structure.

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 1.

Figure 4 is a sectional view taken on line 4—4 of Figure 3.

Figure 5 is a sectional view taken on line 5—5 of Figure 2.

Figure 6 is a sectional view taken on line 6—6 of Figure 4.

Figure 7 is a sectional view taken on line 7—7 of Figure 1.

Figure 8 is an elevation view of the device shown in Figure 1 as seen from line 8—8 thereon, certain parts have been broken away to more clearly illustrate the drive.

Figure 9 is a sectional view taken on line 9—9 of Figure 7, and

Figure 10 is a diagrammatic view illustrating the hydraulic circuit utilized with this 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 or support 15 supporting on its upper end bearings 16 and 17 for a spindle or shaft 18. Secured to one end of spindle 18 is a grinding wheel 19 and the spindle has intermediate its ends a pulley 20 for driving belt 21 whereby the same and grinding wheel 19 are rotated. The belt extends downwardly through the interior of the bed where it is trained about a driving pulley 22 secured to counter shaft 23. A main transmission belt 24 extends about a driving pulley mounted on the counter shaft 23 as well as about a pulley 25 secured on the motor shaft 26 of motor 27. Through the transmission belts 24 and 21 the spindle 18 is rotated at a high or grinding rate of speed in a counter clockwise direction as indicated by the arrow 28 in Figure 8.

Supported by the bed at the other end thereof is a slide 29 having formed integral therewith bearings 30 and 31 in which is journaled a shaft or spindle 32. The shaft or spindle 32 has secured to its outer end a member 33 in the nature of a wheel formed of suitable abrasive material. The spindle 32 and wheel 33 are adapted to be rotated in a counter clockwise direction as indicated by the arrow 34 in Figure 8 at a speed relatively slower than the speed of grinding wheel 19 to control the rate of rotation of a work piece. By this construction the adjacent surfaces of the wheels 19 and 33 travel in opposite directions and the surfaces are spaced from one another to provide a grinding throat in which the work piece to be operated upon is positioned. To support the work piece 35 for peripheral rotation during grinding there is provided, subtending the grinding throat, a work rest blade 36 adjustably secured by means of bolts or the like 37 to a block 38.

The rotation of the shaft or spindle 32 and wheel 33 is effected by an hydraulic motor secured to the end of the spindle 32 and indicated in general by the numeral 40 which comprises a housing 41 having secured to it a plate 42 carrying interiorly of the housing 41 a pair of studs 43 and 44. Anti-friction bearings 45 and 46 surround the studs having their outer races received respectively in counter bores formed in motor gears 47 and 48. The gears 47 and 48 are in mesh with one another and are adapted to be rotated by hydraulic pressure to be later described. The other ends of the gears 47 and 48 are respectively journaled in anti-friction bearings 49 and 50 carried by intermediate plate 51 positioned between housing 41 and tubular housing 52. Motor gear 47 has secured centrally thereof the hub 53 of a spur gear 52' whereby the gear 52' is rotated with and by gear 47. Meshing

with the gear 52' is a pinion 54 secured to the end of worm shaft 55 which has integral therewith a worm 56 for rotating worm wheel 58. The worm wheel 58 is loosely mounted near the end of the shaft or spindle 32. A clutch member 59 is secured to the worm wheel 58 and has clutch teeth 60 adapted to mesh with corresponding clutch teeth 61 formed on one end of shiftable clutch spool 62 slidably keyed to the shaft or spindle 32 so that when said clutch spool is rotated the spindle is correspondingly rotated.

The foregoing description deals with the rotation of the member or wheel 33 at a slow rate of speed to control the rotation of the work piece supported by the blade 36. In order to true or dress the active surface of this wheel it is desirable to rotate same at a much faster rate of speed which is accomplished by the following mechanism. Motor gear 48 has secured centrally thereof the stub shaft 63 integral with bevel gear 64 so as to rotate with said pump gear 48. Bevel gear 64 meshes with a similar bevel gear 65 secured to clutch member 66 loosely mounted on spindle or shaft 32. Clutch member 66 is provided on its inner end with clutch teeth 67 adapted to be engaged by similar clutch teeth 68 formed on the other side of clutch spool 62. The clutch spool 62 is formed with a peripheral groove 69 receiving eccentric 70 formed on one end of shaft 71. The shaft 71 is journaled in the wall of housing 52 and has secured thereto exteriorly of the housing 52 a handle or the like 72. The handle 72 is adapted to be actuated through an arc of 180 degrees for shifting the clutch spool axially of the spindle 32 either to clutch teeth 60 and 61 or to clutch teeth 67 and 68.

To effect a rotation of motor gears 47 and 48 an hydraulic pump is provided having a sprocket 74 about which sprocket chain 75 extends. This sprocket chain also extends about a sprocket 76 secured to counter shaft 23. A suction pipe or conduit 77 extends from the pump 73 into a tank or sump 78 for drawing therefrom suitable hydraulic medium preferably oil. The medium is discharged from the pump through conduit 79 to the main pressure line 80 from which branch conduit 81 conveys the medium into housing 41 for rotating the motor gears 47 and 48, and the spent medium flows from the pump housing 41 through conduit 82 to main exhaust line 83 for delivery back to the tank or sump 78. A valve, shown diagrammatically in Figure 10 and indicated by the numeral 83a, may be placed in the conduit 81 to control the flow of the medium therethrough and the rate of rotation of motor gears 47 and 48.

To effect a stock removal from the work piece the slide 29 and regulating wheel 33 are adapted to be actuated longitudinally of the bed to feed the work piece into the grinding wheel 19 and the slide comprises a bracket 84 depending therefrom having journaled therein the reduced end of an adjusting screw and guide rod 85 which can be locked against rotation as by the set screw 145 shown in Figure 2. A hand wheel 86 is secured to the end of the screw exteriorly of the bracket 84 and the inner end thereof is provided with a guiding piston 87 received within a cylinder 88 carried by the bed 15. Secured to the flange 89 of the cylinder 88 is a bracket 90 having formed therein a cylinder 90a for reciprocating piston 91. The piston 91 is provided with rack teeth 93 meshing with the teeth of gear-nut 94 threadedly received by the threaded portion of piston screw 85. This gear-nut 94 is journaled in suitable anti-friction bearings carried by the upper portion of the bracket 90.

The piston 91 is adapted to be reciprocated through its cylinder by fluid pressure controlled and directed by the valve 92. The hydraulic medium passes from the main pressure line 80 into the valve chamber 95 of valve 92 through port 96 therein. The medium then passes from valve chamber 95 through port 97 into conduit 98 for actuating the piston to the right as seen in Figure 5. The hydraulic medium in the cylinder 90a ahead of the piston is forced out through ports 99 and 100 to the hollow interior of piston guide rod 101 which forms a conduit therefor, to the coupling 102 where it is directed through conduit 103 to the valve chamber 95. A conduit 104 receives the medium from the chamber 95 through exhaust 110 and conveys it to the common discharge line 83 for delivery to the tank or sump 78. Projecting valve rod 143 bearing a handle or operating connection 144 serves to control the position of valve 92.

The piston 93 is provided interiorly thereof with a bore 105 in which a bushing or bearing 106 is secured. As the piston moves through the cylinder this bushing 106 closes off the ports 99 preventing further escape of the hydraulic medium therethrough and forcing same to escape through port 100. It will be noted from Figure 5 that port 100 is of considerably less area than the combined area of ports 99. From this it will be noted that the piston is at first actuated at a rapid rate through its cylinder until the said ports 99 are closed off thereby rapidly advancing the regulating wheel toward the grinding wheel. At this time the regulating wheel and its supporting slide have been adjusted relative to the bed and grinding wheel to a position for feeding the work piece into the grinding wheel to effect a stock removal therefrom. Continued movement of piston 91 is now at a slow rate to correspondingly actuate the slide toward the grinding wheel for feeding work piece into the said grinding wheel.

The withdrawing of the regulating wheel from the grinding wheel is accomplished by shifting the valve 92 to a position to connect inlet port 96 with port 107 and connect port 97 with port 108. At this time the enlarged portion 109 of the valve 92 closes off the exhaust port 110 leading to the conduit 104 so that the pressure entering the cylinder 90a by way of port 96 passes through port 107 and conduit 111 to the other side of the piston 91 for actuating same to the left as seen in Figure 5. At this time the medium ahead of the piston is forced out through conduit 98, port 97 and port 108 to freely flow through conduit 112 connected with the main discharge conduit for delivering the medium to the sump or tank 78.

The active surfaces of the wheels 17 and 33 are formed and reconditioned by an hydraulically controlled mechanism mounted on each side of the bed adjacent each wheel and the mechanisms being duplicates of one another it is deemed sufficient if but one of them be described in detail. The slide 29 has mounted thereon for movement therewith and relative thereto a slide 114 supporting the truing mechanism which comprises a cylinder 115 having mounted interiorly thereof a piston 116 and a piston rod 117. The rod 117 supports at its one end an adjustable tool carrier 118 supporting a diamond or truing tool 119 and the other end of the carrier is provided with a threaded bore 120 threadedly receiving adjusting screw 121. The diamond or truing tool 119 is shifted or actu-

ated across the active face of the wheel by the piston 116 which is moved by hydraulic pressure conveyed from the pressure line 80 through conduit 122 into valve chamber 123 containing shiftable valve spool 124 which, in the position shown in Figure 10, directs the hydraulic medium through conduit 125 to one end of the piston cylinder 115. The hydraulic medium is forced out of the said cylinder 115 through conduit 126 to the valve casing 123. The hydraulic medium then passes through conduit 127 back to the tank or sump 78. To control the operative association of the diamond or truing tool 119 with the active face of the wheel, and epecially when it is desired to form or contour the said face of the wheel, the piston rod 117 has secured thereto a follower 127' cooperating with a cam 128 secured to the bracket portion 129 of the bed or support 15. Contact between the follower 127' and cam 128 is maintained by hydraulic pressure from the main pressure line through conduit 130 directed into one end of cylinder 131 which contains piston 132. The piston rod 133 carried by piston 132 extends through the guide portion 134 formed integral with the cylinder 131. This cylinder is supported by the slide 29 and the piston therein tends to shift the slide 114 relative to the slide 29 by having its piston rod constantly in abutment with the adjustable stop member 135 carried by the slide 114.

The valve 124 has extending therefrom a valve rod 136 having secured on its outer end a circumferentially grooved collar 137 receiving the forked end 138 of manually actuable lever 139. This lever is pivoted intermediate its ends to a bracket 140 carried by the slide 29. A pair of adjustable dogs or collars 141 are secured to the rod having extending between them the outer extended end 142 of cam follower 127'. Therefore, to effect a traverse movement of the diamond across the face of the wheel, the lever 139 is actuated to set valve 124 to effect said movement and as the piston and piston rod move carrying with it the same follower 127' the end thereof engages one of the dogs or collars 141 to shift the valve 124 to its neutral position to stop the traverse movement of the diamond or truing tool 119.

From the foregoing it will be noted that there has been provided a machine tool organization in the nature of a centerless grinder wherein certain of the movable members are under hydraulic control while others are controlled by mechanical means, a single prime mover, such as an electrical motor, is employed for rotating or driving a single counter shaft from which power is taken to drive the hydraulic pump to circulate an hydraulic medium under pressure to various pistons or secondary motors.

What is claimed is:

1. In a centerless grinder the combination of a bed or support, a pair of opposed grinding and regulating members forming a grinding throat therebetween, means for supporting a work piece in the throat between the members, a counter shaft, a prime mover for rotating the counter shaft, transmission means extending from the counter shaft to one of the members for rotating same, an hydraulic motor for rotating the other member, and means driven from the counter shaft for effecting a rotation of the hydraulic motor.

2. In a centerless grinder the combination of a bed or support, a pair of opposed grinding and regulating members forming a grinding throat therebetween, means for supporting a work piece in the throat between the members, a counter shaft, a prime mover for rotating the counter shaft, transmission means extending from the counter shaft to one of the members for rotating same, an hydraulic motor for rotating the other member, and means driven from the counter shaft for effecting a rotation of the hydraulic motor comprising a pump, an hydraulic circuit from the pump to the motor and transmission means extending from the counter shaft to the pump, to operate same thereby.

3. In a device of the class described the combination of a bed or support, a pair of opposed grinding and regulating members carried thereby for effecting a stock removal from and controlling the rate of rotation of a work piece, means supporting one of the members for translation relative to the bed toward and from the other member, and hydraulic means for effecting said rotation and translation of one of the members.

4. In a machine tool organization the combination of a bed or support, a rotatable member carried thereby for translation relative thereto, an hydraulic motor for effecting the rotation of the member, a motor for effecting the translation thereof, a pump for actuating the motors, and a common pressure line connecting the pump and motors.

5. In a machine tool organization the combination of a bed or support, a slide carried thereby for movement relative thereto, a member rotatably carried by the slide, a motor for rotating the member, a motor for translating the slide, a common pressure line actuating the motors, and means for circulating an hydraulic medium under pressure in the pressure line.

6. In a machine tool organization the combination of a pair of opposed grinding and regulating members forming a grinding throat therebetween, a work support in the throat for supporting a work piece for operation thereon, means for truing the active face of the members, and an hydraulic motor for rotating one of the members at normal speed to control the rotation of a work piece and at a much faster speed to true the said face, said motor comprising a pair of pump gears connectable individually with the member for rotating same at said differential speeds.

7. In a device of the class described the combination of a bed, a pair of opposed members carried thereby, one for effecting a stock removal from a work piece and the other for controlling the rate of rotation thereof, means for driving one of the members at a constant speed, and means for driving the other member at a slow and a fast speed including an hydraulic motor, a pair of gears carried thereby, a direct connection between one of the gears and the member, and a worm and worm wheel connection between the other gear and the member, and means for rotating the gears.

8. In a machine tool organization the combination of a bed, a slide carried thereby for movement relative thereto, an adjusting screw for reciprocating the slide relative to the bed, a nut carried by the bed in threaded engagement with the screw, hydraulic means for rotating the nut, a shaft rotatably journaled in the slide, a member carried by the shaft for rotation therewith, an hydraulic motor couplable with the shaft for rotating same thereby, and means for changing the coupling between the motor and shaft whereby the shaft is rotated at differential speeds.

9. In a machine tool organization the combination of a bed, a slide carried thereby for movement relative thereto, a reciprocating motor, connections between the motor and slide whereby the reciprocations of the motor effect the translation of the slide, a rotatable shaft journaled in the slide, an hydraulic motor couplable with the shaft for rotating same thereby, and means for varying the coupling of the motor and shaft to effect a rotation of the shaft at differential speeds.

10. In a machine tool organization the combination of a bed, a slide carried thereby for movement relative thereto, a reciprocating motor, connections between the motor and slide whereby the reciprocations of the motor effect a translation of the slide, a rotatable shaft journaled in the slide, an hydraulic motor couplable with the shaft for rotating same thereby, means for varying the coupling of the motor and shaft to effect a rotation of the shaft an differential speeds, and a pump for circulating an hydraulic medium to effect actuation of the slide motor and rotation of the shaft motor.

11. In a machine tool organization the combination of a bed, a slide carried thereby for movement relative thereto, an adjusting screw, a nut rotatably supported by the bed in threaded engagement with the screw, a reciprocating motor for rotating the nut to effect translation of the slide, a rotatable shaft journaled in the slide, an hydraulic motor couplable with the shaft for rotating same thereby, an hydraulic circuit, a pump for circulating a hydraulic medium through the circuit, and means extending from the pump for conveying the hydraulic medium to the slide reciprocating motor and shaft rotating motor.

12. In a machine tool organization the combination of a slide, a bed therefore, hydraulic means for advancing the slide relative to the bed at rapid traverse and feed rates, a rotatable shaft carried by the slide, an hydraulic motor couplable with the shaft for rotating same thereby and a common source of power for actuating the slide advancing means and rotating shaft motor.

13. In a machine tool organization the combination of a slide, a bed therefore, hydraulic means for advancing the slide relative to the bed at rapid traverse and feed rates, a rotatable shaft carried by the slide, an hydraulic motor couplable with the shaft for rotating same thereby, a common source of power for actuating the slide motor and rotating shaft motor and means for automatically changing the rate of advance of the slide relative to the bed.

14. In a machine tool organization the combination of a bed, a slide carried thereby for movement relative thereto, a reciprocating motor for effecting the translation of the slide, a rotatable shaft journaled in the slide, an hydraulic motor for effecting said rotation of the shaft, a member carried by the shaft for rotation therewith, and an hydraulic mechanism for reconditioning the active face of the member carried by the shaft, a main pressure line containing an hydraulic medium under pressure, and branch conduits extending from the main pressure line to the reciprocating motor, the shaft rotating motor, and the hydraulic reconditioning means.

15. In a centerless grinder the combination of a bed or support, a grinding wheel carried thereby, a regulating wheel carried by the bed, a prime mover, a counter shaft driven by the prime mover, transmission means coupling the counter shaft with the grinding wheel for rotating same thereby, an hydraulic pump, transmission means coupling the pump with the counter shaft for driving same thereby, and means driven by the pump for effecting the rotation of the regulating wheel.

16. In a centerless grinder the combination of a bed or support, a grinding wheel carried thereby, a regulating wheel carried by the bed, a prime mover, a counter shaft driven by the prime mover, transmission means coupling the counter shaft with the grinding wheel for rotating same thereby, an hydraulic pump, transmission means coupling the pump with the counter shaft for driving same thereby, and means driven by the pump for effecting the rotation of the regulating wheel, a slide supporting one of the wheels for movement relative to the bed and toward and from the other wheel, and means for effecting said movements of the slide driven by the pump.

17. In a centerless grinder the combination of a bed or support, a grinding wheel carried thereby, a regulating wheel carried by the bed, a prime mover, a counter shaft driven by the prime mover, transmission means coupling the counter shaft with the grinding wheel for rotating same thereby, an hydraulic pump, transmission means coupling the pump with the counter shaft for driving same thereby, and means driven by the pump for effecting the rotation of the regulating wheel, a slide supporting one of the wheels for movement relative to the bed and toward and from the other wheel, means for effecting said movements of the slide driven by the pump and means for reconditioning the active face of the grinding and regulating wheel operatively connected with the pump.

18. In a centerless grinder the combination of a bed or support, a grinding wheel carried thereby, a regulating wheel carried by the bed, a prime mover, a counter shaft driven by the prime mover, transmission means coupling the counter shaft with the grinding wheel for rotating same thereby, an hydraulic pump, transmission means coupling the pump with the counter shaft for driving same thereby, and means driven by the pump for effecting the rotation of the regulating wheel including an hydraulic motor, a shaft for the regulating wheel, means coupling the shaft with the motor for driving same at substantially the same speed as the motor, and means for coupling the motor with the shaft for driving same at a different speed.

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