July 28, 1953 B. A. WILSON 2,646,651

HYDRAULIC ROLL GRINDER

Filed Feb. 15, 1949 4 Sheets-Sheet 1

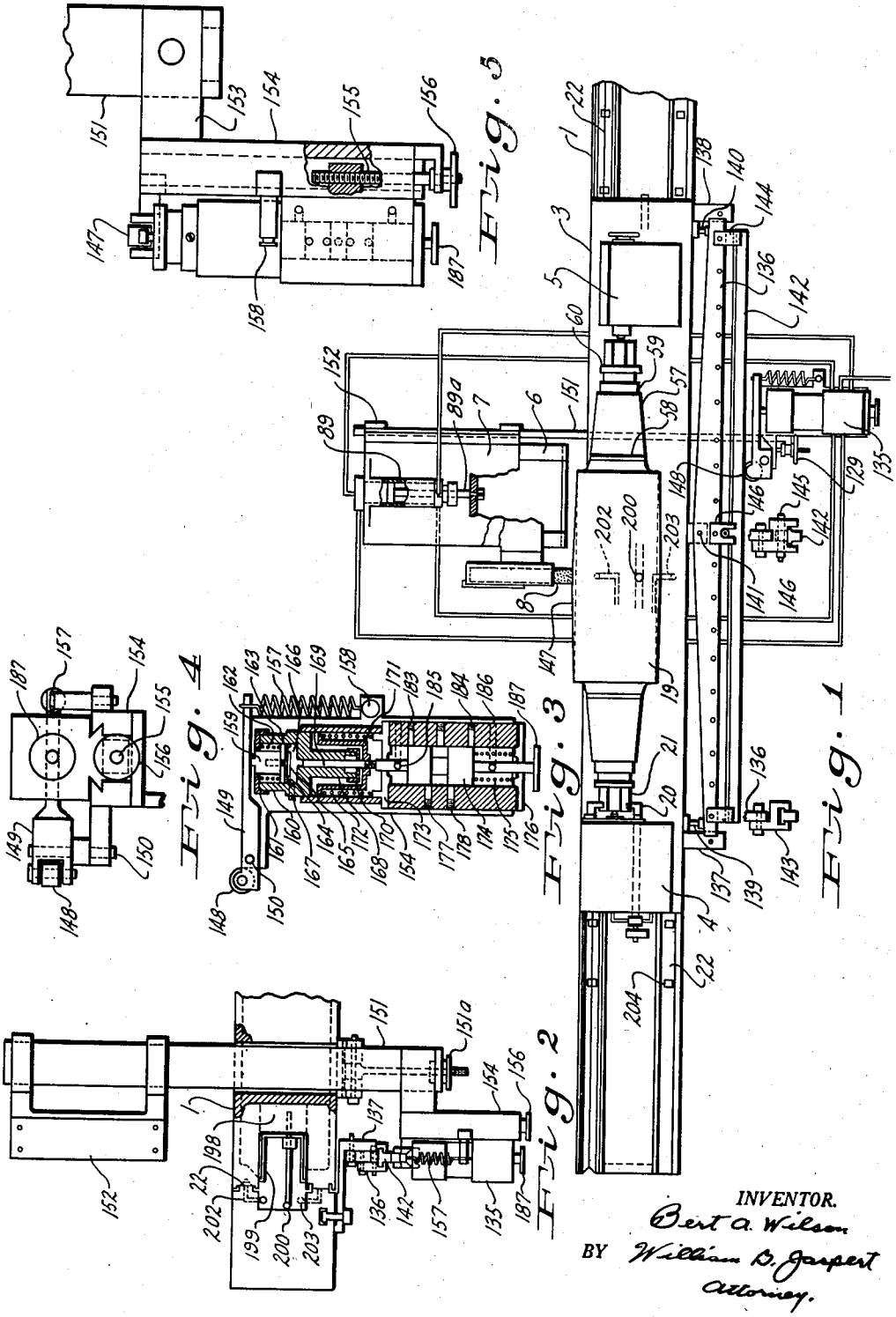


Fig. 1

Fig. 2

Fig. 3

Fig. 4

Fig. 5

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HYDRAULIC ROLL GRINDER

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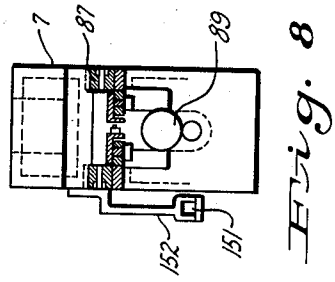


Fig. 8

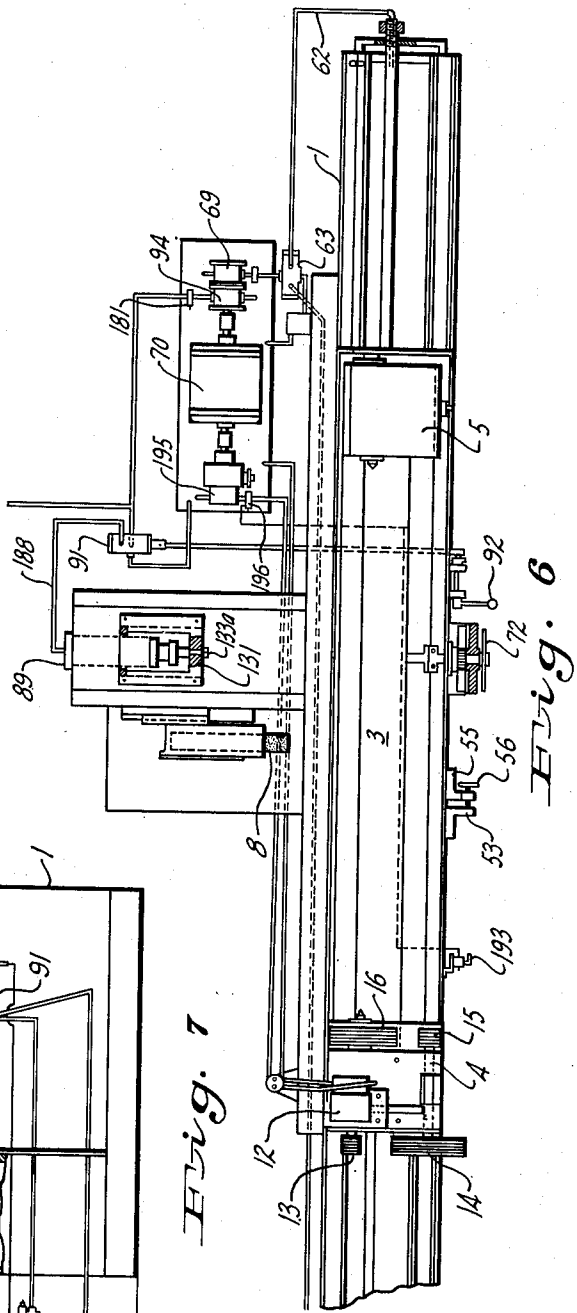


Fig. 6

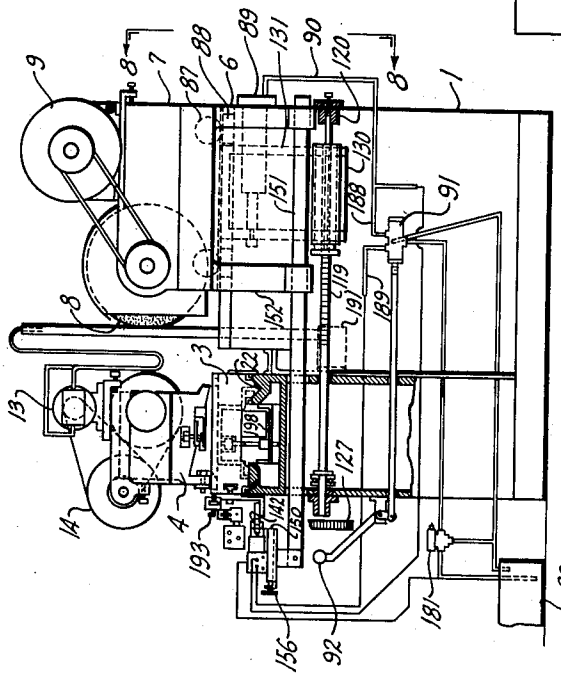


Fig. 7

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HYDRAULIC ROLL GRINDER

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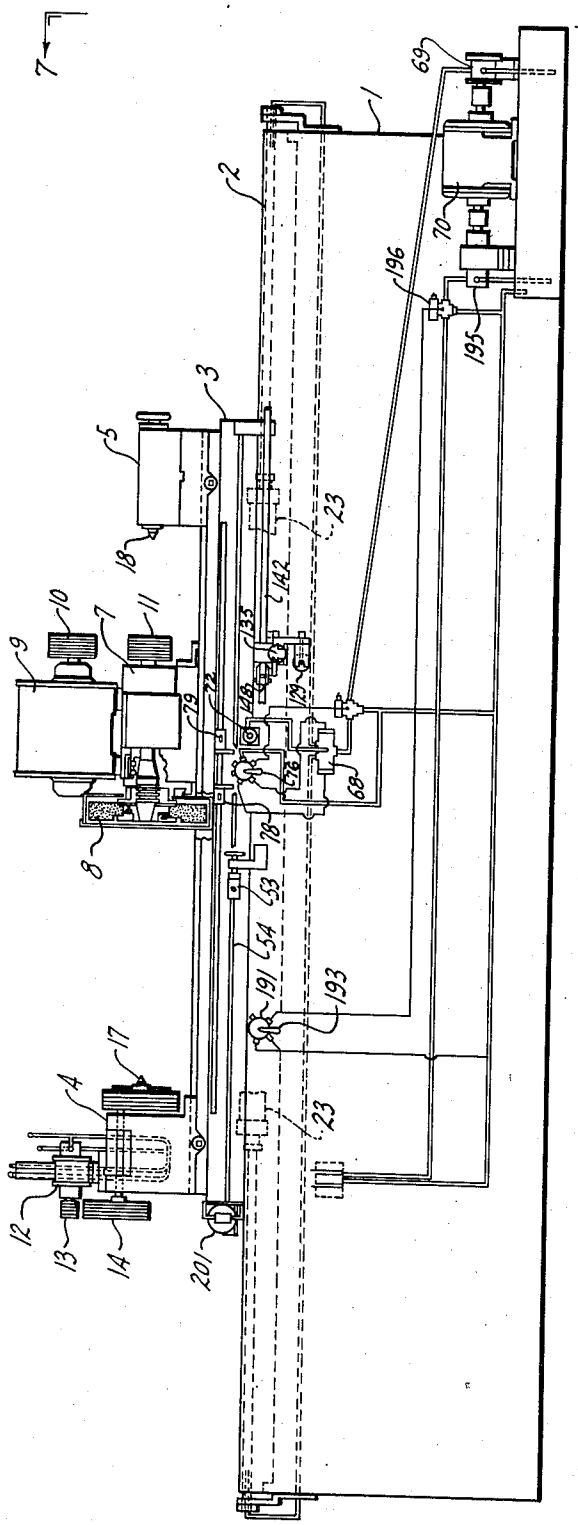


Fig. 10

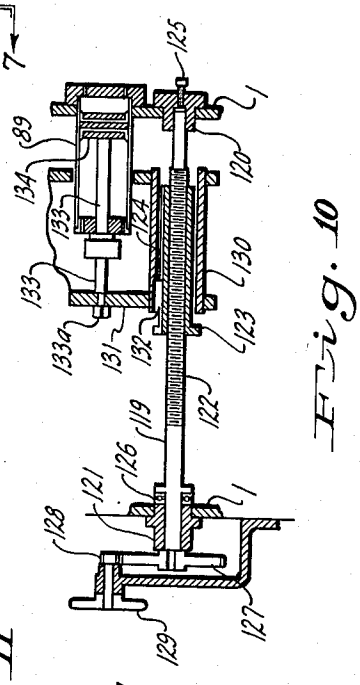


Fig. 11

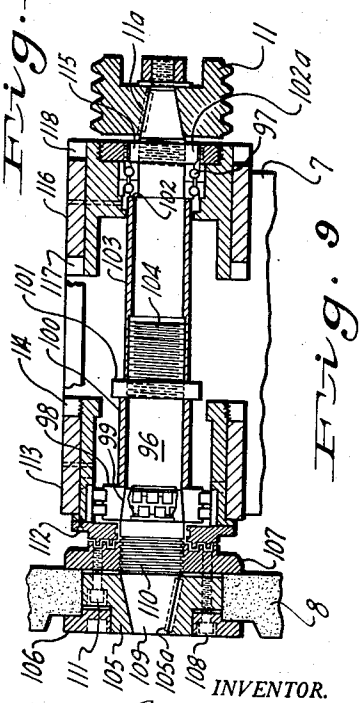


Fig. 9

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HYDRAULIC ROLL GRINDER

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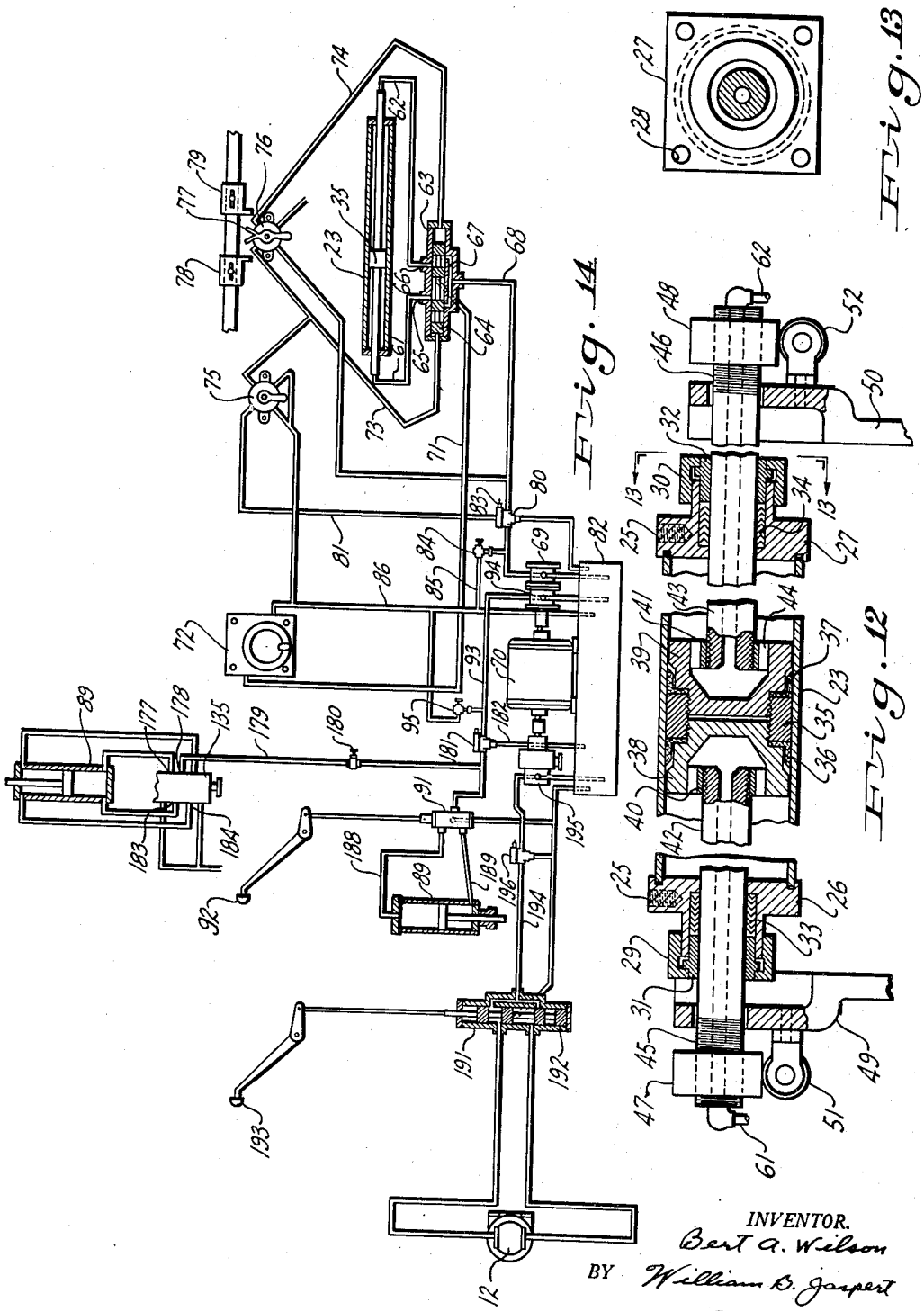


Fig. 13

Fig. 14

Fig. 12

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UNITED STATES PATENT OFFICE

2,646,651

HYDRAULIC ROLL GRINDER

Bert A. Wilson, Pittsburgh, Pa., assignor, by mesne assignments, to Blaw-Knox Company, Pittsburgh, Pa., a corporation of Delaware

Application February 15, 1949, Serial No. 76,436

5 Claims. (Cl. 51—100)

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This invention relates to new and useful improvements in cylindrical roll grinding machines especially adapted for use in grinding large rolls for rolling mills.

It is among the objects of the invention to provide a roll grinding machine which shall be hydraulically powered having a wide range of speed and operated by finger-tip control of a few control valves without the employment of gear wheels.

It is a further object of the invention to provide an hydraulically operated and controlled roll grinding machine having automatic control means for grinding crowns or concavities on the roll surface.

It is still a further object of the invention to provide hydraulically operated roll grinding machines in which the several actuating parts are separately powered by hydraulic pumps with relief valve controls for maintaining suitable fluid pressures and with means for bleeding off or venting any air that may be pumped into the system.

Still another object of the invention is the provision in an hydraulic roll grinding machine of an hydraulically actuated grinding wheel carriage or slide and control means for automatically actuating said slide to grind a tapered or curved contour in response to axial movement of the roll table.

These and other objects of the invention will become more apparent from a consideration of the accompanying drawings, constituting a part hereof, in which like reference characters designate like parts and in which

Fig. 1 is a top plan view, partially cut away, of an hydraulically operated roll grinding machine embodying the principles of this invention;

Fig. 2 a top plan view, partially in section, of a portion of the machine bed and grinder wheel slide actuating bar;

Fig. 3 a vertical cross sectional view of a control valve for the grinder slide;

Fig. 4 an end elevational view of the valve of Fig. 3;

Fig. 5 a side elevational view, partially in section, of the valve shown in Figs. 3 and 4;

Fig. 6 a top plan view of the roll grinder unit with a portion of the bed cut away;

Fig. 7 an end elevational view of the machine taken along the line 7—7, Fig. 11;

Fig. 8 an end elevational view of the grinding wheel slide taken along the line 8—8, Fig. 7;

Fig. 9 a cross sectional view of the grinder head and wheel;

Fig. 10 a cross sectional view of the grinding wheel slide actuating plunger and hand actuating mechanism therefor;

Fig. 11 a front elevational view of the roll grinding machine unit;

Fig. 12 a cross sectional view of the table actuating cylinder and plunger;

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Fig. 13 an end elevational view, partially in section, taken along the line 13—13, Fig. 12; and

Fig. 14 a diagrammatic view illustrating the hydraulic actuating and control mechanism for the several operating parts of the roll grinding machine.

With reference to Fig. 11 of the drawings, the reference numeral 1 generally designates the grinder bed having ways 2 on which is mounted the grinder table 3 that carries a head stock 4 and a tail stock 5. Mounted on the bed 1 and behind the table 2, as shown in Fig. 7, is a grinder base 6 on which is supported a carriage 7 for a grinding wheel 8 that is driven by a motor 9 through V-belts mounted on pulleys 10 and 11. The head stock 4 is driven by an hydraulic motor 12 by V-belts mounted on pulleys 13 and 14, the latter driving pulley 15 that drives the head spindle through pulley 16. The head stock and tail stock are provided with centers 17 and 18 on which the roll to be ground, such as the roll 19, Fig. 1, is mounted, the head stock carrying dogs 20 that interact with the spaces in the wobbler 21 of the roll 19.

The table 3, as shown in Fig. 7, is mounted for sliding movement in ways 22 and is actuated by an hydraulic cylinder 23, shown in detail in Fig. 12 and in the diagrammatic view of Fig. 14. It is bolted to the underside of table 3 at drilled and tapped holes 24 and 25 in cylinder heads 26 and 27, respectively, to be movable with the table. The cylinder 23 may be stainless steel tubing of suitable dimension. The two cylinder heads 26 and 27 may be joined by bolts passing through drill holes 28 in the heads from head to head. Gland nuts 29 and 30 are screwed on heads 26 and 27 to secure the packing glands 31 and 32 and the piston rod packing 33 and 34.

The piston head is made of four parts that consist of an internally threaded sleeve 35 having leather cups 36 and 37 on both sides thereof, which are held by heads 38 and 39 which are machined complementary to the shape of the cups to hold them against the threaded sleeve 35 to constitute a piston head. The heads 38 and 39 are counterbored and provided with threads 40 and 41. A plurality of seamless tube piston rods 42 and 43 are threaded at their ends to interact with the threads 40 and 41. Drill holes 44 are provided in the piston heads 38 and 39 as shown. The other ends of rods 42 and 43 are provided with threads 45 and 46 to receive nuts 47 and 48. When assembled the rods extend through brackets 49 and 50 of the machine bed 1. The end nuts 47 and 48 of the piston rods ride on roller supports 51 and 52 and are adjustable relative to the brackets 49 and 50 to provide an adjustable longitudinal movement of the piston rod through the brackets. This movement occurs on each reversal of the table 3, establishing a pause in its movement so that when the table comes to the end of the grinding cut or pass the roll or

work being ground will make a revolution before the table starts back in reverse. Fig. 12 shows the end nuts in transition position while the rods 42, 43 are moving; it being understood that the table 3 is then stationary in one extreme position. When one of the nuts 47, 48, abuts against a bracket 49 or 50 as the case may be, the rods and piston come to and remain at rest and further flow of oil into the cylinder 23 causes the latter to move and propel the table 3 toward its other or opposite extreme position.

The end of travel of the table is also optionally controlled by an adjustable stop comprising an angle bracket or abutment 53 attached to a T-bar 54, Fig. 11, of the table and an angle bracket 55 attached to the bed 1. An adjusting screw 56 is provided to adjust the stop position of the table at the end of its travel. This travel control means is utilized when grinding the journal necks 57 to bring the grinding wheel up against the shoulders 58 or the shoulders 59 and 60, or whichever portion of the roll is being ground. The table feed power holds the table against abutment 53 to provide chatterproof stop.

The hydraulic fluid for actuating the table is transmitted through the ends of the piston rods 42 and 43 by conduits 61 and 62 which, as shown in Fig. 14 of the drawings, are connected to a four-way valve cylinder 63 which is provided with a spool valve 64. Conduits 61 and 62 are connected to ports 65 and 66 of valve housing 63 which is further provided with a double port or gland 67 connected by a conduit 68 to a source of pressure fluid such as a pump 69 that is operated by a motor 70, Fig. 14. Valve 63 is further connected by a conduit 71 to a valve 72 that controls the rate of travel of the table. The four-way valve 63 is further connected by conduits 73 and 74 to a valve 75 for starting and stopping the table movement and a pilot valve 76 having fingers 77 in the path of adjustable stops 78 and 79 is mounted on rod of carriage shown in Fig. 14, which reverses the movement of the table at the end of the table travel. A relief valve 80 is disposed in the drain line 81 of the control valve 75 leading to a sump 82 for the purpose of regulating the fluid pressure independently of the pressure of the fluid at its source, and for this purpose is provided with a valve adjustment 83.

To eliminate any air that may be pumped into the hydraulic operating and control mechanisms, provision is made for the escape of air through a needle valve 84 which is connected in the main pressure line 68 and is further connected by a transparent plastic tube 85 to the line 86 leading from the feed valve 72 to the sump 82.

The grinding wheel head and its power mechanism is constructed as follows. The slide 7 is mounted on four rollers 87, Fig. 7, and is further provided with side rollers 88, Fig. 7, to reduce friction, and is actuated in sliding movement by the piston rod 133 of an hydraulic cylinder 89 which is controlled selectively by manually controlled four-way valve 91 that is actuated by a handle 92, or by automatic valve 135 subsequently described and explained. The valve 91 is connected by a pressure conduit 93 to a pump 94, Fig. 14, and is provided with a needle valve 95 for bleeding out any air that may be pumped into line 93.

The grinder head in which the grinding wheel is journaled is shown in detail in Fig. 9 of the drawing. The grinding wheel 8 is rotated by a spindle 96 journaled at one end in ball bearings 97 and at its other end in a triple row staggered roller bearing 98. The inner race of bearing 98 is seated on a conical or tapered portion of the spindle 96 on which it is held by a sleeve 100 and a lock nut 101. With the bearings 97 abutting the spindle shoulder 102 on one side and the ring nut 102a on the other, the spindle is locked against axial displacement. Bearings 97 may be pressed off spindle 96 by a sleeve 103 against which the nut 101 acts when turned on the threaded portion 104 of the spindle.

The grinding wheel collet or mount is made of three parts, a hub 105 and wheel flanges 106 and 107 between which the abrasive wheel 8 is clamped by bolts 108. The end of spindle 96 is tapered as shown at 109, behind which the spindle is provided with a square thread 110 on which the wheel flange portion 107 is screwed. The wheel flange portion 107 is also provided with countersunk cap bolts 111, with which the hub 105 is securely attached thereto.

The outer race 112 of the triple staggered roller bearing 98 is inserted in sleeve 113 to which it is bolted. Sleeve 113 is held in wheel slide 7 by nut 114, and one end of the bearings 97 is held in place by nut 115. A second sleeve 116 is held in slide 7 by nuts 117 and 118, in which is pressed the outer races of ball bearings 97, held by retainer 118' threaded into sleeve 116. The mounting of the abrasive wheel 8 permits grinding closer, and the triple roller bearings 98 at the grinding wheel end of the spindle, due to the out of line of the rollers by staggering, gives a smoothness to the spindle and grinding wheel not attainable by ball bearings, and the cause of chattering or vibration on the work is eliminated. The spindle is driven by a pulley or sheave wheel drive 11 as previously described which is keyed on the tapered end of shaft 96 at 11a and the grinding wheel hub 105 is keyed on taper seat at the other end of shaft 96 at 105a.

The wheel slide 7 is provided with a screw feed 119 which is provided with a bearing 120 at one end that is bolted to the machine bed 1, and a second bearing 121 that is also bolted to the machine bed 1. Screw 119 is provided with square cut threads 122 that interact with the thread of a shoulder sleeve 123 having a key-way 124. An adjusting screw 125 keeps the feed screw 119 tight against ball thrust bearing 126. Screw 119 is provided with a gear wheel 127 that interacts with a pinion 128 rotatable by a hand wheel 129 to afford micrometer adjustment of the screw 119. Sleeve 123 is a sliding fit in sleeve 130 held in bracket 131. A key 132 anchored in the bracket sleeve 130 prevents shoulder sleeve 123 from turning when screw 119 is rotated to permit motion of the wheel slide 7 towards the work by action of cylinder 89 as shown in Fig. 10. The shoulder 132 is a stop for the wheel slide or rather the bracket 131 which is bolted to the wheel slide 7. This feed screw is not used to retract the grinding wheel, which is effected simply by reversing cylinder 89 by operation of valve 91.

The cylinder 89 for actuating the wheel slide hydraulically is bolted to the bed 1 of the machine and its piston rod 133 is connected to bracket 131 by the screw 133a, Fig. 10, so that when hydraulic pressure is applied to cylinder 89 the pressure on the piston head 134 displaces bracket 131, carrying with it the wheel slide 7 to feed the grinding wheel 8 into the work. The adjusting and actuating mechanism is securely held against any other displacement movement except that of feeding the wheel to the work.

This design permits the grinding wheel slide 7 to be run back away from the work by reversing the pressure in cylinder 89. The feed screw 119 may be backed slightly while the work is changed in the machine. When it is desired to again feed the wheel to the work, the pressure in cylinder 89 is reversed to bring the bracket 131 against the shoulder or flange of the screw sleeve 123. If the screw feed 119 is not adjusted and the wheel slide is reversed by the pressure in cylinder 89 only, then upon the reversal of pressure which brings slide 131 against the shoulder stop 123, the wheel is again in the same grinding position that it was before reversal.

The grinder head slide 7 may also be automatically fed while the work table is moving back and forth on the machine bed 1 by means of an automatic valve, generally designated by the reference character 135, shown in Figs. 2 to 5 inclusive. The automatic feed is used for grinding crowns, concavities or tapered surfaces on the roll body and shoulders, for which purpose a bar 136, Fig. 1, is employed. It is mounted by brackets 137 and 138 mounted on the table 3. The ends of the bar 136 may be adjusted by micrometer screws 139 and 140, and the center of the bar is pivotally mounted at 141 on a bracket, as shown, which is secured to the table 3. A contour bar 142, which normally is straight, is mounted on the bar 136. It is attached to the bar 136 by brackets 143 and 144, shown in detail to the left at the bottom of Fig. 1, and is provided with an eccentric 145 carried by a bracket 146 bolted to bar 136 as shown in the center at the bottom of Fig. 1, the eccentric 145 being adjustable to bow the bar 142 where it is desired to grind a crown 147 on the face of the roll as shown in Fig. 1 in a manner to be hereinafter explained. The automatic valve 135 is controlled to feed the grinder wheel slide 7 to form the crown on the roll by a follower 148 which, as shown in Fig. 3, is mounted on a lever 149 pivoted at 150 to the valve base. The follower 148 rides against the bar 142 as shown in Fig. 1. The valve is carried upon a slide bar 151 that is connected to the slide 7 by a bracket 152 as shown in Fig. 1, so that the valve moves transversely of the table 3 and synchronously with the grinder head 7 in response to actuation of cylinder 89 which the valve controls. For the purpose of adjusting the grinding wheel head to the work or table the bar 151 may be clamped to the bed by yoke clamp 151*a* as shown in Fig. 2. The bed 7 may then be moved by sliding contact with bar 151 without disturbing valve 135.

One end of the bracket is connected to an arm 153, Fig. 5, of the valve base 154. The base 154 is adjustable by a micrometer feed screw 155 operated by hand wheel 156 to move the wheel slide in the direction of the roll to bring the wheel 8 in contact with the roll preliminary to the automatic feeding as effected by the valve 135 in the following manner. The valve lever 149, Fig. 3, is biased by a spring 157 which is connected to a stud 158 screwed into base 154 of the valve, the spring being absent in Fig. 5.

Pushing against lever 149 is a plunger 159 in cylinder 160 on which is screwed cap 161 under which is a coil spring 162 resting on shoulder 163 of the plunger 159. A special rubber packing cup 164 is fastened underneath the plunger shoulder 163 by a screw 165. A small reservoir 166 is provided below the plunger which is filled with liquid through the opening closed by a small screw 167. Cylinder 160 has an extended sleeve 168 in which is inserted a piston rod 169, a packing cup 170 being provided in the end of the extension sleeve 168. A spring cage 171 is screwed on the piston rod 169, the cage being biased by a coil spring 172 that rests against a flange of the cage and the other end rests upon a spring seat 173. The action of spring 172 is to maintain pressure on the liquid in the reservoir 166.

The piston rod 169 pushes against a spool valve 174 which is controlled by a spring 175 resting on body flange 176. Spring 175 keeps pressure on the spool valve 174 and on the piston 169 and against the fluid in the chamber 166, whereby pressure is maintained against plunger 159 and lever 149, but not enough to stretch or move spring 157. The spool valve controls port holes 177 and 178 which, as shown in Fig. 14, are connected to the lower end of the wheel slide cylinder 89 and the pressure side of pump 94 through conduits 179, a needle valve 180 being provided in the line and a relief valve 181 having a drain 182 to the sump 82. Port holes 183 and 184 are connected to the top and bottom of the cylinder 89 for the return flow of the fluid to the reservoir or sump through port holes 185 and 186. These connections are so made to expel any trapped air in the cylinder 89 when all port holes are covered by the spool valve 174, and the fluid is not passing to either end of the cylinder. The spool shape of the valve 174 provides a pressure balance on all sides of the valve so that it is responsive only to the pressure of the fluid acting through the respective ports of the valve. In other words, no power is lost or required in subjecting the spool valve to axial movement in the valve housing.

So long as the control valve is closed (i. e., follower 148 and lever 149 are not disturbed or moved relative to the valve body) the grinding wheel slide to which it is connected by the slide bar 151 remains stationary or in a fixed position, and it will remain so as long as the contour bar 142 is parallel to the table travel.

When the bar 142 is set for tapering or crowning, roller 148 as it follows the bar will displace lever 149 to press on plunger 159 which in turn exerts pressure on the fluid in reservoir 166, forcing the liquid to expand into the cylinder sleeve 168 against piston 169 which acts upon the spool valve 174, opening ports 177 or 178 and exhausting through ports 183 or 184, permitting the proper amount of oil to flow into one side of cylinder 89 and a like amount to flow from the other side of the cylinder, thereby moving the grinder wheel slide 7. As the slide 7 moves with its bracket 152 carrying bar 151 on which the valve body is bolted, the roller remaining in bearing against the bar 142, the relative displacement tends to restore lever 149 to closed position which brings the control valve back in balance. The shape of the contour bar will thus permit a small amount of pressure fluid to be fed to the cylinder 89 to keep the grinding wheel slide moving in confromity with the contour bar to crown or taper the grinding surface, for whichever the contour bar is set. The spool valve 174 may be manually controlled by pushing in or pulling out the slide 187.

When valve 174 is closed oil is trapped in the cylinder 89 on both sides of the piston, and the grinder slide 7 is rigidly held against displacement in either direction. Movement of the lever 149 opens the ports to both sides of the piston, one to pressure and the other to the reservoir, to a degree proportional to the lever movement but

multiplied as explained below, giving instant movement of the slide in response to displacement of the lever by the contour bar. This movement is synchronously transmitted to the valve 135 itself in such direction as to cause the valve to throttle or close off the oil flow and retard or stop the movement. The slide is thus powered to hunt a position in which the valve is closed, and the piston is rigidly held with oil trapped on each side. The throttling of the valve ports rapidly as closed position is approached inhibits momentum effects and delay in equalizing pressure on both sides of the piston which would impair accuracy of control.

Thus as shown in Fig. 14, the grinder wheel slide 7 may be hydraulically actuated either by the automatic control valve 135 or by lever 92 through valve 91 which is connected by conduits 188 and 189 to the top and bottom of the cylinder 89, which for clarity is shown in Fig. 14 of the drawings as connected both to the automatic control and manual hydraulic controls.

The reservoir 166 functions as sensitizing means in the valve by which small or infinitesimal displacements of the plunger 159 (resulting from corresponding small displacements of lever 149 and roller 148) is translated as large or substantial displacements of the valve operating piston 169. This result is due to the relative areas of the large actuating plunger 159 and small actuated piston 169 and the constant volume of displacement transmitting oil reservoir 166. As an increment of this oil is transferred from cylinder 160 to the small diameter extension 168 the lineal displacements of the piston and plunger are not only proportional to the magnitude of the increment of oil transferred, but the valve motion is intensified in the ratio of areas of the moving parts and is therefore sensitive to minute and practically infinitesimal reactions between the roller 148 and contour bar 142.

With reference to Fig. 14 of the drawings, the head stock is driven by an hydraulic motor 12 connected to a four-way valve cylinder 191 having a spool valve 192 operated by a lever 193. The valve 191 is connected by a conduit 194 to a pump 195 having a relief valve 196 to regulate the pressure of the fluid independently of the pressure at the pump.

The ways 22 of the bed 1 on which table 3 slides are lubricated by providing a reservoir 198 for oil in the bed 1 of the machine as shown in Fig. 2. This is covered by a pan 199 to keep out dust. The cover is provided with a slot a little longer than the travel of the table 3 and a suction pipe 200 is attached to the table extending through the slot into the reservoir 198. At the head stock end of the table is a small motor and pump 201, the suction side of the pump being connected to the pipe 200 and the outlet side of the pump being connected to pipes 202 and 203 which lead to the center of the table ways 22 to supply lubrication. This gives uniform pressure of lubrication throughout the table travel and permits the oil to be returned through holes provided in the ways to the sump without further piping. The ways also are further provided with pockets 204 that are filled with Babbitt or plastic to catch any grit that may accumulate in the ways to prevent it from scratching the surface of the ways.

The operation of the above described roll grinder is briefly as follows. With the roll 19 mounted in the head stock 4 with the dogs 20 disposed in the wobbler head 21 and with the tail stock center all as shown in Fig. 1, the work is set up for grinding by the wheel 8.

The wheel slide 7 is initially moved adjacent the roll surface by the hand wheel 129 which moves the slide. The grinder wheel motor 9, Figs. 7 and 11, is then energized to actuate the grinder wheel 8. The start and stop valve 75, Fig. 14, is then actuated to direct pressure fluid to the table cylinder 23, Fig. 14. Stops 78 and 79 for valve 76 are then set to limit the length of travel of the table 3 to the distance corresponding to the surface on the roll 19 to be ground. Valve 72 is then adjusted to regulate the return of travel of the table back and forth and the wheel is then fed either by the hand wheel adjustment, as shown in Fig. 10, where the surface of the roll or shoulder is straight, or if crowned as shown in Fig. 1 of the drawing the automatic regulator valve 135 is brought into action by adjusting roller 148 to contact the surface of the contour bar 142. If the bar 142 is bulged in the center by an adjustment of the eccentric 145, Fig. 1, the travel of roller 148 on the contour bar will result in a feeding of the wheel 8 through the slide 7 corresponding to the contour of the bar, resulting in a crowned surface 147. If the contour bar 142 is merely thrown at an angle without bulging in the center, or tilted, so to speak, the resulting action of the roller 148 following the contour bar will produce a taper such as shown at 57, Fig. 1 of the drawings, which is the journal neck of the roll. The roll is actuated to rotate through the hydraulic motor 12 by operating lever 193 that controls the valve 191.

For speedy travel of the grinder wheel slide 7 to and away from the work, such as when the roll is removed and a new roll placed on the table, the cylinder 89 is connected to the pressure fluid by manipulating lever 92 which through valve 91 directs the fluid to move the slide head either direction as desired.

The feed screw 119 for the grinding wheel slide with the sleeve and stop shoulder 123 acting to stop the slide with the hydraulic cylinder 89 pushing the wheel slide against the stop, any movement except to feed the wheel to the work is eliminated. There is no back lash in the screw and nut and no wear.

The lubrication of the table ways on the bed is another desirable and important feature as it maintains equal pressure of the lubricant on all points of the table for the full length of travel of the table. It eliminates piping, and supply of oil in unequal pressures resulting in a smoother grinding operation, and prevents scoring of the ways of the table and bed.

The staggered roller bearing 98 for the grinder head, as shown in Fig. 9 of the drawings, produces a smoothness to the spindle operation not obtained by ball bearings or rollers that are in line instead of staggered. It produces a smooth finish on the work and permits deeper feeding into the work, thereby reducing time for the grinding operation.

Another important feature is the table operating cylinder with the composite piston head holding leather packing cups and the manner in which it operates to delay action to allow the work to make a revolution before the table reverses. The adjustable stops on the bed permit of grinding against the shoulders and collars of the work and eliminate the need for a rack on the table. The hydraulic actuators and controls all within the reach of the operator at the front

of the table allow for speedy adjustment and accurate control of the roll grinding operation.

While the invention has been demonstrated as applicable to grinding of rolling mill rolls, it is evident that it may be used for any kind of grinding operations and especially for large industrial parts.

Although one embodiment of the invention has been herein illustrated and described, it will be evident to those skilled in the art that various modifications may be made in the details of construction without departing from the principles herein set forth.

I claim:

1. In a roll grinding machine, a bed having ways for receiving a table, a table mounted for sliding movement on said ways, an hydraulic cylinder mounted on said table parallel to said ways, a floating piston in said cylinder, hollow piston rods comprising fluid conduits extending through both ends of said cylinder connecting to said piston, fluid ports in said piston communicating with the ends of said conduits respectively on opposite sides of said piston, guide means on said bed for said rods permitting longitudinal movement of said rods therein, and stop means on said rods adapted to engage said guide means after limited displacement of said rod in both directions, and reversible valve means for selectively admitting fluid to said cylinder under pressure through one conduit and withdrawing fluid through said other conduit to cause said table to reciprocate along said ways, the said limited displacement of said rods and piston providing a predetermined interval upon reversal of said valve during which the table remains stationary while the rods and piston move to rest against said stop means.

2. In a roll grinding machine constructed according to claim 1, a headstock and tail stock for receiving and turning work to be ground mounted on said table, means for driving said headstock continuously, a grinding wheel adjacent said table at a station fixed longitudinally of said ways, valve reversing fingers adjustably mounted on said table and adapted to engage and operate said reversible valve means when the table is in extreme positions with the ends of the pass on the work at said station, and the said stop means on said rods being mounted to provide one revolution at least of the continuously rotated work at said extreme positions while the table is stationary to complete grinding a full circumference at said extreme positions before reversal of said table.

3. In a roll grinding machine, a machine bed having ways for reaching a table, a table mounted for sliding movement on said ways, hydraulic actuating mechanism for operating said table comprising an hydraulic cylinder mounted on said table, a piston operative in said cylinder, a source of pressure fluid for said cylinder and valve means for directing the fluid to opposite sides of said piston, said piston comprising a plurality of piston heads, a screw sleeve joining the ends of said heads, hollow piston rods connected to said heads, said heads having fluid chambers communicating with said piston rods and having flow passages from said chambers, cup leathers disposed between said heads for providing fluid seals with the wall of the cylinder, and packing glands between the cylinder heads and piston rods externally of the cylinder.

4. In a roll grinding machine, a machine bed, a table mounted for sliding movement on said bed, a slide for supporting a grinder wheel head extending transversely of the path of movement of the table, a grinder head mounted on said slide carrying a grinding wheel, pressure fluid means for moving said head to and away from said table, a valve for controlling the application of pressure fluid for actuating said grinder wheel head, a templet mounted on the table, means for adjusting the contact surface of the templet to the desired contour of the roll to be ground, means engaging said templet for operating said valve in response to movement of said table, said valve comprising a valve housing, a spool valve in said housing, ports controlled by said spool valve connected to a source of pressure fluid and to a sump, spring means normally biasing said spool valve to one position of its travel, fluid pressure means counteracting said spring means, and a lever for regulating the pressure on said fluid pressure means, said lever being biased by a spring relative to its fulcrum point and a follower mounted on said lever for engaging the templet of the table to effect movement of the spool valve and for directing pressure fluid to and from the operating cylinder of the grinder wheel head in response to movement of the table.

5. In an hydraulic roll grinder including a work carrying table reciprocable longitudinally and a grinder carriage movable transversely of said table at a station therealong and a bed having longitudinal and transverse ways for said table and carriage respectively, an hydraulic cylinder mounted in said bed connected to propel said carriage, a templet adjustably mounted on said bed parallel to the path of said carriage, a control valve for said cylinder, mounting means supporting said valve adjacent said templet from said carriage, said means being frictionally held by said carriage, a clamp mounted on said bed adapted to engage and hold said mounting means in fixed relation to said templet and to permit said carriage to slide with respect to said mounting means, the valve and said mounting means being free to move in correspondence with movement of said carriage when said clamp is released, whereby by operating said clamp the carriage may be independently indexed to grind the work at a predetermined depth, and after release of said clamp the contour and depth of grinding as controlled by interaction of said valve and templet.

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