March 19, 1929. W. L. BRYANT 1,705,749

INTERNAL GRINDER

Filed Dec. 29, 1921 5 Sheets-Sheet 1

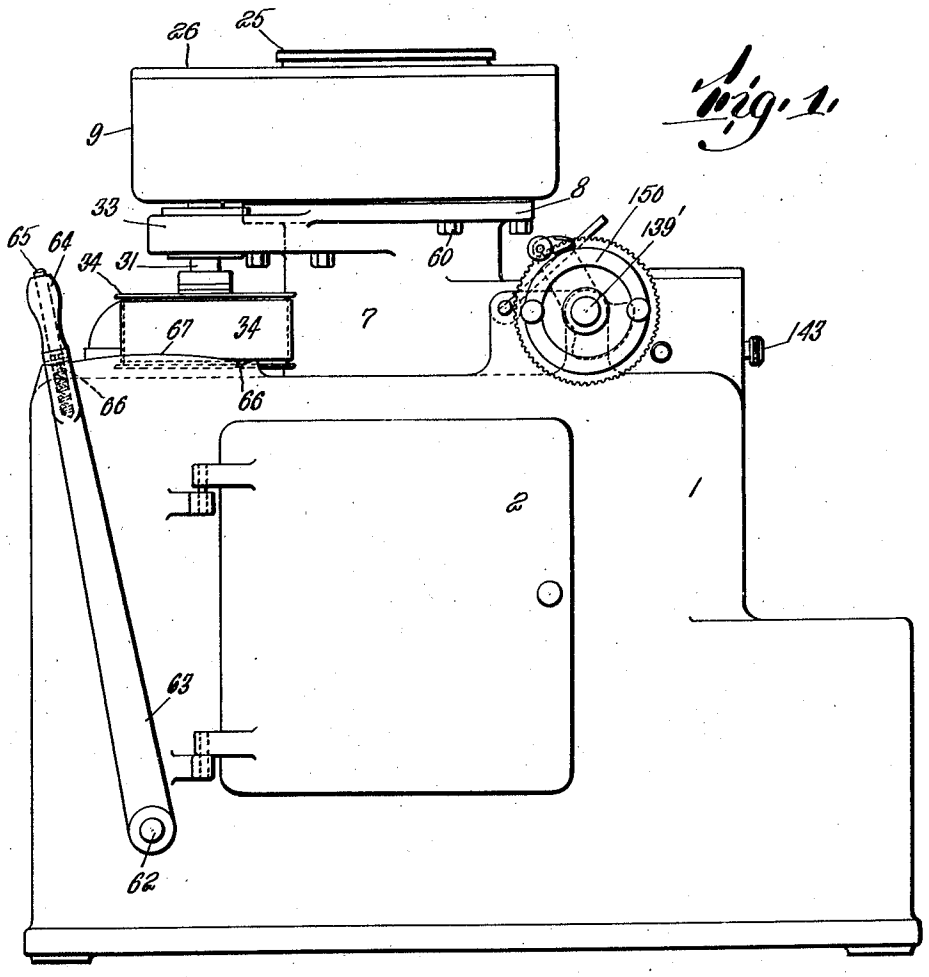


Fig. 1.

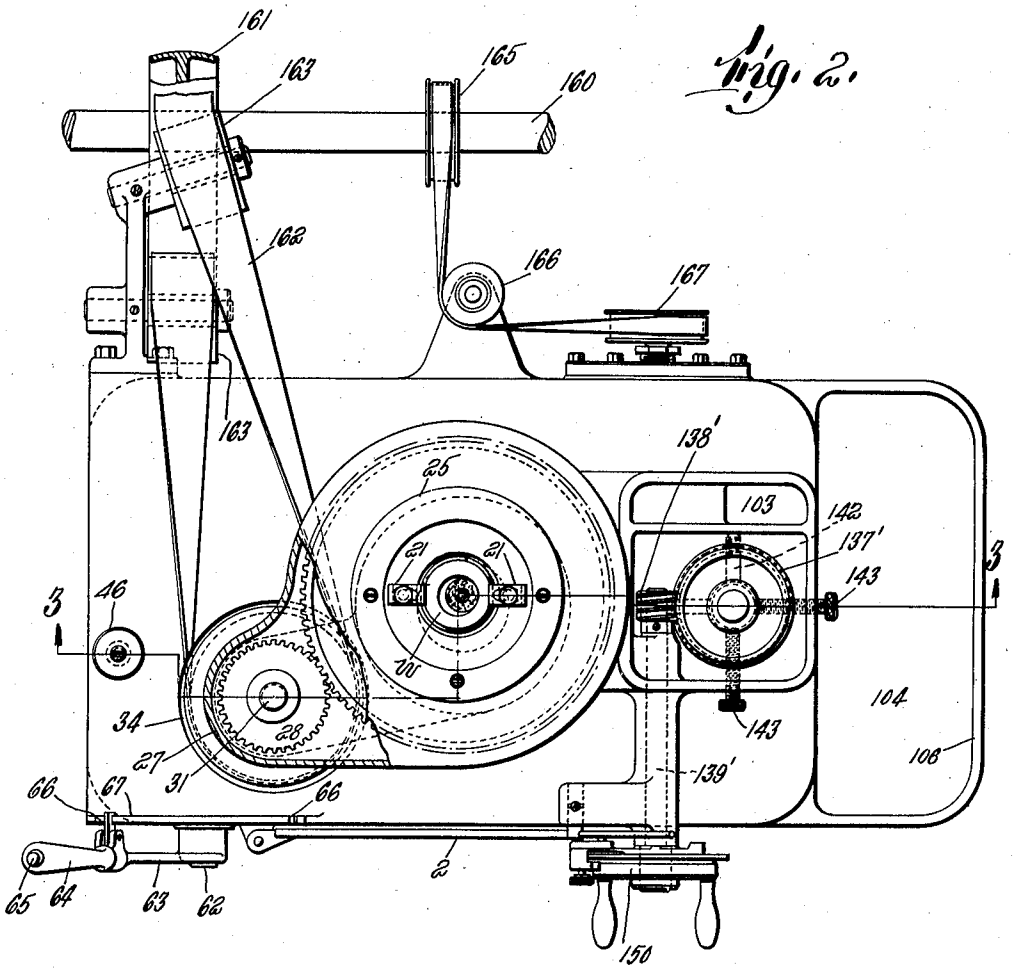
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INTERNAL GRINDER

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Fig. 2.



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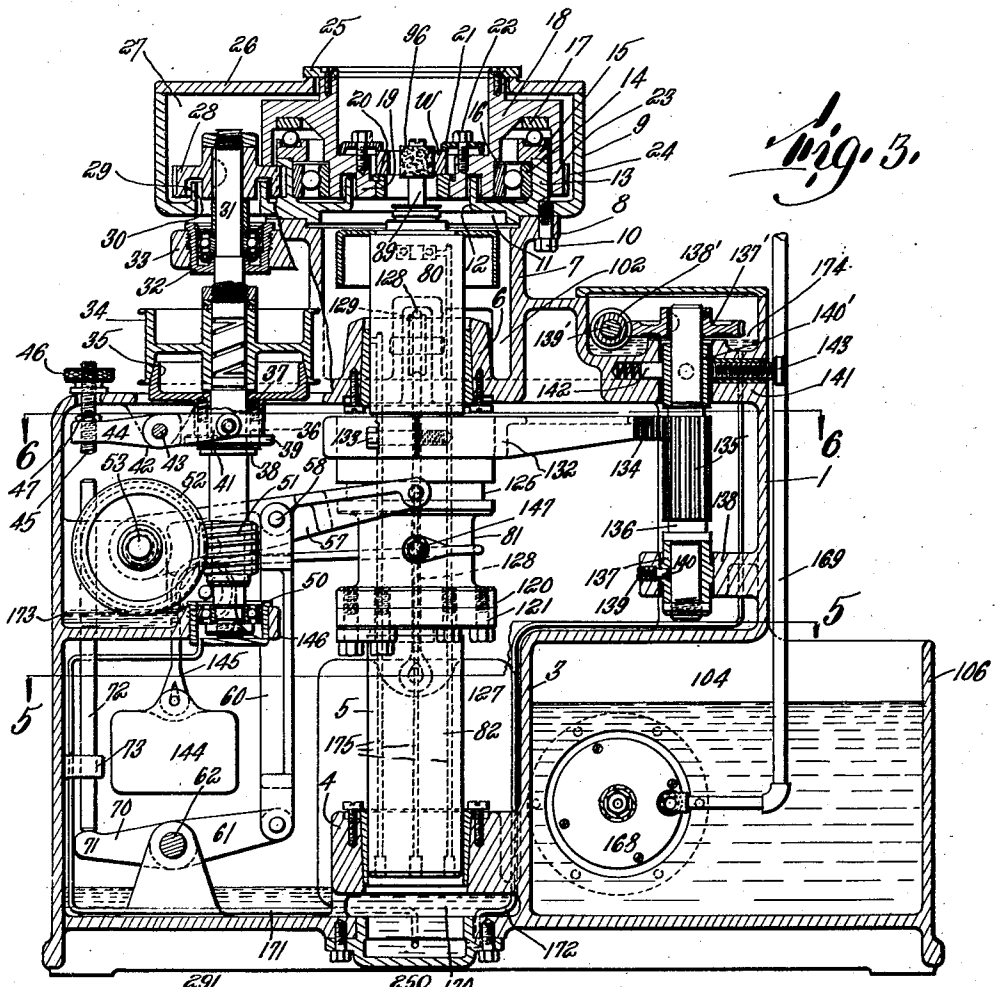


Fig. 3.

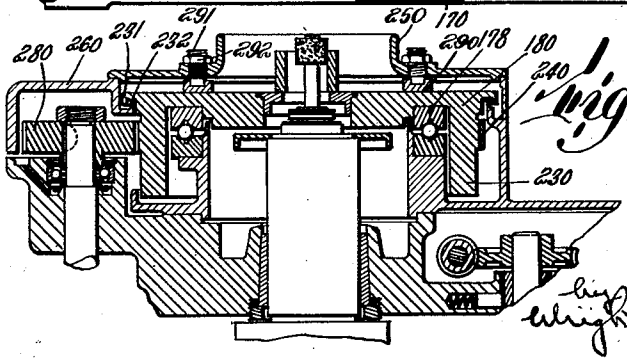


Fig. 4.

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INTERNAL GRINDER

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Fig. 5.

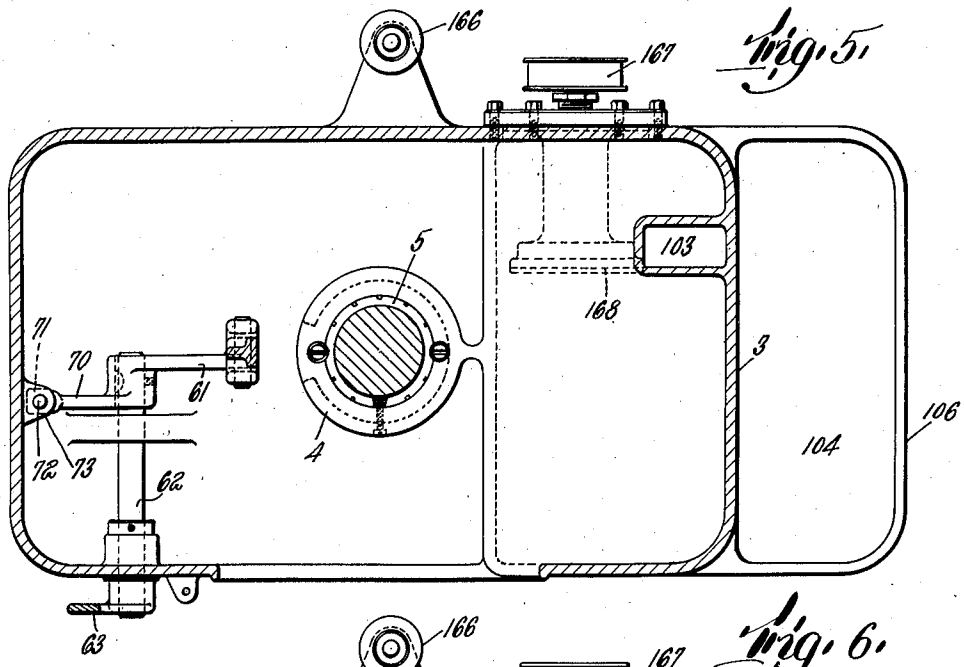
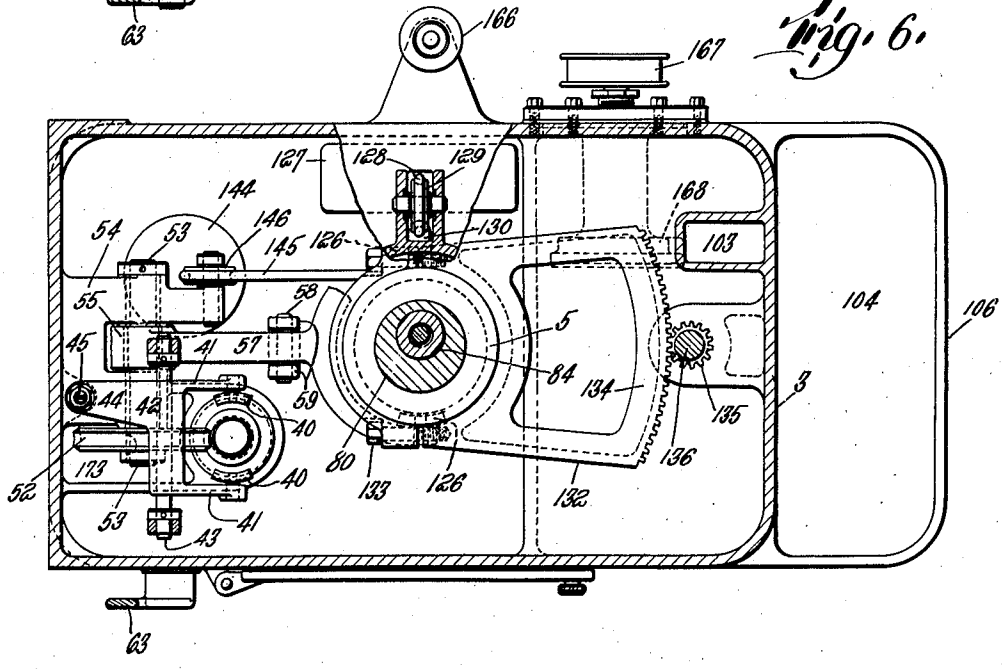


Fig. 6.



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INTERNAL GRINDER

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Fig. 7.

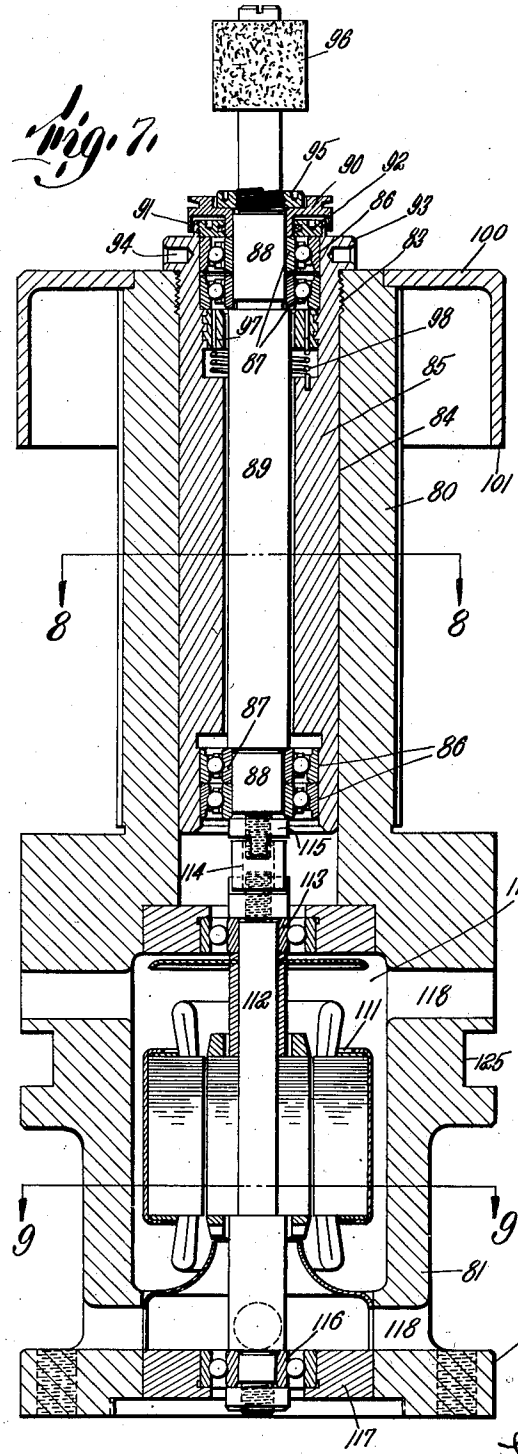


Fig. 8.

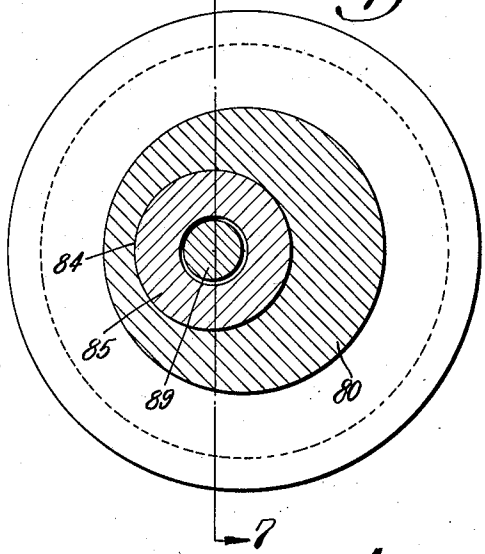
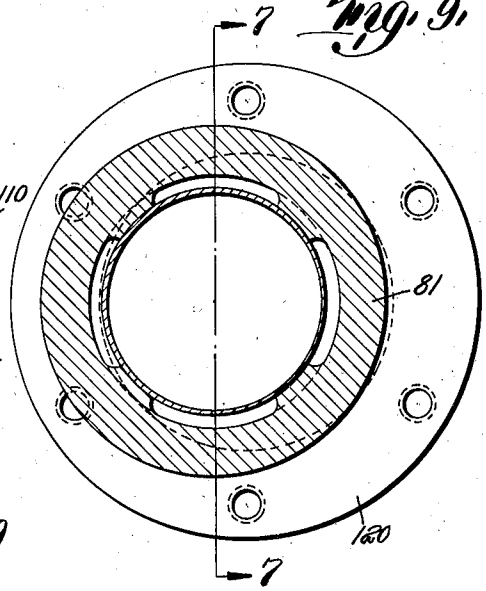


Fig. 9.



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UNITED STATES PATENT OFFICE.

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INTERNAL GRINDER.

Application filed December 29, 1921. Serial No. 525,537.

This invention relates to grinding machines of that type designed for grinding internal surfaces and has been designed more particularly for grinding the internal faces of ball bearing raceways and analogous structures. While many of the novel features of this machine might be otherwise advantageously incorporated, it has been found convenient to embody them in a machine of the vertical spindle type.

One of the features of this invention comprises a plate-like work holder rotatably carried by the machine and having an opening through which the shaft of the grinder wheel or lap passes, the grinding shaft being positioned vertically. This plate is constructed so that it is only necessary to lay it in proper position, preferably on a ball bearing, the upper race of which is carried thereby, its weight retaining it in position without the requirement of any devices specifically for this purpose. The work holder is thus gaged for accuracy of rotation by its side face which rests on the bearings and at points spaced from the axis of rotation of the work considerably further than the surface to be ground which extends in the direction of this axis. The work holder is thus mounted quite independent of the mounting of the grinding wheel in the machine frame and is gaged for accuracy in a plane perpendicular to its rotation axis. This plane is adjacent to the central radial plane of the surface to be ground, the distance between such planes being less than the radius of the bearing engagement of the work holder, whereby the effect to vary angularly the axis of the surface to be ground of any uneven wear or unavoidable irregularity in the bearing surface will be diminished. This work support is rotated by a gear which engages peripheral teeth thereon, the lines of engagement between the meshing teeth being parallel to the axis of rotation so as to minimize interference with the automatic determination of the axis of rotation of the work by its gravity maintained bearing engagement. This is an important feature as it gives great stability for the support of the work making for extreme accuracy of the grinding operation.

A further feature resides in the construction and mounting of the grinder shaft by which a traversing axial motion is effected during the operation of the machine and by which it is retracted axially from the work when the rotation of the work holder is stopped. It is therefore a simple matter to stop the movement of the work and retract the wheel from operative relation thereto for ready inspection or removal of the work.

A still further feature relates to grinder wheel drive mechanism in a unit independent of other mechanisms.

Yet another feature relates to the mechanism for imparting a relative cutting feed transverse to the direction of traverse between the grinder and the work in which there is no possibility of lost motion and by which an exceedingly accurate adjustment is possible.

Other features of this invention relate to lubrication of the machine.

Further features and advantageous details and combinations of parts will appear from a more complete description of an embodient of the invention disclosed in the accompanying drawings in which

Figure 1 is a front elevation of the machine.

Figure 2 is a plan view.

Figure 3 is a section on line 3—3 of Figure 2.

Figure 4 is a section through the upper part of the machine corresponding to a portion of Figure 3 illustrating a modification.

Figure 5 is a section on line 5—5 of Figure 3.

Figure 6 is a section on line 6—6 of Figure 3.

Figure 7 is a vertical section through a portion of the grinding wheel shaft and its mounting substantially on line 7—7 of Figures 8 and 9.

Figure 8 is a section on line 8—8 of Figure 7.

Figure 9 is a section on line 9—9 of Figure 7.

The machine comprises a box-like stationary casing indicated at 1 having a central opening through its forward face adapted to be covered by a hinged door 2. Within the lower portion of this casing a partition 3 shown in Figures 3, 5, and 6 defines a reservoir for a cooling fluid. Adjacent the inner side of the partition 3 is a bearing 4 in which is slidably mounted a vertical plunger 5. This plunger extends upwardly through the machine being guided near its upper end in a bearing 6 and projects upwardly through a cylindrical portion 7 upstanding from the central portion of the casing 1.

The portion 7 terminates in an outwardly directed flange 8 to which may be bolted a casing member 9 by means of bolts 10. The casing 9 serves to house the work and the grinding wheel. This casing has a flat annular base 11 extending inwardly from the walls of the cylindrical portion 7 and terminating on its inner face in an upstanding flange 12. It also has a circular flange 13 concentric with the flange 12 and within this flange 12 is located the outer ring 14 of a ball bearing. On its upper face flange 13 carries a ring 15 of a second ball bearing raceway. Raceway rings 16 and 17 mating rings 14 and 15, respectively support an annular work-holding plate 18 which may be seated in the machine and be retained in position by its weight. The position of the plate is thus gaged directly from its lower face which rests on the ball bearings on a rigid support and in a plane perpendicular to its axis of rotation and is quite independent in its mounting from the grinding wheel mounting which will presently be described. This plate 18 has an annular flange 19 positioned within the flange 12 and carries a ring member 20 to which the work to be ground shown at W may be clamped by clamping plates 21 made fast by the bolts 22. Preferably also the work plate 18 has a depending marginal flange 23 extending outwardly of the flange 13 and carrying on its lower edge gear teeth 24 by which the plate may be rotated. The upper face of the plate 18 has fixed thereto an annular cover member 25 which overlaps a cover member 26 made fast to the casing member 9. This cover plate prevents cooling fluid from finding its way inside of the casing member and outwardly of the work plate but by removing the covers 25 and 26 it is evident that the work plate 18 may be lifted out of the machine, the two sets of ball bearings merely guiding and supporting the plate laterally and vertically.

At one side the casing member 9 is extended to form a housing 27 for a driving pinion 28 meshing with the teeth 24 on the work plate. This driving pinion has an annular recess 29 on its lower face within which engages an upstanding annular flange 30 on the casing 9. This pinion is made fast on the upper end of a vertical shaft 31 journaled in ball bearings 32 carried by a bracket 33 extending outwardly from the cylindrical portion 7. The shaft 31 beneath the bracket 33 has journaled thereon a belt pulley 34. Beneath this belt pulley is positioned a clutch wheel 35 slidable axially of the shaft 31 and keyed to rotate therewith. This clutch is normally urged into engagement with a mating surface on the pulley 34 by means of a plurality of spring-pressed pins 36 seated in sockets in the hub 37 of the clutch which engage on the upper surface of the collar 38 made fast to the shaft 31. The hub 37 is flanged at 39 at its lower end and riding on this flange, at diametrically opposite points, is a pair of shoes 40 which are carried at the ends of a pair of arms 41 of a lever 42 carried by a rock shaft journaled in lugs 43′ depending from the top of the casing 1. By pressing upwardly on the outer end of arm 44 of this lever, it is evident that the shoes engaging the flange 39 depress the clutch wheel 35 to disconnect it from the pulley 34. Threaded through the outer end of the arm 44 is an adjusting stud 45 having a knurled thumb nut 46 threaded on its upper end and normally bearing on the upper face of the casing 1 through a perforation in which the stud passes. A lock nut 47 determines the extent to which the stud 45 shall project below the arm 44.

The shaft 31 is seated at its lower end in a ball step bearing 50 and above this step bearing carries a worm 51. This worm meshes with a worm wheel 52 fixed to a transverse shaft 53 journaled in a bracket member 54 extending inwardly from the casing. This bracket also furnishes the support of the step bearing 50. The shaft 53 has fixed thereon between its ends an eccentric 55 which fits a bearing opening in the end of a lever 57. This lever is fulcrumed at 58 between jaws 59 at the upper end of a link 60 which is pivoted at its lower end to a lever 61 made fast to a rock shaft 62 extending outwardly of the casing and having fixed at its outer end a hand lever 63. This hand lever extends upwardly along the front of the machine, as shown in Figure 1, and terminates in a handle 64 having slidable therein a spring-pressed latch member 65 which may engage in a pair of notches 66 positioned at opposite extremities of a sector 67 extending upwardly from the top face of the casing 1.

The lever 61 has an arm 70 which extends toward the wall of the casing 1, terminating in a shoe 71 on which rides a bar 72 vertically reciprocable through a guide 73 at its lower end, and a portion of the bracket 55. The upper end of this rod 72 is positioned directly beneath the stud 45 so that rocking the lever 63 to the right, as shown in Figure 1, the fulcrum of the lever 57 is lowered, thus lowering its outer end about the eccentric 55 as a pivot and the rod 72 is raised, impinging on the stud 45 and lowering the clutch member 35 from engagement with the pulley 34. At the same time therefore that the outer end of the lever 57 is lowered by movement of the hand lever 63, the driving connection to rotate the work holder 18 is disconnected. This lever 57 actuates the grinding tool in a manner to be described, removing it from operative relation to the work holder 18.

The plunger mechanism 5 comprises an upper section 80 as shown in Figures 3, 7

and 8 and an intermediate section 81 and a lower section 82. The upper section 80 is formed as a sleeve having an eccentric bore 84 longitudinally thereof. A sleeve 85 is threaded therein at its upper end at 83, and carries at opposite ends outer race members 86 of a series of ball bearings. The inner race members 87 are carried by reduced portions 88 of a vertically extending grinder wheel shaft or spindle 89 carrying a grinder wheel 96 at its upper end.

Above the upper bearing member this shaft carries a ring 90 having a marginal depending flange 91 surrounding a plug sleeve 92 to prevent the entrance of water or other material to the bearings. The collar or ring 90 may be retained in position by a lock nut 95 engaging a threaded portion on the spindle 89. The bearings are accessible from the upper end of the sleeve 85 by removal of the plug 92 which is threaded in its upper end. To take up wear of the bearings, race members 86 may be formed tapered and a collar 97 internally threaded in sleeve 85 may be urged against the lower member 86 to wedge the balls inwardly by means of a torsion coil spring 98 engaging at opposite ends with collar 97 and sleeve 85. The upper end of sleeve 85 terminates in a flange 93 which extends over the upper end of the section 80 and has openings 94 for the reception of a spanner wrench by which the sleeve 85 may be screwed into and out of the section 80.

The upper end of the section 80 is provided with a shield or apron 100 formed with a depending marginal flange 101 to direct the cooling liquid adjacent the inner walls of the cylindrical portion 7 and outwardly of the bearing 6, where an annular channel 102 (see Figure 3) is formed to receive it. From this channel the cooling liquid passes through a passage 103 in the casing 1 as shown in Figures 2, 5 and 6 into the chamber or tank 104 formed between the wall 3 and an outer casing wall 106.

The upper and intermediate sections 80 and 81 may be formed integral, if desired, the intermediate section 81 being centrally enlarged and having a chamber therein at 110 in which is housed a high speed electric motor 111. This motor has an armature shaft 112 which extends upwardly within a ball bearing 113 and has fixed at its upper end a universal joint 114 to the upper member 115 of which is fixed the lower end of the spindle 89. The lower end of the shaft 112 is mounted in a ball step bearing 116 in a block 117 closing the lower end of the opening 110. At 118 are shown ventilating openings through the section 81 for the purposes of ventilating the motor and through which electrical conductors may be passed. The lower end of the section 81 terminates in an outwardly extending flange 120 which may be bolted to a similar flange 121 extending outwardly at the upper end of the section 82.

The section 81 has a peripheral groove 125 within which rides a pair of shoes 126 fixed to the bifurcated outer end of the lever 57. By this means rocking of this lever imparts axial motion to the plunger 82, this axial motion being imparted during the operation of the machine by the rocking of this lever about the fulcrum 58 by means of the eccentric 55. This vertical motion of the grinding wheel is of comparatively small amplitude, but gives a traverse of the wheel relative to the work and may properly be termed a vibratory movement. Axial motion of the plunger is also produced by moving the hand lever 63, this motion being sufficient when the lever is carried to its extreme right hand position as shown in Figure 1 to depress the grinder wheel out of cooperative relation with the work held on the work plate 18. When this action takes place, however, the rotation of the work plate stops as before described. With this construction it is easy to stop the rotation of the work and depress the grinder wheel for the removal of the work or measurement or inspection thereof without stopping the rotation of the wheel and without danger of injury being done thereby.

The plunger is normally urged toward its upper position by means of a counterweight 127 made fast to the lower end of a cable 128 which passes over a guide pulley 129 (see Figure 6) and is attached to a lug 130 extending laterally of the section 81.

Because of the eccentric mounting of shaft 89 within the plunger, it will be evident that the shaft may be rotated bodily that is, about an axis eccentric to its own axis by rotating the plunger within its bearings 4 and 6. The grinder wheel will then be moved bodily in an arcuate path about an axis eccentric to the axis of rotation of the work. This action is made use of to feed the wheel into the work since this movement causes a relative change of position between the wheel and the work to vary its eccentricity to the axis of the work. This feed motion is produced by means of an arm 132 made in two sections clamped by means of bolts 133 to the upper section 80. The outer end of this arm 132 is formed as a gear segment 134 which meshes with a long pinion 135 carried by a vertically extending shaft 136. This shaft is carried in a bearing 137 at its lower end mounted for slight rocking movement in the bracket 138 extending inwardly from the wall of the casing 1. The bearing 137 is held in position by means of a screw 139 which is screwed into the bracket 138 and which has a pin 140 engaging in an opening in the bearing 137. The upper end of the shaft 136 is supported in a floating

bearing 140′. This bearing is positioned in an opening in a wall 141 of the casing 1 and is urged in directions at right angles to each other by a pair of spring-pressed pins 142 seated in pockets in the portion 141, the action of these pins being resisted by adjusting screws 143 positioned opposite thereto in the wall 141 and bearing against the member 140′. The upper end of the shaft 136 has keyed thereto a worm wheel 137′ which meshes with a worm 138′ carried by a shaft 139′ which extends to the front of the machine as shown in Figures 1 and 2, and which is actuated by any suitable feed preferably of the ratchet type indicated generally at 150. By adjustment of the screws 143 the worm wheel may be adjusted relative to the worm to take up wear and to insure against lost motion between these parts. Backlash between the gear segment 134 and the pinion 135 is prevented by means of a counterweight 144 attached to a cable 145 extending over a guide pulley 146 partly surrounding the plunger section 81 and made fast thereto by a bolt 147 (see Figure 3). This counterweight causes a constant turning effort to be exerted on the plunger to urge the segment against the teeth of the pinion 135. This pinion is made long so that the plunger reciprocates either in the normal running of the machine or when it is further depressed when it is desired to inspect or remove the work, without becoming disengaged therefrom.

The rotation of the work-holding plate may be effected from a drive shaft 160 positioned at the back of the machine (Figure 2) having a belt wheel 161 thereon from which a belt 162 passing over idlers 163 extends about the belt pulley 34. This shaft also, by means of a belt pulley 165 and idlers 166, drives a pulley 167 of the cooler circulating pump 168. By means of this pump the cooling liquid is pumped through a pipe 169 (see Figure 3) by which it is conducted to any suitable point over the grinding wheel.

If desired, the vertical actuation of the wheel-carrying plunger may be utilized to lubricate the bearings. For this purpose in Figure 3 is shown a receptacle or well 170 positioned below the end of the plunger. From this well oil supply pipes as 171 and 172 may extend to the various bearings, as shown, the pipe 171 extending to the bearing 50 and following upwardly therethrough and into a shallow basin 173 formed on the bracket 54 within which the worm wheel 52 dips, the pipe 172 conducting lubricant to a basin 174 formed on the upper face of the partition member 141 in which the worm 138 dips. Passageways 175 may also be formed through the plunger leading to the various bearings for shaft 89 as deired. Other pipes or passageways may be utilized in the same manner to conduct the lubricant to any point desired.

In Figure 4 is shown a slightly modified construction of work plate in which a single ball bearing is employed to take both lateral and vertical thrust. This ball bearing is indicated at 178, the work holder 180 having a marginal flange 230 depending therefrom and having gear teeth 240 thereon meshing with the pinion 280. The plate 180 also has a smaller flange 231 extending over a slightly smaller flange 232 carried by the casing 260 to form a labyrinth to prevent the flow of cooling fluid to the gear teeth or to the bearings. A cap plate 250 of slightly different form is also shown at the top of the casing, as in certain cases it might not be desirable to rely wholly on the weight of the parts to hold the work holder in operative position. Figure 4 also shows the use of gibs for this purpose. Each gib as shown comprises a segmental shoe 290, preferably of anti-friction bearing metal such as bronze which may be adjusted toward and from the work holder by a screw 291 threaded through the cap plate 250 and being provided, if desired, with a lock nut 292. This construction insures against accidental displacement of the work holder from any cause and also makes it possible to use this type of holder on a horizontal machine.

Having thus described certain embodiments of this invention, it is evident that various modifications and changes might be made therein without departing from the spirit or scope of the invention as defined by the appended claims.

I claim:

1. A machine of the class described comprising a vertically movable plunger, a vertical shaft journaled in said plunger, a grinding wheel carried by the upper end of said shaft, a work holder for supporting work in operative relation to said wheel, a shaft, an eccentric on said shaft, a lever engaging said eccentric at one end and said plunger at the other end, means for rotating said eccentric shaft to vibrate said plunger lengthwise, and means to move the fulcrum of said lever to rock said lever about said eccentric and move said plunger to remove said wheel from operative relation to the work carried by said holder.

2. A machine of the class described comprising a vertically movable plunger, a vertical shaft journaled in said plunger, a grinding wheel carried by the upper end of said shaft, an annular work holder for supporting work in operative relation to said wheel, means for rotating said work holder, a shaft, an eccentric on said shaft, a lever engaging said eccentric at one end and said plunger at the other end, means actuated by said work-holder rotating means for rotat-

ing said eccentric shaft to vibrate said plunger lengthwise, and means to move the fulcrum of said lever to rock said lever about said eccentric and move said plunger to remove said wheel from operative relation to work carried by said holder and to render inoperative said work holder rotating means.

3. In a machine of the class described, an axially movable plunger, a lubricant receptacle into which one end of said plunger extends, a tool shaft mounted in ball bearings in said plunger, a tool on said shaft, a work holder for holding work in operative relation to said tool when said plunger is partially retracted from said receptacle, means for moving said plunger axially to move said tool into and out of operative position, and means for conducting lubricant from said receptacle to said ball bearings on movement of said plunger into said receptacle to move said tool out of operative position.

4. In a machine of the class described, an axially movable plunger, a lubricant receptacle into which one end of said plunger extends, a tool shaft journaled in said plunger, a tool on said shaft, a work holder for holding work in operative relation to said tool when said plunger is partially retracted from said receptacle, associated mechanism, a lubricant receiving basin into which a portion of said mechanism extends, and means for conducting lubricant from said receptacle to said basin on movement of said plunger into said receptacle to move said tool out of operative position.

5. In a machine of the class described, an axially movable plunger, a lubricant receptacle into which one end of said plunger extends, a tool shaft mounted in ball bearings in said plunger, a tool on said shaft, a work holder for holding work in operative relation to said tool when said plunger is partially retracted from said receptacle, associated mechanisms, lubricant receiving basins into which portions of said mechanisms extend, and means for conducting lubricant from said receptacle to said ball bearings and to said basins on movement of said plunger into said receptacle to move said tool out of operative position.

6. A machine for grinding a cylindrical surface comprising a vertical grinder spindle, a stationary horizontal annular supporting frame surrounding such spindle, an annular work support rotatable about an axis eccentric to that of the grinder spindle, and of a diameter greater than that of the cylindrical surface to be ground, to afford a larger traveling annular bearing engagement, maintained by gravity, upon said frame; the plane of such bearing engagement being adjacent to the central radial plane of the cylindrical surface to be ground, the distance between such planes being less than the radius of such bearing engagement; whereby the effect to vary angularly the axis of the cylindrical surface to be ground, of any uneven wear or unavoidable irregularity in the bearing surface will be diminished.

7. A machine such as defined in the preceding claim, comprising means for rotating the work support, the lines of engagement of which with the latter are parallel to its axis of rotation to minimize interference with the automatic determination of the axis of rotation of the work by its gravity maintained bearing engagement.

In testimony whereof I have affixed my signature.

WILLIAM L. BRYANT.