Dec. 22, 1936. M. ROMAINE ET AL 2,065,099

GRINDING MACHINE

Filed Dec. 19, 1932 4 Sheets-Sheet 1

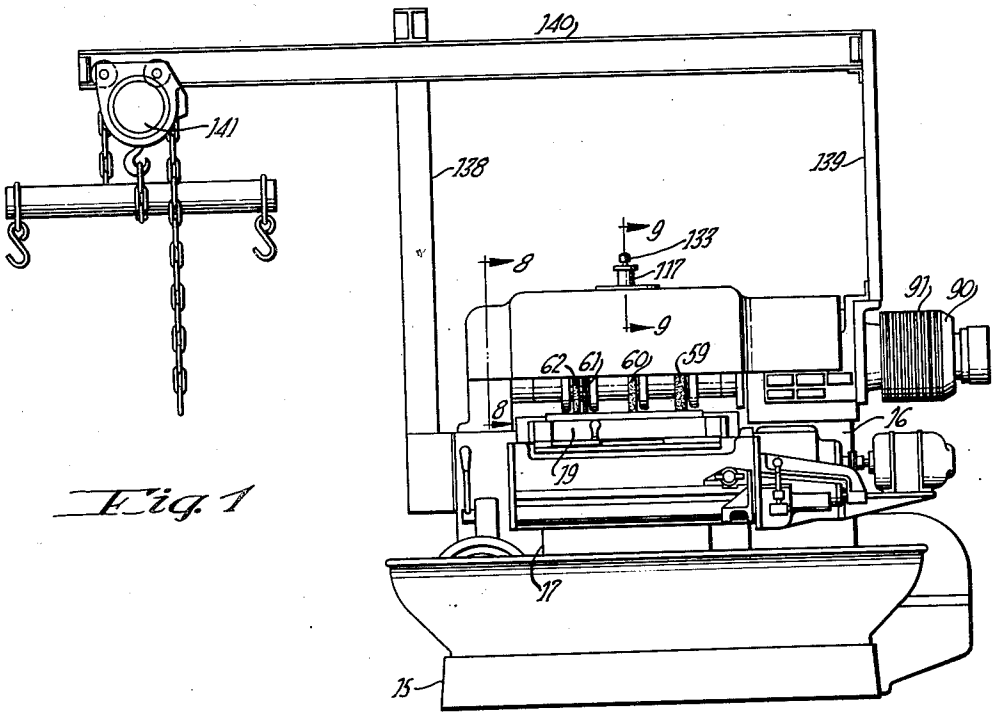
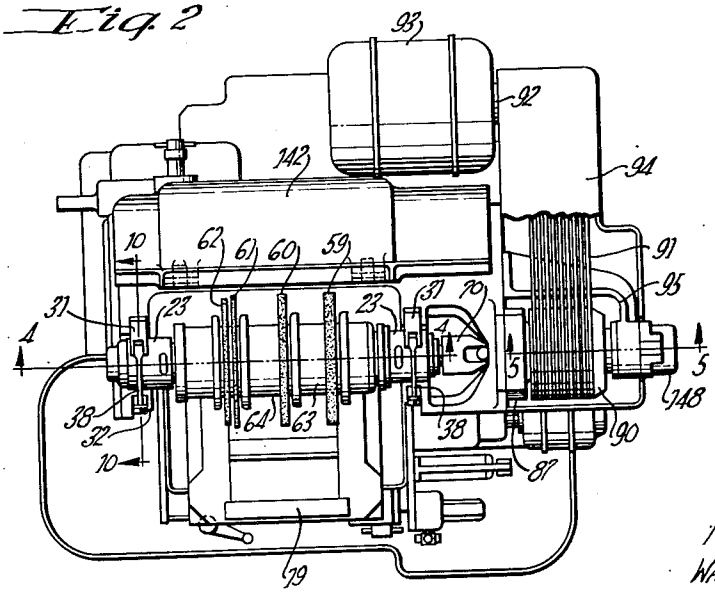


Fig. 1

Fig. 2



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Fig. 10

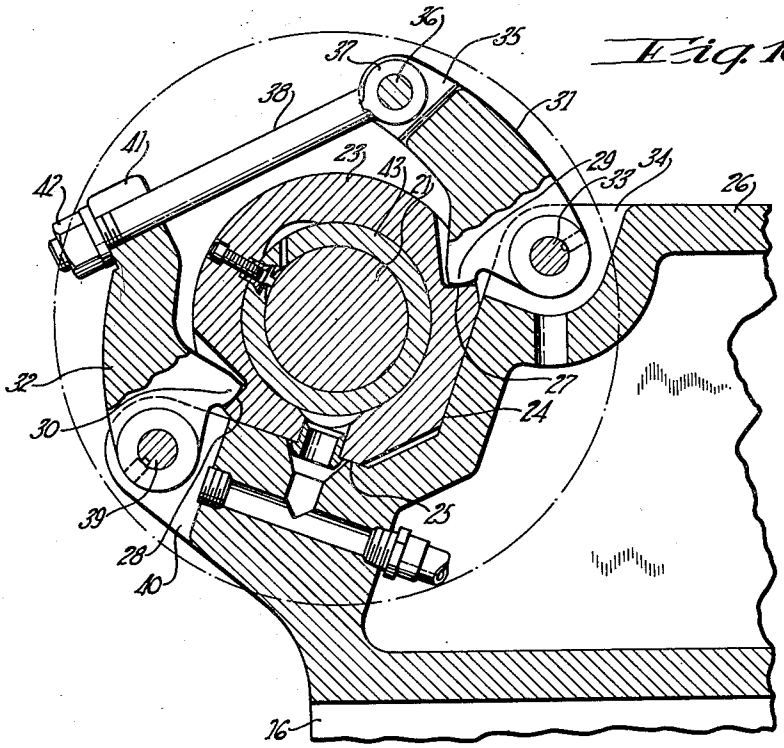
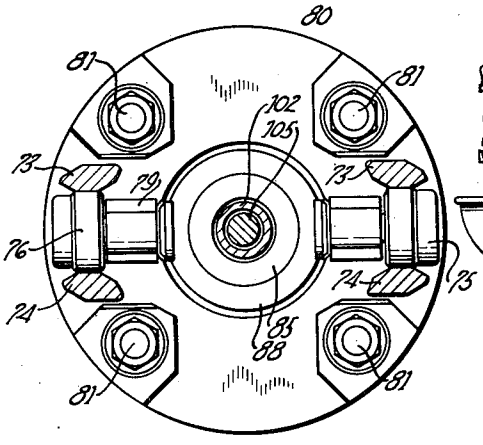


Fig. 11



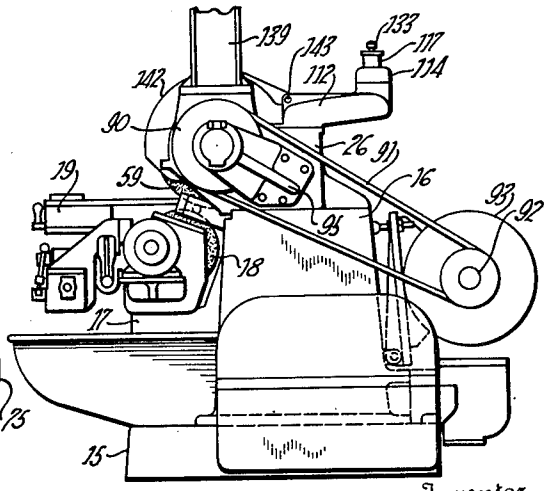


Fig. 3

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GRINDING MACHINE

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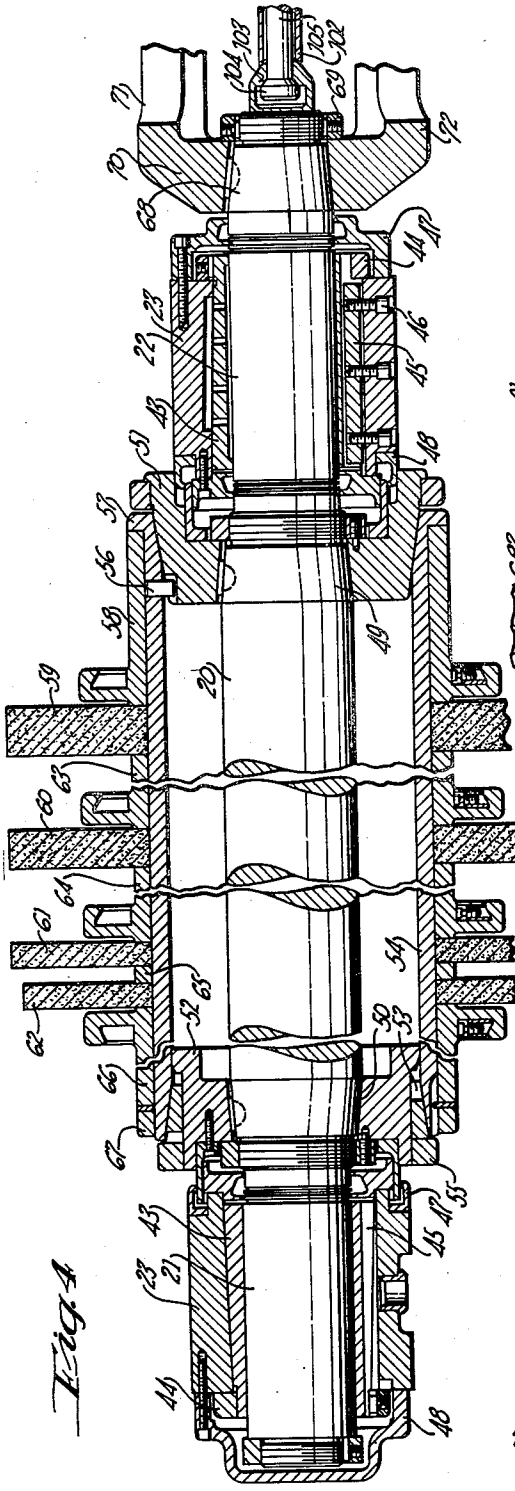


Fig. 4

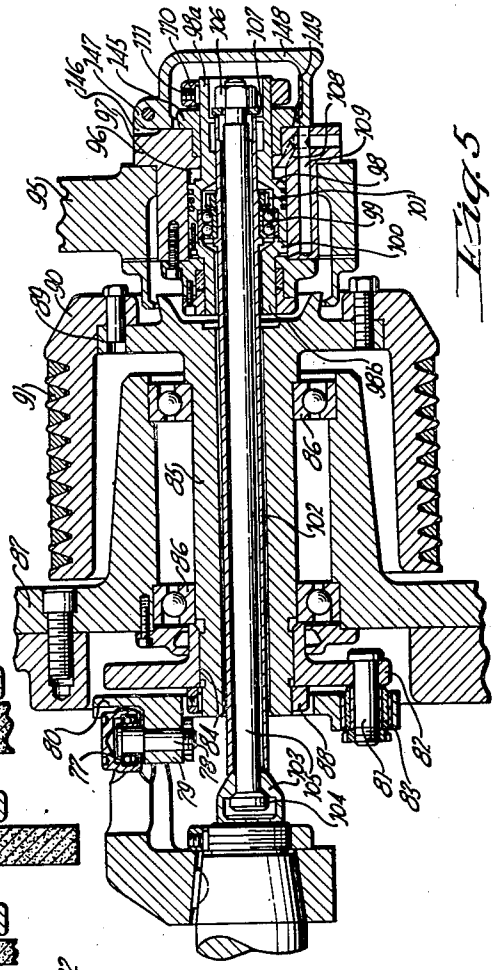


Fig. 5

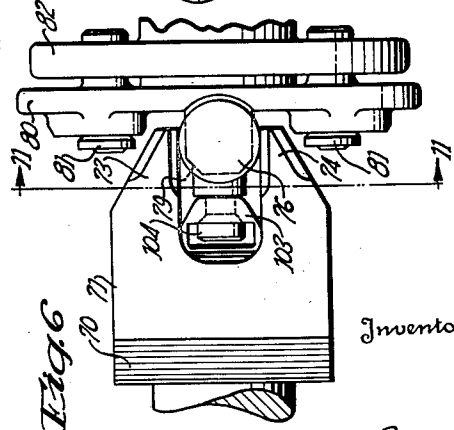


Fig. 6

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GRINDING MACHINE

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Fig. 8

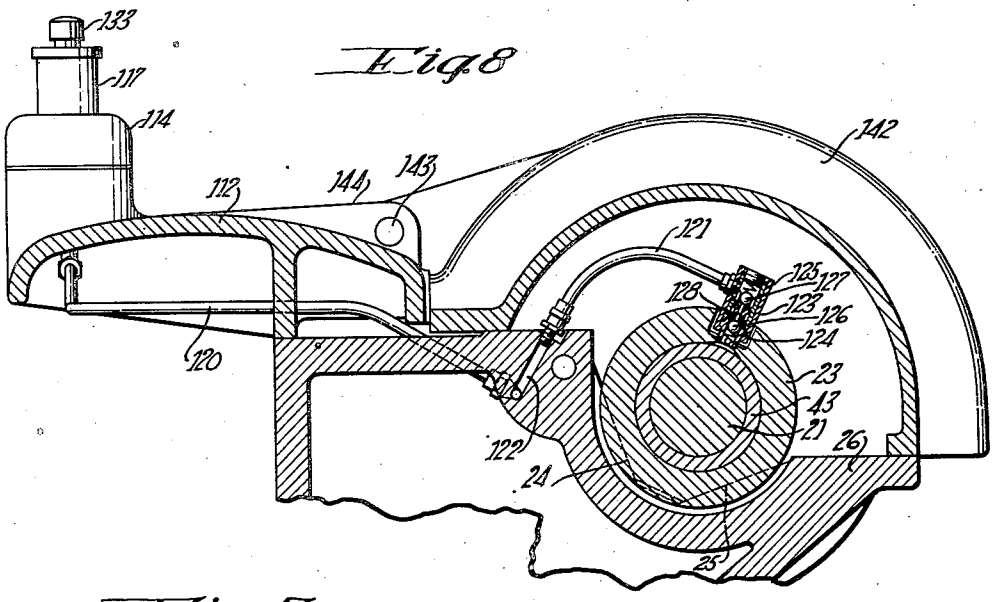
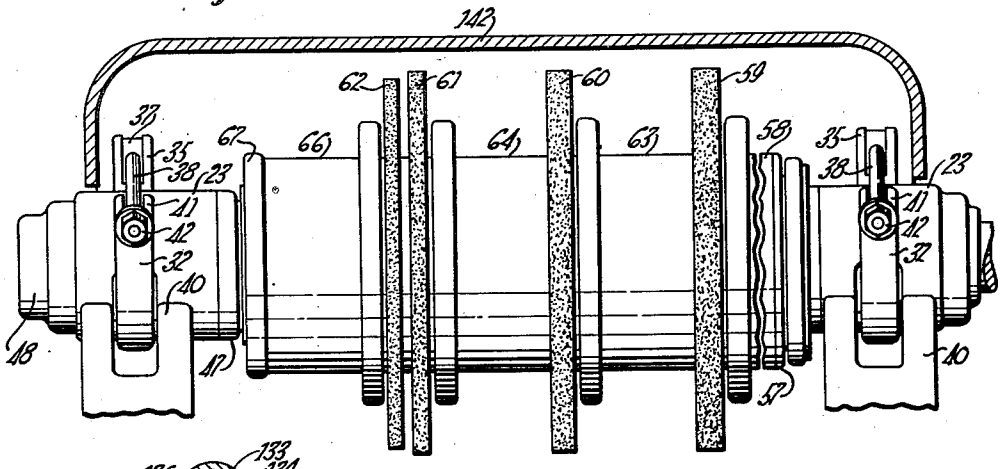


Fig. 7



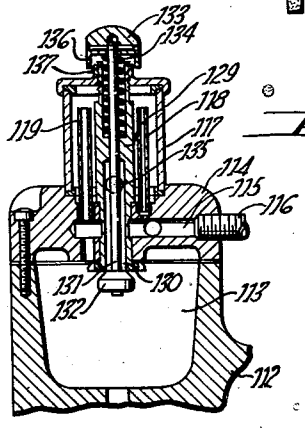


Fig. 9

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UNITED STATES PATENT OFFICE

2,065,099

GRINDING MACHINE

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Application December 19, 1932, Serial No. 647,868

7 Claims. (Cl. 51—166)

This invention relates to improvements in machine tools and especially to improvements in means for supporting and rotating the spindle of a grinding machine.

An object of the invention is the provision of an improved grinding wheel spindle drive whereby the pull of the belts and the like is not taken by the spindle.

Another object of the invention is the provision of a spindle that may form a self-contained unit of a machine tool organization.

A further object of the invention is the provision of a spindle assembly particularly adapted for use with grinding machines and whereby the wheels may be replaced on the spindle without disturbing the spindle bearings or adjustment thereof.

A still further object of the invention is the provision of a spindle for a grinding machine or the like that may be driven from an outside source and thereby relieve the spindle of any belt pull or other lateral torque.

It is also an object of this invention to reduce the idle time of the machine usually consumed during the changing of the grinding wheels, by providing a mechanism whereby the whole grinding wheel and spindle assembly may be made up in advance and substituted for the one in the machine, so that the only idle time is that required to manipulate a couple of simple clamping mechanisms and substitute the spindle assemblies.

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 there shown and described within the scope of the appended claims without departing from or exceeding the spirit of the invention.

In the drawings:

Figure 1 is a front elevation of a grinding machine embodying the improvements of this invention.

Figure 2 is a top plan view of the machine shown in Figure 1.

Figure 3 is an end elevational view of the machine shown in Figures 1 and 2 and as seen particularly from the right hand end thereof.

Figure 4 is a longitudinal sectional view through the spindle, as seen from line 4—4 on Figure 2.

Figure 5 is a sectional view axially through the driving shaft as seen from line 5—5 on Figure 2.

Figure 6 is a fragmentary elevational view of the plates and parts connecting the driving shaft with the spindle and forming a detail of the invention.

Figure 7 is an enlarged elevational view of the spindle assembly and showing the guard therefor in cross section.

Figure 8 is a view partly in section and partly in elevation as seen substantially from line 8—8 on Figure 1 and illustrating the lubricating system for the spindle bearings.

Figure 9 is a sectional view through a manually operated auxiliary spindle lubricating mechanism, as seen from line 9—9 on Figure 1.

Figure 10 is a sectional view through one of the spindle bearings, as seen from line 10—10 on Figure 2.

Figure 11 is a view taken on line 11—11 of Figure 6 showing in plan certain of the parts shown in Figure 6.

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

In the past it has been customary to directly connect a power source with a spindle by means of belts or other flexible transmission members by applying said members directly to the spindle or a pulley carried thereby. In order to maintain the proper frictional grip between said belt or other transmission member, considerable pressure is necessary, which has a tendency to spring the spindle and cause it to run out of true. In addition the tension of the belt or transmission member throw an unnecessary strain on the bearings causing said bearings to wear excessively at the portions thereof directly in the line of tension. In addition where a grinding wheel or other member is mounted on a shaft or spindle in between the bearings that support the said shaft or spindle, it is necessary to break down the bearing and thereby disturb the adjustment thereof in order to replace said wheel or other part. By the present invention these and other serious inconveniences and difficulties have been overcome, since the belt pull is not on the spindle, but on a member extraneous thereto and the wheels may be readily replaced even though intermediate the support bearings without in any wise disturbing said bearings.

In the drawings the invention is illustrated in connection with a centerless grinding machine of the vertical type and since the machine as a whole has no pertinence as respects the invention, it will be very briefly and generally described. Therefore, the machine as a whole comprises a

bed or supporting structure 15 having rising therefrom a column 16. Oscillatably mounted on the column 16 is a slide 17 rotatably supporting a spindle to which is secured a plurality of regulating wheels 18. Also carried by the slide 17 is a work ejecting and loading mechanism 19 for placing work pieces on the regulating wheels and removing same therefrom.

Above the regulating wheels 18 is disposed the grinding wheel spindle 20, shown in Figure 4 as having its opposite ends reduced as at 21 and 22. The reduced ends 21 and 22 are the spindle bearings and since they are substantially identical in structure as well as the enclosing bearing, it is deemed sufficient if but one of them be described in detail. These bearings are shown in Figure 4 on sections taken at right angles to one another and comprise a shell 23 having formed on the lower surface thereof angular seats 24 and 25 respectively engaging complementary seats formed on a supporting housing 26 secured in any desirable manner to the upper surface of the column 16. Adjacent the seats 24 and 25 the shell is provided with notches 27 and 28 respectively receiving clamping lugs 29 and 30 formed on clamp arms 31 and 32. One end of the arm 31 is pinned or otherwise secured to a shaft 33 rotatably journaled in ears 34 provided by the housing member 26. The other end of the arm 31 is forked to provide ears 35 in which is journaled a shaft 36 passing through the eye 37 of a bolt 38. One end of the clamp arm 32 is likewise pinned or otherwise secured to a shaft 39 rotatably journaled in ears 40 formed on the housing 26 and has its other end forked to provide ears 41 between which the free and threaded end of the bolt 38 is received. Threaded to the free end of the bolt 38 is a clamping nut 42 which engages the adjacent surface of the arm 32. From the foregoing it will be noted that rotation of the nut 42 in a given direction will tend to draw the forked ends of the arms 31 and 32 toward one another, thereby rotating the arm 31 in a counterclockwise direction and rotating the arm 32 in a clockwise direction, causing the clamping lugs 29 and 30 to force the shell downwardly and insure engagement between the seats 24 and 25 thereof with the complementary seats on the housing 26.

The bearing shell 23 is provided with a bearing sleeve or bushing 43 having its exterior tapered and received in a correspondingly tapered bore in the shell. The extreme end of the sleeve or bushing 43 is threaded to receive a nut 44 whereby the bearing may be adjusted as respects the shell to take up wear and the like therein. To prevent rotation of the sleeve or bushing a key 45 is provided being secured in any desirable manner such as by the screws 46 to the shell 23. Dust caps 47 and 48 are provided to seal the interior of the shell and parts carried thereby from foreign particles and coolant usual with grinding machines.

The spindle 20 adjacent each of the bearings 21 and 22 is provided with a tapered portion 49 and 50 to which is respectively keyed tapered plug 51 and sleeve 52. The sleeve 52 has slidably mounted on it a tapered ring 53 keyed thereto for rotative movement therewith, but for axial movement independently thereof. Mounted on the tapered plug 51 and tapered ring 53 is a cylinder 54 having an internal bore greater than the maximum dimension of the bearing shells 23 whereby the sleeve 54 may be removed from the spindle 22 over the bearing shells. In this connection it should be noted that the sliding tapered ring 53 is likewise provided with a bore of a sufficient diameter to be likewise slid over the bearing shell 23 and thereby permit the removal of the said ring 53. In order to retain the parts, that is tapered ring 53 and cylinder 54 in position, the sleeve 52 of the spindle 20 has threaded to it an adjusting and locking nut 55 which is also provided with a bore sufficient to permit passing therethrough of the bearing shells 23.

The cylinder 54 is keyed or pinned as at 56 to the tapered plug 51 and is provided adjacent this plug with a radial flange 57 forming an abutment for the grinding wheel spacer sleeve 58. As shown in the drawings, use is made of four grinding wheels, but it is to be understood that a single wheel of a length substantially equal to the length of the sleeve 54 or even a narrow wheel, as is usually employed on single wheel grinding machines, or any number of wheels may be mounted on the cylinder 54 depending entirely on the type of work desired to be performed thereby. The wheels shown in the drawings are indicated by reference characters 59, 60, 61 and 62, the grinding wheel 59 abutting on the other end of the spacer sleeve 58. The other wheels are spaced from one another by means of spacing sleeves 63, 64 and 65. Abutting on the other side of the wheel 62 is the clamping sleeve 66 which also engages with a clamping nut 67 threaded on the free end of the cylinder 54. From the foregoing it will be noted that the grinding wheels and spacing sleeves are all clamped between the radial flange on the cylinder 54 and the clamping nut 67 threaded thereon. It should also be noted that upon withdrawal of the nut 55 and sliding tapered ring 53 the cylinder 54 may be removed entirely from the spindle 20 and with it the grinding wheels in assembled form or the cylinder 54 may be allowed to remain undisturbed on the tapered plug 51 and tapered ring 53 and the nut 67 backed off, which will pass over the nut 55 and consequently the bearing shell 23 and any one or more of the wheels on the cylinder removed or replaced.

One end of the spindle 20, hereinafter referred to as the driving end, is provided with a tapered nose 68 to which is secured as by means of the nut 69 a spider 70. The spider 70 is provided with a pair of arms 71 and 72 each of which is formed to provide fingers 73 and 74. Each pair of the fingers 73 and 74 receive between them driving dogs 75 and 76, shown in Figure 5 as in the nature of anti-friction bearings 77 rotatably mounted on studs 78 carried by lugs 79 projecting outwardly from the face of a driving plate 80. The plate 80 in turn is securely attached as by bolts and nuts 81 to a flange 82. The connection between the plate 80 and the flange 82 is a flexible one for which purpose each of the bolts is surrounded by a rubber bushing 83 whereby vibration and shock are effectively dampened without in the least sacrificing the efficiency of the drive.

The flange 82 has a splined connection as at 84 with a driven shaft 85. The shaft 85 is journaled intermediate its ends on anti-friction bearings 86 carried by a bracket 87, bolted or otherwise secured to the housing 26. A nut 88 is threaded on one end of the shaft 85 to prevent inadvertent dis-association of the flange 82 therefrom and to clamp the shaft to the bearings 86 and eliminate any lost motion or play between these parts. The other end of the shaft 85 is provided with a flange 89 to which is suit-

ably bolted or otherwise secured a pulley or sheave 90 of the multiple V-belt type.

Extending about the sheave or pulley 90 is a plurality of transmission belts 91 of the V-type which are in turn extended about a sheave on the end of motor shaft 92 of the electric motor 93 secured to the rear surface of the column 16. As shown in Figure 2, the motor sheave is enclosed within a suitable guard or cover 94 carried by the side of the column 16.

From the foregoing it will be noted that the drive for rotating the grinding wheels is from the motor 93 through the flexible or other transmission belts 91 to the driven sheave 90. The drive shaft is bolted to the sheave and consequently receives its power from the sheave 90 which in turn through the flange 82 and plate 80 rotates the spider 71 secured to the spindle 20. It will be noted that the flexible connection between the spindle 20 and the driven shaft 85 effectively prevents any belt pull from being exerted on the spindle 20 and consequently on the bearings for the spindle.

In order to take the end thrust of the spindle and in order to properly position the parts, there is provided an L-shaped arm or bracket 95, see Figure 2, bolted or otherwise secured at one end of the column 16 and being provided at its other end with an aperture in which is disposed a bearing support 96. The support 96 is provided interiorly thereof with a cylinder 97 in which is disposed for axial movement relative thereto a piston 98. The piston 98 is in turn hollowed out and formed of two parts, 98*a* and 98*b*. The parts 98*a* and 98*b* are each provided with a seat between which is disposed an anti-friction thrust bearing 99. The thrust bearing 99 is in turn clamped between a flange 100 and a nut 101, the former integral with while the latter is threaded to a hollow shaft or piston rod 102. The hollow shaft or piston rod 102 extends through a central bore formed in the driven shaft 85 and terminates against a swivel joint head 103 formed integral with or secured to the driving end of the spindle 20. The swivel joint head has formed therein a bayonet slot receiving the head 104 of a tie rod 105 that extends through the hollow interior of the piston rod 102. The other end of the rod 105 has threaded thereon a nut 106 which abuts on a washer 107 engaging the free end of the piston rod 102. It is between the head 104 of the tie rod 105 and the washer 107 and nut 106 that the parts are connected to one another and whereby the spindle and driven shaft are axially aligned with respect to one another.

When it is desired, as is usual practice, to axially reciprocate the grinding wheel spindle and grinding wheels, hydraulic pressure is alternately introduced in the ends of the cylinder 97. For this purpose the cylinder 97 has entering it at opposite ends ports 108 and 109 through which the hydraulic medium passes to the opposite ends of the piston 98. In order to limit and adjust the length of the stroke of reciprocation, the piston portion 98*a* has threadedly secured to it a nut 110 which is adapted to be locked in its adjusted positions by means of screw 111 and abuts the outer surface of a plug 145 carried by the bearing support 96. In addition, the bearing support 96 is provided with lugs or ears 146 between which is pivoted the hinge member 147 integral with dust cap 148. This cap 148 encloses the outer ends of the tie rod, piston portion 98*a* and stroke adjusting nut 110 and keeps said parts free from dust and the like and prevents unauthorized manipulation of the adjusting nut 110. The cap is yieldably held in its closed position by means of a spring clip 149 carried interiorly thereof and co-operating with plug 145.

The housing 26 has secured to it above the bearing shells 23 a bracket member 112 in the upper portion of which is formed a lubricant well 113 having lubricant contained therein, see Figures 8 and 9. The reservoir 113 is closed by a cap plate 114 through which is formed a port 115 connected to one terminus of a lubricant supply pipe or conduit 116, the other end of which terminates at a suitable lubricant circulating pump, not shown, as is usual construction. Connected with the port 115 is a lubricant reservoir 117 having extending into it an upstanding pipe 118 through which the lubricant enters the reservoir 117 from the port 115. The lubricant in this reservoir rises to the height of the upstanding pipes 119, of which there may be more than one, whereupon the lubricant flows through said pipes to the well 113. The well 113 is connected by means of conduits 120 and 121 and the port 122 with a valve controlled coupling 123 carried by the bearing shells 23. The coupling 123 is formed of two parts, 124 and 125, the former being threaded into the bearing shell 23 while the latter is carried by the pipe or conduit 121. A spring loaded check valve 126 is associated with the portion 124 of the coupling, while a similar spring loaded check valve 127 is associated with the portion 125 of the coupling. Carried by one of these portions is a rod 128 which unseats the valves 126 and 127 when the parts are connected to one another. These portions are connected to one another in operative relation by a quick connection taking the form of a bayonet joint.

The lubricant reservoir 117 is provided with a central stem portion 129 through which is formed a port 130 encircling a valve rod 131. The port 130 is connected by means of transverse port 135 with the interior of the reservoir 117. The valve rod 131 has secured to one end thereof a valve member 132 and to the other end a head 133. A spring 134 surrounds the stem 131 and abuts against the plunger head 133 for normally holding the valve 132 to its seat and preventing any flow or discharge from the reservoir 117 through the ports 135 and 130 into the well 113.

When first starting the machine, as in the morning after an all night shut down or after any other period of rest during which time the lubricant may have had a chance to drain from the well 113, the head 133 is first engaged to unseat the valve 132 and permit a flow of the lubricant from the reservoir 117 to the bearing shells 23. This will provide ample lubricant for the bearings and prevent a heating and seizing thereof prior to the time the pump is in proper operation. To prevent an immediate closing of the valve 132, the head 133 is provided with a flange 136 which closely engages an upstanding boss 137 associated with the reservoir and which acts as a valve to prevent the influx of atmospheric pressure in the space defined by these parts and thereby retards the seating of the valve 132.

In order to remove the spindle and its bearings from the machine it is necessary to disconnect the lubricant conduits or pipes from the bearing shells which is readily accomplished by separating the portions 124 and 125 of the coupling be-

tween the lubricant pipe and said bearing shells. To prevent the discharge of any lubricant that may be in the well 113 or the conduits 120 and 121 the check valve 123 immediately closes upon separation of the coupling portions. Also to prevent any foreign material entering the bearing shells and to prevent the loss of lubricant that might be in the said shells when the spindle is being transferred, the check valve 126 is immediately applied to its seat.

To assist in the removal of the spindle and all parts carried thereby the bed column 16 has secured to it a pair of uprights 138 and 139 supporting the beam 140 which carries the block and tackle and other rigging indicated generally at 141 which may be attached to the spindle to facilitate the removal thereof. During normal grinding operations and to confine the coolant usual with grinding machines, there is provided a hood member 142 which effectively encloses the grinding wheels and parts associated therewith and the hood is pivoted at 143 to suitable lugs or ears 144 provided on the casting 112 whereby it may be disposed out of the way during the removal of the spindle.

It is believed from the foregoing that the construction and operation of the present invention should be readily understood without further description thereof.

What is claimed is:

1. In a mechanism of the class described the combination of a spindle, a bearing for each end of the spindle and including a shell for each bearing whereby the bearings within each shell may be adjusted, and a tool supporting cylinder carried by the spindle, said cylinder having a bore therethrough whereby it may be removed from the spindle over the said bearings without disturbing the adjustment thereof.

2. A spindle unit for use with machine tool structures comprising a spindle, spindle bearings carried by the spindle, a shell surrounding each of the spindle bearings and having formed thereon seats for use in assembly in the machine tool organization, a tool supporting cylinder adapted to pass over the bearings and their shells and to be disposed on the spindle without interfering with or interference by the spindle bearings and their shells, and means removably clamping the said cylinder to the spindle.

3. A spindle unit for use with machine tool structures comprising a spindle, spindle bearings carried by the spindle, a shell surrounding each of the spindle bearings and having formed thereon seats for use in assembly in the machine tool organization, a tool supporting cylinder adapted to pass over the bearings and their shells and to be disposed on the spindle without interfering with or interference by the spindle bearings and their shells, and means removably clamping the said cylinder to the spindle, said means including tapered cones adjustable with respect to one another for centralizing and clamping the cylinder to the spindle.

4. A spindle unit for use with machine tool structures comprising a spindle, spindle bearings carried by the spindle, a shell surrounding each of the spindle bearings and having formed thereon seats for use in assembly in the machine tool organization, a tool supporting cylinder adapted to be disposed on the spindle without interfering with or interference by the spindle bearings and their shells, means removably clamping the said cylinder to the spindle, and means removably clamping tools to the cylinder whereby said tools may be removed and replaced on the cylinder without disturbing either its mounting on the spindle or the adjustment of the spindle bearings.

5. In a machine tool organization the combination with a bed having formed thereon spindle bearing seats, of a spindle unit including a spindle and bearings therefor, means removably securing the spindle unit to the spindle bearing seats of the bed, a driving unit carried by the bed including a driving shaft operatively connected to the spindle, a pulley on the driving shaft, and a prime mover carried by the bed operatively connected with the pulley for rotating same and parts connected therewith whereby the belt pull is exerted on the driving shaft bearings and not on the spindle bearings.

6. In a machine tool organization the combination with a bed having formed thereon spindle bearing seats, of a spindle unit including a spindle and bearings therefor, means removably securing the spindle unit to the spindle bearing seats of the bed, a driving unit carried by the bed including a driving shaft operatively connected to the spindle, a pulley on the driving shaft, a prime mover carried by the bed operatively connected with the pulley for rotating same and parts connected therewith whereby the belt pull is exerted on the driving shaft bearings and not on the spindle bearings, and a flexible connection between the spindle and driving shaft for dampening any vibrations that may be transmitted from the prime mover to the driving unit.

7. In a machine tool organization the combination with a bed having formed thereon spindle bearings seats, of a spindle unit including a spindle and bearings therefor, means removably securing the spindle unit to the spindle bearing seats of the bed, a driving unit carried by the bed including a driving shaft operatively connected to the spindle, a pulley on the driving shaft, a prime mover carried by the bed operatively connected with the pulley for rotating same and parts connected therewith whereby the belt pull is exerted on the driving shaft bearings and not on the spindle bearings, a flexible connection between the spindle and driving shaft for dampening any vibrations that may be transmitted from the prime mover to the driving unit, and means carried by the driving unit for effecting the axial reciprocation of the spindle relative to its bearings.

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