Sept. 5, 1961 A. M. MATTISON 2,998,679

GRINDING MACHINE

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Fig. 1

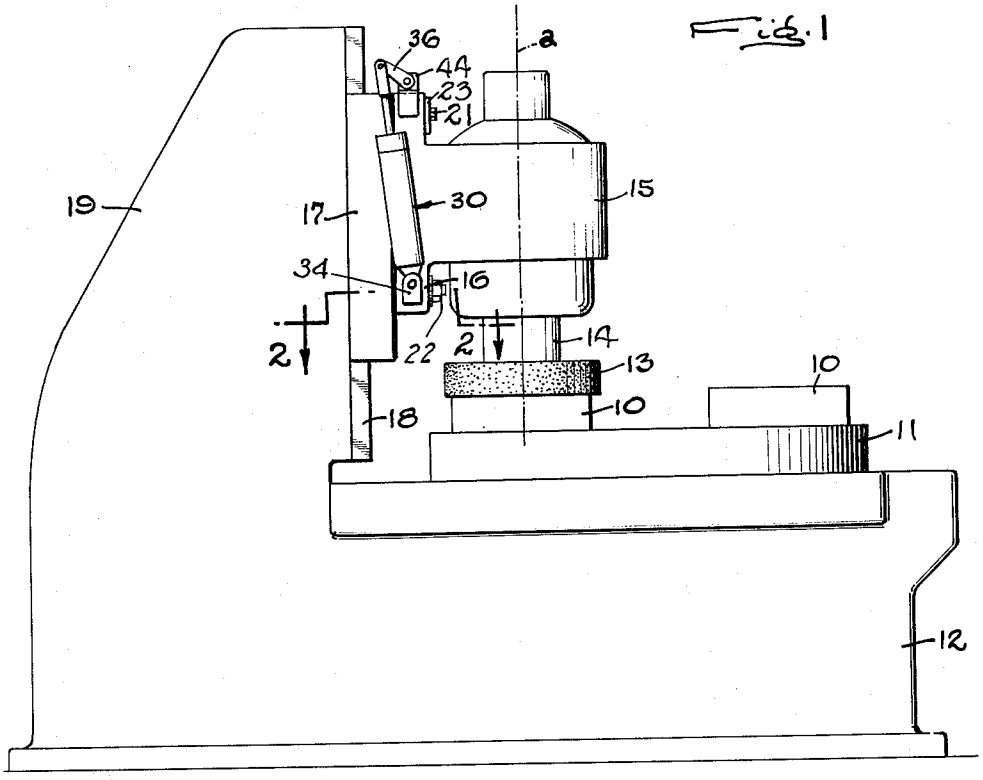
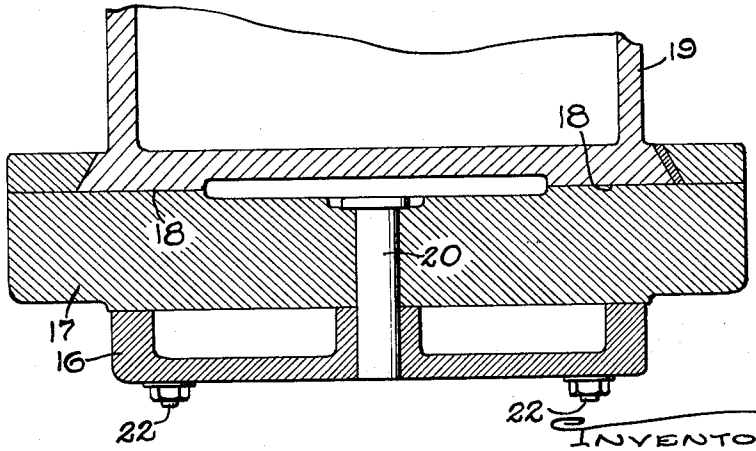


Fig. 2



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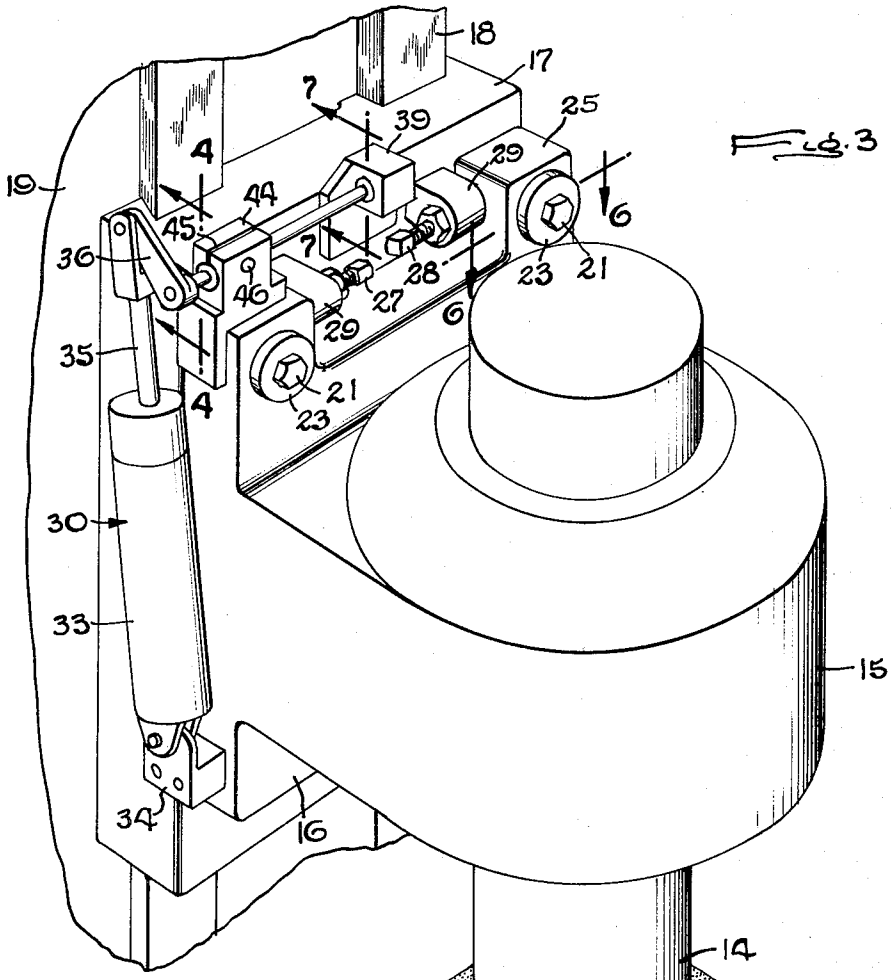
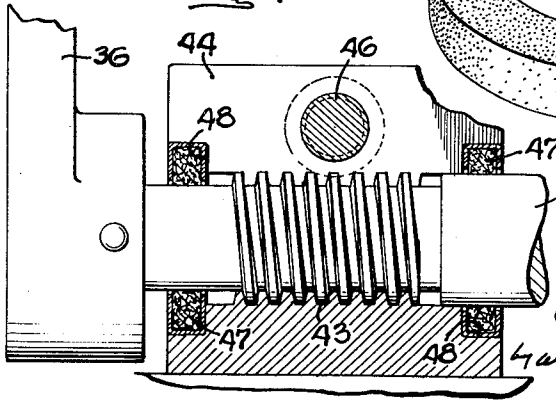


Fig. 3

Fig. 4



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Fig. 5

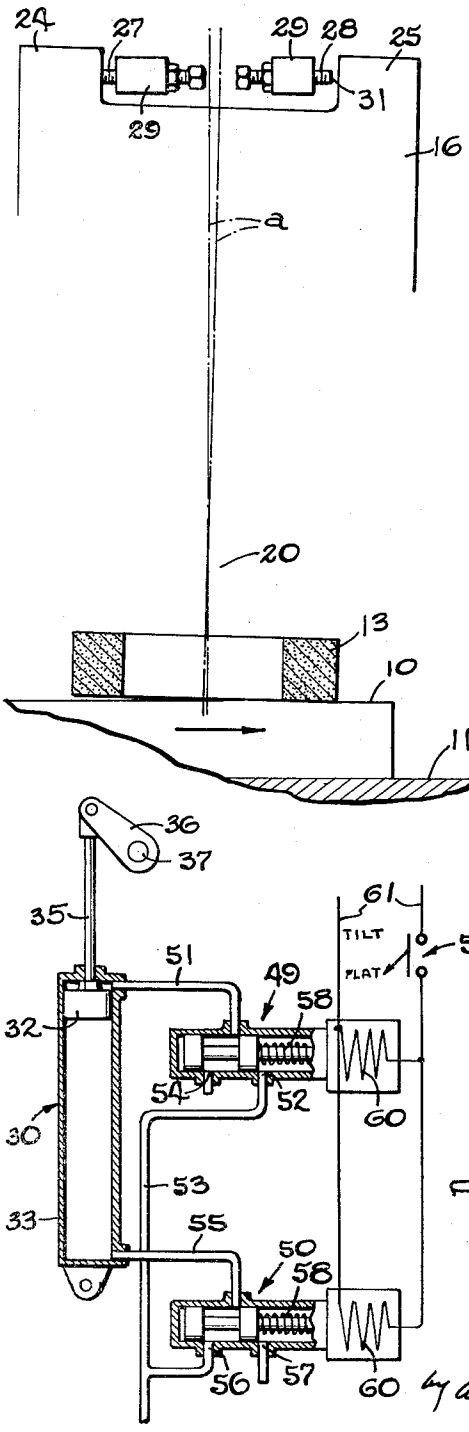


Fig. 6

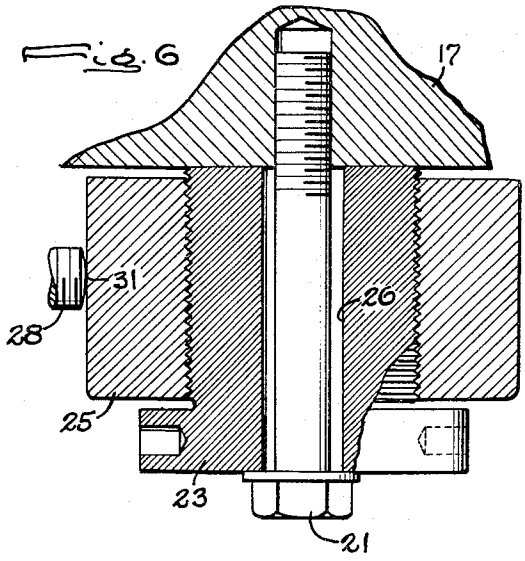


Fig. 7

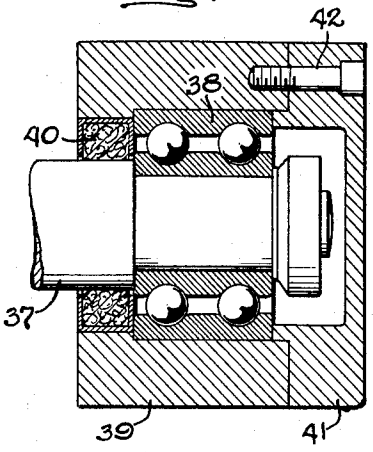


Fig. 8

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2,998,679

GRINDING MACHINE

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5 Claims. (Cl. 51—109)

This invention relates to grinding machines of the type in which the work is held on a table and ground by a grinding wheel supported by a spindle whose axis is generally perpendicular to the table. In finish grinding with such a machine, it is important that the axis of the spindle be precisely perpendicular to the work to obtain a flat finished surface but, for rough grinding, the spindle may be tilted slightly to permit the taking of a deeper cut.

The present invention aims to provide, in a grinding machine of the above character, a means for tilting the spindle quickly and easily by power while precisely positioning the spindle in the vertical position.

Other objects and advantages of the invention will become apparent from the following detailed description taken in connection with the accompanying drawings, in which

FIGURE 1 is a side elevation of a grinding machine incorporating the novel means for tilting the spindle.

FIG. 2 is an enlarged fragmentary sectional view taken along the line 2—2 in FIG. 1.

FIG. 3 is an enlarged fragmentary perspective view of the machine.

FIG. 4 is an enlarged fragmentary sectional view taken along the line 4—4 in FIG. 3.

FIG. 5 is a schematic view of the spindle axis and associated parts.

FIG. 6 is an enlarged fragmentary sectional view taken along the line 6—6 in FIG. 3.

FIG. 7 is an enlarged fragmentary sectional view taken along the line 7—7 in FIG. 3.

FIG. 8 is a diagrammatic view of the control system for the tilting means.

As shown in the drawings for purposes of illustration, the invention is embodied in a grinding machine in which one or more workpieces 10 are carried by a horizontal work table 11 journaled on a base 12 to turn about a vertical axis. The table carries the workpieces successively past a grinding wheel 13 which is fast on the lower end of an upright spindle 14 driven by a motor 15. The latter is rigid with a saddle 16 secured to a slide 17 which moves up and down on vertical ways 18 (FIG. 3) formed on the face of a column 19 upstanding from the base 12.

Grinding machines of this type may be used to make both roughing and finishing cuts. For the roughing cut, it is desirable to tilt the axis *a* of the spindle 14 (see FIG. 5) to raise the periphery of the grinding wheel 13 at the leading edge an amount on the order of .010 of an inch, the opposite edge being lowered a corresponding amount. With the wheel being fed into the work at an angle, a comparatively deep cut may be made. For the finishing cut, however, it is important that the spindle 14 be precisely perpendicular to the work table 11 so that the ground surface of the finished workpiece is exactly flat.

To permit tilting of the spindle 14, the saddle 16 is mounted on the slide 17 by means of a horizontal pin 20 (FIG. 2) which forms the axis for the tilting. The saddle is clamped to the slide in the selected angular position by means of bolts 21 and 22 (FIGS. 1 and 3) which project through the saddle and are threaded into the slide, there being sufficient clearance around the bolts to permit the limited turning of the saddle about the pin 20.

Preferably, means also is provided to adjust the disposition of the spindle 14 in the plane normal to the plane in which it is tilted about the pin 20. Herein, this means

comprises two screws 23 which are threaded through ears 24 and 25 on the upper end of the saddle 16 and abut against the face of the slide 17 as shown in FIG. 6. By turning the screws 23 in one direction or the other, the saddle may be tilted slightly toward or away from the slide to locate the spindle in the exact vertical position. Once this adjustment is made, the setting remains throughout the normal operation of the machine. The upper bolts 21 may, as illustrated in FIG. 6, project through axial bores 26 in the screws 23.

With prior machines of this type, two set screws 27 and 28 have been threaded through lugs 29 on the face of the slide 17, the screw 27 abutting against the inner side of the ear 24 and the screw 28 abutting against the inner side of the ear 25. Thus, by backing off one set screw and tightening the other, the saddle 16 would be tilted about the pin 20. The bolts 21 and 22 normally would be loosened before tilting and then tightened again after the spindle was located in the desired position. Because of the necessity of the spindle being exactly vertical for the finishing cut, tilting of the spindle back to the vertical position has been a tedious job and required constant checking of the position of the grinding wheel 13 as the set screws 27 and 28 were backed off and tightened. Usually, this adjustment took at least 20 or 30 minutes.

The present invention contemplates the provision of a novel means by which the spindle 14 is tilted by power and by which the vertical position of the spindle is attained accurately in a matter of a few seconds. This means comprises a power actuator 30 which acts between the saddle 16 and the slide 17 to turn the saddle about the pin 20 and coacts with an adjustable stop 31 which limits the turning of the saddle in one direction to a position in which the spindle is precisely vertical. Herein, the stop 31 is the end of the set screw 28 which initially is adjusted to abut the ear 25 when the spindle is vertical and then remains fixed for the normal operation of the machine. The other screw 27 either is eliminated or is backed off to provide a limit stop for tilting in the opposite direction.

In the present instance, the power actuator 30 is a piston 32 (FIGS. 3 and 8) sliding in a cylinder 33 which is pivotally connected at one end to a lug 34 rigid with the side of the saddle 16. The rod 35 of the piston projects upwardly and is pivotally connected to the outer end of a crank 36 on the end of a horizontal shaft 37. The other end of the shaft is journaled in an anti-friction bearing 38 (FIG. 7) which is mounted in a block 39 rigid with the slide 17. The bearing is sealed at one end by a sealing ring 40 encircling the shaft 37 and at the other end by a cover 41 removably mounted on the end of the block by screws 42.

Intermediate its ends, the shaft 37 is threaded as indicated at 43 (FIG. 4) and this threaded portion is received by a nut 44 rigidly secured to the ear 24 on the saddle 16. Preferably, the nut is split longitudinally at 45 (FIG. 1) and a bolt 46 spans the split portion so that the nut may be contracted to take up wear in the threads 43. The threads are sealed by rings 47 encircling the shaft and received in recesses 48 in the ends of the nut 44.

With the foregoing arrangement, a pressure fluid such as compressed air is admitted to the top of the cylinder 33 forcing the piston 32 down. This turns the shaft 37 counterclockwise as viewed in FIG. 3 and, since the shaft is held against endwise movement by the bearing 38, the nut 44 moves along the shaft to the left. As a result, the saddle 16 and hence the spindle 14 are tilted about the pin 20 and away from the vertical position. Usually, the precise angular position of the spindle for the roughing cut is not critical and the piston is permitted simply to travel to the lower end of the cylinder. If desired, however, the set screw 27 may be used to limit the tilting and

locate the spindle at a particular angle for the roughing cut.

After the roughing cut is completed, the spindle **14** is returned to the vertical position for the finishing cut. This is achieved by exhausting the upper end of the cylinder **33** and admitting compressed air to the lower end to move the piston **32** up. During the upward travel of the piston, the shaft **37** turns clockwise and advances the nut **44** to the left. This tilts the saddle **16** back until the set screw **28** abuts against the ear **25** and stops the tilting irrespective of whether or not the piston has completed its upward stroke. At this time, the spindle is precisely perpendicular to the work table **11**. Since the tilting has been effected by power, the bolts **21** and **22** may remain comparatively tight and need not be loosened preparatory to the tilting operation.

Preferably, the admission of compressed air to the cylinder **33** is controlled by two solenoid valves **49** and **50** (FIG. 8). The valve **49** is connected to the upper end of the cylinder through a line **51** and selectively admits pressure through a port **52** connected to a pressure supply line **53** or exhausts this end through a port **54**. Similarly, the valve **50** connects the lower end of the cylinder through a line **55** and a port **56** to the pressure supply or through a port **57** to the atmosphere. Both valves are biased by springs **58** to the positions shown in FIG. 8 in which the upper end of the cylinder is exhausted and compressed air is admitted to the lower end. This places the spindle **14** in the vertical or finishing position. By closing a manual switch **59**, the solenoids **60** of the valves are connected across supply lines **61** and are energized to shift the valves against the action of the springs **58**. In this position of the valves, compressed air is admitted to the upper end of the cylinder while the lower end is exhausted and the spindle is tilted for the roughing cut.

It will be observed that the spindle **14** may be tilted toward and away from the vertical position simply by opening and closing the switch **59**. The tilting is effected by the power of the actuator **30** and requires only a few seconds. In spite of the fact that this operation is simple and rapid, the spindle is positioned accurately in the vertical position each time the set screw **28** is brought up against the ear **25**.

I claim as my invention:

1. In a grinding machine, the combination of, a base, a work support adapted to hold a workpiece and mounted on said base to move in a horizontal plane, an upright column rigid with said base, a tool support pivotally mounted on said column to turn relative thereto about a horizontal axis, a spindle journaled on said tool support and adapted to carry a grinding wheel, coacting abutments rigid with said column and said tool support respectively and engageable to dispose said spindle horizontally, a screw and nut connection coupling said column and tool support and operable upon turning of the screw relative to the nut to turn said tool support about said axis, a cylinder, a piston sliding in said cylinder and connected to said screw to turn the screw relative to said nut thereby to move said abutments into and out of engagement with each other, and means for selectively admitting pressure fluid to one end or the other of said cylinder and dispose said spindle in a position perpendicular to said plane or at an angle thereto.

2. In a grinding machine, the combination of, a base, a work support adapted to hold a workpiece and mounted on said base to move in a horizontal plane, an upright column rigid with said base, a tool support pivotally mounted on said column to turn relative thereto about a horizontal axis, a spindle journaled on said tool support and adapted to carry a grinding wheel, coacting abutments rigid with said column and said tool support respectively and engageable to dispose said spindle horizontally, a screw and nut connection coupling said column and tool support and operable upon turning of the screw relative to the nut to turn said tool support about said axis, and a reversible power actuator operable to turn said screw relative to said nut thereby to move said abutments into and out of engagement with each other and selectively dispose said spindle perpendicular to said plane or at an acute angle with respect to said plane.

3. In a grinding machine, the combination of, a base member, a second member pivotally supported on said base member to turn about a predetermined axis, a tool support rigidly mounted on said second member to turn bodily therewith, a spindle journaled on said tool support and adapted to carry a grinding wheel, a stop rigid with one of said members and engageable with an abutment on the other of said members to dispose said grinding wheel in a predetermined plane, a work support disposed in a second plane parallel to said predetermined plane and adapted to hold a workpiece, power operated means for moving said work support through said plane whereby said wheel grinds the workpiece, a cylinder connected to one of said members, a piston sliding in said cylinder and connected to the other of said members to turn said second member about said axis thereby to move said stop into and out of engagement with said abutment and means for admitting pressure fluid selectively to one end or the other of said cylinder to dispose said grinding wheel in a plane parallel to or at an angle to said second plane.

4. In a grinding machine, the combination of, a base member, a second member pivotally supported on said base member to turn about a predetermined axis, a tool support rigidly mounted on said second member to turn bodily therewith, a spindle journaled on said tool support and adapted to carry a grinding wheel, a stop rigid with one of said members and engageable with an abutment on the other of said members to dispose said grinding wheel in a predetermined plane, a work support disposed in a second plane parallel to said predetermined plane and adapted to hold a workpiece, power operated means for moving said work support through said plane whereby said wheel grinds the workpiece, a screw and nut connection coupling said two members and operable upon turning of the screw relative to the nut to turn said second member about said axis, and a reversible power actuator operable to turn said screw relative to said nut thereby to move said stop into and out of engagement with said abutment and selectively dispose said grinding wheel in a plane parallel to or at an angle to said second plane.

5. In a grinding machine, the combination of, a base member, a second member pivotally supported on said base member to turn about a predetermined axis, a tool support rigidly mounted on said second member to turn bodily therewith, a spindle journaled on said tool support and adapted to carry a grinding wheel, a stop rigid with one of said members and engageable with an abutment on the other of said members to dispose said grinding wheel in a predetermined plane, a work support disposed in a second plane parallel to said predetermined plane and adapted to hold a workpiece, power operated means for moving said work support through said plane whereby said wheel grinds the workpiece, and a reversible power actuator mounted on one of said members and connected to the other of said members to turn said second member about said axis thereby to move said stop into and out of engagement with said abutment whereby said grinding wheel is selectively disposed in a plane parallel to and at an angle to said second plane for finishing and roughing cuts respectively.

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