

May 23, 1933.

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1,909,953

GRINDING MACHINE

Filed April 29, 1932

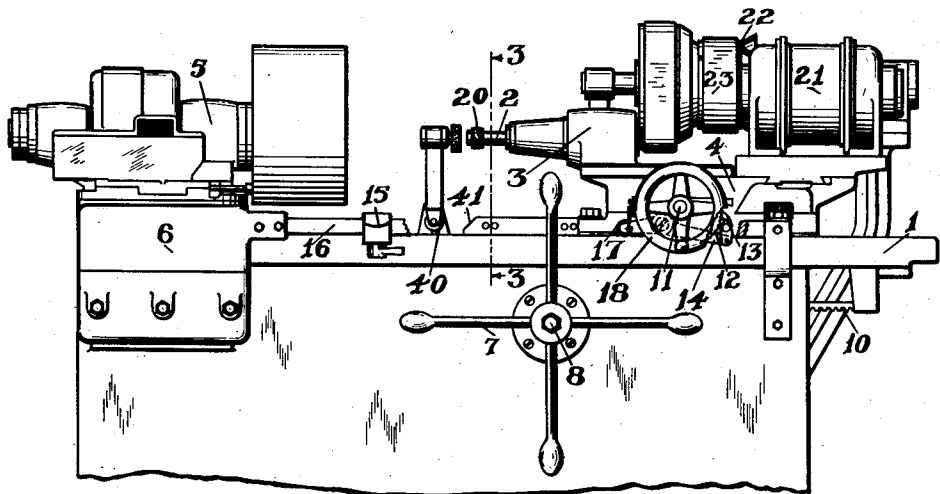


Fig. 1

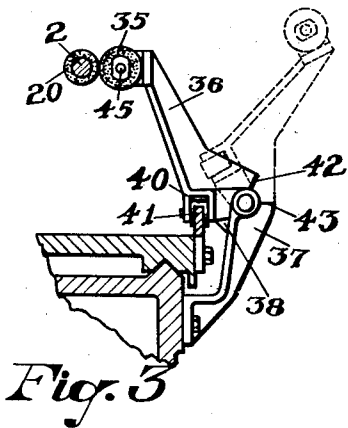


Fig. 3

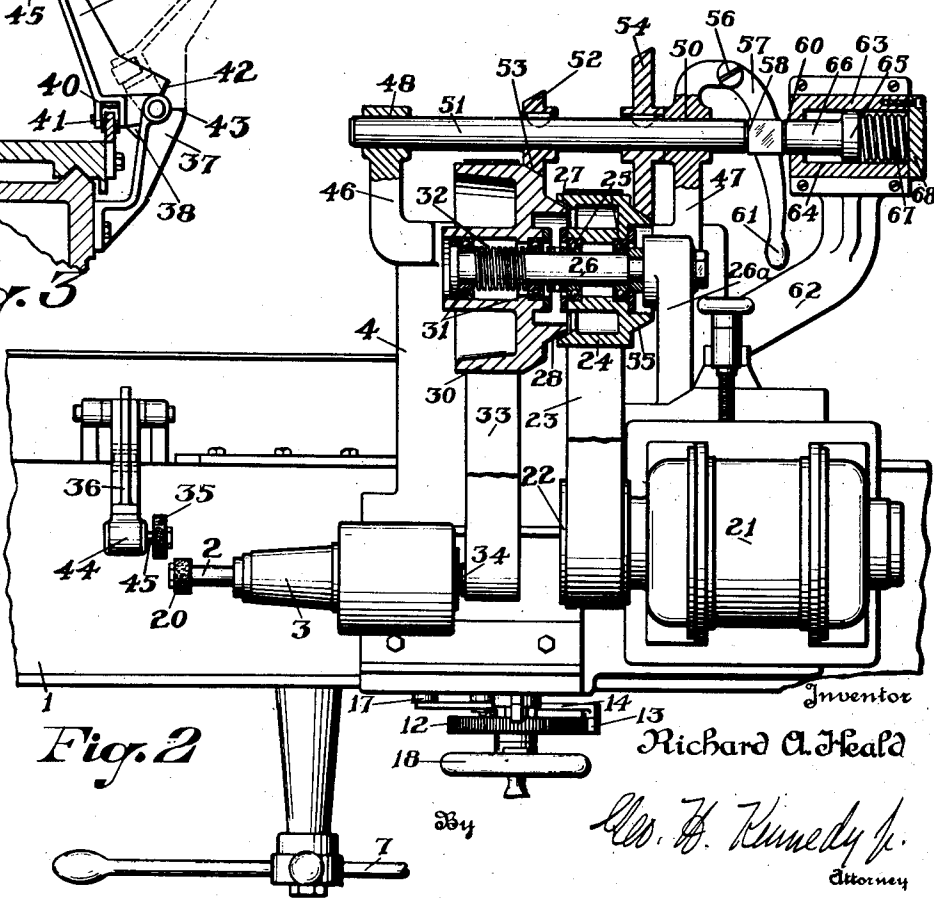


Fig. 2

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GRINDING MACHINE

Application filed April 29, 1932. Serial No. 608,201.

The present invention relates to grinding machines and particularly to a mechanism for procuring a dressing operation on the grinding wheel.

In prior devices of this character, as shown by way of example in the Guild Patent No. 1,682,672, granted August 28, 1928, the grinding wheel is dressed by passing said wheel slowly past a positively located diamond point or other dressing tool which trues up the wheel and establishes a new cutting surface on the periphery thereof. This type of dressing mechanism is entirely satisfactory on the usual grade of grinding wheels, as the dressing tool is appreciably harder than the wheel and is not destroyed by the rotation of said wheel past said tool. However, in the harder type of wheels as, for example, a grinding wheel consisting of diamond particles, tungsten carbide, or other very hard materials bonded together, the usual dressing tool is ineffective since the wheel formed of these hard materials is as hard as, or harder than, the dressing tool and the latter is cut and destroyed without procuring any appreciable dressing action on the wheel.

The only satisfactory method for the dressing of grinding wheels formed of these hard materials is to subject them to the action of a rotating dressing wheel of a similar hard material, and, by relative movement of the surfaces of the dressing wheel and the grinding wheel being dressed, the latter is reduced to the desired size and a suitable smooth cutting surface is established. In this dressing operation, the faster moving wheel procures the dressing action on the slower moving wheel and accordingly, in the use of a rotating dressing wheel for dressing a rotating grinding wheel of equally hard material, the dressing wheel must be moving at a relatively faster surface speed than the wheel being cut or dressed. It is accordingly one of the objects of the present invention to provide for dressing a grinding wheel with a rotating dressing tool by driving the grinding wheel at a slow rate of speed relative to the dressing wheel as said grinding wheel is brought into engagement with the dressing wheel.

While the grinding wheel is operating upon

a workpiece to be ground, the surface speed of the wheel must be relatively high in order to procure a proper cutting action and to leave a smooth finished surface on the workpiece, and, if an attempt were made to dress said grinding wheel while it is moving at the high rate of surface speed for a cutting operation, it would be necessary to drive the dressing wheel at an excessive rate of speed in order that the surface speed of the dressing wheel should be substantially greater than the surface speed of the grinding wheel. It is accordingly a further object of the present invention to provide for diminishing the normal cutting rate of speed of a grinding wheel when the latter is moved into operative relation to a rotating dressing wheel.

Other and further objects and advantages will appear from the following detailed description, taken in connection with the accompanying drawing, in which:—

Fig. 1 is a front elevation of a machine embodying the invention, the lower part of the base of the machine being broken away.

Fig. 2 is an enlarged plan view, partly in section, of a portion of the machine, showing the invention.

Fig. 3 is a fragmentary section of the machine substantially along the line 3—3 of Fig. 1.

Like reference characters refer to like parts in the different figures.

Referring to Fig. 1, the grinding machine illustrated provides a reciprocatory table or carriage 1 by movement of which, on longitudinal slide-ways, not shown, on the base of the machine, a grinding traverse between the grinding wheel and workpiece is procured. The grinding wheel spindle 2 is suitably journaled in a wheelhead 3 which is mounted on a cross-slide 4 carried by the table 1, said cross-slide providing for a transverse feeding movement between the grinding wheel and the workpiece. A workhead 5 is carried on a bridge 6 which spans the slide-ways provided for the movements of the table 1.

In the construction shown, the grinding

wheel is moved into and out of operative engagement with the workpiece in the workhead by rotation of a pilot wheel 7, which is mounted against rotation on the forward end of a shaft 8, journaled in the base of the machine. Said shaft carries a pinion, not shown, which engages with a rack 10 mounted on the under side of the table 1, to procure longitudinal movement of said table in response to rotation of said pilot wheel.

The crossfeed movement of the grinding wheel is procured by rotation of a threaded crossfeed shaft 11, which is journaled in bearings in the table 1, and engages with a threaded nut, not shown, on the under side of the cross-slide 4. The forward end of the crossfeed shaft has secured thereto a ratchet wheel 12 which is actuated by a pawl 13, the latter carried on one end of a lever 14 pivotally mounted on the table 1. Rocking movement of the lever 14 procures a step-by-step rotation of the crossfeed shaft in response to movement of the grinding wheel over the surface of the workpiece and accordingly movement of the grinding wheelhead 3 transversely of the machine. A cam 15 is adjustably mounted on a horizontal bracket 16 extending from the bridge 6, and a roller 17 on the end of the lever 14 engages with and is depressed by said cam 15, thereby elevating the pawl 13 to turn the ratchet wheel, said cam being positioned to engage said roller in response to the reciprocations of the grinding wheel over the surface of the workpiece. A hand wheel 18 is also mounted on the end of the crossfeed shaft 11 for procuring movement of the cross-slide manually, when desired.

The grinding wheel 20 on the end of the spindle 2 is driven by an electric motor 21 mounted on the cross-slide 4, said motor having a pulley 22 connected by a belt 23 to a pulley 24, Fig. 2, journaled on anti-friction bearings 25 on a shaft 26 supported by a lug 26a on the cross-slide 4. Said pulley provides a conical clutch face 27 which cooperates with a similarly-shaped conical clutch face 28 on a pulley 30, the latter being journaled on anti-friction bearings 31 on the shaft 26 and being slidable longitudinally of said shaft for separation of said clutch faces 27 and 28. A spring 32 surrounding the shaft 26 normally urges the pulley 30 to the right toward the pulley 24 to bring said clutch faces into engagement to procure rotation of the pulleys 24 and 30 as a unit. The pulley 30 is connected by a belt 33 to a pulley 34 on the end of the grinding wheel spindle 2, and the pulleys are of proper size so that the grinding wheel 20 is normally rotated directly from the motor 21 through the pulleys 24 and 30 at the high rate of speed desirable for a cutting action.

The grinding wheel is dressed by moving

said wheel over the surface of a rotating dressing wheel 35 carried by an arm 36, the latter being pivotally mounted on a bracket 37 secured to the base of the machine. The dressing wheel 35 is properly positioned relative to the grinding wheel by a stop 38 on the bracket 37 which engages the arm 36 when the latter is in the operative position shown in full lines in Fig. 3, at which time the dressing wheel 35 is in position to engage the grinding wheel 20 as the latter is moved longitudinally of the machine by movement of the table 2. In order to prevent injury to the wheelhead and other parts of the machine, as the grinding wheel is moved into engagement with the workpiece, the arm 36 carries a roller 40 which engages a cam 41 secured to the table 2, said cam raising the arm 36 into the inoperative position shown in dotted lines in Fig. 3 as the grinding wheel 2 is moved from the dressing position of Fig. 1 into operative relation to the workpiece by movement of the table 1. The dressing wheel is maintained in inoperative position by engagement between cooperating surfaces 42 and 43 on the arm 36 and the bracket 37 respectively. Rotation of the dressing wheel 35 is procured by an electric motor 44 carried by the upper end of the arm 36, said dressing wheel 35 being secured to the end of the drive shaft 45 of said motor 44.

As above stated, the grinding wheel 20, which is normally rotated at a rapid rate of speed by the motor 21, is slowed down substantially as said grinding wheel 20 approaches the dressing wheel 35 in order that the surface speed of the grinding wheel shall be less than the surface speed of the dressing wheel, the latter being driven at a constant speed by the motor 44. Referring now to Fig. 2, the cross-slide 4 provides integral extensions 46 and 47 which provide aligned bores 48 and 50 through which a shaft 51 extends, the latter being parallel to the slide-ways on which the table 1 is mounted. Said shaft 51 carries a small conical faced pulley 52 which is positioned to engage with a corresponding conical surface 53 on the pulley 30, and a larger conical faced pulley 54 which is arranged to engage with a conical surface 55 on the pulley 24, both said conical faced pulleys 52 and 54 being secured against rotation and also against axial sliding movement on the shaft 51. The extension 47 carries a stud 56 on which an arm 57 is pivotally mounted, said arm providing opposed flat surfaces 58 and 60, the former being in alignment with and engaging the right hand end of the shaft 51. The end of the arm 57 provides a handle 61 by which said arm is manually operated, and in order to reduce the speed of rotation of the grinding wheel 20, the handle 61 is moved toward the left, thereby shifting the shaft 51 carrying the conical faced pulleys 52 and 54 to the left. As the

pulleys 52 and 54 are spaced apart a distance somewhat greater than the spacing of the conical surfaces 53 and 55, when the pulleys 24 and 30 on which said surfaces are formed are in driving engagement, movement of the shaft 51 to the left first brings the pulley 52 into engagement with the surface 53 on the pulley 30 and in response to further movement of said shaft 51 the pulley 54 is brought into engagement with the conical surface 55. Said further movement of the shaft 51, which brings the pulley 54 against the surface 55, procures separation of the pulley 30 from the pulley 24, said pulley 30 moving to the left axially on the shaft 26 against the spring 32 to withdraw the clutch face 27 from the clutch face 28 so that rotation of the grinding wheel 20 is then procured indirectly through rotation of the shaft 51 as a countershaft. The pulley 24 drives the pulley 54 to turn the shaft 51, thereby rotating the pulley 52 and accordingly procuring rotation of the pulley 30 and thus the grinding wheel 20. The relative sizes of the pulleys are such that this change in the drive of the grinding wheel materially reduces the surface speed of the grinding wheel until it is substantially slower than the surface speed of the dressing wheel.

The reduction in speed of the grinding wheel may be procured automatically as the grinding wheel is brought into operative relation to the dressing wheel. Referring again to Fig. 2, the base of the machine has a bracket 62 extending upwardly therefrom, said bracket carrying adjacent its upper end a member 63 having a bore 64 therethrough in alinement with the shaft 51. Said bore receives a cylindrical member 65 having a projecting end 66 which engages the flat surface 60 on the arm 57. A spring 67 within the bore 64 is positioned between the right hand end of the cylindrical member 65 and a cap 68 for the end of said bore, thereby normally urging the member 65 toward the left.

As the grinding wheel is now moved toward the right by rotation of the pilot wheel 7 to bring said grinding wheel into dressing position, the projecting end 66 of the cylindrical member 65 engages the flat surface 60 of the arm 57, thereby rocking said arm to the left and procuring axial shifting movement of the shaft 51 to reduce the rate of rotation of the grinding wheel in the manner above pointed out. As the spring 67 is substantially heavier than the spring 32, the pulleys 24 and 30 are spaced apart before the spring 67 is compressed, during the right hand movement of the table 1, said separation taking place before the grinding wheel is in opposed relation to the dressing wheel. During the dressing operation, the grinding wheel 20 is manually reciprocated over the surface of the dressing wheel, which reciprocation procures compression of the spring 67, said spring, while said wheels are in engagement, maintaining

the shaft 51 in the relative position shown, with the pulleys 24 and 30 disengaged.

From the foregoing, it will be apparent that the rate of rotation of the grinding wheel is materially reduced as it is moved into operative relation to the dressing tool in response to movement of the carriage carrying said grinding wheel, in order to procure a dressing operation on said grinding wheel. It will be further noted that the reduced speed of the grinding wheel remains constant during reciprocation of the grinding wheel over the surface of the dressing tool, and, as the grinding wheel is moved away from the dressing tool, the normal speed of said grinding wheel is automatically restored. The normal high rate of speed of the grinding wheel, during the grinding operation on a workpiece, not shown, carried by a workholding member journaled in the workhead 5, is thus reduced as the table is moved to withdraw said wheel from the workpiece and to bring said grinding wheel into engagement with the dressing wheel.

I claim,

1. In a grinding machine, a rotary grinding member and a workholding member, a carriage on which one of said members is mounted, means for driving said grinding member at a rapid rate of speed during a cutting operation on a workpiece in the workholding member, and means for varying the rate of rotation of said grinding member in response to movement of said carriage.

2. In a grinding machine, a rotary grinding member, means to procure a translatory movement of the grinding member, and means responsive to the translatory movement for varying the rate of rotation of said grinding member.

3. In a device of the character described, a grinding wheel and a dressing tool, means to move said grinding wheel into contact with said dressing tool to procure a dressing operation on said wheel, and means automatically operative to reduce the speed of rotation of said grinding wheel as the latter is brought into contact with the dressing tool.

4. In a device of the character described, a grinding wheel and a dressing tool, means to move said grinding wheel into contact with said dressing tool to procure a dressing operation on said wheel, means for driving said grinding wheel at a predetermined rate of speed, and means automatically operative to vary the speed of rotation of said grinding wheel as the latter is brought into contact with the dressing tool.

5. In a device of the character described, a grinding wheel, a rotary dressing tool for said wheel, means for driving said dressing tool at a predetermined rate of speed, means for rotating the grinding wheel at a predetermined rate of speed, and means automatically operative to vary the relative speeds

of rotation of the grinding wheel and the dressing tool as the latter is brought into contact with the grinding wheel.

6. In a grinding machine, a grinding wheel
5 and a dressing wheel, a carriage on which one of said wheels is mounted to procure a relative movement of said wheels, means for driving said grinding wheel at a predetermined rate of speed, and means for substantially
10 varying the speed of rotation of said wheel as the latter is moved into operative position relative to the dressing tool.

7. In a grinding machine, a grinding wheel member and a workholding member, a carriage on which one of said members is mounted, means to procure a rapid rate of rotation of said grinding wheel when the latter is in operative relation to a workpiece in said workholding member, a dressing tool spaced
20 from said workholding member, means to withdraw said grinding wheel from the workpiece to move said grinding wheel into operative position relative to said dressing tool, and means responsive to said withdrawal movement to materially reduce the speed of rotation of said grinding wheel.

8. In a grinding machine, a grinding wheel member and a workholding member, a carriage on which one of said members is mounted, means to procure a rapid rate of rotation of said grinding wheel when the latter is in operative relation to a workpiece in said workholding member, a dressing tool spaced from said workholding member, means to withdraw said grinding wheel from the workpiece to move said grinding wheel into operative position relative to said dressing tool, and to reciprocate said grinding wheel over the surface of said dressing tool, and means responsive to said withdrawal movement to materially reduce the speed of rotation of said grinding wheel, said means maintaining the reduced speed during the reciprocation of the grinding wheel over the surface of the dressing tool.

9. In a grinding machine, a rotary grinding wheel, a rotary dressing wheel, means for driving said dressing wheel at a predetermined rate of speed, means for procuring a translatory movement of said grinding wheel to move the latter into operative engagement with the dressing wheel and to procure a reciprocatory movement of said grinding wheel over the surface of said dressing wheel, and means responsive to said translatory movement materially to vary the speed of rotation of the grinding wheel relative to the rotation of the dressing wheel, whereby the surface speed of the grinding wheel is
60 substantially slower than the surface speed of the dressing wheel.

10. In a grinding machine, a rotary grinding wheel, a rotary dressing wheel, means for driving said dressing wheel at a predetermined rate of speed, means for procuring a

translatory movement of said grinding wheel to move the latter into operative engagement with the dressing wheel and to procure a reciprocatory movement of said grinding wheel over the surface of said dressing wheel, and means responsive to said translatory movement materially to vary the speed of rotation of the grinding wheel relative to the rotation of the dressing wheel, whereby the surface speed of the grinding wheel is substantially slower than the surface speed of the dressing wheel, said speed varying means maintaining the rotation of said grinding wheel constant during the reciprocation of said wheel over the surface of the dressing wheel.

11. In a device of the character described, a rotary spindle having a pulley thereon, a driving motor having a pulley thereon, a pair of cooperating pulleys having cooperating clutch faces normally in operative engagement, one of said pulleys being axially movable relative to the other to withdraw said clutch faces from operative engagement, belts connecting said pair of pulleys respectively to said motor pulley and said spindle pulley, and means for spacing said pair of pulleys apart to withdraw said clutch faces from operative engagement and for establishing a positive drive between said pair of pulleys, whereby the latter are rotated relatively to one another, thereby to vary the speed of rotation of said spindle.

12. In a grinding machine, a rotary grinding member, a dressing member, means to procure a translatory movement of one of said members for a relative movement of the grinding member into operative relation to the dressing member, and means responsive to the translatory movement for varying the rate of rotation of said grinding member.

13. In a device of the character described, a grinding wheel and a dressing tool, means to procure a relative movement between said wheel and tool for contact of said wheel with said tool to procure a dressing operation on said wheel, and means automatically operative to reduce the speed of rotation of said grinding wheel as the latter is brought into contact with the dressing tool.

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