

- [54] TWO SPEED GRINDING MACHINE
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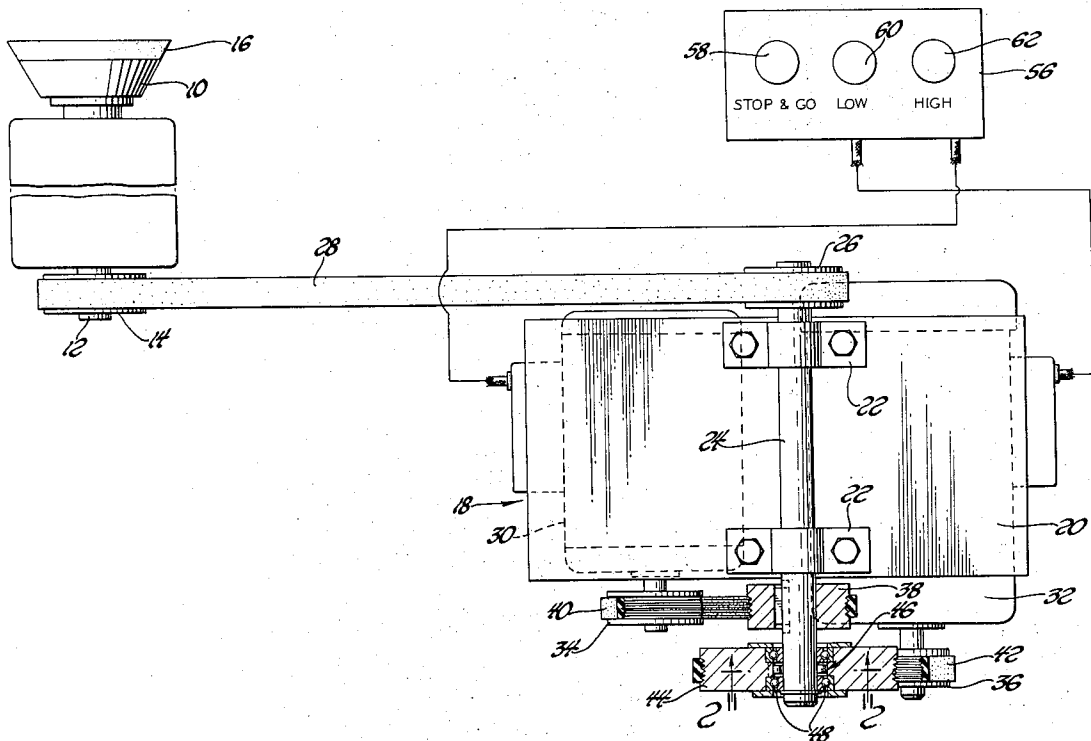
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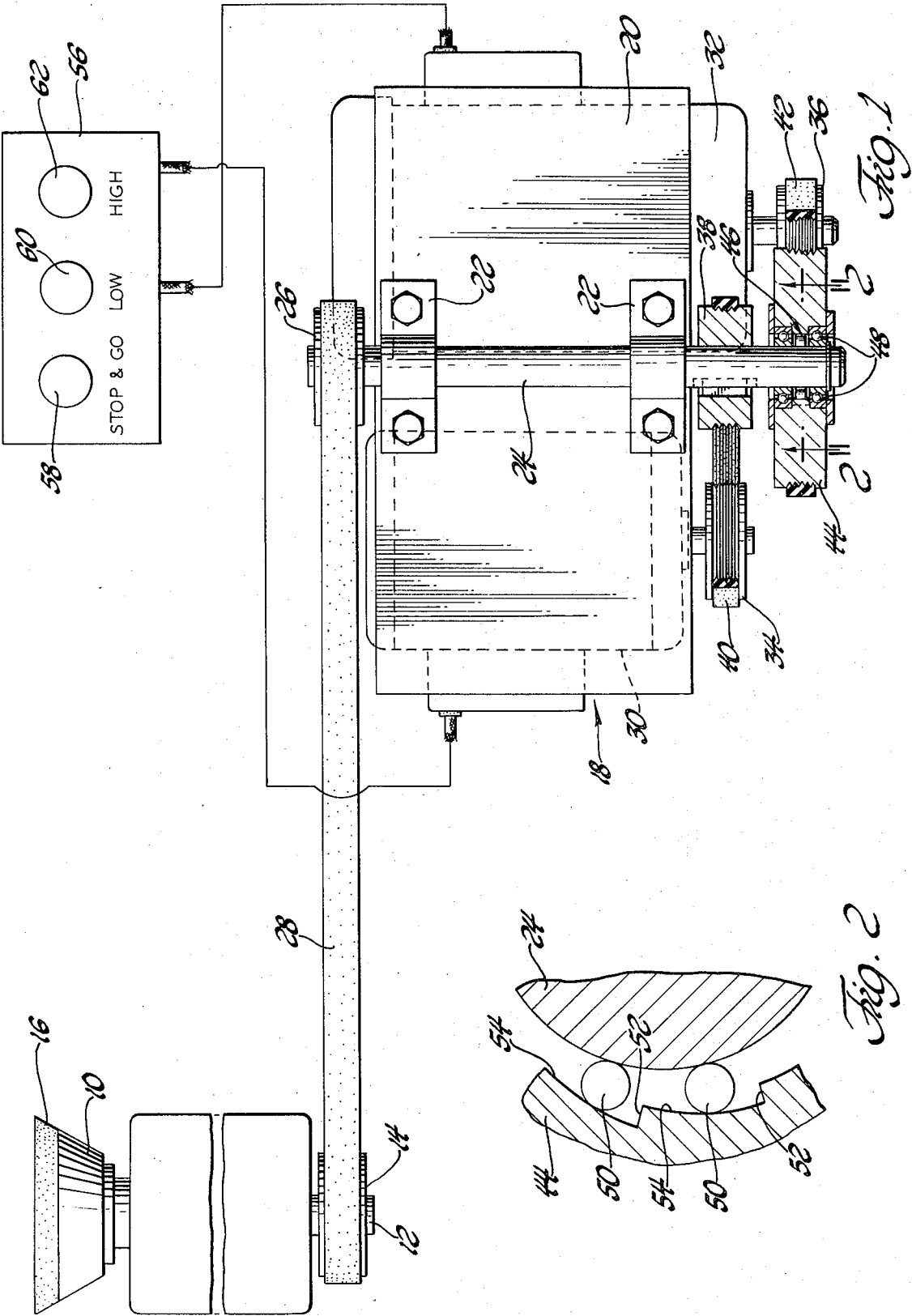
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[57] ABSTRACT
A two speed grinding machine including a spindle with a grinding wheel mounted on the spindle and a dual motor drive means connected with the spindle operable to rotate the spindle at a selected one of two speeds. The drive means includes an output shaft drivingly connected with the spindle and two motors. The output shaft is selectively alternately drivingly connected with the motors such that the output shaft is driven at one speed when it is drivingly connected with one of the motors and is driven at another speed when it is drivingly connected with the other of the motors.

4 Claims, 2 Drawing Figures





TWO SPEED GRINDING MACHINE

This invention relates generally to grinding machines and is particularly concerned with grinding machines wherein the grinding wheel can be driven at a selected one of two speeds, the slower speed being used for rough grinding, or heavy stock removal, and the higher speed being used for finished grinding and light stock removal.

Among the factors that must be considered in grinding a workpiece with a rotating grinding wheel are (1) balance, (2) vibration, (3) the impact of the abrasive or grit (usually diamond particles) on the surface of the workpiece, (4) heat, (5) grinding pressure; (6) torque and (7) the surface speed of the abrasive grit particles (such as diamond chips) of the grinding wheel. Any nonsymmetry of the grinding wheel or spindle creates an out of balance condition that is amplified as the speed of rotation of the spindle and grinding wheel increases. Any condition that creates vibration will be aggravated to create greater vibrations as the speed of rotation of the grinding wheel is increased. Furthermore, at higher speeds of rotation and hence higher surface speed of the abrasive particles, there is a greater impact of the grit particles on the workpiece which increases the likelihood of damaging or loosening the abrasive particle from the grinding wheel.

Heat is generated on the grit particles as they cut through the material of the workpiece which tends to cause plastic flow around and ahead of the abrasive material. When the abrasive particles are embedded in resin, the stored heat tends to cause the bond to weaken and thus loosen the abrasive particles from the bond. At higher speeds, each abrasive particle strikes the workpiece with a greater frequency and there is less opportunity for the heat to be dissipated as the particle revolves around the axis of the grinding wheel between each impact engagement of the particle with the workpiece.

At lower speeds of rotation of the grinding wheel, less pressure is required in order for the abrasive grit or diamond particle to penetrate the workpiece to remove stock from the workpiece. The proper amount of torque must be maintained between the abrasive particle and the workpiece, and the torque required increases relative to the depth of cut, or to the size of chip removed from the surface of the workpiece by the abrasive particle. However, excessive torque tends to cause the abrasive to pull out of the bond. If a constant torque is not maintained on the abrasive particle as it makes a cut through the workpiece, the variation and reversal of forces on the particle tends to loosen the particle from its bond and thus reduce the life of the abrasive portion of the grinding wheel. Similarly, the surface speed of the grinding wheel, particularly that portion containing the abrasive particles, must be maintained substantially constant to prevent the abrasive particles from being loosened and pulled out of the bond.

It has been found that for rough grinding of a workpiece, deeper cuts resulting in a faster rate of stock removal can be obtained at lower surface speeds of the grinding wheel; the workpiece can be fed into the grinding wheel against the abrasive surface at a faster rate when the grinding wheel is rotated at a lower speed but higher torque. For finish grinding, a higher speed can be maintained with the workpiece fed toward the

grinding wheel at a slower rate so that shallower cuts are taken from the workpiece by the abrasive particles on the grinding wheel.

An object of this invention is to provide a grinding machine having a dual speed drive that will permit the grinding wheel spindle to be rotated at a slow speed and high torque for rough grinding and at a higher speed and lower torque for finish grinding.

A more specific object is to provide a grinding machine having a two motor drive with a single output shaft, the output shaft being drivingly engaged with the grinding wheel spindle, a first one of the motors being operable to drive the output shaft at a low speed and high torque when the other motor is deenergized, and the other motor being operable when energized to drive the output shaft at a high speed for finish grinding when the first motor is deenergized.

In carrying out the foregoing, and other objects, a grinding machine according to the present invention includes a spindle with a grinding wheel mounted thereon and a dual motor drive means connected with the spindle. The drive means is operable to rotate the spindle at a selected one of two speeds. The drive means may comprise an output shaft drivingly connected with the spindle, and two motors for selectively alternately driving the output shaft. The output shaft is driven at one speed by one of the motors and can be alternately driven at another speed by the other of the motors.

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

FIG. 1 is a diagrammatic view of a grinding machine according to the present invention; and

FIG. 2 is an enlarged, fragmentary sectional view of a detail of one of the drive members of the machine of FIG. 1 taken approximately on lines 2—2 of FIG. 1.

Reference numeral 10 indicates a conical, cup-type grinding wheel mounted on a spindle 12 to which is fixed an input sheave 14. The grinding wheel 10 has an abrasive portion 16 which may include grit particles such as diamond chips or particles embedded in a resin bond.

The spindle is driven by a dual motor drive indicated collectively by reference numeral 18 and which is operable to rotate the spindle at a selected one of two speeds.

In the illustrated embodiment, the drive means 18 includes a base plate 20 having a pair of bearing members 22 mounted on its upper surface as viewed in the drawings. Rotatably supported within the bearing members 22 is an output shaft 24. Fixed to one end of the output shaft 24 is an output sheave 26. The output sheave 26 is drivingly engaged or connected with the input sheave 14 by a poly V belt 28. Consequently, rotation of the output shaft 24 is transmitted through the belt 28 to the spindle 12 and the speed of the spindle 12 is determined by the speed of the output shaft 24.

Two motors 30 and 32 are mounted on the base plate 18. Fixed to the shaft of the motor 30 is a sheave 34, and fixed to the shaft of the motor 32 is a sheave 36. Sheave 34 is drivingly connected through a poly V belt 40 with a sheave 38, the sheave 38 being nonrotatably fixed to the output shaft 24. Hence, energization of the motor 30 drives the output shaft 24 through the belt 40 and sheave 38.

The sheave 36 is connected through a belt 42 with a sheave 44. The sheave 44 is connected with the output shaft 24 by a sprag clutch 46 so that the sheave 44 is rotatable relative to the output shaft 24 in one direction, but rotates with the shaft in the other direction. The sprag clutch 46 is associated with the output shaft 24 and sheave 44 in such a manner that energization of the motor 32 causes the output shaft 24 to be driven by the motor 32 through the sheave 44 and belt 42. The sheave 44 is rotatably mounted on the shaft 24 by conventional bearing assemblies 48 with the sprag clutch 46 located between the bearing assemblies.

As shown in FIG. 2, the sprag clutch may include balls or rollers 50 received in notches 52 which may be formed on or fixed to the inner periphery of the sheave 44. The notches 52 are connected by wedge or ramp surfaces 54 extending between adjacent pairs of the notches 52. Rotation of the sheave 44 in a counterclockwise direction as viewed in FIG. 2 causes the rollers 50 to become wedged between the wedging surfaces 54 and the surface of the shaft 24 to lock the sheave 44 to the shaft 24 so that counterclockwise rotation of the sheave 44 relative to shaft 24 imparts counterclockwise rotation to the shaft 24. Conversely, however, clockwise rotation of the sheave 44 with respect to the shaft 24 permits the balls or rollers 50 to disengage from the wedge members 54 and to be received in the notches 52 so that the shaft 24 can rotate freely with respect to the sheave 44. Thus, energization of the motor 30 and deenergization of the motor 32 causes the shaft 24 to be driven by the motor 30 with the shaft 24 rotating freely with respect to the sheave 44.

In the illustrated embodiment, the motors 30 and 32 may be constant speed AC motors. Motor 30, when energized, drives the output shaft 24 at a high speed, while motor 32, when energized, drives the output shaft 24 at a low speed. Reference numeral 56 indicates a control panel having a master, on-off switch 58, a low speed switch 60, and a high speed switch 62. When the on-off switch 58 is activated to the "on" condition, either of the low and high speed switches 60 and 62 can then be activated to energize the respective motors 30 and 32. The low speed switch 60 controls the motor 32, while the high speed switch 62 controls the motor 30. When the low speed switch 60 is actuated to energize the motor 32, the high speed motor 30 cannot be energized. Conversely, when the high speed engine 30 is energized, the low speed engine 32 cannot be energized.

When the engine 32 is energized, the sheave 44 drives the output shaft 24, which in turn drives the grinding wheel 10 at the relatively low speed determined by the relationship between the speed of the sheave 36 and the relative diameters of the sheaves 36 and 44. The resulting rotation of the output shaft 24 also causes rotation of the sheave 36 which in turn transmit rotation to the shaft of the high speed engine 30 which is, however, deenergized. When the motor 30 is energized and the motor 32 is deenergized, the shaft 24 drives the grinding wheel 10 at the higher speed determined by the speed of the motor 30 and the relative diameters between the sheaves 34 and 38, which may be of the same diameter. The shaft 24 rotates relative to the sheave 44 during energization of the motor 30 because of the action of the sprag clutch 46.

Thus, for rough and finished grinding of a workpiece, the motor 32 is first energized to rotate the grinding wheel 10 at a relatively low speed to permit heavy stock

removal from the workpiece. Furthermore, the low speed, constant torque, permits a greater feed rate of the workpiece into the grinding wheel to permit faster removal of stock from the workpiece. For finish grinding, motor 32 is deenergized and motor 30 is energized to increase the speed of the grinding wheel 10 to provide a smoother finish to the workpiece, the workpiece feed rate toward the grinding wheel being decreased. Thus, for rough grinding, the grinding wheel 10 is driven at a low speed or rpm to reduce the build up of heat even at deeper cuts and heavy stock removal. However, for finish grinding, the feed rate of the workpiece into the grinding wheel is reduced while the speed or rpm of the grinding wheel is increased. However, at the increased speeds, shallower cuts are taken from the workpiece prevents excessive build up of heat.

An example of a grinding machine of the type generally disclosed herein is disclosed in U.S. Pat. No. 2,424,448. Examples of dual motor drives are disclosed in U.S. Pat. Nos. 1,313,079 and 2,762,220.

While a specific example of the invention is illustrated in the accompanying drawings and described in the foregoing specification, it should be understood that the invention is not limited to the exact construction shown. To the contrary, alterations and modifications in the construction and arrangement of parts, all falling within the scope and spirit of the invention, will be apparent to those skilled in the art.

We claim:

1. A grinding machine comprising: a spindle; a grinding wheel mounted on said spindle; and a dual motor drive means connected with said spindle operable to rotate said spindle at a selected one of two speeds; said drive means comprising: a base member; an output shaft rotatably supported on said base member; means drivingly connecting said output shaft with said spindle; a high speed motor mounted on said base member; a low speed motor mounted on said base member; a high speed input drive member non-rotatably fixed to said output shaft; a high speed power drive member fixed to the shaft of said high speed motor and drivingly engaged with said high speed input drive member; a low speed input drive member rotatably mounted on said output shaft; a low speed power drive member fixed to the shaft of said low speed motor and drivingly engaged with said low speed input drive member; and a clutch means connected between the low speed input drive member and said output shaft operable to drivingly engage said low speed input drive member with said output shaft when said low speed motor is energized and said high speed motor is deenergized to cause said output shaft to be driven by said low speed motor, said clutch means being operable to disengage said low speed input drive member from said output shaft to permit free rotation between said output shaft and low speed input drive member when said high speed motor is energized and said low speed motor is deenergized, said clutch means being connected between said low speed input drive member and said output shaft such that said output shaft is driven in the same direction by both said high speed and low speed motors.

2. A grinding machine as claimed in claim 1 wherein said high speed power and input drive members each comprise sheaves drivingly connected by a belt.

3. A grinding machine as claimed in claim 2 wherein said low speed power and input drive members each comprise sheaves drivingly connected by a belt.

4. A grinding machine as claimed in claim 1 wherein said motors are each AC motors.

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