This invention relates to double disc vertical spindle disc grinders. In disc grinders having opposed rotatable abrasive discs, the discs are generally tilted in a direction relative to the path of travel of the work on the work carrier so that the work passes through a space between the discs which decreases progressively toward the point at which the work emerges from between the discs.

In the past, it has been the practice in conventional disc grinders, particularly horizontal spindle disc grinders, to mount the carrier in a position dependent upon the construction of the bed. This usually resulted in the work on the carrier emerging from between the wheel at approximately a 45° angle.

In order to cause the faces of the discs to converge in the direction of the path of the work, it has been necessary to provide means for tilting the disc in both the horizontal and vertical planes.

It is an object of this invention to provide means whereby the discs may be properly positioned relative to the path of travel of the work, by a single angular adjustment. This is accomplished by positioning the carrier and the disc supporting members so that the path of travel of the work as it emerges from the discs is substantially along a line at right angles to the axes about which the discs are tilted.

Another object is to position the discs and their supporting means and the rotary carrier relative to one another so that when the discs are adjusted angularly, each about a single axis, the path of travel of the work in the carrier, as it passes between the center and the periphery of the discs is substantially along a line at right angles to the axes about which said discs are adjusted.

Another object is to provide means for dressing the discs along a radial path which is parallel to the axis about which the disc is tilted.

Another object is to provide a carrier mounting which may be oscillated through a slight angle during the grinding operation and through a larger angle to remove the carrier from the path of the dresser.

Another object is to provide means whereby the oscillation of the carrier is at a minimum in the loading position, that is, the loading position is close to or directly over the center of oscillation.

Another object is to provide means to facilitate removal of worn abrasive discs and the replacement of new abrasive discs.

Another object is to provide means for stopping the oscillating movement of the carrier when the carrier is moved out of the path of the dresser, without stopping the device which provides the oscillating movement.

FIGURE 1 is a plan view of a vertical spindle disc grinder having two grinding heads for effecting successive grinding operations on a workpiece.

FIGURE 2 is a front elevation of the work carrier drive.

FIGURE 3 is a partial close-up end elevation showing the relation between the discs, carrier, work and work guide.

FIGURE 4 is a close-up of the means for rotating and oscillating the carrier, and for rendering the oscillating means inoperative, and removing the carrier from the path of the dresser.

FIGURE 5 is a section to the eccentric arrangement which provides the oscillating movement of the carrier.

FIGURE 6 is a right end elevation of the apparatus for removing and replacing abrasive discs.

FIGURE 7 is a partial end elevation showing the spindle housings and abrasive discs in an exaggerated angular relation, and the dressing tool in its relation to the angular position of the discs.

FIGURE 8 is a sectional elevation of a clamping bolt for holding the spindle housings in a predetermined position.

FIGURE 9 is a plan view of the dressing mechanism.

Numerals 10 indicates the bed of the machine. 11 is a pedestal for supporting vertical shaft 12. Horizontal arm 13 is pivotally mounted by means of hub member 14 on shaft 12. At the end of arm 13, opposite hub member 14, is an upwardly extending portion 20 having a shaft 21 rotatably mounted therein and a work carrier 22 mounted on the upper end of shaft 21. The lower end of shaft 21 extends into vertical arm 15 and has mounted thereon a worm wheel 25 in operative engagement with worm gear 26 on shaft 27. Worm gear 26 is, in turn, driven by a second worm wheel 30 which is also mounted on shaft 27 and is driven by worm gear 31 on shaft 32. Shaft 32 has a pulley 33 mounted thereon and is connected by belt 34 with a double V adjustable pitch-diameter pulley 35 on shaft 36. Pulley 35 may be shifted by means of handle 37 to vary the total speed ratio of the drive. The second groove on pulley 35 is connected by belt 41 to motor 40 on hub member 14.

Work carrier 22 contains a plurality of openings for receiving workpieces in this case, springs. A guide plate 45 supported beneath work carrier 22 on legs 46 prevents workpieces from dropping out of the work carrier 22, when workpieces are not between abrasive discs 50 and 51.

Annularly opposed abrasive discs 50 and 51 are mounted on vertical spindles 52 and 53 in spindle housings 54 and 55 which are mounted for adjustment about centers 56 and 57 respectively. Centers 56 and 57 are recessed on the undersides of spindle housings 54 and 55 which are secured from adjustment about centers 56 and 57 respectively. Centers 56 and 57 are recessed on the undersides of spindle housing 54 and 55 into which are inserted hardened pivot pins 58 and 59 which are mounted in intermediate slide members 60 and 61. Spindle housings 54 and 55 are secured to intermediate slide members 60 and 61 by means of clamping bolts 64 which pass through abutments 65 on flanges 66 and 69 of spindle housings 54 and 55 respectively. Members 60 and 61 are slidably mounted on vertical columns 62 and 63, and adjusted or positioned on said columns through suitable connections by hand wheels 67 or motors 68.

Abrasive discs 50 and 51 must be tilted in such a direction that they approach closest to each other at the point where the path of the work emerges from between said discs. A radial line through said points where the work emerges from between the discs determines the direction of the axes about which the discs 50 and 51 are tilted.

The axes about which discs 50 and 51 are tilted, define the plane which must contain the path of the dressing tools in order that the faces of discs 50 and 51 may be dressed flat. Ordinarily, this plane will also pass through supporting columns 62 and 63. Therefore, in order not to interfere with the operation of the dresser, the supporting column is set at an angle to the path of the
dresser. In this case, the angle is 30°. Spindle housings 54 and 55, however, remain in the same position and therefore, in this case, the spindle housing is mounted to receive the spindle housing perpendicular to the path of the dresser. Briefly, the column and member 69 are set at an angle to the path of the dresser. The spindle housing remains the same as though the column had not been changed, and the surface of the slide member 60 on which the spindle housing is mounted is changed to compensate for its angular displacement.

The faces of members 60 and 61 are formed at such an angle, preferably at right angles, that spindle housings 54 and 55 may be tilted about centers 56 and 57 to tilt discs 50 and 51 in the direction of the path of travel of the work so that workpieces passing between said upper and lower discs 50 and 51, will move through a progressively narrower space, the minimum space being at the point where the work emerges from between discs 50 and 51.

Work carrier 22 is subjected to a slight oscillating movement as it rotates during a grinding operation. The center of oscillation is the axis of shaft 12 in pedestal 11. The oscillatory movement of the carrier at this point is zero and, therefore, it is the logical point for loading and unloading workpieces. The mechanism for providing this oscillation movement consists of eccentric 70 mounted on an eccentric portion 28 of shaft 27, which shaft also carries worm gear 26 and worm wheel 30.

Eccentric 70 is connected through yoke member 74 to toggle 71, which, in locked position, serves as a connecting rod between arm 13 and anchor member 75 in bed 10. Toggle 71 consists of a series of links 72 which, when moved to the dotted line position by means of handle 73, shifts carrier 22 and arm 13 to the position shown by circle 76, to move carrier 22 away from the center line of discs 50 and 51 and thus out of the path of dresser bar 80 for discs mounted on column 62. When links 72 are in the position shown by the dotted line position, carrier 22 is in position shown by circle 77 and out of the path of dresser bar 80 for the discs mounted on column 63.

The means for dressing discs 50 and 51 consists of dresser bar 80 to which is attached a dressing head having oppositely positioned diamonds 81 or other dressing tools. Said bar member 80 is slidably supported in bracket 82 attached to column 62. Dressing tools 81 traverse the discs in a path which passes very near to or through the centers of said discs and which are parallel to the axes A and B about which the discs rotate. For all practical purposes, it can be said that the dressing tools traverse a path which intersects the center of the abrasive discs. If there is a center opening in the disc, the requirement for dressing a flat surface is satisfied so long as the path of the dressing tool passes through the opening. Where there is no center opening in the disc, as in the case of the disc disclosed herein, the dresser path must pass through the center of the disc in order to subject the entire abrasive surface to the action of the dressing tool. This movement of the dresser bar 80 is effected by rack 83 and pinion 84 in bracket 82. Pinion 84 may be rotated by any suitable apparatus. Pinion 84 may be operated either manually or by power. For the purpose of illustration, hand wheel 85 is shown for this purpose. Hand wheel 85 may be arranged to drive pinion 84 through a worm gear and worm wheel (not shown).

Pinsion is made whereby discs 50 and 51 may be replaced with a minimum of effort. Vertical shaft 90 is supported at the upper end by bracket 91 attached to column 62 and at the lower end by bracket 92 which is attached to bed 10. Rotatably mounted on shaft 90 are a pair of vertically spaced arms 95 and 96. When it is desired to remove discs 50 and 51, arms 95 and 96 are swung into position to receive said discs. Spindle housings 54 and 55 are adjusted until disc 50 rests on arm 95 and disc 51 rests on arm 96. Bolts 49 are then removed, and housings 54 and 55 are backed away, leaving said members on the respective arms 95 and 96 which can then be swung in the opposite direction to a position in which they can be more easily picked up by mechanical handling apparatus.

I claim:

1. In a vertical spindle disc grinder, a base, a tool supporting structure on said base, a slide member mounted for vertical movement on said column, a spindle housing on said slide member, a spindle rotatably mounted therein, an abrasive disc on said spindle, a rotatable carrier and means for supporting said carrier in operative relation to said abrasive disc comprising a pedestal on said base, a vertical shaft in said pedestal, a supporting arm extending horizontally from said pedestal and having one end oscillatably mounted on said vertical shaft, means for rotatably supporting said carrier at the other end of said arm, said supporting means being in the form of a driving member, an eccentric actuated by said driving member, and a connection between said eccentric and said base to effect an oscillatory movement of said carrier during grinding.

2. In a vertical spindle disc grinder, a base, a tool supporting column on said base, a slide member mounted on said said supporting column, an abrasive disc carried on said slide member, a spindle rotatably mounted therein, an abrasive disc on said spindle, a rotatable carrier and means for supporting said carrier in operative relation to said abrasive disc comprising a pedestal on said base, a vertical shaft in said pedestal, a supporting arm extending horizontally from said pedestal and having one end oscillatably mounted on said vertical shaft, means for rotatably supporting said carrier at the other end of said arm, said supporting means being in the form of a driving member, an eccentric actuated by said driving member, and a connection between said eccentric and said base to effect an oscillatory movement of said carrier during grinding.

3. In a vertical spindle disc grinder, a base, a tool supporting column on said base, a slide member mounted on said said supporting column, a spindle housing on said slide member, a spindle rotatably mounted therein, an abrasive disc on said spindle, a rotatable carrier and means for supporting said carrier in operative relation to said abrasive disc comprising a pedestal on said base, a vertical shaft in said pedestal, a supporting arm extending horizontally from said pedestal and having one end oscillatably mounted on said vertical shaft, means for rotatably supporting said carrier at the other end of said arm, said supporting means being in the form of a driving member, an eccentric actuated by said driving member, and a connection between said eccentric and said base to effect an oscillatory movement of said carrier during grinding, and means to open said connection to swing said carrier to a position beyond the range of said eccentric in either direction.

4. In a vertical spindle disc grinder, a base, a tool supporting column on said base, a slide member mounted on said vertical movement on said column, a spindle housing on said slide member, a spindle rotatably mounted therein, an abrasive disc on said spindle, a rotatable carrier and means for supporting said carrier in operative relation to said abrasive disc comprising a pedestal on said base, a vertical shaft in said pedestal and having one end oscillatably mounted on said vertical shaft, means for rotatably supporting said carrier at the other end of said arm, said supporting means being in the form of a driving member, an eccentric actuated by said driving member, a connection between said eccentric and said base to effect an oscillatory movement of said carrier during grinding, and means to stop said oscillatory movement comprising means for disabling said connection.

5. In a vertical spindle disc grinder, a base, a tool supporting column on said base, a slide member mounted on said vertical movement on said column, a spindle housing on said slide member, a spindle rotatably mounted therein, an abrasive disc on said spindle, a rotatable carrier and means for supporting said carrier in operative relation to said abrasive disc comprising a pedestal on said base, a vertical shaft in said pedestal, a supporting arm extending horizontally from said pedestal and having one end oscillatably mounted on said vertical shaft, means for rotatably supporting said carrier at the other end of said arm, said supporting means being in the form of a driving member, an eccentric actuated by said driving member, a connection between said eccentric and said base to effect an oscillatory movement of said carrier during grinding including a member mounted on the peripheral surface of said eccentric.
5. In a vertical spindle disc grinder, a base, a tool supporting column on said base, a slide member mounted for vertical movement on said column, a spindle housing on said slide member, a spindle rotatably mounted therein, an abrasive disc on said spindle, a rotatable carrier and means for supporting said carrier in operative relation to said abrasive disc comprising a pedestal on said base, a vertical shaft in said pedestal, a supporting arm extending horizontally from said pedestal and having one end oscillatably mounted on said vertical shaft, means for rotatably supporting said carrier at the other end of said arm, said supporting means being in the form of a driving member, an eccentric actuated by said driving member, a connection between said eccentric and said base to effect an oscillatory movement of said carrier during grinding comprising a member connecting said eccentric and said base, and means for rendering said connecting member unable to cause said oscillatory movement.

6. In a vertical spindle disc grinder, a base, a tool supporting column on said base, a slide member mounted for vertical movement on said column, a spindle housing on said slide member, a spindle rotatably mounted therein, an abrasive disc on said spindle, a rotatable carrier and means for supporting said carrier in operative relation to said abrasive disc comprising a pedestal on said base, a vertical shaft in said pedestal, a supporting arm extending horizontally from said pedestal and having one end oscillatably mounted on said vertical shaft, means for rotatably supporting said carrier at the other end of said arm, said supporting means being in the form of a driving member, an eccentric actuated by said driving member, and a connection between said eccentric and said base to effect an oscillatory movement of said carrier during grinding, said connection comprising a multiple link toggle device and means for opening said toggle to stop said oscillatory movement.

9. In a vertical disc grinder, a base, a work carrier mounted for horizontal rotation about a vertical axis, a tool supporting column on said base, upper and lower slide members mounted for vertical movement on said column forward and from said work carrier, a spindle housing on each of said slide members, a spindle rotatably mounted in each housing, an abrasive disc centrally on each of said spindles, means for adjusting said spindle housings angularly for tilting said discs on parallel axes at an angle to the horizontal plane of said carrier, and a dressing tool mounted for transverse movement between said discs in a path passing through the centers of said discs and to one side of said support column and parallel to the axes about which said discs are tilted.

10. In a vertical disc grinder, a base, a work carrier mounted for horizontal rotation about a vertical axis, a tool supporting column on said base, upper and lower slide members mounted for vertical movement on said column forward and from said work carrier, a spindle housing on each of said slide members, a spindle rotatably mounted in each housing, an abrasive disc centrally on each of said spindles, means for adjusting said spindle housings angularly on parallel axes for tilting said discs at angle to the horizontal plane of said carrier and a dressing tool mounted for transverse movement between said discs in a path parallel to the axes about which said discs are tilted.

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