ABSTRACT OF THE DISCLOSURE

Drill press work-holding apparatus adapted for operations such as drilling, reaming and tapping characterized by enhanced efficiency, productivity and safety.

Summary of the invention

Drill press work-holding apparatus permitting precision drilling of circular, curvilinear and rectilinear patterns on work pieces having curved or rectangular surfaces.

Brief description of the drawings

In the drawings:
FIGURE 1 is a top plan view of one form of construction of the drill press slide table and bracket portions in accordance with the invention;
FIGURE 2 is a side elevation sectional view of the slide table and bracket portions taken along the line 2-2 of FIGURE 1 and showing how such structures are supported by the rest of the drill press;
FIGURE 3 is an enlarged front elevation sectional view of the table and bracket portions taken along the line 3-3 of FIGURE 1 and showing details of the novel indexing means as well as details of the locking pin and locking control member for detachably securing the fixture or work-holding device to the table portion;
FIGURE 4 is a top plan view similar to FIGURE 1 but showing also a precision rectilinear vise unit as one form of fixture or work-holding device detachably secured to the slide table portion in accordance with the invention for achieving rectilinear drilling patterns on a work piece;
FIGURE 5 is a top plan view similar to FIGURE 1 but showing also a precision rotateable vise unit as another form of fixture or work-holding device detachably secured to the slide table portion in accordance with the invention for achieving circular or curvilinear drilling patterns on a work piece;
FIGURE 6 is a top plan view similar to FIGURES 1 and 4 but showing a simplified form of rectilinear vise unit;
and
FIGURE 7 is an enlarged side elevation sectional view taken along the line 7-7 of FIGURE 4 and showing details of the rectilinear vise unit and further details of the locking pin and locking control member.

Referring to the drawing in detail, in FIGURE 2 there is indicated generally at 11 a drill press which includes a hollow support column 12 vertically mounted on a base, not shown. Mounted at the top of column 12 is a head assembly 13 including an electric motor 14 which has its output shaft 15 coupled through suitable gearing mechanisms in housing 16 to drive a vertical spindle 17 and a drill chuck 18 which holds a drill bit 19 or other rotary tool such as a reaming or tapping tool. In order to move the chuck and drill downwardly into operative engagement with the work piece on the table, a 3-armed control member 20 is manually rotated to the extent required.

Support means for adjustably carrying the work-holding devices or fixtures will now be described. An under table in the form of a bracket or support arm structure 22 is adjustably mounted on column 12 by means of a split sleeve portion 23 and releasably locked at the desired level by means of a screw type locking mechanism or a cam type locking clamp mechanism 24 actuated by lever 25. A special adapter may be provided at 26 with suitable bushing to compensate for differences in the diameter of column 12 and for other dimensional differences in different drill presses. A split safety collar may be secured on column 12 immediately below sleeve portion 23, if desired.

The bracket 22 has a generally horizontal undertable portion 28 bounded on its left side and right side, respectively, by sloping vertical wall portions 29 and 30. Extending horizontally between wall portions 29 and 30 are two parallel elongated ridge portions 31 and 32 raised above undertable portion 28 and having parallel horizontal cylindrical bores or channels 33 and 34, respectively, which extend completely through the ridge portions. Preferably, each of bores 33 and 34 is fitted with an elongated coextensive bushing 35 and 36, respectively.

At 38 there is provided a work table structure which is supported on the bracket 22 for adjustible rectilinear sliding movement in the horizontal Y direction. In other words, in FIGURE 3 table 38 is slideable to the left and to the right. Table 38 has a generally rectangular flat top surface 39 and has a central cylindrical bore 40 which may be fitted with a bushing 41. The cross-slide feature and alignment for table 38 is obtained by providing table 38 with a pair of elongated cylindrical rods 42 and 43 which are substantially horizontal and parallel and which extend, respectively, throughout the length of channels 33 and 34 of bracket 22 and slide therein, or else in their bushings 35 and 36 if provided.

Rods 42 and 43 may be supported at their left-hand ends by passing substantially through, and terminating in, cylindrical holes 44 and 45, respectively, formed through the left-hand wall or flange 46 of table 38, and they may be supported at their right-hand ends by passing substantially through, but not terminating in, cylindrical holes 47 and 48, respectively, formed through the right-hand wall or flange 49 of table 38. Holes 44, 45, 47 and 48 may instead be cylindrical recesses extending part way into walls 46 and 49 so as to provide reentrant socket portions for the ends of rods 42 and 43. With either type of holes, the ends of rods 42 and 43 may be fixedly secured in holes 44, 45, 47 and 48, as by welding. With the holes illustrated in FIGURE 1, the rods 42 and 43 may be free to turn in such holes but yet they will be secured against longitudinal movement by suitable means such as a snap ring 50 or 51 in an annular groove in each rod and abutting against the inner surface of the respective wall. It will thus be seen that table 38 and rods 42 and 43 slide together as a unitary structure on the undertable or bracket 22.

In order slideably to advance and retract table 38 with precision as a micro-control slide table, there is provided (FIGURE 3) a horizontal lead-screw 52 which is rotatably supported in a bore 53 in wall 49 of table 38. A C clip 54 is provided in an annular groove in lead-screw 52 and abuts against the inner surface of wall 49 to permit rotation of screw 52 relative to table 38 but to prevent any rectilinear movement of screw 52 relative to table 38, whereby lead-screw 52 is rotatably secured to table 52. The threaded shank portion passes, with clearance, through a bore 55 in the wall 30 of bracket 22 and is threaded through an internally threaded sleeve 56, which may instead be an internally threaded nut. Sleeve 56 is fixedly secured, as by welding, to the bottom surface of the undertable portion 28 of bracket 22. Fixedly secured to the right-hand end portion of lead-screw 52...
outside wall 49 is a hand-wheel with eccentric control handle 57 and a concentric generally annular dial portion 85 provided to rotate the inner surface of element 80 and a concentric dial rotation of handle 57 serves slideably to advance table 38 across bracket 22 with precision in one direction, for example to the left in FIGURE 3, along the horizontal axis Y, with respect to the spindle axis, whereas clockwise rotation of handle 57 serves slideably to retract table 38 in the opposite direction, for example to the right, along the Y axis.

There will now be described a micro-control work-holding device or fixture in the form of a cross-slide precision vise which complements the rectilinear adjustability of table 38 in the Y direction by providing precision rectilinear adjustability of a work piece in the horizontal X direction. As shown in FIGURES 4 and 7, vise 60 has a generally rectangular stationary mounting plate or base 61 with its flat bottom surface 62 resting upon the top surface 39 of table 38.

Before further describing vise 60, the interchangeability feature including the means for detachably holding the work-holding device, the vise 60 in FIGURES 4 and 7, normally against vertical movement, will now be described. As shown in detail in FIGURES 3 and 7, within the cross-section of figure 40, and its base 61, there is vertically located a locking pin 64 having an intermediate cylindrical shank portion 65, an annular flange portion 66 of greater diameter and an upper portion 67 of diameter similar to portion 66. By suitable means such as screws 68, the locking pin 64 is fixedly secured to the bottom portion of the base 61 of vise 60. Below shank portion 66 in pin 64 there is provided an annular groove 69 of reduced diameter which separates portion 65 from a base portion 70 of the same diameter as portion 65.

Locking control means for pin 64 will now be described. A locking control unit 71 is provided comprising a horizontal elongated metal strip or plate element 72, in the form of a U-shaped clevis at its inner end, a compression spring 73 and a pull rod 74 having its inner end fixedly secured to a flanged outer end portion of element 72. Element 72 is slideably supported in a rectangular channel between table 38 and a plate 75 secured to table 38, and has a thickness slightly less than the height of groove 69, and the outer end of rod 74 is slideably supported in a cylindrical bore 76 in wall 49 of table 38. As shown in FIGURES 3 and 7, spring 73 normally biases rod 74 to element 72 to their innermost position where the two legs 78, the U-shaped cutout portion at the inner end of element 72 straddle more than half of the circumference of groove 69 of pin 64. In this position element 72 prevents vertical movement of pin 64, and the bottom surface of annular flange 66 of pin 64 is held resting on surface 39 of table 38. Since pin 64 is secured to the base 61 of vise 60, it will be seen that in this position the locking control unit 71 and pin 64 serve positively to hold the vise 60 against vertical movement during the drilling of a work piece held in vise 60.

When it is desired to remove the vise from table 38, this may be easily and rapidly accomplished. The operator simply grasps the knob 77 of rod 74 and pulls rod 74 and element 72 to the right (FIGURE 3) against spring 73 until the U-shaped cut-out portion 78 has been withdrawn from groove 69 and is disengaged from pin 64. Vise 60, with pin 64 attached, may now be lifted and removed. When the operator releases his grip on knob 77, the force returning rod 74 and element 72 substantially to their original position in FIGURES 3 and 7.

The rest of vise 60 and its operation will now be described. A flange element 80 is welded at 81 to base 61 of vise 60 and rotatably supports a horizontal lead-screw member 82. In order to prevent longitudinal movement of member 82 to the right, a snap ring 83 is mounted in an annular groove in member 82 and abuts against the inner surface of element 80 and a concentric dial portion 84 of member 82 provided with suitable graduations for micro-calibration. A reference mark is provided on element 80. Fixedly secured to the left-hand end portion of member 82 is a hand-wheel with an eccentric control handle 85. In FIGURE 7 the bracket 90 embraces generally the assembly of those portions of vise 60 which are slideably adjustable in the X direction along the base 61 of vise 60. The base 61 has an elongated guide channel formed therein generally in the transverse cross-section shape of an inverted T by undercutting the base 61, as shown by the dotted lines in FIGURE 4, so that a pair of parallel elongated guide retainer portions 87 and 88 are formed as flanges along which the assembly 90 may be slidably adjusted, the flat bottom surface of the channel being indicated at 89. The assembly 90 has a slideable bottom section 91 with a pair of runners or flanged leg portions 92 and 93 which are located respectively beneath the guide retainer portions 87 and 88. The assembly 90 also includes an upright portion 95 which is either integral with, or fixedly secured to, the bottom section 91. A sleeve or nut 96 is fixedly secured to portion 95 or section 91, as by welding, and is internally threaded to receive the threaded end of lead screw 82. The assembly 90 also includes an upright first jaw portion 97 which has an attached face element 98 and which is either integral with or fixedly secured to bottom section 91. Assembly 90 further includes a second jaw portion 99 which has a face element 100 and which is slideable in the X direction along the underneath flat portions of bottom section 91 and which is thus also slideable to the same degree with respect to portion 95 and the first jaw portion 97. From the above, it will be apparent that when handle 85 is rotated in one direction, the rotation of lead screw 82 will cause assembly 90 to slide inwardly (advance) along the X axis, whereas rotation of handle 85 in the opposite direction will cause assembly 90 to slide back outwardly (retract) along the X axis.

Means for providing further adjustment with precision along the X axis will now be described wherein jaw portions 97 and 99 are made relatively adjustable with respect to each other along the X axis. The upright portion 95 has a horizontal bore 101 which is internally threaded to receive a screw 102 having a head 103 and an unthreaded tip end portion 104 which has an annular groove for receiving therein a snap ring 105. The movable jaw portion 99 has a horizontal bore 107 aligned with bore 101 along the X axis so as to receive the unthreaded end 104 of screw 102. Bore 107 has an annular groove radially aligned with the groove in bore 101 so that the snap ring extends into both grooves to prevent relative longitudinal movement between portions 95 and 97 in the X direction but permitting rotational adjustment of screw 102 relative to portion 99. From the above, it will be apparent that when screw head 103 is rotated in one direction, for example with the aid of a wrench, this will cause screw 102 threadingly to advance through the fixed portion 95 and will thus push the movable jaw 99 inwardly closer to the set jaw 97 and will permit a work piece to be gripped tightly between plates 98 and 100. Similarly, rotation of screw 103 in the opposite direction will cause screw 103 to retract threadingly through portion 95 and hence will pull jaw 99 back away from jaw 97.

In the simplification in FIGURE 6, as compared to FIGURE 4, the means for slideably adjusting the assembly 90 in the X direction, as a unit, have been omitted. Jaw portion 99 is slideable toward fixed jaw 97 along the underneath flat portions of the fixed bottom section of the precision vise 110 and is actuated by rotation of screw 102 cooperating with fixed portion 99 in the same manner as in FIGURE 4.
The novel indexing means and interchangeability feature will now be described with particular reference to FIGURES 4 and 5 wherein there is provided a rotatably adjustable precision vise 112 comprising a generally cylindrically main body 113 having its flat bottom surface supported on the top surface 39 of the table 38 supported in turn by bracket 22 and having a central vertical hole 114 to accommodate the upper portions 116 and 117 of the indexing members 115 which cooperates with a locking control unit 71 as described in connection with FIGURES 3 and 7 above. Pin 64 also serves as a centering means for vise 112 on table 38. Body 113 has formed therein a series of equally spaced elongated guide channels 115 which extend radially inward toward the central hole 114 and pin 64 and which each have a transverse cross-section shape of an inverted T by undercutting body 113 as shown by the dotted lines in FIGURE 5 so that for each channel 115 there is formed as flanges a pair of substantially radial parallel elongated guide retaining portions 116 and 117. Along the flat bottom surface of some or all of the channels 115 there is slidably supported a manually adjusted jaw member 119 (three as shown) having an inner end for gripping the work piece and having under leg portions which are slidably retained and guided in the respective channels 115 beneath the body retainer portion 116 and 117.

Each of member 119 has a cut out or pinched lower portion and is threaded to receive a set-screw 121 which is directed obliquely through the jaw member to the top surface 122 of body 113 to provide a pinch effect or clamping effect when the set screw is tightened after each member has been grasped by the operator's hand and slide to the desired radial position in its channel.

In table 38 there is formed a single vertical indexing hole 123 which extends downward from the table surface 39. Hole 123 extends down throughout the body of table 38 and is offset from the center of the table surface 39 by a predetermined amount. For the rectilinearly adjustable work-holding devices of FIGURES 4 and 6 there was no requirement for rotation or indexing of the device and hence there indexing mechanism served no function and was maintained inoperative, the hole 123, however, being useful as a reference point when desired. Within hole 123 there is located a vertically slideable or reciprocable indexing pin 124 which is described in detail shortly. Pin 124 may be vertically slideable within a vertical bushing (not shown) fitted within hole 123.

Formed in the bottom of body 113 of device 112 are a predetermined number of vertical cylindrical holes 125 having a diameter slightly greater than the diameter of the upper portion of pin 124. Holes 125 are located along a circular path and each is spaced the same radial distance from the center of hole 40 and locking pin 64 as is the indexing hole 123 and indexing pin 124. Each hole 125 extends upwardly from the bottom of body 113 a distance sufficient to accommodate the upper portion of pin 124 when it is in its active extended position as shown in FIGURE 3. As shown in FIGURE 3, pin 124 may be generally cylindrical but is provided in its bottom part with an integral dig or dent portion 127 which extends horizontally outward away from central hole 40 and which has a flat upper surface 128. A compression coil spring 129 is coiled within a central vertical bore in the bottom part of pin 124. The bottom end of spring 129 is retained by a plate 130 secured to the bottom of table 38 as by a screw.

Rotatably supported within the flange portion 46 of table 38 is an indexing control member 132 including a generally cylindrical shaft 133 of said body 134, its inner end a substantially semi-cylindrical eccentric portion 134. The outer end of member 132 is provided with a rotatable wheel with handle 135. A suitable dial with graduations may be provided at the shank portion 136. When pin 124 is in its vertically extended position as shown in FIGURE 3, it is held in this position by spring 129 which also holds the flat top surface 128 of dent portion 127 in abutment against the flat surface of eccentric portion 134 of shaft 133. In this position of FIGURE 3, the upper portion of pin 124 will be located in a desired one of the holes 125 in body 113 so as to lock body 113 and device 112 in a desired first angular position against any rotation. A set screw 137 is supported in the bottom of table 38, and its upper end may be brought into engagement with a groove or slot in shaft 133 to lock device 132 releasably in the angular position of FIGURE 3.

When it is desired to rotate body 113 to its next desired angular position for the next drilling operation, set screw 136 is loosened, and handle 135, and hence shaft 133, is rotated substantially 180 degrees, whereby eccentric portion 134 forces dent portion 127, and hence pin 124, downward against the action of spring 129 to its vertically retracted position, whereas the top of pin 124 is either below or flush with top surface 39 of table 38. The operator may now grasp the edge of body 113 and rotate it to the next desired angular position wherein it will be next hole 123 will be aligned vertically with pin 124. Handle 135 is then rotated another 180 degrees and, under the force of spring 129, pin 124 will be forced up into its position of FIGURE 3 and into such next hole 123 so that body 113 and device 112 may be locked into such next desired angular position and ready for drilling the work piece. The above procedure is repeated until the last desired angular position has been reached and the last drilling operation performed.

While this invention has been described with particular reference to the construction shown in the drawing, it is to be understood that such is not to be construed as imparting limitations upon the invention, which is best defined by the claims appended hereto.

Having thus described my invention, I claim as new and desire to secure by Letters Patent:

1. Work-holding apparatus for a drill press which includes a vertical support column and a spindle spaced therefrom, comprising support means including a bracket portion adapted for vertical mounting on said column and for vertical adjustment on said column, said support means including a work table portion supported by said bracket portion and adjustable for horizontal movement relative to the longitudinal axis of said column, said table portion having a substantially flat top surface wherein there is provided a rotatable work-holding device adapted to hold work pieces having circular or curved portions, said device comprising a main body member having a substantially flat bottom surface and rotatably supported on said flat top surface, means for securing said body member to said means for detachably holding said device, said table portion having formed therein a vertical aperture which extends downward from said flat top surface and which is offset from the center of said top surface, said body member having a plurality of index holes spaced uniformly from said bottom surface and spaced apart along the circumference of a circle, an indexing pin disposed for vertical reciprocal movement in said aperture, said indexing pin having at its lower end below said aperture a detent portion which extends substantially horizontally and which has a flat surface facing upwardly for holding said pin in its upwardly extended vertical position wherein it projects into a first one of said holes to lock said body member in a first one of said holes to lock said body member in a first desired angular position and for holding said pin in its retracted position in which the handle of said body member is rotated from said first angular position toward its next desired angular position and for holding said pin again in its upwardly extended position wherein it projects into
the next one of said holes to lock said body member in said next desired angular position when said body member has been rotated to said last-mentioned angular position, said pin-holding means includes spring means for holding said pin in each of said holes when said body member is in the respective desired angular position, said pin-holding means further including a control member operable against the force of said spring means for holding said pin in its retracted position while said body member is rotated from each of said desired angular positions toward the next desired angular position, said control member including a horizontal eccentric pin manually rotatable from its outer end and having an eccentric portion at its inner end which is generally semi-cylindrical and which has its flat surface facing downward abutting the flat surface of said detent portion when said eccentric pin is in a first angular position and said indexing pin is in said upwardly extended position under the control of said spring means, said eccentric pin being manually rotatable through substantially 180 degrees to a second angular position wherein said eccentric portion has driven said detent portion, and hence the entire indexing pin, down to said retracted position against the force of said spring means, and means for detachably holding said device on said table portion normally against vertical movement.

2. Apparatus according to claim 1 wherein said body member is generally cylindrical and said device-holding means is a rotatable vertical locking pin secured to the center of said body member so that said body member is centered by said locking pin and is rotatable about the longitudinal axis of said locking pin, said body member having at least three guide channels extending radially inward toward said locking pin, at least three manually operated jaw members slideable in respective of said channels radially toward said locking pin to grip a work piece between the jaws of said jaw members, and means releasably locking each of said jaw members in its working-gripping position on said body member.

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