March 19, 1946. W. M. DAVIS 2,396,642

SENSITIVE DRILL PRESS

Filed Feb. 26, 1943 2 Sheets-Sheet 1

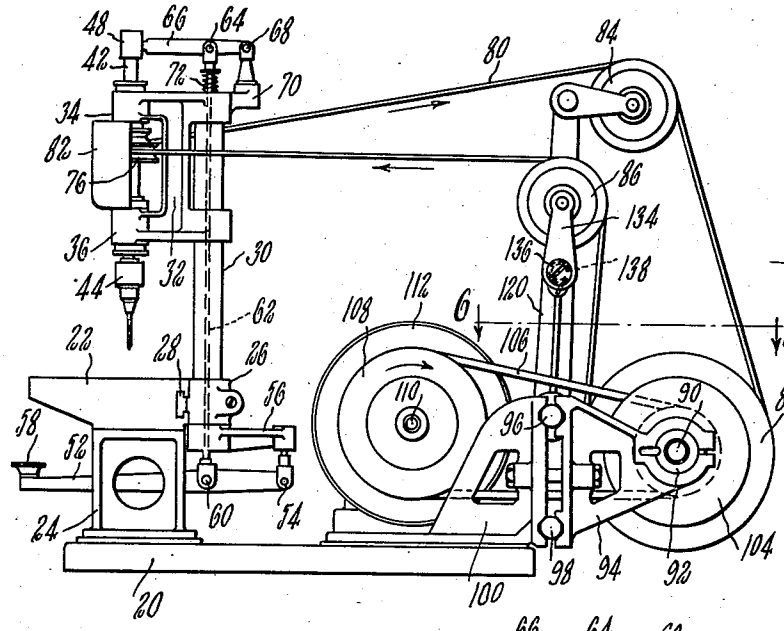


Fig. 1.

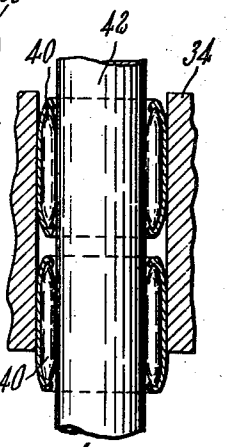


Fig. 5.

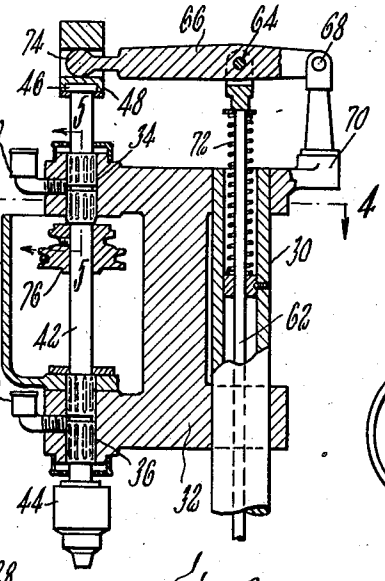


Fig. 3.

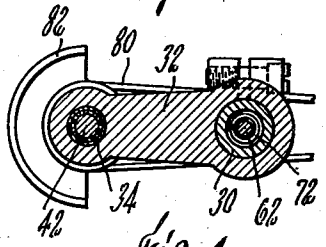


Fig. 4.

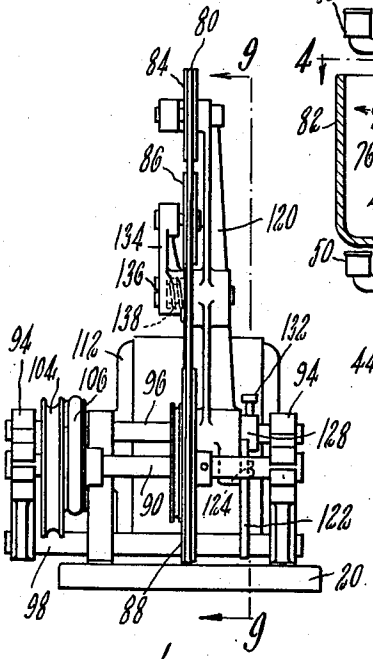


Fig. 2.

Inventor
William M. Davis
by Wright, Brown, Quinby & May
Attys.

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SENSITIVE DRILL PRESS

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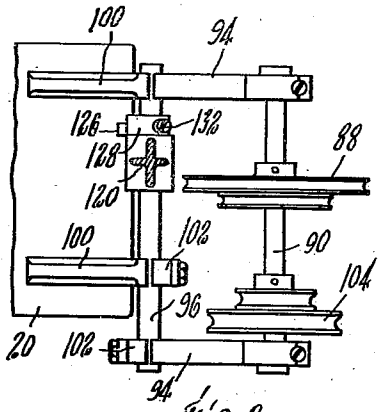


Fig. 6.

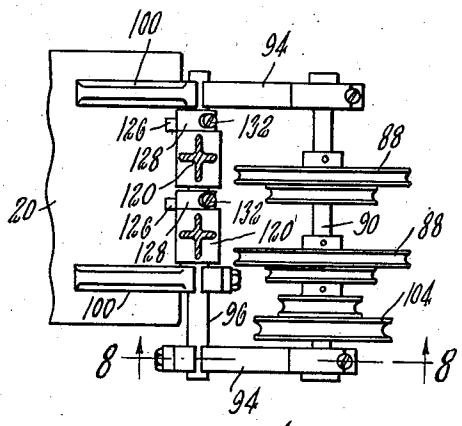


Fig. 7.

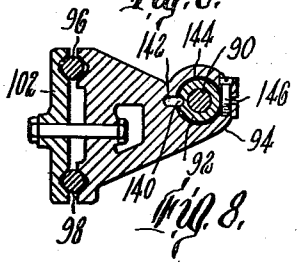


Fig. 8.

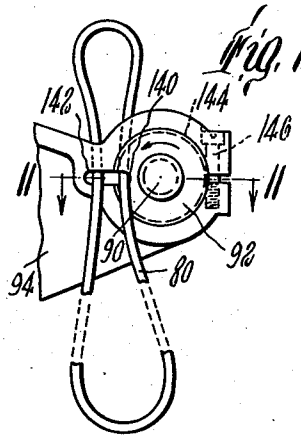


Fig. 10.

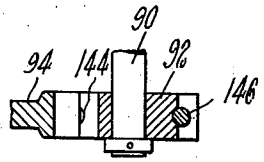


Fig. 11.

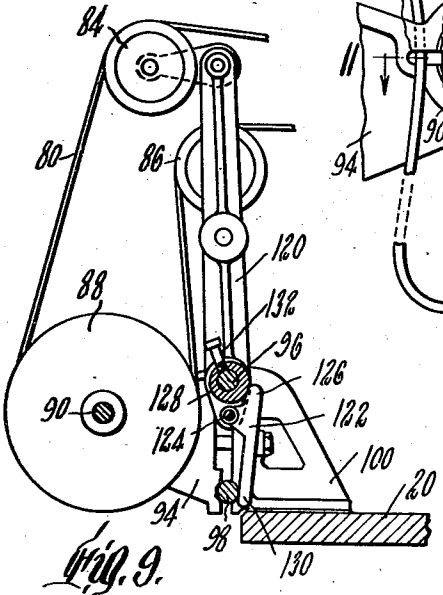


Fig. 9.

Inventor
William M. Davis
by Wright, Brown, Quinby & May
Attys.

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UNITED STATES PATENT OFFICE

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SENSITIVE DRILL PRESS

William M. Davis, Cambridge, Mass.

Application February 26, 1943, Serial No. 477,181

1 Claim. (Cl. 77—30)

This invention relates to improvements in drill presses such as are used for drilling tiny holes through sheet metal. For example, such holes must be drilled in circular plates which are used in watches to support the arbors for the gears in the works. Likewise, the holes drilled in spinnerets for the extrusion of viscose, etc., are very fine. Since the holes to be drilled are of small diameter, the drills themselves must be of equally small diameter and are therefore liable to break unless manipulated with great care.

For drilling of this type drill presses are used wherein the drill is manually pressed against the work. Breakage of the drill is most apt to occur just after the tip of the drill has penetrated through the bottom of the plate which is being drilled. Hence it is important to reduce the pressure on the drill at this point in the operation.

It is an object of the present invention to provide a drill press in which the drill is so supported that the slightest variation in resistance to the axial progress of the drill is easily felt. The operator can thus follow the progress of the drill by the sense of touch and can regulate the manual pressure thereon accordingly.

To achieve this sensitivity, the press is provided with devices for opposing the gravitational pull of the drill spindle and for minimizing resistance, frictional and otherwise, to axial movement of the drill spindle. Thus the spindle responds to the slightest touch, and a very delicate "feel" of the pressure of the drill against the work is afforded.

For a more complete understanding of the invention, reference may be had to the following description thereof, and to the drawings of which

Figure 1 is a side elevation of a machine embodying the invention.

Figure 2 is a rear elevation of the same.

Figure 3 is a side elevation of the drilling head shown in Figure 1, portions being broken away to show in section.

Figure 4 is a section on the line 4—4 of Figure 3.

Figure 5 is a section on the line 5—5 of Figure 3, drawn on a greatly enlarged scale.

Figure 6 is a section on the line 6—6 of Figure 1.

Figure 7 is similar to Figure 6 but shows a portion of a multiple spindle machine.

Figure 8 is a section on the line 8—8 of Figure 7.

Figure 9 is a section on the line 9—9 of Figure 2.

Figure 10 is a fragmentary elevation of an end bearing of the countershaft, showing how the belt is to be mounted.

Figure 11 is a section on the line 11—11 of Figure 10.

The mechanism illustrated in Figure 1 preferably includes a suitable base 20 above which a work-table 22 is supported by a pair of standards 24. A bracket 26 is secured to the rear edge of the work-table 22, preferably by a lug 28 which fits into a T-slot in the rear edge of the table and is secured therein by a suitable bolt (not shown). The T-slot extension extends the entire length of the table 22 and can accommodate two or more brackets 26 according to the length of the table 22 and the number of drilling heads desired. One drilling head is illustrated in Figure 1 but more may be employed as hereinafter described.

Adjustably secured in the bracket 26 is a vertical pillar 30 to which is secured a drilling head 32. The drilling head is provided with two vertically spaced and alined bearings 34 and 36 each of which is preferably equipped with suitable needle bearings such as are illustrated in Figure 5. Each such bearing consists of a tubular bearing race 38 in which a series of needle-like bearing elements 40 roll freely. Bearings of this description are well known in the art. A drill spindle 42 is freely rotatable in these bearings and is also axially slidable therein. During rotation of the spindle 42 the frictional opposition to axial movement of the spindle in either direction is practically zero. At the lower end of the spindle 42 is mounted a suitable drill chuck 44 which may be of any desired description. The upper end 46 of the spindle is supported in a bearing member 48 within which it rotates freely. A plain bearing member is illustrated in Figure 3 but a ball bearing may be employed at this point. The needle bearings 40 are suitably lubricated by any desired means such as oil cups 50. The spindle assembly, including the spindle 42 and the drill chuck 44, is adapted to be depressed toward work on the table 22 by manually operable means such as is illustrated in Figure 1. This means comprises a lever 52 pivoted at the point 54, the pivot being supported by an arm 56 which projects rearwardly from the bracket 26. On the forward end of the lever 52 is a suitable finger-button 58 which is conveniently placed for operation. At an intermediate point of the lever 52 a vertical rod 62 is pivotally connected by a pivot 60. This rod may pass up through the interior of the pillar 30 which is preferably hollow for this purpose. The upper end of the rod 62 is pivotally connected at 64 to a horizontal arm 66 which rocks about a fixed pivot point 68, this pivot being on a bracket 70 which extends to the rear of the drilling head 32. In order to counterbalance in part the downward

pull of gravity on the lever arm 52 and the rod 62, a suitable compression spring 72 is provided as indicated in Figure 3 to encircle the upper portion of the rod 62 and press upwardly against the fitting at the upper end thereof. It is preferred that only 85% to 90% of the gravitational force acting on these parts be carried by the spring 72 during the operation of the mechanism. The forward end 74 of the arm 66 thus bears on the bearing member 48 at the top of the spindle 42.

Since the pillar 30 is adjustable rotatably in the bracket 26, the pillar and the entire drilling head may be adjustably swung around the axis of the pillar, but, when the mechanism is in use, the bracket is set up tightly to grip the pillar and hold it fixed. In somewhat similar manner the arm 56 is independently adjustable about the axis of the pillar 30 so that the finger-button 58, which is handily located just below the forward edge of the work table, can be shifted laterally to the position most convenient to the operator and secured in such position.

Fixed on the spindle 42 is a grooved belt pulley 76 which, as indicated in Figures 1 and 3, may be a double pulley having two different diameters so that the spindle may be driven at different speeds by a driving belt 80. The pulley 76 is preferably mounted on the spindle 42 between the bearings 34 and 36 so that these bearings act as limit stops to the vertical axial movement of the pulley 76 and consequently of the spindle assembly of which the pulley is a part.

In order further to counterbalance the gravitational pull on the spindle assembly and also a portion of the gravitational pull on the depressing mechanism which includes the arms 52 and 66, the driving belt 80 and guide pulleys 84 and 86 therefor are so arranged that one or both of the stretches of the belt which lead from the drive pulley 76 are inclined upwardly so that the upward component of the tension on the belt acting on the upper flange of the pulley which confines the belt in the groove of the pulley, applies a counter force opposing the gravitational forces hereinbefore mentioned. In the embodiment of the invention illustrated in Figure 1, one such stretch of the belt 80 is upwardly inclined, the stretch which travels toward pulley 76 being substantially horizontal so that the belt will more certainly remain on the pulley during the operation of the mechanism. By delicate adjustment of the belt tension, as hereinafter described, the spindle assembly can be made to float with the pulley 76 at any desired level between the bearings 34. In actual operation it is preferable to support the pulley 76 near the upper bearing 34. Since frictional opposition to axial movement of the spindle assembly during rotation thereof is virtually eliminated, the mechanism is very sensitive to any downward pressure on the finger-button 58. Hence, the slightest change in resistance to the progress of the drill in the work is easily felt by the operator so that the drill can be accurately controlled to minimize breakage. A semi-cylindrical guard or shield 82 may be provided in front of the pulley and the portion of the spindle between the two bearings.

The belt 80, as indicated in Figure 1, may pass over two idler pulleys 84 and 86 and around a double pulley 88 which is mounted on a suitable countershaft 90. This countershaft may be conveniently journaled in bearing members 92 (Figures 10 and 11) which are supported by suitable brackets 94. These brackets, as indicated in Figures 6 and 8, may be clamped against a pair of horizontal rods 96 and 98 either by an angle piece 100 or by a clamping member 102. This permits lateral adjustment of the brackets 94. Also mounted on the countershaft 90 is a double pulley 104 connected by a belt 106 to a pulley 108 mounted on the shaft 110 of a suitable electric motor 112 mounted on the base 20. The double pulleys 88 and 104 are each provided with two sheaves of different diameters for the purpose of driving the spindle 42 at different speeds. By selecting different combinations of the pulleys 76, 88 and 104, a considerable variety of speeds of rotation of the spindle 42 can readily be had.

The idler pulleys 84 and 86 are carried by a standard 120 which is pivotally mounted on the rod 96. By adjustably tilting the standard 120, the tension on the belt 80 can be readily adjusted as is evident from Figure 1. The means for adjusting the position of the standard 120 is illustrated in Figure 9. As shown, a lever 122 is pivotally mounted as at 124 on the lower end of the standard 120 which is below the rod 96. The upper end portion 126 of the lever 122 rests against an eccentric collar 128 which is rotatable on the rod 96. The lower end 130 of the lever 122 rests against the rod 98. The eccentric collar 128 is normally secured against rotation by a setscrew 132 which presses against the rod 96 to bind the collar 128 in adjusted position. The setscrew 132 can be backed off by manipulation of the head of the screw which is then used as a handle to rotate the collar 128 about the rod 96. This rotation results in a slight rocking movement of the lever 122 which in turn results in a slight rocking movement of the standard 120 about the rod 96 as a pivot. In this manner, a very delicate adjustment of the belt tension can easily be had.

In order to maintain a constant tension on the belt 80 in spite of possible stretching or other changes in the belt, the idler pulley 86 is carried by an arm 134 which is pivoted to the standard 120 as at 136. A coiled spring 138 is employed to press the arm 134 resiliently in a clockwise direction as illustrated in Figure 1, a suitable stop (not shown) being provided to limit such movement of the arm 134. The strength of the spring 138 is preferably such that normal tension on the belt 80 will swing the arm 134 a small amount in a counterclockwise direction away from the stop. This results in a resilient slack take-up device which helps to maintain the spindle assembly at a constant level when the finger-button 58 is not touched.

In order to avoid vibration in the apparatus when operated at high speeds, it is preferable to employ an endless belt. In order to be able to mount and dismount such a belt without disassembling the countershaft assembly, the bearing members 92 are made in the form of circular disks each having a notch 140 which can be moved into registry with a notch 142 in the bracket 94 in which the bearing member 92 is supported. A shallow peripheral groove 144 is also provided in the bearing member 92 in order to accommodate a binding screw 146 which is employed to set up the split end of the bracket 94 in order to pinch the bearing member 92 firmly in position. Figure 11 shows a plain bearing member 92 but in practice a ball bearing or roller bearing may be employed to advantage. When the screw 146 is released, the bearing member 92 may be rotated to bring the notch 140 into registry with the notch 142 as indicated in Figure 10. A loop of the belt 80 may then be thrust through the opening made by the notches 140 and

142. When the belt is in the position shown in Figure 10, the bearing member 92 is rotated once to carry a portion of the belt around the countershaft. The remainder of the belt is then pulled through the notch, whereupon the belt is ready to be extended around the adjacent pulley 88 and over the idler pulleys 84 and 86 to the spindle pulley 76.

Figure 7 illustrates the rear portion of the mechanism when provided with two spindle assemblies and driving belts for the same. By employing a longer countershaft 90 and, if desirable, longer rods 96 and 98, additional drill units may be carried by the boss 20, each such unit including a drill spindle assembly with a pillar 30 and a depressing means as illustrated in Figure 1, a standard 120 to support a pair of idler pulleys, and a driving pulley 88 mounted on the shaft 90.

It is evident that various modifications and changes may be made in the embodiments of the invention herein shown and described without departing from the spirit or scope thereof as defined in the following claim.

What I claim is:

A sensitive drill press comprising a base, a work table supported on and above said base, a pillar rising above the table and being mounted with provision for angular adjustment about its length dimension, a drilling head mounted on the pillar and overhanging the base having vertically alined bearings, a spindle mounted in said bearings with provision for rotation and axial movement, means on the lower end of the spindle for securing a drill thereto, a lever pivotally supported on said drilling head to swing in a vertical plane and coupled with said spindle for the transmission of axial movement thereto, an arm connected with the table below the supporting surface thereof with provision for angular adjustment about the same axis as the pillar, an operating lever supported pivotally by said arm to swing in a vertical plane, said arm extending under the table and near to the work supporting surface thereof and having a finger button on its free end accessible for depression by the finger of an operator, a connecting rod in pivotal connection with both said levers extending in substantial coincidence with the axis of angular adjustment of the pillar and said arm, driving means operatively engaged with said spindle for rotating it, and a spring operatively disposed to counterbalance in large measure the gravitational force tending to move the spindle downward.

WILLIAM M. DAVIS.