Dec. 20, 1927. 1,653,318

C. A. STICKNEY

ROTATABLE WORK SUPPORT FOR MACHINE TOOLS

Original Filed June 30. 1924 3 Sheets-Sheet 1

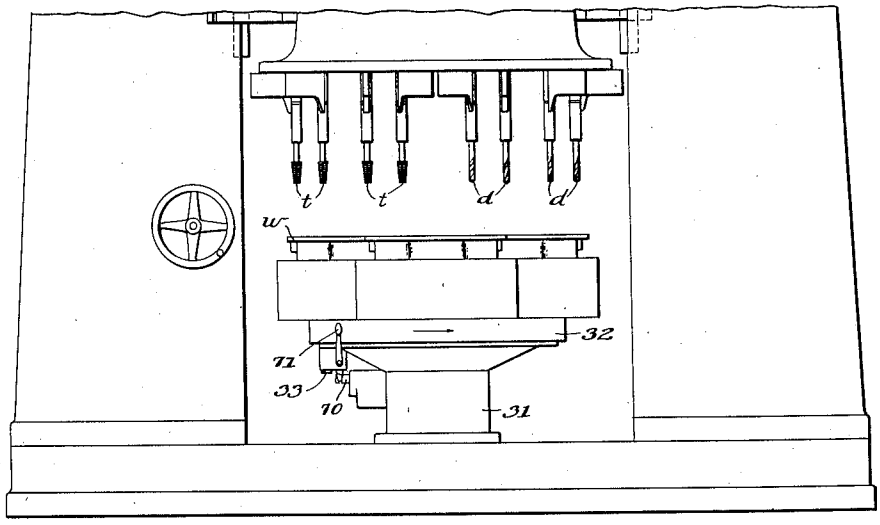


Fig 1.

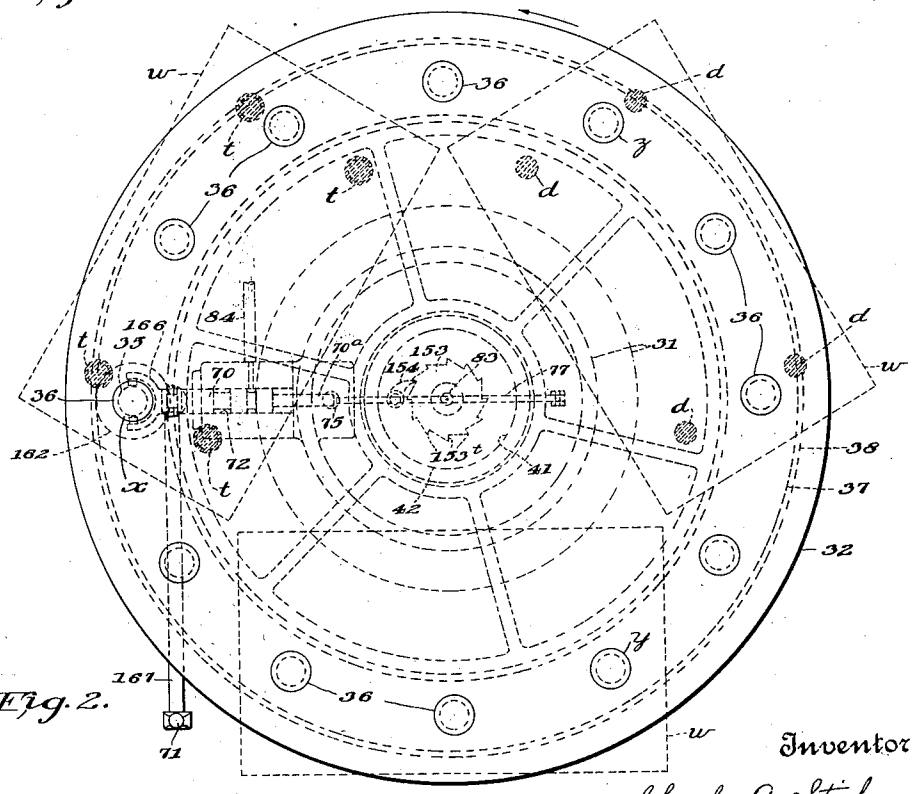


Fig. 2.

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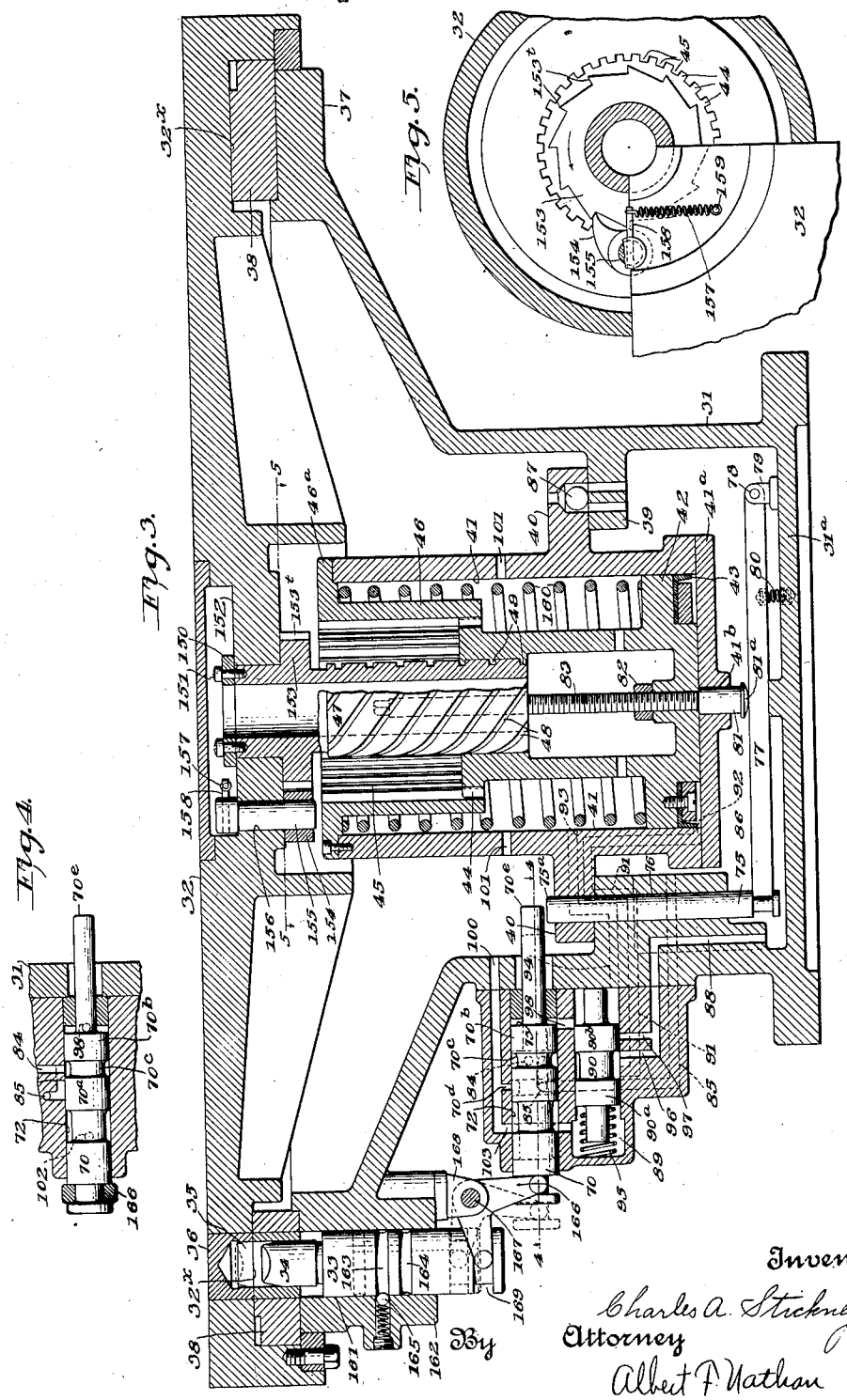


Fig. 5.

Fig. 4.

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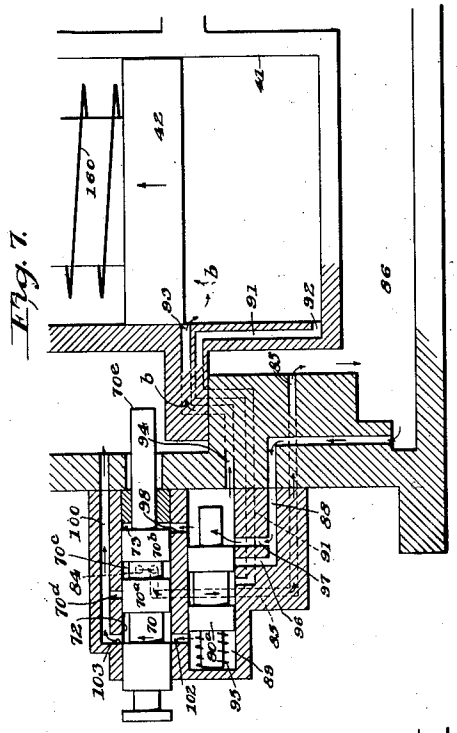


Fig. 7.

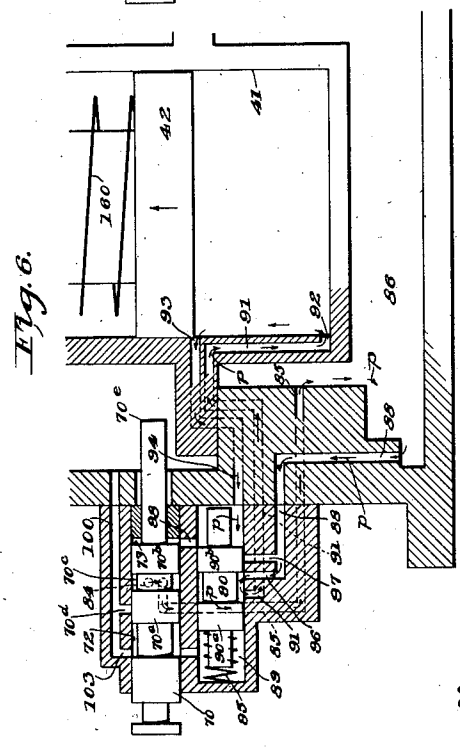


Fig. 6.

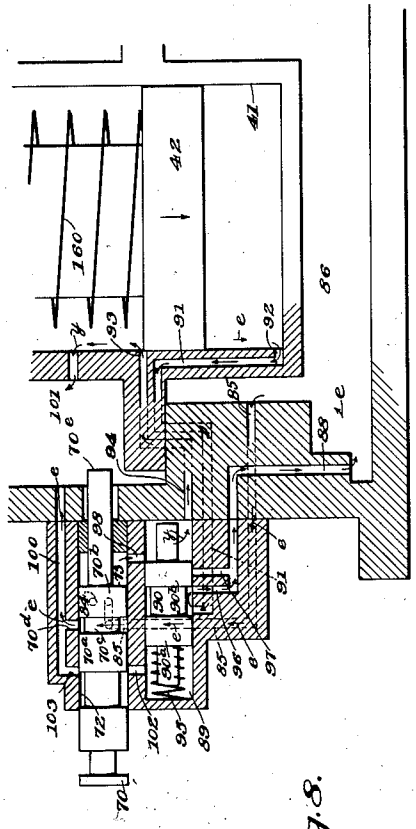


Fig. 8.

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UNITED STATES PATENT OFFICE.

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ROTATABLE WORK SUPPORT FOR MACHINE TOOLS.

Original application filed June 30, 1924, Serial No. 723,164. Divided and this application filed January 19, 1926. Serial No. 82,335.

This invention relates to work-supports for machine-tools and it has for an object to render available an improved work-support of rigid construction capable of presenting a piece of work, secured thereto, successively to the action of a plurality of tools, or sets of tools, located in fixed relation to each other about the axis of the work-support.

Another object of the invention is to provide a work-support having a rotatable work-bed which may be moved intermittently with less noise and vibration than prior devices; which is devoid of complicated rotating mechanism; and which, when once put into motion, automatically will complete a predetermined rotation and be brought to rest and locked in its new position.

Another object of the invention is to provide fluid pressure actuated means for indexing the bed and for actuating a bed-locking means when the bed has been indexed a predetermined amount.

Still another object of the invention is to provide, in a work-table having a bed adapted successively to be rotated and locked against rotation, an interlock between the bed rotating and locking mechanisms so that the locking mechanism may not be rendered ineffective until the indexing mechanism has completed its cycle of operation.

A still further object of the invention is to provide a single manual control for the bed-indexing and locking mechanisms and so to coordinate these mechanisms that a single manipulation of the manual control will effect, successively, an unlocking of the bed, a predetermined indexing thereof, and a subsequent locking of the bed in its new position.

These objects have been attained by the provision of a work-support comprising a rigid standard upon which is rotatably journaled a flat, circular bed to which the work may be secured in any suitable or preferred manner. Adjacent its axis, the bed carries a depending member which has a helical tongue-and-groove connection with another member in the nature of a piston which is held against rotation and which is adapted to be reciprocated toward and from the bed, thereby, through the cam action of the helical connection, causing rotation of the depending member carried by the bed. A ratchet mechanism intermediate this member and the bed causes the bed to be rotated with the member in one direction and permits the member to rotate independently of the bed when the piston is moved in the opposite direction. The piston is fitted within a cylinder and fluid pressure may be admitted into the cylinder beneath the piston to cause upward movement of the piston and thereby rotary movement of the bed. The flow of fluid into the cylinder is controlled by a hand-lever which also releases a lock which normally serves to maintain the bed immovable during the tooling operations.

While this invention is adaptable to various types of machine tools it is particularly useful in connection with the combined drilling and tapping machine disclosed in my pending application Serial Number 723,164 filed June 30, 1924, of which this application is a division.

Other objects and advantages will be in part indicated in the following description and in part rendered apparent therefrom in connection with the annexed drawings.

To enable others skilled in the art so fully to apprehend the underlying features hereof that they may embody the same in the various ways contemplated by this invention, drawings depicting a preferred typical construction have been annexed as a part of this disclosure, and in such drawings, like characters of reference denote corresponding parts throughout all the views, of which:—

Figure 1 is a front elevation of a portion of a combined drilling and tapping machine equipped with a work-supporting table embodying the present invention. Fig. 2 is a plan of the work supporting table. Fig. 3 is a central vertical section thereof. Fig. 4 is a detail horizontal section on the line 4—4 of Fig. 3. Fig. 5 is a horizontal section substantially on the line 5—5 of Fig. 3. Fig. 6 is a diagrammatic view illustrating the initial flow of fluid under pressure for rotating the bed of the work-table. Fig. 7 is a view similar to Fig. 6 but illustrating the flow of fluid in the second stage in the

operation of rotating the bed. Fig. 8 is a similar view illustrating the flow of the fluid when it is being exhausted from the several cylinders forming parts of the bed rotating and locking mechanisms.

Referring more specifically to the drawings, the invention is disclosed as embodied in a work-support comprising a fixed standard 31 upon which is rotatably mounted a work-bed 32. The bed 32 is adapted to support the work *w* beneath suitable sets of tools *d* and *t* and to be rotated a fraction of a revolution after each tooling operation to intermittently transport the work carried thereby to a plurality of stations where it is successively operated on by the various sets of tools, which, as indicated may be drills and taps, or any other suitable tools.

In the operation of a combined drilling and tapping machine, with which this improved work-support advantageously may be combined, the operator is stationed before the table at a convenient place for securing the work to the table and later removing it therefrom. After the work has been properly located on the table, as by means of suitable jigs or fixtures, and after the tool-head has been elevated, the operator, by manipulation of a suitable control-lever, causes a partial rotation of the bed to position the work, just secured thereto, beneath the drill-spindles. Power to rotate the bed may be supplied by fluid under pressure and may be controlled as will later be described.

During the drilling of the work just presented to the drills the operator attaches a second piece of work to the bed and after the drilling is completed again causes the table to rotate 120 degrees (when only two sets of tools are used) as before described. The operation is repeated and the work which has been drilled is placed beneath the tap-spindles where any, or all, of the holes may be tapped. The next movement of the bed returns the first piece of work (which has then been drilled and tapped) to the operator who removes it from the bed and replaces it with a new piece.

It is highly desirable that the bed be locked against movement during the time that the drilling and tapping is being effected. To this end a shot-bolt 33 is slidably mounted in the standard 31 and when the bed has been rotated sufficiently to bring the work to the proper position this bolt is forced upwardly to cause its end 34 to enter a socket 35 formed in a hardened bushing 36 carried by the bed 32; one of these bushings being provided for each operative position of the table. This invention will be described as it is used when, only two sets of tools are utilized and in such usage only the bushings *x*, *y* and *z*, will be used.

As shown in Fig. 3 the standard 31 is formed with an annular flange 37 which supports an annular bearing ring 38 upon which the bed 32 is supported. The standard is also provided with an internal annular flange 39 which supports, coaxial with the bed, as by means of a flange 40, a cylinder 41. Slidably mounted within the cylinder is a piston 42, carrying at its lower end the usual cupped leather 43, and having its upper end reduced and provided with a plurality of vertical ribs or splines 44 adapted to slide between ribs 45 formed in the inner surface of cylinder 46 fixed to and depending from the upper end of the cylinder 41.

Means, later to be described, is provided for moving the piston 42 vertically in the cylinder and in such movement relative rotation between the piston and the cylinder is prevented by the intermeshing of the ribs 44 and 45.

Rotatably journaled in the bed 32 and coaxial therewith is a post 47 which extends downwardly through the cylinder 46 and is formed with a plurality of helical grooves 48. These grooves interfit with teeth 49 formed interiorly of the upper portion of the piston 42. Thus, it will be perceived that upward movement of the piston 42 will, through the cam action of the teeth 49 and grooves 48, cause rotation of the post 47 in one direction and downward movement of the piston will cause rotation of the post in the opposite direction. The post 47 is held against lengthwise movement in the bed in one direction by means of a plate 150 secured to the upper end of the post as by screws 151, which plate rests upon the upper surface of a portion 152 of the bed. Movement of the post in the opposite direction is prevented by an integral flange 153, which abuts the underside of the portion 152. The flange 153 is preferably formed at its periphery with a series of ratchet-teeth 153^t which are engaged by a pawl 154 secured upon a pin 155 journaled at 156 in the bed. A spring 157, connected at one end to a pin 158 carried by the pin 155 and at its other end to a pin 159 fixed in the bed normally acts to hold the pawl 154 in engagement with the ratchet-teeth 153^t.

From the foregoing it will be seen that when the post is rotated anti-clockwise, as viewed in Fig. 5, the bed 32, through the ratchet 153^t and pawl 154, also will be rotated, whereas during clockwise rotation of the post the pawl will slip around the ratchet and no motion will be transmitted to the table.

A coil-spring 160, located within the cylinder 41 intermediate the piston 42 and a flange 46^a of the cylinder 46, acts to force the piston 42 downwardly when the fluid pressure beneath the piston has been relieved.

The shot-bolt 33 for locking the bed in

its adjusted positions is slidingly mounted in a chamber 161 formed in an extension 162 of the standard 31 and is preferably provided with annular grooves 163 and 164 adapted to receive a spring-pressed detent 165. The groove 163 receives the detent when the bed is unlocked and the groove 164 receives it when the bolt 33 has been projected upwardly to cause the end 34 to enter the socket 35. The bolt 33 is adapted to be moved lengthwise in the chamber 161 by a bell-crank lever 166 pivoted upon a shaft 167, journaled in a bracket 168 carried by the extension 162. One arm of the bell-crank engages an annular groove 169 formed in the lower end of the bolt 33 and the other arm is connected with a fluid-actuated piston 70 later to be referred to.

A hand-lever 71 is secured to the shaft 167 and serves (upon movement in a counter clockwise direction as viewed in Fig. 1) to rock the bell-crank 166 to withdraw the bolt 33 from the bed and simultaneously therewith to move the piston 70 inwardly in its cylinder 72 thereby releasing fluid under pressure to cause elevation of the piston 42 and thereby rotation of the work-supporting bed 32. At a certain point in the upward movement of the piston 42 a suitable port is opened which admits pressure behind the wall 73 of the piston 70 thereby forcing the piston outwardly causing it to rock the bell-crank which in turn lifts the bolt 33 to lock the bed as previously described. Outward movement of the piston 70 also shuts off the fluid pressure whereupon the piston 42 is forced downwardly by the spring 160.

Means is provided for preventing manipulation of the hand-lever until the piston has been returned to its lower-most position. This means comprises a rod 75 slidably mounted in a bore 76 formed in the standard 31 and in the flange 40. Operatively connected with the rod 75, at its lower end is a lever 77 pivoted at 78 to a bracket 79 carried by the base 31^a of the standard. The lever 77 is normally forced upwardly by a coil-spring 80 located between the lever and the base 31^a. The cylinder 41 is closed at its lower end by a plate 41^a formed with a bore 41^b within which is slidingly fitted a pin 81 having a head 81^a engaging the lever 77. With the piston 42 raised the spring lifts the lever 77 until the upper end 75^a of the pin 75 contacts with the underside of the extension 70^e of the piston 70 and when the piston 70 is forced outwardly to cause the bolt 33 to lock the bed 32 against turning, the pin 75 is moved upwardly thereby intersecting the path of travel of the end 70^e. With the pin 75 in this position it prevents the piston from being forced inwardly by the hand-lever 71 and therefore retraction of the bolt 33 and the turning on of the fluid pressure is precluded.

Threaded through the piston 42 and maintained in adjusted positions by a lock-nut 82 is a rod 83 adapted, upon lowering of the piston 42 to contact with the pin 81 and thereby retract the pin 75 out of the path of the piston 70. With the pin 75 retracted the bolt 33 is held in its uppermost position by the detent 165 engaging the annular seat 164 until the hand-lever is again depressed.

Fig. 3 shows the position of the parts immediately after actuation of the hand-lever 71 to cause rotation of the bed 32, the dotted lines showing the positions from which the bolt 33, bell-crank lever 166 and piston 70 have just been moved. The bolt 33 having withdrawn from the socket 35, the bed is then free to be rotated which is effected as follows: Fluid under pressure enters the cylinder 72 through a port 84 (which has now been opened by movement (to the right) of the portion 70^b of the piston 70) (see Figs. 4, and 6) and flows through the passage 85, as shown by the arrows p, into a chamber 86, thereby closing the ball check-valve 87. The fluid then enters and follows a passage 88 (still in the direction of the arrows p) into a cylinder 89 between portions 90^a and 90^b of a piston 90 slidingly fitted within the cylinder. From the cylinder 89 the fluid passes through a passage 91 and finally enters the cylinder 41 beneath the piston 42, through a port 92. Pressure beneath the piston 42 causes it to be forced upwardly in the cylinder 41, against the action of the spring 160, until the bottom of the piston passes a port 93. This upward movement of the piston on the post 47 causes rotation of the bed 32 and permits the lever 77 and pin 75 to rise under the action of the spring 80 as hereinbefore explained. The fluid under pressure then flows through a passage 94 in the direction of the arrow p, entering the cylinder 89 behind the portion 90^b and forcing the piston outwardly against the action of a spring 95. This movement of the piston closes a port 96 in the passage 88 and opens a port 97 (see Fig. 7). Closure of the port 96 stops the flow of fluid through the passage 91 and opening of the port 97 permits the fluid to enter the cylinder 89 therethrough and thence backwardly through the passage 94 in the direction of the arrows b, thus fluid is still admitted into the cylinder beneath the piston 42. Fluid also passes from the cylinder 89 through a port 98 into the cylinder 72 behind the wall 73 of the piston 70 thereby forcing the piston 70 outwardly to rock the bell-crank and to force the bolt 33 upwardly until its upper end contacts with the under surface 32^x of the bed 32. Inasmuch as the port 84 is still open fluid under pressure continues to flow through passages 85, 88, port 97 and passage 94 into the cylinder 41 and continues to elevate the piston and thereby ro-

tate the bed 32 until one of the sockets 35 is brought into registry with the end 34 of the bolt 33. When the socket 35 and end 34 are brought into registry, pressure on the wall 73 forces the piston 70 outwardly thereby rocking the bell-crank lever which shoots the bolt 33 upwardly and projects the end 34 into the socket 35. The bolt 33 is maintained in this position by the spring-detent until another depression of the hand-lever 71. As the end 70^e of the piston 70 clears the end 75^a of the pin 75 the latter is forced upwardly by the spring and remains in that position until the piston is lowered and again rocks the lever 77. When the piston 70 moves outwardly in the cylinder the portion 70^b closes the intake port 84, (see Fig. 8) thereby cutting off the fluid pressure and the reduced portion 70^c is aligned with an exhaust-port 70^d. With the fluid pressure discontinued and the exhaust-port 70^d open, the spring 160 forces downwardly on the piston 42 and the spring 95 returns the piston 90 to its original position. As the piston 42 is forced downwardly by the spring 160 the fluid beneath the piston is exhausted through port 92, passage 91, port 96, passages 88 and 85 and out through port 70^d and passage 100 to the atmosphere, all in the direction of the arrows *e*.

Return of the pistons 70 and 90 exhausts the air from the cylinders 72 and 89 through port 98, passage 94, port 93, (which is then above the piston 42), and out through a port 101 to the atmosphere all in the direction of the arrows *y*. Outward movement of the piston 90 exhausts the air in that portion of the cylinder 89 containing the spring 95 through ports 102 and 103 and then through passage 100.

As shown and described a complete movement of the piston 42 will, through the helical tongue and groove connection 48—49, give to the bed a rotation of at least 120 degrees, thereby causing the shot bolt 33 successively and automatically to engage the sockets in the bushings *x*, *y* and *z*, but it is to be understood that a less rotation of the bed may be effected by manually shifting the lever 71 clockwise, as viewed in Fig. 1, before the bed has received its complete movement, thereby causing the shot bolt to engage any desired one of the bushings 36 intermediate those specially designated as *x*, *y* and *z*.

For the foregoing it will be perceived that there has been provided a rotatable work-support in which all of the hereinbefore mentioned objects are attained.

Without further analysis, the foregoing will so fully reveal the gist of this invention that others can by applying current knowledge readily adapt it for various utilizations by retaining one or more of the features that, from the standpoint of the prior art, fairly constitute essential characteristics of either the generic or specific aspects of this invention and, therefor, such adaptations should be, and are intended to be, comprehended within the meaning and range of equivalency of the following claims;—

Having thus revealed this invention, I claim as new and desire to secure the following combinations and elements, or equivalents thereof, by Letters Patent of the United States:—

1. A work-supporting table for machine-tools comprising a standard; a bed rotatably supported upon said standard; a cylinder supported by said standard; a piston movable therein; a post carried by said bed and having a curved tongue and groove connection with said piston; and means for moving said piston to cause said connection to rotate said bed.

2. A work-supporting table for machine-tools comprising a standard; a bed rotatably supported upon said standard; a cylinder supported by said standard; a piston movable therein; a post carried by said bed and having a helical connection with said piston; fluid pressure means for moving said piston in one direction to cause said connection to rotate said bed; and a spring to return said piston to its initial position.

3. A work-supporting table for machine-tools comprising a standard; a bed rotatably mounted on the standard; a cylinder; a piston movable in said cylinder; a member loosely carried by said bed and having a helical connection with said piston; means for moving said piston in said cylinder to cause said connection to rotate said member; and a ratchet and pawl connection between said member and said bed to transmit the rotation of the member to the bed.

4. A work-support for machine tools comprising a base; a bed rotatably mounted upon said base; relatively reciprocable members connected with said base and bed; a cam connection between said members; fluid pressure means to reciprocate one of said members relative to the other whereby said cam connection effects rotation of the other member and said bed; bed locking means; and fluid pressure means rendered effective upon a predetermined reciprocation of one of said members to actuate said bed locking means.

5. A work-supporting table for machine-tools comprising a standard; a bed rotatably carried thereby; fluid-pressure actuated means for rotating said bed on said standard; a lock operative at certain times to prevent rotation of the bed; a slide-valve for controlling the flow of fluid in said bed rotating means; manual means for releasing said bed-lock and opening said slide-valve to admit fluid-pressure to said bed rotating means; and means permitting said fluid pres-

sure to close said valve and to lock said table to said standard.

6. A work-supporting table for machine-tools comprising a standard; a bed rotatably mounted on said standard; a post carried by said bed; a cylinder; a piston movable in said cylinder and having a driving connection with said post to cause rotation of the latter; means for admitting fluid under pressure into said cylinder at one side of said piston to move the latter from its normal position, said means including a slide valve and means for shifting said slide valve; means, rendered effective upon movement of said piston from its normal position, for locking said slide valve against a subsequent operation, and means, actuated by the return movement of said piston, for releasing said valve-locking means.

7. In a machine tool in combination a support; an element rotatably mounted on said support; a cylinder; a piston movable in said cylinder; a member connected with said rotatable element and having an inclined tongue and groove connection with said piston; and fluid pressure means for moving said piston to cause said connection to rotate said rotatable element.

8. A work supporting table for machine-tools comprising a standard; a bed rotatably supported upon said standard; a cylinder supported vertically in said standard; a piston movable in said cylinder; a member carried by said bed and extending downwardly therefrom and having a helical connection with said piston; fluid pressure means for moving said piston in one direction in opposition to the force of gravity to cause said helical connection to rotate said bed in one direction; and lost motion means permitting said piston to be moved in the opposite direction without reversely rotating said bed.

9. In a machine tool, in combination a support; a member rotatably mounted on said support; a cylinder; a piston movable in said cylinder; an element rotatably carried by said bed and having a helical connection with said piston; means for reciprocating said piston in said cylinder to cause said connection to rotate said element in forward and reverse directions; and a one-way driving connection between said element and said member to transmit to the latter the rotary motion of the former in one direction only.

10. A work supporting table for machine tools combining a supporting frame; a bed rotatably mounted on said frame; a cylinder fixed to said frame; a piston movable in said cylinder; a member fixed to said cylinder; a straight tongue and groove connection between said member and said cylinder to prevent rotation of the latter; a helical tongue and groove connection between said piston and said bed; and fluid pressure means to move said piston in one direction to cause said helical connection to rotate said bed.

11. In a rotatable work-support for machine tools including a rotatable bed; a cylinder; a piston within said cylinder and translatable relative to said bed; an operative connection between said piston and said bed whereby reciprocation of the former effects rotation of the latter; of means for admitting fluid pressure into said cylinder at one side of said piston including a fluid pressure supply pipe; a fluid pressure conductor connecting said supply pipe with said cylinder; a valve for controlling the flow of fluid pressure through said fluid pressure conductor; manual means to open said valve to admit fluid pressure from said supply pipe into said cylinder; and means permitting said fluid pressure to close said valve at a predetermined point in the rotation of said bed.

12. In a rotatable work-support for machine tools in combination, a rotatable bed; a cylinder; a piston within said cylinder and translatable relative to said bed; an operative connection between said piston and said bed whereby translation of the former effects rotation of the latter; a locking device adapted to secure said bed in various positions of rotation; means for admitting fluid pressure into said cylinder at one side of said piston, said means including a fluid pressure supply pipe; a fluid conductor connecting said supply pipe with said cylinder; a valve for controlling the flow of fluid into said cylinder; manual means to release said locking device and to admit fluid pressure from said supply pipe into said cylinder; and means permitting said fluid pressure to close said valve and simultaneously therewith to actuate said locking device.

13. In a rotatable work-support for machine tools, in combination, a rotatable bed; a cylinder; a piston within said cylinder and translatable relative to said bed; an operative connection between said piston and said bed whereby translation of the former effects rotation of the latter; a locking device adapted to secure said bed in various positions of rotation; means for admitting fluid pressure into said cylinder at one side of said piston, said means including a fluid pressure supply pipe; primary and secondary fluid pressure conductors adapted successively to connect said supply pipe with said cylinder; a by-pass between said conductors; primary and secondary valves for controlling the flow of fluid pressure through said conductors; manual means to release said locking device and to shift said primary valve to admit fluid pressure from said supply pipe, through said primary con-

ductor into said cylinder; means rendered effective upon a predetermined movement of said piston to permit a reverse flow through said secondary conductor to close said secondary valve and to open said by-pass between said primary and secondary conductors to effect a forward flow through said secondary conductor; and means permitting the fluid pressure flowing through said by-pass to close said primary valve and to actuate said locking device.

In witness whereof, I have hereunto subscribed my name.

CHARLES A. STICKNEY.