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H. S. INDGE

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GRINDING MACHINE TABLE RECIPROCATING MECHANISM

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2 Sheets-Sheet 1

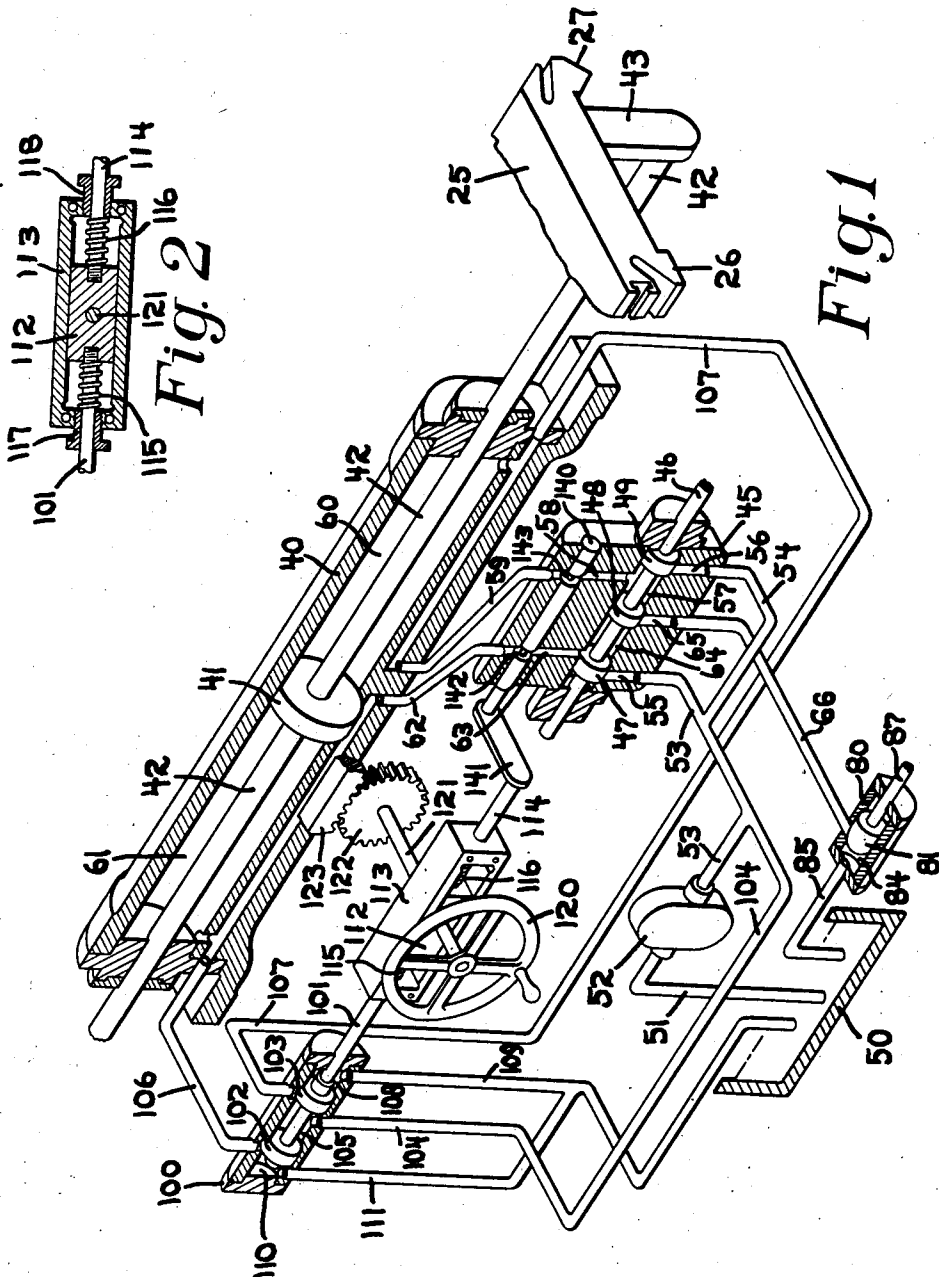


Fig. 1

Fig. 2

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2 Sheets-Sheet 2

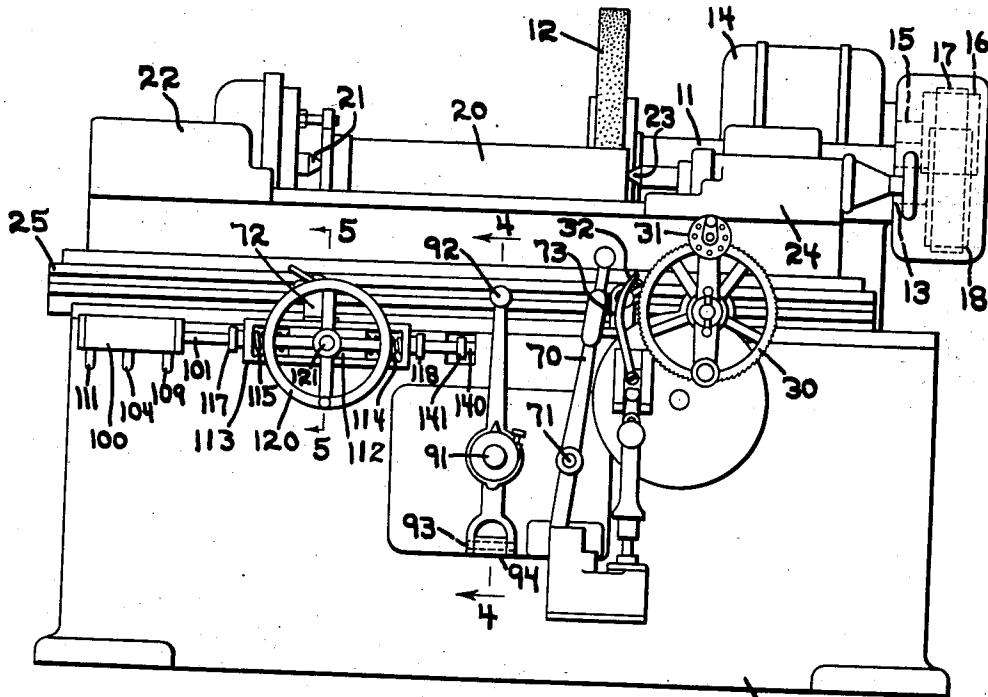


Fig. 3

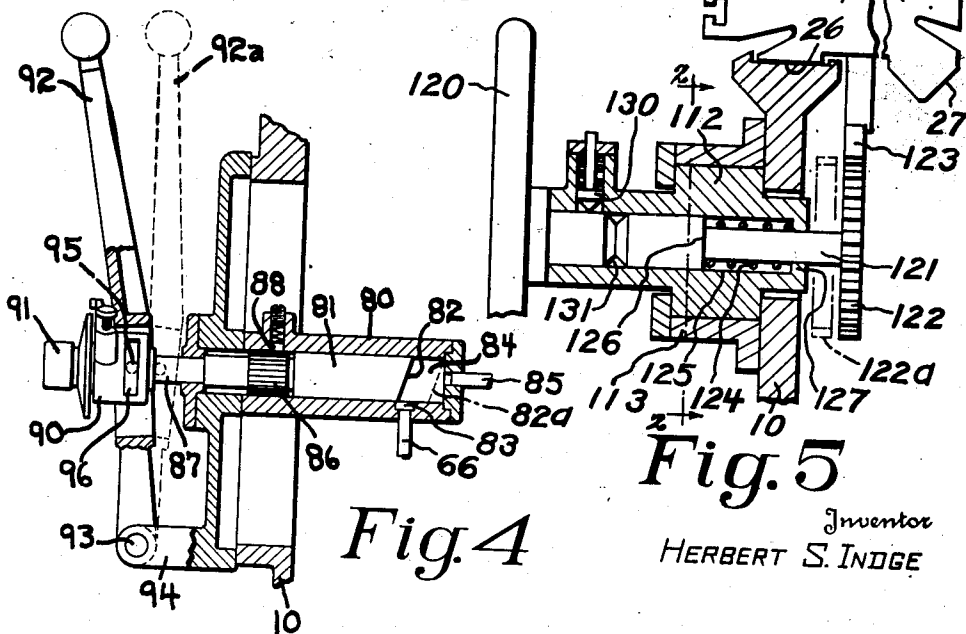


Fig. 4

Fig. 5

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GRINDING MACHINE TABLE RECIPROCATING MECHANISM

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8 Claims. (Cl. 51—233)

This invention relates to machine tools, and more particularly to a table traverse mechanism.

One object of this invention is to provide a simple, thoroughly practical machine tool table traverse mechanism. Another object of this invention is to provide a manually controlled table traverse mechanism by which the table may be traversed easily without undue exertion. Another object of the invention is to provide a manually controlled, hydraulically operated table traversing mechanism. Another object of the invention is to provide a manually controlled, hydraulically actuated table traversing mechanism in which the speed of movement of the control member, such as the rotation of a hand wheel, serves to control the rate of traversing movement of the table. A further object of the invention is to provide a combined manually operable rack and gear and hydraulic traverse mechanism which is so arranged that rotation of the manually operable table traverse wheel serves to actuate and control the position of a hydraulic control valve to control the traversing movement of the table. Other objects will be in part obvious or in part pointed out hereinafter.

The invention accordingly consists in the features of construction, combinations of elements, and arrangements of parts, as will be exemplified in the structure to be hereinafter described, and the scope of the application of which will be indicated in the following claims.

In the accompanying drawings, in which is shown one of various possible embodiments of the mechanical features of this invention,

Fig. 1 is a fragmentary piping diagram of the fluid pressure system for automatically reciprocating and manually traversing the table;

Fig. 2 is a fragmentary sectional view, on a reduced scale, taken approximately on the line 2—2 of Fig. 5;

Fig. 3 is a front elevation of a grinding machine embodying this invention;

Fig. 4 is a fragmentary vertical sectional view, on an enlarged scale, taken approximately on the line 4—4 of Fig. 3, showing the stop and start valve; and

Fig. 5 is a fragmentary cross sectional view, on an enlarged scale, taken approximately on the line 5—5 of Fig. 3.

A cylindrical grinding machine has been illustrated in the drawings having a base 10 which is provided with a wheel slide 11 slidable transversely on the usual V and flat ways (not shown). A rotatable grinding wheel 12 is mounted on a wheel spindle 13 which is supported for rotation

in bearings (not shown) on the wheel slide 11. The grinding wheel 12 may be rotated from any suitable source of power, either by means of a driving belt from an overhead countershaft, or it may be driven by an electric motor 14 mounted on the wheel slide 11. The motor 14 is provided with an armature shaft 15 which supports a pulley 16. The pulley 16 is connected by a driving belt 17 with a pulley 18 mounted on the outer end of the wheel spindle 13.

A work piece 20 is rotatably supported on a headstock center 21 carried by a headstock 22. The other end of the work piece 20 is supported by a footstock center 23 carried by a footstock center 24. The headstock 22 and footstock 24 are mounted on a longitudinally movable table 25 which slides on a flat way 26 and a V way 27 on the base 10.

The grinding wheel slide 11 is arranged for a transverse feeding movement to cause the grinding wheel 12 to approach or recede from the work piece 20 so as to grind the same to the desired extent. A suitable feeding mechanism is provided which may comprise the well-known half nut and rotatable cross feed screw (not shown) which are actuated by a manually operable feed wheel 30 which is rotatably supported on the front of the machine base. The feeding wheel 30 is provided with a micrometer adjusting mechanism 31, and is arranged to be rotated automatically by means of a reciprocable picker or ratchet pawl 32. The details of the grinding wheel feeding mechanism have not been illustrated in the present case since they are not considered part of the present invention. The wheel feeding mechanism utilized is a well-known wheel feeding mechanism such as, for example, that shown in the prior United States patent to C. H. Norton, No. 762,838, dated June 14, 1904. For further details of the feeding mechanism, reference may be had to the above-mentioned patent.

In a cylindrical grinding machine, it is desirable to provide a suitable power operated traversing or reciprocating mechanism to cause a relative longitudinal traversing movement between the rotatable work piece and the rotatable grinding wheel so as to grind the work piece to the required cylindrical form. In the preferred form, a fluid pressure operated mechanism is provided comprising a fluid pressure cylinder 40 which is preferably fixed to the base 10 of the machine. A piston 41 is slidably mounted within the cylinder 40 and is provided with a double end piston rod 42 which extends through the opposite ends

of the cylinder 40 and is fastened to depending brackets 43, only one of which has been illustrated in the drawings. The brackets 43 depend from the opposite ends of the longitudinally movable work table 25 and are either formed integral therewith or rigidly fixed thereto. A control or reverse valve 45 is provided to control the direction of movement of the piston 41 and the table 25. The valve 45 is preferably a piston type valve comprising a valve stem 46 having valve pistons 47, 48 and 49 integrally formed therewith.

A fluid reservoir 50 is located preferably within the base 10 of the machine. Fluid is pumped from the reservoir 50, through a pipe 51, by means of a fluid pressure pump 52, and is forced through a pipe 53 and a pipe 54 and through ports 55 and 56, respectively, in the control valve 45. As shown in the position of the parts illustrated in Fig. 1, fluid under pressure passing through the pipe 54 and port 56 enters a valve chamber 57 located between the valve pistons 48 and 49 and passes outwardly through a port 58 and a pipe 59 into a cylinder chamber 60 to cause the piston 41 and table 25 to move in a direction toward the left (Fig. 1). During the movement of the piston 41 and table 25 toward the left, fluid is exhausted from a cylinder chamber 61, through a pipe 62, a port 63, into a valve chamber 64 located between the valve pistons 47 and 48, and passes out through an exhaust port 65 and a pipe 66, into the reservoir 50.

When it is desired to reverse the direction of movement of the table 25, the valve stem 46 is moved toward the left (Fig. 1) so as to reverse the flow of fluid pressure to and from the cylinder 40. In this position of the valve, fluid under pressure passing through the pipe 53, the port 55, enters the valve chamber 64 between the valve pistons 47 and 48, and passes outwardly through the port 63, the pipe 62, into the cylinder chamber 61, to move the piston 41 and table 25 toward the right, as viewed in Fig. 1. During this movement of the table, fluid within the cylinder chamber 60 is exhausted through the pipe 59, the port 58, into the valve chamber 57, and out through the port 65 and the pipe 66, into the reservoir 50.

The reverse or control valve 45 is preferably actuated automatically in timed relation with the movement of the work table 25. A reversing lever 70 is pivotally mounted on a stud 71 and its upper end is arranged in the path of adjustable dogs 72 and 73 carried by the table 25. The reversing lever 70 is operatively connected to shift the reversing valve 45 in the desired timed relationship with the reciprocation of the table 25.

In order to control the speed or rate of movement of the reciprocable work table 25, a speed control or throttle valve 80 is provided. The speed control or throttle valve 80 is preferably arranged in the exhaust side of the fluid pressure system so that fluid under pressure exhausting from the cylinder 40 is throttled to control the speed of movement of the table. The throttle valve 80 is preferably of a piston type having a slidably mounted piston 81 within the valve casing 80. The valve piston 81 is provided with an angular plane end face 82 which is arranged to open or close a V-port 83 in the exhaust pipe 66 so as to stop and start the flow of fluid in the table traversing mechanism or, when rotated in an open position, the angular plane end face 82 serves to vary the aperture of the V-port 83 so that the traversing speed of the table 25 may be readily varied, as desired. Fluid under pressure

exhausting from the cylinder 40, through pipe 66, enters a chamber 84 in the valve 80 and exhausts therefrom, through a pipe 85, into the reservoir or sump 50. In the full line position (Fig. 4), the valve piston 81 is in an operating position, with the V-port 83 uncovered.

A serrated portion 86 formed on a valve stem 87 cooperates with a spring-pressed pawl 88 to maintain the valve piston 81 in the desired rotary position. Due to the fact that the grooves in the serrated portion 86 are arranged parallel to the axis of the valve, the valve piston 81 may be moved from a stop to a starting position without changing the rotary position of the feed control surface 82 of the piston 81. The valve stem 87 is journaled in a bearing block 90, and a manually operable control knob 91 is mounted on the outer end of the valve stem 87 to facilitate a rotary adjustment of the valve to produce the desired speed.

In order to move the valve piston 81 from a stop to a start position, a manually operable control lever 92 is pivotally mounted on a stud 93 supported in a bracket 94 projecting from the front of the machine base 10. The lever 92 is provided with diametrically opposed pins 95 which ride in slots 96 on opposite sides of the bearing member 90 (only one of the pins and slots being shown in dotted lines in Fig. 4 of the drawings). The pins 95 and slots 96 facilitate endwise movement of the valve piston 81 and also permit a rotary adjustment of the piston 81 to control the speed of movement of the table 25. To stop the exhaust of fluid from the system so as to stop the movement of the table 25, the manually operable control lever 92 is moved into position 92a (Fig. 4) which shifts the control valve piston 81 so that its speed controlling end face 82 is in position 82a, thereby closing the V-port 83 and preventing further exhaust of fluid from the system.

To attain the primary object of this invention, it is desirable to provide a manually controlled table traverse mechanism whereby the table 25 may be traversed longitudinally without undue effort on the part of the operator. It is desirable, therefore, to provide a manually controlled, hydraulically actuated table traversing mechanism in which the speed of movement of a control member, such as the rotation of a hand wheel, serves to control the rate of traversing movement of the table. As illustrated in the drawings, the fluid pressure system is provided with a manually operated control valve 100. This valve is preferably a piston type valve comprising a valve stem 101 having formed integrally therewith valve pistons 102 and 103. Fluid under pressure from the pump 52 passes through pipe 53 and a pipe 104 into a valve chamber 105 between the valve pistons 102 and 103. From the valve chamber 105, the fluid under pressure may pass outwardly through a pipe 106, into the cylinder chamber 61, or may pass through a pipe 107, into the cylinder chamber 60, depending upon the position of the valve stem 101.

During the manually controlled traverse of the table 25, fluid under pressure is exhausted from the cylinder chamber 60, through pipe 107, into a valve chamber 108 formed between the valve piston 103 and the end of the valve 100, and out through a pipe 109, into the reservoir 50. Similarly, when the fluid is exhausted from the cylinder chamber 61, it passes outwardly through the pipe 106, into a valve chamber 110, between the valve piston 102 and the other end of the valve

100, and out through a pipe 111 into the reservoir 50.

The valve 100 is normally held in a central or neutral position so that during the power traversing or reciprocating movement of the table 25, fluid under pressure is cut off from both of the pipes 106 and 107. In the preferred form, the valve stem 101 is connected to a slide block 112 which slides within a slide frame 113 fixed to the base 10 of the machine. The other end of the slide block 112 is provided with a rod 114 which extends outwardly to the other end of the slide frame 113. The slide block 112 is normally held in a central position, to hold the valve 100 also in a central or neutral position, by means of a pair of opposed springs 115 and 116 (Fig. 2). The springs 115 and 116 surround the rods 101 and 114, respectively, and are interposed between the opposite ends of the slide block 112 and the adjacent ends of the slide frame 113.

It is desirable to provide a means for adjusting the compression of the springs 115 and 116 so that the slide block 112 and the valve 100 may be held in the desired central or neutral position. As illustrated in Fig. 2, a pair of adjustable bushings 117 and 118 are screw threaded into the slide frame 113 and have their inner ends engaging the outer ends of the springs 115 and 116, respectively. By adjusting the bushings 117 and 118, the compression of the springs 115 and 116 may be varied as desired.

In order manually to control the table traverse, it is desirable to provide a manually operable hand traverse wheel 120 which is mounted on the outer end of a rotatable shaft 121. The shaft 121 is rotatably supported in the slide block 112. The inner end of the shaft 121 carries a gear 122 which meshes with a rack bar 123 depending from the under side of the table 25.

It is desirable, during the power reciprocation of the table 25, to render the manually controlled traverse mechanism ineffective. This is preferably accomplished by arranging the shaft 121 and the gear 122 so that they may be moved axially to throw the gear 122 out of mesh with the rack 123. This is preferably accomplished by providing a spring 124 within an aperture 125 in the slide block 112. The spring 124 is interposed between a shoulder 126 on the shaft 121 and an inwardly extending flanged portion 127 on the slide block 112. The spring 124 is a compression spring and is under sufficient compression to throw the gear 122 in a direction toward the left (Fig. 5) to disengage the gear 122 from the rack 123 automatically. In order to hold the gear in an inoperative position except when the manually controlled hand wheel 120 is operated, a spring-pressed detent 130 carried by the slide block 112 is arranged to engage a V-shaped groove 131 in the periphery of the shaft 121 to locate and hold the shaft 121 and gear 122 in an inoperative position during the power traversing or reciprocating movement of the table 25.

It is desirable to provide a suitable means for rendering inoperative the automatically power controlled reversing valve 45. This is preferably accomplished by providing a valve 140 (Fig. 1) which is connected by a link 141 with the rod 104. The valve 140 is provided with passages 142 and 143 which are arranged during the power traversing movement to allow free passage of fluid through the ports 58 and 63, respectively, to allow unrestricted flow of fluid under pressure between the cylinder 40 and through the pipes

59 and 62, respectively, and the automatic table controlled reversing valve 45.

When it is desired to traverse the table under manual control, the operator pushes the hand wheel 120 toward the right (Fig. 5) to compress the spring 124 and to throw the gear 122 into mesh with the rack bar 123. The hand wheel 120 may then be rotated in either direction to throw the slide block 112 and valve 100 from a central or neutral position and allow fluid under pressure from the pipe 104 and valve chamber 105 to pass either through the pipe 106 or the pipe 107, into the cylinder chambers 61 or 60, respectively. At the same time the slide block 112 moves to throw the valve 100 off the center or from a neutral position, the rod 114, through the link 141 (Fig. 1), moves the valve 140 from the position illustrated in Fig. 1 so as to close the ports or passages 58 and 63, respectively, and thereby render the table operated reverse control valve 45 inoperative during the manually controlled traverse mechanism.

The operation of this mechanism will be readily apparent from the foregoing disclosure. In the position of the parts (Fig. 1), the table 25 is under the control of the table actuated reversing valve 45 so that the table is reciprocated through a definite reciprocatory path, as controlled by the reversing lever 70 and table dogs 72 and 73, respectively. When it is desired to traverse the table under manual control, the stop and start and speed control valve 80 is actuated by shifting the control lever 92 into position 92a (Fig. 4) which serves to close the V-port 83 and thereby stop the exhaust of fluid from the cylinder 40. The hand wheel 120 is then moved toward the right (Fig. 5) to shift the gear 122 from dotted line position 122a into full line position 122, to throw the gear 122 into mesh with the rack bar 123. The hand wheel 120 may then be rotated in either a clockwise or counterclockwise direction. The rotation of the wheel transmits a rotary motion to the gear 122. The rack bar 123 being stationary, the gear 122 rolls on the rack bar and the slide block 112 is thrown off center against the compression of the balanced springs 115 and 116 to throw the valve 100 off a central or neutral position and admit fluid under pressure through pipe 106 or 107 into the cylinder chambers 61 or 60, respectively, thereby starting the movement of the table 25. The rate of manual rotation of the feed wheel 120 serves to control the aperture of the valve 100 and thereby to control the rate of movement of the table 25 under manual control. The faster the hand wheel 120 is rotated, the slide block 112 and valve 100 will be thrown to a greater extent off center, thereby allowing a greater flow of fluid through either pipe 106 or pipe 107. When the rotation of the hand wheel 120 is reduced or released by the operator, the released tension of the spring 115 or the spring 116 serves to shift the slide block 112 and the valve 100 to a central or neutral position, thereby stopping the flow of fluid under pressure to the cylinder 40 and consequently stopping the manually controlled traversing movement of the table 25. At the same time the valve 100 and slide block 112 return to a neutral position, the valve 140 is shifted to the position indicated in Fig. 1, thereby rendering the table control reversing valve 45 operative so that the table 25 may thereafter be operated under the automatic control of the table movement. When the hand wheel 120 is released by the operator, the compression of the spring

124 is released and the shaft 121, gear 122 and hand wheel 120 are shifted toward the left (Fig. 5) so that the gear 122 moves into dotted line position 122a, out of mesh with the table rack 123 during the automatic table traversing or reciprocating movement.

It will thus be seen that there has been provided by this invention apparatus in which the various objects hereinabove set forth together with many thoroughly practical advantages are successfully achieved. As many possible embodiments may be made of the above invention and as many changes might be made in the embodiment above set forth, it is to be understood that all matter hereinbefore set forth or shown in the accompanying drawings is to be interpreted as illustrative and not in a limiting sense.

I claim:

1. In a machine tool, a longitudinally movable table, a fluid pressure operated piston and cylinder operatively connected to move said table longitudinally in either direction, and a manually operable table traversing mechanism including a control valve operatively connected to admit fluid under pressure to either end of said cylinder, yieldable means to hold said control valve in a central or neutral position, a manually operable control member which is movable bodily and is operatively connected to actuate said valve, and means including a rotatable gear connected with said member and a rack bar fixedly connected with said table whereby the control valve is actuated by and the position thereof is controlled by the rate of movement of said control member.

2. In a grinding machine, a transversely movable rotatable grinding wheel, a longitudinally movable table, a fluid pressure operated piston and cylinder operatively connected to move said table longitudinally in either direction, and a manually operable table traversing mechanism including a control valve operatively connected to admit fluid under pressure to either end of said cylinder, yieldable means to hold said control valve in a central or neutral position, a manually operable rotatable hand wheel which is bodily movable and is connected to actuate said valve, and means including a rotatable gear connected with said wheel and a rack bar fixedly connected with said table whereby the control valve is actuated by and the position thereof is controlled by the rate of rotation of said hand wheel.

3. In a grinding machine, a transversely movable rotatable grinding wheel, a longitudinally movable table, a fluid pressure operated piston and cylinder operatively connected to move said table longitudinally in either direction, and a manually operable table traversing mechanism including a control valve operatively connected to admit fluid under pressure to either end of said cylinder, opposed balanced springs to hold said control valve in a central or neutral position, a manually operable rotatable hand wheel, a movable support therefor which is connected to actuate said valve, and means including a rotatable gear connected with said wheel which meshes with a rack bar fixedly connected with said table whereby the control valve is actuated by and the position thereof is controlled by the rate of rotation of said hand wheel.

4. In a grinding machine, a transversely movable rotatable grinding wheel, a longitudinally movable work table, a fluid pressure operated piston and cylinder operatively connected to move

said table in either direction, and a manually operable table traversing mechanism including a control valve operatively connected to admit fluid under pressure to either end of said cylinder, a slide block operatively connected to move said control valve, a pair of opposed springs to hold said slide block and said valve in a central or neutral position, a manually operable hand wheel rotatably supported in said slide block, a gear operatively connected to rotate with said hand wheel, and a rack bar on said table, whereby the control valve is actuated by and the position thereof is controlled by the rate of rotation of said hand wheel.

5. In a grinding machine, a transversely movable rotatable grinding wheel, a longitudinally movable work table, a fluid pressure operated piston and cylinder operatively connected to move said table in either direction, and a manually operable table traversing mechanism including a control valve operatively connected to admit fluid under pressure to either end of said cylinder, a slide block operatively connected to move said control valve, a pair of opposed springs to hold said slide block and said valve in a central or neutral position, a manually operable hand wheel rotatably supported in said slide block, a gear operatively connected to rotate with said hand wheel, a rack bar on said table, whereby the control valve is actuated by and the position thereof is controlled by the rate of rotation of said hand wheel, and means to normally hold said gear out of mesh with said rack.

6. In a grinding machine, a base, a transversely movable grinding wheel, a longitudinally movable table, a fluid pressure operated piston and cylinder to reciprocate said table, a reversing valve therefor, means including adjustable dogs on said table automatically to actuate said valve, a manually operable table reverse mechanism including a control valve operatively connected to admit fluid under pressure to either end of said cylinder, means to hold said control valve in a central or neutral position, means including a manually operable rotatable hand wheel whereby the control valve is actuated by and the position thereof is controlled by the rate of rotation of the wheel, a shut-off valve to render said reversing valve inoperative, and connections between the control valve and the shut-off valve whereby the reversing valve is rendered inoperative during the manual traverse of the table.

7. In a grinding machine, a base, a transversely movable grinding wheel, a longitudinally movable table, a fluid pressure operated piston and cylinder to reciprocate said table, a reversing valve therefor, means including adjustable dogs on said table automatically to actuate said valve, a manually operable table traverse mechanism including a control valve operatively connected to admit fluid under pressure to either end of said cylinder, opposed balanced springs to hold said control valve in a central or neutral position, means including a manually operable rotatable hand wheel whereby the control valve is actuated by and the position thereof is controlled by the rate of rotation of the hand wheel, means to render said hand wheel inoperative during the power reciprocation of the table, and connections between the control valve and the reverse valve whereby the reverse valve is rendered inoperative during the manual traverse of the table.

8. In a grinding machine, a base, a transversely movable grinding wheel, a longitudinally movable table, a fluid pressure operated piston and

cylinder to reciprocate said table, a reversing valve therefor, means including adjustable dogs on said table automatically to actuate said valve, a manually operable table traverse mechanism
5 including a control valve operatively connected to admit fluid under pressure to either end of said cylinder, opposed balanced springs to hold said control valve in a central or neutral position, means including a manually operable rotatable
10 hand wheel whereby the control valve is actu-

ated by and the position thereof is controlled by the rate of rotation of the hand wheel, means to render said hand wheel inoperative during the power reciprocation of the table, a shut-off valve to render said reversing valve inoperative, and
5 connections between said control valve and shut-off valve whereby the reversing valve is rendered ineffective during the manual traverse of the table.

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