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H. A. SILVEN.

2,269,697

SURFACE GRINDING MACHINE

Filed Oct. 18, 1940

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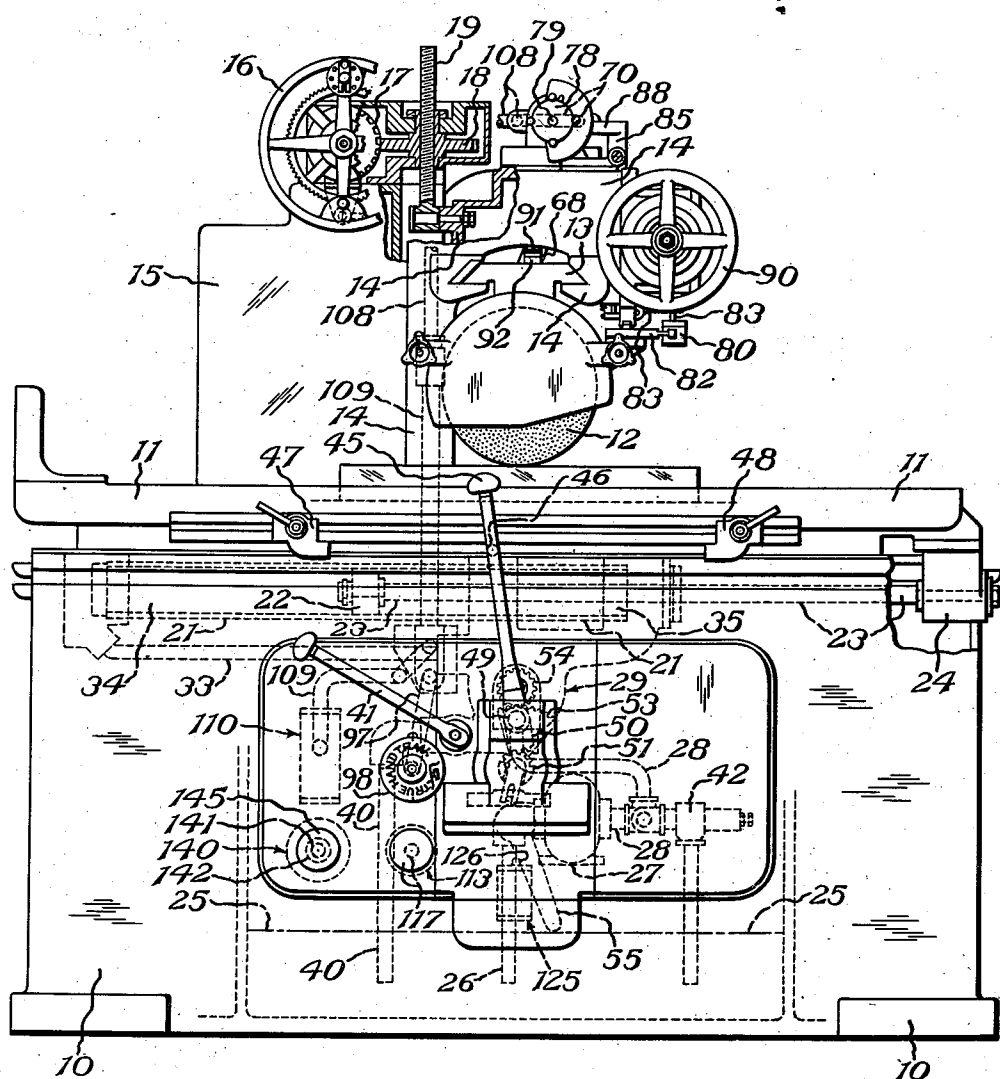


FIG. 1

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Jan. 13, 1942.

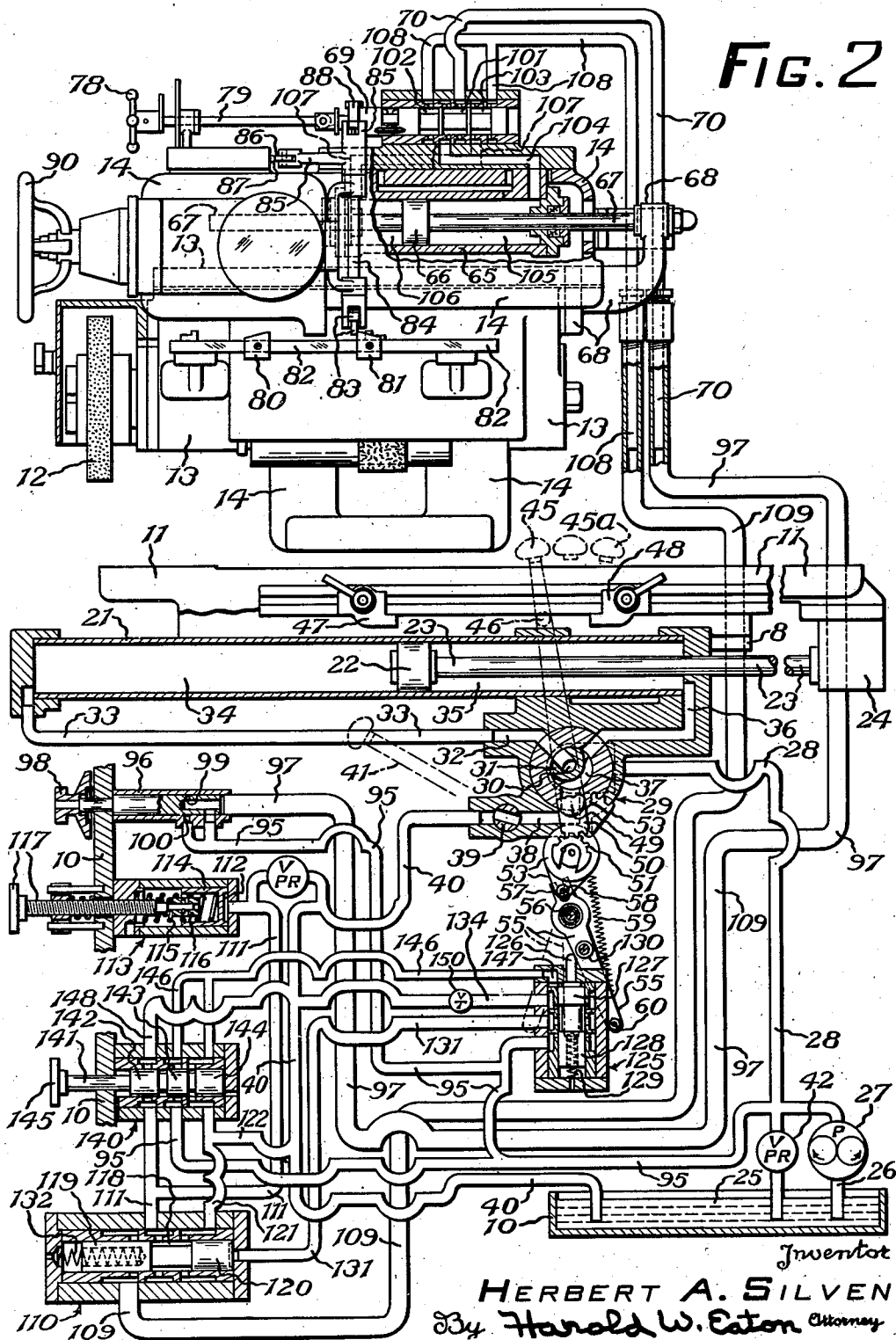
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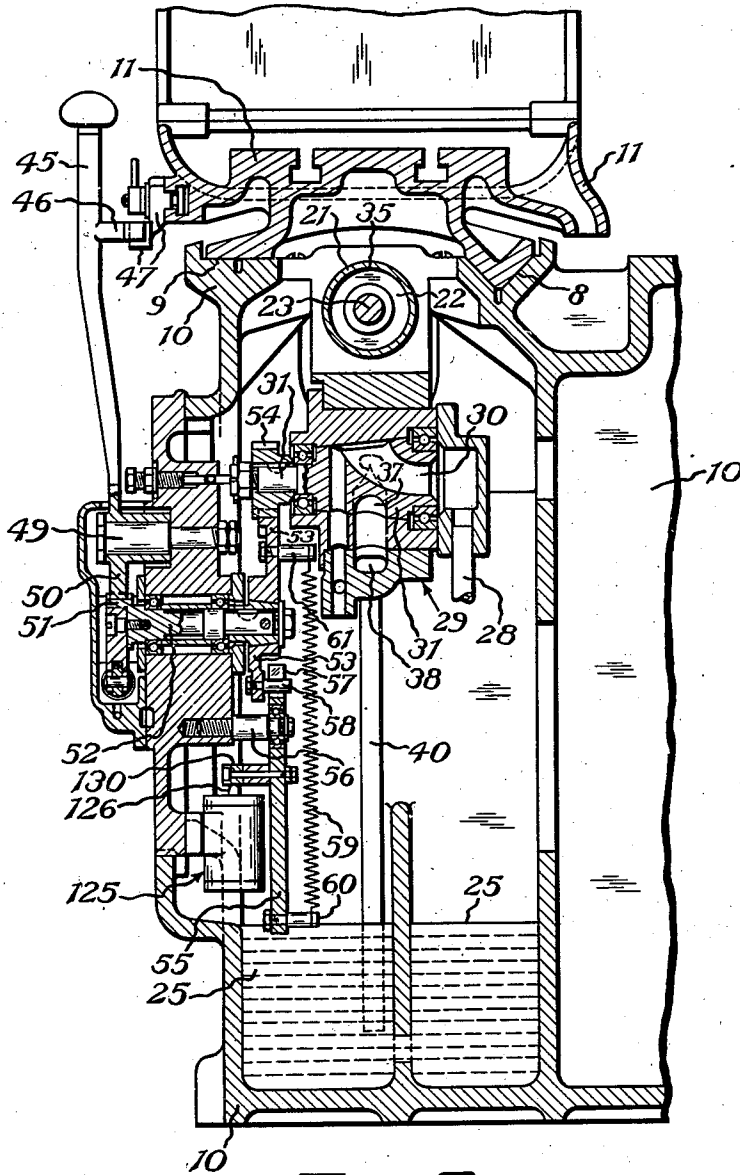


FIG. 3

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SURFACE GRINDING MACHINE

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4 Claims. (Cl. 51—92)

The invention relates to grinding machines, and more particularly to a surface grinding machine for grinding plane surfaces on a work piece.

One object of the invention is to provide a simple and thoroughly practical improved surface grinding machine. Another object of the invention is to provide an improved hydraulically operated grinding machine in which the work table is reciprocated longitudinally by a hydraulically operated mechanism and the wheel slide is indexed or traversed transversely by a hydraulically operated mechanism which is controlled by and in timed relation with the table reciprocating movement.

A further object of the invention is to provide a hydraulic wheel slide actuating mechanism in which a constant pressure is maintained on the active end of the wheel slide cylinder and the feeding movement is obtained by metering a controlled adjustable but predetermined quantity of fluid from the other end of the wheel slide cylinder to produce a controlled, positive and predetermined transverse indexing or feeding movement of the wheel slide and grinding wheel. 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 the invention,

Fig. 1 is a front elevation of the improved surface grinding machine;

Fig. 2 is a diagrammatic view showing the hydraulically operated control system and actuating parts; and

Fig. 3 is a fragmentary vertical sectional view, on an enlarged scale, through the table reciprocating mechanism.

A surface grinding machine has been illustrated in the drawings comprising a base 10 having a longitudinally movable work table 11 supported on the usual V-way 8 and flat way 9 on the base 10. A grinding wheel 12 is rotatably mounted on a transversely movable wheel slide 13 which is supported on a vertically movable slide 14 carried by an upwardly extending portion or column 15 of the base 10. The vertical slide 14 is arranged for manual adjustment to

position the periphery of the grinding wheel 12 relative to the surface of the work piece which is mounted on the table 11 so as to grind the surface thereof to the required extent. This feeding mechanism may comprise a manually operable feed wheel 16 which is preferably of a type similar to the well known feeding mechanism, such as that shown in the prior U. S. patent to Norton, No. 1,108,779, dated August 25, 1914, and the U. S. patent to Flygare and Wood, No. 2,022,542, dated November 26, 1935. The manually operable feed wheel 16 is connected to rotate a gear 17 meshing with a gear 18. The gear 18 is formed with an internal threaded aperture which engages or meshes with a feed screw 19, the lower end of which is fixedly mounted on the vertical slide 14. It will be readily apparent from the foregoing disclosure that rotation of the manually operable feed wheel 16 will be imparted to raise or lower the vertical slide 14 together with the wheel slide 13 and the grinding wheel 12 relative to the surface of the table 11.

A hydraulically operated mechanism is provided for reciprocating the table 11 to reciprocate the work piece to be ground beneath the operative face of the grinding wheel 12. In the preferred form, the reciprocating mechanism may comprise a cylinder 21 which is fixedly mounted within the base 10 of the machine. A piston 22 is slidably mounted within the cylinder 21 and is connected to one end of a piston rod 23. The other end of the piston rod 23 is connected to a bracket 24 depending from the under side of the table 11. The base 10 is provided with a reservoir 25 from which fluid is pumped through a pipe 26 by means of a motor driven fluid pump 27. The pump 27 forces fluid under pressure through a pipe 28 to a control or reversing valve 29.

Fluid under pressure from the pipe 28 enters a central chamber 30 in the valve rotor 31 and in the position shown in Fig. 2, passes out through a passage 32, a pipe 33, into the cylinder chamber 34 to move the piston 22 toward the right (Figs. 1 and 2) to transmit a corresponding movement toward the right to the table 11. During this movement of the piston, fluid within a cylinder chamber 35 exhausts through a passage 36, through a valve chamber 37 formed in the valve rotor 31, through a passage 38, through a throttle or speed control valve 39 and a pipe 40, into the reservoir 25. A manually operable lever 41 is provided on the front of the machine base for

controlling the speed control or throttle valve 39. By manipulation of the lever 41, the reciprocatory speed of the table 11 may be varied as desired or if the valve 39 is completely closed, the table reciprocation may be stopped. A pressure relief valve 42 is connected to the pipe 28 by means of which excess fluid under pressure within the system may be by-passed directly to the reservoir 25.

A reversing lever 45 is provided for either manually or automatically shifting the rotor 31 of the reversing valve 29. The reversing lever 45 is provided with a rearwardly projecting stud 46 which is arranged in the path of a pair of adjustable table dogs 47 and 48. The table dogs 47 and 48 are adjustably mounted in the usual manner in a T-shaped groove formed on the front edge of the table 11. The reversing lever 45 is rotatably supported on a stud 49 which is fixedly mounted relative to the base 10. The reversing lever 45 is provided with an integral, downwardly extending gear segment 50 which meshes with a gear segment 51. The gear segment 51 is mounted on the front end of a rotatable shaft 52. A larger gear segment 53 is fixedly mounted on the inner end of the shaft 52 and meshes with a gear 54 which is fixedly mounted relative to the rotor 31 of the reversing valve 29. The valve rotor 31 may be manually reversed by manually shifting the reversing lever 45 from the full line position 45 (Fig. 1) into the dotted line position 45a (Fig. 2).

In order that the reversing valve rotor 31 may be shifted rapidly into a reverse position after the lever 45 moves toward a central position, a suitable load and fire mechanism is provided including a pivotally mounted lever 55 which is pivotally supported on a stud 56 which is fixed relative to the base 10. The upper end of the lever 55 is formed as a yoke-shaped member 57 which straddles a stud 58 which is fixedly mounted on a downwardly extending portion of the gear segment member 53. A tension spring 59 is connected at one end to a stud 60 which is fixedly mounted at the lower end of the lever 55. The upper end of the spring 59 is connected to a stud 61 carried by the gear segment member 53. It will be readily apparent from the foregoing disclosure that when the reversing lever is moved from one extreme position to the other, the swinging movement of the lever 55 to a central position increases the tension of the spring 59 until the stud 60 passes a central plane passing through the centers of the shaft 52 and the stud 56. After the stud 60 swings past this central plane, the released tension of the spring 59 rapidly shifts the reversing valve rotor 31 into a reverse position.

In grinding plane surfaces on a surface grinding machine, in which the work table reciprocation is beneath the grinding wheel, it is desirable to provide a grinding wheel feeding mechanism to feed the grinding wheel transversely at the end of the table stroke so as to present the wheel face to a different portion of the work on each successive stroke of the table. A fluid pressure feeding or indexing mechanism is provided automatically to index or traverse the grinding wheel 12 transversely at either or both ends of the table stroke. As illustrated in the drawings, the cylinder 65 is mounted within the vertically movable slide 14. A slidably mounted piston 66 within the cylinder 65 is connected by a piston rod 67 to a bracket 68 which projects rearwardly from the wheel slide 13. A reversing valve 69 is

provided to facilitate changing the direction of transverse movement of the wheel slide 13. The valve 69 is of the balanced piston type, in which fluid conveyed from a source of fluid pressure enters through a pipe 70, into a valve chamber 101 between two valve pistons. As illustrated diagrammatically in Fig. 2, fluid under pressure passing through the pipe 70 and into the valve chamber 101 passes through a passage 104 into a cylinder chamber 105 so as to cause a movement of the piston 66, the wheel slide 13 and the grinding wheel 12 toward the left (Fig. 2). During the movement of the piston 66 toward the left, fluid is exhausted from a cylinder chamber 106, through a passage 107, through a valve chamber 103 and a pipe 108, into the reservoir 25 within the base 10 of the machine.

The reversing valve 69 may be moved manually by means of a knob 78 mounted on the left-hand end of a valve stem 79; or, if desired, an automatically actuated reversing mechanism may be provided for shifting the reversing valve 69 when the wheel slide 13 has been moved through a predetermined distance in either direction. This mechanism may comprise a pair of adjustable dogs 80 and 81 which are adjustably mounted on a bar or member 82 which is fixedly mounted on the wheel slide 13. The dogs 80 and 81 are arranged to engage a lever 83 which is fixedly mounted on the lower end of a rock shaft 84. The rock shaft 84 carries an arm 85 at its upper end having a roller 86 engaging a spring-pressed plunger 87. The upper end of the rock shaft 84 carries an arm 88 which is connected by a pin (not shown) which rides in a groove in the valve 69. It will be readily apparent from the foregoing disclosure that the wheel slide 13 moves toward the right, as viewed in Fig. 2. The movement will continue until the dog 80 engages the arm 83 and rocks the roller 86 by the spring-pressed plunger 87, thereby shifting the reversing valve 69 into a reverse position to change the direction of transverse movement of the grinding wheel slide 13 and the grinding wheel 12.

The grinding wheel slide 13 may, if desired, be traversed transversely by means of a manually operable traversing mechanism comprising a hand wheel 90 which is operatively connected to rotate a gear 91 (Fig. 1). The gear 91 meshes with a rack bar 92 fixedly mounted on the upper surface of the wheel slide 13. This mechanism has not been shown or described in detail, since it is not considered to be a part of the present invention. For further details of construction, reference may be had to the prior U. S. patent to Flygare and Wood, No. 2,022,542, dated November 26, 1935, for details of disclosure not contained herein.

In order to obtain the maximum efficiency in a surface grinding operation, it is desirable to provide a transverse indexing or feeding mechanism whereby the grinding wheel 12 may be indexed or traversed transversely by an amount equal to substantially the width of the wheel at each or both ends of the work table stroke so that the grinding wheel 12 abrades a different path across the plane face of the work at each reciprocation of the work table 11. In order to obtain a uniform transverse feeding movement, it is desirable to provide a mechanism whereby a positive fluid pressure is maintained on one side of the piston 66 to move the slide transversely at each reversal and to govern the extent of the transverse movement of the grinding wheel 12 by metering the exhaust of fluid from the

wheel slide cylinder 65. Fluid under pressure from the pump 27 passes through a pipe 95 to a speed control or throttle valve 96. In the position of the valve 96 (Fig. 2), unrestricted passage of fluid from the pipe 95 passes through a pipe 97 which connects with the pipe 70 to admit fluid under pressure through the reversing valve 69 to the cylinder 65. The valve 96 is provided with a manually operable actuating knob 98 which is located on the front of the machine base 10. By manipulation of the knob 98, fluid under pressure may be entirely cut off from the pipe 97 which leads to the wheel slide traverse mechanism, or it may be positioned as shown in Fig. 2 to allow unrestricted passage of fluid under pressure to the wheel slide traverse cylinder 65 or, if desired, the valve 96 may be rotated so that a port 99 is more or less uncovered so that fluid under pressure may pass through a port 100 in the valve casing so that a slow continuous traversing movement of the wheel slide 13 may be obtained for a grinding wheel truing operation.

The wheel slide reversing or control valve 69 is a piston type valve having a plurality of spaced valve pistons formed integrally therewith which form valve chambers 101, 102 and 103. In the position of the valve 69 (Fig. 2), fluid under pressure from the pipe 97 and pipe 70 enters the valve chamber 101 and passes through a passage 104 into a cylinder chamber 105 to move the piston 66 toward the left, thus moving the wheel slide 13 and the grinding wheel 12 toward the left, as governed by the exhaust of fluid from a cylinder chamber 106. Fluid in the cylinder chamber 106 exhausts through a passage 107 into the valve chamber 103 and passes out through a pipe 108 and a pipe 109 to a fluid pressure actuated valve 110 which is controlled in a manner to be hereinafter described. When the valve 110 is opened, the fluid in the pipe 109 may exhaust through a pipe 111 into a chamber 112 of a metering valve 113. The metering valve 113 comprises a valve piston 114 which is normally urged in a right-hand direction by a spring 115. An adjustable stop 116 is provided on the end of a manually operable adjusting screw 117 to limit the movement of the metering valve 113 in a direction toward the left so as to limit the amount of fluid which may exhaust from the cylinder chamber 106. In the position of the valve 110 (Fig. 2), fluid within the pipe 11 may pass through a valve chamber 118 located between a valve piston 119 and a valve piston 120 and pass out through a pipe 121 and a pipe 122 which connects with the exhaust pipe 40.

In order that the grinding wheel 12 may be indexed or traversed transversely at the ends of the work table stroke, a control valve 125 is provided which is actuated by and in timed relation with the table reversing mechanism. The valve 125 is a piston type valve comprising a valve stem 126 having formed integrally therewith valve pistons 127 and 128. The valve is normally held in an upward position by means of a compression spring 129. An actuating roller 130 mounted on the lever 55 is arranged to engage and depress the valve stem 126 each time the reversing lever 45 is shifted to reverse the table movement.

As shown in Fig. 2, fluid under pressure in the pipe 95 is cut off from the valve 125 by the valve piston 128. When the lever 55 swings during reversal, the roller 130 pushes the valve stem 126 downwardly so that fluid under pressure from the pipe 95 enters a valve chamber located between the valve pistons 127 and 128 and passes out through a pipe 131, into a valve chamber

located at the right-hand end of the valve 110. The admission of fluid under pressure to the valve chamber serves to move the valve pistons 120 and 119 toward the left against the compression of a spring 132. The shifting of the valve pistons 120 and 119 toward the left serves to connect the pipe 109 with the pipe 111 so that fluid under pressure within the chamber 105 exerted on the piston 66 causes the piston to force fluid from the cylinder chamber 106, through the pipes previously described, into the valve 110, and through the pipe 111 into the metering valve chamber 112.

The piston 66 can only move a distance as permitted by the amount of fluid which can be exhausted into the metering valve 113. The valve stem 126 is only held downwardly for an instant due to the swinging of the roller 130. As the roller 130 rides over the top of the valve stem 126, the released compression of the spring 129 moves the valve stem 126 upwardly into the position shown in Fig. 2 which serves to cut off fluid under pressure from the pipe 131 and connects the pipe 131 with a pipe 134. The pipe 134 connects with the exhaust pipe 40 so that fluid within the right-hand end chamber of the valve 110 may exhaust through the pipe 131, the valve chamber located between the valve pistons 127 and 128, and out through the pipes 134 and 40 into the reservoir 25. As the released compression of the spring 32 shifts the valve pistons 119 and 129 toward the right (Fig. 2), the valve piston 119 cuts off further exhaust from the pipe 109 and connects the metering valve chamber 112, through pipe 111, the valve chamber 118, and the pipe 121, with the exhaust pipe 40 so that fluid within the metering valve chamber 112 may exhaust into the reservoir 25 so that the metering valve is ready for the next wheel slide indexing or feeding movement. It will be readily apparent from the foregoing disclosure that each time the table reversing lever 45 is shifted by the table dogs 47 or 48, a measured quantity of fluid will be allowed to exhaust from the cylinder 65 so that pressure on the active side of the piston 66 will traverse the wheel slide 13 and grinding wheel 12 by a precise and predetermined amount.

In case it is desired to traverse the wheel slide 13 manually, the reversing valve 69 may be shifted to a central or neutral position so that fluid may readily by-pass between the cylinder chambers 105 and 106, thus enabling the hand traverse wheel 90 to be rotated without the necessity of overcoming the fluid pressure within the system.

During a grinding wheel truing operation, it is desirable to render the metering valve and associated mechanism inoperative so that it will not function each time the reversing lever is shifted either automatically or manually. To accomplish this desired result, a manually operable by-pass valve 140 is provided. The valve 140 is a piston type valve comprising a valve stem 141 having formed integrally therewith a plurality of valve pistons 142, 143 and 144. When it is desired to render the metering valve 113 and the valve 125 inoperative, a control knob 145, mounted on the valve stem 141, is moved toward the left (Fig. 2). Shifting the valve 140 into its left-hand position serves to allow fluid under pressure in the pipe 95 to pass through a valve chamber formed between the valve pistons 143 and 144 and to pass outwardly through a pipe 146 into a chamber 147 at the upper end of the valve 125. The admission of fluid under pres-

sure to the chamber 147 moves the valve pistons 127 and 128 downwardly so that fluid within the pipe 95 enters a valve chamber located between the valve pistons 127 and 128 and passes out through the pipe 131 into the cylinder chamber at the right-hand end of the valve 110 to move the valve pistons 120 and 119 toward the left (Fig. 2) and to maintain them in this position during the time interval in which the valve 125 is held in its downward position.

When the valve 110 is held in its left-hand end position (Fig. 2), fluid within the exhaust pipe 109 is connected with the pipe 111 which in turn is connected with a valve chamber located between the valve pistons 142 and 143 of the valve 140 and is also operatively connected with a pipe 148 which connects with the exhaust pipe 40, thus returning any exhaust fluid under pressure from the pipe 109 to the reservoir 25. It will be readily apparent from the foregoing disclosure that by operation of the by-pass valve 140, the valve 125 may be held in its downward position so that it is not actuated each time the reversing lever 45 is shifted either automatically or manually. In the above-mentioned left-hand position of the by-pass valve 140, the metering chamber 112 together with the pipe 111 is also connected directly with the exhaust pipe 40, thus rendering the metering valve 113 inoperative while the valves are in the above-mentioned condition.

The operation of this improved machine will be readily apparent from the foregoing disclosure. A work piece to be ground is mounted on the upper surface of the table 11 and a reciprocatory movement of the table 11 is started by manually shifting the lever 41 into the broken line position shown in Fig. 2 to open the stop and start valve 39. The table dogs 47 and 48 are adjusted to provide the desired reciprocatory stroke of the table 11 so as to pass the work piece to be ground beneath the grinding wheel 12. The reversing valve 69 is set in position for automatic actuation and the metering valve 113 is adjusted to meter a desired and predetermined quantity of fluid from the cylinder 65 so that fluid under pressure at one end of the cylinder 65 will index or traverse the wheel slide 13 and the grinding wheel 12 transversely a precise and predetermined distance for the next pass of the work piece beneath the wheel 12. At each actuation of the table reversing lever 45 by means of the table dogs 47 and 48, the lever 55 will swing the roller 130 into engagement with the valve stem 126 instantaneously to depress the valve pistons 127 and 128 to admit fluid under pressure to shift the valve 110 to its left-hand end position so that fluid from the cylinder 65 may pass through pipe 109, the pipe 111, into the metering valve chamber 112. The extent of movement of the wheel slide 13 and the extent of transverse movement of the grinding wheel 12 is governed by the adjusted capacity of the metering valve chamber 112.

After the roller 130 passes over the valve stem 126, the released compression of the spring 129 shifts the valve stem 126 into its uppermost position, as shown in Fig. 2, which movement allows fluid from the metering valve chamber 112 to exhaust through the pipe 111, through the valve chamber 118, through the pipe 121 and the pipe 43, into the reservoir 25. The released compression of the spring 115 serves to aid in exhausting fluid from the metering valve chamber 112 to again position the metering valve 113 ready

for the next actuation. By turning the knob 117, the stop 116 may be adjusted to vary the capacity of the metering valve chamber 112 and thereby to vary the extent of transverse indexing movement of the wheel slide 13 and the grinding wheel 12.

It will be readily apparent that as the work piece mounted on the table 11 is reciprocated beneath the grinding wheel 12, the wheel 12 will index at each end of the table stroke in a manner hereinabove set forth until the grinding wheel 12 has ground the entire surface to be ground on the work piece. By means of the adjustable dogs 80 and 81, the reversing valve 69 is automatically shifted so that after the grinding wheel 12 has been indexed through a predetermined distance to grind the entire surface of the work piece, the valve 69 may be reversed so that the wheel 12 may be automatically indexed during a return transverse stroke thereof. It will be readily apparent that by providing a constant pressure within the active end of the cylinder 65 and metering a predetermined amount of fluid from the other end of the cylinder, a precise, uniform, and controlled predetermined indexing movement of the wheel slide 13 is obtained.

An adjustable throttle valve 150 is provided in the pipe 134 to facilitate a control of the valve 110 in its movement toward the right so as to prevent cutting off the passage of exhaust fluid to the metering valve chamber 112 until the chamber 112 is filled.

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 surface grinding machine having a base, a work supporting table thereon, a rotatable grinding wheel, a wheel slide to support said wheel for a transverse movement relative to the table, a vertically movable slide to support said wheel for movement toward and from the table, a fluid pressure system including a piston and cylinder operatively connected to reciprocate said table, a table actuated reversing valve arranged to change the direction of movement of the table, a second piston and cylinder operatively connected to traverse said wheel slide, a second reversing valve which is arranged to convey fluid under pressure to one end or the other of said second cylinder, a metering valve to control the exhaust of fluid from said second cylinder, a normally closed valve which is opened automatically by and in timed relation with the shifting of the table reversing valve, and a pressure actuated stop and start valve located between the normally closed valve and the metering valve so that released pressure on said second piston forces a measured quantity of fluid from the other end of the wheel slide cylinder to produce a predetermined transverse movement of the grinding wheel at the end of the table stroke.

2. In a surface grinding machine as claimed in claim 1, the combination with the parts and features therein specified, of means including a table actuated reversing lever to actuate said revers-

ing valve, a control valve actuated by and in timed relation with the table reversing lever, and a manually operable by-pass valve to render said control valve and metering valve inoperative when desired.

3. In a surface grinding machine having a base, a work supporting table thereon, a rotatable grinding wheel, a transversely movable wheel slide, a fluid pressure piston and cylinder operatively connected to reciprocate said table, a table 10 actuated reversing valve arranged to change the direction of movement of said table, a second piston and cylinder operatively connected to traverse the wheel slide, a wheel slide actuated reversing valve which is arranged to convey fluid under 15 pressure to one end of the wheel slide cylinder, means including a fluid pressure pump to convey fluid under pressure through the wheel slide reversing valve to one end or the other of the wheel slide cylinder, means including a pipe to exhaust 20 fluid from the wheel slide cylinder, a metering valve in said pipe, a normally closed fluid actuated stop and start valve to control the exhaust of fluid into the metering valve, and a valve actuated by and in timed relation with the table 25 reversing valve to control the opening of the stop and start valve during reversal so that released fluid under pressure in one end of said second cylinder moves said piston and exhausts a predetermined volume of fluid from the other end of the second cylinder as governed by said metering valve to cause a predetermined trans-

verse movement of the grinding wheel slide at the end of the table stroke.

4. In a surface grinding machine having a base, a work supporting table thereon, a rotatable grinding wheel, a transversely movable wheel slide to support said wheel, a fluid pressure system including a piston and cylinder operatively connected to reciprocate said table, a table actuated reversing valve arranged to change the direction of movement of the table, a piston and cylinder operatively connected to traverse said wheel slide transversely, a wheel slide actuated reversing valve which is arranged to convey fluid under pressure to one end or the other of said wheel slide cylinder, a metering valve to control the exhaust of fluid from said cylinder, a normally-closed fluid-actuated stop and start valve to control the exhausting of fluid into the metering valve, a valve actuated by and in timed relation with the table reversing valve instantaneously to open the stop and start valve to admit exhausting fluid from the wheel slide cylinder to the metering valve so as to facilitate a predetermined transverse movement of the wheel slide, and an adjustable throttle valve to regulate the rate of closing of said stop and start valve so as to insure a complete filling of the metering valve to provide a precise, predetermined transverse movement of the wheel slide at 30 each table reversal.

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