June 6, 1939. C. G. FLYGARE 2,161,150

GRINDING MACHINE TABLE RECIPROCATING MECHANISM

Filed March 3, 1938 2 Sheets-Sheet 1

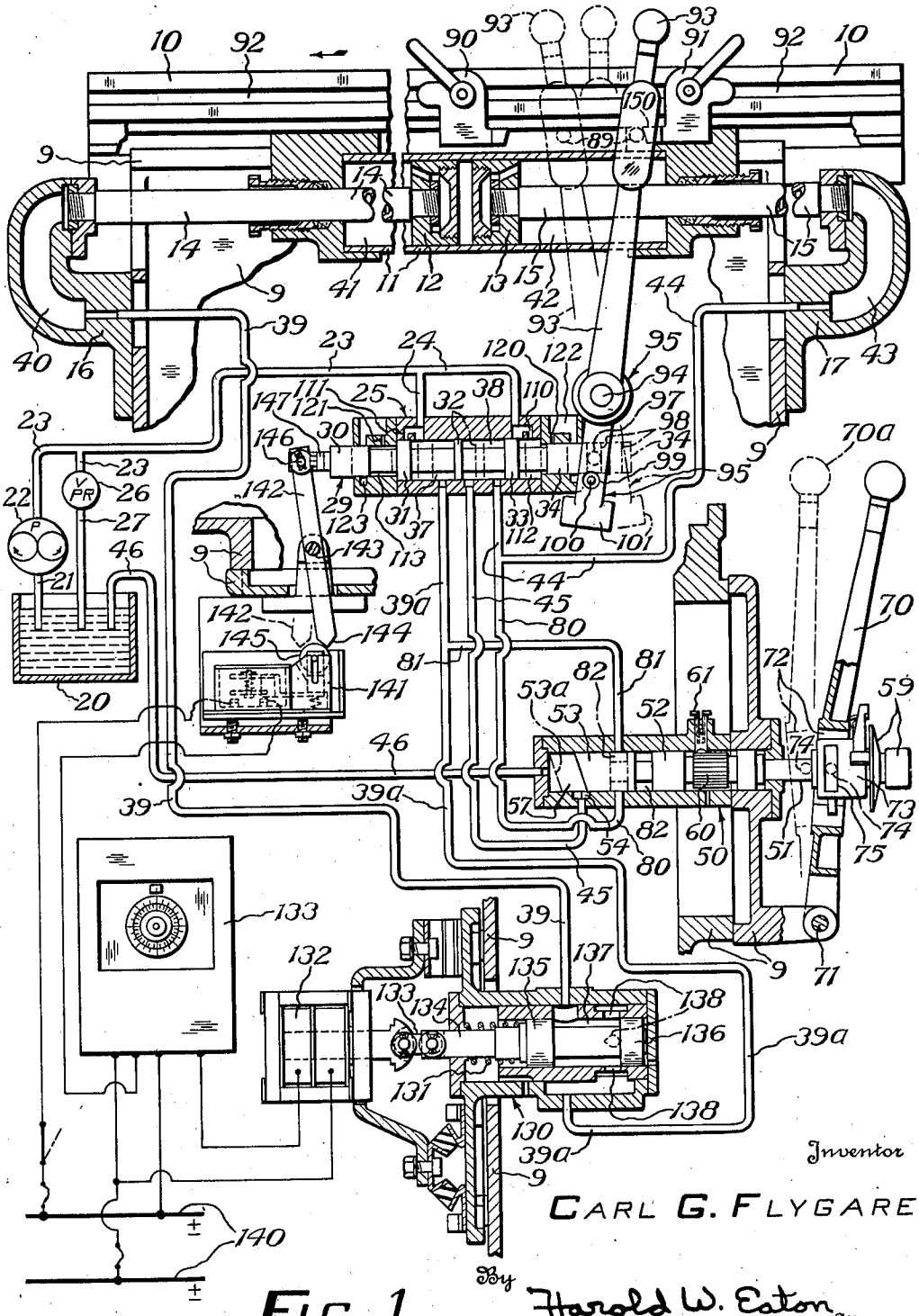


FIG. 1

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GRINDING MACHINE TABLE RECIPROCATING MECHANISM

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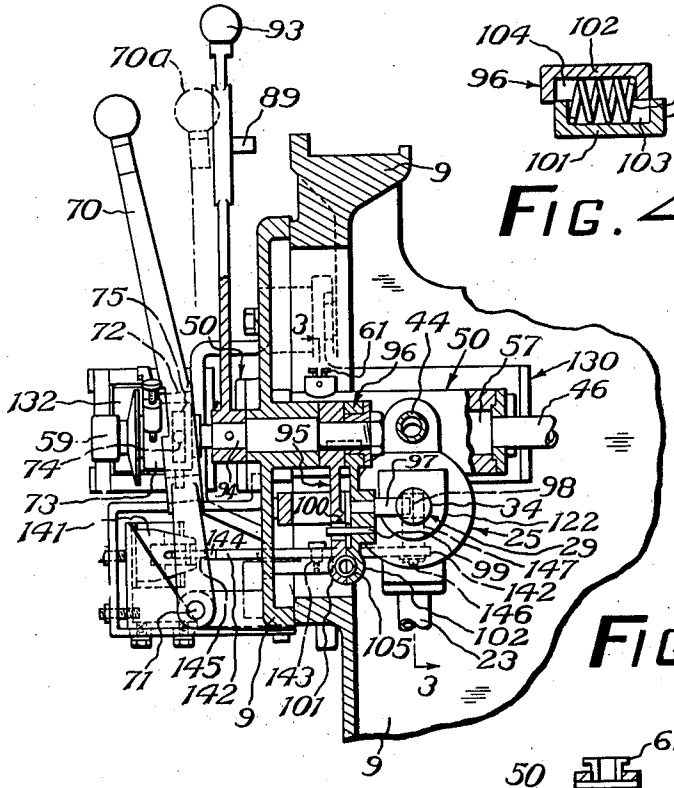
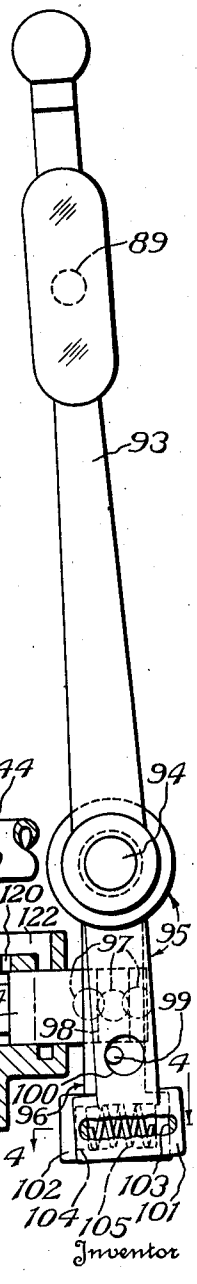


FIG. 2

FIG. 4



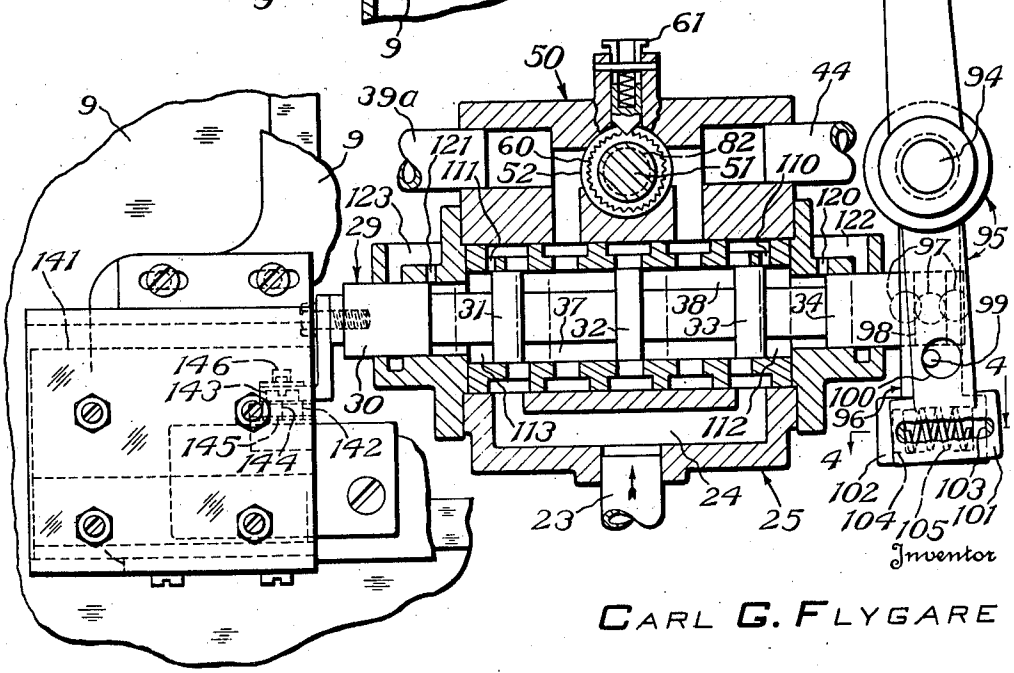


FIG. 3

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UNITED STATES PATENT OFFICE

2,161,150

GRINDING MACHINE TABLE RECIPROCATING MECHANISM

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Application March 3, 1938, Serial No. 193,707

6 Claims. (Cl. 121—45)

The invention relates to grinding machines, and more particularly to a table reciprocating mechanism for a grinding machine.

One object of the invention is to provide a simple and thoroughly practical table reciprocating and reversing mechanism. Another object of the invention is to provide a table reversing mechanism with an improved dwell control mechanism. Another object of the invention is to provide a table reversing mechanism with a mechanism whereby a variable dwell may be obtained at either or both ends of the table reciprocation. A further object of the invention is to provide an electrically controlled dwell control for a table reciprocating mechanism. A further object of the invention is to provide a hydraulically operated table reciprocating mechanism with an electrical time delay relay control therefor to control the extent of dwell at each end of the table stroke. 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 combined hydraulic and electrical diagram of the improved table reciprocating mechanism;

Fig. 2 is a cross sectional view through the table reciprocating mechanism, showing the valve actuating mechanism in cross section;

Fig. 3 is a longitudinal sectional view, on an enlarged scale, taken approximately on the line 3—3 of Fig. 2; and

Fig. 4 is a sectional view taken approximately on the line 4—4 of Fig. 3.

As illustrated in the drawings, the machine embodying this invention comprises a base 9 which supports a longitudinally reciprocable table 10 on the usual V-way and flat way (not shown) for a longitudinal reciprocatory movement relative to the base 9.

A fluid pressure operated reciprocating mechanism is provided to reciprocate the table 10, comprising a fluid pressure cylinder 11 which is fixedly mounted to the under side of the table 10. The cylinder 11 contains a pair of spaced pistons 12 and 13 which are connected by a pair of hollow piston rods 14 and 15, respectively, with a pair of hollow brackets 16 and 17, respectively, mounted on opposite ends of the base 9.

In the preferred construction, the base 9 is formed with a hollow box-like construction, in which the lower portion serves as a reservoir 20 for the fluid pressure system. Fluid is drawn from the reservoir 20 through a pipe 21 by a motor driven fluid pressure pump 22 and is forced through a pipe 23 and a pipe or passage 24 to a table control valve 25. A fluid pressure relief valve 26 is provided in the pipe line 23 and is arranged to allow excess fluid under pressure to by-pass through a pipe 27 into the reservoir 20 in case the pressure within the system increases above a desired predetermined pressure.

A control valve 25 is preferably of a piston type reversing valve which includes a movable valve member 29 having formed integrally therewith a plurality of valve pistons 30, 31, 32, 33 and 34. Fluid under pressure from the pump 22 is forced through the pipes 23 and 24 into a valve chamber 37, between the valve pistons 31 and 32, and passes outwardly through a pipe 39 into an aperture 40 in bracket 16, through the hollow piston rod 14 and piston 12, into a cylinder chamber 41, to cause the cylinder 11 and table 10 to move in a direction toward the left (Fig. 1). During movement of the table toward the left, fluid within a cylinder chamber 42 is exhausted through the piston 13, the hollow piston rod 15, an aperture 43 within the bracket 17, and through a pipe 44 into a valve chamber 38 between the valve pistons 32 and 33, and out through a pipe 45 which returns exhaust fluid through a pipe 46 into the reservoir 20.

A speed control valve 50, as illustrated in the drawings, is preferably formed integral with the valve 25. As illustrated in the diagram (Fig. 1), the valve is shown as a separate valve unit. The valve 50 is preferably located in the exhaust side of the system so as to maintain a uniform fluid pressure on the operative side of the main cylinder. This valve comprises a valve stem 51 which is provided with valve pistons 52 and 53. The casing for the valve 50 is provided with a V-shaped port 54 which is located at one end of the pipe line or passage 45, conveying fluid from either the valve chamber 37 or 38, depending upon the position of the valve 25. The passage or outlet pipe 46 serves to exhaust fluid from a throttle valve chamber 57 into the reservoir 20 within the base of the machine.

The throttle valve 50 is arranged so that it may be moved longitudinally from a full line to a dotted line position. The valve is provided with an actuating knob 59 on the front end of the valve stem 51 which facilitates rotation of the valve. In the preferred construction, the end of the valve piston 53, instead of being a plane surface at right angles to the axis of the throttle valve, is arranged at an angle thereto. By providing an angularly positioned end surface on the valve piston 53, any rotation of the valve member serves as a fine adjustment to cut off more or less of the V-port 54 precisely to regulate the ex-

haust of fluid from the system and thereby permit a fine regulation of the table speed.

In order that the valve piston 53 may be maintained in the desired adjusted position so as to enable the table to be stopped and started as desired, without changing the speed adjustment, a serrated or notched portion 60 is provided which is formed integral with the valve stem 51. A spring pressed pawl 61 is carried by the valve casing 50 so that when the knob 59 is rotated to adjust the valve piston 53 to give the desired table speed, the detent 61 engages notches in the serrated portion 60 and serves to hold the valve piston in its adjusted position so as to permit longitudinal or axial movement of the valve stem 51 by means of a control lever 70 to stop and start the table movement without upsetting the speed adjustment of the valve.

The control lever 70 is pivotally mounted on a stud 71 fixedly mounted on the base 9 of the machine and serves to permit a rapid movement of the valve stem 51 to stop and start the table movement. The lever 70 is provided with an aperture 72 fitting loosely around a sleeve 73 which is mounted on the valve stem 51. A pair of opposed aligned trunnion pins 74 are provided at opposite sides of the aperture 72 on the lever 70 and are arranged to engage vertical slots 75 in the sleeve 73. It will be readily apparent from the foregoing disclosure that when the throttle valve lever is in the position indicated in full lines, the valve stem 51 is positioned so that the valve piston 53 uncovers all or a portion of the V-port 54, allowing the table to move at a predetermined speed. By moving the lever 70 into position 70*a*, as indicated in broken lines in Fig. 1, the valve piston 53 is moved into position 53*a*, thereby closing the V-port 54 and stopping the table movement.

When the throttle valve is in a closed position to stop the hydraulic table movement, it is desirable to provide a suitable fluid by-pass whereby fluid may readily pass from the cylinder chamber at one end of the cylinder to the cylinder chamber at the other end thereof to facilitate a manual traversing movement of the table. In the preferred construction, a pipe or passage 80 is provided to connect the pipe 44 and the valve chamber 38 with a passage or pipe 81 provided as an extension of the pipe 39*a*. When the throttle valve 50 is in a closed position, as indicated in broken lines, fluid may readily pass from the cylinder chamber 41, through the pipe 39, the pipe 39*a*, the pipe 81, through a valve chamber 82 between the valve pistons 52 and 53, through the pipe 80, the pipe 44, and into the cylinder chamber 42. This by-pass in the throttle valve interconnects the cylinder chambers 41 and 42 so that when the fluid pressure system is shut off by closing the throttle valve 50, the table may then be readily moved manually, if desired.

A manually operable table traverse mechanism may be of the type shown in the prior United States Patent No. 2,071,677 and may consist of a manually operable hand wheel and a rack and gear mechanism for moving the table longitudinally.

A suitable reversing mechanism is provided to change the direction of movement of the table, as desired. In the preferred construction, adjustable table dogs 90 and 91 are adjustably mounted in a T-slot 92 on the table 10. The dogs 90 and 91 are arranged to engage a pin 89 on the upper end of a reverse control lever 93 which is pivotally mounted on a stud 94 on the base 9 of the machine. The lever 93 is operatively connected to move the valve stem 29.

In order that the table may be reversed with a minimum amount of vibration, it is desirable to provide a lost motion connection between the reversing lever 93 and the reversing valve 25, so that during the initial movement of the reverse lever under the influence of the table dogs, the valve is not moved. This mechanism preferably comprises a short lever 95 fixedly keyed to the inner end of the stud 94. A short lever 96 is rotatably mounted on the stud 94 and is supported thereon by means of a bushing, so that the lever 96 is free to oscillate relative to the stud 94. The lever 96 carries a pin 97 engaging a groove 98 in an extended portion of the valve stem 29. The lever 95 is provided with an aperture 99. A pin 100 is fixedly mounted to the lever 96 and projects within the aperture 99 in the lever 95. The lower end of the levers 95 and 96 are provided with enlarged end portions 101 and 102, respectively, each of which is provided with a semi-cylindrical aperture 103 and 104, respectively. A spring 105 is provided within the semi-cylindrical apertures 103 and 104 and serves to hold the levers normally in a definite aligned relationship to each other.

Assuming the parts of the reversing mechanism to be in the position illustrated in Fig. 1, the table is moving in a direction toward the left, which movement continues until the reversing lever 93 is moved a sufficient distance to actuate the lever 95 through its lost motion movement until the aperture 99 engages the pin 100. This movement of the lever 95 relative to the lever 96 serves to compress the spring 105 and when the aperture 99 engages the pin 100, continued movement of the table serves to throw the reversing valve stem 29 into a central or neutral position, as indicated in Fig. 3, in which position the pressures are balanced on opposite sides of the main cylinder 11. The compression of the spring 105 then tends to move the valve stem 29 toward the right, which movement is prevented by a means to be hereinafter described.

When the compression of the spring 105 is released, it shifts the valve from a central or neutral position so as to uncover a port 111, decreasing the fluid pressure passing into a chamber 112 and increasing fluid pressure passing into a valve chamber 113. It should be noted that the valve pistons 30 and 31 are of different cross-sectional areas, and fluid under pressure entering the chamber 113 serves, through the differential piston areas on the pistons 30 and 31, to move the valve stem 29 toward the right, as viewed in Fig. 3, to throw the valve into its extreme reverse position and thereby cause a reversal in direction of movement of fluid under pressure to pass the same to the opposite end of the main driving cylinder 11 and thereby cause the table 10 to move in the opposite direction.

Due to the differential in the pressure areas between the valve pistons 30, 34 and 31, 33, respectively, the chambers 113 and 112 function as a pilot valve to cause a reversal of the reversing valve under the influence of fluid under pressure. The reversing lever 93 serves only to cause the reversing valve to move to a central or neutral position, as illustrated in Fig. 3, and the spring 105 then under compression serves to move the reversing valve slightly off center to change the respective openings of the ports 110 and 111 and cause fluid under pressure to operate through the chambers 112 and 113 to cause a fluid pressure

reversal of the reversing valve, thereby combining the functions of a reversing valve and a pilot valve in a single valve unit and eliminating the piping connections and losses due to passages between the various valves as experienced heretofore.

Fluid within the valve chamber 112 may exhaust through a port 120 and similarly fluid within the valve chamber 113 may exhaust through a port 121, into reservoirs 122 and 123, respectively. When the valve piston 29 is moved to either end of its stroke, as shown in the diagrammatic illustration in Fig. 1, fluid within the chamber 113 is free to exhaust through port 121, into the reservoir 123. Similarly, when the valve piston 29 is moved toward the right, fluid within the valve chamber 112 may exhaust through the port 120, into the reservoir 122.

In a cylindrical traverse grinding operation, it is frequently desirable to provide a sufficient dwell of the table at the end of its reciprocatory stroke so that the work piece may rotate at least one complete rotation before the table stops its movement and starts in the reverse direction. The period of dwell necessary to accomplish this result varies with the size of the work being ground, the width of the grinding wheel being used, as well as the relative speeds of the work rotation and table reciprocation. It is, therefore, desirable to provide a variable dwell at either or both ends of the table stroke to accomplish the desired results. In the preferred construction, the dwell at the end of the table stroke may be accomplished by interrupting the flow of fluid within the hydraulic system so as to allow the table to dwell at the end of its stroke for a predetermined adjustable time interval.

In the preferred construction, an electrical control mechanism is provided to delay the admission to or exhaust from one end of the table cylinder when the reverse valve is shifted so that a table dwell of any desired length may be obtained. This is preferably accomplished by means of a cut-off valve 130 which is connected between the pipe 39 and a pipe 39a which is connected to the control valve 25. The valve 130 is preferably a piston type valve, which is normally held in an open position by means of a spring 131 and may be closed by means of an electric solenoid 132 which is connected by a link 133 with the outer end of a piston rod 134. The piston rod 134 has formed integrally therewith a pair of valve pistons 135 and 136 which form a valve chamber 137 therebetween. The casing of the valve 130 is provided with a plurality of V-ports 138 which in the position illustrated in the drawings (Fig. 1) are wide open. When the solenoid 132 is energized, the valve stem 134 together with the valve pistons 135 and 136 are moved toward the left (Fig. 1) against the tension of the spring 131 to close the V-ports 138 and thereby prevent fluid from passing between the pipes 39 and 39a. The valve 130 is arranged so that it may be automatically closed by means of the solenoid 132 which is preferably controlled by an adjustable electrical time delay relay 133. The electrical time delay relay 133 is a standard commercial relay of the type illustrated, known as the Microflex reset timer, which comprises a synchronous motor operated time delay relay. The relay 133 is connected with power lines 140 and is set in motion by a normally open limit switch 141. The limit switch may be actuated in timed relation with the reversing mechanism of the machine, such as, for example, it may be actuated in timed relation with the shifting of the reversing valve 29.

A rock arm 142 is pivotally mounted on a stud 143 which is fixedly supported on the base 9. One arm of the rock arm 142 is provided with an arrow pointed end 144 which is adapted to swing in the path of a roller 145 which actuates the limit switch 141. The other end of the rock arm 142 is connected by a stud 146 with a spool-shaped end 147 on a projecting portion of the valve 29. It will be readily apparent from the foregoing disclosure that when a table dog operates through the reverse lever 93 to shift the valve 29 into its reverse position, the rock arm 142 is actuated thereby to swing the arrow point 144 over the roller 145 to depress the roller 145 and thereby instantaneously close the limit switch 141 which serves to set the time delay relay 133 into operation and also serves simultaneously to energize the solenoid 132 to shift the valve stem 134 toward the left (Fig. 1) to close the V-ports 138 and thereby prevent the passage of fluid under pressure from the pipe 39a from entering the pipe 39 when the table is traveling in one direction or to prevent the exhausting of fluid from the pipe 39 into the pipe 39a when the table is moving in the other direction. The valve 134 remains in a closed position and the solenoid 132 remains energized until a definite time interval, for which the time delay relay 133 has been set, whereupon the time delay relay serves to break the circuit and to deenergize the solenoid 132, thereby releasing the compressed spring 131, which rapidly returns the valve 134 into the position shown in Fig. 1 to allow free passage of fluid between the pipes 39 and 39a. It will be readily apparent that the time limit switch 141 is instantaneously closed each time the valve 29 is shifted into a reverse direction, regardless of which direction the valve is moved. Each time the limit switch 141 is closed, the time delay relay 133 is set in motion and the solenoid 132 is energized to prevent the passage of fluid between the pipes 39 and 39a, so that regardless of whether fluid under pressure is being admitted to or exhausted from the cylinder chamber 41, the valve 130 being closed will prevent such movement of the fluid until the time delay relay automatically opens the circuit after a predetermined time interval to deenergize the solenoid 132 and thus permit the valve 130 to open and allow the table to start its movement in the reverse direction after a predetermined interval of dwell.

The operation of this table reciprocating mechanism will be readily apparent from the foregoing disclosure. Assuming all of the parts have been previously adjusted and the table is traversing in a direction toward the left (Fig. 1), this movement continues until a projection 150 on the reversing dog 91 engages a pin or stud 89 on the reverse lever 93. Movement of the reverse lever in a counterclockwise direction serves through the parts above described to shift the valve 29 toward the right (Fig. 1) first to stop the table movement and then to shift into a reverse position so that fluid may be admitted to cause the table 10 to traverse in the reverse direction. During the time the reverse valve 29 is shifting toward the right to cut off fluid so as to stop the table movement, the rock arm 142 is rocked in a clockwise direction by movement of the valve 29 so that when the valve 29 reaches a central or neutral position, the arrow point 44 has depressed the roller 145 and closed the limit switch 141, which closing serves to set the time delay relay 133 in

operation and simultaneously to energize the solenoid 132 to close the V-ports 138 so that when the control valve 29 reaches its reverse position, fluid under pressure entering the pipe 44 cannot start the table moving in the reverse direction until a definite time interval has elapsed due to the fact that the V-ports 138 are closed and fluid within the cylinder chamber 41 cannot exhaust through the pipe 39 into the pipe 39a. The table thus remains stationary for a predetermined time interval until the electrical time delay relay 133 operates again to deenergize the solenoid 132 so as to allow the released compression of the spring 131 to shift the valve stem 134 and open the V-ports 138, which movement allows the fluid within the chamber 41 to exhaust and the table to start its movement in the reverse direction.

It will be readily apparent from the foregoing disclosure that the limit switch 141 is actuated each time the valve 29 is shifted regardless of which direction the valve is moved to operate the time delay relay and energize the solenoid 132 to prevent the passage of fluid between the pipes 39 and 39a to cause a predetermined adjustable dwell at each end of the table stroke.

By manipulation of the adjustable time delay relay 133, the dwell at each end of the table stroke may be adjusted as desired.

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 grinding machine, a longitudinally reciprocable table, means including a fluid pressure piston and cylinder to reciprocate said table, means including a reversing valve to control the admission of fluid to said cylinder, a lever operatively connected to move said valve, adjustable dogs on said table to move said lever and shift the valve into a reverse position, and an electrically controlled mechanism which is actuated by and in timed relation with the movement of said reverse valve to prevent the flow of fluid between said reverse valve and one end of said cylinder until the table has stopped for a predetermined period of dwell.

2. In a grinding machine, a longitudinally reciprocable table, means including a fluid pressure piston and cylinder to reciprocate said table, means including a reversing valve to control the admission of fluid to said cylinder, a lever operatively connected to move said valve, adjustable dogs on said table to move said lever and shift the valve into a reverse position to stop and reverse said table movement, and an electrically controlled time delay mechanism which is actuated by and in timed relation with said reversing valve to prevent the flow of fluid between said reverse valve and one end of said cylinder for a predetermined time interval before allowing the table to start moving in the opposite direction.

3. In a grinding machine, a longitudinally reciprocable table, means including a piston and cylinder to reciprocate said table, means including a reversing valve to control the admission of fluid to said cylinder, a lever operatively connected to move said valve, adjustable dogs on said table to move said lever and shift the valve into a reverse position to stop and reverse the table movement, an electric switch actuated by said reversing valve, and means including an electric time delay relay which is set in motion by said switch to prevent the flow of fluid between the reversing valve and one end of said cylinder for a predetermined time interval before allowing the table to start moving in the opposite direction.

4. In a grinding machine, a longitudinally reciprocable table, means including a piston and cylinder to reciprocate said table, means including a reversing valve to control the admission of fluid to said cylinder, a lever operatively connected to move said valve, adjustable dogs on said table to move said lever and shift the valve into a reverse position to stop and reverse the table movement, an electric switch actuated by said valve, a solenoid valve which is closed by said switch to prevent the flow of fluid between the reversing valve and said cylinder, and an electrical time delay relay which is actuated by said switch to operate said solenoid valve to start the table moving in the reverse direction after a predetermined period of dwell.

5. In a grinding machine, a longitudinally reciprocable table, means including a piston and cylinder operatively connected to reciprocate said table, a reversing valve therefor which is arranged to admit fluid under pressure to either end of said cylinder, a pair of adjustable dogs on said table, a reversing lever operatively connected to said valve and arranged to move said valve into a reverse position when acted upon by one of said dogs, an electrically controlled valve which is operatively connected between said reversing valve and said cylinder, a switch actuated by said reversing valve to close said electrically controlled valve, and a time delay relay rendered operative by said switch to open said electrically controlled valve after a predetermined time interval and thereby permit the flow of fluid between the control valve and one of said cylinders so as to start the movement of the table in the reverse direction.

6. In a grinding machine, a longitudinally reciprocable table, means including a piston and cylinder operatively connected to reciprocate said table, a reversing valve associated therewith and arranged to admit fluid under pressure to either end of said cylinder, a reversing lever operatively connected to move said valve, adjustable dogs on said table which are arranged to actuate said lever to shift the reversing valve into a reverse position, a solenoid controlled valve interposed between said reversing valve and said cylinder, a spring normally to hold said solenoid valve open, a normally open switch, a rock arm actuated by said reverse lever when moved in either direction to close said switch and energize said solenoid to close said solenoid valve and thereby prevent passage of fluid between the reverse valve and said cylinder, and an electrically operated time delay relay set in motion by the closing of said switch which serves after a predetermined time interval to open a circuit and deenergize said solenoid to open said solenoid valve and allow passage of fluid between the reversing valve and said cylinder to start the table moving in the reverse direction after a predetermined period of dwell.

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