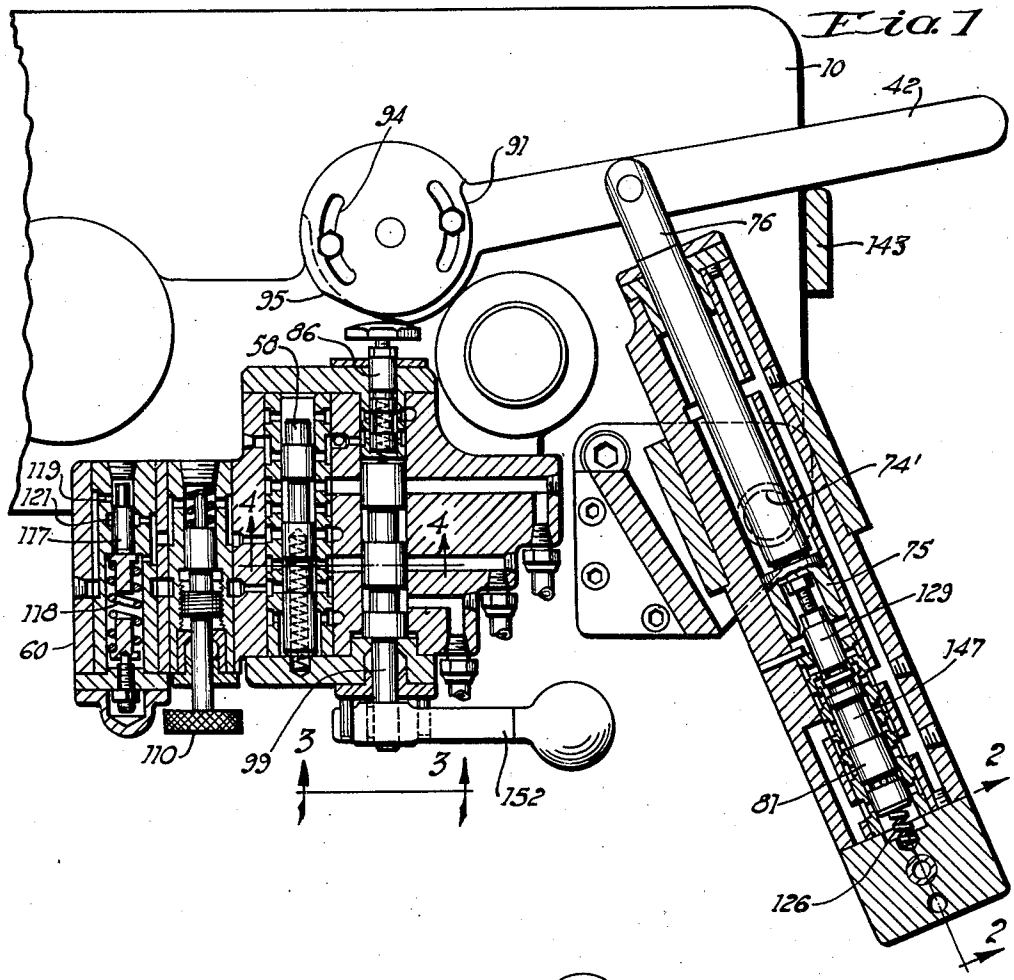
Aug. 25, 1942. R. D. WORTENDYKE ET AL 2,294,265

AUTOMATIC INFEEDING MECHANISM FOR GRINDING MACHINES

Filed Aug. 4, 1941 3 Sheets-Sheet 1

Fig. 1



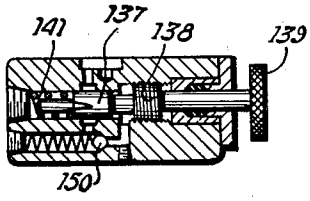


Fig. 2

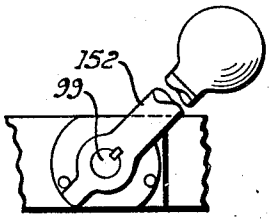


Fig. 3

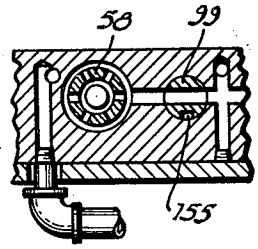


Fig. 4

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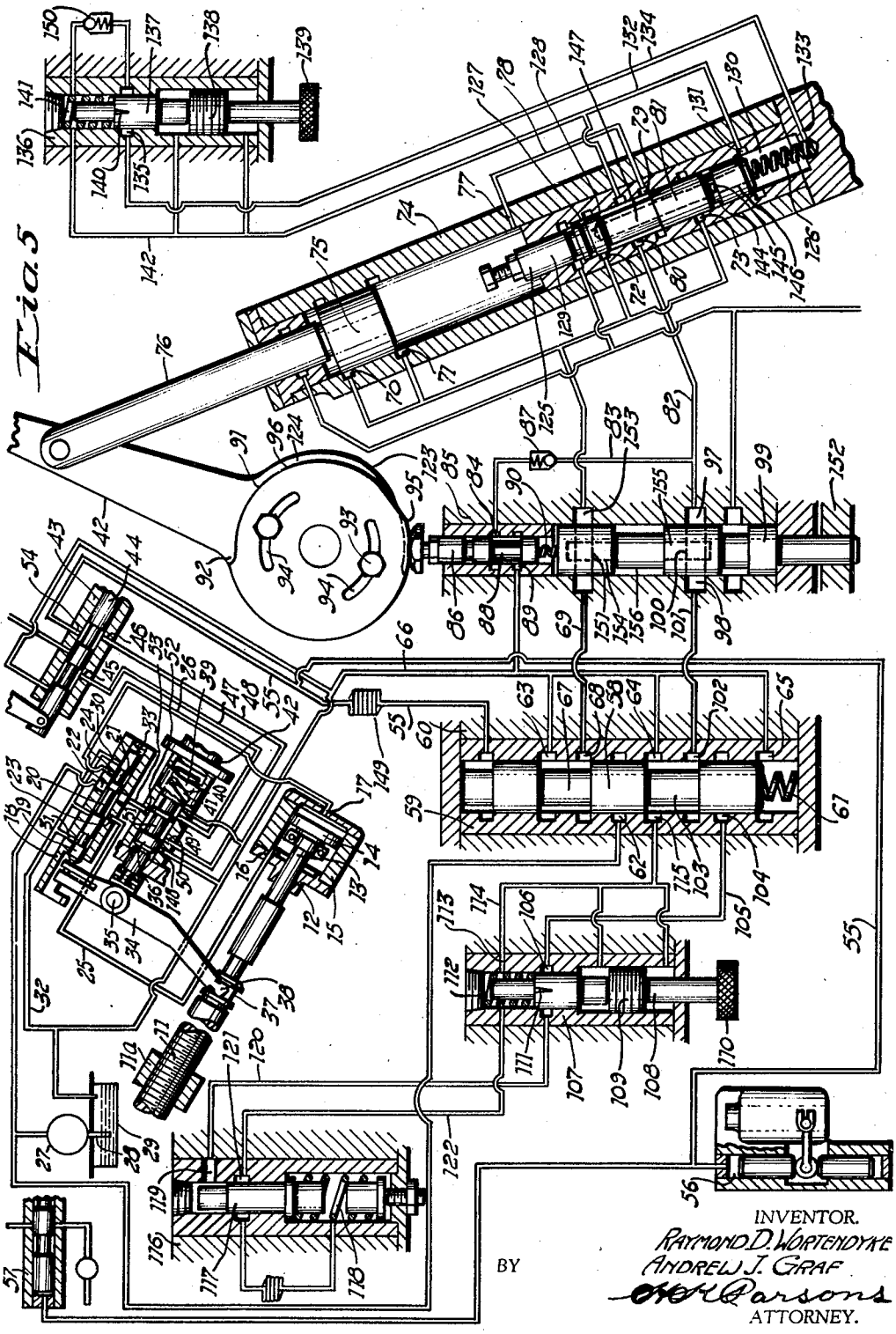
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AUTOMATIC INFEEDING MECHANISM FOR GRINDING MACHINES

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Fig. 5



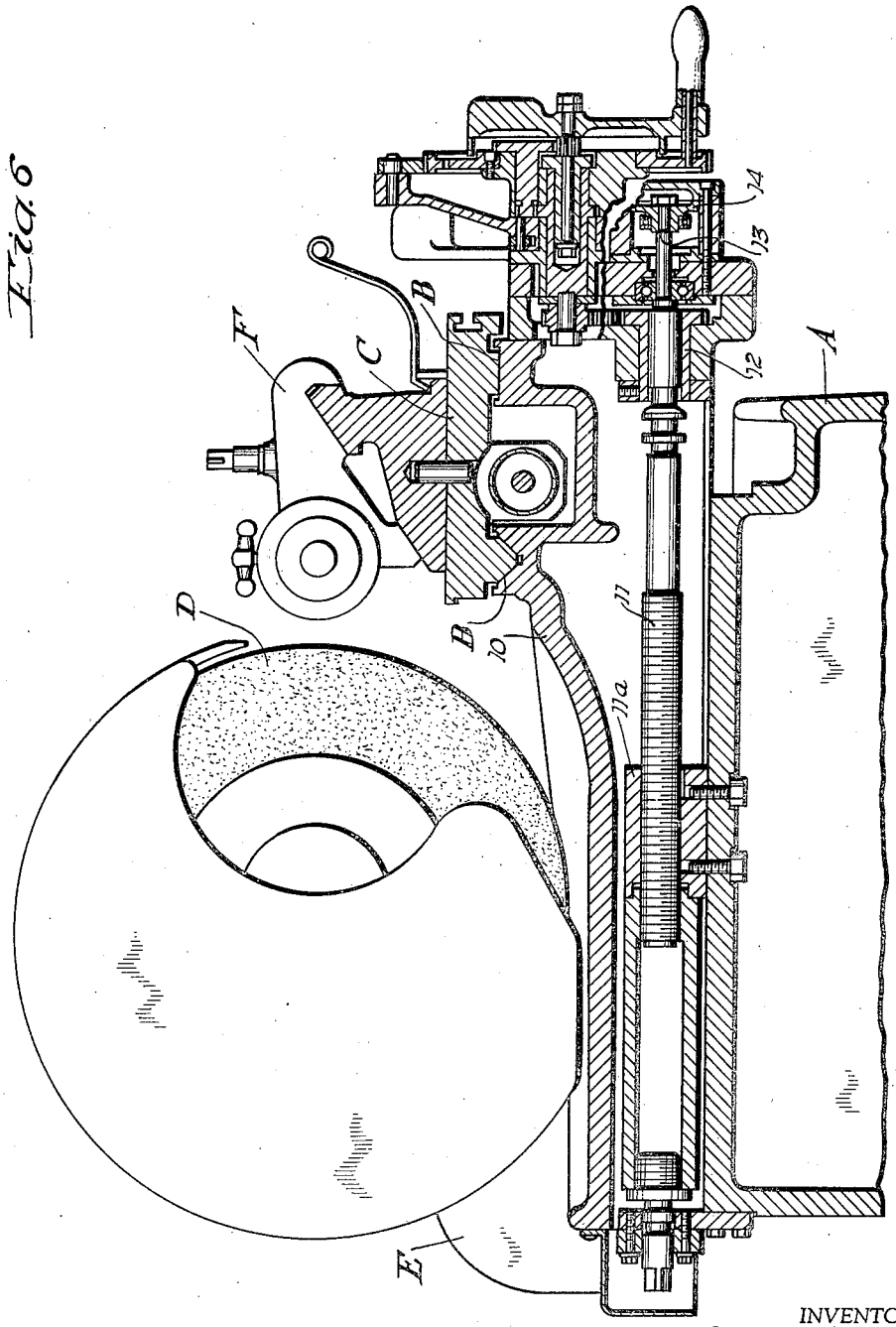
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AUTOMATIC INFEEDING MECHANISM FOR GRINDING MACHINES

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Fig. 6



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Patented Aug. 25, 1942 2,294,265

UNITED STATES PATENT OFFICE

2,294,265

AUTOMATIC INFEEDING MECHANISM FOR GRINDING MACHINES

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Application August 4, 1941, Serial No. 405,362

15 Claims. (Cl. 51—2)

This invention relates to machine tools and more particularly to improvements in grinding machines.

One of the objects of this invention is to provide improvements in automatic infeeding mechanisms for grinding machines.

Another object of this invention is to provide improved means for power actuating a manually operable infeed control lever of a grinding machine.

A further object of this invention is to provide an automatic infeed cycle control attachment for grinding machines which will convert a manual control infeed mechanism into an automatic cycle controlled mechanism.

Other objects and advantages of the present invention should be readily apparent by reference to the following specification, considered in conjunction with the accompanying drawings forming a part thereof and it is to be understood that any modifications may be made in the exact structural details there shown and described, within the scope of the appended claims, without departing from or exceeding the spirit of the invention.

Referring to the drawings in which like reference numerals indicate like or similar parts:

Figure 1 is an elevational view partly in section of the attachment comprising this invention.

Figure 2 is a sectional view on the line 2—2 of Figure 1.

Figure 3 is a detail view of a manual control lever as viewed on the line 3—3 of Figure 1.

Figure 4 is a sectional view on the line 4—4 of Figure 1.

Figure 5 is a diagrammatic view of the hydraulic control circuit of this invention.

Figure 6 is a fragmentary transverse sectional view of one form of grinding machine in conjunction with which the present invention is adapted to be employed.

This invention is particularly applicable to a grinding machine of the type disclosed in United States Patent No. 2,101,644, issued December 7, 1937, and the reference numeral 10 in Figure 1 of the drawings indicates the saddle of such a machine. This saddle, as disclosed in the patent, carries the work and is bodily movable on the bed A toward and from a cutting tool such as the grinding wheel D for effecting a grinding operation. Such movement may be effected by rotating a screw 11, Figures 5 and 6, which has one end threaded in a nut 11a which is fixed with the bed A of the machine and the other end slidably journaled in a bearing 12 carried by the saddle 10.

The tool or grinding wheel D is carried by the column or tool support E rising from the rear portion of the bed or support A. The saddle 10 is supported on the bed for in and out movement and is provided at its forward portion with the ways B for the translatable table or work support C which is in turn provided with work holding means indicated in part at F. It will thus be noted that due to the position of the work support on the upper forward portion of the saddle 10, it is relatively movable with respect to the tool support E and in a direction toward and from said support with the saddle as controlled by the screw 11 and the piston cylinder or motor structure 14—15 as hereinafter described.

The screw has a reduced portion 13 to which is fitted a piston 14, the piston being slidably mounted in a cylinder 15. It will be obvious that during rotation of the screw that pressure must be maintained in one end of the cylinder 15 in order that the screw may impart movement to the saddle. The screw adjustment is utilized more particularly with a pick feed mechanism during traverse grinding but is not suitable for automatic infeed grinding operations. Therefore, the piston and cylinder arrangement is provided for infeeding operations because by admitting pressure to port 16 and connecting port 17 to exhaust the saddle may be moved quickly to effect engagement between the work and grinding wheel after which, by properly controlling the rate of flow, the movement may be continued at a slower rate to effect the grinding operation.

The admittance of fluid pressure to the cylinder 15 is controlled by a servo-valve indicated generally by the reference numeral 18 and this valve has a plunger 19 in which is formed two grooves 20 and 21 for alternately connecting a pressure port 22 with motor ports 23 and 24 which are connected by channels 25 and 26 to the cylinder ports 16 and 17 respectively. The pressure port 22 is continuously supplied with pressure by suitable means such as the pump 27 having an intake 28 through which fluid is withdrawn from a reservoir 29. The exhaust ports 30 and 31 of the servo-valve are connected by a return line 32 to the reservoir.

The servo-valve plunger 19 is continuously urged in one direction by a spring 33 which holds the valve plunger into contact with one end of a lever 34 which is pivotally connected at an intermediate point 35 to a plunger 36, and at the

other end to the screw 11 by means of a shifter groove 37 into which the ball-shaped end 38 of the lever fits.

The plunger 36 is held against rotation and is surrounded by a rotatable sleeve 39 to which it is operatively connected by pin 40 engaging cam slot 41. The cam slot 41 is angularly arranged with respect to the axis of the sleeve and plunger whereby rotation of the sleeve will effect axial movement of the pin and thus of the plunger 36.

A manual control lever 42 is attached to the sleeve 39 for imparting rotation thereto and thereby effecting reciprocation of the plunger 36.

The cam slot 41 is so angularly arranged that when the lever 42 is rotated in a clockwise direction as viewed in Figure 5, the plunger 36 is axially shifted to cause clockwise rotation of the lever 34 about its pivot 38, thereby shifting the servo-valve plunger 19 is a direction to connect pressure port 22 with port 23 whereby pressure fluid is admitted to the cylinder 15 at the port 16. This will cause the saddle to move toward the grinding wheel. When the lever 42 is returned in a counterclockwise direction, the lever 34 is rotated in a clockwise direction by the plunger 36, thereby connecting pressure port 22 to port 24, causing the admission of fluid pressure to the cylinder 15 at the port 17. This will cause movement of the saddle away from the grinding wheel. It will be noted that the lever 34 is moved in a direction opposite to the subsequently desired movement of the saddle.

When the saddle moves, the servo-valve sleeve and the pivot point 35 move together causing return movement of the plunger in the same direction as the sleeve and pivot point move but due to the lever advantage the plunger moves faster than the sleeve and eventually closes the pressure port, thus producing the necessary follow-up movement.

This invention is directed to an infeed cycle control unit which may be attached to the front of the saddle for automatically effecting movement of the lever 42, causing it to be rotated in one direction first at a fast or rapid traverse rate and then at a slow or grinding rate, automatically reversed and subsequently returned to a starting position. It is necessary, however, that the operator rotate the lever 42 through a small predetermined angle in order to start the automatic cycle.

Attention is invited to the fact that the machine is provided with a selector valve 43 having a plunger 44 and this plunger is positioned as shown in Figure 5 when it is desired to select the infeed cycle.

This valve has two ports 45 and 46 which are connected by channels 47 and 48 to ports 49 and 50 of the sleeve 39. The plunger 36 has an annular groove 51 for connecting a pressure port 52 alternately to the ports 49 and 50. The port 52 is continuously supplied with pressure from the pump 27 by a branch line 53 leading from the pressure port 22 of the servo-valve 18. When the mechanism is in a starting position the pressure port 52 is connected to the port 49 but since the port 45 is blocked in the valve 43 no action takes place. The handle 42 must be rotated a sufficient amount to shift the plunger 36 and connect the pressure port 52 to the port 50 in order to start the automatic cycle.

When these connections are established the pressure fluid flows through the line 48 to the port 46 of the valve 43 which is interconnected at this time to a port 54 whereby the fluid pressure will continue to flow through line 55 to a pair of cylinders 56 and 57. The cylinder 56 contains a piston for automatically actuating a switch to start rotation of the headstock and the cylinder 57 contains a piston for automatically turning on the coolant. Therefore, since the line 55 is put under pressure at the beginning of the rotation of the lever 42, use is made of pressure in this line to effect shifting of a plunger 58 in a starting valve 59 located in the valve body 60 of the attachment to start operation of the automatic cycle.

As shown in Figure 5, the plunger 58 is normally held in the position shown by a spring 61. This valve has a pressure port 62 which is connected by flexible tubing or other means to the pump 27 and a plurality of exhaust ports 63, 64 and 65 which are all connected to a common return line 66.

When the plunger 58 is moved down by the incoming pressure in line 55 the port 62 is connected by an annular groove 67 in the plunger to a port 68 and this port is connected by flexible channel means 69 to a plurality of ports 70, 71, 72 and 73 in the actuating cylinder 74 pivotally supported at 74' on the saddle. The cylinder contains a piston 75 that is operatively connected by the piston rod 76 to the manual control lever 42.

It will be noted that it was necessary to rotate the lever 42 to a predetermined angle in order to effect the pressure connection to line 45 and this rotation of the lever moves the piston 75 downward a sufficient amount to close the port 71 and open the port 70 and this is the condition of these ports at the time that the pressure connection is made to line 69. It will now be obvious that the fluid pressure may enter the port 70 so as to start the power movement of lever 42.

The fluid in the lower end of cylinder 74 exhausts through port 77, channel 78 and interconnected ports 79 and 80 of a reversing valve, indicated generally by the reference numeral 81, to channel 82. This channel has a branch connection 83 to port 84 of a by-pass or rapid traverse control valve, indicated generally by the reference numeral 85 and including a plunger 86. The channel 83 has a check valve 87 serially arranged therein and so directed that pressure in line 82 will open the check valve.

The valve plunger 86 has an annular groove 88 for interconnecting port 84 with an exhaust port 89. At the beginning of the cycle the plunger 86 is held downward against the resistance of a spring 90 in a position to interconnect ports 84 and 89 and thereby form a low resistance path to reservoir from the cylinder 74.

The plunger 86 is actually held in this position by a rapid traverse control cam 91 which is attached to the hub 92 of the control lever 42 as by bolts 93. By means of the elongated slots 94 in the cam plate 91 the cam may be rotatably adjusted relative to the lever in order to adjust the rate change point 95 of the rapid traverse cam and thus determine the point during the travel of the piston 75 at which the rate of movement will change from rapid traverse to feed. In other words, at the point 95 the cam falls away rapidly to the inactive portion 96 of the cam, permitting the plunger 86 to rise under the urge of the spring 90 and thereby close the port 89.

The closing of port 89 forces the fluid in channel 82 to traverse a new path comprising ports

97 and 98, of a manually rotatable valve 99 which is normally in a position that a cross bore 100 in the plunger interconnects ports 97 and 98. A channel 101 connects port 98 to port 102 of the starting valve 59, the plunger 58 of which is in a position that the annular groove 103 in the plunger connects port 102 to port 104. The fluid continues through this port and channel 105 to port 106 of an infeed rate control valve, indicated generally by the reference numeral 107.

This valve has a plunger 108 which is threadedly connected at 109 to the housing whereby rotation of the plunger by the knurled knob 110 will adjust the V-notch 111 relative to the port 106 and thereby control the rate of flow through the valve. The fluid collects in the upper chamber 112 and passes through port 113, channel 114 to port 115 of the starting valve, which port is part of the annular groove 64 so that regardless of the position of the plunger 58 the fluid will continue through the groove to the exhaust line 66.

It will now be apparent that the closing of the rapid traverse valve changes the rate of movement of the piston 75 from a rapid traverse movement to a feed movement. It will be obvious that the setting of the rapid traverse cam makes the rate change point uniform for each cycle and does not allow for variations in the size of work coming to the machine. In other words, the cam must be set to suit the largest size of work coming to the machine and some time would be lost when work smaller than the maximum comes to the machine. In order to eliminate this lost time, provision is made whereby the operator may press on the lever 42 and thus accelerate the movement until the grinding wheel engages the work and begins to spark. This adds versatility to the device.

This is made possible by providing a "run-ahead" valve 116 having a plunger 117 normally held in the position shown by a spring 118. This valve has a port 119 which is connected by channel 120 to the annular groove port 106 of the rate valve whereby when the pressure in this groove rises beyond or overcomes the resistance of spring 118 the plunger 117 is forced downward a sufficient amount to interconnect port 119 with port 121 whereby the fluid may return through channel 122 to the chamber 112 of the rate valve, thus bypassing the resisting groove 111 permitting a greater amount of fluid to exhaust through the line 114 which is necessary in order that the piston 75 may move at a more rapid rate.

After the grinding wheel is in grinding relation with the work the feeding movement continues at the rate determined by the rate valve until the grinding operation has been completed or, in other words, until the servo-motor piston 14 has reached the end of its stroke. Positioned so as to be timed with this, is a rise 123 on another cam 124 integral with the hub 92 of the control lever 42 which rise actuates the plunger 76 to open the rapid traverse valve, thus short-circuiting the return line 82 to reservoir again, permitting the piston 75 to move at a rapid rate for a short distance, thereby opening the servo-valve without a compensating follow-up movement due to the fact that the piston 14 is at the end of its cylinder. This causes a rise in pressure in the cylinder 15 firmly holding the saddle against what might be termed a positive stop. After this has been accomplished, the piston 75 engages the end of a reversing valve plunger 125 which is located in the end of the cylinder 74 and shifts it against the resistance of a spring 126.

A small movement of the reversing plunger will crack the port 72 which is under pressure at this time and the fluid pressure will rush into the chamber 127 and continue the movement due to the fact that the spool 128 on the valve is larger in diameter than the spool 129 which produces a differential effect. Any fluid in the space 130 below the valve will exhaust freely through the port 131 and branch line 132 to the annular groove port 80 and thus to reservoir until the port 130 is closed by the plunger. It will be seen that the operation up to this point, is that the piston rotated the lever at a fast rate to bring the grinding wheel ino the work, then rotated it at a slow rate to effect the grinding operation which operation terminated when the piston 14 reached the end of its cylinder. The lever 42 was still capable of a small additional movement, and during this movement, the rapid traverse valve was opened and the reversing valve was shifted resulting in a short fast movement of the lever which opened the servo-valve to firmly hold the saddle against its positive stop which movement also shifted the reversing valve sufficiently to start its own movement independent of the lever actuating piston which is necessary because the piston is stopped from further movement by the lever engaging the positive stop 143.

The movement of the reversing valve is retarded by a tarry valve in the following manner.

The fluid is forced through the port 133 and channel 134 to port 135 of a tarry valve indicated generally by the reference numeral 136. This valve has an adjustable plunger 137 which is threadedly connected at 138 to the valve and rotatably adjusted by the knurled knob 139 to set the position of the resistance V-groove 140 relative to the port 135 to control the rate of escape of the fluid through the valve and thereby regulate the amount of tarry of the reversal. The fluid escaping through the valve accumulates in the chamber 141 and passes through line 142 back to the annular groove 80 and return line 82.

As the reversing valve continues to move, a groove 144 in the valve registers with port 131. In this groove are radial holes 145 which communicate with the spring bore 146 for spring 126, thus forming a by-pass around the tarry valve, the fluid in chamber 130 now escaping through the spring bore 146, radial holes 145, groove 144, port 131 and channel 132 to the exhaust groove 80. This permits a quick movement of the reversing valve plunger which is sufficient to completely and quickly uncover the pressure port 73 whereby the annular groove 147 will connect port 73 to port 79.

When this has been established it will be noted that the pump pressure is now connected to both ends of the cylinder 74 but since the area of the lower end of piston 75 is larger than the area of the upper end, the piston 75 will move upwards returning the lever 42 while the reversing valve plunger 125 will be prevented from returning to its normal position by the pump pressure in the lower end of cylinder 74 whereby the return movement of piston 75 can be completed without interruption.

As the lever 42 reaches the end of its return stroke, the plunger 36 will have been shifted sufficiently to interconnect port 50 of valve 39 to an exhaust port 148. This will connect the channel 55 which supplied the pressure for holding the

starting valve in a running position to reservoir whereby the valve plunger 58 will return under the urge of spring 61 but in order to retard this returning movement a choke coil 149 is inserted in the line 55 so as to maintain the return movement of the lever 42 long enough to close the port 70. When the starting valve plunger is returned sufficiently to interconnect ports 68 and 63, the pressure in cylinder 74 is released and the reversing valve plunger 129 is returned to its starting position by the spring 126.

Ordinarily the movement of plunger 125 would tend to create a vacuum in the chamber 130, but this is prevented at the beginning of the stroke by the fact that the groove 144 is in registry with the port 131 whereby fluid may be drawn from the return line 82 through channel 133 and after these parts move out of registry, fluid is drawn from the same line 82 through channel 142, chamber 140, check valve 150 which is only held closed by a light spring, annular groove 135 in the tarry valve and channel 134. Thus, all the parts have automatically returned to their starting position.

The rotatable valve 99 has in addition to the cross bore 100, a second cross bore 151 which interconnects the parts of channel 69. This valve plunger has an operating lever 152 keyed to the lower end thereof as shown in Figures 1 and 3. Rotation of this valve blocks the lines from ports 68 and 102 of the starting valve and interconnects parts 153 and 97 by means of longitudinal grooves 154 and 155 and annular groove 156, thereby interconnecting the ends of cylinder 74 to permit manual operation of lever 42. This valve may also be used for emergency stop purposes.

There has thus been provided an improved automatic infeed attachment suitable for attaching to grinding machines having a manual infeed control lever for automatically imparting movement to the lever in a manner to effect a complete automatic infeed grinding cycle.

What is claimed is:

1. In a machine tool having a work support and a tool support and means for effecting relative movement between the supports including a manual control lever which is oscillatable through a predetermined angle to effect a cyclic advance and retraction between said supports, the combination of an automatic cycle control unit attachable to the machine, said unit having a power operable member connectible to said lever, a source of power for said member, and means automatically responsive to a small manual movement of said lever to connect said source of power to said power operable member whereby the initial manual movement of the lever will be continued automatically.

2. In a grinding machine having a work support and a grinding wheel support, means for effecting an infeeding movement between said supports including a manual control lever, a cycle control unit for the lever, said unit having a fluid operable member, a source of pressure therefor, means responsive to manual movement of the lever for connecting said source of pressure to said fluid operable member whereby the lever will be moved by power to effect an infeed grinding operation, and means automatically shiftable for reversing the direction of movement of said member to effect return of the grinding wheel to a starting position.

3. In a machine tool having a work support and a tool support, means for effecting relative movement between the supports including a manual control lever, a cycle control unit attachable to the machine and having means in the unit for operating said lever, means to control the rate and direction of movement of the lever, a source of power, and means controlled by said lever for connecting said source of power to said cycle control unit.

4. In a machine tool having a work support and a tool support, means for effecting relative movement between the supports including a manual control lever, an automatic cycle control unit attachable to the machine for operating said lever, said unit including a fluid operable member connectible to said lever, a feed rate control valve, a cam operated valve for rendering the feed rate control valve ineffective, a source of fluid pressure in the machine, means operable by the lever for connecting said source to said unit, and cam means carried by said lever for operating said cam operated valve at preselected points in the cycle of lever movement.

5. In a cycle control unit for a machine tool having a manually operable cycle control lever, the combination of a fluid operable piston in said unit operatively connected to said lever, said unit having a shiftable valve means for connecting a source of fluid pressure to said piston to effect movement in one direction, a reversing valve, means operable by the piston for shifting said reversing valve sufficiently to stop the movement of the piston, fluid operable means for continuing the shifting of said reversing valve after the piston has stopped, a tarry control valve for controlling the time of shifting and thereby provide a dwell in the movement of said lever, and means responsive at the end of the shifting of said reversing valve for effecting return movement of said piston.

6. In a machine tool having a work support and a tool support, means for effecting relative movement between the supports including a manual control lever, a cycle control unit attachable to the machine and having a power operable member for moving said lever, a start and stop valve in the unit for connecting fluid pressure to the power operable unit, a source of pressure in the machine connected to said valve, means operable by the lever for connecting said source of fluid pressure for shifting said valve to start operation of the power operable member, means in the unit for automatically reversing the direction of movement of the lever, means operable by the lever during its return movement to disconnect the shifting pressure from the start valve, resilient means for returning said start valve, and a choke coil for retarding the return of said start and stop valve whereby the return stroke of the lever will be greater than its power advance stroke.

7. In a machine tool having a work support and a tool support, means for effecting relative movement between the supports including a manual control lever, a cycle control unit attachable to the machine, a fluid operable member in the unit connectible for shifting said lever, a source of fluid pressure connected to said unit, valve means in the unit for connecting said source of fluid pressure to the fluid operable member, a return channel from said fluid operable means including a rate control valve for determining the rate of movement of said member, a reservoir by-pass valve connected to said channel, cam means carried by said lever for holding said by-pass valve open during the initial stroke of the fluid operable means whereby

the lever will be moved at a rapid traverse rate, said cam means being formed to permit closure of the valve after a predetermined movement of the lever to produce a feed rate, and other cam means carried by the lever for opening said valve at the end of the advance stroke of the lever.

8. In a machine tool having a work support and tool support means for effecting relative movement between the supports including a manual control lever, a cycle control unit attachable to the machine and having a source of pressure connected thereto, said unit including a fluid operable member connectible for actuation of the lever, a start and stop valve for connecting said source of fluid pressure to said member, a throttle valve controlling the rate of exhaust from said member, separate channels for connecting each of said valves to said fluid operable members, and an auxiliary control valve serially connected in said channels and positionable at will to block the portions of the channels leading from said valves and interconnecting the portions of the channels from said fluid operable member to permit manual operation of said lever.

9. In a machine tool having a work support a tool support and means for effecting relative movement between the supports including a manual control lever, a cycle control unit attachable to the machine, said unit containing a fluid operable piston, means to connect the piston to said lever for power operation thereof, a source of fluid pressure connected to said unit, means in said unit controlled by said lever for connecting said source of fluid pressure for operation of the piston, a reversing valve adapted to be shifted by the piston to initiate a self-energized stroke thereof, a tarry valve for controlling the rate of said stroke, and means operable by the reversing valve for short-circuiting said tarry valve whereby the final movement of the reversing valve will be at a fast rate to effect the necessary connections to cause a rapid return movement of the piston.

10. In a device of the character described, the combination with an actuating piston, of a hypositely coupled with the piston for conveying tuation of said piston, an exhaust conduit opdraulic circuit for effecting a unidirectional achydraulic actuating medium displaced thereby, a pair of alternatively available exhaust conduits, means for effecting low resistance to flow in one of said conduits, means for effecting higher resistance to flow in the other of said conduits, a selector device for determining the effective coupling of the piston exhaust conduit with respect to the low resistance exhaust conduit, whereby feed or rapid traverse movements of the piston may be effected under given actuating pressure according to the high or low resistance exhaust conduit reaction thereon, and additional means for bypassing the high pressure resistance to permit increased rate of discharge of the actuating medium by way of the high pressure resistance conduit.

11. In a device of the character described, the combination with an actuating piston, of a hydraulic circuit for effecting a unidirectional actuation of said piston, an exhaust conduit oppositely coupled with the piston for conveying hydraulic actuating medium displaced thereby, a pair of alternatively available exhaust conduits, means for effecting low resistance to flow in one of said conduits, means for effecting higher resistance to flow in the other of said conduits, a selector device for determining the effective coupling of the piston exhaust conduit with respect to the low resistance exhaust conduit, whereby feed or rapid traverse movements of the piston may be effected under given actuating pressure according to the high or low resistance exhaust conduit reaction thereon, additional means for bypassing the high pressure resistance to permit increased rate of discharge of the actuating medium by way of the high pressure resistance conduit, and additional means for blocking the flow through the high resistance conduit.

12. The combination with a pair of relatively movable support elements and a servo-mechanism including relatively displacable parts for controlling the movement of said element, of means for determining cycle actuation of the servo-mechanism, including a selector valve, means serially coupling the selector valve with the servo-mechanism, a normally closed cycle determining valve for hydraulic actuation by way of the valve upon activating displacement of the servo- elements, an auxiliary hydraulic actuating motor for said servo-elements and control circuits for said motor coupled with and completable by way of the cycle valve upon hydraulic actuation thereof.

13. The combination with a pair of relatively movable support elements and a servo-mechanism including relatively displacable parts for controlling the movement of said element, of means for determining cycle actuation of the servo-mechanism, including a selector valve, means serially coupling the selector valve with the servo-mechanism, a normally closed cycle determining valve for hydraulic actuation by way of the valve upon activating displacement of the servo-elements, an auxiliary hydraulic actuating motor for said servo-elements, control circuits for said motor coupled with and completable by way of the cycle valve upon hydraulic actuation thereof, said control circuits including a low resistance exhaust conduit and a second exhaust conduit including a variable throttling resistance, a first means actuable by the motor for controlling the exhaust flow through the low pressure conduit, and additional means for bypassing the throttling resistance in the other conduit to lower the resistance to flow therethrough substantially as and for the purpose described.

14. In a machine of the character described, the combination with a servo-control mechanism including relatively shiftable parts, of means for effecting a cycle movement of said relatively shiftable parts including an auxiliary hydraulic motor, a hydraulic operating circuit for said motor including a cycle control valve, and means for determining the circuit completing effective position of the cycle control valve as respects the hydraulic motor including a cycle selector valve serially interposed between the cycle valve and the servo-members and positionable hydraulically to couple actuating medium from the servo to position the cycle valve upon relative activating movement of the servo-elements in one pressure coupling direction.

15. In a machine of the character described, the combination with a servo-control mechanism including relatively shiftable parts, of means for effecting a cycle movement of said relatively shiftable parts including an auxiliary hydraulic motor, a hydraulic operating circuit for said motor including a cycle control valve, means for determining the circuit completing effective position of the cycle control valve as respects the

hydraulic motor including a cycle selector valve serially interposed between the cycle valve and the servo-members and positionable hydraulically to couple actuating medium from the servo to position the cycle valve upon relative activating movement of the servo-elements in one pressure coupling directon, means for effecting an opposite directional positioning of the cycle control valve to prevent activation of the auxiliary control motor, and means for delaying the response of the cycle valve to opposite positioning of the servo-elements.

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