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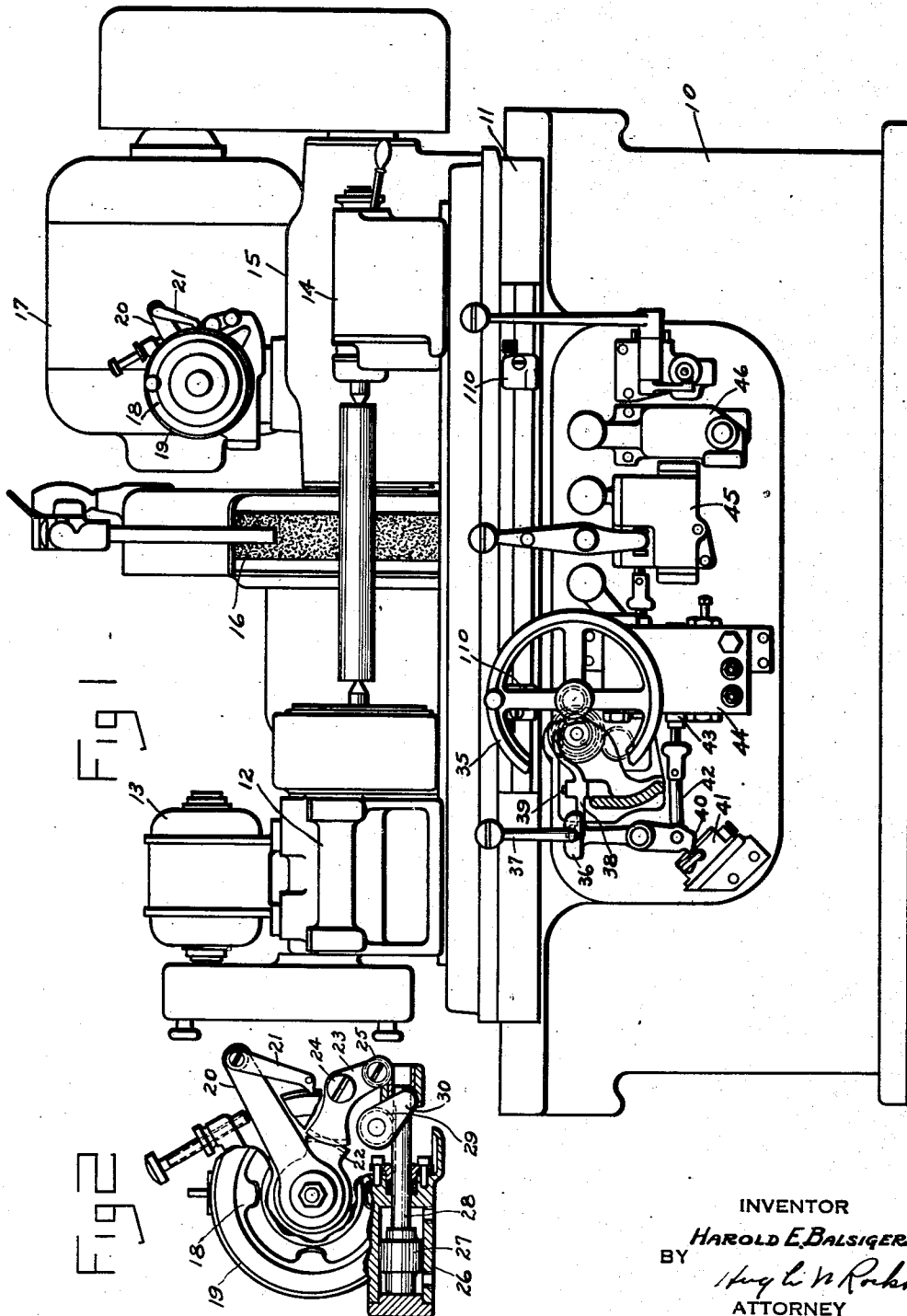
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2,249,343

REVERSING MECHANISM

Filed April 21, 1937

3 Sheets-Sheet 1



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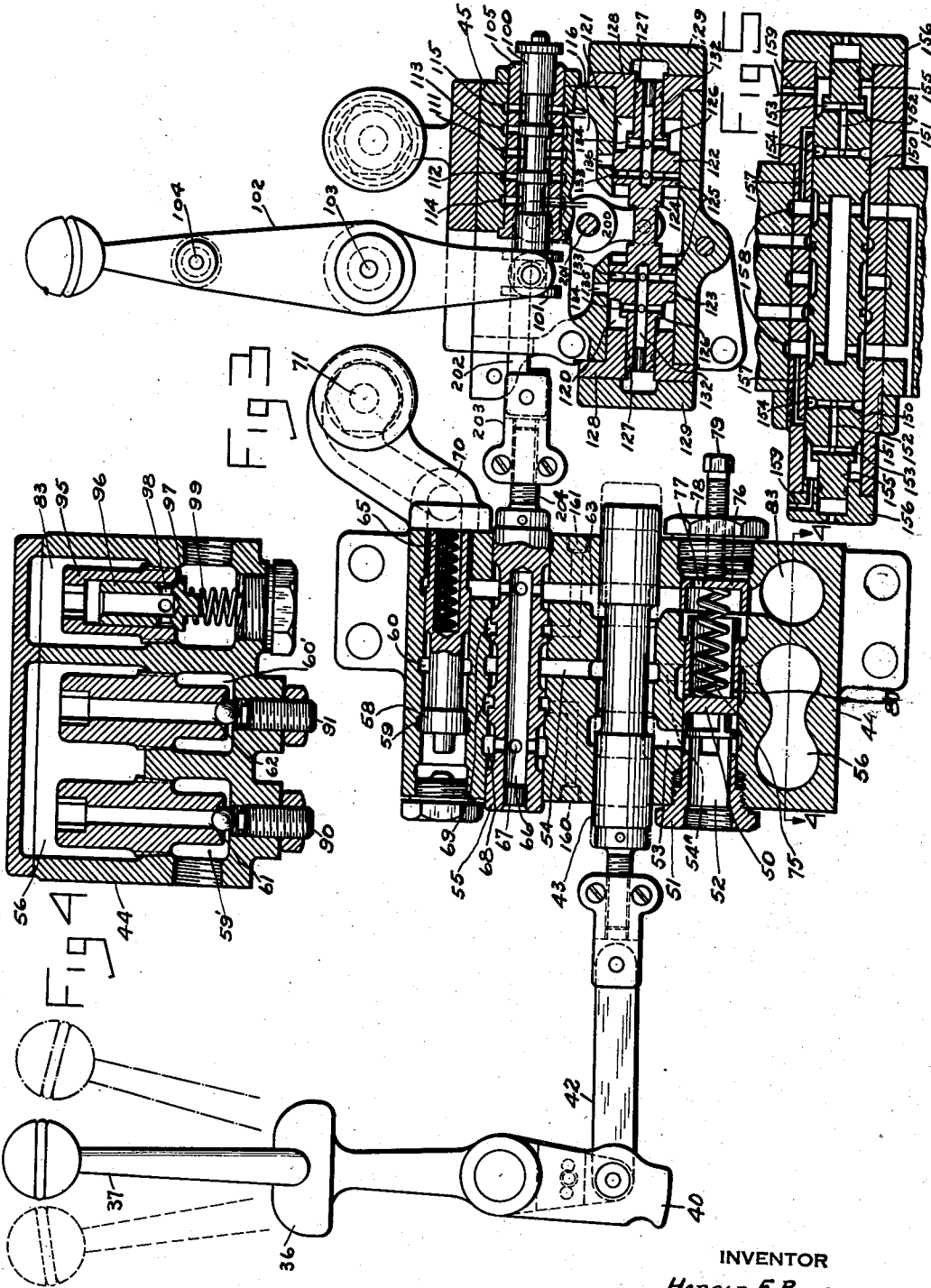
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REVERSING MECHANISM

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3 Sheets-Sheet 2



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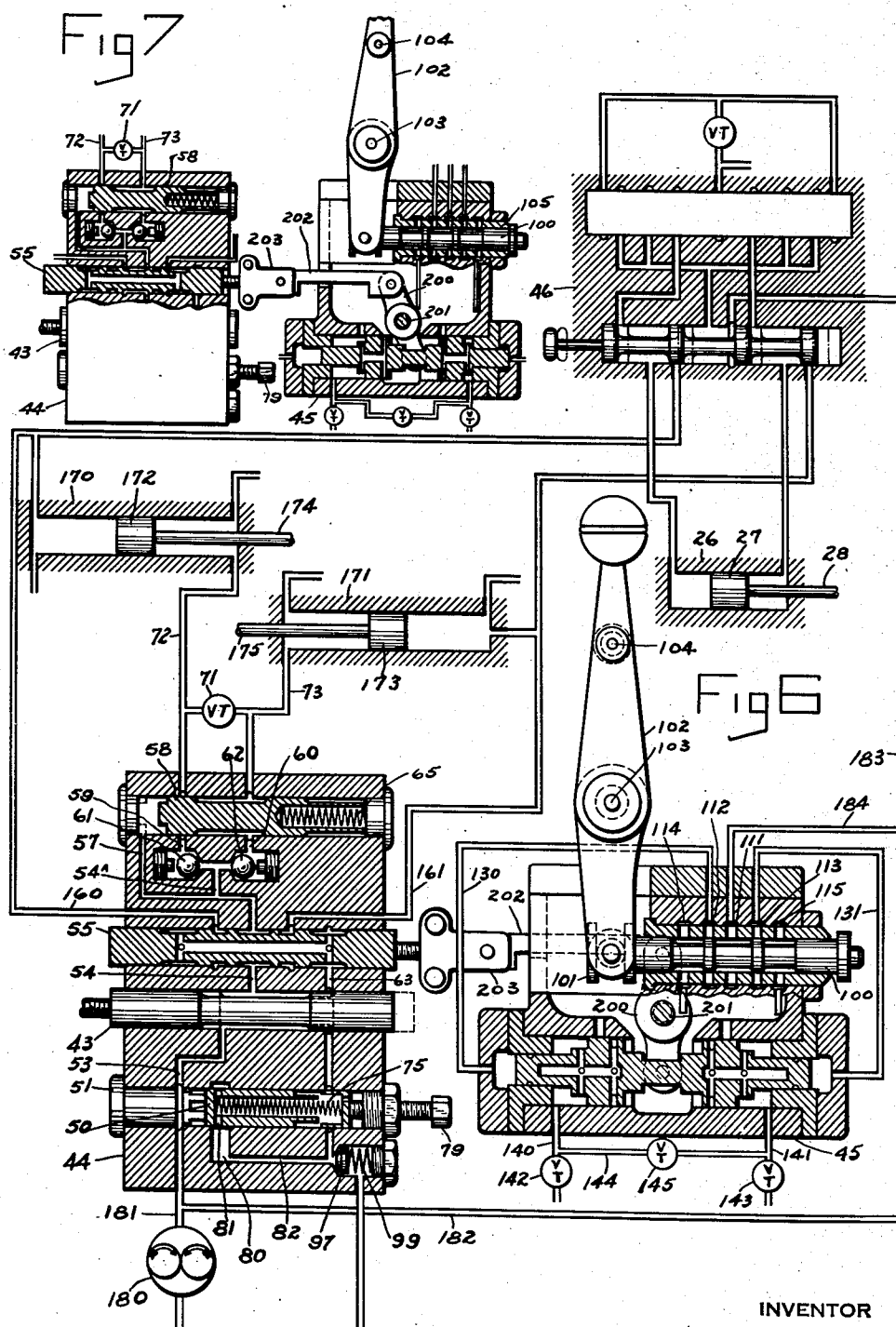
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REVERSING MECHANISM

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3 Sheets-Sheet 3



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REVERSING MECHANISM

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Application April 21, 1937, Serial No. 138,245

3 Claims. (Cl. 121—45)

My invention refers to reversing and feed mechanisms for machine tools, especially grinding machines, and this application is a continuation-in-part of copending Balsiger et al. application for Piston grinding machine, Serial No. 46,168, filed Oct. 22, 1935, and issued on May 21, 1940 as Patent No. 2,201,218.

An object of my invention is to provide a reversing mechanism which will operate with a minimum of effort and shock.

A further object is to provide means for obtaining a dwell in the traverse movement at one or both reversal points.

A further object is to provide controllable means for shifting the reversing mechanism.

A further object is to provide means for automatically bypassing a traverse speed control valve when pressure on the traverse mechanism is released.

My reversing mechanism consists essentially of three parts, a reversing valve, tarry mechanism and a pilot valve. I realize that each of these elements is old in the art, but I do not believe that this particular combination, and the results obtained therefrom, have ever been known in the prior art. Previous to my invention of the above device it was known to operate a reversing valve from a pilot valve, but the reverse was instantaneous, no provision being made for a dwell in the traverse movement. In previous types of tarry mechanisms, the reversing lever was first shifted to a neutral position by the moving part to stop the movement thereof. The parts were allowed to remain in that position for a predetermined interval after which they were quickly shifted to reverse position by some form of load and fire mechanism. Another form of tarry mechanism consisted of a lever which was shifted by the traversing carriage to load a spring on the reversing mechanism. At a predetermined point the spring was released and the reversing mechanism shifted quickly to a central position where it was checked in its movement by a dash pot or similar device. The shifting movement then continued at a slower rate until it was completed.

My invention consists of a pilot valve actuated by a traversing element, a fluid operated tarry mechanism actuated by fluid under pressure from said pilot valve, and consisting of pair of opposed pistons connected through a link and lever mechanism to a reversing valve. This piston may also be attached directly to said reversing valve and exhaust fluid may be used to keep the tarry cylinders filled. Upon actuation of the reversing

lever by the traversing element the pilot valve directs fluid to one side of the tarry mechanism which is instantly shifted far enough to center the reversing valve and positively stop the carriage. The time required for the reversing valve to be shifted from central position to a position just short of reversing may be varied but as that point is reached the valve is shifted instantly to said reverse position. This arrangement provides an extremely accurate reverse.

The feed mechanism is arranged so that by shifting a valve the feed may be actuated by the reversing mechanism or independently thereof. This feed mechanism is of the well known ratchet and pawl type actuated by a hydraulically reciprocated piston which may be shifted each time the carriage is reversed by fluid under pressure directed thereto from the reversing valve. In the absence of a traverse movement a self-reversing feed control valve may be used. The operator of the machine may select one or the other of these mechanisms for operating the pawl and ratchet by simply pushing or pulling the selector valve.

In the drawings—

Fig. 1 is the front elevation of a machine on which my invention is incorporated.

Fig. 2 is a front elevation partly in section of the mechanism for actuating a pawl and ratchet type feed mechanism.

Fig. 3 is a front elevation in section of my reversing and tarry mechanism.

Fig. 4 is a section on line 4—4 of Fig. 3.

Fig. 5 is an optional arrangement of the tarry and reversing valve.

Fig. 6 is a sketch showing the piping for my device.

Fig. 7 is a diagrammatic sketch showing the control mechanism in position to shift the carriage to the right.

In Figures 1 and 2 numeral 10 indicates the bed of a grinding machine, 11 a work support slidably mounted thereon, 12 a headstock, 13 a headstock motor, and 14 a footstock, all mounted on said work support. A wheel support 15 is also mounted on said bed for movement transversely of the work support. A grinding wheel 16 is rotatably mounted on said wheel support. A motor 17 for driving said wheel is mounted on said wheel support. A hand wheel 18 may be used in connection with any suitable mechanism to provide a means for feeding the grinding wheel toward and from the work. The feed mechanism may also be operated by a means such as that shown in Figure 2. A ratchet wheel 19 is mounted

on the hand wheel shaft adjacent to hand wheel 18. An arm 20 carrying a pawl 21 is also mounted on said hand wheel shaft, and said pawl is held in contact with said ratchet wheel by some suitable resilient means not shown. A gear segment 22 is mounted on said hand wheel shaft and attached to arm 20. Meshing with gear segment 22 is another segment 23 in the form of a bent lever, pivoted at 24 and having a roller 25 on the end opposite the gear teeth. Under the hand wheel shaft and perpendicular thereto is mounted a cylinder 26 in which is a piston 27 which may be actuated in either direction by fluid under pressure from a source which will be described later. An elongated piston rod 28 has rack teeth cut therein, said teeth engage a pinion 29 to which is secured a cam shaped arm 30 adapted upon rotation to engage roller 25.

In Figure 1 a hand wheel 35 is connected to suitable gearing to drive the work carriage 11. A clutch in said gear train is actuated by a cam surface 36 on the start and stop lever 37, in contact with one end of the clutch operating lever 38 pivoted at 39. The lower end of lever 37 has another cam surface 40 for operating the normally open limit switch 41. Also attached to said lever is a link 42 for operating a start and stop valve 43 in valve body 44. A housing 45 containing a pilot valve and tarry device is mounted adjacent to valve body 44. The means for driving the carriage 11 is a hydraulic motor, shown diagrammatically in Figure 6, and consists of two cylinders 170 and 171 in which are mounted pistons 172 and 173 respectively. Piston rods 174 and 175 are connected to carriage 11 in a suitable manner. This structure is similar to that shown in my co-pending application 524,706 filed March 23, 1931 for Cylindrical grinding machine, now Patent No. 2,103,808 granted December 28, 1937, except that in this case the inner ends of the cylinders are connected through a fluid passage containing a throttle valve which controls the speed of the carriage 11 while in the earlier filed case the connecting line is between the outer ends of the cylinders.

My traverse control valve consists of a housing 44 in which is mounted a relief valve 50, a start and stop valve 43, a reversing valve 55 and a by-pass valve 58. The bore containing said relief valve extends the entire width of the housing 44, the end of said bore is closed by a cap 51 inserted therein having a passage 52 through which fluid under pressure may enter the housing. A port 53 connects valve 50 with start and stop valve 43. A passage 54 connects valve 43 with reversing valve 55, and also through a branch passage 54a with a chamber 56 in the lower part of housing 44. An extension 57 of passage 54 serves to direct fluid to the left end of by-pass valve 58. A spring 65 mounted in a hollow end portion of said valve 58 urges said valve to the left. Two ports 59 and 60 are connected by passages through the front part of the housing 44 with chamber 56 in which are mounted a pair of check valves 61 and 62. Said ports are also connected through a manifold 70 to the opposite sides of a throttle valve 71. Each of said check valves is inserted in a recess 59' or 60' which in turn is connected to port 59 or 60 as shown. Both of said check valves open into a portion of chamber 56 which is supplied with fluid under pressure thru passage 54a. Adjusting screws 90 and 91 determine the maximum opening of said check valves. An exhaust passage 63 connects the right-hand end of all the valves. A spring

65 serves to hold the by-pass valve 58 in an extreme left-hand position in the absence of fluid under pressure at that point. Ports 69 in reversing valve 55 direct fluid from the passage 54 alternately through passages 160 and 161 to opposite ends of a traverse motor. An axial passage 66 in said reversing valve is connected through radial ports 67 with exhaust port 68 and an exhaust line 63.

The start and stop valve 43 and lever 37 are shown in intermediate positions. The first or inoperative position of said parts is shown by dotted lines. The third position is shown by dot and dash lines. In the first position the switch 41 is open rendering headstock motor 13 inoperative. Valve 43 is in the extreme right hand position as shown by the dotted lines and thus cuts off the supply of fluid under pressure from port 53. Passage 54 is connected to exhaust passage 63. In the intermediate position shown in solid lines, switch 41 is closed and the headstock motor is started. Valve 43 is so positioned that port 53 is partially opened and exhaust passage 63 is partially closed. Thus fluid under pressure entering through port 53 is immediately returned to the reservoir through exhaust passage 63 and the traversing mechanism remains inoperative. Fluid under pressure is available for other mechanisms, however, at any point in the system between the pump 180 and the relief valve 50. In the third position the switch is still held in closed position and valve 43 is moved far enough to the left to open port 53 completely and to close passage 63. Fluid under pressure is then directed through passage 54 and 54a to the traverse motor.

The relief valve consists of a movable piston element 50 having a hollow portion in which is mounted a spring 75. Said spring urges said piston 50 to the left or closed position against a seat formed by the inner end of cap 51. The other end of said spring is seated in a cup shaped member 76 having a hole 77 therein to prevent fluid from becoming locked between said cup and the end cap 78. An adjusting screw 79 is threaded in said cap and bears against said cup 76 for varying the setting of the valve. Upon an excess of fluid entering passage 52, piston 50 will be shifted enough to permit such excess to enter port 80. From port 80 fluid may pass through passage 82 (shown diagrammatically in Fig. 6) to exhaust passage 63.

The elements mounted in chamber 56 and in the lower end 83 of exhaust passage 63 are shown in Figure 4. Check valves 61 and 62 have been described above. The other element, also a valve, consists of a seat portion 95 inserted in chamber 83 in a manner similar to the corresponding parts of valves 61 and 62. The movable part of this valve consists of a cylindrical element 96 having a bevel flange 97 for engaging a seat portion. Said element 96 is hollowed to a point approximately even with the seat at which point it is pierced by several radial openings 98. Said valve is held against the seat by means of a spring 99. One end of said spring rests against a plug in the front end of chamber 83. The purpose of this valve is to prevent drainage of the fluid system when the fluid under pressure is cut off.

Means for actuating the reversing valve consists of a pilot valve and a tarry device in the housing 45. The pilot valve is a conventional reversing valve consisting of a piston 100 having a spool 101 in one end, a lever 102 pivoted at 103 and having a lug 104 for engagement by revers-

ing dogs 110 is suitably constructed to engage said spool and shift said valve piston when actuated either manually or by said dogs. Piston 100 is slidably mounted in a sleeve 105 in which are machined the necessary ports. Said sleeve is in turn mounted in housing 45. Fluid under pressure is supplied to said valve through a port 111 and is distributed to either side of the tarry mechanism through ports 112 and 113. The exhaust ports 114 and 115 direct the exhaust fluid to reservoir 116 from which it is utilized by the tarry mechanism. Any overflow from said reservoir is conducted back to the main reservoir.

The tarry mechanism consists of a pair of cylinders 120 and 121 below the level of reservoir 116. A pair of pistons 122 and 123 joined together by connecting portion 124 are slidably mounted in said cylinders. A lever 200 pivoted at 201 is operably attached to said connecting portion. The other end of said lever is connected to a link 202 which is in turn connected to a coupling 203. This coupling is threaded on an extension 204 of the reversing valve 55. Each piston consists of the piston proper 125, a shoulder portion 126 and a reduced portion 127 in the form of a second piston. Adapter pieces 128 bored and inserted in cylinders 120 and 121 provide cylinders for said piston 127. Each of the pistons 122 and 123 contains an axial bore 132 intersected by two sets of radial passages 133 and 134, one set in the piston proper 125 and one set in the shoulder portion 126. Passages 135 and 136 connect cylinders 120 and 121 with reservoir 116. Cylinder heads 129 cover the outer ends of said cylinders. Fluid under pressure is directed to said smaller cylinders through cored passages 130 and 131 shown diagrammatically in Figure 6.

Each of the cylinders 120 and 121 has exhaust passages 140 and 141 respectively, and in each is inserted a throttle valve 142 and 143 respectively. Fluid passing through these valves is returned to the reservoir. Another line 144 connects passages 140 and 141 and has a throttle valve 145 mounted therein. Thus it is possible to provide a uniform dwell period at each reversal of the carriage by closing valves 142 and 143 completely and causing fluid to pass between cylinders 120 and 121 through valve 145. When it is desired to control the dwell period independently at each end of the stroke, valve 145 is closed and valves 142 and 143 are adjusted as desired.

Another form of my tarry is shown in Figure 5. In this figure the reversing valve and the piston are single units 150 slidably mounted in a valve body 151. Those portions of the unit corresponding to the tarry pistons each have axial bores 152 joining the two sets of radial passages 153 and 154. The operating piston 155 functions in cylinders provided by boring out the cylinder heads 156. This form of tarry also may be operated by fluid under pressure from pilot valve 100. Fluid is supplied to the tarry cylinders through passages 157 from exhaust ports 158 in the reversing valve. Fluid is discharged from the tarry cylinders through passages 159 and throttle valves not shown which determine the rate of discharge of each cylinder independently of the other. With this arrangement the dwell period at each end of the carriage movement may be varied independently from an immediate or instantaneous reverse to an indefinite dwell.

My reversing mechanism is used to control the movement of a hydraulic traverse motor, particularly of the type shown diagrammatically in Fig-

ure 6, which consists of a pair of cylinders 170 and 171 in which are mounted pistons 172 and 173 respectively. Piston rods 174 and 175 are connected to carriage 11 in a suitable manner not shown. The piston rod ends of said cylinders are connected by fluid passages 72 and 73 and throttle valve 71. Passages 72 and 73 are also connected to bypass valve 58.

Operation

To start the machine the operator must open throttle valve 71 to permit fluid to pass there-thru between the cylinders 170 and 171, then he must shift valve 43 to the left by means of lever 37. Cam 36 on said lever actuates another lever 38 to disengage the hand wheel 35 from the traverse mechanism. Cam 40 on the lower end of said lever actuates limit switch 41 to start the headstock motor 13.

Fluid under pressure is supplied to the valve body 44 from pump 180 through line 181 and passage 52 in cap 51 from which it passes through relief valve 50 and passage 53 to valve 43. Upon shifting valve 43 to the left fluid from passage 53 is directed to passage 54 through which it passes to passage 57 and then to the left end of bypass valve 58 shifting said valve to the right thus preventing an unobstructed passage of fluid between cylinders 170 and 171 and causing fluid to pass through throttle valve 71. Said valve determines the traverse speed of the carriage 11. Fluid under pressure passes from passage 54 through passage 54a and then through either or both of the check valves 61 and 62 and passages 59 and 60 to insure that the rod ends of the two cylinders 170 and 171 and a connecting line are kept full of oil and free of air.

Reversing valve 55 also receives a supply of fluid under pressure from passage 54. In Figures 3 and 6 valve 55 is shown in central position. In Figure 7 said valve is shown in position to cause the carriage 11 to move to the right. Said reversing valve is actuated indirectly by reversing lever 102. Said lever might be actuated either manually or by reversing dogs 110 on carriage 11. Shifting said lever to the right as in Figure 7 shifts the pilot valve 100 to the left. Fluid under pressure is supplied to this pilot valve from pump 180 through lines 182 and 184 to port 111. With said pilot valve in a position shown in Figure 7, fluid under pressure is directed from port 111 to port 112 and through line 130 to the outer end of the left tarry cylinder where it acts on a piston 127 and shifts the same into right hand position. Through lever 200, link 202 and coupling 203 said piston shifts the reversing valve 55 to the left. The movement of the tarry piston 122 is unobstructed and the fluid from cylinder 121 passes freely to the reservoir through passage 136 until piston 122 closes the mouth of said passage. At this point valve 55 is in central position and movement of carriage 11 is stopped immediately. After passage 136 is closed off fluid in said cylinder must pass out through throttle valve 143 or through valve 145 to cylinder 120 as the case may be. The rate of movement of the reversing valve is determined by the setting of said throttle valve until piston 122 has moved far enough that radial passage 133 becomes aligned with passage 136. At this point the fluid in the cylinder 121 is released through passages 134, 132, 133 and 136 to reservoir 116, thus permitting a rapid movement of the reversing valve from a central position to a reverse position. With piston 122 in the position de-

scribed above, fluid from reservoir 116 is admitted to cylinder 120 through passage 135 in preparation for the movement of the mechanism in the opposite direction. Upon the shifting of lever 102 by the carriage as it moves from right to left the above described cycle is repeated.

The operation of the optional structure shown in Figure 5 is believed to be obvious in view of the description thereof. Therefore, I do not think it necessary to render a detailed account of said operation.

My invention may be constructed in various forms and applied in various ways without departing from the spirit thereof. Therefore, I do not limit my invention to the structure described in the specification and set forth in the drawings but only as indicated in the appended claims.

I claim:

1. In a grinding machine, a bed, a carriage slidably mounted on said bed, a hydraulic motor for moving said carriage, a reversing valve for controlling the direction of movement of said carriage, means for shifting said valve comprising a pair of oppositely disposed piston elements, a cylinder for each of said elements, a reduced portion on each of said elements, a corresponding reduced portion in each cylinder, means for supplying fluid under pressure alternately to each of said reduced portions, comprising a pilot valve, means for controlling the rate of movement of said reversing valve and shifting means comprising a reservoir, a supply of fluid therein, connections between said reservoir and the larger cylinders, outlet passages in each of said cylinders, and a throttle valve in each of said passages.

2. In a machine of the kind described a work

carriage, mechanism for effecting a reciprocating movement of said carriage, a reversing mechanism to control said reciprocating movement, a tarry mechanism to retard action of said reversing mechanism, comprising a cylinder, a pair of pistons mounted therein, a portion of each piston providing a driving surface and another portion thereof providing a control surface, outlet passages at opposite ends of said cylinder, a throttle valve in each passage, connections between said reversing mechanism and said pistons to reciprocate the same and cause fluid to pass from one or the other of said passages, said fluid serving to retard the movement of said piston, and means separate from said throttle valves to release said fluid at a predetermined point in the movement of said reversing mechanism.

3. In a grinding machine having a reciprocable carriage, means for driving said carriage, a reversing mechanism for said driving means, a carriage actuated reversing lever, means responsive to movement of said lever for shifting said reversing mechanism, comprising a pair of cylinders, a piston in each cylinder, a portion of each piston providing a driving surface and another portion thereof providing a control surface, the driving surface of one piston being acted upon by fluid under pressure for shifting same, the control surface of the other piston acting on a body of fluid to remove same from said cylinder, means for adjusting the rate at which said fluid may be discharged from said cylinder, and connections between said pistons and said reversing mechanism.

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