Dec. 18, 1934. O. LUNDAHL 1,984,535

CONTROL MECHANISM

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Fig. 1.

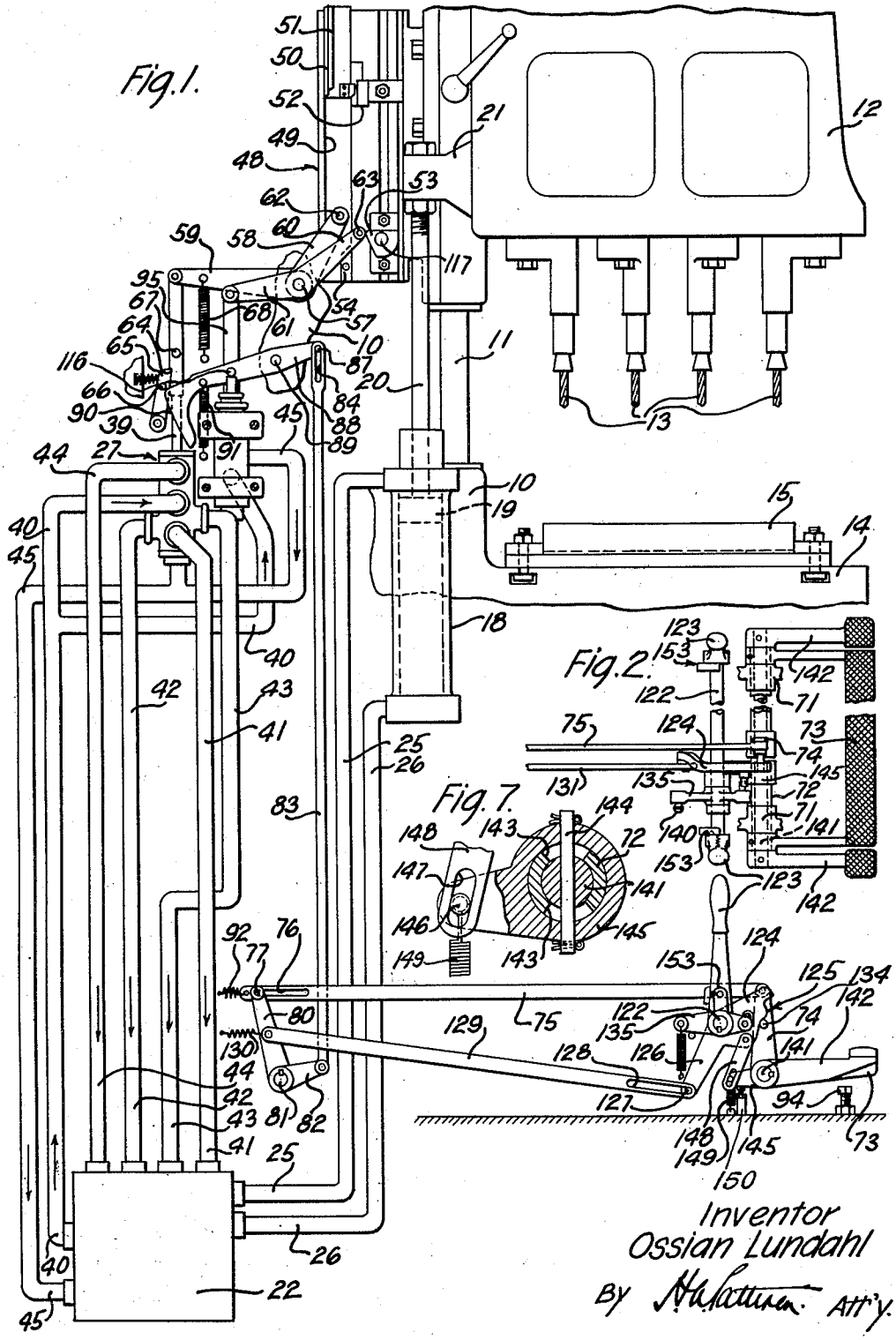


Fig. 2.

Fig. 7.

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Fig. 3.

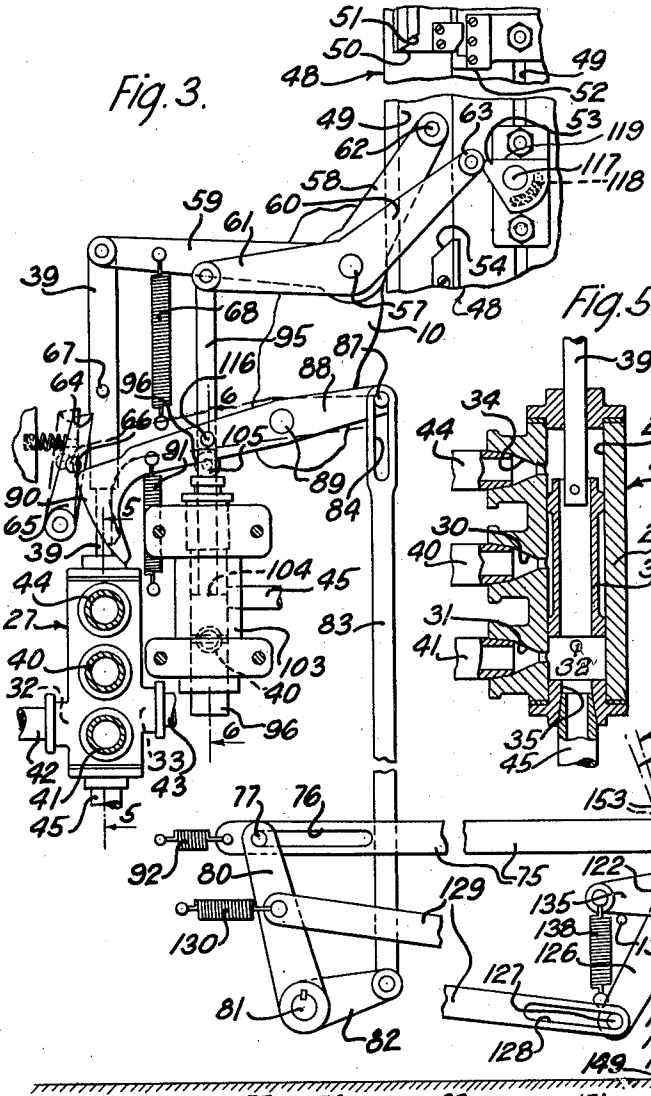


Fig. 5.

Fig. 6.

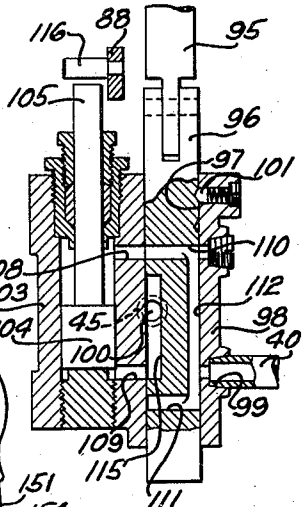
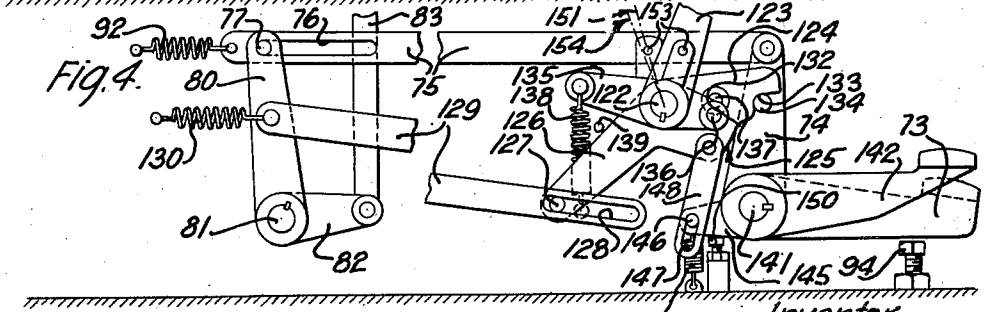


Fig. 4.



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UNITED STATES PATENT OFFICE

1,984,535

CONTROL MECHANISM

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Application November 16, 1928, Serial No. 319,867

4 Claims. (Cl. 60—52)

This invention relates to control mechanisms, and more particularly to a control mechanism for machine tools.

The primary object of this invention is to provide an improved control mechanism for controlling various operations of machine tools.

In accordance with one embodiment of this invention as applied to a multiple spindle drill press having a reciprocatory head, there is provided an automatic inelastic pressure medium variable displacement pump of a commercial type for supplying an inelastic pressure medium to the drill head feed cylinders for producing variable speeds of advance and a return movement of the drills carried by the head. The action of the pump is automatically controlled by the actuation of a main valve and an auxiliary valve and piston, the latter actuating the main valve for causing the head to be returned to its normal position to begin another cycle. The valves are responsive to different positions of the drill head by means of a plurality of adjustable cam and dog members carried by the drill head and operatively connected to the valves by interconnected link and leverage mechanisms.

A plurality of foot treadles and a hand lever connected to the link and leverage mechanism, upon actuation, serve to start and stop the drill head, one of the treadles upon being depressed causing the operation of the main control valve to start a cycle if the hand lever is in a neutral position. In another position of the hand lever the treadle is latchably maintained in its actuated position to cause automatic continuous cycles of the drill head. By actuating the hand lever to another latchable position or depressing another of the treadles operatively connected to the lever, which serves to latch the treadle, the drill head, while it is moving, either during a single cycle movement or a period of continuous operation, may be immediately stopped, or by moving the lever to still another position, either when the drill press is idle or at any time in a cycle, whether it be during a single cycle or a period of continuous operation, and holding it there, the head may be moved beyond its normal position where it will be automatically stopped at its extreme limit of travel. When the machine is operating continuously a depression of one of the treadles during a cycle causes the head to complete the cycle, returning the machine and the treadle and lever control mechanism to their normal position.

Other objects and advantages of this invention will more fully appear from the following detailed description, taken in connection with the accompanying drawings, wherein

Fig. 1 is a fragmentary side view of a multiple spindle drill press in which one embodiment of the control mechanism of this invention is employed to control the reciprocation of the drill head, the press and the control mechanism being illustrated in partial diagrammatic form;

Fig. 2 is a detail plan view of a portion of the control mechanism shown in Fig. 1;

Fig. 3 is an enlarged fragmentary view of Fig. 1;

Fig. 4 is a view of the lower portion of Fig. 3 with the parts in an actuated position for effecting continuous operation;

Figs. 5 and 6 are enlarged detail sections on the lines 5—5 and 6—6, respectively, of Fig. 3, illustrating the main control valve and the auxiliary valve and piston, and

Fig. 7 is an enlarged vertical detail section through the foot treadle mechanism.

Referring now to the drawings in detail wherein like reference numerals indicate similar parts, particularly Fig. 1, which illustrates a multiple spindle drill press of a well known type equipped with one embodiment of this invention, a vertical frame 10 is fragmentarily shown upon which is supported for vertical reciprocation upon standards 11 fixed to the frame 10, only one of which is illustrated, a drill head 12 carrying a plurality of power driven drills 13. A work table 14 is fixed to the frame 10 below the drill head 12 to which is attached a holder 15 for the work to be drilled. The drills 13 may be rotated in any suitable manner, the details of which are not shown, since they are not believed necessary to a complete understanding of this invention. The drill head 12, referring particularly to Fig. 1, is reciprocated by an inelastic pressure medium, such as oil, acting through a pair of vertically arranged feed cylinders 18, only one of which is illustrated. Each of the cylinders 18 is provided with a piston 19 and a stem or rod 20 extending therefrom, the latter being fixed at their upper ends to lugs 21, only one of which is illustrated, formed upon the drill head 12, the cylinders being suitably attached to the frame 10.

In drilling operations with a press of the herein described type it is, for example, desirable to move the drill head 12 toward the work from its normal position at a high rate of speed, since this is merely an idle movement of the drills, and this movement for the sake of brevity will hereinafter be termed "rapid approach movement." When the drills are about to engage the work the rate of speed is diminished, to be termed "feeding movement #2", this speed varying with the nature of the material composing the work being drilled and the size of the drills. When the drills are about to complete their drilling operation, "feeding movement #2" is changed to a still slower rate of speed, to be termed "feeding movement #1", to prevent injury to the work when the drills are

about to break through the work and thereafter the direction of movement of the drill head is reversed, to be termed "reverse movement", and the head moves upwardly at a high rate of speed.

Oil is supplied to the cylinders 18 to cause reciprocation of the drill head 12 at variable speeds by a variable displacement pump 22 of a commercial type, known as an "oil gear" and manufactured by The Oil Gear Company of Milwaukee, Wisconsin, and inasmuch as the specific construction of this pump forms no part of the present invention and is not considered necessary to a complete understanding thereof, detailed illustration and description thereof is deemed unnecessary and therefore is illustrated diagramatically in Fig. 1. A pump of this type is illustrated and described in Patent 1,854,127, issued April 12, 1932, to W. Ferris. The pump 22 is provided with two oil conduits 25 and 26 connected to the upper and lower ends, respectively, of each of the cylinders 18. It will be apparent that upon oil being entered into the upper ends of the cylinders 18, under suitable pressure, by means of the conduit 25, the piston 19 with the attached drill head 12 will be moved downwardly and similarly when the oil is entered into the lower ends of the cylinders through the conduit 26, the pistons and the drill head will be moved upwardly, the speed of the drill head in either direction being governed by the rate of flow of the oil into the cylinders from the pump 22. It will be apparent that the conduits 25 and 26 in addition to supplying oil alternately to opposite sides of the piston also serve alternately as conduits for returning the oil from above or below the piston 19 to the pump 22.

The action of the pump 22, that is, the direction and rate of flow of the oil therefrom and through the conduits 25 and 26, is automatically controlled by the actuation of a main slide valve 27, referring particularly to Figs. 3 and 5, which comprises a casing 28 provided with a longitudinal axial bore 29 and a plurality of ports 30, 31, 32, 33, 34 and 35. Mounted to slide in the bore 29 is a valve member 38 having fixed to its upper end the lower end of a valve actuating rod 39, the upper end of the rod being operatively connected to a mechanism to be presently described for automatically actuating the valve 27 in a predetermined manner to control the action of the pump 22 to provide for the hereinbefore described movements of the drill head 12.

The ports 30, 31, 32, 33, 34 and 35 of the valve casing 28 are connected to the pump 22 by conduits 40, 41, 42, 43, 44 and 45, respectively. The pump 22 has an oil reservoir formed in its lower portion from which the oil under constant pressure is pumped through the outlet conduit 40 to the inlet port 30 of the valve 27. From the port 30 the oil is directed through either of the ports 31, 32, 33 and 34, depending on the particular position of the valve member 38, through the conduits 41, 42, 43 and 44, respectively, and to a mechanism included in the pump 22 for determining the direction and volume of oil to be delivered by the pump through either of the conduits 25 and 26 to the feed cylinders 18, or as shown in Fig. 5, wherein the valve member 38 is in a neutral position with the inlet port 30 out of communication with the other ports, the pump is idling. When the pump 22 is idling or ineffective the oil is maintained at a substantially constant predetermined pressure in the pump outlet conduit 40 and at the port 30 of the valve 27, any excess pressure being relieved automatically by suitable mechanism included in the pump 22 after the predetermined pressure is built up at the port 30. The port 35 and conduit 45 serve to carry back to the oil reservoir of the pump 22 any low pressure oil by-passed through the valve member 38 either from the pressure conduit 40 and through the port 30 to escape past the valve member at either end thereof or when it drains directly into the valve bore 29 through any one of the ports 31, 32, 33 and 34 from their respective conduits. It is to be understood that when the valve inlet port 30, which is connected to the pressure conduit 40 from the pump 22, is in communication with certain of the ports 31, 32, 33 or 34 the rest of the ports are connected to the exhaust port 35 which is connected to the low pressure conduit 45.

The pump 22 is so constructed that its oil displacing action through either of the conduits 25 and 26 into the cylinders 18 is controlled by the return flow of oil to the pump through the valve ports 31, 32, 33 and 34. Briefly described, a return flow of oil through ports 31, 32 and 33 to the pump results in an oil displacement by the pump through the conduit 25 to the upper ends of the cylinders 18, which causes a "rapid approach movement" of the drill head. A return flow of oil through ports 32 and 33 changes the oil displacement by the pump through the conduit 25 to the upper ends of the cylinders to decrease the speed of movement of the drill head to "feeding movement #2." A return flow of oil through port 33 changes the oil displacement by the pump through the conduit 25 to the upper ends of the cylinders, whereby the speed of movement of the drill head is further decreased to "feeding movement #1." A return flow of oil through port 34 results in an oil displacement by the pump through the conduit 26 to the lower ends of the cylinders, which causes a rapid return or "reverse movement" of the drill head.

Fixed to the rear face of the drill head 12, or as viewed in Fig. 1 at the left portion thereof, is a plate 48 having a plurality of vertical slots or grooves 49 within which is adjustably secured a plurality of cams or dogs 50, 51, 52, 53 and 54, serving in the reciprocation of the drill head to actuate the valve 27 at predetermined intervals to vary the action of the pump 22. Journaled upon a stud 57 fixed to the frame 10 are a plurality of lever arms 58, 59, 60 and 61, the arms 58 and 60 carrying upon their free ends (Figs. 1 and 3) a pin and a roller 62 and 63, respectively, for engagement with certain of the cams or dogs 50, 51, 52, 53 and 54. The arms 58 and 59 form a single lever and move together about their pivot point and the arms 60 and 61 act in a similar manner. The free end of the lever arm 59 is pivoted to the upper end of the valve rod 39, the latter having formed therein a latch notch 64 into which in the neutral position of the control mechanism is entered a pivotal spring pressed latch 65 provided with a laterally extending pin 66, the valve rod also being equipped with a similarly directed pin 67. The function of the pins 66 and 67 will be made apparent shortly. A tension spring 68 having opposite ends attached to the lever arm 59 and a stationary part of the drill press acts, upon the latch 65 being moved out of the notch 64, to rock the lever arm 59 counterclockwise, thereby moving the valve rod 39 downwardly

and shifting the valve member 38 in the valve 27 to a position wherein the oil inlet port 30 will be in communication with the port 31, which is connected by the conduit 41 to the pump 22, the oil displacing action of which is immediately changed to cause a predetermined flow of oil through the conduit 25, and consequently a large volume of oil will be admitted to the upper ends of the feed cylinders 18 through the conduit 25 and thus a "rapid approach movement" is effected of the drill head 12 towards the work. The movement of the lever arm 59 carries the pin 62 of the lever arm 58 against the left face of the left groove 49 of the cam and dog plate 48, thus limiting the downward movement of the rod under the action of the spring 68. Means for releasing the latch 65 comprises the following manually actuated mechanism.

Supported on the floor by standards 71 (Figs. 1 and 2) is a rock sleeve 72 having a foot treadle 73 fixed thereto. Secured to the sleeve 72 is a lever 74 to the upper free end of which is pivoted one end of a link 75, the opposite end of which is provided with a slot 76. Extending freely into the slot 76 of the link 75 is a pin 77 fixed to the upper free end of a lever 80, secured to a rock shaft 81, which may be journaled in standards (not shown) supported on the floor. Also secured to the rock shaft 81 is a lever 82 to the free end of which is pivoted the lower end of a vertical link 83. The upper end of the link 83 is provided with a slot 84 into which freely extends a pin 87 fixed to one end of a lever 88 journaled on a stud 89 carried by the frame 10. The opposite end of the lever 88 is provided with a cam face 90 which is arranged to engage the pin 66, hereinbefore referred to, carried by the latch 65 and cam the latter out of the notch 64, upon the lever 88 being rocked clockwise about its pivot stud 89, thus permitting the spring 68 to act as hereinbefore described. A tension spring 91 attached to the lever 88 serves normally to hold the pin 87 at the upper end of the slot 84 of the link 83 as shown in Figs. 1 and 3, with the cam face 90 of the lever 88 slightly spaced from the pin 66 of the latch 65. A tension spring 92 secured to the left end of the link 75 it will be apparent acts to balance the weight of the treadle 73 and the connected lever and link mechanism comprising the lever 74, link 75, levers 80 and 82 and the link 83, thus holding them in their normal position as shown in Figs. 1 and 3. It will be apparent that a depression of the foot treadle 73 (Figs. 1 and 3) through the described cooperating lever and link mechanism will result in an unlatching of the valve actuating rod 39, the latch 65 being cammed out of the notch 64 of the rod 39 by the cam face 90 of the lever 88. The means provided for limiting the action of the spring 92 will be brought out as the description progresses. An adjustable stop 94 is provided under the treadle 73 for limiting the operative stroke thereof.

When the lever arm 59 is rocked as just described under the action of the spring 68, the lever arm 58 carrying the pin 62 and movable with the lever arm 59 is rocked into the path of the cam 50 which is descending with the drill head 12 under the "rapid approach movement" and upon the cam 50 engaging the pin 62 it causes the lever arms 58 and 59 to be rocked clockwise, thus resetting the valve 27 by drawing upwardly the valve member 38 until the oil inlet port 30 is in communication with the port 32 (Figs. 3 and 5) and the oil displacing action of the pump 22 will be changed and consequently the volume of oil admitted to the upper ends of the feed cylinders 18 through the conduit 25 will be such that "feeding movement #2" is effected of the drill head 12 during the greater part of the drilling operation. This rate of movement of the drill head 12 continues until the pin 62 rides off the cam 50 and onto the cam 51, the continuing movement of the latter causes the resetting of the valve 27 in a manner similar to the previous resetting by drawing upwardly, still further, the valve member 38 until the oil inlet port 30 is in communication with the port 33 (Fig. 3), the oil displacing action of the pump again being changed, and thus "feeding movement #1" is effected by the drill head 12 during the final drilling period. Upon completion of this last movement of the drill head 12 the action of the pump 22 is changed to cause a return movement of the head. This is accomplished in the following manner:

Referring particularly to Figs. 3 and 6, to the free end of the lever arm 61 is pivoted one end of a depending link 95, the opposite end being pivoted to an auxiliary valve member 96 slidable in a longitudinal bore 97 of a valve casing 98 provided with an inlet port 99 and an outlet or drain port 100 connected with the pump outlet conduit 40 and the conduit 45 connected to the pump reservoir, respectively.

A spring pressed latch pin 101 mounted in the casing 98 cooperating with a pair of notches formed in the slidable valve member 96 serves to yieldably maintain the valve member in either its upper or lower positions. Formed integral with the valve casing 98 is a vertical feed cylinder 103 provided with a piston 104 having a stem or rod 105 extending upwardly therefrom. The valve casing 98 is provided with two ports 108 and 109 connecting the bore 97 with the chamber of the cylinder 103 at either end thereof. The port 108 communicates in the normal position of the valve member 96 with a port 110 extending laterally therethrough, a similar port 111 is also formed in the valve member 96 adjacent the lower end thereof. A passage 112 interconnects the ports 110 and 111 and also communicates with the inlet port 99. Opposite the passage 112 is another passage 115 which in the normal position of the valve member 96 is in communication with the outlet port 100 and the port 109. It will be apparent with the valve member 96 in its normal position as shown in Fig. 6 that the pressure of the oil directed through the port 99 from the conduit 40 will constantly act upon the upper side of the piston 104 to hold it in its lower position. The piston 104 in moving to its lower position forces the oil from under it through the port 109, passage 115 and through the outlet port 100 to the conduit 45 previously referred to.

The lever 88 is provided with a stud 116 which lies in the path of the rod 105 and normally is slightly spaced therefrom (Figs. 3 and 6). Upon completion of "feeding movement #1" the dog 52 which determines the downward limit of travel of the head moves into engagement with the roller 63 on the free end of the lever arm 60 and rocks the latter clockwise (Fig. 3) drawing upwardly the rod 95 and the slide valve member 96 carried thereby to a point where the port 111 of the member 96 will cause communication between the inlet port 99 and the port 109 of the

valve casing 98, thus admitting the oil into the cylinder 103 under the piston 104 at the same time forming communication between the port 108 and the outlet port 100 by means of the passage 115. Thus the piston 104 will move upwardly, the upper end thereof engaging the stud 116 of the lever 88 and rocking it clockwise (Fig. 3) about its pivot 89, the pin 87 moving idly along the slot 84 of the link 83 and thus not effecting the link and leverage mechanism connected to the foot treadle 73. The lever 88 is rocked sufficiently to cause the left end upper surface thereof to engage the pin 67 of the main control valve actuating rod 39 and move it upwardly until the valve member 38 attached thereto establishes communication between the oil inlet port 30 and the port 34 of the valve 27, the oil displacing action of the pump 22 again being changed to cause a predetermined flow of oil through the conduit 26, and thus "reverse movement" is effected of the drill head and it moves upwardly at a high rate of speed. It will be understood that at the time the lever 88 moves upwardly to engage the pin 67, the latter is nearer to the lever than is shown in Figs. 2 and 3, since the valve actuating rod 39 previously unlatched had moved downwardly, as hereinbefore described. The "reverse movement" of the head continues until the dog 53 which determines the normal upward limit of travel of the head and which in the downward movement of the head moved away from the roller 63 of the lever 60, reengages it, the roller 63 having been moved in the clockwise movement of the lever 60 by the descending dog 52 into the path of the dog 53. The dog 53 is pivoted on a stud 117, a spring 118 tending to rotate it counterclockwise against a stop. The purpose of pivoting the dog 53 is in case the head 12 is moved upwardly, as will hereinafter be described, to a point where the dog 53 is positioned above the roller 63 and the head is then lowered, the roller 63 will engage the dog 53 and the latter will rotate clockwise about its pivot against the section of the spring, and when the dog is below the roller it will return to its normal position. At the end of the "reverse movement" the roller 63 engages the upper surface 119 of the dog 53 and the lever arms 60 and 61 are rocked counterclockwise, the dog not moving about its pivot. It will be apparent that during the upward movement of the valve actuating rod 39, energy is being stored in the spring 68 for drawing the rod downward when it is next unlatched.

This last movement of the lever arms 60 and 61 through the link 95 moves the slidable valve member 96 back to its lower or normal position (Fig. 6) and consequently the piston 104 and rod 105 are moved downwardly, due to the pressure of the oil through the port 108, following which the lever 88 moves counterclockwise about its pivot 89 under the action of the spring 91 to the position shown in Figs. 1 and 3, if the foot treadle was released after the unlatching of the latch 65 from the notch 64 of the main valve actuating rod 39. This last movement of the lever 88 withdraws the left end upper surface thereof from the pin 67 and upon the cam face 90 of the lever clearing the pin 66 of the latch 65. The spring 68 acts to move downwardly the valve actuating rod 39, the latch 65 engaging in the notch 64 thereof with the valve member 38 stopping in the neutral position (Fig. 5). It is to be understood that when the spring pressed latch 65 has moved toward the right after the cam face 90 of the lever 88 is positioned below the pin 66, the notch 64 of the rod 39 is slightly above the engaging end of the latch and in the continued movements of the latch and the rod the former moves into the notch, thus maintaining the parts in their neutral position. The drill head 12 is now positioned at its neutral position after completing a single cycle with variable speed of advance toward the work and a rapid return therefrom.

In some drilling machine operations it is possible to use an automatic mechanism of either a reciprocable or a rotatable indexable type for positioning the work, depending on the nature thereof, upon the work holder 14, in the interval of time during which the "reverse movement" and the subsequent "rapid approach movement" of the drill head takes place, in which case automatic continuous cycles of the drill head are effected in the following manner: Associated with the foot treadle mechanism hereinbefore described for tripping the latch 65 is a hand lever control mechanism for latching the treadle 73 in its depressed position wherein automatic continuous cycles of operation of the head 12 each similar to the cycle of operation previously described are effected. Journaled in suitable standards (not shown) supported on the floor is a rock shaft 122 having fixed thereon at either end a hand lever 123. Fixed to the shaft 122 intermediate the levers 123 is a lever 124 provided at one end with a cam face 125, its opposite end being in the form of an arm 126 having a pin 127 extending laterally therefrom. The pin 127 extends freely into a slot 128 formed in one end of a link 129, the opposite end of the link being pivoted to the lever 80 intermediate its ends. A tension spring 130 attached to the left end of the link 129 serves to normally draw the link towards the left, thus tending to rock the lever 124 clockwise. The purpose of the arm 126, link 129 and the spring 130 will be made apparent shortly. The cam face 125 of the lever 124 is provided with two cam depressions 132 and 133 and engageable therein in different positions of the hand levers 123 is a pin 134 extending from the lever 74, movable with the foot treadle 73. Rotatably mounted on the rock shaft 122 is a lever 135 having a pin 136 extending from one end which is engaged with the underside of a pin 137 extending from the lever 124, the opposite end of the lever 135 having attached thereto one end of a tension spring 138. A stop pin 139 arranged under the left end of the lever 135 limits the counterclockwise rotation of the lever 135 under the action of the spring 138 and holds the pins 136 and 137 of the levers 135 and 124, respectively, in operative engagement when the hand lever 123 is in a neutral position or in a position for latching the treadle 73 in a depressed position. The purpose of the tensioned lever 135 and connected parts is to return the hand levers 123 to their normal position (Figs. 1 and 3) upon being unlatched after a period of continuous operation, to be hereinafter described.

The operation of the foot treadle 73 and the cooperating lever and link mechanism for releasing the latch 65 to complete a cycle of movements of the drill head 12 has previously been described. The operation of the hand levers 123 for latching the treadle 73 to provide for automatic continuous cycles of operation of the head 12 will now be described. The treadle 73 is de-

pressed in a manner similar to starting the drill head 12 on a single cycle of movements until the lower surface thereof is in contact with the stop 94 and while in such position either one of the hand levers 123 is rocked clockwise to the angular position shown in Fig. 4. This movement of the lever 123 with the attached lever 124 moves the cam depression 133 into the path of the pin 134. The treadle 73 is thereafter released and due to the action of the spring 92 is rocked counterclockwise and comes to rest slightly spaced from the stop 94 with the pin 134 lodged in the cam depression 133, thus holding the treadle 73 in its operative depressed position. In moving the hand lever 123 to its latched position the pin 137 of the lever 135, which is independently rotatable upon the shaft 122, rocks the lever 135, thus storing energy in the spring 138 which acts when the hand lever 123 is unlatched to bring it back to its normal vertical position (Figs. 1 and 3), the lever 135 coming to rest against the stop pin 139. It will be apparent with the treadle 73 held in its depressed position and through the cooperating lever and link mechanism that the latch 65 will be held away from the notch 64 of the valve actuating rod 39, the lever 88 and the latch 65 assuming the position shown in dotted outline (Fig. 3), and thus the rod 39 will be permitted to move downwardly under the action of the spring 68 after the completion of a cycle of movements of the drill head 12 and set the main valve 27 for another "rapid approach movement" to begin another cycle, the drill head 12 thereafter being operated continuously as long as the treadle is in its latched depressed position. When it is desired to stop the drill head during a period of continuous operation thereof, the operator merely depresses the foot treadle 73 sufficiently to engage the stop 94, which movement draws the pin 134 from the cam face 125 of the lever 124 a distance sufficient to permit the latter to move counterclockwise to its normal position, due to the energy stored in the spring 138 as hereinbefore described, the action of the spring 138 being balanced by the action of the spring 130 acting through the link 129 when the pin 127 of the arm 126, integral with the lever 124, engages the right end of the slot 128.

It may be necessary or desirable during the rapid approach and various feeding movements of the drills 13 toward the work, either during a single cycle movement or a period of continuous operation, to immediately bring the head 12 to a stop in order to prevent damage or injury to the mechanism or an operator. This is accomplished in the following manner: Extending through the rock sleeve 72 and independently rotatable therein is a rock shaft 141 having fixed thereto at either end a foot treadle 142. The sleeve 72 intermediate its ends and at a point substantially directly under the lever 124 is provided with diametrically opposite slots 143 (Fig. 7). Fixed to the shaft 141 by a pin 144 extending at opposite ends through the slots 143, is a lever 145 which is journaled on the sleeve 72. The free end of the lever 45 is provided with a pin 146 which freely enters a slot 147 provided in the lower end of a link 148, the upper end of the link being pivoted to the lever 124. The length of the slots 143 is such that the lever 145 and the rock sleeve 72 may be independently rocked the required distance by the movement of the foot treadles 142 and 73, respectively, without interference. A tension spring 149 secured to a projecting end of the pin 146 acts to maintain the lever 145 and the attached foot treadles 142 in their normal position (Figs. 1, 3 and 4), with a lower surface of the lever 145 engaging a stop 150 mounted in the floor. Referring particularly to Fig. 4, wherein the levers 123 have been rocked to latch the foot treadle 73 for a period of continuous operation, it will be observed that the pin 146 is engaging the upper end of the slot 147 of the link 148.

Upon a depression of either of the end foot treadles 142 and the resulting movement of the shaft 141 and the lever 145, the pin 146 will be rocked upwardly and through the link 148 attached to the lever 124 the latter will be rocked counterclockwise, carrying the hand levers 123 therewith to an angular position indicated by a broken line 151 and through the arm 126 of the lever 124 the pin 127 riding along the slot 128 of the link 129 will engage the right end of the slot and draw the link toward the right. This movement of the link 129 which is connected to the lever 80 rocks the lever 82 and the attached link 83 downwardly and thereby rocks the lever 88 clockwise, the left end upper surface of which engages the pin 67 secured to the valve actuating rod 39, which at this time is in one of its lower positions, and resets the valve 27, the valve member 38 stopping in the neutral position (Fig. 5). Thus the drill head 12 is immediately stopped without completing the cycle. In case the treadle 73 has been depressed to begin a single cycle and has moved back to its normal position, the hand levers 123 being in their normal vertical position, the position of the cooperating treadles, levers and links will be that shown in Fig. 3, with the exception that the valve actuating rod 39 will be either in its lower position or in an intermediate position, depending on what movement of the head 12 is taking place. In this latter case a depression of either of the foot treadles 142 first moves the pin 146 idly along the slot 147 of the link 148 until it engages the end of the slot and thereafter the link is raised with the same result obtained in a depression of the treadle 142 during a period of continuous operation. In both cases the hand levers 123 are rocked counterclockwise and come to rest at the same angle, indicated by the broken line 151, as they did in the first case from the vertical position thereof illustrated in Fig. 3, where they are held by spring pressed latch devices 153. The same result, the immediate stopping of the drill head 12 as is accomplished with a depression of either of the treadles 142, it will be apparent, may be effected by the operator grasping one of the hand levers 123 and rocking it counterclockwise to its latchable position. By providing the interconnected hand lever and plural foot treadle control for immediately stopping the drill head an operator may use whichever means he finds the most convenient, thereby expediting the stopping of the head, which in some instances might be very necessary.

At times it may be desirable, for the purpose of making repairs on the drill press or in changing work holders or for other reasons, to cause a reverse movement of the drill head 12 to the extent of its limit of travel on the frame 10, that is, a reverse movement extending further than its normal reverse movement as shown in Figs. 1 and 3, which movement, as hereinbefore described, is determined by the vertical adjustment

of the dog 53 in the slot 49. This movement of the drill head 12 may be accomplished when the drill press is idle or at any time in a cycle, whether it be during a single cycle or in a period of continuous operation in the following manner: In the case of the press being idle, or in its normal position (Figs. 1 and 3), one of the hand levers 123 is grasped by the operator and rocked counterclockwise to the limit of its travel, to an angular position indicated by a broken line 154, and held there by the operator. The arm 126 of the lever 124, movable with the levers 123, through the link 129, levers 80 and 82 and link 83 rock the lever 88 clockwise, first unlatching the valve actuating rod 39 but almost instantly engaging the pin 67 of the rod 39 and moving it upwardly. The upward movement of the rod 39 rocks the lever arms 59 and 58 clockwise, moving the pin 62 against the right face of the left groove 49 of the cam and dog plate 48, which stop determines the movement of the hand levers 123 counterclockwise. The rod 39 being moved upwardly until the valve member 38 establishes communication between the oil inlet port 30 and the port 34 of the valve 27 and thus "reverse movement" is effected and the head moves upwardly until the cam 54, the purpose of which has not heretofore been set forth, engages the pin 62 of the lever arm 58 and through the attached lever arm 59 moves downwardly the rod 39 against the thrust of the operator holding the hand levers 123, as hereinbefore described.

This movement of the rod 39 sets the valve member 38 in its neutral position and the head stops, the hand lever 123 moving clockwise, due to the downward movement of the rod 39, the operator releasing his hold thereon and it continues its clockwise rotation and is latched at the position indicated by the broken line 151 by the device 153.

It will be readily apparent that in a similar counterclockwise movement of the hand lever 123 as just described during any period of a single cycle or in a period of continuous operation, the valve actuating rod 39 will be moved upwardly to effect a "reverse movement" of the drill head to the limit of its movement on the frame 10 and thereat stop.

By merely omitting the cams 50 and 51 from the plate 48 or mounting them thereon out of reach of the pin 62 of the lever arm 58, as the drill head 12 moves downwardly, it will be obvious that continuous operation of the head may be had in alternate directions at a constant speed in either direction, which operation may be desirable in some classes of work.

Although the control mechanism in the embodiment herein illustrated and described is particularly adapted for inelastic pressure medium actuated reciprocatory drill press heads, it is not limited to this use and may be adapted for a variety of other purposes and the invention is only to be limited by the spirit and scope of the appended claims.

What is claimed is:

1. In a fluid pressure control mechanism, a casing having a plurality of fluid transmission ports, a valve member movable therein to a plurality of operative positions for controlling said ports, and means for actuating and controlling the valve member comprising a manually releasable latch member for holding the valve member in one of said positions, impositive means rendered effective by the release of the latch member for moving the valve member to another of said positions, a reciprocable member having a cam element mounted thereon for movement therewith, and fluid operated means actuated by the cam element at a predetermined position in the movement of said reciprocable member for moving the valve member to another of its operative positions.

2. In a fluid pressure control mechanism, a casing having a plurality of fluid transmission ports, a valve member movable therein to a plurality of operative positions for controlling said ports, and means for actuating and controlling the valve member comprising a reciprocable member having a plurality of cam elements mounted thereon for movement therewith, mechanical means actuated by one of said cam elements at a predetermined position in the movement of said reciprocable member for moving the valve member to one of its operative positions, and fluid operated means actuated by another of said cam elements at another predetermined position in the movement of said reciprocable member for moving the valve member to another of its operative positions.

3. In a fluid pressure control mechanism, a casing having a plurality of fluid transmission ports, a valve member movable therein to a plurality of operative positions for controlling said ports, and means for actuating and controlling the valve member comprising a manually releasable latch member for holding the valve member in one of said positions, impositive means rendered effective by the release of the valve member for moving the valve member to another of said positions, a reciprocable member, mechanical means rendered operative by the reciprocable member at predetermined positions in its movement for selectively moving the valve member to others of its operative positions, and fluid operated means rendered operative by the reciprocable member at another predetermined position in its movement for moving the valve member to another of its operative positions.

4. In a fluid pressure control mechanism, a casing having a plurality of fluid transmission ports, a valve member movable therein to a plurality of operative positions for controlling said ports, and means for actuating and controlling the valve member comprising a spring actuated member for moving the valve member to one of its operative positions, a reciprocable member, mechanical means rendered operative by the reciprocable member at predetermined positions in its movement for selectively moving the valve member to others of its operative positions, fluid operated means rendered operative by the reciprocable member at another predetermined position in its movement for moving the valve member to another of its operative positions, and manually controlled means for effecting the movement of the valve member from any one of its operative positions to any other one of its operative positions.

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