

April 16, 1935.

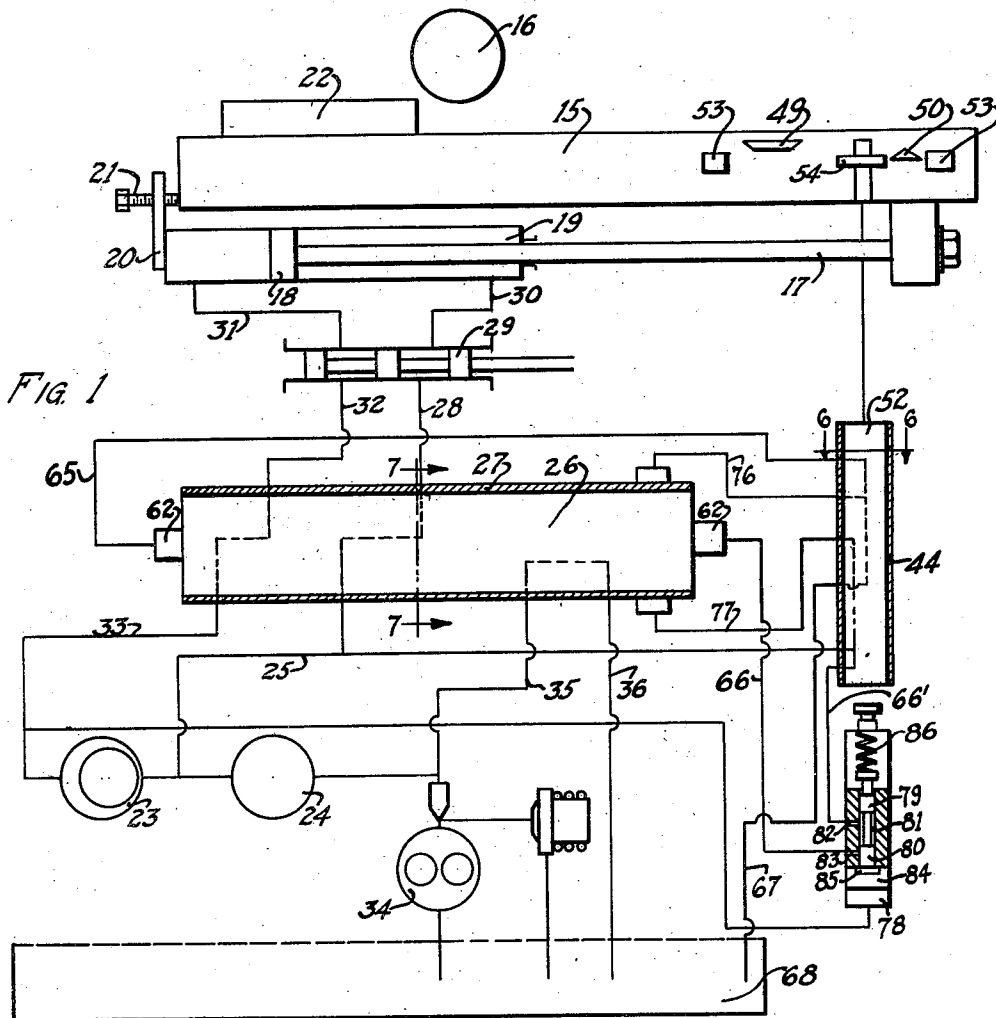
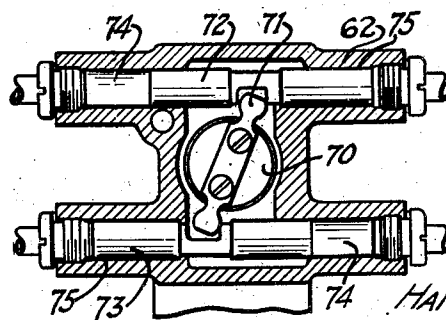
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HYDRAULIC FEED CONTROL

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4 Sheets-Sheet 1



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4 Sheets-Sheet 2

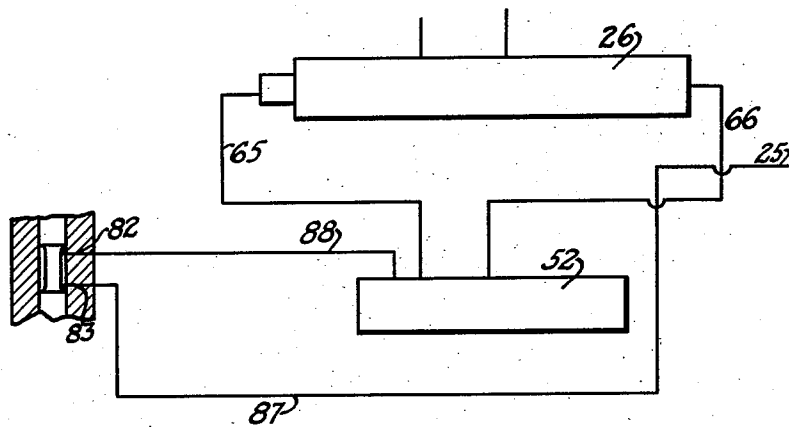


FIG. 2

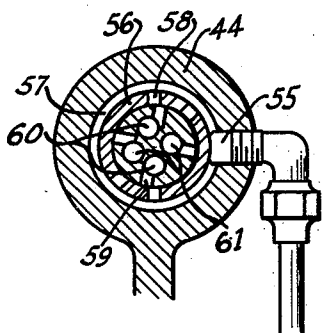


FIG. 6

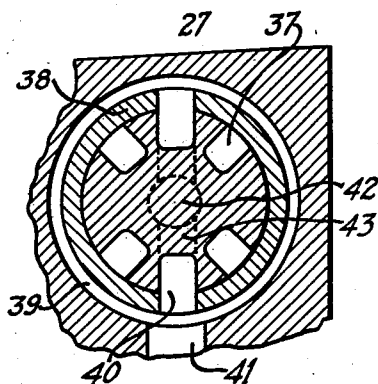


FIG. 7

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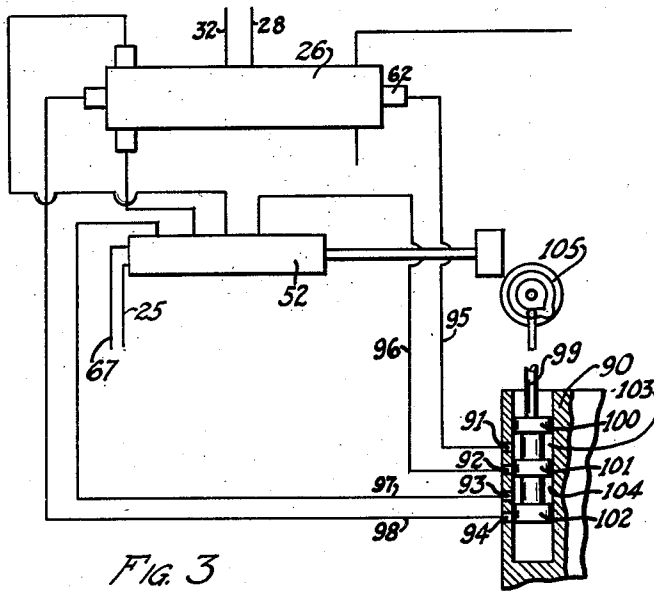
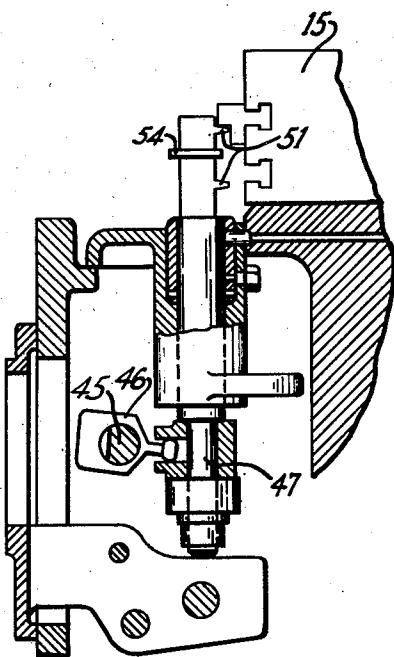
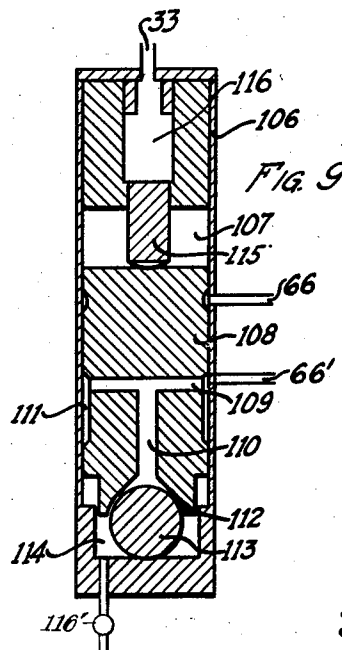
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4 Sheets-Sheet 3



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HYDRAULIC FEED CONTROL

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Fig. 4.

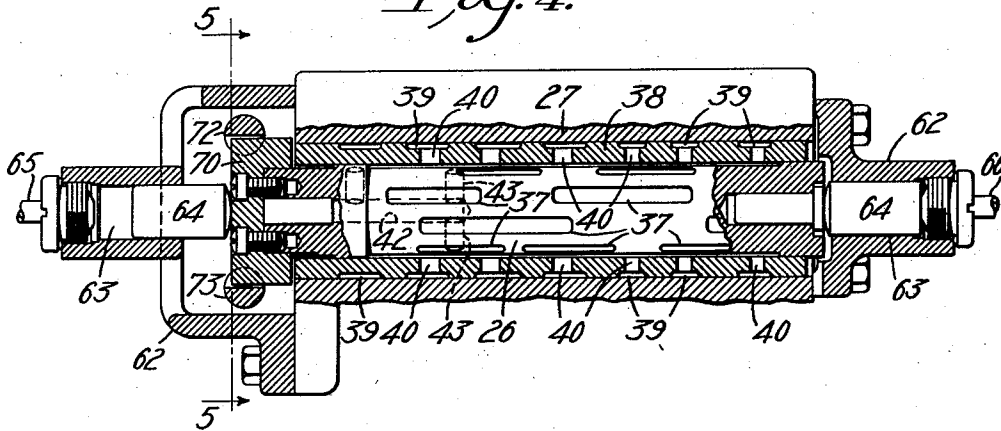
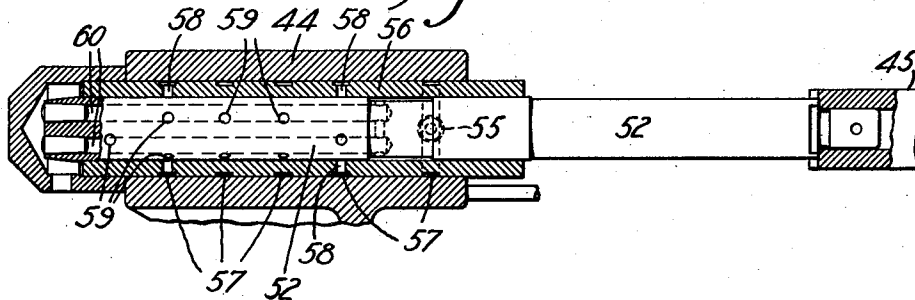


Fig. 10.



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UNITED STATES PATENT OFFICE

1,998,003

HYDRAULIC FEED CONTROL

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Application February 28, 1929, Serial No. 343,486

19 Claims. (Cl. 121—45)

This invention relates to hydraulic feed control mechanisms and more particularly to mechanism especially adapted for controlling the relative feed or shifting movement of machine tools.

5 Prior to the present invention, machine tools, of which a milling machine may be taken as a characteristic example, have been provided with a shifting mechanism for effecting a relative translatory movement of the tool and work 10 through the medium of hydraulic pressure. A conventional embodiment has included the utilization of a cylinder carried by one of the members and a piston within the cylinder coupled with the other member and capable of variable actuation to shift the member at either 15 a quick traverse or feed rate. The drive in this event is effected by a suitable hydraulic mechanism including an actuating fluid such as oil or the like and means for causing a flow of the fluid and controlling and directing such flow. 20

In milling or like operations the actuation must be with a sufficient pressure to prevent vibration or fluctuation in position of the relatively movable parts during cutting and in some instances difficulty has been experienced in proper shifting of the fluid directing valve due to tendency of the same to become cramped or locked by the pressures of actuating fluid therein and there-around, interfering with ready mechanical shifting of the valve to vary the effective 25 operation of the machine at a particular moment.

One of the objects of the present invention therefore is the provision of a mechanism which will eliminate valve operating difficulties as 30 hitherto experienced and will facilitate the rapid, accurate and positive shifting movement of the valve at desired points in the relative translatory movement of work and tool.

A further object of the invention is the provision of means for effectively translating and mechanically determining operations such as co-operating dog and trip instrumentalities into hydraulic or power actuation of the shiftable valve or control members. 40

Another object of the invention is the provision of a mechanism of the general character above referred to in which the time of actuation of the control valve may be established independent of the timing of the mechanical actuating mechanism to be effective either simultaneously therewith, or subsequent thereto. 50

A further object of the invention is the provision of an improved control mechanism or series which will make possible the selection of 55 the ensuing next succeeding rate and direction

of relative movement to be imparted to the parts by suitable pre-setting of a portion of the control mechanism without effecting the continuation of the existing actuation of the parts.

Additionally, the invention contemplates the 5 provision in conjunction with such a setting or predetermining mechanism of means preferably automatically operated on completion of prescribed relative movement of the parts for rendering the system effective to carry out the relative translation determined through said pre-setting. 10

Other objects and advantages of the present invention should be readily apparent by reference to the following specification considered in 15 conjunction with the accompanying drawings illustrative thereof and it will be understood that we may make any modifications in the specific arrangement or details hereinafter disclosed within the scope of the appended claims without 20 departing from or exceeding the spirit of the invention.

Figure 1 is a diagrammatic view of a complete hydraulic circuit mechanism including the several controls therefor and the essential parts to 25 be actuated thereby.

Figure 2 is a similar view of a slightly different control circuit embodying the same general principles but with the power transmitting circuit 30 omitted for clarity.

Figure 3 is a similar diagrammatic view of the control circuits in connection with a mechanically operable disconnecter.

Fig. 4 is a longitudinal sectional view, partly in elevation, of the main control valve, and showing also the mechanism for imparting to the movable element of the valve its oscillatory and axial shifting movements. 35

Figure 5 is a section as on line 5—5 of Figure 4 particularly illustrating the mechanism for oscillating said main valve. 40

Figure 6 is a transverse section as at line 6—6 of Figure 1 illustrating certain of the mechanical structural details of the setting or selector valve.

Figure 7 is a similar sectional view through the 45 main control as on line 7—7 of Figure 1.

Figure 8 is a fragmentary section illustrating the mechanical details of the dog actuated trip mechanism for positioning the selector valve,

Figure 9 is an enlarged sectional view of the 50 retarding or timing valve utilized in Figure 2, and Fig. 10 is a detail sectional view, partly in elevation, of the selector valve and a portion of its supporting casing.

Referring particularly to Figure 1 of the draw- 55

ings there is diagrammatically indicated the table member 15 mounted for translation beneath the cutter 16 and having secured thereto rod 17 of piston 18 which is movable longitudinally of cylinder 19.

Associated with the cylinder 19 is a bracket 20 bearing the adjustable stop member 21 for limiting left hand movement of the table in the form illustrated. The several parts are here illustrated as just completing the feeding of the table toward the left so that work piece 22 has had its upper surface properly milled.

To effect this movement the hydraulic actuating fluid has been supplied from variable delivery pump 23 and booster pump 24, through the high pressure conduit 25, suitable ports of valve 26 in casing 27, conduit 28, stop valve 29 and conduit 30 to the right hand end of the cylinder 19. At the same time the rate of movement of piston 18 and thus of its coupled or associated table has been determined by the return flow of fluid from the left hand end of the cylinder through conduit 31, stop valve 29, conduit 32, valve 26 and back pressure conduit 33 of the variable displacement pump 23.

It will be noted that the variable displacement pump serves to measure or meter out the return flow of the hydraulic actuating medium and that said line is therefore, constantly under the pressure created by the joint action of pumps 23 and 24 in the power end of the cylinder.

Valve member 26 serves to control the direction of flow of actuating medium reversing the coupling of lines 28 and 32 respectively, with power lines or conduits 25 and 33 dependent on the longitudinally shifted position thereof. In addition, the valve is capable of rotative adjustment to selectively couple the rapid traverse pump 34 and its conduit 35 selectively with either conduit 28 or 32 and the other of said conduits with low pressure return line 36 so that the table may be shifted in either direction at a rapid or quick traverse rate.

It will be noted by reference to Figures 4 and 7 that the valve member 26 is of general cylindrical form having the various grooves or slots as at 37 for coupling with the ports of valve casing 27, and intermediate bushing 38 having cannellures 39 and ports 40 aligned with the ports 41 of casing 27 serving to transmit the power circuit actuating medium. Valve 26 may if desired be formed with the central passage 42 communicating as through outlets 43 with the grooves 37.

It will of course be understood that the rotated movement will line up different grooves 37 with different inlet and outlet ports and that similarly longitudinal sliding of the valve member will also couple different series of ports through the groove according to whether actuating medium is to be directed into cylinder 19 for urging the piston in one direction or the other and for rotating the piston in given directions at either a feed or quick traverse rate.

As has been mentioned the amount of pressure required for said actuation of the machine tool mechanism is frequently relatively great and this pressure sometimes acts to cause a sticking or binding action of the valve such that an ordinary mechanically actuatable spring tension load and fire mechanism may not efficiently shift the valve or cause actuation thereof in the desired direction at a particular desired time.

To overcome defects of this nature we have provided a setting or selector valve unit diagrammatically illustrated in Figure 1 as located at

44 and shown in detail in Fig. 10. This member is coupled as by shaft 45 and rock arm 46, (see Fig. 8), with the vertical shiftable and axially oscillatable trip plunger 47 designed to be carried by the bed of the machine adjacent the moving edge of table member 15. The table member may be effectively provided with lifting or depressing dogs as at 49 and 50 for cooperation with lugs 51 on the inner face of the plunger to impart desired up and down or vertical movement to the trip.

By reference to Figure 8 it will be seen that this vertical movement will in turn impart an oscillatory movement to valve 52 while engagement of the dogs 53 with wing flange 54 on the plunger serves to oscillate the trip and impart longitudinal movement to the valve 52. The valve has thus for convenience been shown as movable in two directions although it will be understood that step by step longitudinal or oscillatory movement alone could be imparted to the valve for effecting desired shiftings thereof to various inlet and outlet ports of the casing 44 with the respective units to be effected thereby without effecting the general principles of operation of the invention. The particular mechanical details of the valve here in question have been illustrated in Figures 6 and 10 in which the casing 44 is shown with an inlet port connection as at 55 and a contained distributor bushing 56 having the cannellures or grooves as at 57 circumferentially communicating with the conduit 55 and provided with ports 58 couplable through passages 59 with the longitudinally extending distributor passages 60 or 61 of the valve member. These longitudinal passages in the structural views are shown as arranged in pairs as facilitating balance pressure conditions within the valve although it will be understood that it has a single inlet and since existing passage with suitable communicating ports could be employed if preferred, although the liability of lateral cramping under pressure might even be increased as the balance condition would be disturbed. It will be noted as particularly illustrated, for example, in conjunction with Figures 1 and 4 that means are provided for a power or hydraulic shifting of the main power control valve utilizing the same source of power as that by which the table itself is shifted but are otherwise independently controlled circuits.

The casing member for the main control valve is provided with a bracket portion 62 at each end including a cylinder 63 and piston 64. Coupled with the cylinder at one end is conduit 65 and the other end conduit 66.

Actuation of controlling valve 52 serves to couple one of these conduits as for example conduit 65 with power line 25 to actuate piston 64 into position as indicated in Figure 4 longitudinally shifting the main control valve. At the same time conduit 66 is coupled through the valve with the low pressure or opening discharge line 67 leading back to the general oil or actuating medium reservoir 68.

The essentials of the circuit just described therefore including a power application control valve member 26 for determining the rate and direction of movement of the table or the shiftable limit of the machine tool in conjunction with a supplemental power circuit including the selector valve 52 mechanically actuatable into various positions to direct an actuating fluid against one end or the other of the main control valve to shift the control valve a prescribed limited amount longitudinally varying the effect thereon, there

being no continuous flow through the valve 52 but only transfer of a sufficient amount of fluid to effect the desired shifting.

Additionally valve 26 is provided at one end with the cap 70 bearing a table end rock arm 71 having its termini engaged in slots in the table end piston members 72 and 73 supported in the cylinders 74 and 75 supported by bracket 62. Diagonally opposed cylinders such as 74 are coupled by a conduit 76 with valve 52 and the other pair 75 with conduit 77. If rotative movement of valve 52 is utilized for example to effect longitudinal shifting and thus reversal of the main power circuit control valve 26 then an axial sliding movement of valve 52 may be utilized alternatively to connect either line 76 or 77 with the power circuit 25 and the opposite conduit with discharge 67.

In this manner pistons 72 and 73 will be oppositely actuated toward the right and left causing a power oscillation of the main power circuit effecting valve to alternatively produce feed or quick traverse coupling of the power lines with the cylinder 19.

In this manner the mechanically effected movement of a small, readily shiftable selector valve having small ports and minimum liability of binding or locking serves to properly couple heavy actuating pressure in desired manner to the main power circuit transmitting valve for either longitudinal shifting or axial rotation of the latter valve whereby the valve will be positively shifted under all circumstances to effect desired movement of the table as determined by the particular porting of this main valve.

It will be understood that this porting may be varied as desired to secure particular operation of circuits from different table dog settings and adjustments, this porting not being described in detail as forming no essential part of the present invention.

In the particular aspect just described the invention therefore comprises a main power circuit, a valve for variably coupling the power circuit and transmitting the actuating medium therethrough to the part to be shifted at prescribed rates and directions depending on the adjustment of this valve, together with supplemental control circuits for causing the desired actuation of the main valve which control circuits impart definite degrees of movement only and are completed through a supplemental non-binding main valve position determining valve which latter is coupled with means for automatically mechanically positioning thereof, preferably actuated by dogs carried by the movable member of the machine.

Particular attention is invited to the actuation delivering mechanism shown at the lower right hand portion of Figure 1 as coupled into circuit 66. This comprises a casing unit 78 having a valve chamber or cylinder at 79 within which slides the valve member 80 having the reduced or transmitting portion 81 adapted to couple port 82 of conduit 66' from valve 52 with port 83 of conduit 66 extending to cylinder 62.

The casing further includes a supplemental piston chamber 84 for piston 85 on the lower end of valve 80. This cylinder portion 84 is continuously coupled with the return line 33 to inlet side of variable displacement pump 23. Consequently, so long as the table is being urged toward the left as shown in Figure 1 with a force against the right hand side of piston 18, so long as the volumetric rate or pressure of the actuating medium is in excess of the rate of discharge permitted by operation of pump 23 there will be

an existing back pressure in line 33 which will be transmitted to chamber 84 forcing piston 85 and valve 80 upward preventing flow through line 66'.

Consequently, while the shifting may be instantly made at any time from feed to rapid traverse or the like depending on movement of valve 52 reversal movement of valve 26 cannot be effected until valve 80 is shifted and thereafter cannot take place under the normal operating conditions of the machine. However, when the table has completed its movement to the left and is brought in engagement with stop 21 continued operation of pump 23 will tend to reduce the pressure in line 33 and exhaust the actuating fluid from chamber 84. When this occurs, extension of spring 86 will depress the valve coupling conduits 66 and 66' when the power actuating medium can flow from line 25 through conduits 66' and 66 to the piston 62 for longitudinal shifting movement of the main circuit control valve.

It will thus be seen that the valve 52 serves merely as a determinator of the subsequent movement of the selector valve while the trip-in pressure at the completion of the prescribed table movement controls the operative effect of the control circuit without relation to the in-feed time limit between mechanical actuation of trip plunger 47 and the table reversal. With this arrangement the dog tripping may be at any point desired in advance of the reversal position so that the slow power shifting of the table if needed may be utilized for mechanical, positive actuation of valve 52 and the reversal independent of special load and fire mechanical reversing mechanisms or the like but is dependent entirely on a series of hydraulic power controlled circuits and it will be understood that when the table is actually reversed the renewed back pressure in line 33 will close valve 80 again preventing actuation of the main valve 26 until such time as it is again released by drop or decrease in the back pressure.

Figure 2 illustrates an alternative circuit arrangement for accomplishment of similar results the distinction being that the main power line 25 is coupled by conduit 87 direct with port 83 of the delivery unit while port 82 is connected by conduit 88 with the valve 52 which selectively directs the actuating medium from conduit 25 into line 65 or 66. The general operation is in all essential respects the same in that the valve 52 may be positioned as desired but the positioning is ineffective to cause shifting of the main circuit control valve 26 until the supplemental delivery unit is operated. The rapid traverse coupling control of Figure 2 being intended for utilization in all respects similar to that just described has been omitted to more clearly explain the control circuit, per se.

In Figure 3 there has been illustrated what may be termed as safety duplicate delivery valve comprising the casing 90 having inlet ports 91, 92, 93 and 94 permanently associated respectively with conduits 95, 96, 97 and 98. In this instance the power circuit is again introduced through line 25 to the initial or positioning valve by which it may be selectively coupled with either line 96 or 97 while the opposite line is correspondingly coupled with discharge conduit 67. Consequently actuating pressure for example will flow through parts 25, 52, 97, 93, 94, 98 to the left hand end of the main circuit control valve while the previously contained pressure is discharged from the right hand end through parts 95, 91, 92, 96 and 67. That the circuits may both be normally interrupted but jointly completed, use is made of the

plunger valve member 99 having the piston portions 100—101 and 102 forming the circumferential groove 103 adapted when the piston is in depressed position to couple ports 91 and 92 and a second groove 104 adapted to couple ports 93 and 94.

Conventional mechanical means such as a driven cam 105 for positive operation of the valve member 99 has been illustrated in place of the hydraulic control previously employed.

The particular advantage of this system is two fold in that it permits of a mechanical actuation of the valve at any desired point in conjunction with the table stroke and at the same time it interrupts both the actuation and the return circuit as a table safe-guard against accidental flow through the respective conduits.

Figure 9 illustrates a slightly different form of pressure controlled valve which can be readily substituted for the delay valve unit illustrated for example in Figures 1 and 2. The member in this instance includes the valve casing member 106 having the valve chamber 107 for the reciprocable valve 108 having the T shaped passage 109 and 110 therein communicating with the cannellure 111.

At the bottom of the T slot is a socket 112 for the ball valve member 113 depressed in chamber 114. To impel and retain the valve in depressed position use is made of the supplemental plunger 115 bearing on the head of valve 108 and downwardly actuated by back pressure introduced into chamber 116 from the general back pressure conduit 33. So long as back pressure exists due to urge of the table the valve 108 will be held in closed position and firmly seated against ball 113. At the same time line 66' may have been coupled by movement of valve 52 with the general power circuit but the pressure area against ball 113 through the T slot 109 and 110 is not sufficient to raise the valve.

However, upon drop in back pressure the actuating medium will act through 110 against ball 113 raising the valve member 108 to couple inlet 66' with conduit 66 connected to cylinder 63 for actuation of the main circuit control valve. The general operation and coupled circuit is substantially the same as previously described, the principal difference being that the valve illustrated in Fig. 9 is provided with a bleeder escape line 116' connected with the chamber 114 in order that the actuating medium may be forced there-through on recurrence of pressure in chamber 116.

From the foregoing description considered in connection with the accompanying drawings the present invention and particularly the hydraulic actuation and control of the table circuit transmitting valve should be readily apparent and it will be seen that we have provided an improved control circuit and mechanism for actuation and regulation thereof which will satisfactorily care for various operating conditions which will positively power actuate or shift the main control valve to instantly change from rapid traverse to feed or reverse in desired intermittent cycle with the actuating means therefore, positively power actuated by movement of the table or other shiftable part of the machine tool and which in addition provides a similar positive actuation of an hydraulic control circuit regulating member from table movement and prior to designed reversal of the table movement which will definitely set a control circuit for subsequent actuation of the main circuit control valve

by pressure to reverse said valve and consequently the movement of the shiftable unit and that additionally we have provided means actuatable either by the drop in back pressure when the movement of the unit has been mechanically limited, actuatable by direct mechanical connections or the like for rendering effective the action of the hydraulic power shifting of the main control valve at a time subsequent to automatic determination of the subsequent effect to be attained by said main valve shifting.

We claim:—

1. A machine tool combining a cutter, a support therefor, a work support, an hydraulic actuator for effecting relative movement between said supports, a fixed stop for arresting said relative movement against the effort of said hydraulic actuator, a control valve for the actuator, a selector valve adapted to be actuated by the movement of one of said supports for determining the actuation of the control valve and means controlled by a variation in pressure in the actuator for accomplishing the actuation of the control valve predetermined by the adjustment of the selector valve.

2. A machine tool combining an hydraulic propeller, a member actuated thereby, a main valve for determining action of said hydraulic propeller, an auxiliary valve for determining the actuation of the main valve, means actuated by the movement of said member for mechanically shifting the auxiliary valve, means hydraulically actuatable by fluid passed by the auxiliary valve for operating the main valve and means for delaying the time of start of actuation of the main valve.

3. A machine tool combining an hydraulic propeller, a main hydraulic system for actuating said propeller, a main valve embodied in said system for determining the action of said hydraulic propeller, an auxiliary hydraulic system for determining the action of the main valve including a selector valve and an actuation control valve adapted to defer action of said main valve until after a predetermined pressure drop in said main system.

4. A machine tool combining an hydraulic propeller, an hydraulic circuit for actuation thereof, a main valve serially interposed in said circuit for determining the action of the hydraulic propeller, a supplemental hydraulic circuit including a selector valve and an actuation controlling valve arranged in series with the supplemental hydraulic circuit for determining the actuation of the main valve in the propelling circuit, and means operable automatically after said hydraulic propeller has come to rest to actuate said actuation controlling valve.

5. A machine tool combining an hydraulic propeller, an hydraulic circuit for actuation thereof, a main valve serially interposed in said circuit for determining the action of the hydraulic propeller, a supplemental hydraulic circuit including a selector valve and an actuation controlling valve arranged in series with the supplemental hydraulic circuit actuated in timed relation with the movement of said hydraulic propeller for determining the actuation of the main valve in the propelling circuit and means operable by the propeller for positioning the selector valve.

6. A machine tool combining an hydraulic propeller, an hydraulic circuit for actuation thereof, a main valve serially interposed in said circuit for determining the action of the hydraulic pro-

5 peller, a supplemental hydraulic circuit including a selector valve and an actuation controlling valve arranged in series with the supplemental hydraulic circuit for determining the actuation of the main valve in the propelling circuit, and means for operating the actuation control valve in pre-determined relation to the operation of the propeller.

10 7. A machine tool combining a translatable member, hydraulic means for shifting said member, an hydraulic circuit including a control valve for determining the rate and direction of movement of the shiftable member, actuators for said valve; a supplemental hydraulic circuit coupled with one of the actuators for the control valve for actuation thereof including a constantly available circuit for shifting the valve to determine the rate of movement, an interruptable circuit connected with another of said valve actuators for shifting the valve to determine the direction of movement of the table, a single valve serially mounted in both of said control circuits to determine the effective coupling thereof with the main control valve actuators and additional means for determining the effectiveness of the direction varying circuit.

30 8. A machine tool combining a translatable member, hydraulic means for shifting said member, an hydraulic circuit including a control valve for determining the rate and direction of movement of the shiftable member, actuators for said valve, a supplemental hydraulic circuit coupled with one of the actuators for the control valve for actuation thereof including constantly available circuit for shifting the valve to determine the rate of movement, an interruptable circuit connected with another of said valve actuators for shifting the valve to determine the direction of movement of the table, a single valve serially mounted in both of said control circuits to determine the effective coupling thereof with the main control valve actuators, additional means for determining the effectiveness of the direction varying circuit and means operable by movement of the table for effecting the various desired settings of the control circuit valve.

50 9. A machine tool combining a translatable member, hydraulic means for shifting said member, an hydraulic circuit including a control valve for determining the rate and direction of movement of the shiftable member, actuators for said valve; a supplemental hydraulic circuit coupled with one of the actuators for the control valve for actuation thereof including a constantly available circuit for shifting the valve to determine the rate of movement, an interruptable circuit connected with another of said valve actuators for shifting the valve to determine the direction of movement of the table, a single valve serially mounted in both of said control circuits to determine the effective coupling thereof with the main control valve actuators, additional means for determining the effectiveness of the direction varying circuit, means operable by movement of the table for effecting the various desired settings of the control circuit valve, and additional means responsive to table movement for determining the effective coupling of the reversing controlling circuit.

70 10. A machine tool combining a translatable member, an hydraulic motor operatively connected with said member, a fluid pressure system connected with opposite ends of said motor, a control valve embodied in said system and serving selectively to admit fluid under pressure into oppo-

site ends of said motor to effect positively directed reciprocation of said member, a supplemental circuit in series with said valve for effecting translation at a different rate and in a direction determined by adjustment of the valve, hydraulically operable means for actuating the valve to different settings whereby the rate and direction of movement of the translatable member is determined by said valve settings, hydraulic control circuits for effecting actuation of said hydraulically operable means for power shifting of said valve, and a dog-operable selector valve embodied in said hydraulic control circuits for determining the effective coupling of the control circuits with the valve operating means.

15 11. A machine tool combining a translatable member, an hydraulic motor operatively connected with said member, a fluid pressure system connected with opposite ends of said motor, a control valve embodied in said system and serving selectively to admit fluid under pressure into opposite ends of said motor to effect positively directed reciprocation of said member, a supplemental circuit in series with said valve for effecting translation at a different rate and in a direction determined by adjustment of the valve, hydraulically operable means for actuating the valve to different settings whereby the rate and direction of movement of the translatable member is determined by said valve settings, hydraulic control circuits for effecting actuation of said hydraulically operable means for power shifting of said valve, a mechanically actuated selector valve embodied in said control circuits for determining the effective coupling of the control circuits with the control valve, and additional means for variably interrupting one of the control circuits, as established by the selector valve, whereby the time of operation of said control valve may be controlled independent of the actuation of said selector valve.

40 12. A machine tool combining a carrier, hydraulic means for shifting the carrier, a selector valve having axial and oscillatory movement for control of rate and direction of actuation of the carrier, a main valve mechanism in series with the hydraulic means for establishing several effective circuits thereof, and supplemental control circuits selectively completable by movement of the selector valve to actuate the main valve mechanism to effect a selected movement of the carrier.

50 13. A machine tool combining a translatable table member, an hydraulic motor for effecting translation of said member, a conduit system connected with opposite ends of said motor, a main control valve mechanism embodied in said conduit system and selectively shiftable to effect a plurality of distinct couplings of the conduit system with the motor to vary the rate and direction of actuation of the translatable member, supplemental hydraulic control circuits operable to effect the individually selected movements of the main valve mechanism, a valve supported for axial and oscillatory movement having a plurality of ports selectively positionable by said movements into series with individual control circuits to determine the hydraulic actuation of the main valve mechanism and means effective on movement of the translatable member for imparting desired axial and oscillatory movement to the selector valve for varying the position of the main valve mechanism and thus of the table actuation.

75 14. A machine tool comprising a translatable member, an hydraulic motor operably connected

with said member, a fluid pressure system connected with opposite ends of said motor, a control valve embodied in said system, means supporting the valve for rotary movement to effect rate of movement variations transmitted to the translat-
 5 movement member, and for axial movement to determine directional movement thereof, a supplemental valve similarly supported for rotary and axial movements, trip mechanism coupled with
 10 the supplemental valve, means on the translatable member for axially shifting the supplemental valve, supplemental control circuits selectively completable by longitudinal movement of the
 15 supplemental valve for effecting rotary adjustments of the main valve, additional means associated with the translatable member for imparting oscillatory movement to the supplemental valve and control circuits selectively completed by oscillation of the supplemental valve
 20 for imparting a reciprocating movement to the main valve.

15. In a transmission and control mechanism for machine tools the combination of a single member shiftable to first, second and third positions respectively productive of different effect
 25 from said transmission, fluid operable shifting elements respectively operable to shift said member to the different of said positions, a fluid supply source, and a single valve having three positions
 30 respectively to connect said source with different of said elements.

16. In a transmission and control mechanism for machine tools the combination of a single member shiftable to first, second and third positions respectively productive of different effect
 35 from said transmission, a fluid operable shifting means adapted to selectively shift said member to any of said positions, including valve means adjustable to different positions respectively individual to the different member positions.
 40

17. In a milling machine, the combination of a relatively movable spindle and table, and means for relative movement therebetween including a transmission operable for forward and reverse
 45 quick traverse rate and alternatively for a feed

rate, hydraulic shifter means operative for adjusting said transmission for each of said effects and for a plurality of rates in the same direction, said shifter means including a plurality of separately operable piston devices respectively for different transmission adjustments, valve means for
 5 controlling said hydraulic shifter devices, trip means adjacent said table and connected with said valve means and dog means fixed on said table for the operation of said trip means during
 10 a unidirectional movement of said table to change the rate thereof.

18. A machine tool having a reciprocating support, hydraulic means for effecting said reciprocation including a reversible hydraulic motor having a pair of ports each alternatively available
 15 for intake or discharge of the actuating medium, a pump having an output port for supplying said medium to the motor, a reverser interposed between the ports of the pump and the motor for
 20 changing the directional effect of the pump output pressure on the motor and thereby a reversal in the support movement, hydraulically actuable means connectible to the pressure output port
 25 of the pump for shifting said reverser, and control means for potentially effecting said connection including a delay unit for postponing said shifting movement.

19. A machine tool having a reciprocating slide, a fixed stop, hydraulic means including a source of pressure for feeding the slide against the stop,
 30 a reversing valve for said means, hydraulically actuated means for shifting the valve to effect return of the slide, an auxiliary control valve, dog actuated means effective upon approach of the
 35 slide to the stop to shift the control valve to divert pressure from said source to said hydraulically actuated means, and means to delay the effect of said diverted pressure on said hydraulic actuated means and thereby postpone re-
 40 turn of the slide.

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