May 12, 1936. F. A. PARSONS 2,040,528

MILLING MACHINE ORGANIZATION

Filed Jan. 19, 1931 4 Sheets-Sheet 1

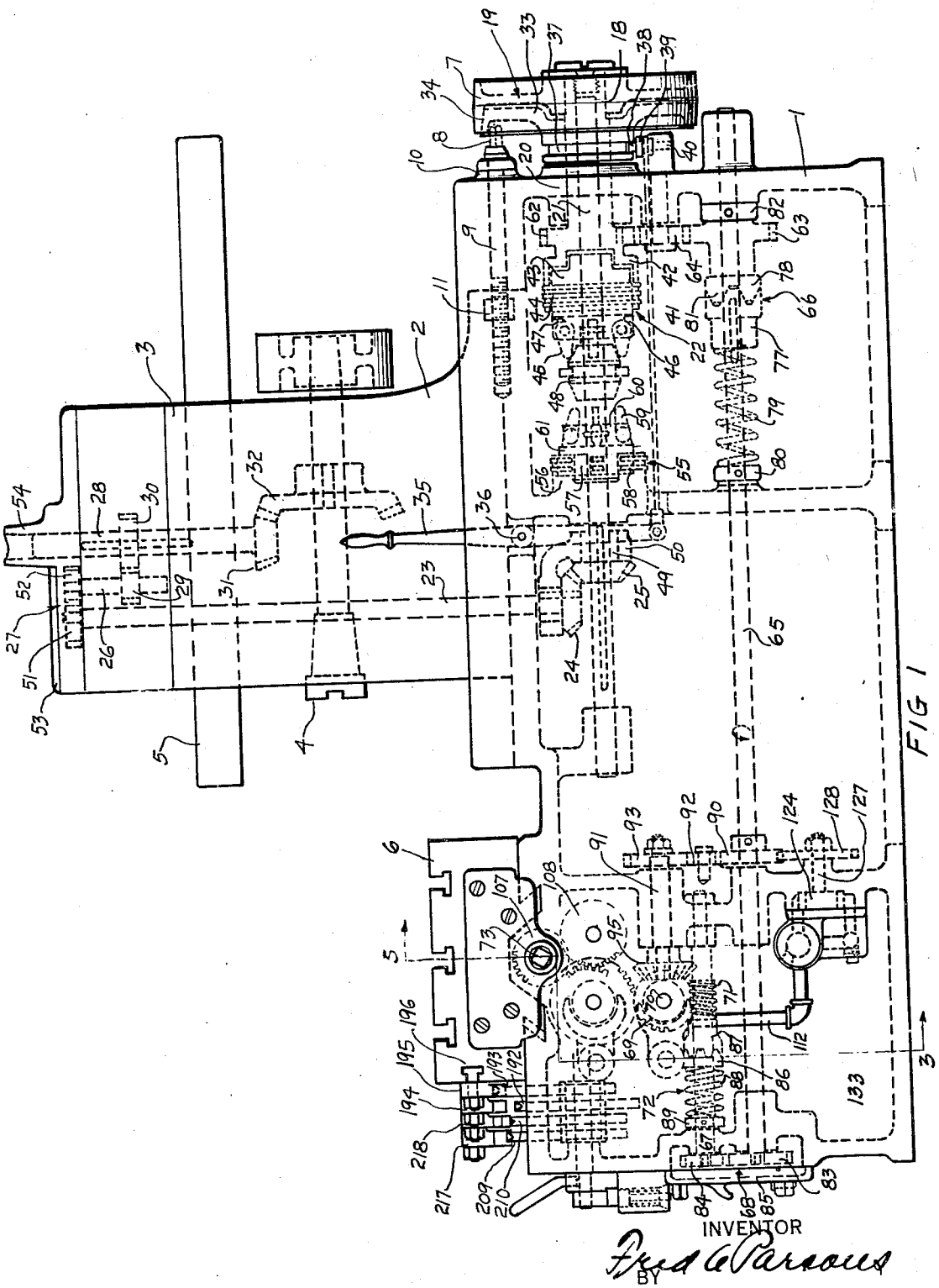


FIG 1

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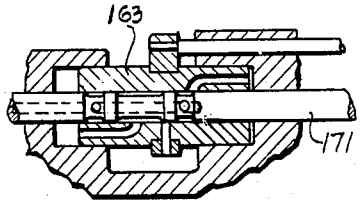


FIG. 7

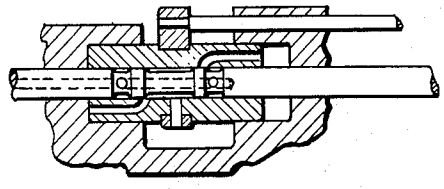


FIG. 8.

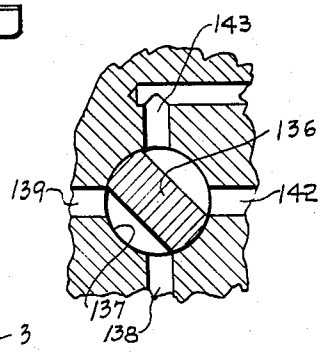


FIG 9

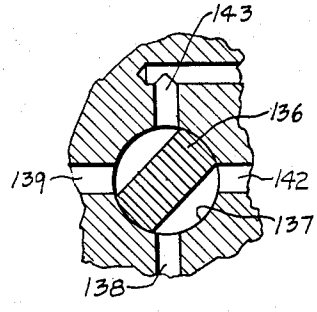


FIG 10.

FIG. 2.

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FIG 4.

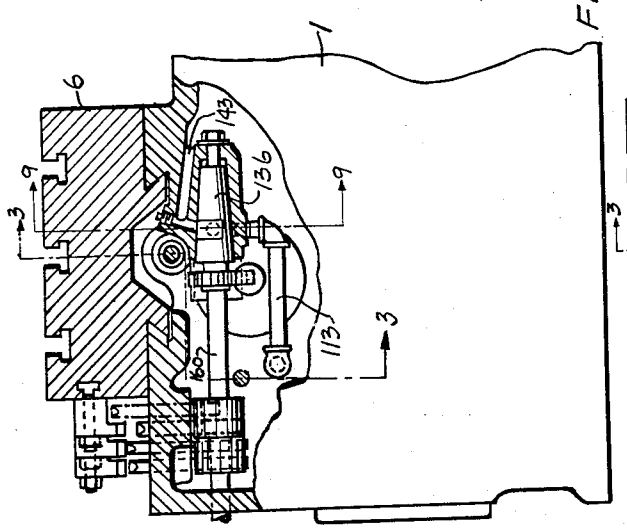


FIG. 5

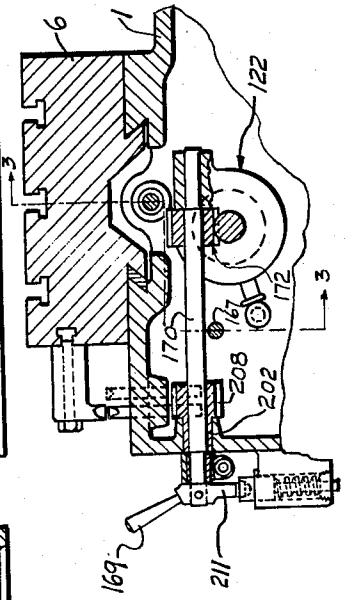
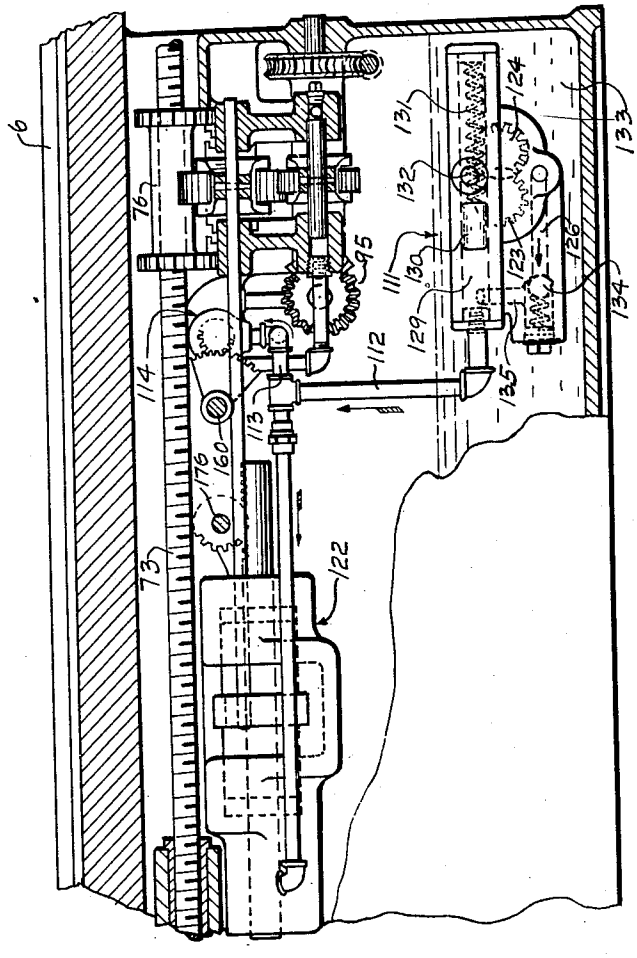


FIG 3.



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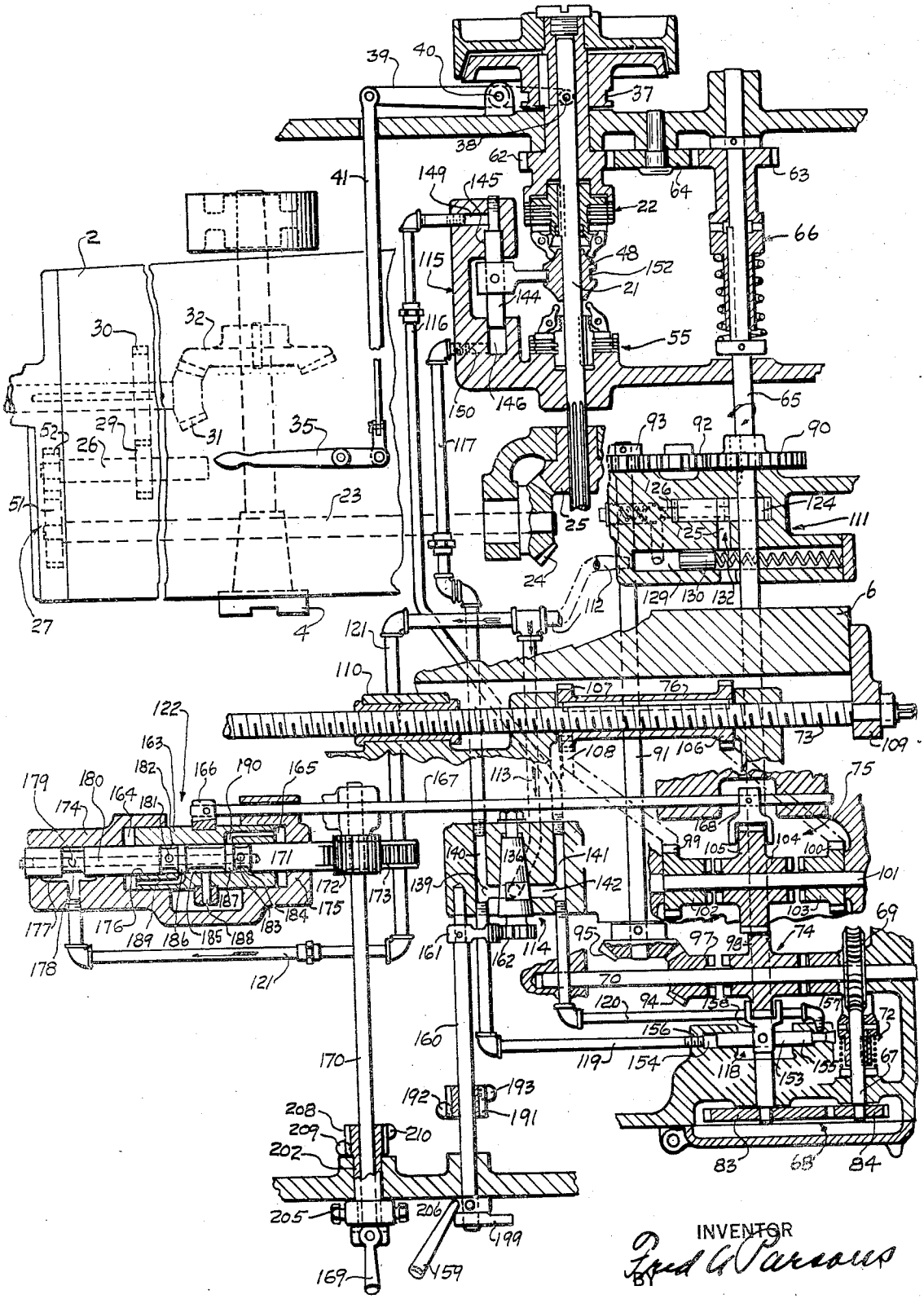


FIG 6.

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UNITED STATES PATENT OFFICE

2,040,528

MILLING MACHINE ORGANIZATION

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Application January 19, 1931, Serial No. 509,700

15 Claims. (Cl. 90—21)

This invention relates to machine tool transmission and control mechanism and more particularly to a form of such mechanism especially adapted for milling machines.

Machine tools such as milling machines require mechanism for a relatively slow feed or cutting movement of the work relative to the cutter and it is important for various reasons that this movement shall be operative only when the tool spindle is running. There is generally provided also mechanism for a relatively fast traverse movement for quickly traversing the machine through idle or non-cutting portions of the movement cycle. During the quick traverse movements it is preferable for a variety of reasons that the tool spindle should be stationary. Because of these different requirements it has been customary to provide separate trains to transmit the feed and the quick traverse movements from the point where the table transmission separates from the main or spindle transmission.

It is a purpose of the present invention to provide improved mechanism which will make it possible to combine the feed and quick traverse trains into a single train through at least a portion of their extent, while retaining the desirable feature mentioned above.

It is also an object to provide control mechanism of simplified operating characteristics and improved construction. In part this purpose relates to combining under a single control device certain functions previously ordinarily provided with separate or individual control devices, whereby a reduced number of control elements and movements are required for operating the machines through a working cycle.

The various devices shiftable for controlling the machine operation have ordinarily in the past been operated through strictly mechanical motion transmitting trains, and it is a purpose of the present invention to provide improved control motion trains and more particularly of a type in part operating by the means of a fluid or liquid.

The control devices of a machine tool may be hand or automatically operated or both, but in either event it is desirable that the elements primarily moved should move freely with little resistance and with a resistance independent of the resistance of the members to be finally actuated. It is a purpose of the present invention to provide improved mechanism for movement of the controlled parts and particularly in a form such that the part primarily moved for control purposes merely releases or controls the application of a secondary power device for the final or resulting movement. More particularly it is a purpose to provide such power movement by the means of fluid or liquid controlled by suitable primary control devices such as valves.

Another object is to combine the various above mentioned improvements and purposes into an organization especially suited both as to transmission and control mechanism to machine tools and particularly for milling machines.

Another object is generally to improve and simplify the construction and operation of machine tools with particular reference to milling machines and still other objects will be apparent from this specification.

The invention consists in the construction and combination as herein illustrated, described, and claimed, and in such modifications thereof as may be equivalent to the claims.

In the drawings like reference characters have been applied to the same parts in each of the several views, of which:

Fig. 1 is a right side elevation of a milling machine incorporating the invention.

Fig. 2 is a partial front elevation of the same machine.

Fig. 3 is a sectional view on the line 3—3 of Fig. 1 (also indicated in Figs. 4 and 5).

Fig. 4 is a sectional view on the line 4—4 of Fig. 2.

Fig. 5 is a sectional view on the line 5—5 of Fig. 2.

Fig. 6 is a diagrammatical view in the nature of a development in which certain of the parts are shown out of their natural positions and proportions, designed to show the operation of the complete machine.

Fig. 7 is a sectional view of a shifter device indicated in Fig. 5, showing the parts in a certain relation.

Fig. 8 is a similar view showing the parts in a different position.

Fig. 9 is a sectional view of a valve taken on the line 9—9 of Fig. 4, showing a valve member in a certain position.

Fig. 10 is a similar view showing the valve member in another position.

As shown in Fig. 1, the machine comprises a bed or base 1 on which is slidably mounted a head frame 2, the head frame supporting a spindle carrier 3 in which is rotatably mounted a spindle 4. Overarms 5—5 are slidably supported in carrier 3 for cooperation with a tool arbor, not shown, in the usual manner. A work table 6 is slidably supported on bed 1 and is movable in suitable relation to spindle 4 for tooling of a work piece

fixed with the table by means of a cutter fixed with the spindle. Spindle 4 and table 6 may be driven from a pulley 7 through suitable mechanism to be presently described.

Head frame 2 may be adjusted on bed 1 by means of a crank or the like, not shown, applied to the squared portion 8 of a screw 9 prevented from moving axially relative to bed 1 by means of a bearing 10 and engaging a nut 11 fixed with head frame 2.

Spindle carrier 3 may be raised and lowered in head frame 2 by means of a screw 12, Fig. 2, fixed against axial movement relative to frame 2 in a bearing 13 and engaging a nut 14 fixed with carrier 3. Screw 12 may be turned by means of a suitable crank, not shown, applied to squared portion 15 of a shaft 16 journaled in head frame 2 and driving screw 12 through bevel gears 17 fixed respectively with shaft 16 and screw 12.

Any suitable means may be provided for clamping head frame 2 with base 1 and for clamping spindle carrier 3 with head frame 2. Many such means being well known and forming no part of the present invention, they are not shown here.

The following mechanism is provided for driving spindle 4 from pulley 7. Referring to Fig. 1, pulley 7 is journaled on a sleeve 18 which it drives through the medium of a clutch, generally denoted by numeral 19 and which is journaled in a suitable bearing 20 in bed 1 and drives a shaft 21 rotatably fitted in the bore of sleeve 18 through a clutch, generally denoted by numeral 22, shaft 21 driving a vertical shaft 23 through bevel gears 24 and 25 fixed with shafts 23 and 21 respectively. Shaft 23 is journaled in suitable bearings in head frame 2 and drives a shaft 26 through a rate changer, generally denoted by numeral 27, shaft 26 driving a shaft 28 through gears 29 and 30 fixed with the respective shafts and shaft 28 driving spindle 4 through bevel gears 31 and 32 fixed respectively with shaft 28 and spindle 4. Clutch 19 comprises a member 33, Figs. 1 and 6, slidably keyed with sleeve 18 and having a tapered friction surface 34 adapted to engage a complementary surface on the inside of pulley 7 and capable of being moved into and out of engagement therewith by means of a hand lever 35 pivoted on a stud 36 fixed with bed 1. Member 33 has an annular groove 37 engaged by a pin 38 fixed with a lever 39 pivoted on a stud 40 fixed with bed 1 and a rod 41 pivotally connects the ends of the levers whereby movement of lever 35 to the left in Fig. 1 will disengage clutch 19, while movement thereof to the right will engage the clutch, as will be understood. Clutch 22 comprises a driving member 42 fixed with sleeve 18 and a driven member 43 fixed on shaft 21. A plurality of friction discs 44 are disposed between members 33 and 43, alternate discs being slidably fixed with members 42 and 43. The discs may be pressed into mutual driving relation by means of levers 45 pivoted on an adjustable nut 46 adjustable with relation to member 43. The levers on actuation press against a plate 47 slidably keyed with member 43 compacting the discs into mutual driving relation and thereby causing transmission of motion from member 42 to member 43 and shaft 21. For actuating levers 45 a spool 48 is slidably keyed with shaft 21 and adapted, when moved to the right in Fig. 1, to cause such actuation of levers 45.

To allow longitudinal motion of head frame 2 gear 25 is slidably keyed on shaft 21 and has a hub 49 journaled in a bracket 50 depending from head frame 2 through a suitable slot in bed 1.

Rate changer 27 comprises a gear 51 removably keyed with shaft 23 and meshing with a gear 52 removably keyed on shaft 26, a suitable housing being provided for the gears and having a removable cover 53 so that the gears may be reached and either interchanged or replaced with others of different ratio for obtaining a variety of speeds in shaft 26. Shaft 28 is slidably keyed in gear 30 so that it may move vertically upon adjustment of spindle carrier 3, a suitable housing 54 enclosing the projecting upper end of the shaft.

A brake, generally denoted by numeral 55, is provided for promptly bringing the above described parts to a stop under certain conditions and comprises a stationary member 56 fixed with a part of bed 1 and a movable member 57 fixed with shaft 21. A series of friction discs 58 are disposed between members 56 and 57, alternate discs being slidably keyed with member 56 and the remainder with member 57. The discs may be compacted into frictional contact by means of levers 59 pivoted on a collar 60 longitudinally adjustable on shaft 21. Levers 59 may be actuated by a movement to the left, in Fig. 1 of spool 48, and pressed against a plate 61, forcing the same against discs 58. The proportions of spool 48 are such that clutch 22 is necessarily disengaged before brake 55 is applied. Spool 48 is moved to the right or left by means of mechanism to be presently disclosed.

The following mechanism is provided for driving table 6 from pulley 7. Sleeve 18 has fixed therewith a gear 62 which drives a gear 63 through an idler 64 journaled on a suitable stud fixed with bed 1, gear 63 driving a shaft 65 through an overload releasing device, generally denoted by numeral 66. Shaft 65 drives a shaft 67 through a rate changer, generally denoted by numeral 68, shaft 67 driving a worm wheel 69 journaled on a shaft 70 by means of a worm 71 journaled on shaft 67 and driven therefrom through an overload release, generally denoted by numeral 72. Worm wheel 69 constitutes the terminus of the feed train and as shown in Figs. 2 and 6 drives a table screw 73 through a clutch device, generally denoted by numeral 74, a reverser, generally denoted by numeral 75, and a sleeve 76 slidably keyed with table screw 73.

Overload release 66, Fig. 1, comprises a clutch member 77 slidably keyed with shaft 65 forced into driving relation with a clutch member 78 fixed with gear 63 by means of a spring 79 bearing at one end against a collar 80 fixed with shaft 65 and at the other end against clutch member 77, the teeth 81 of the clutch members being of such form as to allow relative motion therebetween in case the torque transmitted exceeds a predetermined amount. A collar 82 fixed with shaft 65 takes the resulting thrust of gear 63, thus eliminating the continuous friction which would otherwise result from the pressure of the spring and gear against stationary parts of bed 1.

Rate changer 68 comprises gears 83 and 84 removably keyed with shafts 65 and 67 respectively, within a suitable housing having a cover 85 allowing access to the gears. The gears may be removed and interchanged or replaced with others of different ratios, also mutually interchangeable to provide a plurality of rates in shaft 67.

Overload release 72 comprises a clutch member 86, slidably keyed to shaft 67 and urged into driving relation with a clutch member 87 fixed with worm 71 by means of a spring 88. Spring 88 bears at one end against member 86 and at the

other end against a collar 89 fixed with shaft 67. Clutch members 86 and 87 are provided with complementary clutch teeth so shaped as to cause a positive transmission of motion therebetween so long as the torque transmitted does not exceed a predetermined amount, but in the event that it does, to cause clutch member 86 to be forced to the left in Fig. 1 whereby the teeth will slip by each other, thus interrupting the drive and preventing damage.

It might appear that overload release device 72 would be unnecessary in view of the provision of overload release device 66, but this is not true, owing to the provision of rate changer 68 between the shafts, since at such times as a gear ratio were in use, which would result in driving shaft 67 at a reduced rate relative to the shaft 65, the torque which it would be possible to develop in shaft 67 would be that in shaft 65 multiplied by such ratio, and might reach a value sufficient to cause damage before release device 66 would operate. Under such conditions release device 72 would operate and save the machine or work from damage.

On the contrary, if the ratio of rate changer 68 were such as to drive shaft 67 at a higher rate than shaft 65, the torque in shaft 67 would be less than in shaft 65 and upon overload the torque in shaft 65 might reach a dangerous value before device 72 would operate. In such a case device 66 would function and prevent damage to any part of the feed train.

A rapid traverse train for driving table 6 originates in a gear 90 fixed with shaft 65. Gear 90 drives a shaft 91 through an idler 92 journaled on a suitable stud fixed with bed 1 and meshing with a gear 93 fixed with shaft 91. Shaft 91 drives a bevel gear 94, Figs. 2 and 6, through a bevel gear 95 fixed with the shaft, gear 94 being journaled on shaft 70 and having a hub portion 97 provided with suitable clutch teeth adapted to engage member 74 upon movement thereof to the left in Figs. 2 and 6. The dimensions of member 74 are such that it is impossible to engage it with both worm wheel 69 and bevel gear 94 at the same time. Accordingly, movement of member 74 to the right will cause its engagement with worm wheel 69 and rotation at a relatively slow rate, while movement of member 74 to the left will cause its engagement with bevel gear 94 and rotation at a relatively fast rate. Member 74 has a gear 98 fixed therewith adapted to drive reverser 75.

Reverser 75 comprises gears 99 and 100 spaced apart and journaled on a shaft 101 and having hub portions 102 and 103 respectively, provided with clutch teeth adapted to cooperate with suitable clutch teeth on a shiftable member 104 slidably journaled on shaft 101 between gears 99 and 100. Member 104 is provided with a gear 105 adapted to mesh with gear 98 on member 74. Member 104 may thus be moved longitudinally on shaft 101 to engage and drive either gear 99 or 100, the faces of gears 98 and 105 being sufficiently wide to allow a suitable amount of axial motion of the members without impairing the driving relation therebetween. Gear 100 drives sleeve 76 through a gear 106 meshing with gear 100, while gear 99 drives a gear 107 also fixed with sleeve 76 through an idler 108, (Fig. 1) journaled on a suitable stud fixed with bed 1. Consequently when member 104 is engaged with gear 100, sleeve 76 and table screw 73 will be rotated in one direction and when member 104 is engaged with gear 99, they will be rotated in the opposite direction. Table screw 73 is journaled in suitable bearings 109—109 and thereby fixed against axial movement relative to the table. Screw 73 engages a nut 110 fixed with bed 1, whereby rotation of screw 73 will cause sliding movement of table 6.

The above outlined shiftable members in the present instance are controlled by mechanism actuated by fluid pressure. The fluid pressure originates in a pump and accumulator, generally denoted by numeral 111, Figs. 3 and 4, and passes through a duct 112 having a branch 113 leading to a control valve, generally denoted by numeral 114 from which it is conducted to a clutch shifter, generally denoted by numeral 115, Fig. 6, through pipes 116 and 117. Fluid is conducted also from valve 114 to a rapid traverse shifter, generally denoted by numeral 118 through pipes 119 and 120. Another branch 121 from duct 112 leads to a reverser shifter, generally denoted by numeral 122.

Pump 111 may be of any suitable type, but in the present instance consists of gears 123 and 124, Fig. 3, meshed together in a substantially closed casing having an inlet port 125, Fig. 6, and an outlet port 126. Gear 124 is fixed with a shaft 127, Fig. 1, and driven from shaft 65 through a gear 128 meshing with gear 90. An accumulator cylinder 129, Fig. 3, is associated with the casing of the pump and has a piston 130, movably fitted therein and pressed to the left in Fig. 3 by means of a spring 131. Inlet port 125, Fig. 6, communicates with cylinder 129 at a point to the right of piston 130 and a port 132 communicates from a point substantially opposite port 125 with a suitable reservoir 133, Figs. 1 and 3. Accordingly pump 111 receives fluid through ports 132 and 125 and forces it through discharge port 126, a check valve 134, and a port 135 to cylinder 129 at a point to the left of piston 130. The accumulation of fluid to the left of piston 130 forces the same to the right against the pressure of spring 131 and when a predetermined amount of fluid has been forced into cylinder 129 in this manner, piston 130 covers port 125 and prevents access of fluid to the suction side of the pump. Since fluid pressure is prevented from acting backwardly from port 135 against the pump by check valve 134, and since no fluid is admitted to the pump through port 125, the pump will be relieved from load at such times as a predetermined accumulation of fluid is present in cylinder 129 sufficient to satisfy the needs of the various shifters.

Valve 114 comprises a rotatable plug 136, Figs. 6, 9, and 10, fitted in a bore 137. Fluid from pipe 113 enters bore 137 through a port 138 and with valve member 136 in the position shown in Fig. 9 passes through a port 139 to a passage 140 connecting with pipes 117 and 119 leading to shifters 115 and 118. Any fluid returned from shifters 115 and 118 through pipes 116 and 120, respectively, passes through a passage 141 and enters bore 137 through a port 142 passing through a bore 137 to a port 143 leading back to reservoir 133 as shown in Fig. 4. With valve 114 in the position shown in Fig. 10, fluid from pipe 113 will be directed through port 142 and passage 141 to shifters 115 and 118 through pipes 116 and 120, respectively, and any fluid returning from shifters 115 and 118 through pipes 117 and 119 will pass through passage 140 and port 139 to bore 137 and return to reservoir 133 through port 143.

Clutch shifter 115 comprises a plunger 144, Fig. 6, fitted for reciprocatory movement in cyl-

inders 145 and 146 connected respectively with pipes 116 and 117 through ports 149 and 150.

The plunger has fixed therewith a shifter fork 151 engaging a suitable groove 152 in spool 48. Accordingly, when fluid is admitted to cylinder 146 and exhausted from cylinder 145, plunger 144 will move upwardly in Fig. 6, thereby engaging clutch 22, while when fluid is admitted to cylinder 145 and exhausted from cylinder 146, plunger 144 will be moved downwardly in Fig. 6, thereby disengaging clutch 22 and applying brake 55.

Rapid traverse shifter 118 comprises a plunger 153 slidably fitted in cylinders 154 and 155 fixed with bed 1 and connected respectively with pipes 119 and 120 through ports 156 and 157. Plunger 153 has a shifter fork 158 fixed therewith and engaging the sides of gear 98, whereby motion of plunger 153 will cause shifting of member 74. Accordingly, when fluid is admitted to cylinder 154 and exhausted from cylinder 155, member 74 will be engaged with worm wheel 69 for driving table 6 at a feed rate, while when fluid is admitted to cylinder 155 and exhausted from cylinder 154, member 74 will be moved into engagement with bevel gear 97 for driving table 6 at a rapid traverse rate.

Valve plug 136 may be moved by means of a hand lever 159 fixed with a shaft 160 journaled in bed 1 and having a sector 161 fixed therewith and engaging a gear 162 fixed with plug 136. Thus when lever 159 is moved to the left, Figs. 2 and 6, valve plug 136 is turned to the position shown in Fig. 9 and fluid is admitted to port 139, flowing through pipes 117 and 119, causing engagement of clutch 22 and shifting member 74 into engagement with worm wheel 69. When, however, hand lever 159 is moved to the right, valve plug 136 is turned to the position shown in Fig. 10, and fluid is admitted to port 142, passing through pipe 116 and causing disengagement of clutch 22 and application of brake 55, thus bringing spindle 4 promptly to a stop. At the same time, fluid passes through pipe 120 causing plunger 153 to shift member 74 to the left, disengaging it from worm wheel 69, and engaging it with bevel gear 97, thus shifting from a feed drive rate to a rapid traverse rate.

Reverser shifter 122 operates independently of valve 114. The shifting is done by action of fluid pressure from pump 111 acting on a plunger 163 slidable in cylinders 164 and 165. Plunger 163 has a member 166 fixed therewith and connecting with a rod 167 leading to a shifter fork 168 engaging the sides of gear 105 whereby movement of plunger 163 will cause corresponding movement of gear 105 and member 104. The action of the fluid in cylinders 164 and 165 may be controlled by the hand lever 169 fixed with a shaft 170 journaled in bed 1 and actuating a stem 171 through a gear 172 fixed with shaft 170 and engaging a rack portion 173 of stem 171. Stem 171 is slidably fitted in coaxial bores formed in plunger 163 and in portions 174 and 175 of the cylinder member cooperating with the bores to form valve means for effecting such control, the bore in plunger 163 being denoted by numeral 176.

Fluid is admitted to cylinders 164 and 165 from pipe 121 through an elongated port 177 registering at all times with a reduced portion 178 of stem 171. It then enters an opening 179 communicating with a bore 180 axially formed in stem 171 and escapes through an opening 181 into an annular groove 182 formed in stem 171. Fluid also passes further in bore 180 and escapes through an opening 183 into a second annular groove 184. A cut-away portion 185 of stem 171 forms pistons 186 and 187 separating grooves 182 and 184 from cut-away portion 185 and provides an exhaust chamber for used fluid. An exhaust port 188 is formed through the wall of plunger 163 in position to register with cut-away portion 185 in the various relative positions of plunger 163 and stem 171. A port 189 leads from a predetermined point in bore 176 through plunger 163 to the interior of cylinder 164 and a port 190 leads from another point in bore 176 through plunger 163 to the interior of cylinder 165.

Ports 189 and 190, when plunger 163 and stem 171 are in their respective mid-positions, enter bore 176 substantially opposite pistons 186 and 187. The device is accordingly stable in this position since fluid is prevented from passing from groove 182 into port 189 or from groove 184 into port 190 by pistons 186 and 187 respectively. If now stem 171 is moved, for example to the right, by the action of the gear 172, fluid will be admitted from groove 182 to port 189, flowing into cylinder 164 and tending to force plunger 163 also to the right. In the meantime, fluid already in cylinder 165 will pass out through port 190 into exhaust chamber 185 and escape through port 188, stem 171 having moved sufficiently to establish registration between port 190 and chamber 185. This action will continue until plunger 163 moves sufficiently to reestablish the relation with stem 171 which obtains in Fig. 6, when ports 189 and 190 will be again closed by pistons 186 and 187 and the movement will stop.

If, on the other hand, plunger 163 be displaced from its central position, for example to the left in Fig. 6, fluid will be immediately admitted from groove 182 to port 189 as before and plunger 163 will again be moved to the right until it has taken a position in which ports 189 and 190 are again closed by pistons 186 and 187.

Plunger 163 will accordingly operate to shift member 104 in accordance with the movements of hand lever 169 as communicated to stem 171.

In the event that plunger 163 or member 104 should stick in one of the engaged positions, for example to the right, it is possible that stem 171 might be moved, for instance, to its extreme left position before plunger 163 would move from its extreme right position. The relation of pistons 186 and 187 to each other and the length of stroke of the parts is such that the above described action of the fluid will still be carried out as is clearly apparent from Fig. 7 wherein the plunger is shown in its extreme right position and the stem in its extreme left. If it proves to be desirable to maintain plunger 163 under a definite pressure when at either end of its travel, this may be done by making the travel of stem 171 slightly greater than the maximum travel of plunger 163 in either direction from central position. The result of this is clearly shown in Fig. 8 in which even though plunger 163 is moved to the limit of its leftward travel, communication is still open from groove 184 to port 190 and fluid pressure is acting continuously in cylinder 165 while cylinder 164 is open to the exhaust through port 189, chamber 185, and port 188.

This over travel of stem 171 is not necessary, however, since, as above outlined, plunger 163 will take up a position after each movement in which ports 189 and 190 are substantially opposite pistons 186 and 187. It is automatically prevented from being displaced from this position and accordingly its travel is always substantially

equal to that of stem 171, so that if stem 171 is caused to move the desired amount, plunger 163 will move the same amount.

Power movement from table dogs is provided for valve 114 for which the mechanism is as follows: Shaft 160 has a gear 191 fixed therewith engaging plungers or trip pins 192 and 193 having beveled ends and arranged for the movement of lever 159 to lift the one or the other of the pins into the path of movement of dogs 194 and 195 respectively, Fig. 2, which are adjustably fixed on the front edge of the table by means of a T-slot 196 and T-bolts 197 and 198 in the usual manner. The pins 192 and 193, for reasons to be explained later, stand at different distances from the edge of the table and the dogs have beveled pin contacting portions suitably spaced from the table to correspond with the respective pins. The shaft 160 is provided with a cam 199 fixed thereon and adapted to co-act with a pointed plunger 200 which is pressed upwardly by a spring 201. The arrangement is such that when the valve 114 is in the one or the other position, the point of the plunger rests on the one or the other side of cam 199, and when shifted to change to the other position, the plunger is forced downwardly as the shaft 160 turns, until the point of the cam moves past the point of the plunger, after which the plunger reacts on the cam to quickly shift the valve to its opposite position. As previously noted, either direction of movement will move one of the trip pins 192 or 193 up into the path of movement of one of the dogs 197 or 198 and the proper dog may be positioned to contact the raised pin during the continued movement of the table and move it down again until the point of cam 199 has passed plunger 200, as above described. The plunger then quickly completes the valve movement, thus actuating shifters 115 and 118 and changing the rate of movement of the table, and at the same time raises the other plunger into the path of the other dog where it may later be contacted to similarly change the rate again. Thus during movement of the table in either direction, the rate may be changed at any point, and as often as desired, by suitably positioning suitable dogs similar to dogs 197, 198.

It may occur that rate changes are desired during one direction of table travel which are not desired at corresponding positions in the opposite direction of table travel. In such case dogs are used of a type having plunger contacting portions hinged to be effective in only one direction of table travel, but since such hinged dogs are well known in the operation of mechanically actuated supports, examples thereof are not here shown.

Power movement is provided for reverser shifter 122 for which the mechanism is as follows: Shaft 170, Fig. 6, above mentioned, is journaled in a sleeve 202 which is in turn journaled in bed 1. Sleeve 202 is provided with ears or lugs 203 and 204, Fig. 2, which carry adjustable screws 205 and 206 respectively, adapted to contact with opposite sides of a lug 207 fixed with shaft 170. The screws 205 and 206 may be adjusted to permit a considerable movement of sleeve 202 in either direction before the points of the screws contact the lug 207 to move shaft 170. Sleeve 202 extends into bed 1 and has fixed therewith a gear 208, Fig. 6, upon opposite peripheral sides of which a plurality of trip pins or plungers 209 and 210 are engaged by suitable rack teeth. The arrangement is such that the pins are moved oppositely when sleeve 202 is moved, and a movement of sleeve 202 to a position for table movement to the right in Fig. 2 will move the left-hand pin upward and the other pin downward, and vice versa. Fixed on sleeve 202 outside of bed 1 is a cam 211, Fig. 2, configurated to provide a central notch 212 and high points 213 and 214 on each side of the notch. A pointed plunger 215 co-acts with cam 211 under pressure of a spring 216. When sleeve 202 is moved in either direction to move the cam points 213 and 214 past the point of plunger 215, the cam and plunger will cooperate under pressure of spring 216 to continue the movement of sleeve 202 until stem 171 has been moved to the full extent of its movement in such direction.

The construction described provides an adjustable lost motion device interposed in the transmitting connections between pins 209 and 210 and stem 171, but not between hand lever 169 and stem 171.

Dogs 217 and 218, Fig. 2, are adjustably fixed on the front of the table by means of T-slot 169 and T-bolts 219 and 220 in the usual manner and are each provided with portions suitably positioned to contact with pins 209 and 210 during the travel of table 6 in the one or the other direction. The contact portions may be made of such dimensions as to force the pins contacted downward to any desired extent sufficient to move sleeve 202 until the notch of cam 211 has been moved past the point of plunger 215 in either direction of travel by the one or the other dog. However, it will occur that if the screws 205 and 206 are suitably adjusted, plunger 163 and member 104 will be moved to a neutral position before this happens, and the table will cease to move while the plunger is still engaged in the notch which will yieldably hold the parts in such position until lever 169 has been manually operated. It is to be noted, however, that the lever cannot be operated to continue table movement in the same direction because prevented by contact with the pin and the dog which has just forced it down, but table movement may be reestablished in the opposite direction by continuing the movement started by the dog until the cam notch will have passed the plunger, when the cam and plunger will quickly move the parts under pressure from spring 216. Such is the operation if the screws 205 and 206 are adjusted to provide little or no lost motion between the ends of the screws and a lug 96, but if adjusted to provide considerable lost motion, so much as may be necessary to permit the central notch 212 to move completely past the point of the plunger before the plunger 163 and member 104 have reached a neutral position, then immediately before the parts reach a neutral position, the cam and plunger will cooperate under the pressure of the plunger spring and continue the movement of the parts through such neutral position until the opposite position is reached, and the table will immediately start to move in the opposite direction. Thus either a stop or a reversal of table movement may be effected at either end of the table stroke in accordance with the adjustment of screws 205 and 206. The screws may both be adjusted to give a reversal of table movement, in which case when once started by hand lever 169, the table will continue an automatic forward and backward movement indefinitely so long as clutch 19 is engaged and pulley 7 is driven. Also, either screw may be adjusted to

cause a stop at the one end of the table travel and the other screw to effect a reversal of table movement. Thus the table may, for instance, be started by hand movement of lever 169 to travel to the left in Fig. 2, and after completing the desired left movement, dog 218 will strike plunger 210, and, screw 206 being properly adjusted, the table movement will be reversed. The table then travels to the right until the starting point is reached, when dog 217 contacts plunger 209 and, screw 205 being properly adjusted, the table stops. This constitutes an automatic cycle of forward and return movement which may be performed in either direction.

The handle 169 is connected directly to shaft 170 without motion being transmitted through the lost motion connection, as previously noted, and thus even through the lost motion device is adjusted to provide table reversal when the parts are dog actuated, table movement may always be interrupted at any point by positioning the hand lever centrally.

It will be noted that the rate change trip plungers 192 and 193 are spaced at different distances from the front edge of table 6. This is in order that the dogs effective on the respective plungers will not contact the other plungers on the continued or return movement of the table. Reverse plungers 209 and 210 are also spaced at different distances from table 6 than rate changer plungers 192 and 193, as shown in Fig. 1, whereby rate change dogs 194 and 195 may be placed between reverse dogs 217 and 218 when desired without interfering with the reverse plungers 209 and 210.

The above being a full and complete description of a machine illustrative of the invention, what is claimed is:

1. In a milling machine, the combination of a reciprocable work table, a supporting structure therefor, a rotatable tool spindle at a level above said table and axially transverse to the path of table movement, said structure providing a spindle supporting portion uprising adjacent a longitudinal edge of said table and at one side of a vertical plane passing through said edge; a spindle train including a power source, a motion interrupting means, a rate changer and said spindle serially connected in the order recited, a transmission for movement of said table driven from the said power source to exclude said interrupting means and including in the order recited a plurality of branch lines one of which includes a feed rate changer, a device shiftable to be selectively driven from the one or the other of said branch lines, a reverser and said table, said reverser being positioned adjacent to said table, and control mechanism for said machine including dog operable means adjacent said table, a connection from said dog operable means for the operation of said reverser, manually operable means having a portion positioned at the other side of said vertical plane and adjacent the other longitudinal edge of said table, connections from said manually operable means for the operation both of said shiftable device and said motion interrupting means.

2. In a milling machine, the combination of a tool spindle, a work support, a support for said spindle, one of said supports being movable in a path transverse to the axis of said spindle, a power train for movement of said spindle including a power source, a motion interruptor, transmission means for movement of said support driven to exclude said interruptor including a plurality of branch lines one of which includes a feed rate changer, a device shiftable to be selectively driven from the one or the other of said branch lines and a reverser shiftable to cause movement of said support selectively in one or the other direction, and control means including a first controller adapted to dependently operate said motion interruptor and said device, and a second controller for controlling said reverser and operable independently of said first controller each of said controllers comprising a primary control means and secondary control means including fluid operable shifters controlled from said primary control means.

3. In a milling machine, the combination of a reciprocable work table, a supporting structure therefor, a rotatable tool spindle at a level above said table and axially transverse to the path of table movement, said structure providing a spindle supporting portion uprising adjacent a longitudinal edge of said table and at one side of a vertical plane passing through said edge, a power source associated with said machine, transmission means for driving said spindle including said power source, a motion interruptor and a rate changer serially connected between said power source and said spindle, a transmission for movement of said table including a plurality of branch lines each driven from said spindle transmission to exclude said motion interruptor, a selector shiftable to be selectively driven from the one or the other of said branch lines and a train connecting said selector with said work table and including a reverser adjacent said table and selectively shiftable into positions to cause movement of said table in one or the other direction, and control means including a first controller having a motion transmitting connection for shifting of said reverser, and a second controller operable independently of said first controller and including a motion transmitting connection to said shiftable selector, a fluid operable shifter for actuation of said motion interruptor, a valve controlling said fluid operable shifter, and a motion transmitting connection to said valve, whereby said second controller is operable for dependent operation of said shiftable selector and said motion interruptor, each of said controllers having portions exposed at the other side of said vertical plane and adjacent the other longitudinal edge of said table, and dogs fixed with said table and adapted to contact said exposed portions at predetermined points in table movement.

4. In a milling machine, the combination of a tool spindle, a work support, a support for said spindle, one of said supports being movable in a path transverse to the axis of said spindle, a power train for rotation of said spindle including a motion interruptor and a power source, control means for said motion interruptor including a fluid operable shifter device, transmission means for movement of said support driven from said power source exclusive of said motion interruptor, and including a feed rate train, control means for said transmission including a device, shiftable for altering the transmission effect, a source of fluid supply for said fluid operable shifter, valve means controlling the supply of fluid to said fluid operable shifter, and a controller connected for simultaneous operation of said valve means and of said shiftable device.

5. In a milling machine, the combination of a reciprocable work table, supporting structure therefor, a rotatable tool spindle at a level above said table and axially transverse to the path of

table movement, said structure providing a spindle supporting portion uprising adjacent a longitudinal edge of said table and at one side of a vertical plane passing through said edge, a power source associated with said machine, transmission means for driving said spindle from said power source including a motion interruptor and rate changer serially connected between said power source and said spindle, a feed train driven from said transmission at a point between said power source and said motion interruptor and including a feed rate changer, a rapid transverse train driven from said transmission at a point between said power source and said selector means shiftable to be selectively driven from the one or the other of said trains, a train connecting said selector means and said table including a reverser adjacent said table, and control means including a plurality of separately operable controllers each having a portion exposed adjacent the other longitudinal edge of said table, a connection from one of said controllers to said reverser, another connection from the other of said controllers to said selector and to said motion interruptor, and means fixed with said table adapted to contact said exposed portions at predetermined points in the travel of said table.

6. In a milling machine, the combination of a rotatable spindle, a support therefor, a second support, one of said supports being movable with respect to the other support, a power train for rotating said spindle including a power source and a motion interruptor, a transmission for said movable support including a plurality of branch lines each driven from said power train at a point between said power source and said motion interruptor, one of said branch lines including a feed rate changer, a selector shiftable to be driven selectively from one or the other of said branch lines, and a train connecting said selector with said movable support and including a reverser, control means including a first controller for dependently operating said selector and said motion interruptor, and a second controller for said reverser and operable independently of said first controller, each of said controllers including primary control means and secondary control means including power operated shifters, responsive to said primary control means.

7. In a milling machine, the combination of a reciprocable work table, a supporting structure therefor, a rotatable tool spindle supported at a level above said table and axially transverse to the path of table movement, said structure providing a spindle supporting portion uprising adjacent a longitudinal edge of said table and at one side of a vertical plane passing through said edge, a power source associated with said machine, transmission means for driving said spindle therefrom including a clutch and a rate changer serially connected between said power source and said spindle, a power train driven from said transmission means at a point between said power source and said clutch and adapted to drive said table at a feed rate, a second power train driven from said transmission means at a point between said power source and said main clutch and adapted to drive said table at a rapid traverse rate, a reverser shiftable into positions to cause movement of said table selectively in one or the other direction, means including a fluid operable shifter adapted to cause shifting of said reverser, a selector device adapted to determine which of said trains shall be effective to drive said table through said reverser, means including a fluid operable shifter adapted to cause actuation of said device, a fluid operable shifter for actuation of said main clutch, a train actuable for causing operation of certain of said shifters for shifting said reverser, a train actuable to cause operation of certain of said shifters for causing dependent operation of said selector device and said main clutch, said trains having portions exposed adjacent the other longitudinal edge of said table, and dogs fixed with said table and adapted to contact said exposed portions at predetermined points in table movement whereby to actuate said trains.

8. In a machine tool, the combination of a rotatable spindle, a support therefor, and a second support, one of said supports being movable with respect to the other support, a power train for rotating said spindle including a power source and a main clutch, a feed transmission for movement of said support driven from said power train at a point between said power source and said clutch, a rapid traverse transmission for movement of said support driven from said power train at a point between said power source and said clutch, a selector shiftable to cause movement of said support from one or the other of said transmissions, a reverser shiftable to selectively cause said support to be driven in one or the other direction, primary control means for dependently operating said selector and said main clutch, primary control means for controlling said reverser separate from the above mentioned control means, secondary control means including fluid operated shifters controlled from said primary control means and adapted to actuate said main clutch, said selector and said reverser, and means including a pump driven from said power train at a point between said power source and said main clutch and adapted to supply fluid to said secondary control means.

9. In a milling machine, the combination of a base, a work support movably supported from said base, a tool spindle disposed at a level above said work support and axially transverse to the path of movement thereof, means for supporting said spindle including a member uprising from said base adjacent a longitudinal edge of said work support, and a spindle carrier adjustably supported from said member and adapted to support said spindle, a power train for rotating said spindle including a power source and a main clutch, a transmission for movement of said work support at a feed rate driven from said power train at a point between said power source and said clutch, a transmission for movement of said work support at a rapid traverse rate driven from said power train at a point between said power source and said clutch, a device shiftable to selectively cause movement of said support from the one or the other of said transmissions, a reverser shiftable to cause actuation of said work support from one of said transmissions selectively in one or the other direction, primary control means situated adjacent the other longitudinal edge of said work support for dependently operating said device and said main clutch, primary control means also situated adjacent such edge of said work support for controlling said reverser separate from the above mentioned control means, secondary control means including fluid operated shifters responsive to said primary control means and adapted to actuate said main clutch, said device, and said reverser means, a pump driven from said power train at a point

between said power source and said main clutch and adapted to supply fluid to said secondary control means, and means adapted to automatically operate said primary control means in response to movements of said work support.

10. In a machine tool, the combination of a rotatable spindle, a support therefor, and a second support, one of said supports being movable with respect to the other support, a power train for rotating said spindle including a power source, a main clutch and said spindle in the order recited, a feed transmission for movement of said support at a feed rate, and a transmission for movement of said support at a rapid traverse rate, said transmissions having a portion common to each other and driven from said power train at a point between said power source and said clutch, an overload release device associated with said common portion, a selector shiftable to cause actuation of said support from either of said transmissions, a reverser shiftable to cause actuation of said support selectively in either direction, and a second overload release device associated exclusively with said feed transmission.

11. In a machine tool, the combination of a rotatable spindle, a support therefor, and a second support, one of said supports being movable with respect to the other support, a power train for rotating said spindle including a power source, a clutch, a second clutch and said spindle in the order recited, a feed transmission for movement of said support at a feed rate, a rapid traverse transmission for movement thereof at a rapid traverse rate, said transmission having a common portion driven from said power train at a point between said clutches, an overload release device associated with said common portion, a selector shiftable to cause actuation of said support from either of said transmissions, a reverser shiftable to cause actuation of said support selectively in either direction, and a second overload release device associated exclusively with said feed transmission.

12. In a milling machine, the combination of a rotatable tool spindle, a support therefor, a work table reciprocable adjacent said spindle in a path transverse to the spindle axis, a spindle transmission including a power source and a motion interruptor, a table transmission including a feed rate branch line and a quick traverse rate branch line each driven from said spindle transmission exclusive of said motion interruptor, a selector shiftable to be driven from the one or the other of said branch lines and a train connecting said selector with said table and including a motion reverser, a controller providing a motion transmitting connection with said reverser, and a second controller operable independently of the first mentioned controller and providing a motion transmitting connection with said selector and another motion transmitting connection with said motion interruptor, the two last mentioned connections being interconnected to effect a motion transmitting position of said interruptor when said selector is driven from said feed branch line.

13. A milling machine as specified in claim 12 including a fluid operable shifter for said motion interruptor, and a valve controlling the operation of said shifter, said valve and shifter constituting a portion of said motion transmitting connection to said motion interruptor.

14. In a milling machine, the combination of a rotatable tool spindle, a support therefor, a work table reciprocable adjacent said spindle in a path transverse to the spindle axis, a spindle transmission including a power source and a motion interruptor, a table transmission including a feed rate branch line and a quick traverse rate branch line each driven from said spindle transmission exclusive of said motion interruptor, each of said branch lines providing terminal elements, selector clutch means shiftable to selectively engage the feed line terminal element or the quick traverse train terminal element, and a train driven through said clutch means and including a shiftable reverser clutch having two positions respectively productive of different directions of table movement, a controller for shifting said reverser clutch, a dog fixed on said table for operation of said controller, a second controller, and means operable from movement of said second controller for shifting said selector clutch means, means operable from said second controller for operating said motion interruptor.

15. A milling machine as specified in claim 14 in which the last mentioned means includes a pump driven from said power source exclusive of said motion interruptor, a shifter connected with said motion interruptor and adapted to be operated by the means of fluid from said pump, and valve means controlling the admission of fluid to said shifter from said pump.

FRED A. PARSONS.

CERTIFICATE OF CORRECTION.

Patent No. 2,040,528. May 12, 1936.

FRED A. PARSONS.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 6, first column, line 51, claim 1, strike out the article "the"; page 7, first column, line 14, claim 5, before "selector" insert the words and comma motion interruptor, ; and that the said Letters Patent should be read with these corrections therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 18th day of August, A. D. 1936.

(Seal)

Henry Van Arsdale
Acting Commissioner of Patents.