July 30, 1940. L. F. NENNINGER ET AL 2,209,469

OPERATING CONTROL MECHANISM FOR MILLING MACHINES

Original Filed May 31, 1934 2 Sheets-Sheet 1

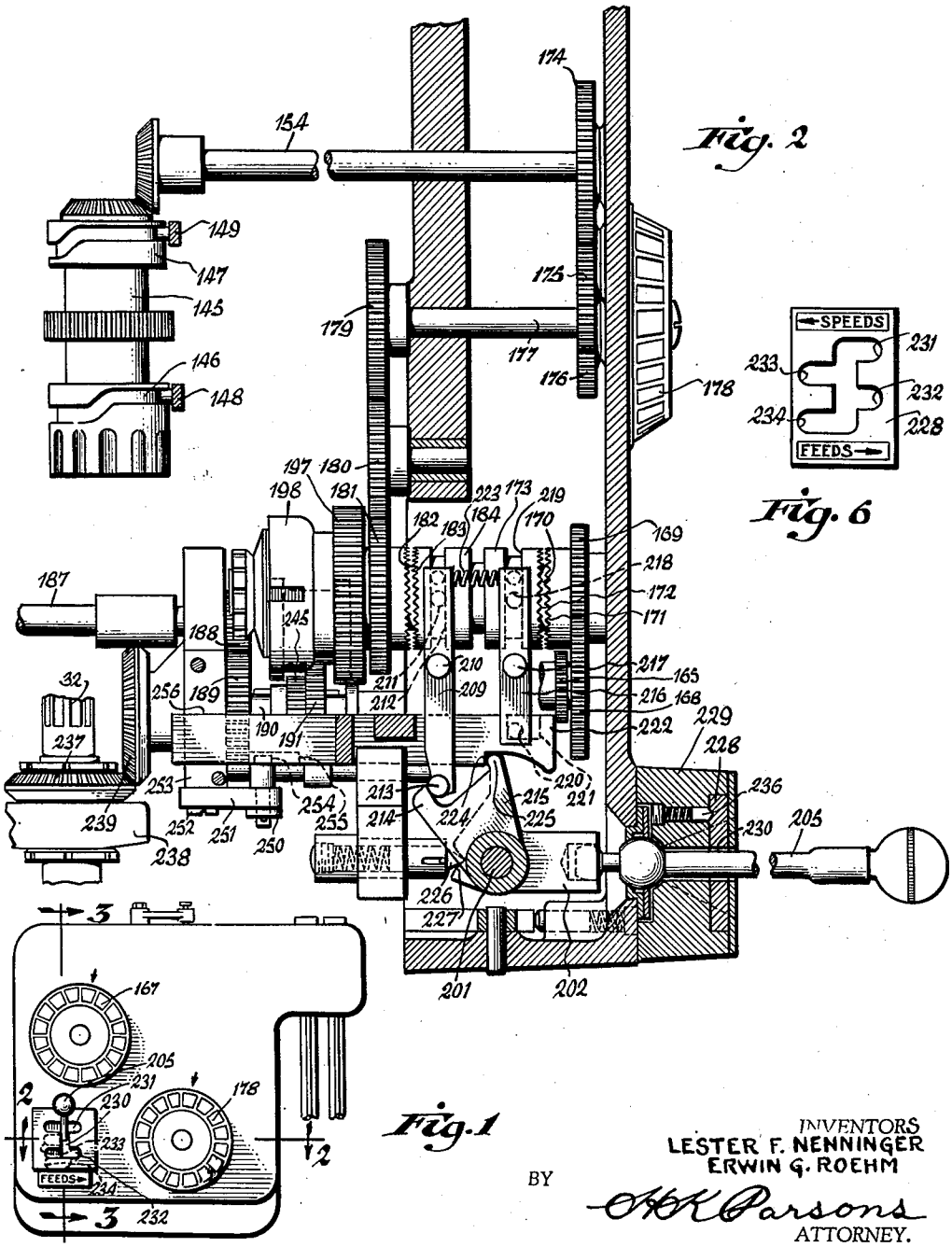


Fig. 1

Fig. 6

Fig. 2

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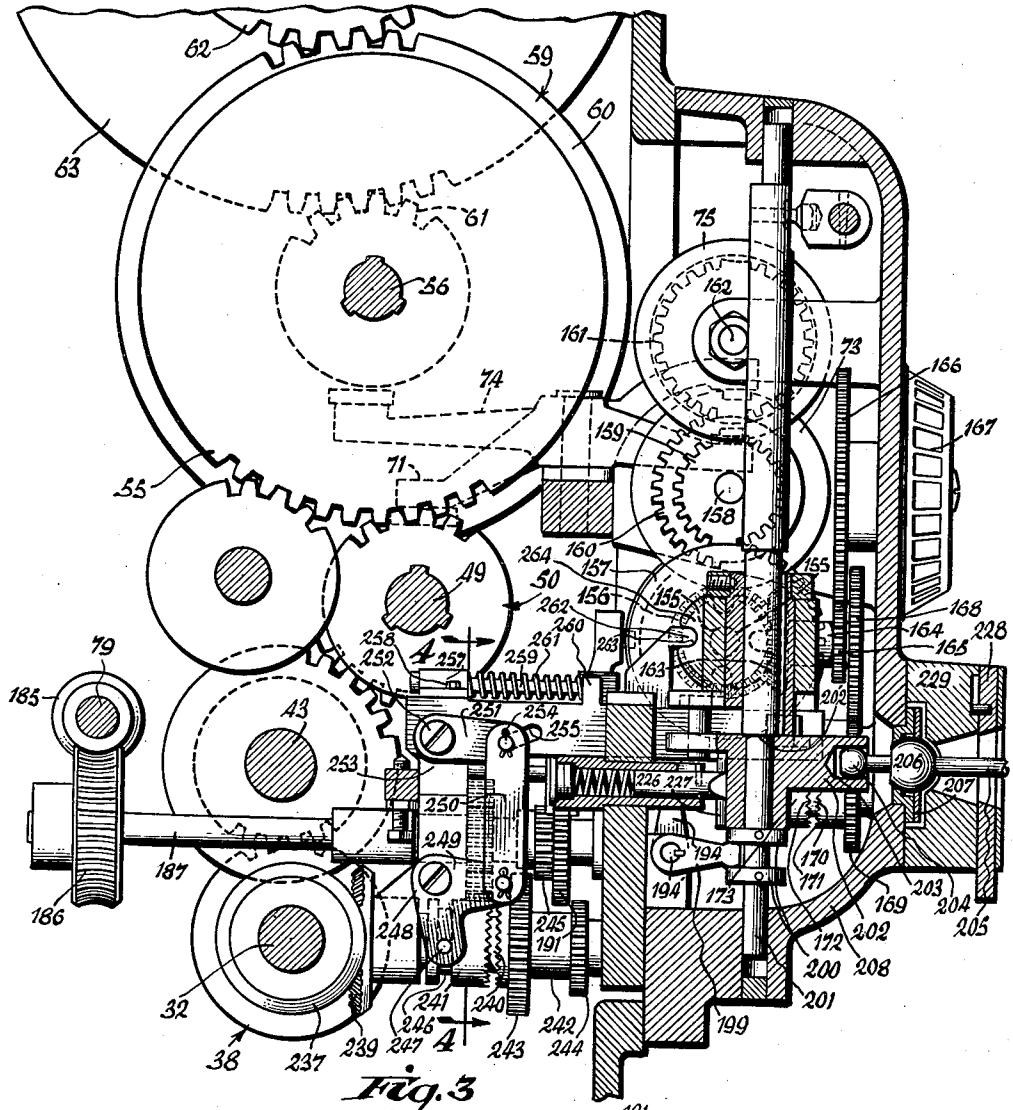


Fig. 3

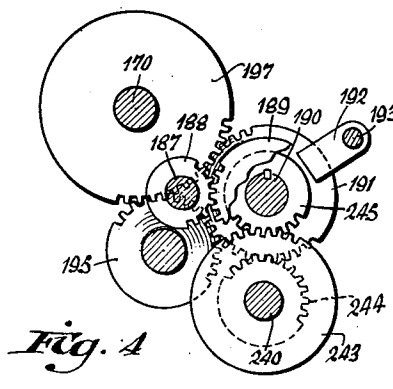


Fig. 4

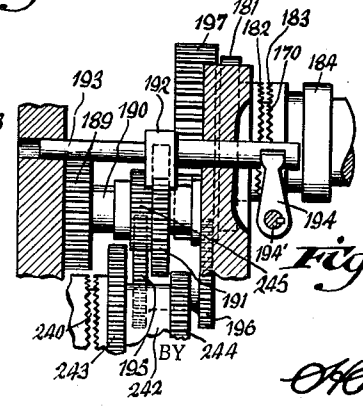


Fig. 5

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OPERATING CONTROL MECHANISM FOR MILLING MACHINES

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Original application May 31, 1934, Serial No. 728,322, now Patent No. 2,164,884, dated July 4, 1939. Divided and this application February 13, 1939, Serial No. 256,081

16 Claims. (Cl. 90—18)

This invention relates to improvements in milling machines of the type embodying relatively translatable tool spindle and work support members in which organized variable speed transmissions are employed respectively for effecting rotation of the tool supporting member and relative translation of the parts; the present application being a division of our co-pending application, Serial No. 728,322, filed May 31, 1934, Patent 2,164,884, July 4, 1939.

One of the principal objects of the present invention is the provision in connection with the variable rate and feed control mechanisms of an improved control device for selective determination of the respective adjustments thereof.

A further object of the present invention is the provision in connection with a plurality of power actuable feed or speed rate variators of a simplified control mechanism for selectively determining the rate and direction of actuation of the respective actuators for effecting either increases or decreases in the ultimate potential power output rates.

A further object of the invention is the provision in connection with mechanism of the character above specified of an improved coupled control mechanism for selectively determining the rate and direction of auxiliary drive of certain of the shiftable elements during rate determining movement thereof.

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

Figure 1 is a front view of the gear box of a milling machine with our improved control applied thereto.

Figure 2 is a horizontal sectional view with parts shown in elevation, taken as on the line 2—2 of Figure 1.

Figure 3 is a similar view taken at right angles to Figure 2 as on the line 3—3 of Figure 1.

Figure 4 is a detail view of the reverser mechanism taken as on line 4—4 of Figure 3.

Figure 5 is a front elevation of the parts shown in Figure 4.

Figure 6 is a detail view of the feed-speed selector control plate.

As the particular structural elements of the milling machine to which our invention is applied form in themselves no part of the present invention, but are shown in detail in connection with the parent application of which this is a division, they are not specifically here illustrated but it is to be understood that the present invention is capable of application to standard forms of milling machines, such, for example, as shown in the parent application referred to as of the knee and column type in which through suitable train of drive gearing, such as particularly illustrated in Figure 3, rotary motion is applied to the cutter spindle, while by a similar organized speed transmission a screw or like final mover serves to effect relative translation of the spindle and a suitable work support.

The rates of the spindle transmission, commonly known as a speed transmission, and the feed transmission for effecting translation are determinable by rotation of power actuable cams such as the cams 73 and 75, indicated in Figure 3, and the cams 146 and 147 indicated in Figure 2.

These parts are shown both in the parent application and in the prior art, as for example, Nenninger et al. Patent 1,997,338, and since the present invention relates not to the cam and gear mechanisms but to the control of power actuation of said cams, reference is made to the patent aforesaid and the parent application as disclosing the environment in which this specific invention here at issue is intended to be utilized.

Referring to the drawings in which for simplicity of reference, characters corresponding to those employed in the parent application have been utilized in designation of the corresponding parts, there has been shown a transmission comprising a main drive shaft 32 having splined thereon a gear couplet 38 engageable with a second couplet carried by shaft 43 which, in turn, through the gear couplet 50 imparts rotation to shaft 49. This shaft, in turn, drives selective gears including gear 55 on shaft 56 having couplet 59 including gears 60 and 61 engageable respectively with gears 62 and 63 which are carried by the main or cutter bearing spindle of the machine for determining the power actuation of said spindle.

The sliding of the various couplets on their spline shafts for determining selected rates of speed are effectable as by pivoted levers including the members 71 and 74 shown in Figure 3, controlled respectively by the power driven cams 73 and 75. A corresponding variable speed transmission correspondingly controlled by a series of power actuable cams including the members 146

and 147 shown in Figure 2, serves to control the rate of power output of the feed transmission. The control cams 146 and 147 are carried by shaft 145 driven by bevel gears from control shaft 154 and serve respectively to actuate the shifters 148 and 149 in a manner similar to the operation of the members 71 and 74.

This invention contemplates an improved operating control mechanism whereby the shifting cams of both transmissions may be interconnected for control by a single lever and whereby either set of cams may be selectively rotated in either direction so that the desired new rate may be obtained by progressive increase thereto or progressive decrease thereto, thereby reducing the number of intermediate steps to a minimum. Furthermore, the invention contemplates a mechanism which is automatically operable when rate changes are made in one of the transmissions to slowly rotate or jog the same to facilitate intermeshing of the gears.

To this end a shaft 155 is provided with a first gear 156 through which it receives power, and a second gear 157 of the intermittent type, as shown in Figure 3, having teeth on only one quarter of its periphery. This gear serves to intermittently rotate shaft 158, which bears cam 73, through the mutilated gear 159. The gear 157 is also in a two to one ratio with the gear 159 so that for each revolution of the gear 159 and shaft 158 will be given one-half of a revolution.

The shaft 158 also has an intermittent gear 160 secured thereto, the teeth of which extend around one-half of its periphery for intermeshing with the mutilated gear 161 carried by shaft 162 which supports the cam 75. The gears 160 and 161 are in a one to one ratio but due ot the intermittent teeth on gear 160 the shaft 162 will only make one-half a revolution for each revolution of the shaft 158.

The bevel gear 156 on shaft 155 intermeshes with the bevel gear 163 carried by shaft 164. This shaft has a first spur gear 165 which is connected to the large gear 166 for rotating the speed rate indicating dial 167; and a second gear 168 which intermeshes with gear 169 mounted for free rotation on the shaft 170. Gear 169 has clutch teeth 171 formed on the hub thereof for inter-engagement with complementary clutch teeth 172 formed on shiftable clutch member 173.

The drive shaft 154 for the feed rate control cams has a spur gear 174 secured to the end thereof, as shown in Figure 2, which is interconnected by an idler 175 and gear 176 to the dial shaft 177 which shaft has a feed rate dial 178 secured to one end thereof. The shaft 177 has a gear 179 keyed to the other end thereof and interconnected through the intermediate idler 180 to the spur gear 181 mounted for free rotation on the shaft 170. The gear 181 has clutch teeth 182 formed on the hub thereof for intermeshing with complementary clutch teeth 183 formed on one face of the clutch member 184. The clutches 184 and 173 are splined on the power shaft 170 and selectively shiftable into mesh with their respective gears to cause rotation of either the speed rate control cams or the feed rate control cams.

The shaft 170 is driven from the continuously rotating shaft 79 through the following train: A pair of spiral gears 185 and 186 interconnect shaft 79 with shaft 187 which in turn drives, through spur gears 188 and 189, the shaft 190. The shaft 190 has a shiftable gear 191 splined thereon which has only two positions although it is shown in a midway position in Figure 5, the power transmitting positions being on either side of the position shown. This gear is shifted by a shifter fork 192, fixed with the shifter rod 193 which is interconnected with a crank 194.

The gear 191 has a first position to the left of that shown in Figure 5 in mesh with gear 195 which has integral therewith a gear 196 intermeshing with the drive gear 197 of shaft 170. The gear 197 is connected to the shaft by a multiple disc friction clutch 198 as more particularly shown in Figure 2 and this clutch is set to provide a safety factor so as to permit slippage and prevent damage to the various cams in case anything should happen to prevent proper intermeshing of the gears.

The gear 191 has a position to the right of that shown in Figure 5 for direct intermeshing with gear 197 to rotate the same in an opposite direction. It will thus be seen that this mechanism is really a reversing mechanism for determining the direction of rotation of the shaft 170 and thereby whether the subsequent rates to be effected are attained by progressively increasing or by progressively decreasing the present rate.

The crank arm 194 which shifts the gear 191 is mounted on shaft 194' which has an arm 199, the end of which fits between a pair of collars 200 fixed to the oscillatable and reciprocable shaft 201, Figure 3. This shaft has a freely rotatable arm 202 mounted thereon. The arm is fixed, however, between a collar 200 and a shoulder 202' for axial movement with the shaft. In the end of the arm is formed a socket 203 for receiving the ball end 204 of the manually operable control lever 205 which is supported for universal movement by means of an enlarged ball 206 fitting in the socket 207 carried by the housing 208. It will now be seen that as the lever 205 is moved up or down, it will shift the gear 191 to its various positions.

The lever 205 is laterally movable from the position shown in Figure 2, for selectively engaging the feed or speed control clutches 184 and 173. The feed clutch 184 has a shift lever 209 which is centrally pivoted on pin 210, and has a finger 211 in one end thereof engaging the annular groove 212 formed in the clutch member 184. The other end of the lever has a depending pin 213 engageable by the hook-shaped portion 214 of the arm 215 which is integral with the arm 202.

A second shift lever 216 is pivotally mounted on a pin 217 and has a depending finger 218 at one end for engaging the annular groove 219 formed in the clutch member 173. The other end of lever 216 has a pin 220 which depends into a slot 221 formed in a shiftable bar 222. A spring 223 interconnects the ends of the shifter levers so that each lever acts as an abutment to hold one end of the spring during movement of the other lever. The bar 222 has a notch 224 cut in one face thereof for engagement by the head 225 projecting from the arm 215. The notch is provided with clearance so that when the control lever 205 is moved upward as viewed in Figure 2, the head 225 will leave the abutment 224 and cause the arm 215 to shift only the lever 209 and thereby engage clutch 183 to effect changes in feed rate without disturbing the neutral position of the clutch 172. Upon downward movement of the manual control lever 205, the head 225 on arm 215 will move the bar 222 to the left which will cause the lost motion between the pin 220

and the slot 221 to be taken up first and then will cause shifting of the clutch 172 into engagement with gear 160. At the same time, the hook-shaped portion 214 will move away from the pin 213 carried by lever 209 with the result that the feed clutch 183 will remain disengaged during engagement of the clutch 172.

A spring pressed detent 226 is provided for holding the lever 202 in a neutral position and this detent engages a V-shaped groove 227 formed in the arm 202. As shown in Figure 3, the notch 227 is sufficiently long to maintain engagement with the detent during up and down movement of the shaft 201. It will now be seen that the lever 205 has two directions of movement, one of which is to select whether the rate change is to be made in the feed transmission or in the speed transmission, and the other movement determines the manner of effecting the rate change such as by progressive increase or progressive decrease. To facilitate this selection and prevent as far as possible mistakes by the operator, a sliding plate 228 is mounted in the end of a projecting boss 229. This plate has an irregular shaped opening in it, as shown in Figure 1, comprising a center slot 230, a pair of lateral extensions 231 and 232 on one side, and a second pair 233 and 234 on the other side but the latter pair is arranged alternately with respect to the first pair. The boss 229 has a cover plate 235 which, as shown in Figure 1, has an H-shaped slot cut therein, but when the plate 228 is in the position shown in Figure 1 the lever 205 can only be moved to the right, which limits the function of the control lever 205 to engagement and disengagement of the feed rate control clutch 183. The plate 228 may be manually moved upward to align the slots 233 and 234 with the slots in the left half of the H-plate and disalign the slots 231 and 232 with the slots in the right half of the H-plate thereby permitting movement of the lever 205 only in a direction to engage the speed rate control clutch 172. As shown in Figure 2, a spring pressed detent 236 serves to hold the plate 228 in either one of its two positions.

To further facilitate shifting of the gears in the speed transmission, there has been provided a power means for jogging the gears in the speed train, that is, imparting a slow, steady rotation thereto during the shifting movement. This power means is so arranged as to become automatically effective when the clutch 173 is engaged, but is ineffective when the feed clutch 184 is engaged. To this end the shaft 32 is provided with a bevel gear 237 which, as shown in Figure 3, is connected to the shaft by means of a friction clutch 238. The gear 237 meshes with a bevel gear 239 mounted on the end of shaft 240, this shaft being connectible by the shiftable clutch 241 to the gear couplet 242 which is mounted for free rotation on the shaft. The couplet 242 comprises a relatively large gear 243 and a relatively smaller gear 244, these gears being adapted to be selectively engaged by gear 245 or gear 191. In other words, when the reverser gear 191 is shifted to the left as viewed in Figure 3, it also intermeshes gear 245 with gear 243 to make possible a relatively slow jogging of the speed train and when shifted to the right from the position shown, the gear 191 will also be intermeshed with gear 244 to effect a faster rate of jogging to the spindle train. These gear connections will be reversed every time the reverser gear 191 is shifted, but power jogging of the train will be determined by the clutch 241. This clutch is only engaged when the speed rate control clutch 172 is engaged. This result is automatically accomplished in the following manner.

The clutch 241, as shown in Figure 3, has an annual groove 246 into which fits a pin 247 carried by one arm of the pivoted bell crank 248. The other arm 249 of the bell crank is connected by a link 250 to a second swinging arm 251 mounted in parallel relation to the arm 249 so that the link 250 travels in substantially a straight line. The arm 251 is pivoted on the pin 252 which is threaded in a fixed part 253 of the column. The arm 251 carries a pin 254 which rides in a cam slot 255 formed in the bar 222 so that upon movement of the bar to the left the link 250 will effect oscillation of the bell crank 248 and engage clutch 241. The bar 222 is guided in a slot 256 formed in the part 253 and held in place by a cap 257 and screws 258. The cap 257 also has a bore through which the rod 259 slides, the other end of the rod being fixed in a lug 260 carried by the bar. A spring 261 surrounds the rod 259 so as to normally urge the bar 222 toward the right. The bar 222 is moved toward the left only when the clutch 172 is engaged and therefore the clutch 241 is only engaged when the speed clutch 172 is utilized. The lost motion in the slot 216 makes it possible for the clutch 241 to be engaged and cause power rotation of the gears before the clutch 172 is engaged to rotate the cams and cause shifting of the gears.

The bar 222 has another lug 262 integral therewith which is adapted to engage any one of four equally spaced notches 263 formed in the member 264 which is rotatable with shaft 155. This serves as an automatic positive detent and since it is interconnected by means of the bar 222 and shifter arm 216 with the clutch 172, it will be apparent that if the lever 205 is returned to a neutral position before the control cam carried by the shaft 155 has completed its movement to the next position, that the lug 262 will engage the periphery of the member 264 to prevent the spring 261 from shifting the bar toward the right and effecting disengagement of the clutch 173. But as soon as the member 264 has rotated to a position that the lug 262 begins to enter one of the grooves 263, it will permit gradual disengagement of the clutch 173 and as the movement of the member 264 continues the lug 262 will seat itself in the groove and act as a positive lock to prevent further rotation and also will effect complete disengagement of the clutch 172 to prevent further application of power to the cam. It will thus be seen that these parts cooperate with one another to disconnect the power at the proper time and positively lock the cam in its various positions.

What is claimed is:

1. A control mechanism for a milling machine or the like of the character having a tool spindle, a work support, a prime mover, variable speed transmissions for coupling the prime mover to the spindle and for effecting relative translatory movement of the spindle and work support and individual power operable rate changing mechanisms associated with each transmission, said control mechanism including a unidirectionally power actuated member, transmission means individual to the power operable rate changing mechanisms, and a common reverser intervening the unidirectionally driven member and said rate changing mechanisms for determining the direction of actuation of said mechanisms.

2. A control mechanism for a milling machine

or the like of the character having a tool spindle, a work support, a prime mover, variable speed transmissions for coupling the prime mover to the spindle and for effecting relative translatory movement of the spindle and work support and individual power operable rate changing mechanisms associated with each transmission, said control mechanism including a unidirectionally power actuated member, transmission means individual to the power operable rate changing mechanisms, a common reverser intervening the unidirectionally driven member and said rate changing mechanisms for determining the direction of actuation of said mechanisms, and means for selectively determining the particular mechanism actuable by the reverser in a preselected direction of actuation.

3. A control mechanism for a milling machine or the like of the character having a tool spindle, a work support, a prime mover, variable speed transmissions for coupling the prime mover to the spindle and for effecting relative translatory movement of the spindle and work support and individual power operable rate changing mechanisms associated with each transmission, said control mechanism including a unidirectionally power actuated member, transmission means individual to the power operable rate changing mechanisms, a common reverser intervening the unidirectionally driven member and said rate changing mechanisms for determining the direction of actuation of said mechanisms, and means to determine the coupling of said rate changing mechanisms with the power actuator, said means including a common control lever having a first plane of movement to select the rate changer mechanism to be coupled to the prime mover and additional planes of movement for determining the direction of rotation of the selected mechanism.

4. A control mechanism for a milling machine having a tool spindle, a work support and means for effecting relative rotary and translatory movement of said parts including a prime mover, a first shiftable gear transmission coupling the prime mover to the spindle and a second shiftable gear transmission coupling the prime mover to the translating mechanism, said control mechanism comprising a first rate change mechanism including rotatable cams for shifting the gears of one transmission, a second rate change mechanism including a plurality of cams for shifting the gears of the second transmission, a continuously actuated source of power including a reverser, and means to selectively connect the cams of either mechanism to the reverser for actuation thereby.

5. A control mechanism for a milling machine having a tool spindle, a work support and means for effecting relative rotary and translatory movement of said parts including a prime mover, a first shiftable gear transmission coupling the prime mover to the spindle and a second shiftable gear transmission coupling the prime mover to the translating mechanism, said control mechanism comprising a first rate change mechanism including rotatable cams for shifting the gears of one transmission, a second rate change mechanism including a plurality of cams for shifting the gears of the second transmission, a continuously actuated source of power including a reverser, means to selectively connect the cams of either mechanism to the reverser for actuation thereby, a control lever, motion transmitting connections between the control lever and the reverser and the selecting means, said lever being movable in a first plane to determine the direction of rotation, and in a second plane to effect said selection, and an interlock plate to confine the reversal movements to the selected rate change mechanism.

6. A control mechanism for a milling machine which embodies an organized variable speed transmission and an organized variable feed transmission, individual power actuators for determining the respective shiftings of said transmissions and a single source of power for operation of the adjusters, said control mechanism including a first device shiftable to determine the direction of operation and a selector device shiftable to determine the effective coupling of one or the other of the adjusters for actuation in a selected direction and a single control member variably positionable to effect the several shiftings of said devices.

7. A control mechanism for a milling machine which embodies an organized variable speed transmission and an organized variable feed transmission, individual power actuators for determining the respective shiftings of said transmissions and a single source of power for operation of the adjusters, said control mechanism including a first device shiftable to determine the direction of operation and a selector device shiftable to determine the effective coupling of one or the other of the adjusters for actuation in a selected direction and a single control member variably positionable to effect the several shiftings of said devices, a first H-plate member for guiding the control member in its variable positioning, and a second H-plate member having slot portions disposed in staggered relation as respects the slottings of the first H-plate and alternatively alignable therewith whereby to limit the directional movements of the control member, substantially as and for the purpose described.

8. A control mechanism for a milling machine which embodies an organized variable speed transmission and an organized variable feed transmission, individual power actuators for determining the respective shiftings of said transmissions and a single source of power for operation of the adjusters, said control mechanism including a first device shiftable to determine the direction of operation and a selector device shiftable to determine the effective coupling of one or the other of the adjusters for actuation in a selected direction and a single control member variably positionable to effect the several shiftings of said devices, a first H-plate member for guiding the control member in its variable positioning, and a second H-plate member having slot portions disposed in staggered relation as respects the slottings of the first H-plate and alternatively alignable therewith whereby to limit the directional movements of the control member, substantially as and for the purpose described, said shiftable H-plate having alternatively exposable portions indicating the control effect by a selected adjustment thereof.

9. The combination with a milling machine having feed and speed transmissions, individual rate adjusting mechanisms for said feed and speed transmissions, of a shifter control mechanism for selective determination of the feed and speed rates of the machine, said mechanism including a rate determinator, a direction determinator and a plurality of selector devices and a control member actuable in one direction for effecting a combined rate and directional determi-

nation, and actuable in an angularly related direction for selection of the transmission adjusting mechanism to be activated.

10. The combination with a milling machine having feed and speed transmissions, individual rate adjusting mechanisms for said feed and speed transmissions, of a shifter control mechanism for selective determination of the feed and speed rates of the machine, said mechanism including a rate determinator, a direction determinator and a plurality of selector devices and a control member actuable in one direction for effecting a combined rate and directional determination, and actuable in an angularly related direction for selection of the transmission adjusting mechanism to be activated, an auxiliary milling machine transmission actuating drive, completable through the rate selecting mechanism, and means actuable on movement of the selecting mechanism for completing the drive for said transmission.

11. The combination with a milling machine having feed and speed transmissions, individual rate adjusting mechanisms for said feed and speed transmissions, of a shifter control mechanism for selective determination of the feed and speed rates of the machine, said mechanism including a rate determinator, a direction determinator and a plurality of selector devices and a control member actuable in one direction for effecting a combined rate and directional determination, and actuable in an angularly related direction for selection of the transmission adjusting mechanism to be activated, an auxiliary milling machine transmission actuating drive, completable through the rate selecting mechanism, and means actuable on movement of the selecting mechanism for completing the drive for said transmission, said means including a lost motion connection to the selector whereby the auxiliary drive transmission may be rendered operative prior to actuation of the selector.

12. A control mechanism for a milling machine of the type including variable feed and speed transmissions jointly effective in performance of a milling operation and power shifting mechanism individual to said transmissions for determination of the rate of operation thereof, and a power drive for operation of said power adjusting means, said control mechanism including a shifter yoke, a pair of clutch shifters engaged thereby for actuation upon opposite oscillations of the yoke, movement of one of said shifters determining operative connection of one of the gear adjusting mechanisms, a gear drive coupleable by shifting of the second of said shifters, a third clutch shifter controlling the other of said two first-mentioned power operable gear adjusting mechanisms, and lost motion connection between one of the two first-named shifters, and said third shifter for insuring sequential actuation thereof.

13. A control mechanism for a milling machine of the type including variable feed and speed transmissions jointly effective in performance of a milling operation and power shifting mechanism individual to said transmissions for determination of the rate of operation thereof, and a power drive for operation of said power adjusting means, said control mechanism including a shifter yoke, a pair of clutch shifters engaged thereby for actuation upon opposite oscillations of the yoke, movement of one of said shifters determining operative connection of one of the gear adjusting mechanisms, a gear drive coupleable by shifting of the second of said shifters, a third clutch shifter controlling the other of said two first-mentioned power operable gear adjusting mechanisms, lost motion connection between one of the two first-named shifters, and said third shifter for insuring sequential actuation thereof, an actuator for said yoke, and a direction determinator coupled with and shiftable by movement thereof for determination of directional actuation of a plurality of shifter controlled mechanisms.

14. In a milling machine of the type having feed and speed transmissions and power actuable mechanism for determining the rates of actuation of the respective transmissions, a control mechanism for the transmissions and their power rate variators including a member supported for both rotatable and longitudinally shiftable movements, a power source, a combined rate and direction determinator driven thereby and activated by one of the movements of said member, a plurality of control transmissions including individual clutches, and connections between said member and the clutches activatable by the other movement of the member for selective determination of the connection of said transmissions with the power source.

15. In a milling machine of the type having feed and speed transmissions and power actuable mechanism for determining the rates of actuation of the respective transmissions, a control mechanism for the transmissions and their power rate variators including a member supported for both rotatable and longitudinally shiftable movements, a power source, a combined rate and direction determinator driven thereby and activated by one of the movements of said member, a plurality of control transmissions including individual clutches, and connections between said member and the clutches activatable by the other movement of the member for selective determination of the connection of said transmissions with the power source, one of said connections including a lost motion device for securing sequential operation of the selected clutches.

16. In a milling machine of the type having feed and speed transmissions and power actuable mechanism for determining the rates of actuation of the respective transmissions, a control mechanism for the transmissions and their power rate variators including a member supported for both rotatable and longitudinally shiftable movements, a power source, a combined rate and direction determinator driven therebf and activated by one of the movements of said member, a plurality of control transmissions including individual clutches, connections between said member and the clutches activatable by the other movement of the member for selective determination of the connection of said transmissions with the power source, and a shiftable selector for variably limiting the potential movements of the member and thus the connections establishable thereby.

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