Dec. 8, 1959 F. D. DICKAS 2,915,910

CONTROL ASSEMBLY

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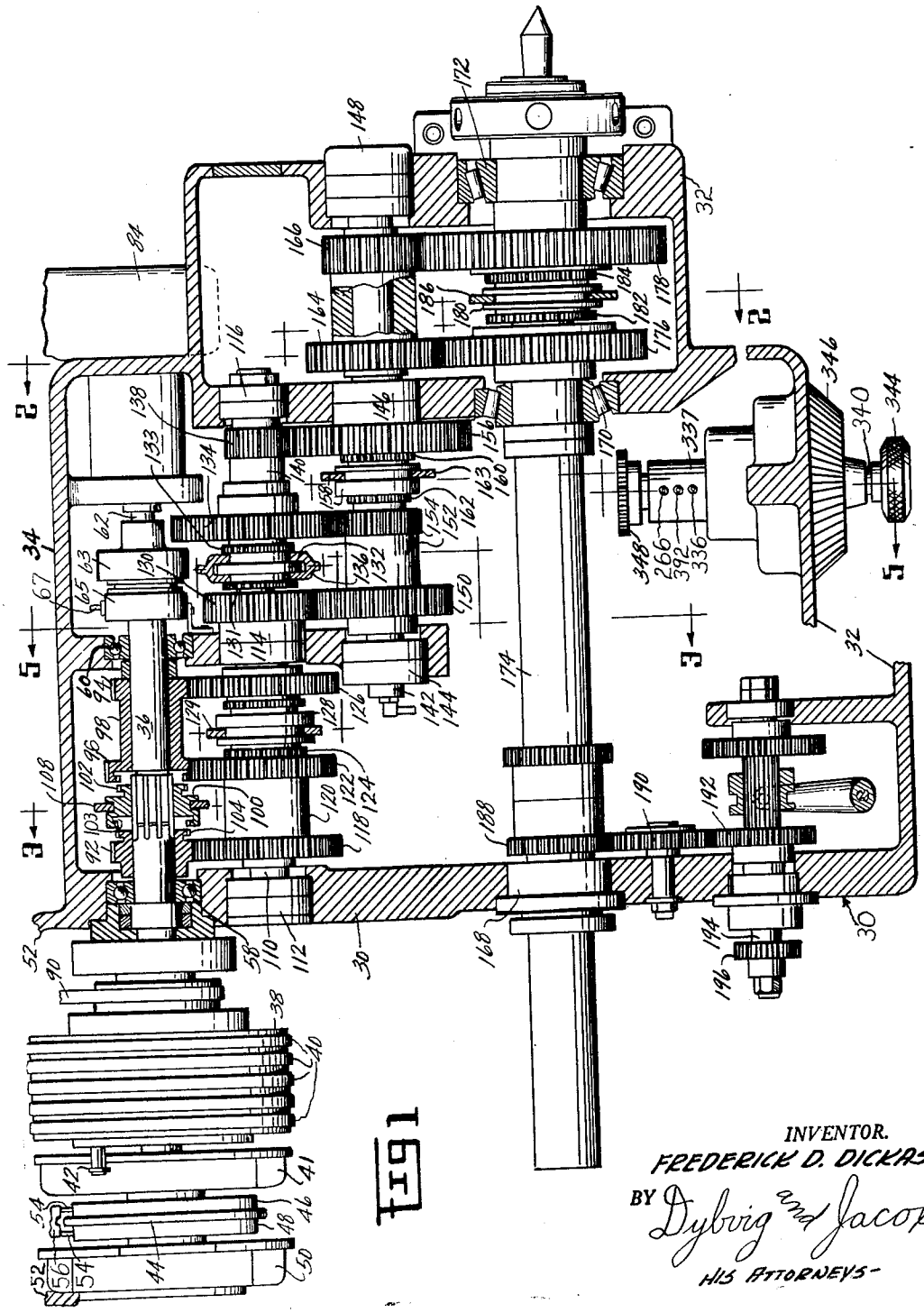


Fig 1

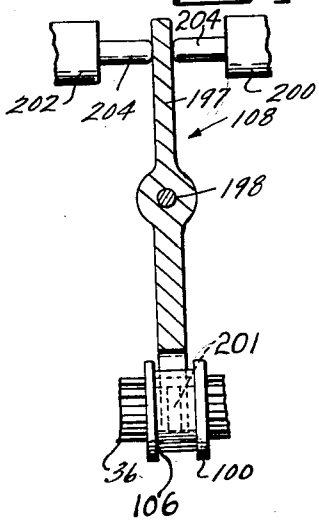
INVENTOR.
FREDERICK D. DICKAS
BY Dybvig and Jacox
HIS ATTORNEYS

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CONTROL ASSEMBLY

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Fig 4



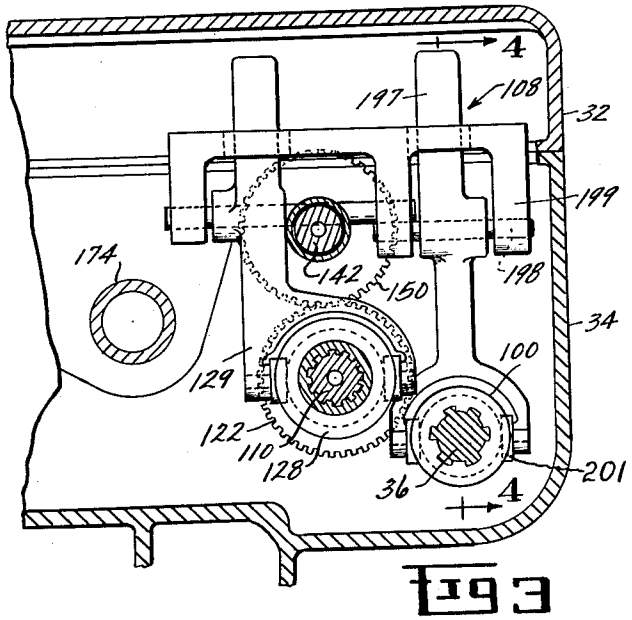
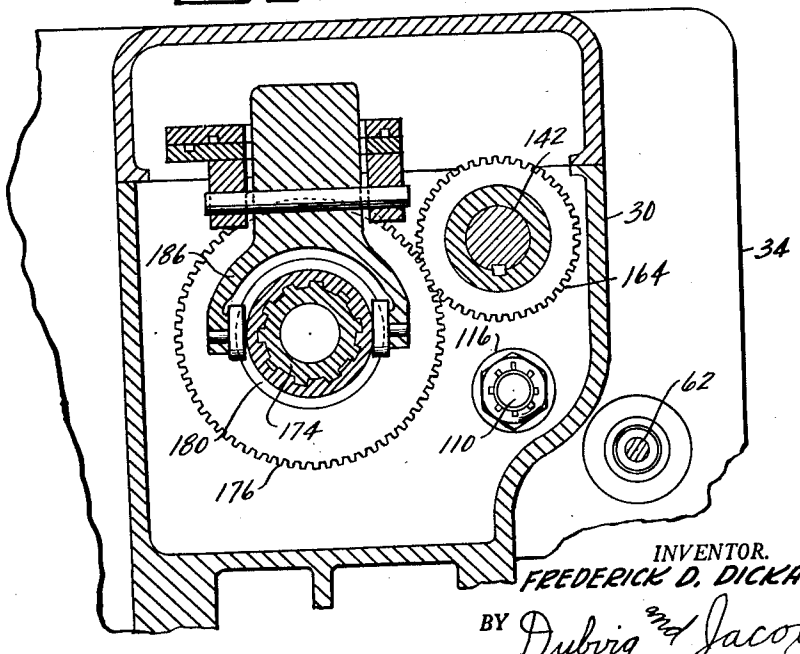


Fig 3

Fig 2



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Fig 6

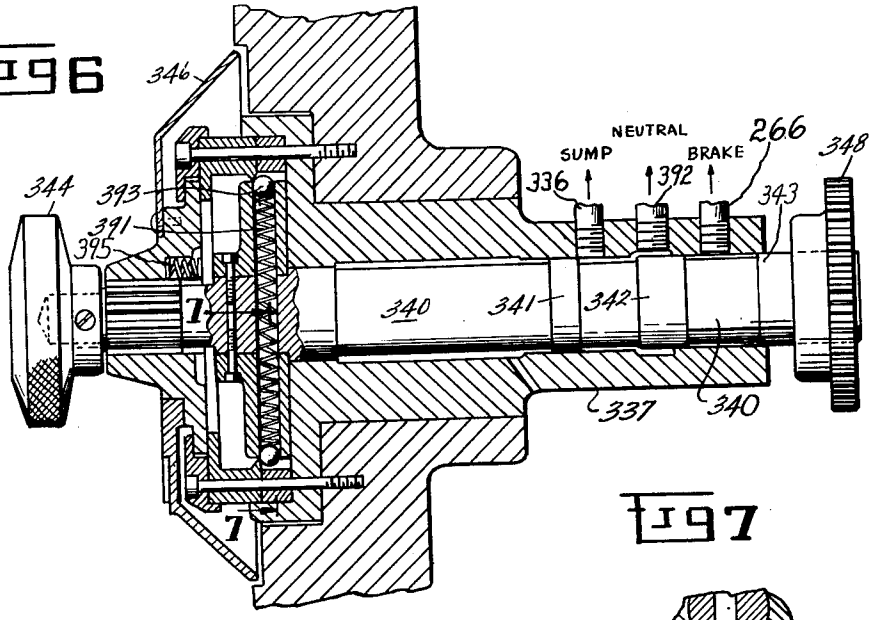


Fig 7

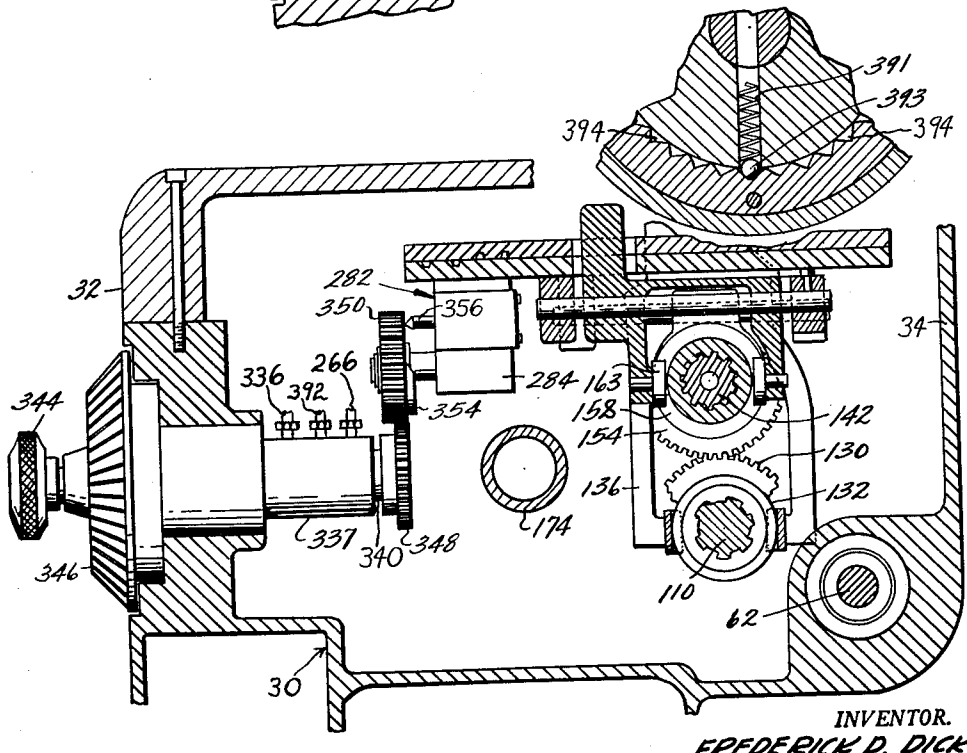


Fig 5

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CONTROL ASSEMBLY

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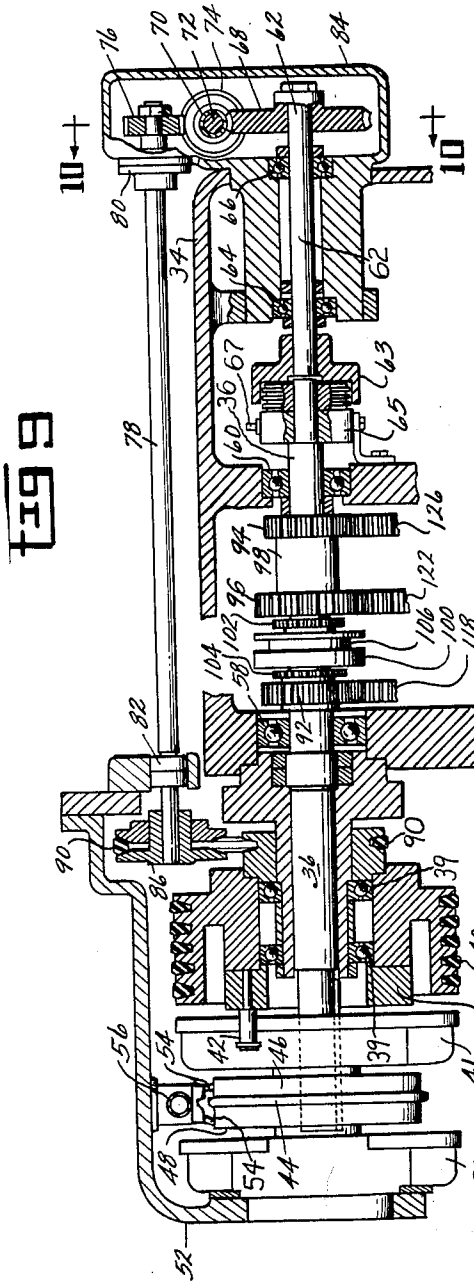


Fig. 9

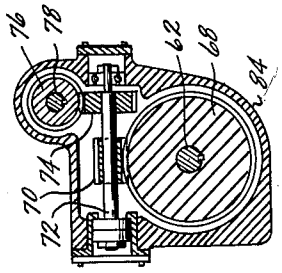


Fig. 10

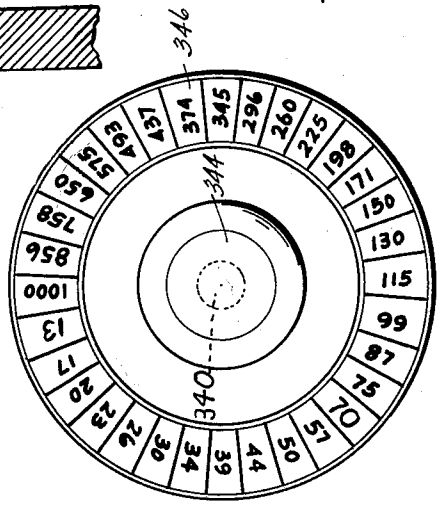


Fig. 8

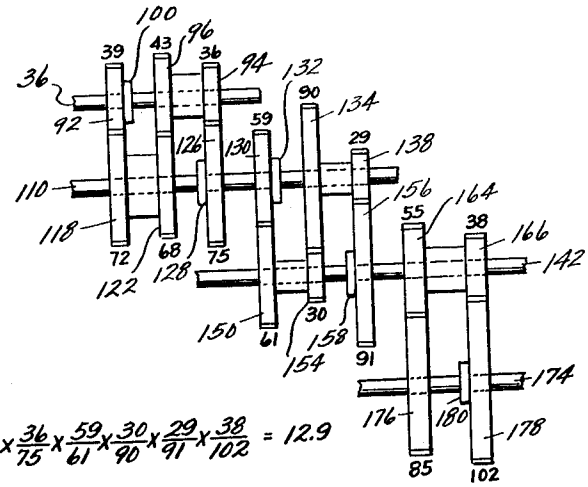
INVENTOR.
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CONTROL ASSEMBLY

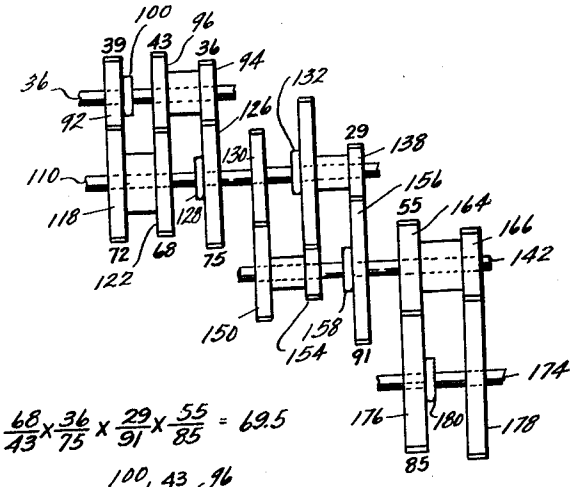
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Fig 11



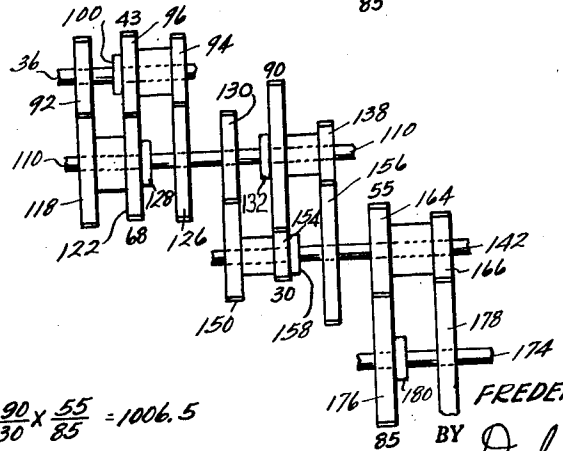
$\frac{820\ RPM}{1} \times \frac{39}{72} \times \frac{68}{43} \times \frac{36}{75} \times \frac{59}{61} \times \frac{30}{90} \times \frac{29}{91} \times \frac{38}{102} = 12.9$

Fig 12



$\frac{820\ RPM}{1} \times \frac{39}{72} \times \frac{68}{43} \times \frac{36}{75} \times \frac{29}{91} \times \frac{55}{85} = 69.5$

Fig 13



$\frac{820\ RPM}{1} \times \frac{43}{68} \times \frac{90}{30} \times \frac{55}{85} = 1006.5$

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CONTROL ASSEMBLY

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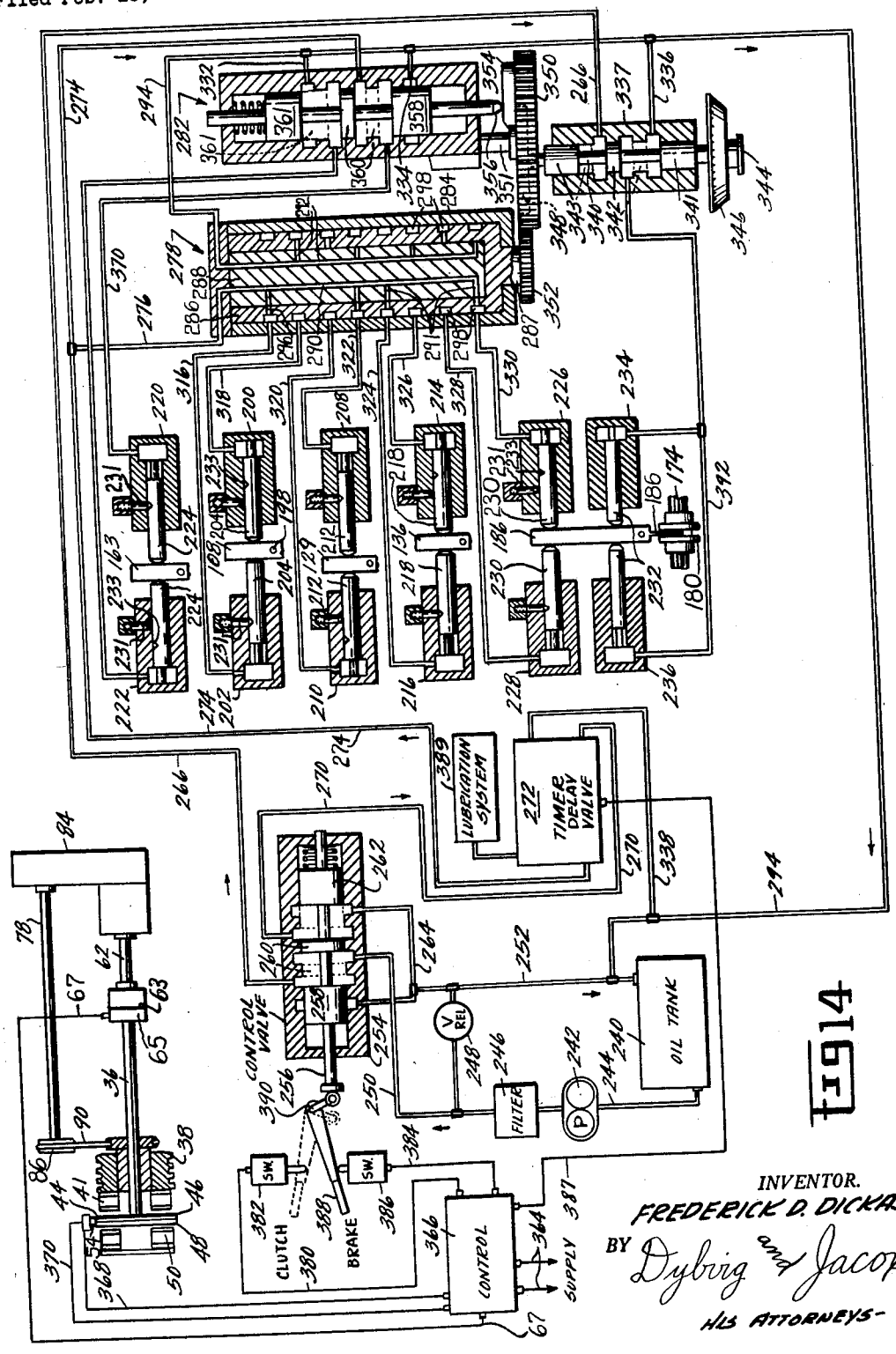


Fig. 14

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CONTROL ASSEMBLY

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Fig 16

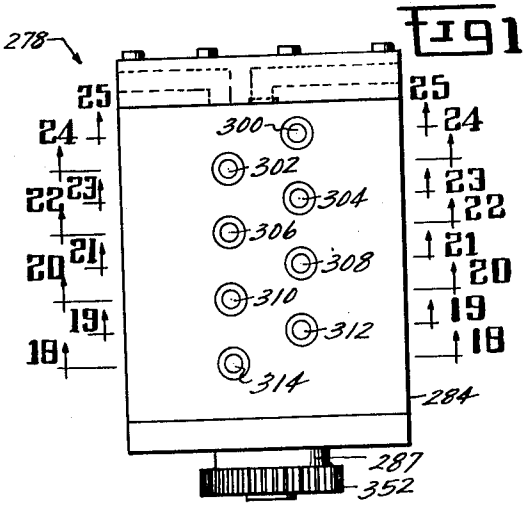


Fig 17

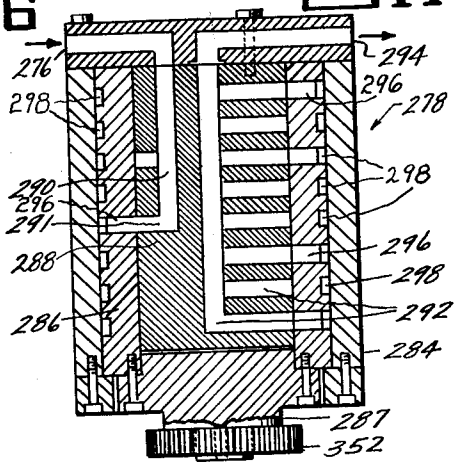


Fig 18

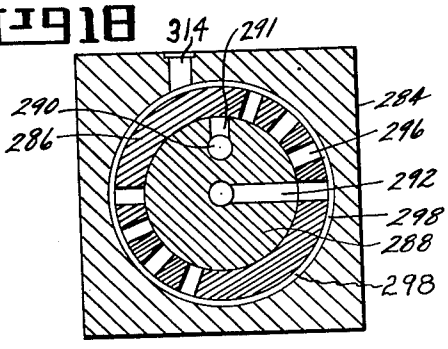


Fig 19

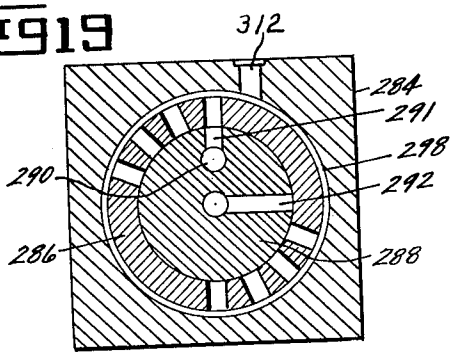


Fig 20

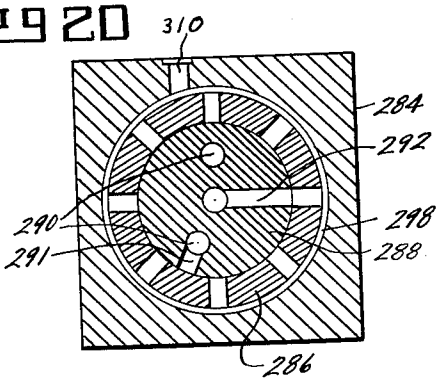


Fig 21

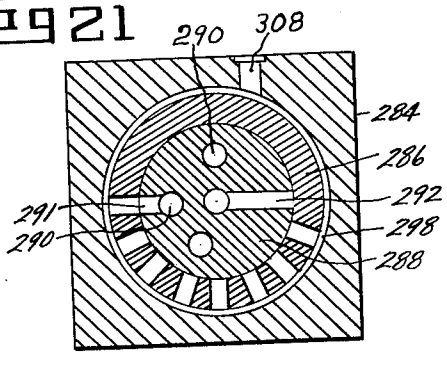
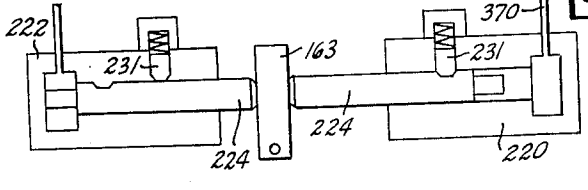


Fig 28



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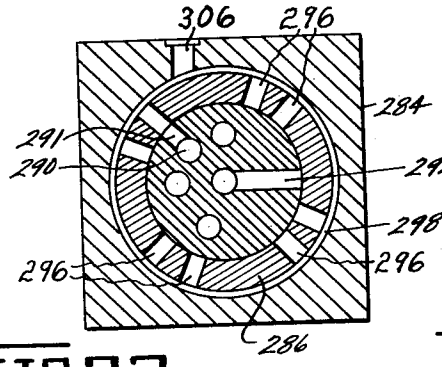


FIG 22

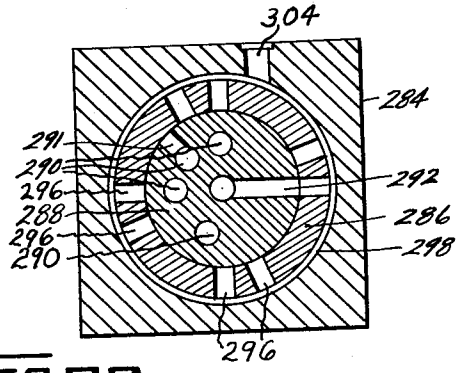


FIG 23

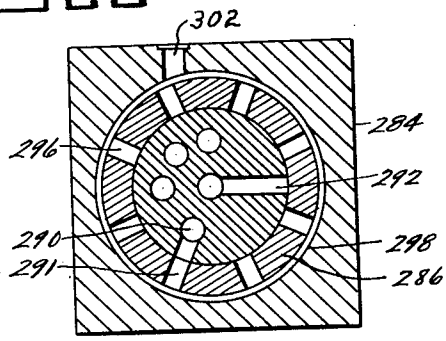


FIG 24

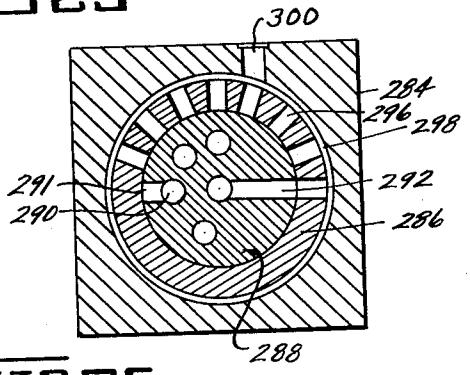


FIG 25

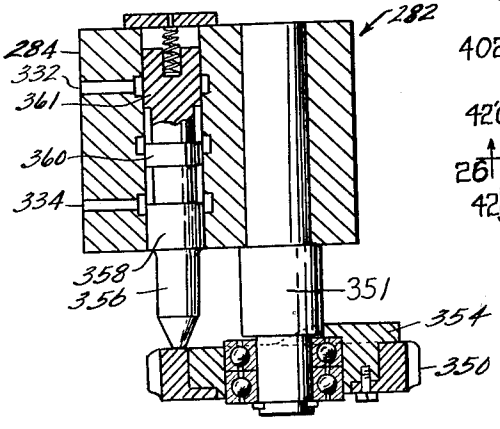


FIG 15

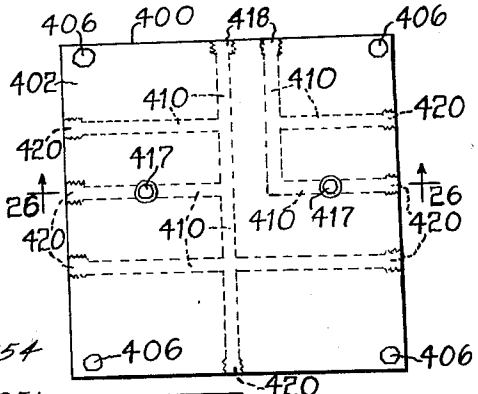


FIG 26

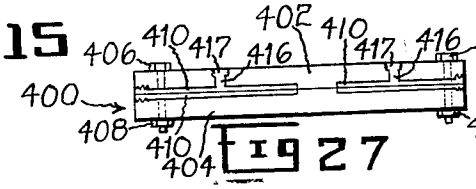


FIG 27

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United States Patent Office 2,915,910 Patented Dec. 8, 1959

2,915,910

CONTROL ASSEMBLY

Frederick D. Dickas, Sidney, Ohio, assignor to The Sidney Machine Tool Company, a corporation of Ohio

Application February 18, 1957, Serial No. 640,634

11 Claims. (Cl. 74—359)

This invention relates to a control assembly. The invention relates more particularly to a control assembly which uses fluid pressure as a source of energy. The invention relates more particularly to a control assembly for the clutching of gear members for changing gear ratios in a gear assembly. The invention relates still more particularly to a control assembly for the head stock of a lathe. However, the invention is not so limited due to the fact that the invention may be applied to numerous types of devices and mechanisms.

Problems have long existed in the art of gear assemblies in which gear ratios are changed by means of toothed clutch members which axially move into and out of engagement with gear members. It has been found that it is very difficult to readily mesh the axially movable toothed clutch members with gear members without the clashing of gear teeth and possible damage to the gear teeth. This problem has particularly existed in the art of gear assemblies associated with the head stock of a lathe.

It is an object of this invention to provide a control assembly for a gear mechanism which control assembly automatically and quietly changes gear ratios.

It is another object of this invention to provide a control assembly for the changing of gear ratios which control assembly is operated by means of any suitable fluid.

Another object of this invention is to provide a head stock control assembly by which the gear ratios thereof may be easily and readily changed.

Another object of this invention is to provide a selector valve mechanism which is capable of controlling fluid flow to and from a plurality of elements.

Another object of this invention is to provide means by which fluid from a given source is used during some periods to actuate fluid motors and by which the same fluid is used during other periods to lubricate movable elements of a gear assembly.

Other objects and advantages reside in the construction of parts, the combination thereof, the method of manufacture, and the mode of operation, as will become more apparent from the following description.

In the drawing:

Figure 1 is a sectional view of a gear assembly the ratio and operation of which may be easily, readily, and automatically governed by a control assembly of this invention.

Figure 2 is a sectional view taken substantially on line 2—2 of Figure 1.

Figure 3 is a sectional view taken substantially on line 3—3 of Figure 1.

Figure 4 is a sectional view taken substantially on line 4—4 of Figure 3.

Figure 5 is a sectional view taken substantially on line 5—5 of Figure 1.

Figure 6 is an enlarged fragmentary sectional view showing the dial mechanism of the control assembly of this invention.

Figure 7 is a sectional view taken substantially on line 7—7 of Figure 6.

Figure 8 is a front view of a selector dial of the control assembly of this invention.

Figure 9 is an enlarged fragmentary sectional view showing the crawl mechanism of the control assembly of this invention.

Figure 10 is a sectional view taken substantially on line 10—10 of Figure 9.

Figure 11 is a diagrammatical view of a gear and clutch mechanism operable by a control assembly of this invention. Figure 11 shows the clutch members positioned to obtain given gear ratios.

Figure 12 is a diagrammatical view similar to Figure 11. Figure 12 shows the clutch members positioned to obtain gear ratios different from the gear ratios obtained by the members as shown in Figure 11.

Figure 13 is a diagrammatical view similar to Figures 11 and 12. Figure 13 shows the clutch members positioned to obtain gear ratios different from the ratios as shown in Figures 11 and 12.

Figures 14 is a diagrammatical view showing a fluid operable control assembly of this invention adapted for operation with a lathe head stock assembly.

Figure 15 is an enlarged fragmentary sectional view showing control means for operation of one of the valves of the control assembly of this invention.

Figure 16 is a plan view showing a master control valve of the control assembly of this invention.

Figure 17 is a longitudinal sectional view of the master control valve of the control assembly of this invention.

Figure 18 is a sectional view taken substantially on line 18—18 of Figure 16.

Figure 19 is a sectional view taken substantially on line 19—19 of Figure 16.

Figure 20 is a sectional view taken substantially on line 20—20 of Figure 16.

Figure 21 is a sectional view taken substantially on line 21—21 of Figure 16.

Figure 22 is a sectional view taken substantially on line 22—22 of Figure 16.

Figure 23 is a sectional view taken substantially on line 23—23 of Figure 16.

Figure 24 is a sectional view taken substantially on line 24—24 of Figure 16.

Figure 25 is a sectional view taken substantially on line 25—25 of Figure 16.

Figure 26 is a top plan view showing a preferred modification of a fluid distribution system of the control assembly of this invention.

Figure 27 is a sectional view taken substantially on line 27—27 of Figure 26.

Figure 28 is an enlarged view of a portion of the elements shown in Figure 14.

Referring to the drawings in detail, a control assembly of this invention is particularly adapted for operation with a head stock assembly as shown in Figure 1.

A housing or support structure 30 has a front portion 32 and a rear portion 34. Rotatably supported adjacent the rear portion 34 of the housing 30 and extending therefrom is a drive shaft 36. The drive shaft 36 rotatably carries a main drive pulley 38, by means of bearings 39, as clearly shown in Figure 9. The main drive pulley 38 has a plurality of belts 40 rotatably engageable therewith in a conventional manner, as shown in Figures 1 and 9, for rotation thereof.

Attached to the main drive pulley 38 in axial alignment therewith and axially movable with respect to the main drive pulley 38 is a clutch plate 41 which is attached to the main drive pulley 38 by means of a plurality of pins 42. The clutch plate 41 is axially movable upon

the pins 42 and is rotatable wtih the main drive pulley 38. The clutch plate 41 is also rotatable with respect to the drive shaft 36.

Attached to the drive shaft 36 and in axial alignment with the clutch plate 41 is a magnetizable drive clutch member 44. The clutch member 44 is slightly axially movable upon the drive shaft 36. The drive clutch member 44 has an electrically energizable clutch portion 46 adjacent the clutch plate 41 and an electrically energizable brake portion 48 adjacent a brake plate 50 which is non-rotatably attached to an auxiliary wall 52 of the housing 30.

Electrical energy is transmitted to either the portion 46 or the portion 48 of the drive clutch member 44 by means of brushes 54, in slidable engagement with the portions 46 and 48. The brushes 54 are supported by a conduit member 56 which also carries suitable electrical leads which connect to the brushes 54.

The drive shaft 36 extends within the housing 30 and is supported by bearing members 58 and 60. In axial alignment with the drive shaft 36 within the housing 30 is a connector shaft 62 which is supported by bearing members 64 and 66.

A connector clutch 63, which is shown herein as being electrically operable, joins the connector shaft 62 to the drive shaft 36. An electric slip ring housing 65 is supported adjacent the electric clutch 63. Electrical energy is transmitted to the electric clutch 63 by means of electric conductor members 67 which enter the electric slip ring housing 65, as shown in Figure 9.

At the end of the connector shaft 62, opposite the connector clutch 63, is a worm gear 68 which is in meshed relation with a worm 70. The worm 70 is attached to a shaft 72 which extends normal to the connector shaft 62 and which carries a spur gear 74 which is in meshed relation with a spur gear 76. The spur gear 76 is attached to a crawl shaft 78 which is rotatably supported exterior of the housing 30 by bearing members 80 and 82. The crawl shaft 78 is substantially parallel to the drive shaft 36 and the connector shaft 62. The gear members 68, 70, 74, and 76 and the shaft 72 are disposed within a cover member 84 attached to the housing 30.

As shown in Figures 9 and 14, adjacent the main drive pulley 38 and attached to the crawl shaft 78 is an auxiliary drive pulley 86. The auxiliary drive pulley 86 is operably connected to the main drive pulley 38 by means of a belt 90.

It is to be understood that within the purview of this invention the crawl shaft 78 may be driven by separate motor means or the like rather than by the main drive shaft 36, as shown.

As shown in Figures 1 and 9, supported by the drive shaft 36 within the housing 30 and adjacent the bearing 58 is a gear member 92 which is rotatable with respect to the drive shaft 36. Also rotatably supported upon the drive shaft 36 and adjacent the bearing 60 is a gear member 94 which is joined to a gear member 96 by means of a sleeve 98. Thus the gears 94 and 96 are secured one to the other and are normally rotatable with respect to the drive shaft 36.

Non-rotatably carried by the drive shaft 36 and disposed intermediate the gears 92 and 96 is a selector clutch 100. The selector clutch 100 is splined to the drive shaft 36, as shown in Figure 1, and is axially movable upon the drive shaft 36. Integral with the clutch 100 and adjacent the gear 96 are radial teeth 102 which are meshable with internal teeth of an annular portion of the gear 96 as shown in Figure 1. The portion of the selector clutch 100 opposite the teeth 102 has an annular recess 103 provided with internal teeth adapted to mesh with auxiliary teeth 104 of the gear 92.

The selector clutch 100 is also provided with an annular peripheral groove 106, as shown in Figure 9, within which a shifter member 108 is slidably disposed, as shown in Figure 1. Movement of the shifter member 108 causes axial movement of the selector clutch 100 for connecting the selector clutch 100 to either the gear 96 or the gear 92. Thus, when the selector clutch 100 is engaged with the gear 96, the gear 96 and the gear 94 are connected to the drive shaft 36 for rotation therewith. Likewise, when the selector clutch 100 is engaged with the gear 92, the gear 92 is connected to the drive shaft 36 for rotation therewith.

As shown in Figure 1, within the housing 30 adjacent the drive shaft 36 and parallel therewith is a jack shaft 110. The jack shaft 110 is rotatably supported by bearings 112, 114, and 116. Rotatably supported upon the jack shaft 110 and in meshed relation with the gear 92 of the drive shaft 36 is a gear 118. The gear 118 is integrally connected by a sleeve 120 to a gear 122, which is rotatable upon the jack shaft 110. Integral with the gear 122 and laterally extending therefrom at a lesser diameter are auxiliary teeth 124. Also rotatably carried upon the jack shaft 110 adjacent the bearing 114 is a gear 126 having internal teeth as shown in gear 96.

A selector clutch 128 is non-rotatably attached to the jack shaft 110 between the gears 122 and 126 and is axially movable upon the jack shaft 110. The selector clutch 128 is similar to the selector clutch member 100 and has means for meshed engagement with the internal teeth of the gear 126 or with the auxiliary teeth 124 of the gear 122 for rotation thereof with the jack shaft 110. A shifter member 129 slidably engages the selector clutch 128 for axial movement thereof.

On the opposite side of the bearing 114 and rotatably attached to the jack shaft 110 is a gear 130 which is engageable by an axially movable selector clutch 132. The selector clutch 132 is non-rotatably attached to the jack shaft 110. On the other side of the selector clutch 132 is a gear 134 which is rotatably carried by the jack shaft 110. The selector clutch 132 has toothed portions 131 and 133 for meshed engagement with internal teeth of the gears 130 and 134, respectively. A shifter member 136 slidably engages the selector clutch 132 for axial movement thereof. A gear 138 is axially spaced from the gear 134 and is attached thereto by means of a sleeve 140. The gear 138 is also rotatable upon the jack shaft 110. Thus, the selector clutch 132 is movable in one direction to connect the gear 130 to the jack shaft 110 for rotation therewith. The selector clutch 132 is movable in the opposite direction to connect the gears 134 and 138 to the jack shaft 110 for rotation therewith.

Also rotatably supported within the housing 30 is an intermediate shaft 142, as shown in Figure 1, which is carried by bearing members 144, 146, and 148. Rotatably supported upon the intermediate shaft 142 adjacent the bearing 144 is a gear 150 which is in meshed relation with the gear 130 of the jack shaft 110. Also rotatably attached to the intermediate shaft 142 and connected to the gear 150 by means of a sleeve 152 is a gear 154. The gear 154 is in meshed relation with the gear 134 of the jack shaft 110.

Adjacent the bearing 146 and rotatably carried by the intermediate shaft 142 is a gear 156. Intermediate the gear 156 and the gear 154 is a selector clutch 158 which is non-rotatably and axially movable upon the intermediate shaft 142. The clutch 158 has a plurality of teeth 160 adapted to mesh with internal teeth of the gear 156. The selector clutch 158 also has internal annularly arranged teeth similar to the teeth shown in the selector clutch 100 in Figure 1. These teeth are adapted to mesh with teeth 162 integral with the gear 154. Thus, the selector clutch 158 is axially movable to connect either the gear 156 or the gear 154 to the intermediate shaft 142 for rotation therewith.

A pivotal shifter member 163 slidably engages the selector clutch 158 for axial movement thereof.

On the other side of the bearing member 146 and rigidly attached to the intermediate shaft 142 are spaced-apart gears 164 and 166.

Also rotatably carried by the housing 30 and mounted in bearings 168, 170, and 172 is a spindle 174. Rotatably mounted upon the spindle 174 adjacent the bearing 170 is a gear 176. The gear 176 is in meshed relation with the gear 164 of the intermediate shaft 142. Also rotatably attached to the spindle 174 and adjacent the bearing 172 is a gear 178 which is in meshed relation with the gear 166 of the intermediate shaft 142.

Between the gear 176 and the gear 178 is a non-rotatable and axially movable selector clutch 180. At one end of the selector clutch 180 are a plurality of teeth 182 which are adapted to mesh with internal teeth within the gear 176. At the other end of the clutch 180 are a plurality of teeth 184 which are adapted to mesh with internal teeth of the gear 178. Thus, the selector clutch 180 is axially movable to connect either the gear 176 or the gear 178 to the spindle 174 for rotation therewith. The selector clutch 180 is slidably engaged by a shifter member 186 which is adapted to axially move the selector clutch 180.

Thus, it is to be understood that by means of the gear members above described, the spindle 174 is driven by the drive shaft 36. It is also to be understood that by means of the selector clutch members above described, various gear ratios may be obtained so that the spindle 174 may be driven at any one of various rotational speeds with the same rotational speed of the drive shaft 36.

Rigidly attached to the spindle 174 adjacent the bearing 168 is a gear 188 which is in meshed relation with an idler gear 190 carried by the housing 30. The idler gear 190 is in meshed relation with a gear 192 carried by a shaft 194. The shaft 194 has a gear 196 attached thereto. The gear 196 is in meshed relation with a gear (not shown) and is adapted for operation of a conventional feed rod mechanism of a lathe.

A control assembly of this invention is shown diagrammatically in Figure 14 and includes means for operating the shifter members above described for obtaining various gear ratios between the drive shaft 36 and the spindle 174. Preferably, each of the shifter members is pivotally supported and is disposed within the housing 30. As shown in Figures 3 and 4, the shifter member 108 comprises an arm 197 pivotally supported by a pin 198 carried by a yoke 199. The lower end of the arm 197 has fingers 201 which slide within the peripheral groove 106 of the selector clutch 100.

Mounted within the housing 30 and at one side of the arm 197 of the shifter member 108 is a fluid motor 200, as shown in Figures 4 and 14. On the opposite side of the arm 197 is a fluid motor 202. Each of the fluid motors 200 and 202 has an actuator rod 204 engageable with the arm 197 for pivotal movement thereof. The actuator rod 204 of the fluid motor 200 when actuated forces the upper portion of the arm 197 toward the fluid motor 202 and causes movement of the selector clutch 100 into meshed engagement with the gear 96. Likewise fluid pressure within the fluid motor 202 forces the upper portion of the arm 197 toward the fluid motor 200, thus forcing the selector clutch 100 into engagement with the gear 92. Thus, the fluid motors 200 and 202 move the selector clutch 100 by means of the shifter member 108.

Likewise, the shifter member 129 is pivotally moved by fluid motor 208 and 210, as shown in Figure 14. The fluid motors 208 and 210 are provided with actuator rod 212 engageable with the shifter member 129. Thus, the fluid motors 208 and 210 serve to axially move the clutch 128.

Likewise, fluid motors 214 and 216 having actuator rods 218 serve to pivotally move the shifter member 136 for axial movement of the selector clutch 132.

In like manner, fluid motors 220 and 222 having actuator rods 224 serve to move the shifter member 163 for axial movement of the selector clutch 158.

In a like manner, fluid motors 226 and 228 having actuator rods 230 serve to pivotally move the shifter member 186 for movement of the selector clutch 180 mounted upon the spindle 174. Each of the fluid motors 200, 202, 208, 210, 214, 216, 220, 222, 226, and 228 has a spring urged detent pin 231 movable into a notch 233 of its respective actuator rod to retain the actuator rod in extended position, as shown in Figure 14.

The shifter member 186 is operable by means of fluid motors 234 and 236 as well as by means of fluid motors 226 and 228. Each of the fluid motors 234 and 236 has an actuator rod 232 engageable with the shifter member 186. The fluid motors 234 and 236 are neutralizing motors and serve to cause the shifter member 186 to move the selector clutch 180 to its neutral position so that the selector clutch 180 engages neither the gear 176 nor the gear 178. In such position of the selector clutch 180, the spindle 174 may be freely rotated without rotation of the other shafts of the assembly.

As shown in Figure 14, fluid for operation of the fluid motors above described is pumped from a fluid tank 240. The tank 240 may contain oil or any other suitable fluid. Fluid is pumped from the tank 240 by a pump 242 through a conduit 244. The fluid may then pass through a filter 246 in a line 250. A relief valve 248 is shown through which fluid above a given volume in the line 250 returns to the tank 240 through a conduit 252. The line 250 connects to a control valve 254 which is provided with an axially movable shaft 256. Within the control valve 254 is a piston 258, a piston 260, and a piston 262 which are rigidly attached to the shaft 256 in spaced-apart relation. The control valve 254 has outlet conduits 264 connecting to the conduit 252 for return of fluid to the fluid tank 240.

The control valve 254 also has a conduit 266 extending therefrom. The conduit 266 connects to an auxiliary selector valve 337 which is preferably disposed adjacent the front portion 32 of the housing 30, as shown in Figures 1 and 14. A conduit 270 extending from the control valve 254 leads to a timer delay valve 272. The timer delay valve 272 controls flow of fluid from the conduit 270 to a conduit 274. The conduit 274 connects to a conduit 276 which leads to a main selector valve or master valve 278. The conduit 274 also connects to a high-low valve 282.

The main selector valve 278 comprises a housing 284 within which is a rotatable closure member or drum 286 having a stem 287 extending from the housing 284. The rotatable closure member 286 is carried by a cylindrical block member 288 which is rigidly and non-rotatably supported within the housing 284. The cylindrical block member 288 has a plurality of longitudinally extending passages 290 therein. These passages 290 permit fluid to flow from the conduit 276 into the cylindrical block 288. The cylindrical block 288 also has radial passages 291 joining the longitudinal passages 290 and leading from the block 288 to the drum 286. The cylindrical block member 288 also has passages 292 therein which join to a conduit 294 which is attached to the housing 284 of the main selector valve 278 and leads therefrom.

The rotatable closure member or drum 286 has a plurality of radially extending fluid ports 296 therethrough which may be aligned with one or more of the passages 291 and 292 of the cylindrical block 288 when the rotatable closure member 286 is rotated to various positions. The rotatable closure member 286 has a series of parallel annular peripheral grooves 298 extending about the fluid ports 296. Thus, fluid which flows through any of the fluid ports 296 may also flow in the annular grooves 298 at the periphery of the rotatable closure member 286.

As shown in Figure 16 the housing 284 has apertures 300, 302, 304, 306, 308, 310, 312, and 314 extending therethrough. Fluid flowing in any one of the annular grooves 298 may also flow through an aperture 300, or

302 or 304 or 306 or 308 or 310 or 312 or 314 in alignment therewith.

A conduit 316 connects the aperture 300 to the fluid motor 202. A conduit 318 connects the aperture 302 to the fluid motor 200. A conduit 320 connects the aperture 304 to the fluid motor 210. A conduit 322 connects the aperture 306 to the fluid motor 208. A conduit 324 connects the aperture 308 to the fluid motor 216. A conduit 326 connects the aperture 310 to the fluid motor 214. A conduit 328 connects the aperture 312 to the fluid motor 228. A conduit 330 connects the aperture 314 to the fluid motor 226. Thus, fluid may flow between the conduit 276 and any one of the fluid motors set forth above. Fluid ports 296 which are open for flow of fluid or closed against flow of fluid are controlled by the rotative position of the closure member or drum 286.

The conduit 294 connects to a conduit 332 of the high-low valve 282. The conduit 294 also connects to a conduit 334 of the high-low valve 282. The conduit 294 also connects to a conduit 336 of an auxiliary selector valve 337. The conduit 294 also connects to the conduit 250 leading to the fluid tank 240. The conduit 294 also connects to a conduit 338 which leads to the timer delay valve 272.

The auxiliary selector valve 337 has a shaft 340 rotatably carried thereby. Within the auxiliary selector valve 337 and rigidly attached to the shaft 340 in spaced-apart relation are pistons 341, 342, and 343. The shaft 340 is also axially movable within the valve 337. The shaft 340 preferably extends through the front portion 32 of the housing 30. At the exterior end of the shaft 340 is a knob member 344 for rotation of the shaft 340. Also attached to the shaft 340 immediately exterior of the front portion 32 of the housing 30 is a dial 346.

At the other end of the shaft 340 and exterior of the auxiliary selector valve 337 is attached a gear wheel 348, as shown in Figures 5 and 6. The gear 348 is in meshed relation with a gear wheel 350 rotatably supported by a shaft 351 carried by the high-low valve 282. In meshed relation with the gear 350 is a gear 352 which is attached to the stem 287 of the rotatable closure member 286 for rotation thereof.

The gear wheel 350 carries a cam 354 extending axially therefrom. The cam 354 is engageable with an axially movable shaft 356 extending longitudinally through the high-low valve 282. Within the high-low valve 282 and firmly attached to the shaft 356 is a piston 358. Also attached to the shaft 356 in spaced-apart relation are a piston 360 and a piston 361.

To obtain electrical energy for the control assembly, power supply lines 364 are provided, as shown in Figure 14, and are adapted to connect to any suitable source of electrical energy. The power supply lines 364 extend from a control unit 366. The control unit 366 includes any suitable conventional electrical elements to perform the functions set forth herein.

As shown in Figure 14, an electrical conduit member 368 extends from the control unit 366 to the portion 48 the electric clutch 44. An electrical conduit member 370 extends from the control unit 366 to the portion 46 of the electric clutch 44 for energization thereof. The conductor 67 extending from the slip ring housing 65 of the electric connector clutch 63 is also connected to the control unit 366.

Also extending from the control unit 366 is a control lead 380 which connects to a clutch switch 382. Also extending from the control unit 366 is a control lead 384 which connects to a brake switch 386. A control lead 387 extends between the control unit 366 and the timer delay valve 272.

A pivotally mounted operating lever 388 is engageable with the switch members 382 and 386 for operation thereof, as shown in Figure 12. The operating lever 388 has an arm 390 engageable with the shaft 256 of the control valve 254.

Operation

As stated above, the drive pulley 38, shown in Figures 1, 9, and 14, may be rotatably operated by any suitable means. Ordinarily, during the time that the gear assembly is in use, the drive pulley 38 is being constantly rotated by the driving means. The drive pulley 38, being rotatably mounted upon the drive shaft 36, does not drive any of the other members of the assembly until other elements thereof are actuated.

Any desired spindle speed may be selected by means of rotative movement of the dial 346, shown in Figures 5, 6, 8, and 14. The dial 346 has inscribed thereupon numerals indicating the various spindle speeds obtainable, as shown in Figure 8. If, for example, it is desired to operate the spindle at a speed of approximately 13 r.p.m. the knob or the handle 344 is rotated until the "13" on the dial 346 is aligned with any suitable indicator. This rotative movement of the dial 346 with the shaft 340 causes rotative movement of the gears 348. Rotation of the gear 348 causes rotation of the gear 350 and 352 as discussed above. Thus, the closure member 286 within the main selector valve 278 is rotatively moved. The shaft 340 and the gears 348, 350, and 352 are retained in any adjusted rotative position by means of a spring 391 adjacent the dial 346 which resiliently urges balls 393 into notches 394, as shown in Figures 6 and 7.

The operator of the assembly then pivotally moves the operating lever 388 upwardly to the clutch position thereof, as shown in dotted lines in Figure 14. In the the clutch position of the operating lever 388 the clutch switch 382, is actuated causing operation of relays (not shown) within the control unit 366 to energize the electric connector clutch 63. The connector clutch 63 thus operatively joins the connector shaft 62 to the drive shaft 36. Due to the fact that the main drive pulley 38 is constantly rotating, the auxiliary drive pulley 86 attached to the crawl shaft 78 is constantly rotating. Thus, the crawl shaft 78, through the gear members 76, 70, and 68, causes the connector shaft 62 to be constantly rotating. Of course, due to the fact there is a high ratio of speed reduction obtained by means of the gears 76, 74, 70, and 68, the connector shaft 62 is constantly rotated at a low rate of speed. Therefore, when the connector clutch member 63 joins the connector shaft 62 to the main drive shaft 36, the main drive shaft 36 is rotated at a low rate of speed.

When the clutch switch 382 is actuated by movement of the lever 388 to its clutch position, control devices within the control unit 366 are automatically actuated to start the timer delay valve 272 to begin a timing operation. The timer delay valve 272 controls valve mechanisms therewithin for controlling flow of fluid from the conduit member 270 to the conduit member 274.

Due to the fact that the pump 242 is constantly operating during rotation of the main drive pulley 38, fluid is constantly being pumped from the fluid tank 240, through the filter 246, and through the conduit 250 to the control valve 254. Excess fluid is permitted to flow through the relief valve 248 and return to the fluid tank 240 through the conduit 252.

Due to the fact that the operating lever 388 is in the clutch position, as shown in dotted lines in Figure 14, the pistons 260 and 262 within the control valve 254 are positioned as shown in dotted lines in Figure 14. Therefore, fluid being pumped into the conduit 250 flows into the control valve 254 and flows through a chamber within the valve 254 formed between the piston 260 and the piston 262. The fluid thence flows outwardly from the control valve 254 into the conduit 270 and into the timer delay valve 272. The timer delay valve 272 has valve mechanisms therewithin which cause all of the fluid reaching the timer delay valve 272 through the conduit

270 to flow into the conduit 274. Thus, fluid flows into the conduit 274 and is forced into the conduit 276 and into the main selector valve 278.

When the desired rotational speed of the spindle 174 was selected by rotative movement of the dial 346 to the speed desired, the shaft 340 of the auxiliary selector valve 337 was rotated so that the gear members 348, 350, and 352 were rotated. Thus the rotatable closure member 286 was rotated so that the fluid ports 296 therein were aligned with some of the radial flow passages 291 of the cylindrical block 288. Therefore, as fluid is pumped into the cylindrical block 288 through the conduit 276 fluid flows through some of the passages 290 and 291 within the cylindrical block 288 and the fluid thence flows through the ports 296 of the closure member 286 which are aligned with passages 291 of the cylindrical block 288.

In order that the spindle speed of 13 r.p.m. may be obtained, the rotatable closure member 286 is rotated by the shaft 340 during selection of the desired speed to a position in which the fluid ports 296 permit fluid to flow outwardly from the main selector valve 278 through the conduits to cause actuation of the proper fluid motors for movement of the selector clutches to obtain the desired gear ratios. Thus, the rotatable closure member 286 permits fluid to flow outwardly from the main selector valve 278 through the conduit 316 and into the fluid motor 202. Thus, the shifter member 108 is engaged by the actuator rod 204 of the fluid motor 202 so that the selector clutch 100 is moved into engagement with the gear 92 of the main drive shaft 36. Due to the fact that the main drive shaft 36 is being rotated very slowly by means of the connector shaft 62, the teeth of the selector clutch 100 and the teeth of the gear 92 are meshed quickly and easily by axial movement of the selector clutch 100. Thus, the selector clutch 100 is moved into engagement with the gear wheel 92, as shown in Figure 11.

Simultaneously with flow of fluid through the conduit 316 for actuation of the fluid motor 202, fluid flows through the conduit 322 to the fluid motor 208 for engagement of the actuator rod 212 of the fluid motor 208 with the shifter member 129. Thus, the selector clutch 128 is moved into engagement with the gear wheel 126 as shown in Figure 9.

Simultaneously with the flow of fluid through the conduits 316, and 322, fluid flows through the conduit 324 for energization of the fluid motor 216. Thus, the shifter member 136 is engaged, moving the selector clutch 132 into engagement with the gear member 130, as shown in Figure 11. Also, fluid simultaneously flows through the conduit 330 for energization of the fluid motor 226 so that the shifter member 186 causes movement of the selector clutch 180 into engagement with the gear member 178.

When the desired spindle speed was selected by rotative movement of the dial 346, rotative movement of the gear 350 resulted. Thus, the cam member 354 which is firmly attached to the gear 350 adjusted the axial position of the shaft 356 of the high-low valve 282. Thus, the piston members 358, 360, and 361 are moved to the position shown in Figure 14. Thus, the fluid flowing through the conduit 274 enters the high-low valve 282, between the pistons 358 and 360 and thence flows through a conduit 370 to the fluid motor 220 for movement of the shifter member 163 so that the selector clutch member 158 is moved into engagement with the gear member 156. Thus, the gear member 156 is caused to rotatably move with rotation of the shaft 142. For purposes of illustration, the number of teeth on each of the gear members may be as shown by the numerals adjacent thereto as shown in Figures 11, 12, and 13. The rotational speed of the main drive shaft 36, for purposes of illustration, is specified herein as 820 r.p.m. Therefore, the rotational speed of the spindle 174 with the selector clutches adjusted as shown in Figure 11 as 12.9 r.p.m. which, as a practical matter, is shown on the selector dial 346 as being 13 r.p.m.

As stated above, fluid is permitted to flow for actuation of the fluid motors for movement of the selector clutches during a short time interval governed by the control unit 266 and by the timer delay valve 272. During this period in which the selector clutches are actuated by the fluid motors the crawl shaft 78 is driving the main drive shaft 36 through the connector shaft 62 and through the connector clutch 63. After actuation of the control unit 366 and the timer delay valve 272 by movement of the control lever 388 to the clutch position, as shown in dotted lines in Figure 14, only a short period of time, preferably in the order of 3 to 10 seconds, elapses for the actuation of the selector clutches for establishing any selected gear ration.

After this short interval of time during which the desired gear ratios are established, the timer delay valve 272 closes the fluid conduit 274 so that fluid pressure is relieved from the main selector valve 278 and from the fluid motors which have been actuated. The timer delay valve 272, thus, at the end of the clutch selector interval, diverts all of the fluid pumped to the timer delay valve 272 to a lubrication system 389 of the assembly, as shown schematically in Figure 14. The lubrication system 389 lubricates the gears, clutches, shafts, and other movable elements of the assembly.

When fluid pressure within the fluid actuator motors is released by means of operation of the timer delay valve 272, the actuator rods of the fluid motors are retained in actuated positions by means of the spring urged detent members 230 within the notches 233 of the actuator rods, as shown in Figure 14.

Thus, at the end of the gear selection interval the control unit 366 and the timer delay valve 272 automatically cause deactuation of the connector clutch 63 and energization of the portion 46 of the clutch member 44. Thus, the clutch member 44 and the clutch plate 41 move axially one toward the other into firm engagement. Therefore, the drive shaft 36 is driven by means of the main drive pulley 38.

Thus, as discussed above, the dial 346 may be set for any desired spindle speed, such as 13 r.p.m. However, no actuation of the elements in response to the setting of the dial 346 occurs until the main operating lever 388 is moved to its clutch position as shown in Figure 14. Movement of the main operating lever 388 to the clutch position, thus, as discussed above, automatically causes a timing operation during which the main drive shaft 36 is driven at a crawl speed and during which the proper fluid motors are actuated to cause movement of the selector clutches for establishing the proper speed ratios between the main drive shaft 36 and the spindle 174. Then the rotation of the main drive shaft 36 automatically changes from crawl speed to normal speed after the clutching interval. When the drive shaft 36 rotates at its normal rate the spindle 174 rotates at the speed selected upon the dial 346 prior to actuation of the sequence.

When it is desired to operate the spindle 174 at another speed of rotation the selector dial 346 is rotated to indicate the desired speed. Such a selection by rotation of the dial 346 may be made at any time, and may be made even when the gear assembly is operating at normal speed. However, the selector clutches are not actuated to obtain the new desired speed ratios until the control unit 366 is deactuated and reactuated by movement of the operating lever 388 from its clutch position and returned to its clutch position. Usually the operating lever 388 is moved directly from its clutch position to its brake position to stop rotation of the drive shaft 36 before the operating lever 388 is returned to its clutch position.

When the operating lever 388 is moved to its brake

position, as shown in Figure 14, the control unit **366** energizes the portion **48** of the clutch member **44**. Thus, the clutch member **44** moves axially upon the shaft **36** into engagement with the stationary brake plate **50**. Engagement of the clutch member **44** with the stationary brake plate **50** causes the drive shaft **36** to stop. The operating lever **388** may then be moved to its clutch position, as shown in dotted lines in Figure 14, which again starts the timing sequence, as discussed above, for operation of the drive shaft **36** at crawl speed during which the desired gear ratios are established, followed by automatic connection of the drive shaft **36** to the main drive pulley **38** for operation therewith.

The spindle **174** thus operates at the speed selected upon the selector dial **346**, as discussed above. Thus, any spindle speed such as shown on the selector dial **346** in Figure 8, including any of the gear ratios shown for purposes of illustration in Figures 11, 12, and 13, may be obtained.

In Figure 12 a spindle speed of 69.5 is shown obtainable by the movement of the selector clutches. As a practical matter the dial **346** is marked with a numeral "70" for the setting of the dial **346** to obtain the ratio as shown in Figure 12.

Likewise, Figure 13 shows adjustment of the selector clutches **100**, **128**, **132**, **158**, and **180** for obtaining a spindle speed of approximately 1006 r.p.m. when the main drive shaft **36** is rotated at approximately 820 r.p.m. For practical purposes the selector dial **346** is marked "1000" for the setting of the dial **346** to obtain the gear ratios as shown in Figure 13.

If the operator desires to freely rotate the spindle **174**, it is possible to place the selector clutch **180** in a neutral position. The operator moves the operating lever **388** to its brake position causing the arm **390** at the end thereof to force axial movement of the shaft **256** to the position thereof shown in Figure 14. Thus fluid pumped by the pump **242** flows through the line **250** into the control valve **254** between the pistons **258** and **260** so that the fluid flows outwardly from the control valve **254** through the fluid conduit **266**. The fluid thus flows from the control valve **254** through the fluid conduit **266** to the auxiliary selector valve **337**.

After the operator has moved the operating lever **388** to the brake position thereof, he then manually grasps the knob **344** of the auxiliary selector valve **337** and pulls the knob **344** and shaft **340** axially outwardly. Thus, the piston **342** within the auxiliary selector valve **337** is moved to the position as shown in dotted lines in Figure 14.

As shown in Figures 5 and 14, the gear **350** is wider than the gear **348**. Therefore, as the shaft **340** is moved axially, the gear **348**, attached thereto, remains in mesh with the gear **350**.

Due to the fact that the shaft **340** of the auxiliary selector valve **337** is moved axially outwardly, fluid flows into the auxiliary selector valve **337** and flows between the pistons **342** and **343**. Fluid thence flows outwardly from the auxiliary selector valve **337** through a conduit **392** to the fluid motors **234** and **236**.

Thus, the fluid motors **234** and **236** are actuated causing movement of both of the actuator rods **232** through an equal distance. Thus, the shifter member **186** moves the selector clutch **180** to a neutral position so that the selector clutch **180** is out of engagement with both the gear **176** and the gear **178**. Therefore, the spindle **174** may be freely rotated without rotation of the other elements of the assembly.

When the shaft **340** is permitted to return to its normal position, as shown in Figures 6 and 14, fluid pressure created in the conduit **392** is released as fluid flows into the auxiliary selector valve **337** between the pistons **341** and **342** and returns to the fluid tank **240** through conduits **336** and **294**. A spring **395** is shown in Figure 6 for resiliently maintaining the shaft **340** in its normal axial position.

Thus, it is to be understood that the control assembly of this invention provides means for automatically obtaining any given pre-selected speed ratios in a gear assembly while the gear members are being slowly rotated. Therefore, the meshing of the gear members is easily and quietly performed. The control assembly of this invention also provides means by which the gear members are automatically operated at a normal rate of speed after the clutch operations have been automatically performed.

It is also to be understood that the control mechanism of this invention may be applied to other types of operations and to other types of assemblies.

It is to be understood that the conduits leading to the fluid motors and to other elements of the assembly may be conventional pipes or tubes. The conduits may also be formed by grooves within adjacent surfaces of plates which are secured one to the other to form a two piece manifold.

For example, Figures 26 and 27 show a preferred modification of a conduit system of a control assembly of this invention. A manifold **400** comprises a pair of plates **402** and **404** which are similar in size and shape and are adapted to be secured together by a plurality of bolts **406** having nuts **408**. Each of the plates **402** and **404** has a plurality of grooves **410** therein. The grooves **410** of each of the plates **402** and **404** are disposed so as to be in lateral alignment with the grooves of the other plate. The plate **402** has a plurality of passages **416** therein, each of which extends from one of the grooves **410** to the upper surface of the plate **402** having outlet openings **417** therein. Thus, when the plates **402** and **404** are secured together, as shown in Figure 27, the grooves **410** form conduits or passages within the manifold **400**.

Thus fluid may enter the manifold **400** through inlet ports **418**. These inlet ports **418** have threaded openings to receive suitable fittings. Fluid may thence be distributed through the grooves **410** to the outlets **417** at the upper surface of the manifold **400** and to outlet ports **420** in the edges thereof. The outlet ports **417** and **420** also have threaded openings as shown for connection to suitable fittings and for connection to devices such as to the fluid motors **220**, **222**, **200**, **202**, etc.

Although the preferred embodiment of the device has been described, it will be understood that within the purview of this invention various changes may be made in the form, details, proportions and arrangement of parts, the combination thereof and mode of operation, which generally stated consist in a device capable of carrying out the objects set forth, as disclosed and defined in the appended claims.

Having thus described my invention, I claim:

1. In combination with a gear assembly having a plurality of reciprocally movable clutch members, a control apparatus comprising a plurality of shifter members, a plurality of pairs of actuator members, there being a pair of actuator members adjacent each shifter member for operation thereof, there being one actuator member in each pair of actuator members on one side of the shifter member for moving the clutch in one direction and an actuator member on the other side of the shifter member for moving the clutch in the opposite direction, each actuator member having a fluid cavity therein, a reciprocally movable plunger within each cavity and extending from the actuator member into engagement with the shifter member for movement thereof, each plunger having an extended actuated position, a resiliently operable detent member in each actuator member and engageable with the plunger thereof resiliently retaining the plunger in extended actuated position, a plurality of fluid conduit members, there being a fluid conduit member connected to

each actuator member for transmission of fluid to and from the fluid cavity thereof.

2. In a control assembly a housing having internal wall surfaces forming a cylindrical bore therein, an elongate cylindrical block rigidly supported within the housing concentric with the bore therein, a hollow cylindrical drum within the housing and rotatably supported by the cylindrical block, the drum being disposed between the block and the internal wall surfaces of the housing, the cylindrical block having a plurality of fluid passages therewithin and extending substantially in an axial direction therethrough, each fluid passage extending substantially the length of the block, there being radial connector passages connecting each fluid passage to the peripheral surface of the cylindrical block, said fluid passages also having openings adjacent one end of the block, the drum having a plurality of fluid ports extending therethrough, each of the fluid ports of the drum being alignable with at least one of the connector passages at the peripheral surface of the cylindrical block, the drum having a plurality of substantially parallel annular peripheral grooves, there being one peripheral groove in alignment with each of the fluid ports, the housing having a plurality of fluid passages extending therethrough and opening into the bore thereof, there being a passage of the housing aligned with each one of the grooves of the drum, the grooves thus connecting to the fluid passages through the housing so that the drum may be rotatably moved to selectively align connector ports thereof with fluid passages of the block so that fluid may flow through the fluid passages of the block and through the grooves and through the fluid passages of the housing.

3. In an actuator assembly for a gear mechanism having a plurality of gear members and a plurality of axially movable clutch members engageable with the gear members, a plurality of shifter members, there being one shifter member for each clutch member, the combination comprising a plurality of fluid motors, there being at least two fluid motors for each shifter member engageable therewith for movement thereof, one of the fluid motors moving the shifter member in one direction and the other fluid motor moving the shifter member in the opposite direction, each of the fluid motors having an actuated position, resilient means retaining each fluid motor in actuated position, a selector valve, a plurality of fluid conduit members connected to the selector valve, there being at least one of the conduit members connected to each of the fluid motors, the selector valve including a housing member, a cylindrical block rigidly retained within the housing member, a drum encompassing the cylindrical block and rotatably carried thereby, there being a plurality of axially extending flow passages within the cylindrical block extending substantially the length thereof and open adjacent one end of the block, input and output fluid lines connecting to said open end of the flow passages, the flow passages within the block also being open at the peripheral surface thereof, the drum having a plurality of fluid ports therethrough, each of the fluid ports being alignable with the opening at the peripheral surface of at least one of the flow passages through the block, the housing having a plurality of flow passages therethrough connecting with the fluid conduit members which lead to the fluid motors, and means for selective rotative movement of the drum, selective rotative movement of the drum thus permitting alignment of the fluid ports of the drum with selected flow passages of the cylindrical block for flow of fluid to and from selected fluid motors, fluid flow to a fluid motor causing movement of a shifter member and also forcing movement of a fluid motor from an actuated position.

4. In a control assembly including a main selector valve, the main selector valve comprising a rotatably movable closure member having a plurality of flow passages therethrough, the main selector valve having a plurality of fluid conduits leading therefrom, the closure member being rotatably movable so that the flow passages thereof connect with the fluid conduits, a plurality of fluid motors, there being a fluid motor connected to each of the fluid conduits, each fluid motor having an actuated and a deactuated position, resilient means included in each fluid motor for retaining the fluid motor in actuated position, a source of fluid, means for connecting the main selector valve to the source of fluid, an auxiliary selector valve connected to the source of fluid, the auxiliary selector valve including a housing, a rotatable shaft extending through the housing, means attached to the shaft external of the housing and operably connected to the movable closure member of the main selector valve for rotative movement of the closure member, a piston member attached to the shaft within the housing of the auxiliary closure member, the auxiliary closure member having a plurality of fluid ports, one of the fluid ports being connected to the source of fluid, the other fluid ports being connected to fluid motors, the shaft being axially movable for moving the piston member adjacent the fluid ports for controlling flow of fluid through the fluid ports, fluid flow from the source of fluid to the fluid motors being thus controlled by the main selector valve and by the auxiliary selector valve.

5. In a control assembly for a gear mechanism of the type having support structure, a plurality of shafts rotatably carried by the support structure, a plurality of gear members, there being a pair of gear members rotatably carried by each shaft, a plurality of selector clutches, there being a selector clutch axially movable upon each shaft and rotatable therewith, each selector clutch being disposed between the pair of gears upon its respective shaft and individually engageable with each gear for interlocking the gear with the shaft upon which it is mounted, a plurality of shifter members, there being one shifter member engageable with each selector clutch for axial movement thereof, the combination comprising a plurality of fluid motors, there being a pair of fluid motors operably connected with each shifter member for movement thereof, fluid conduit means connecting to each fluid motor, selector valve means connected to the fluid conduit means, rotatable closure means within the selector valve, the closure means being operable to prevent fluid flow to one fluid motor in each pair thereof while permitting fluid flow to the other fluid motor of each pair thereof, a pair of neutral fluid motors, said neutral fluid motors having means engageable with opposite sides of one of said selector clutches, said selector valve means including means for providing equal fluid flow to each of the said neutral fluid motors to retain said one of the selector clutches in neutral position by application of equal force on each side of said selector clutch

6. In a control mechanism for a gear assembly having support structure, a plurality of parallel rotatable shaft members carried by the support structure, a pair of gear wheels rotatably carried by each shaft, a plurality of selector clutch members, there being a selector clutch member axially movable between the gear wheels engageable therewith and rotatable with the shaft member, one of the shaft members being a main drive shaft, a pulley wheel rotatably carried by the main drive shaft, a crawl shaft rotatable with the pulley wheel, a connector shaft in axial alignment with the drive shaft, a speed reduction unit joining the connector shaft to the crawl shaft, a connector clutch joining the connector shaft to the drive shaft, a clutch plate attached to the pulley wheel and rotatable therewith, a drive clutch member attached to the drive shaft and rotatable therewith, a brake plate carried by the support structure adjacent the drive clutch member and engageable by the drive clutch, the drive clutch member also being operable to engage the clutch plate for connecting the drive clutch member to the drive pulley for rotation of the drive shaft with the drive pulley, a fluid motor operably connected to each of the selector clutch members for axial movement thereof, a selector

valve, conduit means connected to the selector valve and to each fluid motor, a source of fluid, the combination comprising control and timer means connected to the connector clutch and to the drive clutch member, the control and timer means also being connected to the conduit means, the control and timer means controlling flow of fluid from the source thereof to the selector valve, the control and timer means also being connected to the connector clutch for actuation thereof so that fluid is permitted to flow from the source thereof to the selector valve during actuation of the connector clutch, said control and timer means also including means for deactuating the connector clutch and for stopping flow of fluid to the selector valve after a given interval of time, the control and timer means also including means for actuation of the drive clutch member to connect the drive clutch member to the clutch plate after said given interval of time, the control and timer means also including means for actuation of the drive clutch member to connect the drive clutch member to the brake plate for preventing rotation of the drive shaft.

7. In a control assembly for a gear mechanism provided with support structure, a plurality of shafts rotatably carried by the support structure, a plurality of gear members, there being a pair of gear members rotatably carried by each shaft, a plurality of selector clutches, there being a selector clutch axially movable upon each shaft and rotatable therewith, each selector clutch being disposed between the pair of gears upon its respective shaft and individually engageable with each gear for interlocking the gear with the shaft upon which it is mounted, a plurality of shifter members, there being one shifter member engageable with each selector clutch for axial movement thereof, a plurality of fluid motors, there being a pair of fluid motors engageable with each shifter member for movement thereof, fluid conduit means connecting to each fluid motor, the combination comprising selector valve means connected to the fluid conduit means for providing fluid pressure to only one of each pair of said fluid motors, a pair of neutral fluid motors, said neutral fluid motors being operable to retain one of said selector clutches in neutral position by application of equal force on each side of the selector clutch, said selector valve means including means for providing equal fluid pressure to each of the last said neutral fluid motors, one of said shafts being a drive shaft, brake means operably connectable to the drive shaft for preventing rotation theerof, means connecting the brake means to the selector valve means for controlling flow of fluid to the selector valve means so that fluid can flow to the neutral fluid motors only during actuation of the brake means.

8. In a control mechanism for a gear assembly having support structure, a plurality of parallel rotatable shaft members carried by the support structure, a pair of gear wheels rotatably carried by each shaft, a plurality of selector clutch members, there being a selector clutch member axially movable upon each shaft between the gear wheels thereof, each selector clutch member being rotatable with its respective shaft member and engageable with either one of the gear members for rotation thereof with its respective shaft member, the gears of one shaft being in meshed relation with the gears of an adjacent shaft, one of the shaft members being a main drive shaft, an auxiliary wheel rotatably carried by the main drive shaft, the combination comprising a rotatable crawl shaft, means connecting the crawl shaft to the auxiliary wheel so that the crawl shaft rotates with the auxiliary wheel, a connector shaft operably disposed between the crawl shaft and the drive shaft, a speed reduction unit joining the connector shaft to the crawl shaft, connector clutch means joining the connector shaft to the drive shaft, a clutch plate attached to the auxiliary wheel and rotatable therewith, a drive clutch member attached to the drive shaft and rotatable therewith, a brake plate carried by the support structure adjacent the drive clutch member and engageable by the drive clutch member to prevent rotation of the drive shaft, the drive clutch member also being engageable with the clutch plate for rotation of the drive shaft with the auxiliary wheel, fluid motor means operably connected to each of the selector clutch members for axial movement thereof, a selector valve, conduit means connected to the selector valve and to each fluid motor means, a source of fluid, timer means, the timer means controlling flow of fluid from the source thereof to the selector valve, the timer means also connected to the connector clutch means for causing clutching operation thereof so that the fluid is permitted to flow to the selector valve during clutching operation of the connector cluch means, said timer means also including means for declutching the connector clutch means and for stopping flow of fluid to the selector valve after a given interval of time, the timer means also including means for causing engagement of the drive clutch member after said given intereval of time, control means, the control means being connected to the timer means, an electric clutch switch and an electric brake switch connected with the control means, the brake switch causing clutching operation of the drive clutch member so that there is engagement of the drive clutch member with the brake plate, and a pivotally movable control lever movable to a plutch position and engageable with the clutch switch to operate the clutch switch causing the control means to begin operation of the timer means, the control lever being movable to a brake position engageable with the brake switch to actuate the brake switch, and valve means operable by the control lever for controlling flow of fluid to the selector valve.

9. In a fluid control assembly, a main selector valve, the main selector valve including a housing, a support block within the housing rigidly supported thereby, the support block having a plurality of passages extending therethrough, a drum rotatably carried by the support block, the drum having apertures therethrough, the drum being rotatable so that each aperture is movable into juxtaposed alignment with at least one of the passages of the support block so that fluid flow from the passage is permitted through the aperture during such alignment, the housing being provided with a plurality of fluid ports thercthrough connecting to the apertures of the drum, a first auxiliary selector valve, the first auiiiary selector valve including a housing, the housing of the first auxiliary selector valve having a plurality of openings therein, an axially movable and rotatable shaft within the housing of the first auxiliary selector valve, the shaft having a plurality of spaced-apart pistons thereon within the housing of the first auxiliary selector valve, the pistons being movable intermediate the openings in the first auxiliary selector valve housing by axial movement of said shaft so that fluid flow through the housing between the openings thereof is governed by the axial position of the shaft, means connecting said drum of the selector valve to the shaft of the first auxiliary selector valve for rotation therewith, a second auxiliary selector valve, the second auxiliary selector valve comprising a housing having a plurality of fluid ports therein, an axially movable shaft within the housing, a plurality of spaced-apart pistons attached to the shaft within the housing of the second auxiliary selector valve for controlling flow of fluid between fluid ports thereof, means interposed between the first and second auxiliary selector valves and operable by the first auxiliary selector valve for movement of the axially movable shaft of the second auxiliary selector valve.

10. In a fluid control assembly, a main selector valve, the main selector valve including a housing, the housing having conduits therein, a support block within the housing rigidly supported thereby, the support block having a plurality of passages extending in an axial direction therethrough, each of the passages extending

substantially the axial length of the block, each of the passages having an open end communicating with a conduit of the housing, each of the passages also having a portion extending to the peripheral surface of the block and open at the surface of the block, a drum rotatably carried by the support block, the drum having apertures therethrough, the drum being rotatable so that each aperture is movable into juxtaposed alignment with at least one of the passages of the support block so that fluid flow from the passage is permitted through the aperture during such alignment, the housing being provided with a plurality of fluid ports therethrough connecting to the apertures of the drum.

11. A control assembly for a gear mechanism of the type having a plurality of shafts and a plurality of gear members, a main drive shaft, a crawl shaft, selector means for selectively engaging the gear members, normal means for operation of the drive shaft at a given normal rate, connector means for operation of the drive shaft by means of the crawl shaft, the combination comprising control means connected to said selector means and normal means and connector means, timer means connected to the control means, actuator means connected to the timer means, operation of the actuator means causing the timer means to operate the control means so that the connector means operates with the selector means followed by deenergization of the connector means and the selector means with energization of the normal means, the crawl shaft thus automatically operating the drive shaft during engaging movement of the gear members followed by drive shaft operation at normal rate after the selected gear members are engaged.

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