

Aug. 17, 1943.

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2,327,255

CYLINDRICAL GRINDING MACHINE

Filed March 7, 1941

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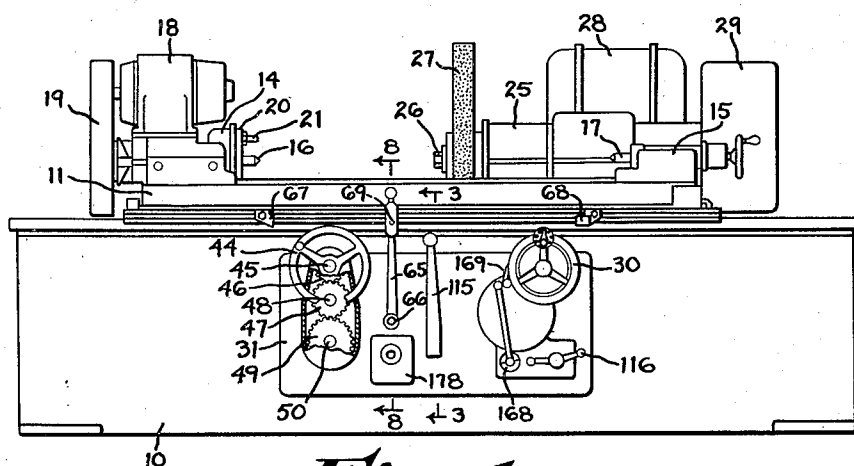


Fig. 1

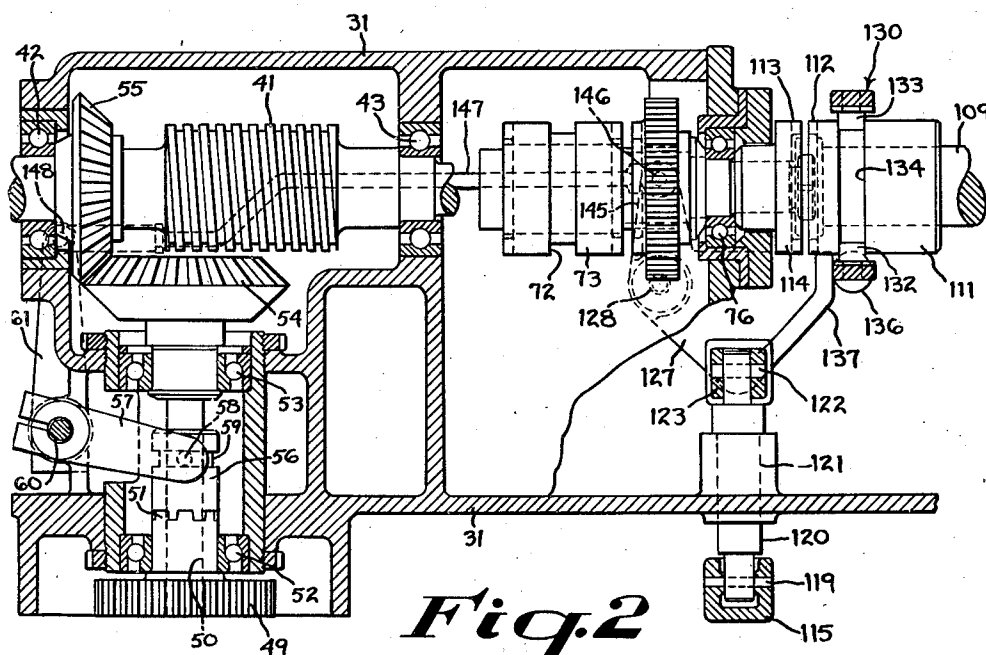


Fig. 2

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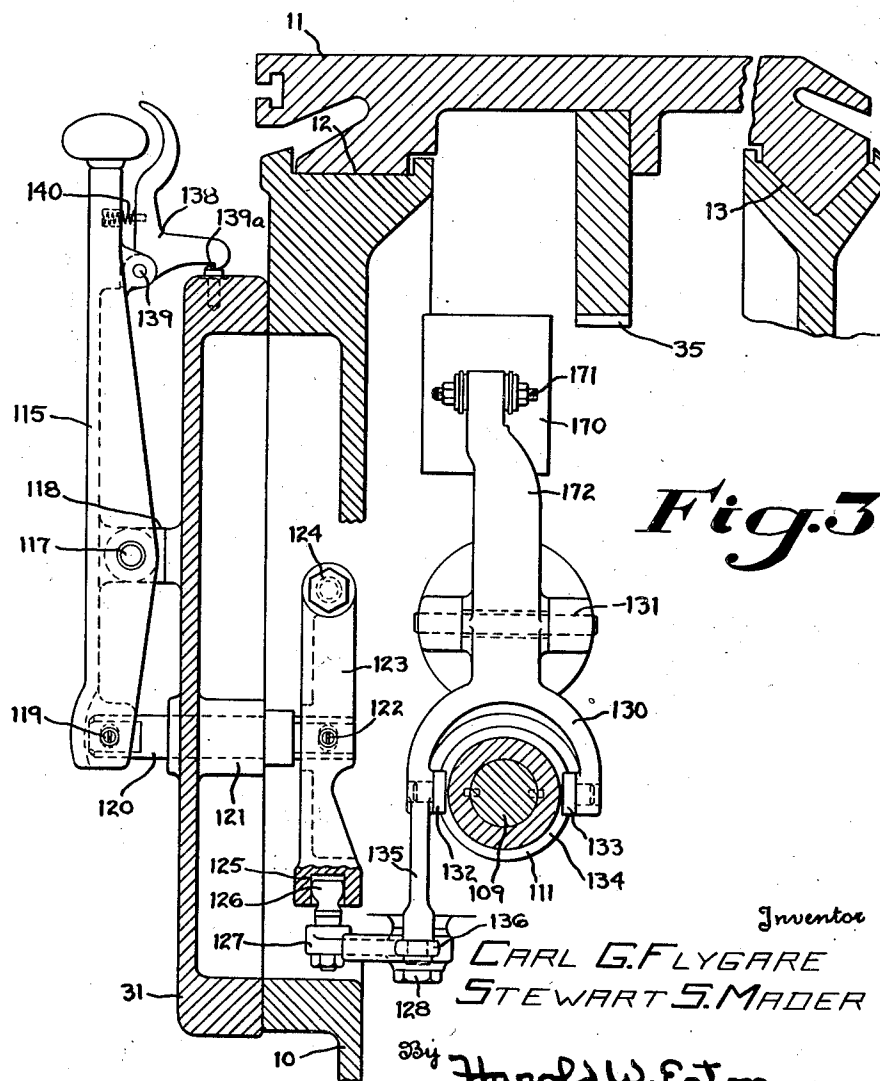
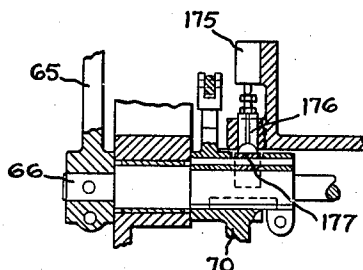
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C. G. FLYGARE ET AL
CYLINDRICAL GRINDING MACHINE

4 Sheets-Sheet 2

Fig.4



Aug. 17, 1943.

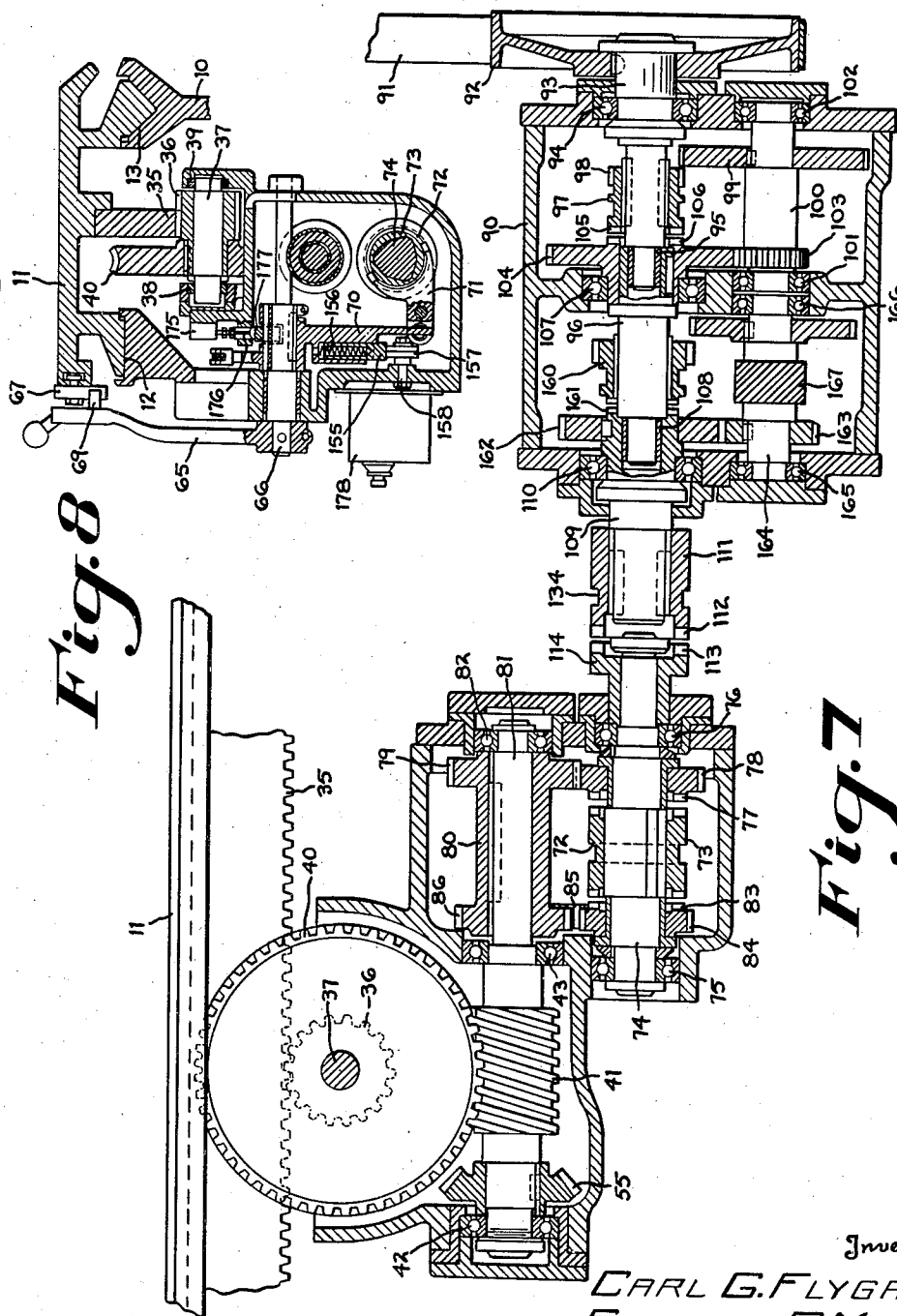
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4 Sheets-Sheet 4



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CYLINDRICAL GRINDING MACHINE

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8 Claims. (Cl. 74—27)

The invention relates to grinding machines, and more particularly to an improved cylindrical grinding machine.

One object of the invention is to provide a simple and thoroughly practical cylindrical type grinding machine. Another object of the invention is to provide an improved table traversing and reciprocating mechanism. Another object of the invention is to provide a table reversing mechanism with an adjustable dwell control mechanism. Another object of the invention is to provide a table reversing mechanism with an adjustable dwell control mechanism whereby a variable dwell may be obtained at each end of the table stroke.

A further object of the invention is to provide a table driving and reversing mechanism having a reversing clutch and a stop and start clutch with a dwell control mechanism which controls the stop and start clutch at reversal to provide a predetermined table dwell which is independent of the action of the reversing clutch. Other objects will be in part obvious or in part pointed out hereinafter.

The invention accordingly consists in the features of construction, combinations of elements, and arrangements of parts, as will be exemplified in the structure to be hereinafter described, and the scope of the application of which will be indicated in the following claims.

In the accompanying drawings, in which is shown one of various possible embodiments of the mechanical features of the invention,

Fig. 1 is a front elevation of the improved grinding machine;

Fig. 2 is a fragmentary horizontal sectional view, on an enlarged scale, of the table reciprocating mechanism and the manually operable traversing mechanism;

Fig. 3 is a fragmentary vertical sectional view, on an enlarged scale, taken approximately on the line 3—3 of Fig. 1;

Fig. 4 is a fragmentary vertical sectional view, on an enlarged scale, through the reversing lever;

Fig. 5 is a fragmentary front elevation, on an enlarged scale, of the table controlling mechanism;

Fig. 6 is an electrical wiring diagram of the table dwell control mechanism;

Fig. 7 is a fragmentary longitudinal sectional view, on an enlarged scale, through the table reciprocating and reversing mechanism; and

Fig. 8 is a fragmentary cross-sectional view, on an enlarged scale, taken approximately on

the line 8—8 of Fig. 1, through the table reversing mechanism.

A grinding machine has been illustrated in the drawings, comprising a base 10 which supports a longitudinally reciprocable work supporting table 11 on the usual flat way 12 and V-way 13 for a longitudinal reciprocatory movement relative to the base 10. The work supporting table 11 is provided with a rotatable work support, comprising a headstock 14 and a footstock 15 which are provided with work supporting centers 16 and 17, respectively. The headstock 14 is preferably a motor driven headstock, in which an electric motor 18 is mounted on the upper surface of the headstock 14. The motor 18 is connected by a belt driving mechanism (not shown) contained within the belt guard 19 which serves to drive the headstock spindle (not shown), having a face plate 20 mounted on its opposite end. The face plate 20 is provided with an adjustable work driving pin or stud 21 which is arranged drivingly to engage either a projection of the work piece or a work driving dog which is clamped adjacent to the left-hand end of a work piece.

The base 10 also serves as a support for a transversely movable wheel slide 25 which is arranged to move transversely relative to the base on the usual well known V-way and flat way (not shown). The wheel slide 25 rotatably supports a wheel spindle 26 in suitable bearings (not shown) which serves as a support for a grinding wheel 27. The grinding wheel 27 and its supporting spindle 26 are preferably motor driven by means of an electric motor 28 mounted on the upper surface of the wheel slide 25. The motor 28 is connected by a belt driving mechanism (not shown) contained within a belt guard 29. The wheel slide 25 may be fed transversely relative to the base 10 by the usual and well known nut and screw feed mechanism which may be actuated either manually or by power through a manually operable feed wheel 30 mounted on the front of the machine base.

A table reciprocating and wheel feeding mechanism is supported within a casing or apron 31 which is fixed to the front of the machine base 10. This apron 31 contains a power operated table reciprocating mechanism, a manually operable table traverse mechanism, and a wheel feeding mechanism.

The table 11 may be traversed longitudinally by means of a manually operable mechanism, comprising a rack bar 35 depending from the under side of the table 11. The rack bar 35

meshes with a gear 35 which is supported on a shaft 37 journaled in bearings 38 and 39 (Fig. 8) which are in turn fixedly supported within the casing 31. The shaft 37 also carries a worm gear 40 which meshes with a rotatable worm 41. The worm 41 is journaled in bearings 42 and 43 in the housing or apron 31. A manually operable traverse wheel 44 which is mounted on the outer end of a shaft 45 is provided. The shaft 45 carries a gear 46 which meshes with a gear 47 carried by a rotatable shaft 48. The gear 47 meshes with a gear 49 which is rotatably supported on a shaft 50. The gear 49 is provided with an integrally formed clutch member 51. The clutch member 51 together with the gear 49 are journaled in an anti-friction bearing 52 carried by the apron 31. The rear end of the shaft 50 is supported by an anti-friction bearing 53. A bevel gear 54 is mounted on the rear end of the shaft 50 and meshes with a bevel gear 55 which is fixedly mounted on the worm shaft 41.

A clutch member 56 is slidably keyed to the shaft 50. In the position shown in Fig. 2, the clutch 56 is engaged with the clutch member 51 so that a rotary motion of the manually operable traverse wheel 44 is transmitted through the gear 46, the gear 47, the gear 49, through the clutch members 51-56, to rotate the shaft 50, and through the bevel gears 54 and 55 to rotate worm 41. The rotation of the worm 41 is transmitted through the worm gear 40, the shaft 37, the gear 36, and the rack bar 35, to produce a longitudinal traversing movement of the table 11. The direction of traversing movement of the table 11 is determined by the direction of rotation of the manually operable traverse wheel 44.

The clutch member 56 is arranged to be shifted automatically in a manner to be hereinafter described by means of a yoked member 57 which is provided with diametrically opposed studs 58 engaging a groove 59 formed in the clutch member 56. The yoked member 57 is supported on a rock shaft 60. A lever 61 is also fixedly supported on the rock shaft 60 and is arranged to be actuated automatically in a manner to be hereinafter described to render the manually operable traverse mechanism inoperative during power traverse of the table and vice versa.

A reversing mechanism is provided, comprising a pivotally mounted reversing lever 65 which is fixedly mounted on the outer end of a rock shaft 66 (Figs. 1 and 5). The reversing lever 65 is arranged to be shifted either in a clockwise or counterclockwise direction by means of a pair of adjustably mounted dogs 67 and 68 which are arranged in the path of a stud 69 carried by the reversing lever 65. The rock shaft 66 supports a downwardly extending arm 70 (Fig. 3) which is arranged to shift a yoke-shaped member 71 longitudinally when the reversing lever 65 is actuated by the table dogs 67 and 68. The yoke-shaped member 71 is arranged to straddle or engage a groove 72 formed in the periphery of a slidably mounted clutch member 73. The clutch member 73 is slidably keyed on a rotatable shaft 74 which is journaled in anti-friction bearings 75 and 76 (Fig. 7).

When the clutch member 73 is shifted toward the right (Fig. 7), it engages or meshes with clutch teeth 77 formed integral with a gear 78. The gear 78 is rotatably supported relative to the shaft 74 and meshes with a gear 79 which is keyed to or formed integral with a sleeve 80. The sleeve 80 is keyed to a reduced portion 81 of the

worm shaft 41. The outer end of the reduced portion 81 is supported by an anti-friction bearing 82.

When the clutch member 73 is shifted toward the left (Fig. 7), the clutch teeth on the left-hand end of the clutch member 73 are shifted into engagement with a set of clutch teeth 83 formed integral with a gear 84 which is in turn rotatably supported on the shaft 74. The gear 84 meshes with an idler gear 85 which in turn meshes with a gear 86 which is formed integral with the sleeve 80. It is readily apparent from the foregoing disclosure that when the clutch member 73 is shifted toward the left (Fig. 7), a rotary motion is transmitted by the shaft 74, through the clutch member 73, through the clutch teeth 83, the gear 84, the idler gear 85, and the gear 86, to rotate the sleeve 80 in the reverse direction.

A power operated driving mechanism is provided for rotating the shaft 74. This mechanism may comprise a change speed gear unit 90 which is fixedly mounted within the base 10 of the machine. Power is supplied to the change speed gear unit 90 by means of a driving belt 91 from any suitable source of power such as, for example, an electric motor mounted on the rear of the machine base 10. The driving belt 91 drivingly engages a pulley 92 mounted on the right-hand end of a rotatable shaft 93. The shaft 93 is journaled at one end in an anti-friction bearing 94 supported in the casing 90. The other end of the shaft 93 is journaled in a bearing 95 formed in the hollow end of a rotatable shaft 96. A clutch member 97 is slidably keyed on the shaft 93. A gear 98 is formed integral with the clutch member 97 and is arranged to be thrown into or out of mesh with a gear 99 which is keyed to the right-hand end of a rotatable shaft 100. The shaft 100 is journaled in anti-friction bearings 101 and 102, respectively, which are supported in the housing 90. A gear 103 is formed integral with the shaft 100 and meshes with a gear 104 which is keyed to the right-hand end of the shaft 96. The clutch member 97 is provided with clutch teeth 105 which are arranged to be thrown into or out of mesh with clutch teeth 106 formed integral with the gear 104.

It will be readily apparent from the foregoing disclosure that when the clutch member 97 is moved toward the left, the shaft 93 will be connected directly to rotate the shaft 96 at the same speed. If a reduced or slower speed is required on the shaft 96, the clutch member 97 may be moved toward the right (Fig. 7) to throw the gear 98 into mesh with the gear 99 so that the rotary motion of the shaft 93 is transmitted through the gear 98, the gear 99, the shaft 100, and the gear 103, to rotate the gear 104 and the shaft 96 at a reduced or slower speed. A manually operable clutch shifting lever 116 is provided on the front of the machine base. The lever 116 is operatively connected to actuate the clutch member 97 so that either a fast or a slow speed may be provided to traverse or reciprocate the work supporting table 11 at either a fast or a slow speed as desired.

The right-hand end of the shaft 96 is rotatably supported by an anti-friction bearing 107 (Fig. 7) carried by the casing 90. The other end of the shaft 96 is rotatably journaled in a bearing sleeve 108 formed in a hollow end portion of a rotatable shaft 109. The shaft 109 is journaled in an anti-friction bearing 110 supported in the casing 90. The shaft 109 serves as a support for a slidably

mounted clutch member 111 having clutch teeth 112 which are arranged to be thrown into or out of engagement with clutch teeth 113 formed on a clutch member 114. The clutch member 114 is fixedly mounted on the right-hand end of the shaft 74 (Fig. 7). The clutch member 111 together with its associated parts serves as a stop and start clutch whereby the reciprocatory movement of the work supporting table 11 may be stopped or started when desired. A manually operable clutch shifting lever 115 is pivotally mounted on the front of the machine base and is operatively connected to actuate the clutch member 111 to stop and start the table movement as desired.

The stop and start lever 115 is pivotally supported on a stud 117 which is supported by a bracket 118 fixedly mounted on the apron 31. The lower end of the lever 115 is connected by means of a stud 119 with the left-hand end of a slidably mounted plunger 120 (Fig. 3) which is journaled in a bearing 121 formed in the apron 31. The inner end of the plunger 120 is operatively connected by a stud 122 with a rock arm 123. The rock arm 123 is pivotally supported by a stud 124 which is fixedly mounted within the apron 31. The lower end of the rock arm 123 is provided with a transversely extending slot 125 within which fits a spherically shaped stud 126. The stud 126 is fixedly mounted to a pivotally mounted plate 127 which is in turn supported by a stud 128 (Figs. 2 and 5). The stud 128 is fixedly mounted within the apron 31. A yoke-shaped lever 130 is pivotally supported on a stud 131 (Fig. 3) which is fixed relative to the apron 31 and the base 10. The yoke-shaped lever 130 is provided with shoes 132 and 133 which are arranged to ride within a groove 134 formed in the periphery of the clutch member 111. The yoke-shaped lever 130 is provided with a downwardly extending arm 135 which supports a roller 136 at its lower end. The roller 136 is arranged in the path of a cam face 137 formed on the pivotally mounted plate 127.

It will be readily apparent from the foregoing disclosure that when the stop and start lever 115 is rocked in a clockwise direction into the position illustrated in Fig. 3, the plunger 120 will be moved toward the left, which movement serves to rock the rock arm 123 in a clockwise direction (Fig. 3). This movement of the rock arm 123 serves through the spherically shaped stud 126 to rock the plate 127 in a clockwise direction (Fig. 2) during which movement the cam face 137 engages the roller 136 and rocks the yoke-shaped lever 130 in a counterclockwise direction (Fig. 5) which movement shifts the stop and start clutch member 111 toward the right to disengage the same, thus stopping the traversing or reciprocating movement of the work supporting table 11.

A spring-pressed pivotally mounted latch member 138 is supported on a stud 139 carried by the lever 115. The latch member 138 is arranged to engage a latch pin 139a which is fixedly supported on the apron 31. The latch member 138 is yieldingly held in the position illustrated in Fig. 3 by means of a compression spring 140 and serves normally to hold the lever 115 in a position to hold the stop and start clutch 111 in a disengaged position so that the table is not moved by power. A tension spring 141 (Fig. 5) is connected between a stud on the yoke-shaped lever 130 and a stud which is fixed within the apron 31. The spring 141 serves normally to tend to

hold the stop and start clutch member 111 in an engaged position to reciprocate the table 11 by power. When the cam plate 127—137 moves into the positions illustrated in Figs. 2, 3 and 5, the yoke-shaped member 130 is moved against the tension of the spring 141.

When it is desired to start reciprocation of the table 11 by power, the operator grasps the knob at the upper end of the lever 115 so as to release the latch 138 and then swings the lever 115 in a counterclockwise direction (Fig. 3) which movement shifts the plunger 120 toward the right to rock the rock arm 123 in a counterclockwise direction. This movement of the rock arm 123 serves to rock the plate 127 in a counterclockwise direction (Fig. 2) so that the cam face 137 moves away from the roller 136, thus releasing the tension of the spring 141 which serves to throw the clutch member 111 toward the left (Figs. 2, 5 and 7) into an engaged position to start the power traverse or reciprocation of the work supporting table 11.

It is desirable to provide a suitable interlocking mechanism between the stop and start clutch 111 for actuating the table by power and the clutch 56 for engaging or disengaging the manually operable traverse wheel 44. The plate 127 (Fig. 2) is provided with a rearwardly projecting arm 145 which is connected by a stud 146 with one end of a connecting rod 147. The other end of the connecting rod 147 is pivotally connected by a stud 148 with the arm 61 (Fig. 2) which actuates the clutch member 56 for rendering operative or inoperative the manually operable hand wheel 44. In the position of the parts as shown in Fig. 2, the power traverse mechanism is disengaged, that is, the stop and start clutch 111 is shifted to its right-hand disengaged position and the clutch member 56 is engaged with the clutch teeth 51 so that the manually operable hand traverse wheel 44 is rendered operative. In this position of the parts, the table 11 may be traversed longitudinally by rotation of the manually operable traverse wheel 44, and the direction of movement of the table 11 is determined by the direction of rotation of the hand wheel 44.

When it is desired to start the power traverse or reciprocation of the table 11, the stop and start lever 115 is shifted from the position shown in Fig. 3 in a counterclockwise direction, which movement rocks the plate 127 (Fig. 2) also in a counterclockwise direction, thus releasing the tension of the spring 141 to throw the stop and start clutch member 111 into operative engagement so that power will be transmitted through the gear mechanism 90 to reciprocate the table 11. At the same time the plate 127 is moved in a counterclockwise direction, the connecting rod 147 is moved toward the left, which movement rocks the lever 61 and the yoked member 57 in a counterclockwise direction to throw the clutch member 56 upwardly (Fig. 2) into a disengaged position, thus automatically rendering the manually operable traverse wheel 44 inoperative during the power reciprocation of the table 11. Similarly, when the stop and start lever 115 is moved into the position illustrated in Fig. 3 to disengage the clutch 111, the rod 147 automatically shifts the lever 61 and the yoke 57 automatically to engage the clutch member 56 with the clutch teeth 51, thus automatically rendering the manual traverse wheel 44 operative.

The table reversing mechanism is provided with a load and fire mechanism whereby the reversing

clutch 73 is disengaged by movement of the table 11, after which the load and fire mechanism automatically shifts the clutch 73 into its reverse position. A spring-pressed, arrow-pointed plunger 155 is slidably mounted within the arm 70. A spring 156 of the compression type exerts a downward pressure on the plunger 155 to maintain it in operative contact with a rotatable roller 157 which is supported on a stud 158. The stud 158 is in turn fixedly supported on the apron 31. When the reversing lever 65 is shifted by the table dogs 67 or 68 to reverse the direction of movement of the table 11, the spring-pressed plunger 155 rides up the surface of the roller 157 which movement serves to further compress the spring 156. At the time the clutch 73 is disengaged, the plunger 155 has just passed over the high point on the roller 157, after which the released compression of the spring 156 rapidly throws the reversing clutch 73 into its reverse position.

A clutch member 160 which is slidably keyed on the shaft 96 serves when moved toward the left to throw the clutch teeth formed on the left-hand end of the clutch member 160 into engagement with clutch teeth 161 formed on the right-hand end of the shaft 103, so that the shaft 109 will be rotated directly by and at the same speed as the shaft 96. In this position of the parts, a gear 162 keyed to the shaft 109 meshes with a gear 163 fixedly mounted on a rotatable shaft 164. The shaft 164 is journaled in anti-friction bearings 165 and 166 in the gear casing 90. The shaft 164 also carries a spiral gear 167 (Fig. 7) which serves to transmit motion to actuate the grinding wheel feeding mechanism. The spiral gear 167 is operatively connected to rotate a crank plate 170 and thereby to transmit an oscillating movement to a feed pawl 171 which serves to produce an infrequent movement of the wheel slide 25 and the grinding wheel 27.

In grinding cylindrical work pieces where the traverse grinding method is employed, it is desirable to provide a suitable dwell control mechanism to maintain the work supporting table 11 stationary for a predetermined time interval at the ends of its reciprocatory stroke before it starts traversing in the reverse direction in order that the end portion of a work piece may rotate in operative grinding contact with the grinding wheel 27 so that the end portion of the work piece will be ground to the same extent that the center portion thereof is ground. In the preferred construction, a dwell control mechanism is provided which operates independently of the main table reversing clutch whereby the table may be caused to dwell for a predetermined time interval. The stop and start clutch 111 is utilized to control the table dwell at the ends of the reciprocatory stroke thereof. An electrical solenoid 170 (Fig. 3) is operatively connected by means of a stud 171 to an upwardly extending arm 172 which is formed integral with the yoked member 130. It will be readily apparent from the foregoing disclosure that when the solenoid 170 is energized, the arm 172 (Figs. 3 and 6) and the yoked member 130 will be rocked to move the clutch member 111 into a disengaged position, as shown in Fig. 7.

A suitable control mechanism is provided for maintaining the clutch 111 in a disengaged position for a desired predetermined interval. A normally open limit switch 175 is fixedly mounted within the apron 31 and is arranged to be automatically closed by a vertically movable plunger

176 which is actuated by a cam 177 carried by the rock shaft 66. It will be readily apparent from the foregoing disclosure that each time the reversing lever 65 is shifted by either the table dog 67 or the dog 68, the rocking movement thereof serves to throw the reversing clutch 73 into a disengaged position and at the same time the cam 177 causes a vertical movement of the plunger 176 to close the normally open switch 175. The limit switch 175 serves when closed to energize the solenoid 170 to shift the stop and start clutch 111 into a disengaged position. As shown in the wiring diagram (Fig. 6), electric power is supplied from a source, as indicated by the power lines 179. The power lines 179 are connected to the normally open limit switch 175 and also to the solenoid 170 and to an electric time delay relay 178. The time delay relay 178 may be any of the standard adjustable time delay relays such as, for example, that known as the Microflex electric time relay, as manufactured by the Signal Electric Corporation of Moline, Illinois.

The switch 175, solenoid 170 and electric time delay relay 178 are so interconnected that when the switch 175 is instantaneously closed during reversal, it serves to close a circuit to energize the solenoid 170 and at the same time to set the time relay 178 in motion. The energizing of the solenoid 170 disconnects the stop and start clutch 111, thus breaking the power connection to the table driving mechanism which remains disengaged for a predetermined time interval, as governed by the time relay 178. After the predetermined time interval has elapsed, the time relay 178 breaks the circuit to deenergize the solenoid 170, thus releasing the tension of the spring 141 (Fig. 5) which rapidly throws the stop and start clutch 111 into engagement to start the movement of the table 11 in the opposite direction. It will be readily apparent from the foregoing disclosure that the dwell control mechanism as above described in no way interferes with the normal operation of the reversing clutch 73 and functions independently thereof. By manipulation of the control knob of the time relay 178, a dwell of the desired and predetermined extent may be obtained at both ends of the table stroke.

The operation of this improved cylindrical grinding machine will be readily apparent from the foregoing disclosure. A work piece to be ground is placed in position on the work supporting centers 16 and 17. The headstock motor 18 and grinding wheel motor 23 are started to initiate the work rotation and the rotation of the grinding wheel 27, after which the driving belt 91 is set in motion and the grinding operation may then be started.

Assuming all of the adjustments to have been previously made, the manually operable stop and start lever 115 is shifted in a counterclockwise direction (Fig. 3) to throw the clutch 111 into engagement to start the reciprocatory movement of the table 11, after which the grinding wheel slide 25 and the grinding wheel 27 may be fed transversely into operative grinding engagement with the work piece. The table 11 traverses in a manner above described in one direction until either the dog 67 or the dog 68 engages the pin 69 carried by the reversing lever 65, and continued movement operates to swing the lever 65 so as to disengage and reverse the position of the table reversing clutch 73.

At the same time the table reversing clutch 73 is disengaged, the swinging movement of the reversing lever 65 operates through the cam 177

and the plunger 176 to close the normally open limit switch 175 to energize the solenoid 179, thereby disengaging the stop and start clutch 111 and at the same time setting the electric time relay 178 in motion. The table 11 dwells at the end of its reciprocatory stroke for a predetermined time interval to allow the grinding wheel to grind around the end portion of the work piece, as governed by the setting of the time delay relay 178. After the predetermined dwell interval has elapsed, the time relay 178 operates to break the circuit so as to deenergize the solenoid 179, thereby releasing the tension of the spring 141 which serves to shift the stop and start clutch 111 rapidly into engagement to start the table 11 moving in the reverse direction. It will be readily apparent from the foregoing disclosure that the time interval or dwell may be readily controlled by manual adjustment of the time relay 178.

The clutch member 111 is interconnected with the clutch 56 so that when the stop and start clutch 111 is in position for driving the table 11 by power, the clutch 56 will be disengaged, thus rendering the manually operable traverse wheel 44 inoperative. Similarly, when the stop and start clutch 111 is moved to a disengaged position, the clutch 56 will be automatically shifted into an engaged position so that the table 11 may be manually traversed and adjusted by rotation of the manually operable traverse wheel 44.

It will thus be seen that there has been provided by this invention apparatus in which the various objects hereinabove set forth together with many thoroughly practical advantages are successfully achieved. As many possible embodiments may be made of the above invention and as many changes might be made in the embodiment above set forth, it is to be understood that all matter herein set forth or shown in the accompanying drawings is to be interpreted as illustrative and not in a limiting sense.

We claim:

1. In a grinding machine having a base, a longitudinally reciprocable table thereon, means including a reversing lever and clutch to reciprocate said table, a driving mechanism including a start and stop clutch to drive said reversing clutch and table, and means actuated automatically in timed relation with movement of said reversing lever to disengage said start and stop clutch during table reversal for a predetermined period of dwell.

2. In a grinding machine having a base, a longitudinally reciprocable table, means including a reversing lever and clutch to reciprocate said table, a driving mechanism including a stop and start clutch to drive said reversing clutch and table, means actuated automatically by said reversing lever to disengage said stop and start clutch during table reversal, and means automatically to engage said start and stop clutch after a predetermined time interval.

3. In a grinding machine having a base, a longitudinally reciprocable table, means including a reversing lever and clutch to reciprocate said table, a power operated driving mechanism including a start and stop clutch to drive said reversing clutch and table, and an electrically actuated dwell control mechanism which is actuated by and in timed relation with movement of said reversing lever to disengage said start and stop clutch for a predetermined time interval.

4. In a grinding machine having a base, a longitudinally reciprocable table, means including a

reversing lever and clutch to reciprocate said table, a driving mechanism including a start and stop clutch to drive said reversing clutch and table, means including a control lever to engage said start and stop clutch, a solenoid operatively connected to disengage said start and stop clutch, and means including a switch actuated by and in timed relation with movement of said reversing lever to energize said solenoid so as to disengage said start and stop clutch for a predetermined time interval.

5. In a grinding machine having a base, a longitudinally reciprocable table, means including a reversing clutch to reciprocate said table, a table actuated reversing lever and a load and fire mechanism automatically to shift said reversing clutch into a reverse position at the ends of the table stroke, a driving mechanism including an independent start and stop clutch to drive said reversing clutch and table, means including a control lever to engage said start and stop clutch, a solenoid operatively connected to disengage said start and stop clutch during the period of reversal, means including a switch actuated by and in timed relation with movement of said reversing lever to energize said solenoid to disengage said stop and start clutch, and means including an electrical time delay relay which is set in motion by the switch to deenergize the solenoid after a predetermined time interval automatically to engage said start clutch to start the table in the reverse direction after a predetermined period of dwell.

6. In a grinding machine having a base, a longitudinally reciprocable table, means including a reversing lever and clutch to reciprocate said table, a driving mechanism including a start and stop clutch to drive said reversing clutch and table, yieldable means normally to maintain said clutch engaged, a cam operatively connected to disengage said clutch, a control lever to actuate said cam, a manually operable table traverse mechanism, a clutch interposed between said mechanism and the table, and operative connections between said cam and said latter clutch automatically to render said manual traverse mechanism operative when said cam is moved to disengage said start and stop clutch.

7. In a grinding machine having a base, a longitudinally reciprocable table, means including a reversing lever and clutch to reciprocate said table, a driving mechanism including a start and stop clutch to drive said reversing clutch and table, a spring normally to maintain said clutch engaged, a cam operatively connected to disengage said clutch, a control lever to actuate said cam, a manually operable table traverse mechanism having a clutch interposed between the mechanism and the table, and operative connections between said cam and said latter clutch automatically to render said manual traverse mechanism inoperative when said cam is moved to engage said stop and start clutch.

8. In a grinding machine having a base, a longitudinally reciprocable table, means including a reversing clutch to reverse the movement of the table, a table actuated reversing lever to actuate said clutch, a load and fire mechanism to shift said reversing clutch rapidly into a reverse position, a driving mechanism including an independent stop and start clutch to drive said reversing clutch and table, a manually operable lever to actuate said start and stop clutch, and an automatic dwell control therefor including a solenoid operatively connected to disengage said

start and stop clutch, an adjustable electric time relay operatively connected therewith, and a limit switch actuated by movement of said reversing lever which is operatively connected to energize said solenoid and simultaneously to start the time relay to disengage said stop clutch to cause a predetermined dwell at the end of the table stroke,

said relay being arranged after a predetermined time interval to deenergize said solenoid, thereby engaging said stop clutch to start the table in the reverse direction.

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