April 13, 1954 H. A. SILVEN ET AL 2,674,831

GRINDING MACHINE

Filed May 7, 1952 6 Sheets-Sheet 1

FIG. 1

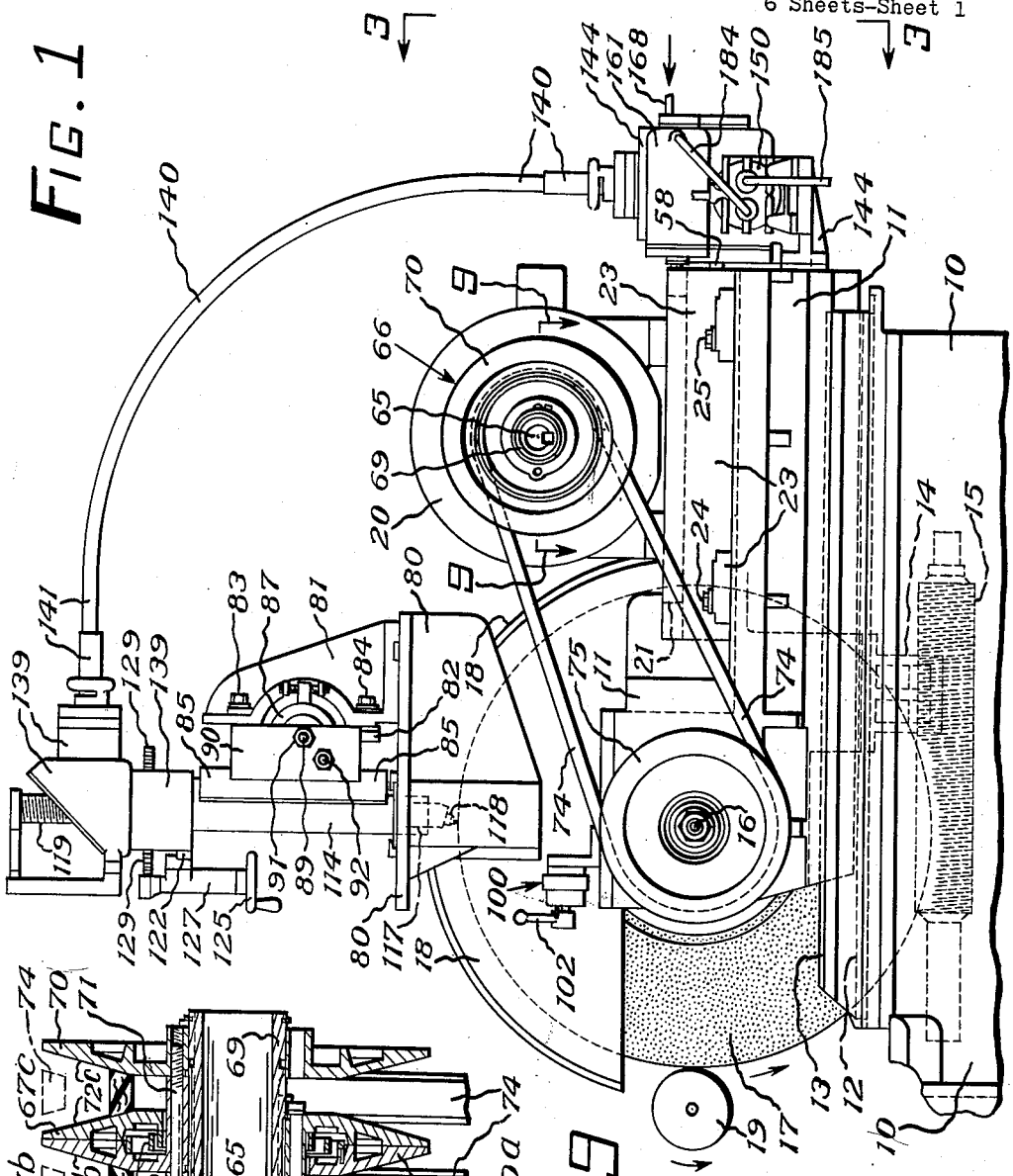
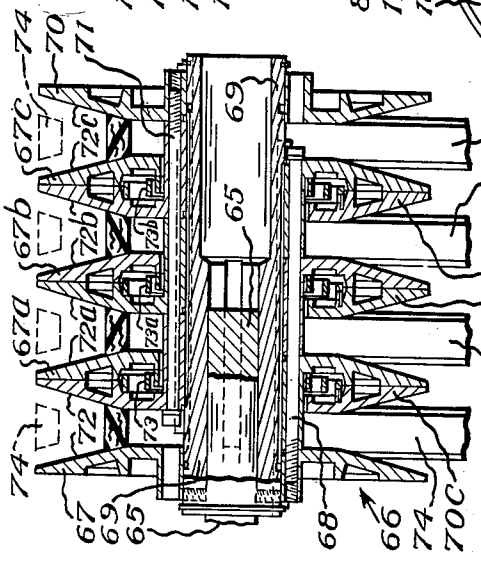


FIG. 9



Inventors
HERBERT A. SILVEN
STEWART S. MADER
By Harold W. Eaton
Attorney

April 13, 1954 H. A. SILVEN ET AL 2,674,831

GRINDING MACHINE

Filed May 7, 1952 6 Sheets-Sheet 2

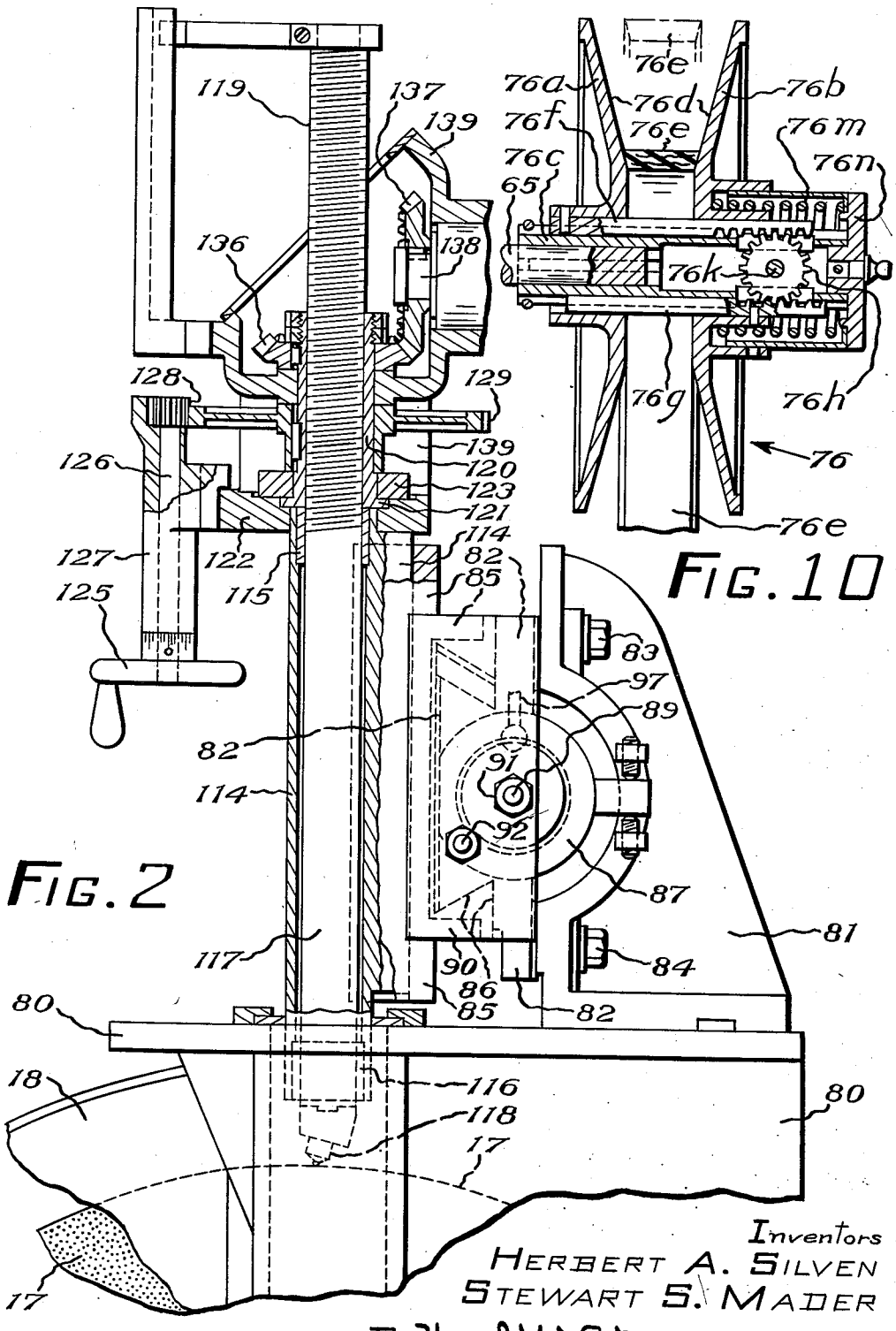


FIG. 2

FIG. 10

Inventors
HERBERT A. SILVEN
STEWART S. MADER
By Harold W. Eaton Attorney

April 13, 1954 H. A. SILVEN ET AL 2,674,831

GRINDING MACHINE

Filed May 7, 1952 6 Sheets-Sheet 3

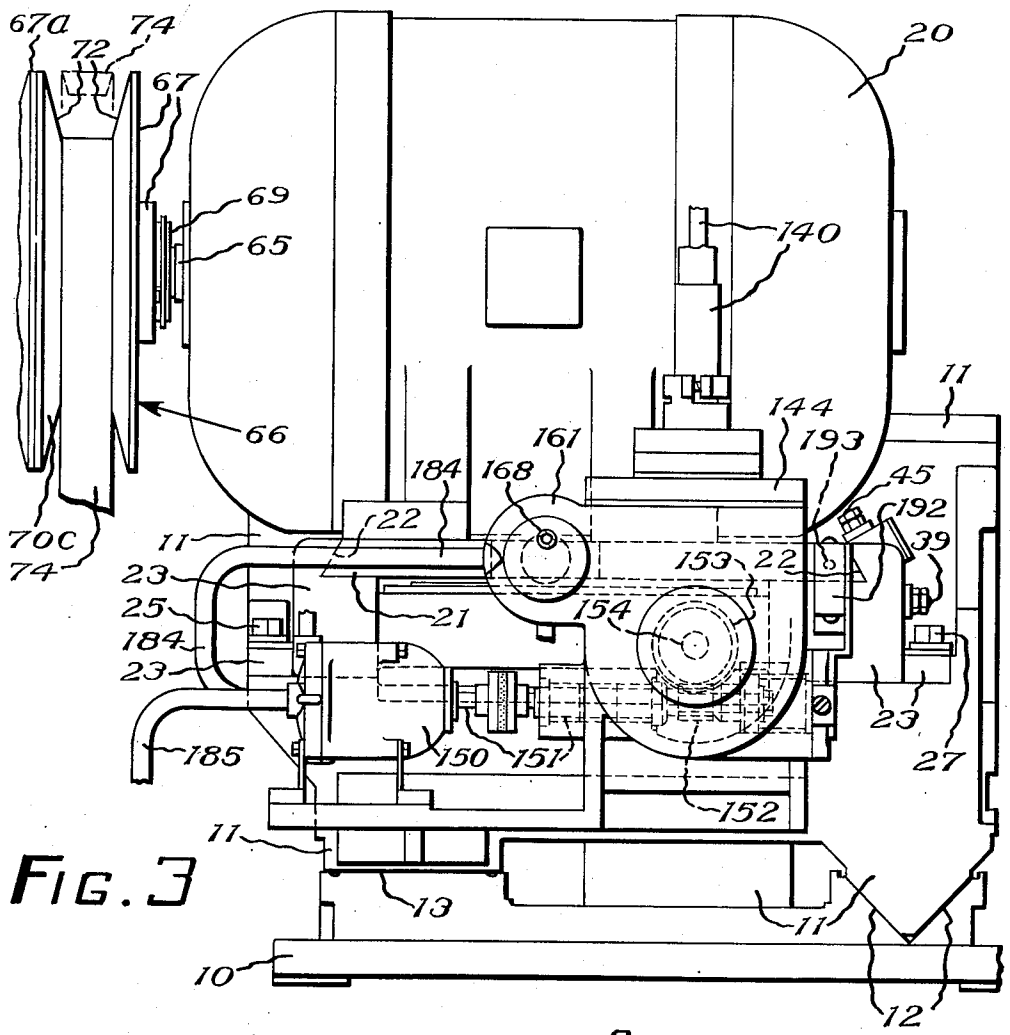


FIG. 3

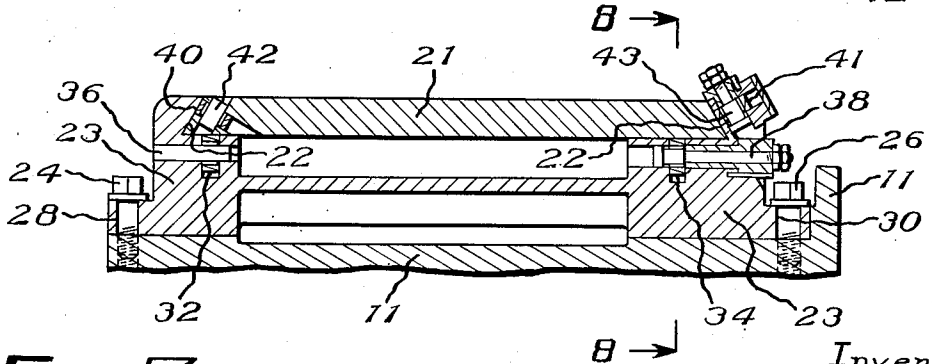


FIG. 7

Inventors
HERBERT A. SILVEN
STEWART S. MADER
By Harold W. Eaton Attorney

April 13, 1954 H. A. SILVEN ET AL 2,674,831

GRINDING MACHINE

Filed May 7, 1952 6 Sheets-Sheet 4

FIG. 4

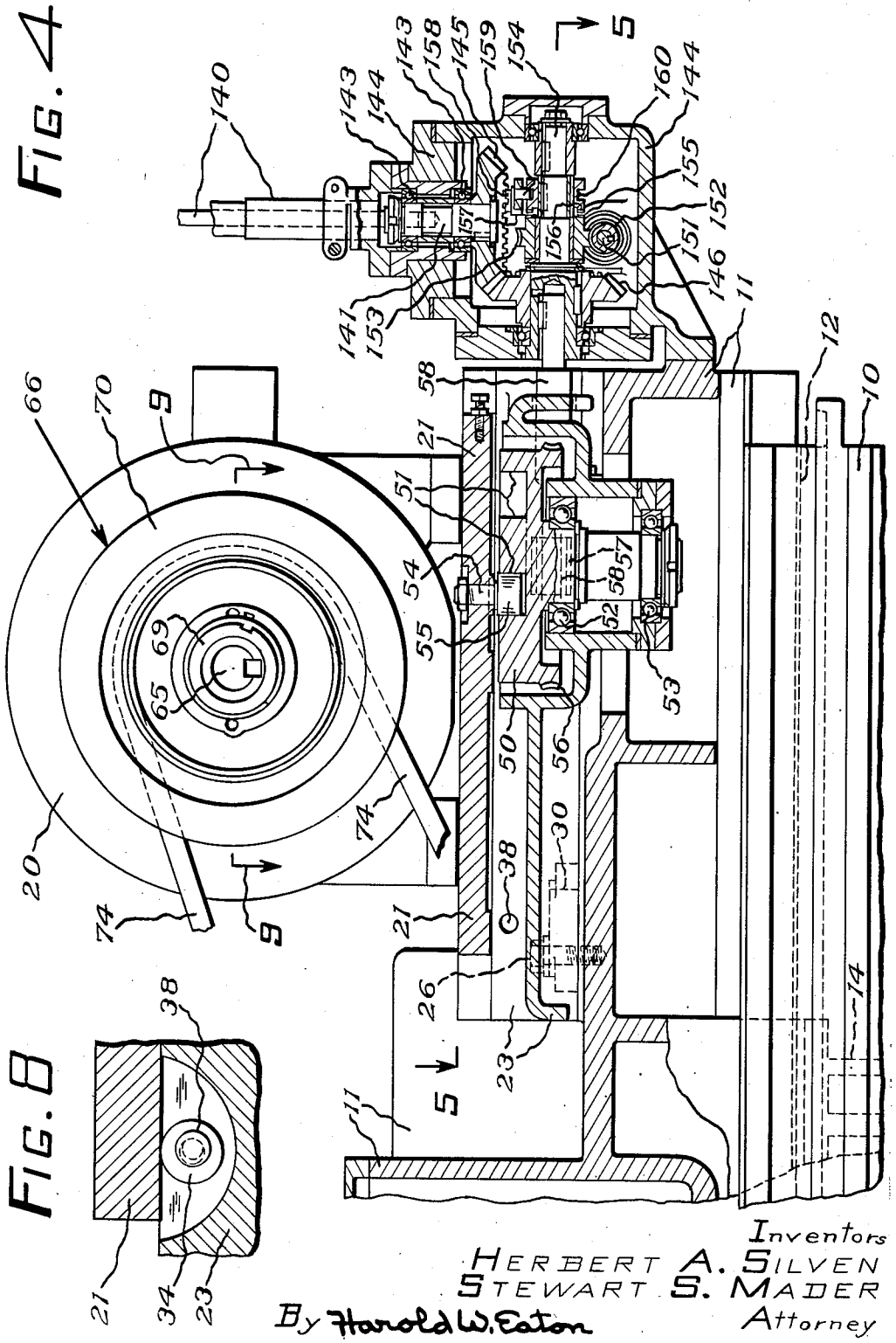


FIG. 8

Inventors
HERBERT A. SILVEN
STEWART S. MADER
By Harold W. Eaton
Attorney

April 13, 1954 H. A. SILVEN ET AL 2,674,831

GRINDING MACHINE

Filed May 7, 1952 6 Sheets-Sheet 5

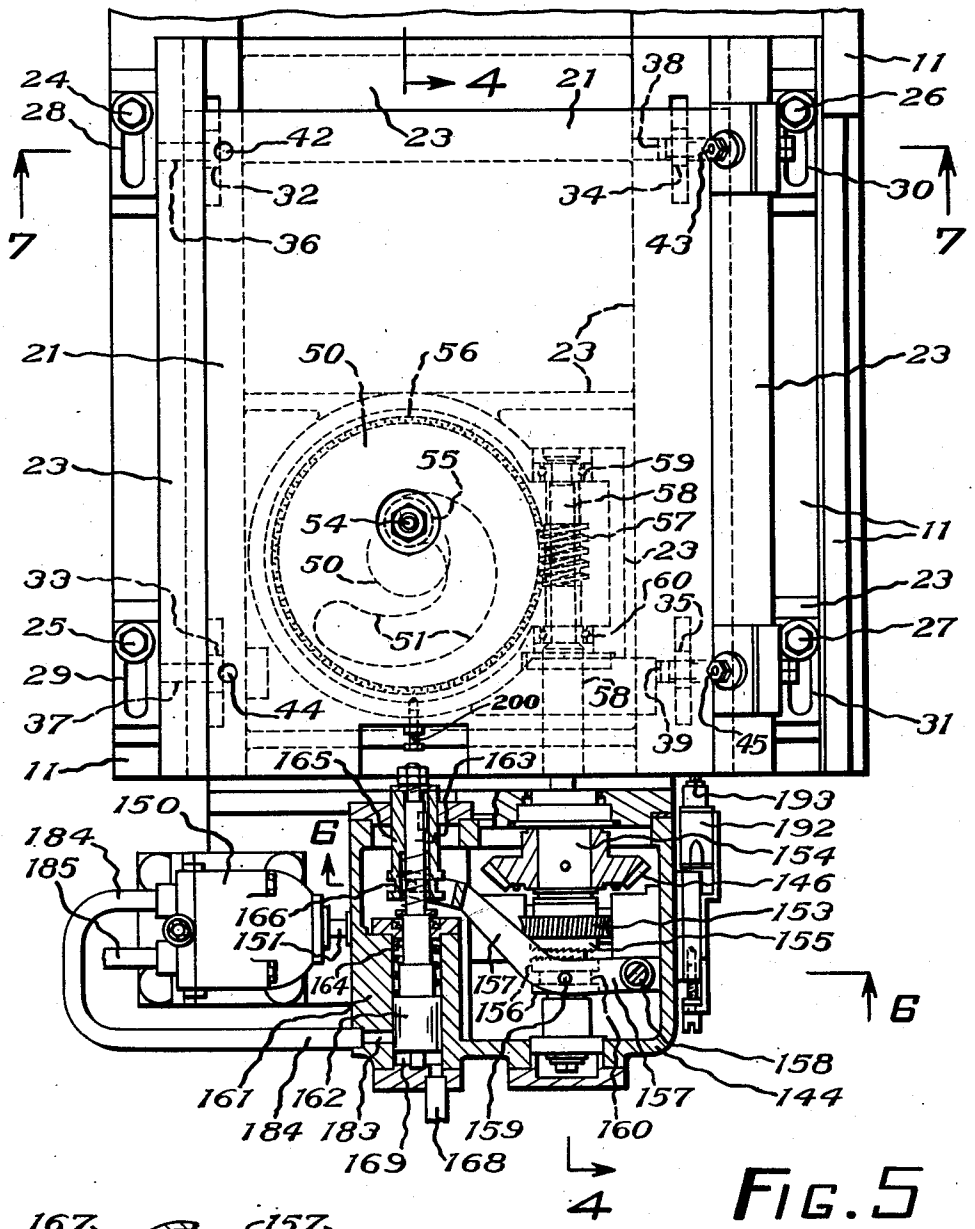


FIG. 5

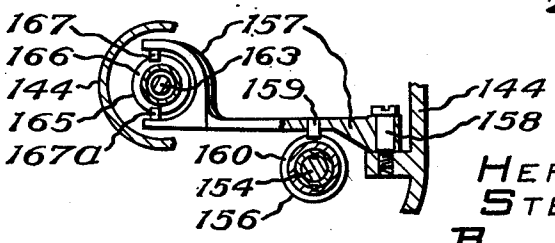


FIG. 6

Inventors

HERBERT A. SILVEN

STEWART S. MADER

By Harold W. Eaton

Attorney

April 13, 1954 H. A. SILVEN ET AL 2,674,831

GRINDING MACHINE

Filed May 7, 1952 6 Sheets-Sheet 6

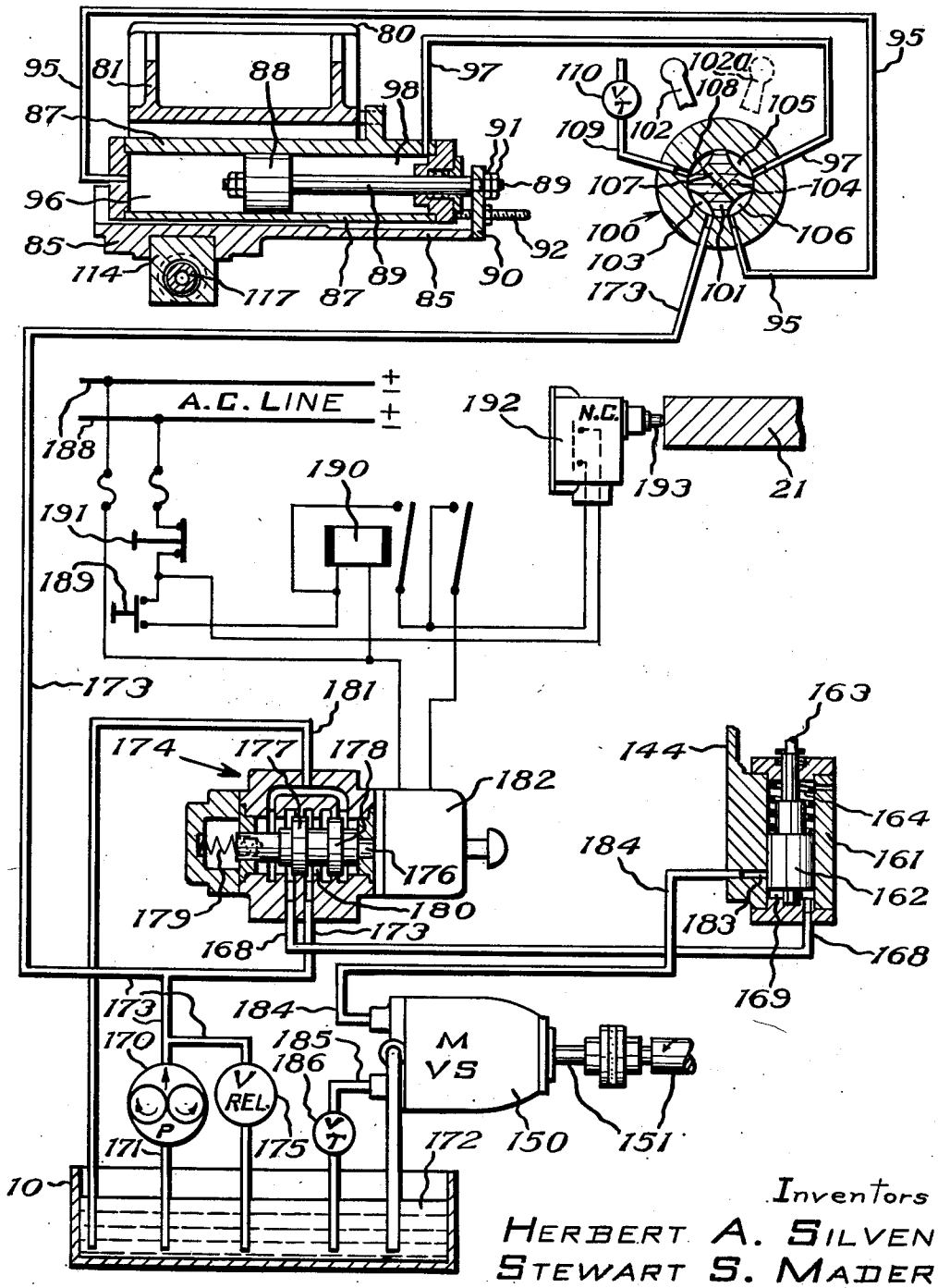


FIG. 11

Inventors
HERBERT A. SILVEN
STEWART S. MAIER

By Harold W. Eaton
Attorney

Patented Apr. 13, 1954

2,674,831

UNITED STATES PATENT OFFICE

2,674,831

GRINDING MACHINE

Herbert A. Silven and Stewart S. Mader, Worcester, Mass., assignors to Norton Company, Worcester, Mass., a corporation of Massachusetts

Application May 7, 1952, Serial No. 286,472

8 Claims. (Cl. 51—5)

1

This invention relates to grinding machines, and more particularly to a grinding wheel speed control device automatically to maintain a uniform peripheral speed of the grinding wheel.

One object of the invention is to provide a simple and thoroughly practical grinding wheel speed control mechanism automatically to maintain a substantially constant peripheral speed on the grinding wheel as it wears away. Another object is to provide an automatically actuated V-belt wheel driving mechanism for varying the speed of rotation of a grinding wheel spindle so as to maintain a substantially constant peripheral speed of the wheel as it wears away. Another object is to provide an automatically actuated mounting for the wheel driving motor arranged to facilitate varying the distance between the axis of the motor shaft and the wheel spindle so as to vary the speed of the spindle. Another object is to provide a driving connection between the truing tool feeding mechanism and the motor mount actuating mechanism automatically to increase the speed of the wheel spindle so as to maintain a substantially constant peripheral speed of the grinding wheel as it wears away. Other objects will be in part obvious or in part pointed out hereinafter.

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

Figure 1 is a fragmentary side elevation of a grinding machine, showing the grinding wheel driving mechanism, the truing apparatus, and the driving connection for adjusting the speed of rotation of the grinding wheel;

Figure 2 is a vertical sectional view, on an enlarged scale, of the truing apparatus feeding mechanism, and the driving connection for adjusting the speed control;

Figure 3 is a fragmentary rear elevation, on an enlarged scale of the parts shown in Figure 1;

Figure 4 is a fragmentary vertical sectional view, on an enlarged scale, taken approximately on the line 4—4 of Figure 5, of the mechanism for adjusting the position of the wheel driving motor to facilitate varying the speed of rotation of the grinding wheel;

Figure 5 is a horizontal sectional view, taken approximately on the line 5—5 of Figure 4, showing the mechanism for adjusting the position of the wheel driving motor;

Figure 6 is a fragmentary sectional view taken approximately on the line 6—6 of Figure 5;

Figure 7 is a vertical sectional view, taken approximately on the line 7—7 of Figure 5, through the motor supporting platen;

2

Figure 8 is a fragmentary sectional view, on an enlarged scale, taken approximately on the line 8—8 of Figure 7, through one of the roller supports for the motor platen;

Figure 9 is a cross sectional view on an enlarged scale, taken approximately on the line 9—9 of Figure 1, through the variable speed motor pulley;

Figure 10 is a cross sectional view, through a modified variable speed motor pulley; and

Figure 11 is a combined hydraulic and electrical diagram of the actuating mechanism and the controls therefor.

A grinding machine has been illustrated in drawings comprising a base 10 which serves as a support for a rotatable work support (not shown). The base 10 serves as a support for a transversely movable wheel slide 11 which is arranged to slide transversely on V-way 12 and flatway 13 on the upper surface of the base 10.

A suitable feeding mechanism is provided for causing a transverse feeding movement of the wheel slide 11 relative to the base 10 comprising a half nut 14 depending from the under side of the wheel slide 11. The half nut 14 meshes with or engages a rotatable feed screw 15 which is rotatably supported by the base 10. The feed screw 15 may be actuated by any of the well known conventional feeding mechanisms. The feeding mechanism above described serves to facilitate a tranverse feeding movement of the grinding wheel 17 to grind a rotatably mounted cylindrical work piece 19. The work piece 19 is supported for rotation by a conventional type head stock and foot stock (not shown), such as, for example that shown in the expired U. S. patent to C. H. Norton No. 762,838, dated June 14, 1904, to which reference may be had for details of disclosure not contained herein.

The wheel slide 11 serves as a support for a rotatable wheel spindle 16 which is journalled in spaced bearings (not shown). The spindle 16 supports a grinding wheel 17 on its left hand end, (Fig. 2). The grinding wheel 17 is partially surrounded by a wheel guard 18 which is adjustably fastened to the wheel slide 11.

The wheel spindle 16 and grinding wheel 17 are driven by an electric motor 20 which is mounted on a transversely adjustable platen 21 supported by dovetailed slide-ways formed on the upper surface of a motor base 23. The motor base 23 is adjustably mounted on the upper surface of the wheel slide 11 by means of a plurality of screws 24, 25, 26 and 27 which pass through elongated slots 28, 29, 30 and 31 formed in the motor base 23 and are screw threaded into the wheel slide 11.

A roller support is provided between the motor

base 23 and the platen 21 comprising a plurality of rollers 32, 33, 34, and 35 each is supported by horizontally arranged studs 36, 37, 38 and 39 respectively. A plurality of rollers 40 and 41 are supported by the platen 21 and rotate on a plurality of studs 42, 43, 44 and 45 respectively which are arranged so that their axes are parallel with the dovetailed surface of the slide-way 22.

The platen is arranged so that it may be adjusted automatically relative to the wheel slide 11 to facilitate adjusting the position of the motor 20 so as to vary the speed of the wheel spindle 16 and the grinding wheel 17 in a manner to be hereinafter described. The motor base 23 supports a rotatable member 50 having a cam 51 formed in its upper plane face. The member 50 is supported by spaced anti-friction bearings 52 and 53 which are carried by the motor base 23. The platen 21 is provided with a vertically arranged downwardly projecting stud 54 having a follower roller 55 rotatably supported on its lower end which rides within the cam 51. A driving mechanism is provided for the member 50 comprising a worm gear 56 formed integrally therewith. The worm gear 56 meshes with a worm 57 which is mounted on a horizontally arranged rotatable shaft 58 (Fig. 5). The shaft 58 is journalled in spaced bearings 59 and 60 carried by the motor base 23.

A driving mechanism is provided between a motor shaft 65 on the motor 20 and the wheel spindle 16 which is arranged so that the speed of the wheel spindle 16 may be automatically varied to maintain a substantially constant peripheral speed on the grinding wheel 17 as it is reduced in diameter due to wheel wear and successive truing operations. This driving mechanism may comprise an automatic variable pitch motor pulley 66, such as, manufactured by Allis-Chalmers Mfg. Co., under U. S. Patent No. 2,262,197 to E. Otto et al. dated November 11, 1941, to which reference may be had for details of disclosures not contained herein. The pulley may be a multiple V-groove pulley 66, as shown in Fig. 9 comprising a plurality of pulley flanges 67, 67*a*, 67*b* and 67*c* which are keyed together by means of a tie-rod 68 which is carried by a sleeve 69. A plurality of pulley flanges 70, 70*a*, 70*b* and 70*c* are slidably mounted on the sleeve 69 and held together by means of a tie-rod 71. The pulley flanges 67 and 70 are arranged to form a plurality of variable V-grooves 72, 72*a*, 72*b* and 72*c*. A plurality of compression springs 73, 73*a* and 73*b* are interposed between pulley flanges 70*c*—67*a*, 70*b*—67*b* and 70*a*—67*c* to facilitate movement of the flanges to vary the size of the V-grooves 72, 72*a*, 72*b* and 72*c*. The pulley 66 is connected by multiple V-belts 74 with a multiple V-groove pulley 75 mounted on the end of the wheel spindle 16. As illustrated in the drawings, the motor supporting platen 21 is shown in a rearward position so that the pulley grooves 72, 72*a* and 72*b* and 72*c* are expanded so that the V-belt 74 rides in the grooves adjacent to the bottom thereof. It will be readily apparent that as the motor platen 21 is adjusted toward the wheel spindle in a manner to be hereinafter discussed, the center distance between the motor shaft 65 and the wheel spindle 16 will be shortened thereby allowing the compression springs 73*a* and 73*b* to expand thereby reducing the size of the V-grooves 72, 72*a*, 72*b* and 72*c* so that the driving belts ride higher up in the V-grooves thereby increasing the effective diameter of the driving pulley 66 to increase rotative speed of the grinding wheel spindle 16 and the grinding wheel 17. This movement may continue until the V-belts 74 ride within the grooves adjacent to the outer periphery of the pulley flanges 67 and 70.

If desired a single V-belt drive may be utilized comprising a single V-groove pulley 76 which is mounted on the motor shaft 65 (Fig. 10). This pulley may be a "Roto-Cone" variable pitch motor pulley, such as manufactured by Gerbing Mfg. Corp. of Northbrook, Illinois, under U. S. Patents No. 2,475,954 and No. 2,475,955 to W. E. Gerbing dated July 12, 1949 to which reference may be had for details of disclosure not contained herein. The pulley 76 may comprise a pair of pulley flanges 76*a* and 76*b* which are slidably mounted on a sleeve 76*c* supported by the motor shaft 65. The flanges 76*a* and 76*b* have inner frustoconical surfaces 76*d* forming a V-groove which is engaged by a single V-belt 76*e*. The pulley flanges 76*a* and 76*b* are arranged to move toward and from each other to vary the size of the V-groove 76*d*. A rack bar 76*f* is fixedly connected to the pulley flange 76*a*. A rack bar 76*g* is connected to the pulley flange 76*b*. The rack bars 76*f* and 76*g* mesh with a gear 76*h* which is rotatably supported by a stud 76*k* carried by the sleeve 76*c*. A compression spring 76*m* is interposed between a flange 76*n* carried by the sleeve 76*c* and hub portion of the pulley flange 76*b*. It will be readily apparent from the foregoing disclosure that as the center distance is changed between the motor shaft 65 and the wheel spindle 16, the compression of the spring 76*m* will serve through the mechanism above described to simultaneously adjust the position of the pulley flanges 76*a* and 76*b*. As illustrated in the drawings the single V-belt 76*e* is riding at the bottom of the V-groove 76*d* when the motor platen 21 is in a rearward position. As the motor platen 21 is adjusted transversely toward the wheel spindle, the compression of the spring 76*m* will serve to decrease the size of the V-groove 76*b* so that the V-belt 76*e* rides higher in the V-groove thereby increasing the speed of rotation of the wheel spindle 16 and the grinding wheel 17.

Wheel guard 18 serves as a support for a housing 80 having an upper plane surface which supports a bracket 81. The bracket 81 is arranged to support a grinding wheel truing apparatus. A slide base 82 is fixedly supported on the bracket 81 by means of a plurality of clamping screws 83 and 84. The slide base 82 serves as a support for longitudinally traversable slide 85 which is arranged to slide longitudinally on a dovetailed slide-way 86 formed on the slide base 82.

A hydraulically operated mechanism is provided for traversing the slide 85 longitudinally comprising a hydraulic cylinder 87 which contains a slidably mounted piston 88. The piston 88 is connected to the left hand end of a piston rod 89 (Fig. 11), the other end of which is fastened to an end cap 90 fixedly mounted on the end of the longitudinally movable slide 85. A pair of nuts 91 serve to lock the piston rod 89 to the end cap 90. The end cap 90 carries an adjustable stop screw 92 which is arranged in the path of the end of the cylinder 87 to facilitate limiting movement of the slide 85 toward the left. When fluid under pressure is passed through a pipe 95 into a cylinder chamber 96, the piston 88 together with slide 85 will be moved

toward the right (Fig. 11). During this movement of the piston 88, fluid within a cylinder chamber 98 may exhaust through a pipe 97.

A suitable control mechanism is provided for controlling the admission to and exhaust of fluid from the cylinder 87 comprising a rotary type reversing valve 100 having a valve rotor 101 which may be manually actuated by a control lever 102. When fluid under pressure is passed through a pipe 173 from a motor driven fluid pump 170, it passes into a valve chamber 103, through a traverse passage 104 formed in the valve rotor 101 into a valve chamber 105 and through the pipe 97 into the cylinder chamber 98 to cause the piston 88 to move toward the left (Fig. 11). This movement of the piston 88 and the slide 85 toward the left continues until the stop screw 92 engages the right hand end of the cylinder 87. During movement of the piston 88 toward the left fluid within the cylinder chamber 96 may exhaust through the pipe 95 into a valve chamber 106, through a transverse passage 107 in the valve rotor 101, into a valve chamber 108 and out through an exhaust pipe 109 and through a throttle valve 110. By manipulating of the throttle 110, the speed of movement of the piston 88 and the longitudinally movable slide 85 may be readily varied as desired.

When it is desired to reverse the direction of the movement of the slide 85 and the piston 88, the control lever 102 is moved in a clockwise direction into the dotted line position 102a (Fig. 11) which movement shifts the valve rotor so that fluid under pressure from the pipe 173 passes into the valve chamber 106, through the pipe 95 into the cylinder chamber 96 to move the piston 88 and the slide 85 toward the right. During this movement fluid within the cylinder chamber 98 may exhaust through the pipe 97 into the valve chamber 105, through the passage 104 into the valve chamber 103 and out through the exhaust pipe 109 and the throttle valve 110.

The longitudinally movable slide 85 serves as a support for a vertically arranged housing 114. The housing 114 is provided with a pair of spaced bearings 115 and 116 which support a vertically arranged truing tool carrier 117 having a truing tool 118 mounted at its lower end.

A suitable feeding mechanism is provided for feeding the carrier 117 vertically in either direction relative to the slide 85. This mechanism may comprise a nut and screw feeding mechanism in which a screw threaded portion 119 is provided on the carrier 117. A rotatable nut 120 meshes with or engages the threaded portion 119. The nut 120 is provided with an integral flange 121 which is rotatably supported on the housing 114 by a pair of plates 122 and 123.

A manually operable feed wheel 125 is mounted on the lower end of a vertically arranged rotatable shaft 126 which is rotatably supported within a housing 127. The housing 127 is fixedly mounted relative to the housing 114. The upper end of the shaft 126 is provided with a pinion 128 which meshes with a gear 129 keyed on the outer periphery of the nut 120. It will be readily apparent from the foregoing disclosure that a rotary motion of the hand wheel 125 will be imparted through the mechanism above described to rotate the nut 120 and thereby impart a vertical movement to the truing tool carrier 117 and the truing tool 118. The direction of movement of the hand wheel 125 serves to determine the direction of the movement of the carrier 117.

In order to attain one of the main objects of the invention, it is desirable to actuate the cam 51 automatically by and in timed relation with the operating mechanisms of the machine to increase the rotative speed of the grinding wheel 17 so as to maintain the peripheral face thereof at a substantial uniform speed as the wheel wears away due to wheel wear and truing. In the preferred form, the cam 51 is preferably connected to be actuated by and in timed relation with the truing apparatus feeding mechanism. As illustrated in the drawings a beveled gear 136 is keyed to the nut 120. The beveled gear 136 meshes with a beveled gear 137 which is carried by a rotatable shaft 138. The shaft 138 is rotatably mounted in a housing 139 and is connected to one end of a flexible driving shaft 140. The other end of the flexible driving shaft 140 is connected to a rotatable shaft 141 which is journalled in spaced bearings 143 and supported within a housing 144. The housing 144 is supported on the rear end of the wheel slide 11. The shaft 141 carries a beveled gear 145 (Fig. 4) which meshes with a beveled gear 146 which is keyed on the left hand end of a shaft 154. The shaft 154 is in turn keyed to the right hand end of the worm shaft 58. It will be readily apparent from the foregoing disclosure that when the feed wheel 125 is rotated to cause a down feeding movement of the truing tool carrier 117 and a truing toool 118, a rotary motion will be imparted to the cam 51 through the mechanism above described to cause a transverse movement of the motor platen 21 relative to the wheel slide 11. The transverse movement of the platen 21 serves to shorten the distance between the axis of the motor shaft 65 and the axis of the wheel spindle 16 thereby allowing the released compression of the springs within the pulley 66 to narrow the V-grooves 72 of the pulley and thereby cause the V-belts 74 to ride upon a larger diameter of the grooves 72 so as to increase the rotative speed of the wheel spindle 16 to maintain a substantially uniform peripheral speed on the grinding wheel 17 as it wears away.

After the wheel 17 has been worn to a predetermined smaller diameter, however, it is necessary to replace the wheel with a larger diameter wheel and at the same time to reset both the truing tool 118 and the platen 21 into their initial positions. This is preferably accompanied by means of a fluid pressure actuated mechanism comprising a fluid motor 150 mounted on the rear end of the wheel slide 11. The fluid motor 150 is provided with a drive shaft 151 which has a worm 152 keyed thereon. The worm 152 meshes with a worm gear 153 rotatably mounted on a shaft 154 which is keyed to the worm shaft 58. The worm gear 153 has a clutch member 155 fixedly mounted thereon. A clutch member 156 is slidably keyed on the shaft 154 and is arranged so that it may be thrown into or out of engagement with the clutch member 155. A clutch shift lever 157 is pivotally mounted on a stud 158 carried by the housing 144. The clutch lever 157 is provided with a pin 159 which rides in a groove 160 formed in the periphery of the clutch member 156. It will be readily apparent from the foregoing disclosure that when the clutch shift lever 157 (Fig. 5) is rocked in a clockwise direction, the clutch member 156 will be moved into engagement with the clutch member 155 so that a rotary motion of the fluid motor shaft 151 will be transmitted to rotate the shaft 58, the worm 57 and the worm gear 56 in a clock-

wise direction (Fig. 5) to move the platen 21 rearwardly to its initial position.

A hydraulically operated mechanism is provided for actuating the clutch lever 157 comprising a cylinder 161 which contains a slidably mounted piston 162. The piston 162 is provided with a piston rod 163. A compression spring 164 serves normally to hold the piston 162 in the position illustrated in Fig. 5 with the clutch member 156 disengaged. The piston rod 163 supports a slidably mounted sleeve 165 which is provided with an annular groove 166. The left hand end of the clutch lever 157 is yoke shaped and is provided with a pair of diametrically opposed studs 167 and 167a (Fig. 6).

When fluid under pressure is admitted through a pipe 168 into a cylinder chamber 169, the piston 162 is moved upwardly (Fig. 5) against the compression of the spring 164 to rock the clutch lever 157 in a clockwise direction so as to engage the clutch member 156 with the clutch member 155.

A fluid pressure system is provided for supplying fluid under pressure comprising the motor driven fluid pump 170 which draws fluid through a pipe 171 from a reservoir 172 and passes fluid under pressure through the pipe 173 through the control valve 190 above described and also to a control valve 174 for controlling the admission of fluid to the cylinder 161. A pressure relief valve 175 is connected in the pipe line 173 to facilitate maintaining the desired operating pressure within the fluid pressure system. The control valve 174 is a piston type valve comprising a valve stem 176 having a pair of spaced valve pistons 177 and 178 formed integrally therewith. A compression spring 179 normally holds the valve stem 176 in a right hand end position as illustrated in Fig. 11. A solenoid 182 is provided for shifting the valve stem 176 toward the left to admit fluid under pressure to the cylinder 161. When the solenoid 182 is energized, the valve stem 176 moves toward the left against the compression of the spring 179 so that fluid under pressure from the pipe 173 enters a valve chamber 180 formed between the valve pistons 177 and 178 and passes through the pipe 168 into the cylinder chamber 169 to engage the clutch members 156—155 in a manner above described.

The cylinder 161 and piston 162 serve as a sequence valve to control the admission of the fluid to the fluid motor 150. When fluid under pressure is passed through the pipe 168 into the cylinder chamber 169 to cause an upward movement of the piston 161 (Fig. 11), the piston 161 gradually uncovers a port 183 after which fluid under pressure may pass through a pipe 184 to start the fluid motor 150. Fluid exhausts from the motor 150 through a pipe 185 and a throttle valve 186 which controls the rate of rotation thereof.

An electrical control apparatus is provided comprising power lines 188. A start switch 189 serves to close a circuit to energize a relay switch 190. When the start switch 189 is closed, it serves to close the relay switch 190 and thereby to energize the solenoid 182 to shift the valve 174 so as to admit fluid under pressure to the cylinder chamber 169. A normally closed limit switch 192 is arranged so that its actuated plunger 193 lies in the path of movement of the motor platen 21. When the motor platen 21 is in an extreme rearward position, the switch 192 is opened. The switch 192 serves as a safety device to deenergize the relay switch 190 and thereby to deenergize the solenoid 182 when the motor platen 21 reaches a rearward position so as to disengage the clutch 156—155 and thereafter to stop the fluid motor 150.

The operation of this improved speed controlled mechanism will be readily apparent from the foregoing disclosure. Assuming a full size grinding wheel 17 is mounted on the wheel spindle 16, the grinding operation proceeds until the grinding wheel 17 requires truing. During this initial operation the grinding wheel 17 is rotated at a maxmum speed. When the grinding wheel requires truing, the feed wheel 125 is rotated to cause a downfeeding movement of the diamond or truing tool 118 after which the control lever 102 is manipulated to cause a longitudinal movement of the slide 85 to traverse the truing tool 118 across the peripheral face of the grinding wheel 17. The truing tool may be passed as many times as desired across the periphery of the grinding wheel 17 and the diamond feed downwardly before each traversing movement by manipulation of the hand wheel 125. As above described, the rotary motion of the feed nut 120 will be imparted through the flexible shaft 143 to impart a rotary motion to the cam 51 so as to cause a transverse movement of the motor platen 21 thereby changing the center distance between the motor shaft 65 and the wheel spindle 16 to increase the rotary speed of the wheel spindle 16 to maintain a substantially constant peripheral speed on the grinding wheel 17. After the grinding wheel has been completely worn out and requires replacement, the truing tool 118 is reset and the motor platen 21 moved rearwardly to its initial position by actuation of the start switch 189 to first engage the clutch members 156—155 thereafter to start the fluid motor 150 so as to rotate the worm 57, the worm gear 56 and the cam 51 in the reverse direction to cause a rearward movement of the motor platen 21. During the rearward movement of the platen 21, as it approaches its rearward position, an adjustable screw 200 (Fig. 5) on the platen 21 engages the forward end of the piston rod 163 and shifts it rearwardly so that the piston 162 gradually closes the port 183. Gradual closing of the port 183 serves gradually to cut-off the flow of fluid to the motor 150 so as to gradually slow-down the motor 150, and also to disengage the clutch 155—156 at the same time the platen 21 engages and actuates the limit switch 192 to stop the platen 21 in its rearward or initial position. The resetting movement of the truing tool 118 and the motor platen 21 may be stopped at any position desired by manipulation of the stop switch 191.

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 successively 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 hereinbefore 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 transversely movable wheel slide, a rotatable wheel spindle thereon, a grinding wheel on said spindle, an electric motor adjustably mounted on said wheel slide, a variable speed V-belt drive between said

motor and wheel spindle including a V-groove variable pitch automatic pulley on said motor, a V-belt groove pulley on said spindle, a V-belt connected therebetween, means including a cam and follower mechanism interposed between said motor and wheel slide to facilitate adjustment of said motor relative to the said slide so as to vary the center distance between the motor and the wheel spindle and thereby to vary the speed of the grinding wheel, a wheel truing apparatus on said slide including a longitudinally movable slide, a transversely movable carrier on said longitudinal slide, a truing tool thereon, a feeding mechanism interposed between said longitudinal slide and said carrier for feeding the truing tool toward and from the grinding wheel, and operative driving connections between the truing tool feeding mechanism and the cam mechanism whereby actuation of the said mechanism automatically actuates said cam to adjust the position of the motor relative to the wheel slide so as to vary the speed of the wheel spindle to maintain a substantially constant peripheral speed of the grinding wheel as it wears away.

2. In a grinding machine having a transversely movable wheel slide, a rotatable wheel spindle thereon, a grinding wheel on said spindle, a slidably mounted platen on said wheel slide, an electric motor on said platen, a variable speed V-belt drive between said motor and wheel spindle including a V-groove variable pitch automatic pulley on said motor, a V-pulley on said spindle, a V-belt connected therebetween, means including a cam and a follower interposed between said platen and wheel slide to facilitate adjusting said platen relative to said slide so as to vary the center distance between the motor and wheel spindle and thereby to vary the speed of the grinding wheel, a truing apparatus on said slide including a longitudinally movable slide, a transversely movable carrier on said slide, a truing tool thereon, a feeding mechanism interposed between said longitudinal slide and carrier for feeding the truing tool toward and from the grinding wheel, and operative driving connections between the truing tool feeding mechanism and the cam mechanism whereby actuation of the truing tool feeding mechanism automatically actuates said cam to adjust the position of the motor platen relative to the wheel slide so as to vary the speed of the spindle to maintain a substantially constant peripheral speed of the grinding wheel as it wears away.

3. In a grinding machine having a transversely movable wheel slide, a rotatable wheel spindle thereon, a grinding wheel on said spindle, a slidably mounted platen on said wheel slide, an electric motor on said platen, a variable speed V-belt drive between said motor and wheel spindle including a V-groove variable pitch automatic pulley on said motor, a V-groove pulley on said spindle, a V-belt connected therebetween, means including a rotatable cam and a follower interposed between said platen and wheel slide to facilitate adjustment of said platen relative to the wheel slide so as to vary the speed of the grinding wheel, a wheel truing apparatus on said slide including a longitudinally movable slide, a transversely movable carrier thereon, a truing tool on said carrier, a feeding mechanism including a rotatable nut and a feed screw interposed between said slide and carrier for feeding the truing tool toward and from the grinding wheel, a flexible shaft, operative connections between one end of said shaft and said rotatable nut, and operative connections between the other end of said shaft and the cam mechanism whereby actuation of the feeding mechanism automatically actuates said cam to adjust the position of the motor platen relative to the wheel slide so as to vary the speed of the wheel spindle to maintain a substantially constant peripheral speed of the grinding wheel as it wears away.

4. In a grinding machine having a transversely movable wheel slide, a rotatable wheel spindle thereon, a grinding wheel on said spindle, a slidably mounted platen on said wheel slide, an electric motor on said platen, a variable speed multiple V-belt drive between said motor and spindle including a multiple V-groove variable pitch automatic pulley on said motor, a multiple V-groove pulley on said spindle, multiple V-belts connected therebetween, means including a rotatable cam and a follower interposed between said platen and wheel slide to facilitate adjustment of said platen relative to the slide so as to vary the speed of the grinding wheel, a wheel truing apparatus on said slide including a longitudinally movable slide, a transversely movable carrier on said longitudinal slide, a truing tool thereon, a nut and screw feeding mechanism including a rotatable nut interposed between said slide and carrier for feeding the truing tool toward and from the grinding wheel, a flexible shaft, operative connections between the rotatable nut and said shaft and operative connections between the other end of said shaft and said cam whereby actuation of the feeding mechanism automatically actuates said cam so as to adjust the position of the motor platen relative to the wheel slide and thereby to vary the speed of the spindle so as to maintain a constant peripheral speed on the grinding wheel as it wears away.

5. In a grinding machine having a transversely movable wheel slide, a rotatable wheel spindle thereon, a grinding wheel on said spindle, a slidably mounted platen on said wheel slide, an electric motor on said platen, a variable speed multiple V-belt drive between said motor and wheel spindle including a multiple V-groove variable pitch automatic pulley on said motor, a multiple V-groove pulley on said spindle, multiple V-belts connected therebetween, means including a rotatable cam and a follower interposed between said platen and wheel slide to facilitate adjustment of said platen relative to the slide, a worm and warm gear mechanism to rotate said cam, a wheel truing apparatus on said slide including a longitudinally movable slide, a transversely movable carrier on said slide, a truing tool thereon, a nut and screw feeding mechanism including a rotatable nut interposed between said slide and carrier for feeding the truing tool toward and from the grinding wheel, a flexible shaft, gearing connecting one end of said shaft to said rotatable nut, and gearing connecting the other end of said shaft with the worm and worm gear mechanism whereby actuation of the truing tool feeding mechanism automatically actuates said cam so as to adjust the motor platen relative to the wheel slide and thereby to vary the speed of the spindle so as to maintain a substantially constant peripheral speed of the grinding wheel as it wears away.

6. In a grinding machine, as claimed in claim 1 in combination with the parts and features therein specified of a hydraulically operated mechanism to return said electric motor and truing tool carrier to initial positions including a fluid motor on said wheel slide, means includ-

ing a normally inoperative clutch on said wheel slide operatively connected to actuate said cam mechanism in the reverse direction when engaged, means including a piston and cylinder on said slide operatively connected to actuate said clutch, said cylinder serving as a normally closed sequence valve to control the admission of fluid under pressure to the fluid motor after the clutch is engaged, and a manually controlled solenoid valve to control the admission of fluid under pressure to said cylinder to engage said clutch and thereafter to start said fluid motor.

7. In a grinding machine, as claimed in claim 2, in combination with the parts and features therein specified of a hydraulically operated mechanism to return said electric motor and truing tool carrier to initial positions including a fluid motor on said slide, means including a normally inoperative clutch on said slide operatively connected to rotate said cam in the reverse direction when engaged, means including a piston and cylinder on said slide operatively connected to actuate said clutch, said cylinder serving as a normally closed sequence valve to admit fluid to said fluid motor after the clutch is engaged, a manually controlled solenoid valve to control the admission of fluid under pressure to said cylinder to engage said clutch and thereafter to start said fluid motor, and means including a normally closed limit switch on said wheel slide having an actuating plunger in alignment with said platen which is actuated by the rearward movement of the platen to deenergize said solenoid valve to disengage said clutch and to stop said fluid motor when the platen reaches its initial or rearward position.

8. In a grinding machine, as claimed in claim 2, in combination with the parts and features therein specified of a hydraulically operated mechanism to return said electric motor and truing tool carrier to initial positions including a fluid motor on said wheel slide, means including a normally inoperative clutch on said wheel slide operatively connected to actuate said cam mechanism in the reverse direction when engaged, means including a piston and cylinder on said slide operatively connected to actuate said clutch, said cylinder serving as a normally closed sequence valve to control the admission of fluid under pressure to the fluid motor after the clutch is engaged, a manually controlled solenoid valve to control the admission of fluid under pressure to said cylinder to engage said clutch and thereafter to start said fluid motor, and means including an adjustable screw on said platen which is arranged to engage and move said piston rod rearwardly as the platen approaches its initial position so as to gradually cut-off the flow of fluid under pressure to said fluid motor to slow-down the rearward movement of said electric motor before the clutch is disengaged to stop the rearward movement of the electric motor in its initial position.

References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
2,088,948	Crzellitzev	Aug. 3, 1937
2,103,464	Judelsohn	Dec. 28, 1937
2,162,038	Trible	June 13, 1939
2,271,598	Maurer	Feb. 3, 1942
2,302,304	Elherty	Nov. 17, 1942
2,394,209	Scuse	Feb. 5, 1946
2,454,988	Bunker	Nov. 30, 1948