Feb. 6, 1945. T. H. LJUNGGREN 2,368,992

MACHINE FEED MECHANISM

Filed May 15, 1942 4 Sheets-Sheet 1

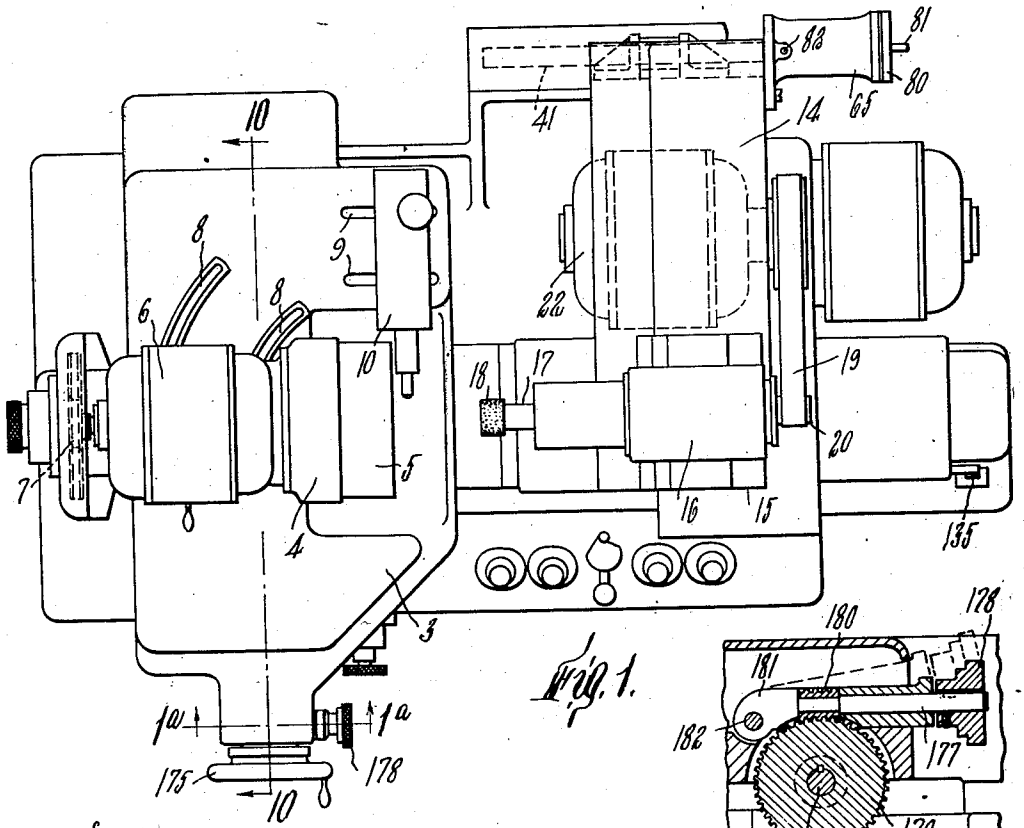

Fig. 1.

Fig. 1a

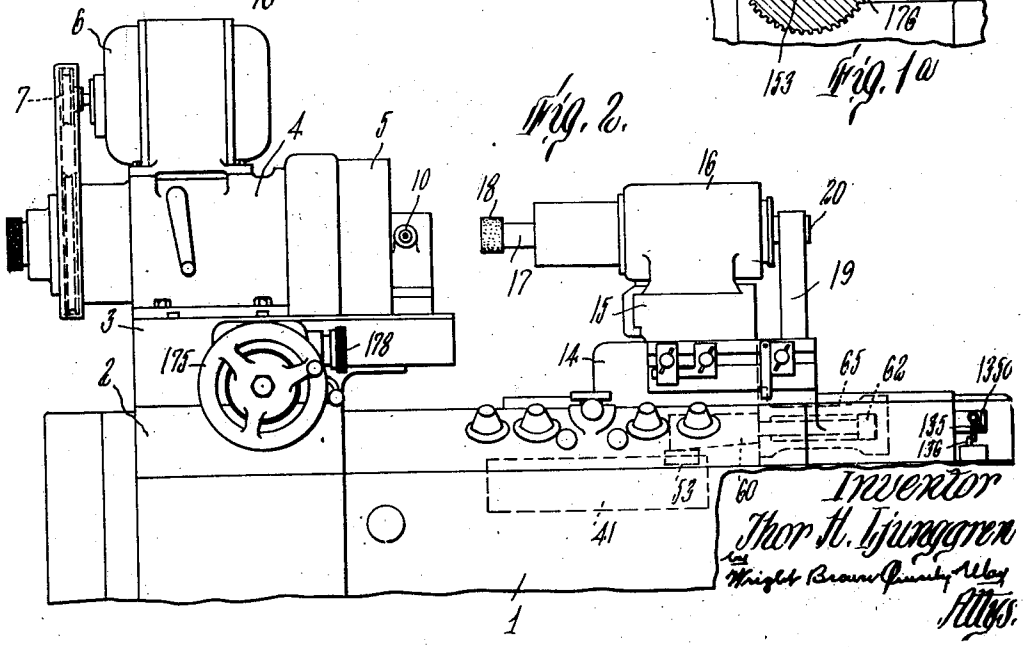

Fig. 2.

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Feb. 6, 1945. T. H. LJUNGGREN 2,368,992

MACHINE FEED MECHANISM

Filed May 15, 1942 4 Sheets-Sheet 2

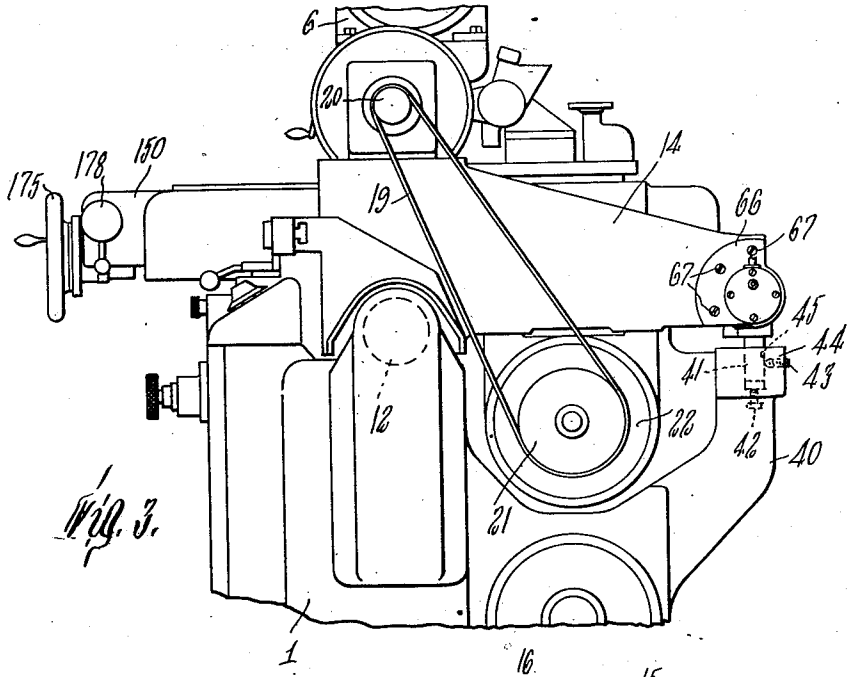

Fig. 3.

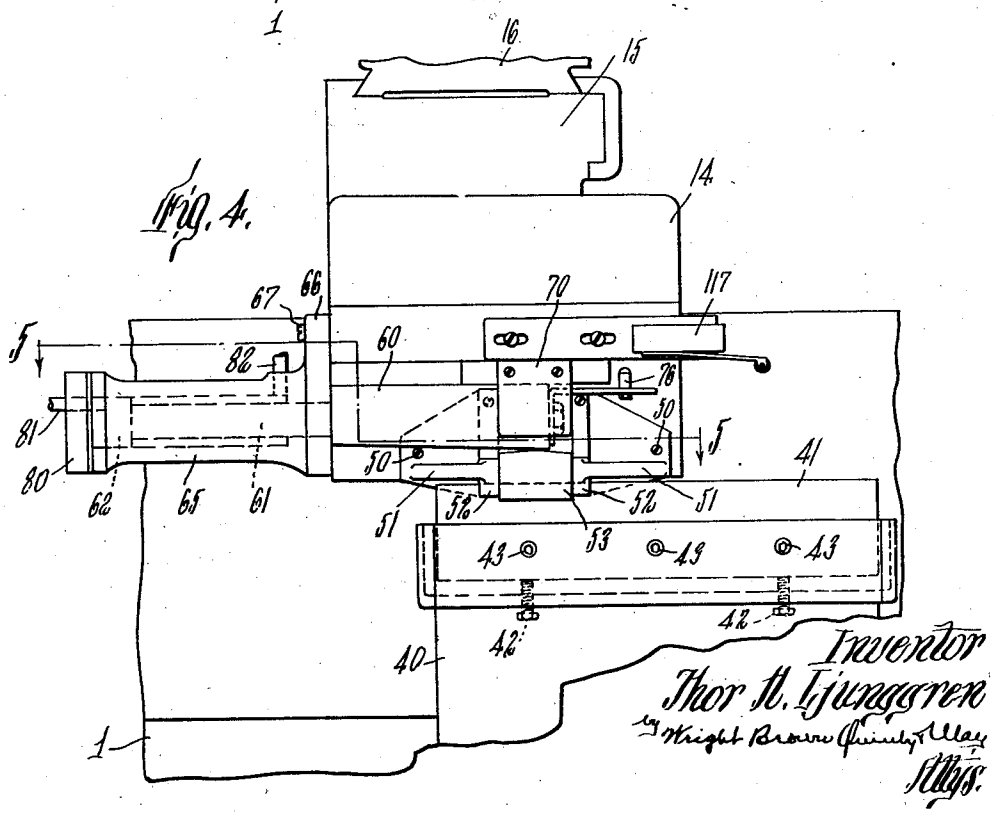

Fig. 4.

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Feb. 6, 1945. T. H. LJUNGGREN 2,368,992

MACHINE FEED MECHANISM

Filed May 15, 1942 4 Sheets-Sheet 3

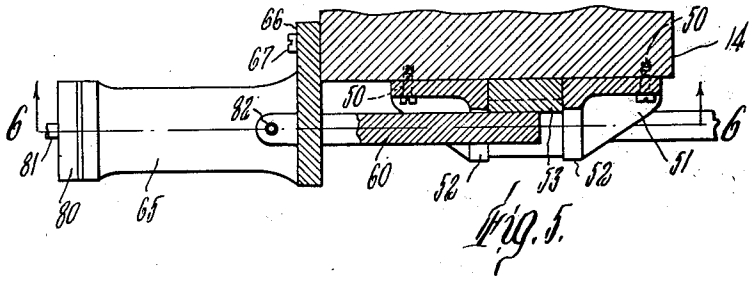

Fig. 5.

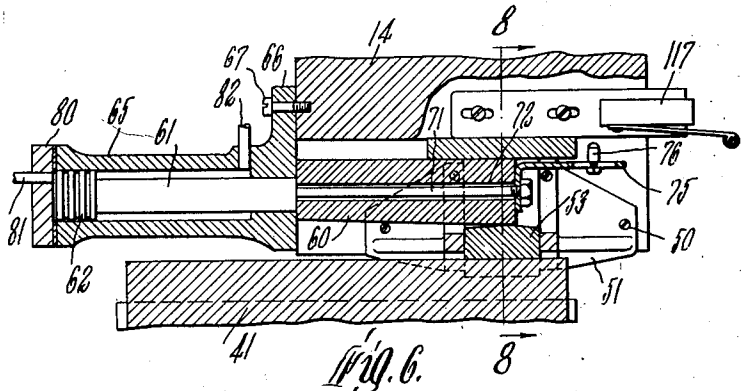

Fig. 6.

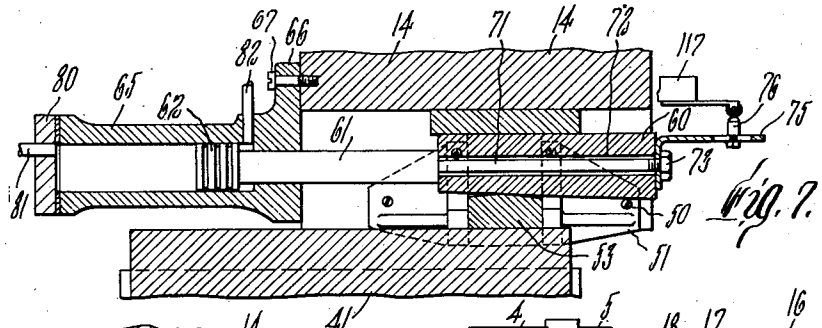

Fig. 7.

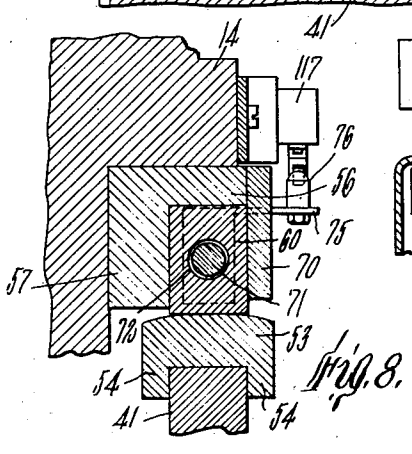

Fig. 8.

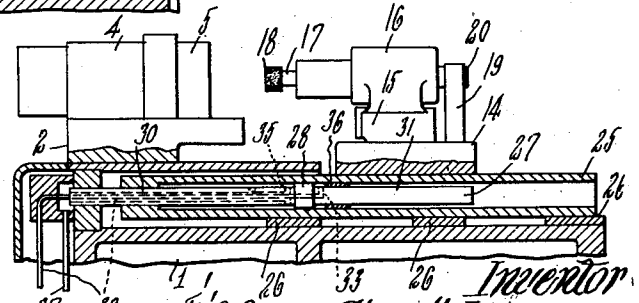

Fig. 9.

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Feb. 6, 1945. T. H. LJUNGGREN 2,368,992

MACHINE FEED MECHANISM

Filed May 15, 1942 4 Sheets-Sheet 4

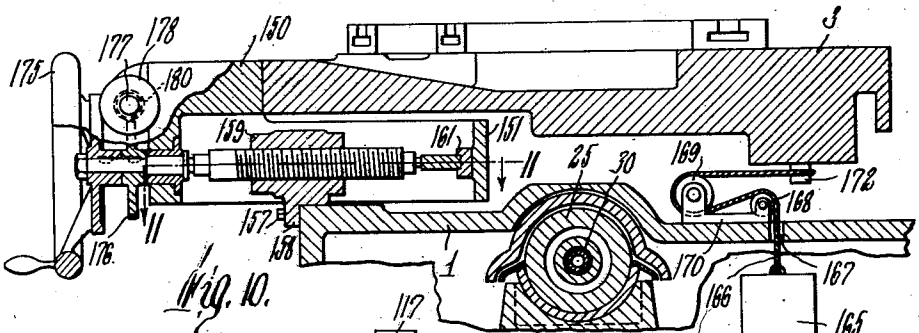

Fig. 10.

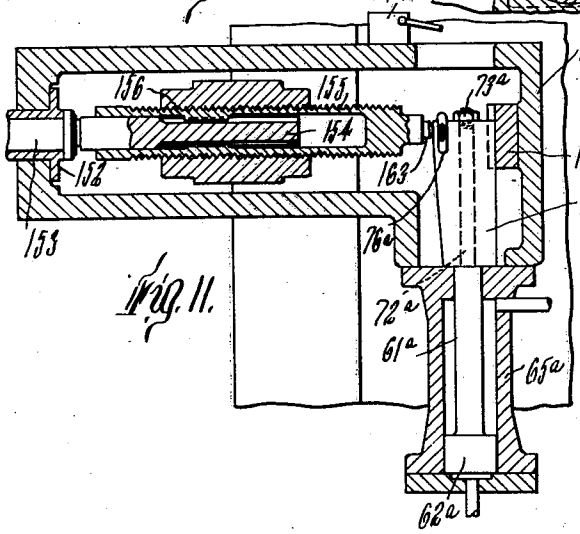

Fig. 11.

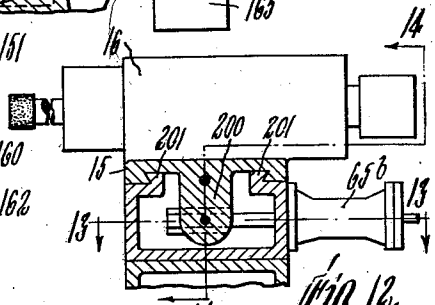

Fig. 12.

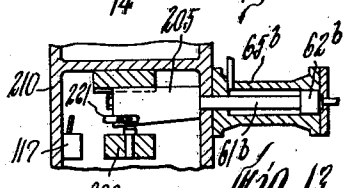

Fig. 13.

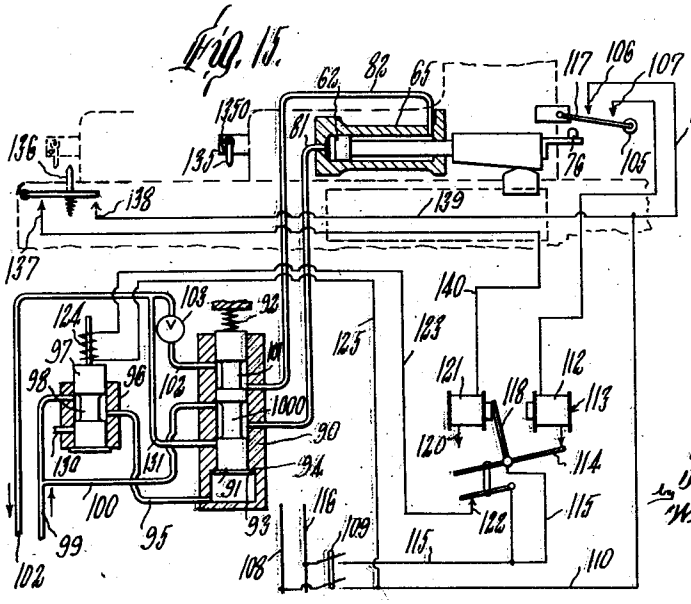

Fig. 15.

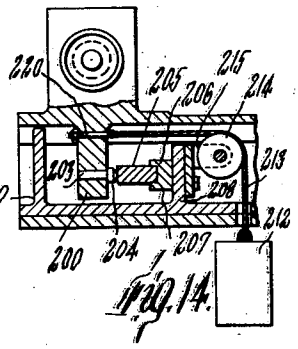

Fig. 14.

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UNITED STATES PATENT OFFICE

2,368,992

MACHINE FEED MECHANISM

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Application May 15, 1942, Serial No. 443,114

7 Claims. (Cl. 51—50)

This invention relates to the feeding of work and a tool relatively, and is particularly concerned with such feeding as applied to the grinding of work. In such machines it is usual practice to produce a rapid traverse of the wheel on the work during the grinding operation.

It is an object of the present invention to present a gradual continuous relative feed motion between the work and the wheel without interfering with and during this traverse. This feed may be produced by motion of either the work or of the wheel laterally of the line of traverse.

A further object is to produce the feed automatically at a predetermined rate and to a predetermined extent.

Still another object is to provide for automatic retraction at the end of a grinding cycle preparatory to operation on a new work piece.

For a more complete understanding of this invention reference may be had to the accompanying drawings in which

Figures 1 and 2 are top plan and fragmentary front elevations, respectively, of a grinding machine embodying one form of the invention.

Figure 1*a* is a detail section on line 1*a*—1*a* of Figure 1.

Figures 3 and 4 are fragmentary right hand and rear elevations of the same.

Figure 5 is a detail sectional view on line 5—5 of Figure 4.

Figure 6 is a detail sectional view on line 6—6 of Figure 5.

Figure 7 is a view similar to Figure 6, but showing the parts in different positions.

Figure 8 is a detail sectional view on line 8—8 of Figure 6.

Figure 9 is a fragmentary view partly in elevation and partly in section showing the traversing mechanism.

Figure 10 is a detail section on line 10—10 of Figure 1 showing feed as applied to the work.

Figure 11 is a detail sectional view on line 11—11 of Figure 10.

Figure 12 is a view partly in side elevation and partly in vertical section of the wheel head showing a modification of wheel feed mechanism.

Figures 13 and 14 are detail sectional views on lines 13—13 and 14—14, respectively, of Figure 12.

Figure 15 is a diagrammatic view showing the control mechanism for the feed shown as applied to the mechanism of Figures 1 to 8, inclusive.

Referring first to Figures 1, 2 and 3, at 1 is shown a machine bed having at one end a platform 2 on which is mounted for motion from front to back, a work slide 3. This work slide may have any suitable means for moving it forwardly or backwardly in case it is desired to produce a relative feed between the work and tool by motion of this head. As shown it supports work holding means indicated at 4, this means including a rotary work-carrying spindle for supporting a piece of work as at 5, this spindle being rotated as by a motor 6 carried by the casing of the work holding means 4 and connected to the spindle as by a driving belt 7. This work holding means may be adjustable angularly on the slide 3, for this purpose arcuate slots being shown at 8 for receiving suitable bolts securing the work holder holding means in position. At 9 are shown longitudinally extending slots for attachment of a suitable truing mechanism indicated generally at 10 when a grinding wheel is the tool which operates on the work.

The machine base may be provided with a rocking support at 12 on which may be carried for rocking and axial motion a tool carriage 14. This tool carriage may support a transverse slide 15 carrying a grinding wheel head 16 within which is mounted a wheel shaft 17 carrying a grinding wheel 18 for operating on the work. The spindle 17 may be rotated at high speed as by means of a belt 19 passing around a pulley 20 at its rear end and connected to the drive pulley 21 of a motor 22 supported from the carriage 14.

This machine as so far described is of the type shown in the Arms Pat. No. 2,310,338 granted February 9, 1943, for Metal working machines and is not, per se, my invention. It is sufficient to say that the carriage 14 is moved axially to cause the wheel to traverse the work and at the end of a grinding operation, the wheel slide is retracted into the position shown in Figures 1 and 2 to bring the wheel out from the work, this being accomplished by hydraulic mechanism. For example, in Figure 9 the carriage 14 is shown as rockably supported on a tube 25 which is slidably mounted on semi-cylindrical bearing members 26. Extending into the tube 25 is a shaft 27 provided with an enlarged diameter portion 28 which slidably fits within the tube 25 and forms a piston therefor. The shaft 27 has reduced diameter end portions 30 and 31. The portion 30 is hollow and through the center of it passes a pipe 32 which extends into the piston portion 28 and communicates through a port 33 to the interior of the tube 25 to the right of the piston. The space outwardly of the

pipe 32 and between it and the inside of the shaft portion 30 communicates through a port 35 with the interior of the tube 25 at the left hand side of the piston 28. The shaft portion 31 is solid in cross section and is slidably guided through a sleeve 36 which engages a larger internal diameter portion of the tube 27 and forms a closed end to the pressure cylinder containing the piston 28 and which travels relative to the piston 28. The right hand end of the tube 25 is open but the left hand end is closed to the tube 32. When fluid is introduced through the pipe 32 and discharged around the pipe 32 and out through the pipe 37, the pressure cylinder 25 and the tool carriage is moved to the right, while when fluid under pressure supplied to the pipe 37 and allowed to escape through the pipe 32, the tool slide is moved to the left or toward the work spindle.

Suitable means (not shown herein but well known in the art) may be provided for controlling the supply and discharge of fluid under pressure to opposite sides of the piston 28 to control the traverse of the grinding wheel with reference to the work between normal grinding limits, and to produce an extended traverse of the grinding wheel beyond one of such limits out of operative relation to the work as at the end of a grinding cycle.

It will be evident that a feed motion of the grinding wheel with reference to the work may be produced by rocking the carriage 14 about the axis of the tube 25, which is eccentric to the working contact between the wheel and the work, and means for accomplishing the feed by such method is shown in Figures 4 to 8, inclusive. The bed 1 is provided with an arm 40 along its back portion, this arm 40 being arranged to support a cam plate 41. As shown best in Figures 3 and 4, this cam plate 41 may be supported adjacent to opposite ends on adjusting screws 42, and it may be held in adjusted position as by means of set screws 43 threaded through the back wall portion 44 of a socket slot 45 in the top face of the arm 40, these screws 44 bearing against the cam plate 41 and forcing it against the inner wall of the slot 45.

To the rear extremity of the carriage 14 is secured, as by screws 50, spaced brackets 51 having spaced upright fins 52, between which is slidably mounted a bearing block 53 which has downwardly extending side flanges 54 engaging over the upper edge of the cam member 41. Bearing on the top face of the block 53 and re-acting between it and a top wall member 56 of the bracket member 57, is a wedge cam 60 which is secured to the outer end of a piston rod 61 having a piston 62 slidable in a cylinder 65 provided with a segmental foot 66 secured to the outer end of the slide 40 as by the screws 67. The wedge cam 60 may be held in position as by a cover plate 70 as shown in Figure 8, and it may be secured to the piston rod 61 as by a reduced diameter portion 71 of the rod extending through a hole 72 of the wedge cam and having a nut 73 threaded on its outer extremity. This nut 73 may also secure in position a bracket 75 carrying a switch actuating element 76 the purpose of which will later be described.

The outer end of the cylinder 65 may be closed off as by a cylinder head 80, and pipes 81 and 82 leading through the head 80 and the cylinder wall, respectively, may be employed to conduct fluid under pressure into or discharge fluid pressure from opposite end portions of the cylinder beyond the piston 62. It will be noted that the end of the wedge cam 60 adjacent to the piston rod 61 is narrower than that end further remote therefrom. When the wider portion of the wedge cam bears against the block 53, as in Figure 6, the rear end of the carriage 14 is held in a somewhat elevated position with the grinding wheel forward at the start of the grinding operation, but as the piston is moved to the right from the position of Figure 6 to that of Figure 7, the narrower portion of the wedge cam 60 engages the block 53, allowing the rear end portion of the carriage 14 to drop and moving the grinding wheel rearwardly, feeding it into the work.

Means may be provided as shown in Figure 15 to produce this feed motion of the grinding wheel relative to the work during the operative traverse between the wheel and the work and to a predetermined extent, the wheel then being returned to its initial feed position automatically. On the extended traverse of the wheel which brings it out of operative relation to the work, as at the end of a grinding operation, the finished work is taken from the machine and an unground piece of work substituted therefor, upon which the next grinding operation is to be performed. Referring to Figure 15, the pressure pipes 81 and 82 lead to a valve casing 90 within which is movable a valve 91 normally downwardly pressed in the casing 90 as by means of a spring 92. In the position shown in Figure 15, this piston 92 is lifted as far as permitted by a head 93 thereon which engages a shoulder 94 of the valve casing, and it is held in this position by fluid pressure admitted beneath the piston 91 as through a pipe 95 leading from a valve casing 96 within which is axially movable a valve 97. In the position shown this valve 97 is lifted so that an annular recess 98 therein opens communication to the pipe 95 from a pressure supply pipe 99. When the valve 91 is in its upper posiiton as shown, a branch 100 leading from the pressure pipe 99 communicates through the casing 90 around a neck portion 1000 of the valve 91 to the pipe 81, while the pipe 82 communicates around a valve neck 101 to the discharge pipe 102 having an adjustable valve 103 therein by which the rate of discharge of fluid under pressure may be controlled. This causes the piston 62 to be driven from its position of Figure 15 toward the right at a speed dependent upon the setting of the valve 103 to produce a gradual feed of the grinding wheel into the work. This persists until the switch actuating element 76 strikes a switch arm 105, closing the contacts 106 and 107. This makes an electrical connection from the line 108, the main switch at 109 being closed, through the leads 110 and 111, the contacts 106 and 107 of the switch 117, through a solenoid 112 of a relay 113, an arm 114 of this relay, and lead 115 back through the switch 109 to the line 116. The actuation of the solenoid 112 throws over the armature switch arm 118 toward the solenoid 112, breaking the connection to the arm 114 and closing a connection 120 of the solenoid 121 and opening a contact 122 leading from the lead 115. This contact 122 is in circuit through a lead 123 with a solenoid 124 and a lead 125 to the lead 110, so that the opening of the contact 122 deenergizes the solenoid 124, allowing the valve 97 to drop, thus cutting off the pressure to the pipe 95 and opening this pipe 95 to free discharge through the pipe 130. This allows the valve 91 to drop, cut-

ting off the pipe 81 from the pressure line 100 and opening the pipe 82 to this pressure line, while opening the pipe 81 to the discharge pipe 131 which by-passes the valve 103 to free discharge. Thus the piston 62 is returned rapidly to the position of Figure 15 in position to start the next cycle of operations.

After the extended traverse of the wheel slide has been produced and the slide starts back toward the work, a switch actuating element 135 on the wheel carriage depresses a switch arm 136, making an electrical connection between the contacts 137 and 138. The switch actuating element 135 is free to tilt out of the way on the extended outward traverse so that at that time it does not actuate the switch arm 136. A stop 1350 holds the element 135 in position to depress the arm 136 on return of the wheel slide. This establishes an electric connection from the lead 110 and lead 139, the contacts 138 and 137, and lead 140, extending to the left hand solenoid 121 of the switch 113, and as the previous energization of the solenoid 112 served to close the contact 120 with the switch arm 114 and lead 115 to the line 116, this again energizes the solenoid 121 and returns the switch arm 114 to the position shown, whereupon the cycle of operations is repeated, the wheel returning to its normal traversing path and the slow feed of the wheel commencing.

Feed between the wheel and the work may be effected, if desired, by motion of the work carriage 3 rather than by motion of the wheel slide, and mechanism for accomplishing the feed in this manner is illustrated in Figures 10 and 11. Referring to the construction shown in these figures, the work slide 3 carries a bracket 150 provided with a yoke member 151 which extends rearwardly beneath the carriage 3. The forward wall of the bracket 150 is provided with an opening within which is seated a bushing 152 and journaled therein and held against axial motion is a feed shaft 153 having a rearward splined extension 154. This extension projects within a feed sleeve 155 having inwardly extending portions 156 engaging in the grooves of the extension 154 so that relative axial motion between the parts 154 and 155 is permitted while they are prevented from independent rotation. By rotating the feed shaft 153, therefore, it will be evident that the sleeve 155 will also be rotated. This sleeve 155 is externally threaded and has threaded engagement with a nut member 159 which is secured to the forward face of the bed 1 as by means of screws 157 extending through a downwardly extending flange 158 of the nut 159 and into the forward portion of the base 1. The inner wall of the yoke member 151 carries a guide block 160 having a horizontal groove 161 therein within which rides a wedge cam 162. The opposite edge of the wedge cam engages a wear piece 163 in the inner end of the sleeve 155. The guide block 160 is held into engagement with the wedge cam 162 and the wedge cam in engagement with the wear piece 163 by means which urges the work slide 3 forwardly in feeding direction. This as shown is accomplished by a weight 165 fixed to the end of a cable 166 which extends through a hole 167 in the top of the base 1, over a guide pulley 168 and under a guide pulley 169, both journaled in a bracket 170 secured to the top face of the bed 1, and then to a post 172 depending from the work slide 3, to which post the other end of the cable is secured.

The feed shaft 153 may carry a hand wheel 175 at its outer end and it may also carry a suitable worm gear 176 connected for rotation by a worm 180 (see Figure 1a) on a transverse shaft 177 carrying a knurled hand wheel 178 at its outer end. The shaft 177 is journaled in a lever 181 fulcrumed at 182 so that the worm 180 may be lowered into engagement with the worm wheel 176 in which case by its rotation the shaft 153 may be slowly rotated, or lifted so that the shaft 153 may be rotated at a faster rate by rotation of the hand wheel 175. When the worm is in its lowered position it locks the shaft 153 against rotation by the hand wheel 175.

The wedge cam 162 may be arranged to be traversed during the operation of the wheel on the work to produce feed motion, this being shown as accomplished by the fluid pressure cylinder 65a containing the piston 62a connected to the piston rod 61a, this piston rod being provided with a shaft extension 72a extending through the cam 162 and secured as by a nut 73a engaging the threaded outer end of the member 72a. This cylinder 65a may be connected up to the mechanism shown in Figure 15 in place of the cylinder 65 shown in that figure and the wedge cam 162 may be provided with an actuating element 76a for engagement with the switch 117.

The feed may also be produced by motion of the wheel slide 16 forward or backward relative to the carriage 14. Such an arrangement is illustrated in Figures 12 to 14. The wheel slide 15 may be provided with a depending portion 200 which extends down between ways 201 upon which the slide 15 is mounted. This depending portion 200 may have fixed transversely thereof a pin 203 having a hardened head 204 which engages one edge face of a wedge cam 205. The opposite edge of the wedge cam 205 is guided in a notch 206 of a block 207 secured to a flange 208 upstanding from the base of a channel shaped member 210, the side flanges of which form the ways 201. The slide 15 is pressed toward the flange 208 by any suitable means such as the weight 212 attached to a cable 213. This cable 213 passes over a guide pulley 214 carried by a bracket 215 secured to the flange 208 and is secured as by an eye bolt 220 to the depending portion 200. Movement of the wedge cam 205 to bring its narrower portion between the members 207 and 203 permits the weight 212 to move the grinding wheel transverse to its axis to effect feed of the wheel with reference to the work. A switch actuating element 221 secured to the wedge cam may impinge upon the switch 117 at the limit of feed as in Figure 15 and the feed motion of the feed cam may be produced by the pressure cylinder 65b having the piston 62b and the piston rod 61b which may be connected into the system in place of the cylinder 65 and piston 62 and rod 61 of Figure 16, thus to control the cycle of the feed in the same manner that it can be controlled by rocking the wheel carriage 14 or by motion of the work carriage.

From the foregoing description of an embodiment of this invention, it should be evident to those skilled in the art that various changes and modifications might be made without departing from the spirit or scope of this invention.

I claim:

1. The combination with a pair of members, one of said members supporting work and the other of said members supporting a tool, moving means, connections between said moving means and one of said members causing movement of said moving means in one direction to produce

relative feeding motion between said members, and in another direction to produce relative retraction between said members, a transverse wedge member in said connections, means acting to produce relative traverse between said members transverse to feeding direction, and means for automatically moving said wedge member endwise in a rectilinear path during the traversing action of the tool on the work.

2. The combination with a pair of members, one of said members supporting work and the other of said members supporting a tool, moving means, connections between said moving means and one of said members causing movement of said moving means in one direction to produce relative feeding motion between said members, and in another direction to produce relative retraction between said members, a transverse wedge member in said connections, means acting to produce relative traverse between said members transverse to feeding direction, fluid pressure mechanism for moving said wedge member endwise in a rectilinear path during the traversing action of the tool on the work, and an electric control for said fluid pressure mechanism.

3. The combination with a pair of members, one of said members supporting work and the other of said members supporting a tool, means for relatively reciprocating said members to cause the tool to traverse the work between normal traverse limits, and beyond one of said limits through an extended traverse wherein said tool is spaced from the work, means for producing a relative motion of said members transverse to the direction of reciprocation to cause feed and retraction of the tool relative to the work, electrical means for controlling said feed motion including a limit switch for stopping the feed motion at a predetermined point and setting said members relatively to a starting feed position, and switch means contacted and actuated by one of said members during return from said extended traverse for conditioning said electrical means to cause said feed motion moving means to start a feeding cycle.

4. In combination, a work supporting member, a tool supporting member, one of said members being a slide, a yoke movable with said slide, a fixed nut, a threaded sleeve arranged in the direction of motion of said slide engaging said nut, a shaft splined to and within said sleeve, a cam plate between one end of said sleeve and said yoke, means pressing said yoke in a direction to hold said sleeve against said cam plate, means for rotating said shaft to move said slide, and means actuable in a predetermined cycle to move said cam plate to move said slide in accordance with the contour of said cam plate to effect a relative feed motion between work on said work supporting member and a tool on said tool supporting member.

5. The combination with a pair of members, one of said members supporting work and the other of said members supporting a tool for operation on such work, one of said members being pivotally supported eccentric to the working contact between said tool and the work to cause feed and retraction between the tool and work on rocking of said rockably supported member, a former cam fixed with respect to the other of said members, a follower movably carried by said pivotally mounted member and engaging said former cam, means for relatively reciprocating said members lengthwise of said former cam, a wedge cam between said follower and a portion of said pivotally mounted member, and means for moving said wedge cam to move said follower with reference to said pivotally mounted member.

6. In combination, a base, a bar rockably and axially slidable on said base, a member secured to said bar, a member carried by said base, one of said members supporting work and the other of said members supporting a tool for operating on said work, a former cam carried by said base and arranged parallel to said bar, a follower for said cam movably carried by said bar-carried member, means for reciprocating said bar-carried member with said bar, the angular position of said bar-carried member being determined partly by engagement of said follower on said former cam, a wedge cam arranged between said cam follower and bar-carried member, and means for moving said wedge cam to move said follower with relation to said bar-carried member.

7. In combination, a slide, a yoke movable with said slide, a fixed nut, a threaded sleeve arranged with its axis in the direction of motion of said nut, a shaft splined to and within said sleeve, a transversely arranged cam plate between one end of said sleeve and said yoke, means pressing said yoke in a direction to hold said sleeve against said cam plate, means for rotating said shaft to move said slide, and means operatively engaging said cam plate and actuable to move said cam plate transverse to said shaft to move said slide independently of the motion of said slide caused by rotation of said shaft and in accordance with the contour of said cam plate.

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