Oct. 17, 1939. R. H. CRAMER 2,176,249

TABLE TRAVERSING MECHANISM

Filed Dec. 21, 1937 3 Sheets-Sheet 1

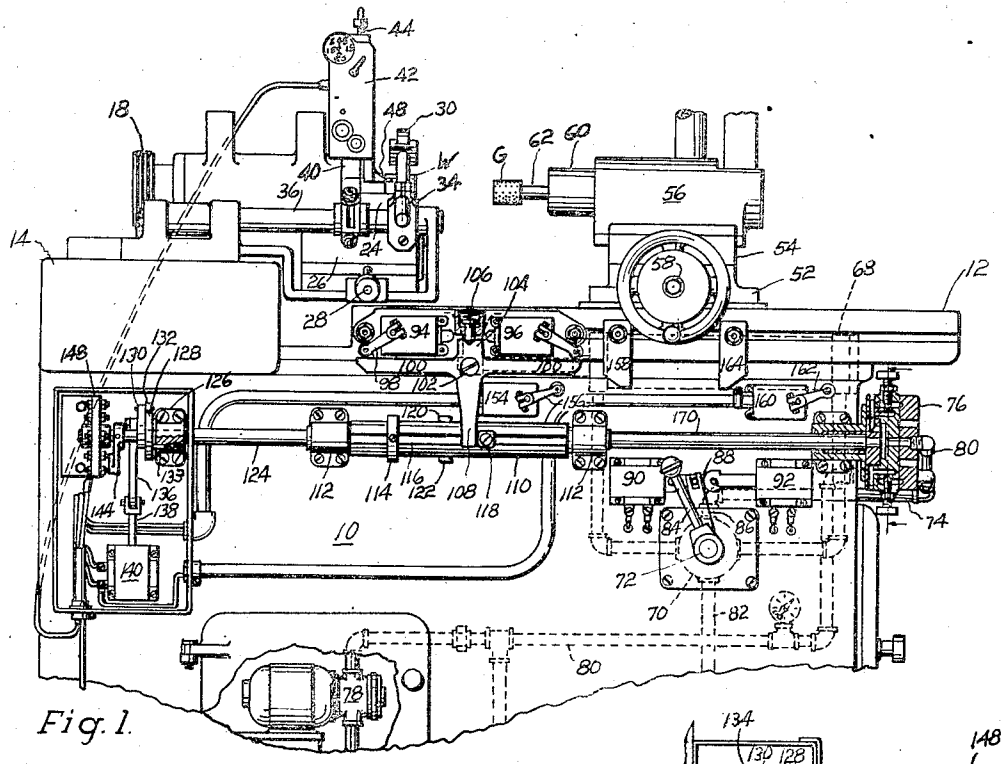


Fig. 1.

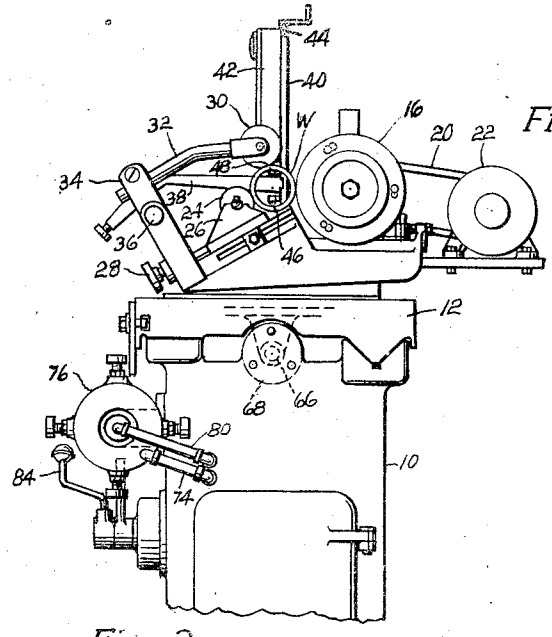


Fig. 2.

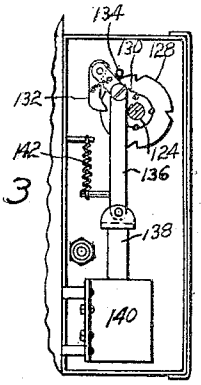


Fig. 3

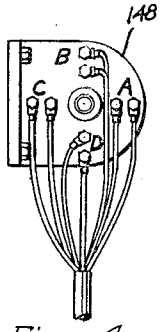


Fig. 4.

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TABLE TRAVERSING MECHANISM

Filed Dec. 21, 1937 3 Sheets-Sheet 2

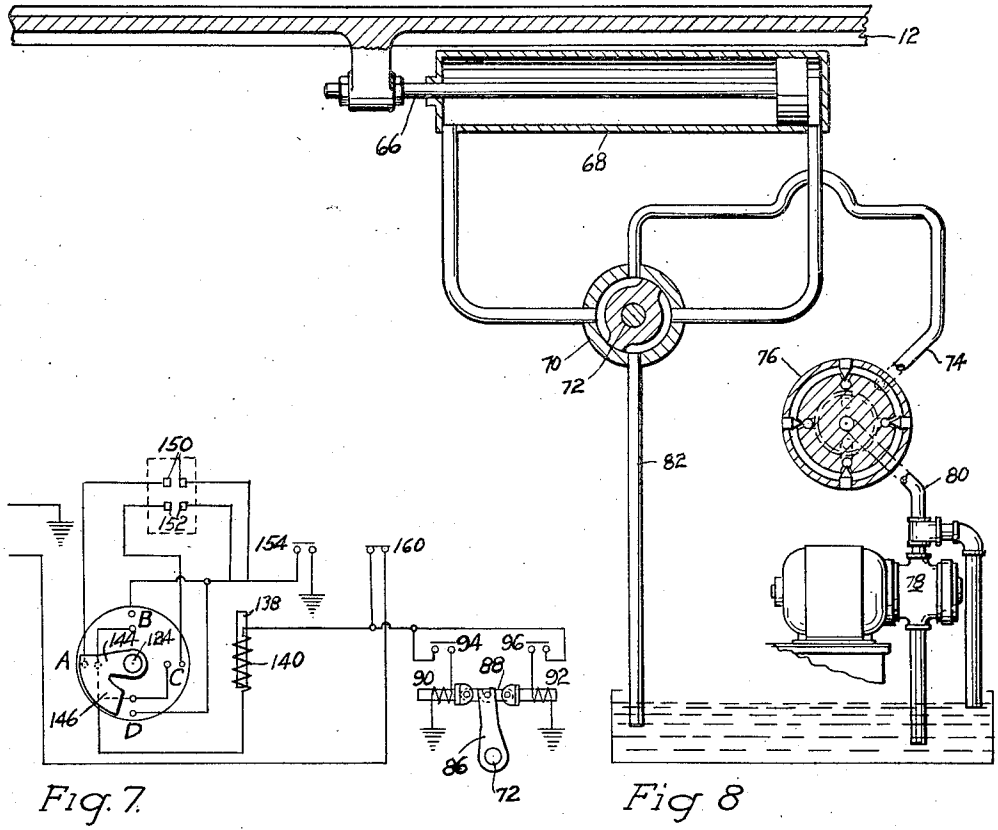


Fig. 7.

Fig 8

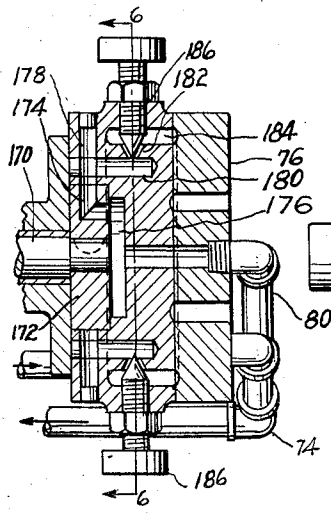


Fig. 5

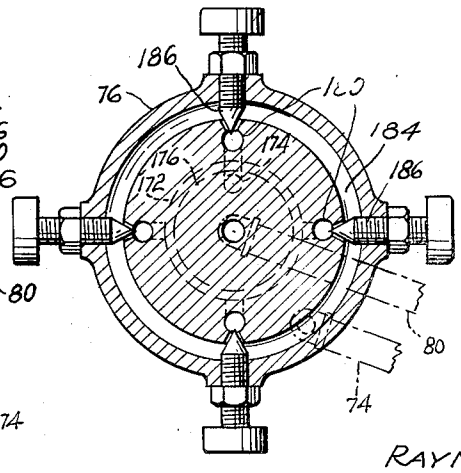


Fig. 6

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TABLE TRAVERSING MECHANISM

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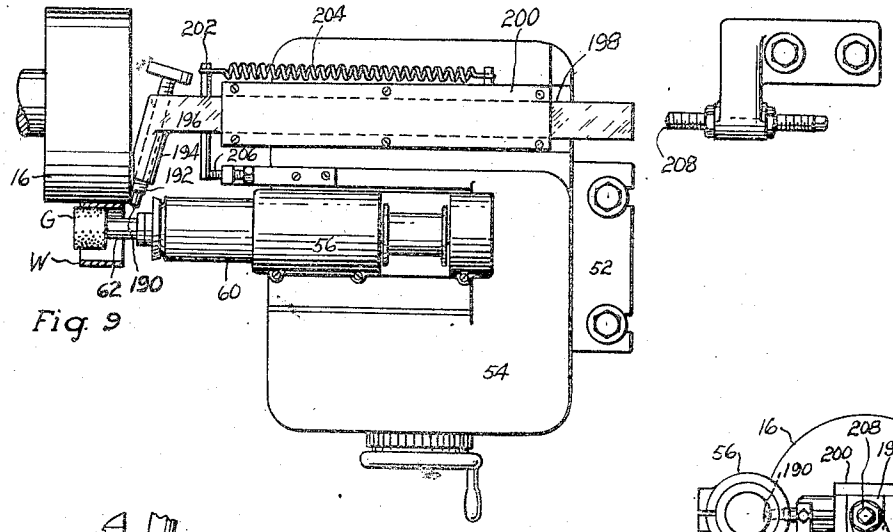


Fig. 9

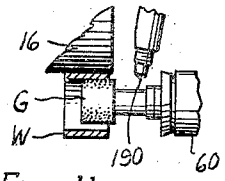


Fig. 11.

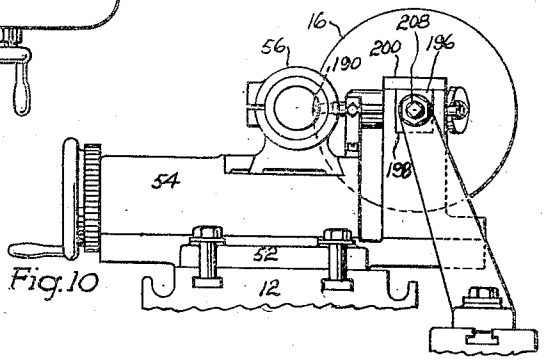


Fig. 10

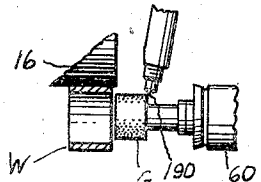


Fig. 12.

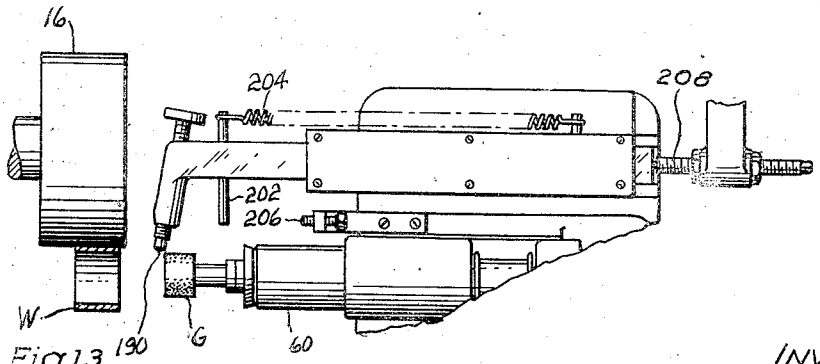


Fig. 13.

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Patented Oct. 17, 1939

2,176,249

UNITED STATES PATENT OFFICE

2,176,249

TABLE TRAVERSING MECHANISM

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Application December 21, 1937, Serial No. 181,005

16 Claims. (Cl. 51—48)

This invention relates to table traversing mechanism for grinding machines and the like and comprises all of the features of novelty herein disclosed. An object of the invention is to provide improved mechanism for controlling the stroke of a reciprocating table for working traverse and for amplified movements, as for wheel dressing or work handling. Another object is to provide improved mechanism for varying the speed of reciprocation of a table at different stages of a cycle of movements. Another object is to provide improved mechanism for definitely correlating changes in the amplitude of reciprocation with changes in the speed. Still another object is to provide improved means for causing table movements to effect dressing of a grinding wheel. Yet another object is to provide a wheel dressing device which is so constructed as to enable the grinding spindle to have a small overhang and a resulting stiffer support.

To these ends and also to improve generally upon devices of the character indicated, the invention consists in the various matters hereinafter described and claimed.

In the accompanying drawings:

Fig. 1 is a front elevation of the machine with portions in section.

Fig. 2 is an end elevation, the wheel head being omitted.

Fig. 3 is an end view of an indexing mechanism.

Fig. 4 is an end view of wiring to switch contacts.

Fig. 5 is an axial section of a speed control valve.

Fig. 6 is a cross section on line 6—6 of Fig. 5.

Fig. 7 is a wiring diagram.

Fig. 8 is a piping diagram.

Fig. 9 is a plan view of a wheel head and a dressing mechanism.

Fig. 10 is an end view of Fig. 9.

Figs. 11, 12 and 13 are plan views showing different positions of the wheel and the dressing diamond with respect to the work.

The numeral 10 indicates the main frame of an internal grinding machine which supports a reciprocating table 12. Fixed to the left end of the frame is a raised support 14 for a work head of the chuckless type. This head comprises a regulating wheel 16 having a pulley 18 driven by a belt 20 from a motor 22. The work W is supported against the regulating wheel by an idler wheel 24 carried by an inclined slide 26 which is adjustable by means of a screw 28. The work is held down by a pressure idler wheel 30 carried by an arm 32 secured in a block 34 fastened to a rock shaft 36. Another arm 38 is secured to the rock shaft and carries an upright bracket 40 on which a gauge housing 42 is vertically adjusted by a screw 44. The bracket has a lower feeler 46 entering the work and supported upon its interior surface. Projecting from the gauge housing is an upper feeler 48 which engages the interior of the work and moves with respect to the lower feeler 46 as the work changes size. The movement of the upper feeler successively controls a pair of electric contacts which control the time of wheel dressing and the final sizing of the work. The foregoing structure, in its general aspects, is well known and is disclosed in greater detail in Hutchinson Patents 2,080,941 and 1,823,900.

Mounted to reciprocate with the table 12 is a plate 52 carrying a cross slide 54 for a grinding wheel head 56 which has cross feeding movement under control of a feed screw 58, the feed preferably being automatic as the table reciprocates. A quill 60 is clamped in the head and supports a rotary spindle 62 having a grinding wheel G.

The table 12 is connected to a piston rod 66 operating in a cylinder 68 mounted within the frame and controlled by a reversing valve 70 having a rock shaft or stem 72. Pressure fluid comes to the reversing valve through a pipe 74 from a metering valve 76. This metering valve, as will later appear, has a rotary indexing member which controls the speed with which the pressure fluid is supplied at various times to the reversing valve 70. A pump 78 pumps the fluid from a tank through a relief valve and a pipe 80 to the center of the metering valve. Exhaust fluid returns through a pipe 82 from the reversing valve 70 to the tank. The stem 72 of the reversing valve can be manually controlled by a starting handle 84 and is automatically rocked by a forked arm 86 engaging a pin on a link 88 which connects the plungers of two solenoids 90 and 92.

The solenoids 90 and 92 are alternately energized under control of two switches 94 and 96 carried by the table 12, each switch having a roller-carrying arm 98 engaging one of two oppositely extending horizontal arms 100 on a lever pivoted at 102 to the table. The lever has a short upwardly projecting arm 104 with a V-shaped slot which receives the end of a spring-pressed centering plunger 106. This plunger tends to hold the arms 100 in a neutral position but permits them to be tilted when a fourth arm

or finger 108 is carried against various stops as the table reciprocates. The stops are carried by an indexing shaft or drum 110 journalled in boxes 112 on the frame. One stop 114 is a continuous ring adjustably fastened to the drum by screws. The position of the stop 114 determines the limit of the inward or left hand stroke of the table. The drum has a plurality of longitudinal grooves or guides 116 located 90° apart. In one groove, a wheel-dressing stop 118 is adjustably secured by a screw. In two opposite grooves, stops 120 and 122 are adjustably secured, the position of these stops determining the limit of the outward or right hand stroke of the table as when the grinding wheel is making its cutting reciprocation in the work. Stop 114 may be an arm adjustable on frame 10.

The drum 110 has an extended shaft 124 journalled in a box 126 on the frame and carrying a ratchet wheel 128 with four notches. Pivoted on the shaft is an arm 130 carrying a pawl 132 which successively actuates the ratchet wheel through arcs of 90°, a spring pressed shoe 133 preventing overrunning. A stop pin 134 limits movement of the arm in one direction. The arm is connected by a link 136 with the plunger 138 of an indexing solenoid 140 which furnishes the indexing power. A coil spring 142 returns the plunger. On the end of the shaft 124 is a switch arm 144 having an arcuate contact plate or wiper 146 adapted to successively connect adjacent pairs of conductors at stations A, B, C and D on an insulating plate 148 attached to the frame. See the diagram.

One of the contacts at station A is wired to one of two co-operating contacts 150 in the electric gauge housing 42. These contacts 150 are set to complete a circuit when the work is nearly down to size and they institute the wheel dressing operation. One of the contacts at station C is wired to one of two co-operating contacts 152 in the gauge housing, these contacts being set to complete a circuit when the work is finished. One contact at each station is wired to the indexing solenoid 140. A contact at each of stations B and D is wired to a switch 154 which is mounted on the frame and normally tends to open but can be momentarily closed as when its roller-carrying arm 156 is engaged by a dog 158 which is adjustably secured to the table 12. This momentary closing occurs when the table is near the end of its inward or left-hand stroke. The indexing solenoid 140 is wired to a switch 160 which is mounted on the frame and is normally closed, this switch being opened only when its roller-carrying arm 162 is engaged by a dog 164 adjustably secured on the table, when such table retreats to its outermost position after the work is finished.

Fig. 1 shows the table and the finger 108 reaching the outward limit of travel for the dressing stroke, the stop 118 being effective and the stop 120 having been indexed upwardly to an inoperative position. In the usual short or grinding reciprocation, the stop 120 is at the front of the drum and the finger 108 alternately engages the ring 114 and the stop 120. Obviously, this will alternately actuate the switches 94 and 96 and alternately energize the solenoids 90 and 92 so that the reversing valve stem 72 is rocked back and forth. The gauge contacts 150 come together when the work is nearly to size, the rotary switch 144 at that time bridging the contacts at station A. The table may then be moving in either direction but nothing occurs until the table completes an inward stroke to momentarily close the switch 154. This completes a circuit through the indexing solenoid 140 and the gauge, and the drum or shaft is turned 90° to swing the rotary switch to station B, to bring the dressing stop 118 to operative position at the front, and to carry the stop 120 out of operative position. The table then makes an amplified stroke to the right until the finger 108 engages the stop 118 and causes a reversal of the table. The speed of the table is slow as will appear. On the inward stroke, the dog 158 momentarily closes the switch 154 so that the indexing solenoid 140 is again energized. This swings the switch 144 to station C and indexes the shaft or drum 110 to bring the stop 122 to operative position. Thus the table resumes its normal working reciprocation but the speed, as will appear, is faster than the dressing stroke and slower than the original reciprocation in order that a fine finish may be imparted to the work. When the work reaches size, the second set of gauge contacts 152 and the switch 154 similarly complete a circuit so that the indexing solenoid 140 is again energized and the drum turns to move the stop 122 out of operative position. Thus the finger 108 will meet no stop and the table will run out to the limit of its stroke, the dog 164 opening the switch 160 so that the electric circuits are broken. The rotary switch 144 then is at station D. When the valve 72 is actuated manually by starting handle 84 to send the table in again, the dog 158 momentarily closes switch 154 which causes another indexing movement of the drum and brings the stop 120 to the front, the rotary switch then being at station A.

To produce the desired variations in speed of table reciprocation in synchronism with the above described control of the amplitude of the table stroke, the indexing shaft or drum controls the metering valve 76. The drum has a shaft extension 170 journalled in an extension of the valve casing. Fixed to the end of the shaft within the valve casing is a plug or disc 172 having an angular port 174 which successively connects a central chamber 176 with a series of radial ports 178 each intersecting an axial port 180 in the valve body. Each port 180 intersects a conical recess 182 which opens outwardly into a circular passage 184 which delivers pressure fluid to the pipe 74. There are four needle valves 186 adjustably secured in radial positions in the valve body. They are individually set to produce the desired speed of reciprocation of the table for each stage of the operation. For instance, the diamonding stroke desirably has the slowest speed and the corresponding needle valve would be nearly closed. The initial short working reciprocation would be quite fast while coarse feed grinding occurs and the corresponding valve would be well open. The final short working reciprocation should be slower to produce a good finish and the corresponding valve would be less open. The final retreat of the table and its initial run in can be at fast speed and the corresponding valve would be wide open. These speeds are easily changed at any time by adjusting the valves 186.

In the usual internal grinding machine, the dressing diamond is shifted rearwardly out of the way of the wheel head during grinding reciprocation and is brought forward when dressing is to occur. The mechanism for causing this movement at the proper time has hitherto been complicated. The present invention maintains the dressing diamond in a forward position with provision for sliding it parallel to the wheel axis and so makes possible the use of a short stubby

spindle which reduces the overhang of the wheel beyond its support. The wheel cannot engage the work and the diamond at the same time. The diamond 190 is carried on an adjusting screw 192 threaded in a housing 194 on a slide 196 which is shiftable lengthwise in an upwardly open groove or guideway 198 having a cover plate 200. The slide has a cross pin 202 which is connected by a coil spring 204 to the head, the spring urging the cross pin against a stop 206 on the head. Thus the slide and the diamond tend to follow all normal sliding movements of the table and reciprocate therewith. The end of the slide is spaced from a stop screw 208 secured to the frame of the machine independently of the table. The space is such that the slide will not engage the stop screw upon normal short table-reciprocation. However, when the table makes its amplified dressing stroke to the right, the slide finally engages the stop screw 208, and the slide and the diamond are held from further retreat with the wheel and the table, the coil spring 204 then becoming elongated. As the wheel retreats, it is carried slowly across the diamond and then returns to resume the grinding stroke. During dressing, the diamond is far enough out from the work so that the wheel will not engage it and the work at the same time. When the wheel returns, the diamond is shifted out of the way of the quill 60 and the overhang of the wheel spindle beyond the quill can be desirably short.

Figs. 9 and 11 indicate the limits of normal working reciprocation of the wheel. The diamond follows these movements but the slide 196 does not engage the stop screw 208 until the wheel starts to withdraw from the work for the dressing operation. Then the diamond stops moving and the wheel traverses slowly across it from the position shown in Fig. 12 to the position shown in Fig. 13. The stop 206 which is adjustable recedes from the pin 202 which remains stationary until, upon the return stroke, the stop again engages the pin and shifts the diamond away from the advancing quill 60 or rather keeps the diamond in advance of the quill.

Thus, during the grinding traverse, the diamond maintains a relatively fixed relation to the spindle and is as close to the wheel as it can be and still avoid contact with the work or the work holder when the wheel is at the end of its entering stroke. The quill or spindle support is close to the diamond and closer than it could be to the grinding wheel if the diamond were fixed in the dressing position shown in Fig. 12. Accordingly, the spindle has minimum overhang from its supporting quill and the wheel has a stiff support, and yet there is provision for locating the diamond in a dressing position sufficiently far from the work so that the wheel will not have the undesired contact with the work while the wheel traverses the diamond.

I claim:

1. In a machine of the character indicated, a frame, a table mounted to reciprocate with respect to the frame, a reversing member, means to engage the reversing member to determine the limit of table travel in one direction, a shaft having a plurality of stops movable successively into operative relation to the reversing member to change the stroke of the table in the opposite direction, ratchet mechanism for turning the shaft step by step, and a work gauging device to control at least one of the step by step movements of the shaft; substantially as described.

2. In a machine of the character indicated, a frame, a table mounted to reciprocate with respect to the frame, a reversing member, a stop to engage the reversing member to determine the limit of table travel in one direction, a shaft having a plurality of stops movable successively into operative relation to the reversing member to change the stroke of the table in the opposite direction, ratchet mechanism for turning the shaft step by step, and means operated by movement of the table to control one of the step by step movements of the shaft; substantially as described.

3. In a machine of the character indicated, a frame, a table mounted to reciprocate with respect to the frame, a reversing member, a stop to engage the reversing member to determine the limit of table travel in one direction, a shaft having a plurality of stops movable successively into operative relation to the reversing member to change the stroke of the table in the opposite direction, ratchet mechanism for turning the shaft step by step, a work gauging device controlling one of the step by step movements of the shaft, and means actuated by movement of the table for causing another step by step movement of the shaft; substantially as described.

4. In a machine of the character indicated, a frame, a table mounted to reciprocate with respect to the frame, a reversing member, a stop to engage the reversing member to determine the limit of table travel in one direction, a shaft having a plurality of stops movable successively into operative relation to the reversing member to change the stroke of the table in the opposite direction, ratchet mechanism for turning the shaft step by step, a solenoid for operating the ratchet mechanism, and a work gauging device and a table operated switch for causing repeated energizing of the solenoid; substantially as described.

5. In a machine of the character indicated, a frame, a table mounted to reciprocate with respect to the frame, a work head on one of said members and a wheel head on the other, a reversing member, stroke limiting means to engage one side of the reversing member to determine the limit of table travel in the direction causing approach of the heads, a shaft mounted in proximity to the reversing member, stops mounted on the shaft in angularly spaced relation and adapted to engage the other side of the reversing member in sequence, said stops including a spaced pair having substantially the same longitudinal position on the shaft and an intermediate stop having a different longitudinal position, and means for rotating the shaft step by step to bring the three stops successively into operative relation to the reversing member and to finally move all of the stops out of operative relation to the reversing member to provide successive changes in the length of table reciprocation and a final remote retreat of the table beyond the range of said successive changes in length of reciprocation; substantially as described.

6. In a machine of the character indicated, a frame, a table mounted to reciprocate with respect to the frame, power operated means to reciprocate the table and comprising a reversing valve, a rotary shaft, stops spaced angularly and longitudinally on the shaft to operate the reversing valve and to control changes in the amplitude of table reciprocation, a series of throttling valves spaced angularly with respect to the shaft and all communicating with said reversing valve

to control speed of reciprocation, means on the shaft to make said throttling valves effective in sequence, and means for giving the shaft a step by step rotation to bring a new stop and a new throttling valve into action; substantially as described.

7. In a machine of the character indicated, a frame, a table mounted to reciprocate with respect to the frame, means for causing successive changes in the amplitude of the reciprocating stroke of the table, a metering valve having a throttling member corresponding to each amplitude, a rotary shaft having means to cause successive action of the throttling members to change the speed of the table when the amplitude of reciprocation is changed, ratchet mechanism for turning the shaft step by step, and a work gauging device to control energizing of the ratchet mechanism; substantially as described.

8. In a machine of the character indicated, a frame, a table mounted to reciprocate with respect to the frame, a metering valve having a series of angularly spaced throttling members to change the speed of reciprocation in a series of steps, a rotary indexing shaft having means to cause successive action of the angularly spaced throttling members, and means comprising a series of spaced stop members mounted on the shaft and directly controlled by the turning of the shaft to effect successive changes in the amplitude of table reciprocation corresponding to the changing speeds; substantially as described.

9. In a machine of the character indicated, a work head, a wheel head, a spindle projecting from the wheel head and having a grinding wheel, means for causing relative movement of reciprocation between the wheel and the work for grinding traverse, a dressing tool having a supporting slide shiftable with respect to the wheel head, a spring for urging the slide to a limiting position, a stop normally spaced from the slide, and means for causing separation of the wheel and the work, to thereby effect engagement between the slide and the stop and a resulting traversing engagement between the wheel and the dressing tool; substantially as described.

10. In a machine of the character indicated, a work head, a wheel head, a spindle projecting from the wheel head and having a grinding wheel, means for reciprocating the wheel head to traverse the wheel along the work, a dressing tool having a supporting slide shiftable with, and with respect to, the wheel head, a spring for urging the slide to a limiting position on the wheel head, a stop normally spaced from the slide, and means for amplifying the stroke of the wheel head to cause the slide to engage the stop and effect traversing engagement between the wheel and the dressing tool; substantially as described.

11. In a machine of the character indicated, a work head, a wheel head, a spindle projecting from the wheel head and having a grinding wheel to engage the work, a dressing tool adjacent to the spindle and having a supporting slide shiftable upon the wheel head, a stop to engage and arrest the slide, and means for shifting the wheel head towards the stop to retract the wheel from the work and traverse the wheel along the dressing tool; substantially as described.

12. In a machine of the character indicated, a work head, a wheel head, a spindle projecting from the wheel head and having a grinding wheel to engage the work, a dressing tool adjacent to the spindle and having a supporting slide shiftable upon the wheel head, a spring urging the slide to a limiting position on the wheel head, a stop in the path of the slide, and means for shifting the wheel head and the slide towards the stop to retract the wheel from the work and traverse the wheel along the dressing tool; substantially as described.

13. In a machine of the character indicated, a work head, a wheel head, a spindle projecting from the wheel head and having a grinding wheel to engage the work, a dressing tool adjacent to the spindle and having a supporting slide shiftable with, and with respect to, the wheel head, a stop normally spaced from the slide, and means for shifting the wheel head to retract the wheel from the work and to cause the slide and the stop to engage one another to effect a relative traversing engagement between the dressing tool and the wheel; substantially as described.

14. In a machine of the character indicated, a work head, a wheel head, a spindle projecting from the head and having a grinding wheel, means for reciprocating the wheel head for grinding traverse along the work, a dressing tool slidably mounted on the wheel head, means for causing the dressing tool to reciprocate with the wheel head during the grinding traverse to keep the dressing tool out of contact with the wheel head, and means to stop the reciprocating movement of the dressing tool upon an amplified stroke of the wheel head to provide for traversing the wheel across the dressing tool; substantially as described.

15. In a machine of the character described, a frame, a table mounted to reciprocate with respect to the frame, a work head on one of said members and a tool head on the other, a reversing member, means to engage the reversing member to determine the limit of table travel in the direction causing approach of the heads, a rotary indexing shaft having a plurality of stops movable successively into operative relation to the reversing member to change the stroke of the table in the direction causing separation of the heads, a plurality of speed determining members spaced angularly of said indexing shaft, and a member mounted on said shaft and indexed therewith to make said speed determining members effective in sequence to change the speed of table reciprocation when the stroke of reciprocation is changed; substantially as described.

16. In a machine of the character described, a frame, a table mounted to reciprocate with respect to the frame, a reversing member, means to engage the reversing member to determine the limit of table travel in one direction, a rotary indexing shaft having a plurality of stops movable successively into operative relation to the reversing member to change the stroke of the table in the opposite direction, a plurality of throttling members spaced angularly with respect to said indexing shaft, and a member mounted on said shaft and indexed therewith to make said throttling members effective in sequence to change the speed of table reciprocation when the stroke of reciprocation is changed by said stops; substantially as described.

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