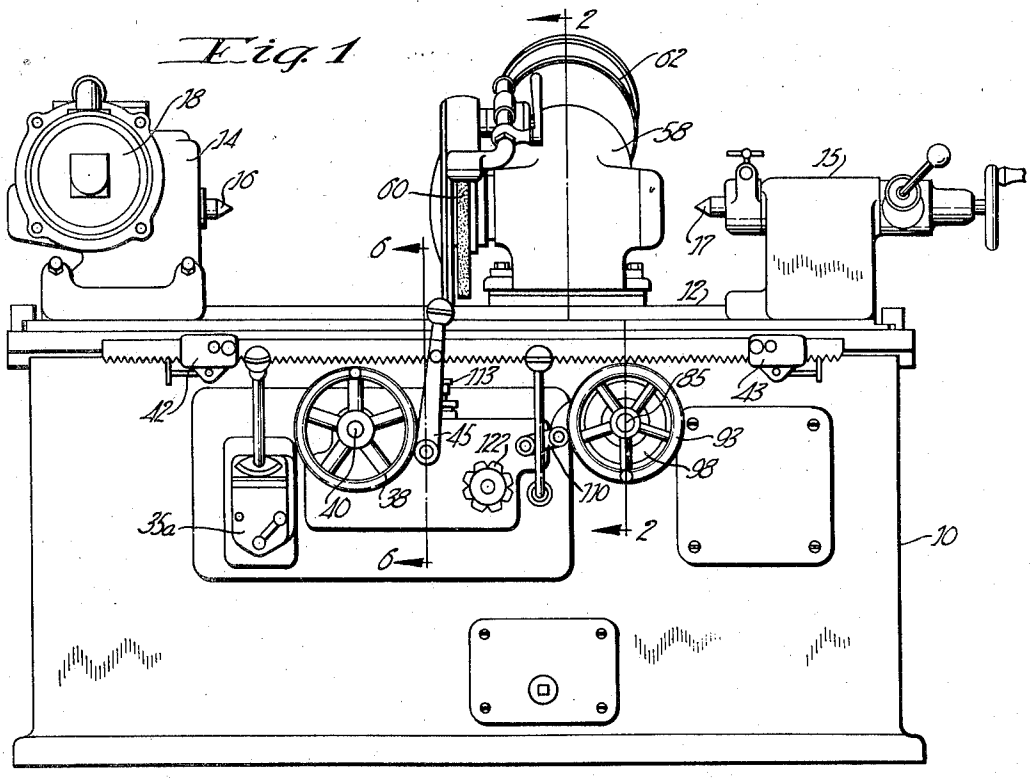
Oct. 23, 1934. F. S. HAAS 1,978,132

GRINDING MACHINE

Original Filed April 2, 1931 3 Sheets-Sheet 1

Fig. 1



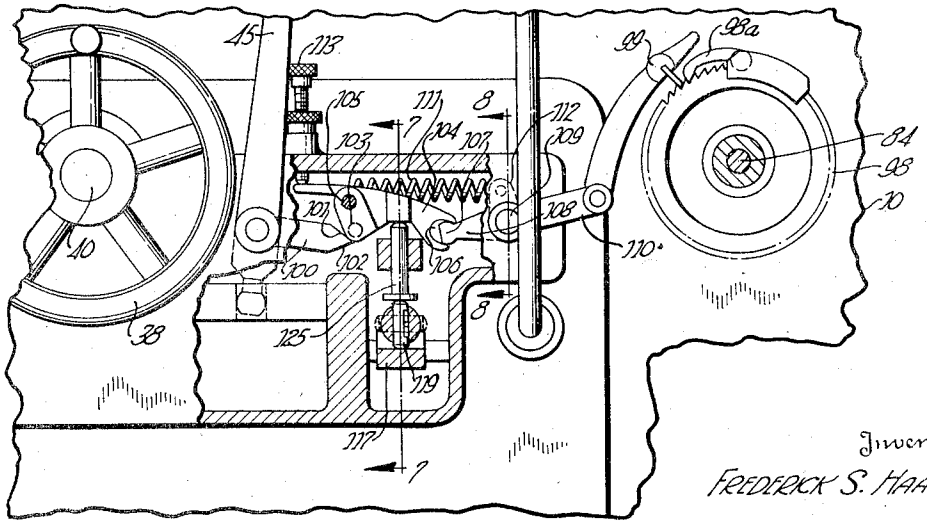


Fig. 3

Inventor
FREDERICK S. HAAS

By H. K. Parsons
Attorney

Oct. 23, 1934. F. S. HAAS 1,978,132

GRINDING MACHINE

Original Filed April 2, 1931 3 Sheets-Sheet 2

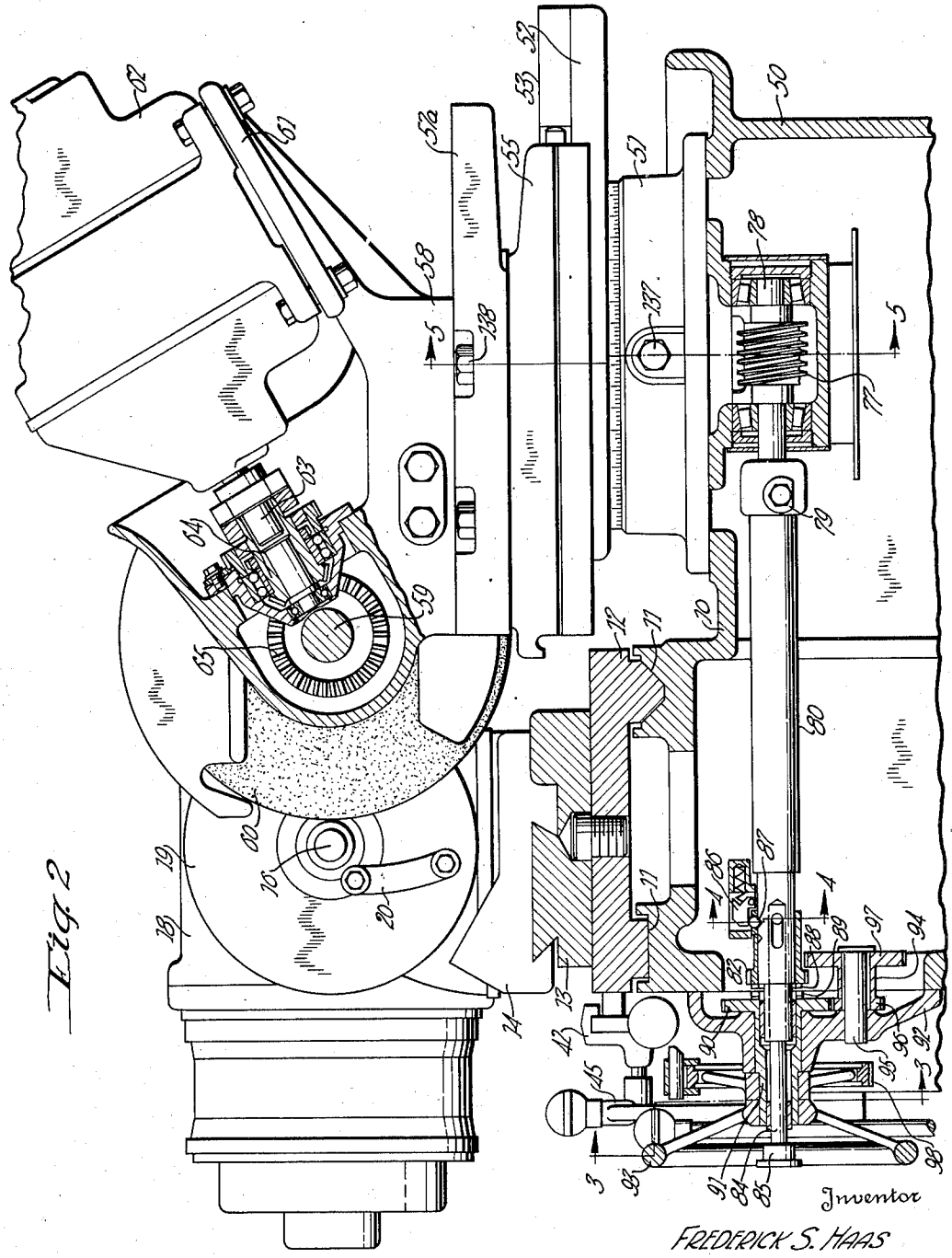


Fig 2

Inventor

FREDERICK S. HAAS

By H K Parsons

Attorney

Oct. 23, 1934. F. S. HAAS 1,978,132

GRINDING MACHINE

Original Filed April 2, 1931 3 Sheets-Sheet 3

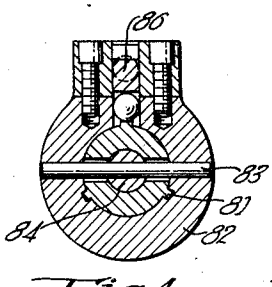


Fig. 4

Fig. 5

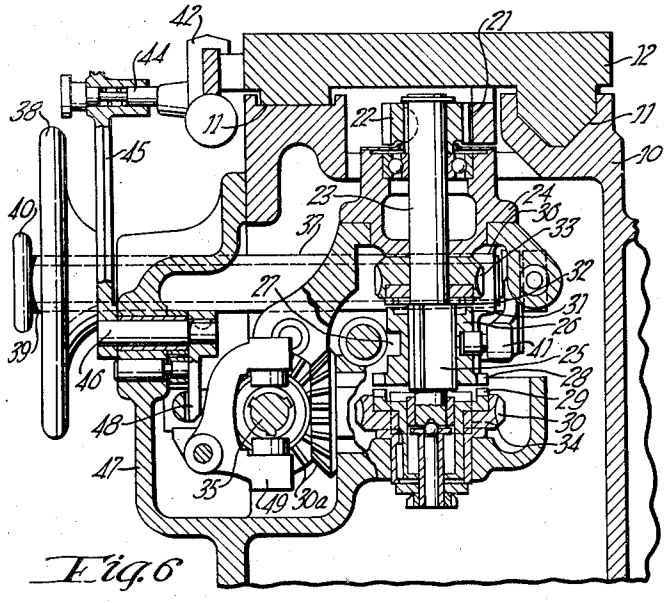


Fig. 6

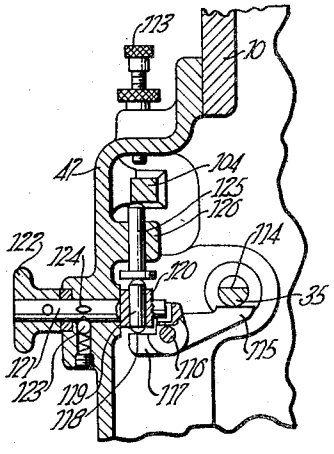


Fig. 7

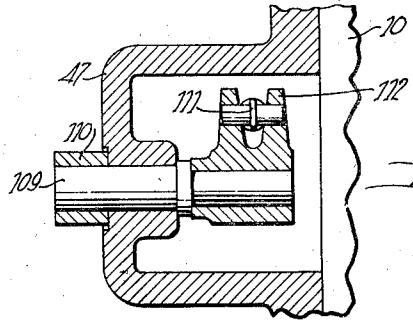


Fig. 8

Inventor

FREDERICK S. HAAS

By H. K. Parsons

Attorney

Patented Oct. 23, 1934 1,978,132

UNITED STATES PATENT OFFICE

1,978,132

GRINDING MACHINE

Frederick S. Haas, Cincinnati, Ohio, assignor to Cincinnati Grinders, Incorporated, Cincinnati, Ohio, a corporation of Ohio

Original application April 2, 1931, Serial No. 527,251. Divided and this application October 7, 1932, Serial No. 636,714

4 Claims. (Cl. 74—440)

This is a divisional application of my application filed on April 2, 1931, having been given Serial Number 527,251.

The invention relates to improvements in machine tools and especially to improvements in mechanism or means for eliminating the play or back lash between driven and driving members utilized for moving or adjusting a slide or other part of the machine.

An object of the invention is the provision of improved means for eliminating the back lash or play between the teeth of a driven rack and its driving pinion frequently employed for effecting the movement or translation of part of a machine tool organization.

Another object of the invention is the provision of improved means for eliminating back lash between the teeth of driving and driven members regardless of the direction of drive.

Other objects and advantages of the present invention should be readily apparent by reference to the following specification considered in conjunction with the accompanying drawings and it is to be understood that any modifications may be made in the exact structural details there shown and described, within the scope of the appended claims, without departing from or exceeding the spirit of the invention.

In the drawings:

Figure 1 is a front elevational view of a grinding machine embodying the improvements of this invention.

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

Figure 3 is a view partly in elevation and partly in section as seen from line 3—3 of Figure 2.

Figure 4 is a sectional view taken on line 4—4 of Figure 2.

Figure 5 is a sectional view on line 5—5 of Figure 2.

Figure 6 is a view taken substantially on line 6—6 of Figure 1.

Figure 7 is a sectional view taken on line 7—7 of Figure 3.

Figure 8 is a sectional view on line 8—8 of Figure 3.

Throughout the several views of the drawings similar reference characters are employed to denote the same or similar parts.

A device of this invention may comprise a base or bed 10 having formed at its upper end guideways 11 for a reciprocating table 12. A swiveled plate 13 is mounted on the table 12 and supports for adjustment relative thereto a headstock 14 and a tailstock 15. Centers 16 and 17 are carried respectively by the head and tailstocks and extend toward one another for supporting a work piece to be operated upon. A motor 18 is operatively associated with the headstock 14 for driving a suitable face plate 19 which carries the dog 20 for effecting a rotation of the work.

In order to effect movement or reciprocation of the table 12 and parts carried thereby the said table is provided on its under face with a rack 21 meshing with a pinion 22 keyed or otherwise secured to a vertical shaft 23 suitably journaled in anti-friction bearings in a bracket 24 supported by the bed. The shaft 23 is provided intermediate its ends with a splined portion 25 slidable of which is a clutch spool 26 having a peripheral groove 27 formed therein. The clutch spool 26 has formed on one end thereof clutch teeth 28 adapted to mesh with complementary clutch teeth 29 secured to a worm wheel 30. Clutch teeth 31 are formed on the other end of the clutch spool 26 for engagement with clutch teeth 32 carried by a worm wheel 33. The worm wheel 30 is adapted to be power driven by worm 34 driven through the gears 30A from reversing shaft 35 receiving its power from any suitable or desirable source which drives through a suitable speed change mechanism 35A to control the ultimate rate of the reversing shaft. The worm wheel 33 is driven by a worm 36 on shaft 37 which carries at its outer end a hand wheel 38. The manually operable shaft 37 is tubular in form and has extending therethrough a clutch shifter rod 39 which has on one end knob 40 and on the other end suitable mechanism for actuating clutch shifter fork 41 received in the peripheral groove 27 of the clutch spool 26.

The knob 40 and clutch shifter rod are rotatable and have a plurality of positions for positioning the clutch spool 26 in the neutral position, shown in Figure 6, and for engaging either clutch teeth 28 and 29 or clutch teeth 31 and 32.

In order that the table 12 may be reversely longitudinally shifted it is provided with the usual adjustable trip dogs 42 and 43 adapted to engage at opposite limits of movement of the table with a plunger 44 carried by reversing lever 45 secured to stud 46 oscillatably journaled in reversing plate 47. The stud 46 has secured to its inner end a shifter lever 48 for actuating the shifter fork 49 to connect the usual reversing mechanism with the power driven reversing shaft 35 for effecting reverse actuation of the worm wheel 30 and work supporting table 12.

The bed 10 is provided with an extension 50 to which is secured the base 51 for the cross feed slides and carriage. A swivel plate 52 is mounted on the base 51 and is formed with a dove-tailed guide 53 received in a similarly formed way 54 of slide 55. A trunnion 56 is formed integral with the slide 55 and projects above said slide being received in a socket 57 carried by intermediate plate 57A to which is secured the tool carriage 58. The carriage 58 has rotatably journaled therein a spindle 59 for the grinding wheel 60. A bracket 61 on the carriage 58 supports a motor 62 to the shaft 63 of which motor a bevel pinion 64 is secured meshing with a gear 65 on the spindle 59 for effecting its rotation and rotation of the grinding wheel. The base 51 has formed integral therewith a bearing sleeve 127 which has extending above the base 51 an external bearing 128 received in a bore 129 of the swivel plate 52. The swivel plate is also provided with a T slot 130 receiving the heads 131 of clamp studs 132 each having a notch 133 formed therein. One wall 134 of the notches 133 is inclined and cooperates with the tapered nose 135 of clamp pins 136 operated by clamp screws 137 threadedly received in and projecting through the base plate 51 as seen in Figure 5. The intermediate plate 57A and carriage 58 are swiveled about the axis of trunnion 56 and are clamped to the slide 55 by means of clamp screws 138 extending through suitable bores in the intermediate plate and having angularly related heads 139 on one end thereof. These heads 139 are received in a clamping slot 140 formed in the slide 55.

The grinding wheel 60 is fed toward the work either by manual or power means through a rack 66 secured to the under face of the slide 55 and meshing with a pair of rack pinions 67 and 68. The pinion 68 is formed on the end of a tubular shaft 69 journaled in suitable anti-friction bearings supported by the bearing sleeve 127 integral with or secured to the base 51. A worm wheel 70 is secured to the other end of the tubular shaft and is provided interiorly thereof with a lug 71 forming an abutment for a tightly coiled spring 72. The other end 73 of spring 72 extends through a slot 74 of a spring retainer 75 keyed to the lower end of a shaft 76 which has formed integral therewith at its other end the pinion 67. The spring 72 tends to uncoil thereby tending to rotate the pinions 67 and 68 in opposite directions or cause the opposite sides of corresponding teeth of the pinions 67 and 68 to engage the opposed walls of the space between adjacent rack teeth in rack 66 thereby eliminating all play or back lash between the teeth of the rack 66 and the teeth of the pinions 67 and 68.

The worm wheel 70 has meshing with it worm 77 formed on shaft 78 coupled as at 79 with shaft 80. The forward end 81 of shaft 80 is splined for the complementary splined pinion 82 which is slidable relative to the portion 81. The pinion 82 is connected by a pin 83 with a shifter rod 84 slidable in a bore formed in the outer end of the shaft 80. The slide or shifter rod 84 has secured to its free end a knob 85 and the pinion 82 carries a spring pressed detent 86 cooperating with notches 87 formed in the shaft 80 for locking the pinion 82 and slide rod 84 in adjusted positions. The forward end of the pinion 82 is further provided with clutch teeth 88 adapted to mesh with clutch teeth 89 formed on gear 90. The gear 90 has extending from it a bearing sleeve 91 journaled in a bracket 92 secured to the bed 10 and the said sleeve has secured to it a hand wheel 93. The bracket 92 also carries a stud 95 on which is journaled a compound gear 94 having pinion 96 and gear 97. The gear 90 meshes with the pinion 96 while the gear 97 meshes with the pinion 82. Actuation of the pinion 82 through the shifter rod 84 will disengage the pinion 82 and gear 97 and will mesh the clutch teeth 88 and 89.

From the foregoing it will be noted that with the parts in the position shown in Figure 2 the grinding wheel may be advanced toward the work at a rapid rate since the gear ratios 90, 96, 97 and 82 will speed up rotation of the worm 77 relative to the speed of rotation of the hand wheel 93. If the clutch teeth 88 and 89 are engaged the speed of the shaft 80 and worm 77 will be the same as the speed of the hand wheel 93.

In order to feed the grinding wheel by power means the gear sleeve 91 has secured to it intermediate the hand wheel 93 and the bracket 92 a pick feed ratchet 98 cooperating with a pawl 99 operable at each end of movement of the table 12 by means to be later described or operable by other means when the table 12 is held against longitudinal movement.

As was noted above, the wheel 70 may be fed toward the work intermittently at short intervals, as for example, when grinding a piece of work of substantially the same width as the grinding wheel or may be fed intermittently at longer intervals as when traversing the work relative to the grinding wheel. The former method is frequently known as the continuous in-feed method for the performance of plunge cut grinding operations while the latter is designated as traverse cylindrical grinding. When grinding by the latter method use is made of the reversing lever 45 which, as was noted above, is secured to stud 46 oscillatable with the movement of the lever 45. An arm or pawl 100 is secured to the stud 46 for movement therewith which arm is provided at its forward end with cam faces 101 and 102 engaging a roller 103 on rocker arm 104. The rocker arm 104 is pivoted at 105 to reversing plate 47 and has formed in its one end a socket 106. The ball end 107 of arm 108 is received in the socket 106 and the said arm 108 is secured to oscillatable shaft 109 coupled by link 110 with the pick feed pawl 99. A spring 111 has one end secured to the split ear 112 of the arm 108 for returning said arm to its normal position and for positioning the pawl 99 for the next feeding movement. An adjustable stop 113 limits the movement of rocker arm 104 in one direction to determine the amount of feed to be given the grinding wheel and its slide at each reversal of the supporting table.

From this it will be seen that with the reversing lever 45 in the position shown in Figure 1 and assuming the table 12 traveling to the left, as seen therein, the lever 45 will be oscillated in a counter-clockwise direction causing the cam face 101 of the arm 100 to oscillate the rocker arm 104 in a counter-clockwise direction and, through the pawl 99, advance the ratchet 98. The reversing lever would then be inclined in the opposite direction to that shown in Figure 1 so that with the table traveling to the right the lever would be oscillated in a clockwise direction thereby causing cam face 102 of the arm 100 to again oscillate rocker arm 104 and additionally advance the ratchet 98.

In order to feed the grinding wheel at comparatively short intervals and without traversing the work supporting table, use is made of the reversing shaft 35 which, as shown in Figure 7,

has formed thereon a flat 114 cooperating with arm 115 for oscillating same about pivot shaft 116. The arm 115 is provided on the other side of the pivot 116 with a tang 117 having a flat face 118 abutting one end of a pin 119 slidable in socket 120. The socket 120 is integral with a shaft 121 extending through the reverse plate 47 to a convenient position within reach of the operator and has pinned to its outer end an actuating knob 122. A spring actuated detent 123 cooperates with notches 124 formed in the shaft 121 for holding the said shaft in adjusted positions. The shiftable pin 119 abuts on its upper end with a sliding stud 125 mounted in bearing 126 carried by the reverse plate 47. The sliding stud 125 in turn abuts with the rocker arm 104 for oscillating said arm about the pivot 105. The spring 111 maintains contact between the arm 115 and the reversing shaft 35 so that each time the flat 114 on the reversing shaft is aligned with the end of the arm 115 the said arm 115 falls onto the flat thereby allowing the rocker arm to oscillate in a counterclockwise direction about the pivot 116 and position the pawl 99 for the next in-feed movement of the ratchet which is obtained by engagement of the arm 115 with the concentric part of the shaft 35 which returns the said arm 115 to its other position.

The operation of the mechanism is as follows: A work piece is mounted between the centers 16 and 17 which have been adjusted to the desired length of work. In the event the work is of greater length than the width of the grinding wheel 60 the knob 122 is rotated a quarter of a turn to dispose the pin 119 at right angles to the position shown in Figure 7, at which time it will be in the dotted line position shown in Figure 3. The dogs 42 and 43 are now adjusted so that each time the work has gone past the grinding wheel its full length one of the dogs engages the reversing lever 45 to change the direction of reciprocation of the work table 22. Engagement of the lever 45 with one of the dogs oscillates the pawl 100 about the axis of stud 46 for actuating the rocker arm 104 in the direction to tension the spring 111 so that as soon as the pawl 100 falls free of the rocker arm the spring returns the rocker arm to its normal position thereby rotating the ratchet 98 an amount permitted by the previous adjustment of the feed stop 113. This cycle continues until the work is down to size at which time the pawl 99 is thrown out of engagement with the ratchet 98 by the guard 98*a* carried by the said ratchet.

Should the work be of a length substantially equal to the width of the face of the grinding wheel and it is to be ground by the plunge cut method, the knob 122 is positioned, as shown in Figure 7, at which time the inner end of the arm 115 is held against the reversing shaft 35 so that at each revolution of the said reversing shaft 35 the arm 115 is oscillated about the axis of pivot 116 which oscillation, through the sliding pin 119 and stud 125, oscillates the rocker arm 104 in a manner similar to that obtained through the pawl 100. This relatively continuous in-feed of the grinding wheel is effected until the work is down to size when the guard 98*a* again slides under the pawl 99 and disengages it from the ratchet 98.

The speed at which the grinding wheel will be fed into the work is determined by the position of the pinion 82 on the cross feed shaft 80 which, if in engagement with the gear 97 as shown in Figure 2, will be at a relatively rapid rate due to the particular ratio between gear 90 and pinion 96 and gear 97 and pinion 82. If, however, it is desired to provide a fine finish on the work, which means that the feeding would have to be effected at a comparatively slow rate of speed, then a shifting of the pinion 82 through the knob 85 will connect clutch teeth 88 and 89 so that the shaft is rotated at the same speed as the ratchet wheel 93 or hand wheel 93.

All back lash and play between the teeth of the driving pinion and the rack associated with the grinding wheel carriage being taken up, as noted above, the work will be reduced to an accurate dimension and given a comparatively fine finish since the possibility of chatter between the wheel and work is reduced to an absolute minimum. The tension of the spring 72 will not only provide the most desirable fit between the pinion and rack when the machine is first built but will take up the wear between the pinion and rack while in use so that the same fine fit will be maintained between the parts throughout the life thereof. Since the tension of the spring can neither be lessened or increased during use, the parts when first assembled will always maintain their proper and desired positions.

Frequently due to the character or form of the work being operated upon it is desirable to feed the work and tool toward one another other than in paths at right angles. To take care of this situation the entire tool or grinding wheel supporting mechanism may be oscillated about the axis of the sleeve or bracket 127 on the bearing 128. This would dispose the axis of the swivel plate 52 and guide 53 at an angle to the axis of base 51, or the angular adjustment may be obtained by actuating the intermediate plate 57*a* and carriage 58 about the trunnion 56 without disturbing the position of the swivel plate 52 and slide 55. In either event it will be noted that the axis of oscillation is coincident with the axis of rotation of the pinions 67 and 68 so that regardless of the angular adjustment of the parts all lost motion or back lash will be eliminated.

What is claimed is:

1. In a machine tool organization the combination of a bed, a slide carried thereby and movable relative thereto, a rack having a plurality of adjacent teeth secured to the slide, a pair of rack pinions each having a tooth within the space between a pair of adjacent teeth, a shaft carried by each pinion and the shafts telescoping with one another, and a coiled spring having its one end connected with the end of one of the shafts and its other end connected to the end of the other shaft, whereby the tendency of the spring to uncoil will cause opposite faces of the pinions' teeth to engage opposite walls of the space between the rack teeth.

2. In a machine tool organization the combination of a bed, a slide carried thereby and movable relative thereto, a rack having a plurality of adjacent teeth secured to the slide, a pair of rack pinions each having a tooth within the space between a pair of adjacent teeth, a shaft carried by each pinion and the shafts telescoping with one another, a coiled spring having its one end connected with the end of one of the shafts and its other end connected to the end of the other shaft, whereby the tendency of the spring to uncoil will cause opposite faces of the pinions' teeth to engage opposite walls of the space between the rack teeth, a worm wheel carried by one of the shafts, and means engaging the worm wheel

to rotate same and the shaft carried thereby to effect actuation of the slide.

3. In a machine tool organization the combination of a slide, a rack secured to the slide, a pair of pinions having their axes co-incidental and engaging with the rack, a shaft for each pinion, power driven means secured to one of said shafts, a spring retainer secured to the other shaft, yielding means having one end secured to the power driven means and the other end secured to the spring retainer for rotating the shafts in opposite directions, and power means for rotating the power driven member to rotate the pinions in a given direction.

4. In a grinding machine of the class described the combination of a bed, a grinding wheel carriage mounted thereon for movement relative thereto, a cross feed mechanism including a rack carried by the carriage, a driving pinion intermeshed with the rack, a shaft for the pinion, means carried by the shaft adapted to be power actuated for correspondingly actuating the shaft and driving pinion, and means for eliminating the back lash between the driving pinion and the rack comprising a second pinion intermeshed with the rack, a shaft depending from the second pinion, and a spring having one end secured to the power driven member of the driving rack shaft and having its other end secured to the shaft of the second pinion and tending to actuate said second pinion in a direction opposite to the direction of actuation of the driving pinion.

FREDERICK S. HAAS.