July 20, 1937 E. T. BYSSHE ET AL 2,087,662

GRINDING MACHINE

Filed Feb. 24, 1936 2 Sheets-Sheet 1

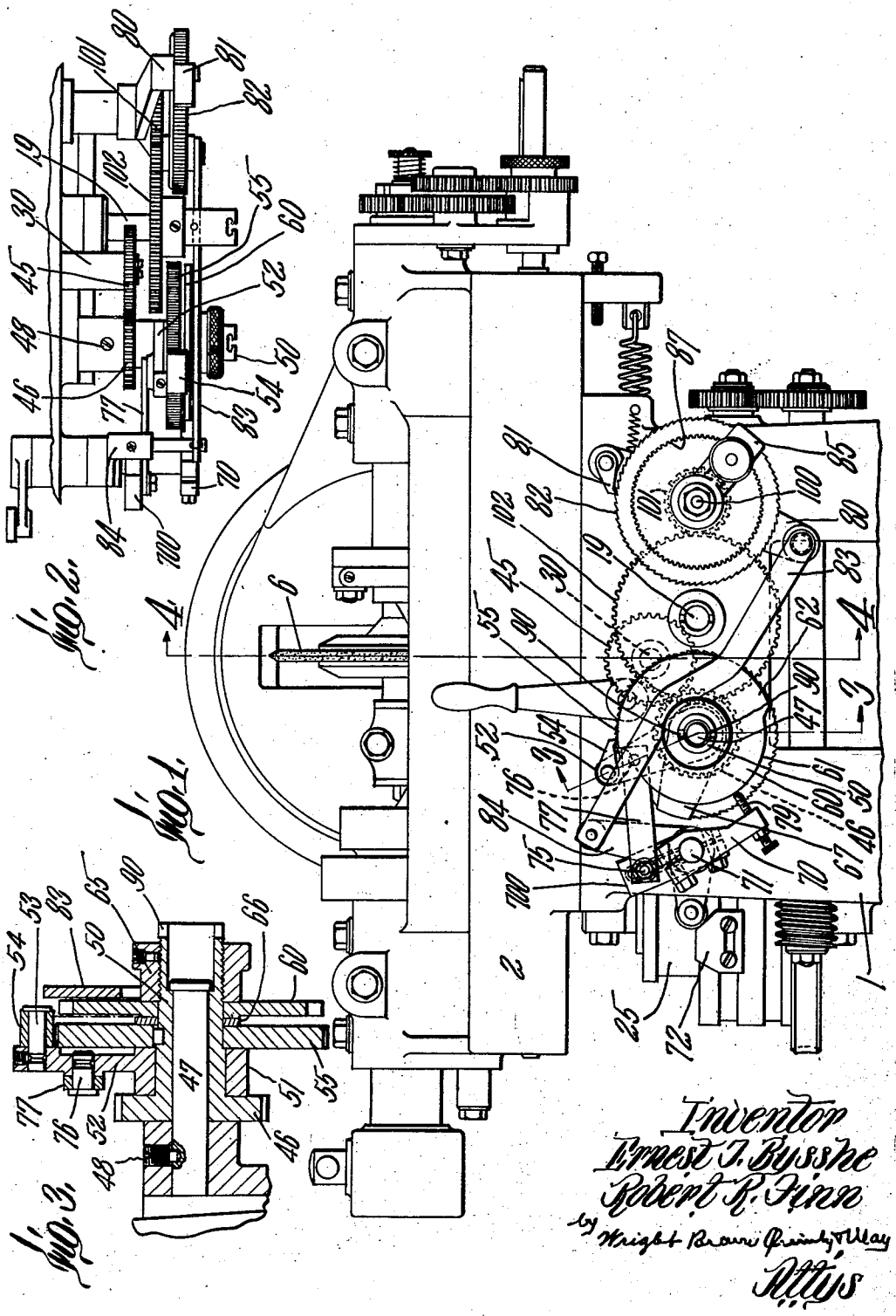


Fig. 2.

Fig. 1.

Fig. 3.

Inventor
Ernest T. Bysshe
Robert R. Finn
by Wright Brown Quinby & Clay
Attys

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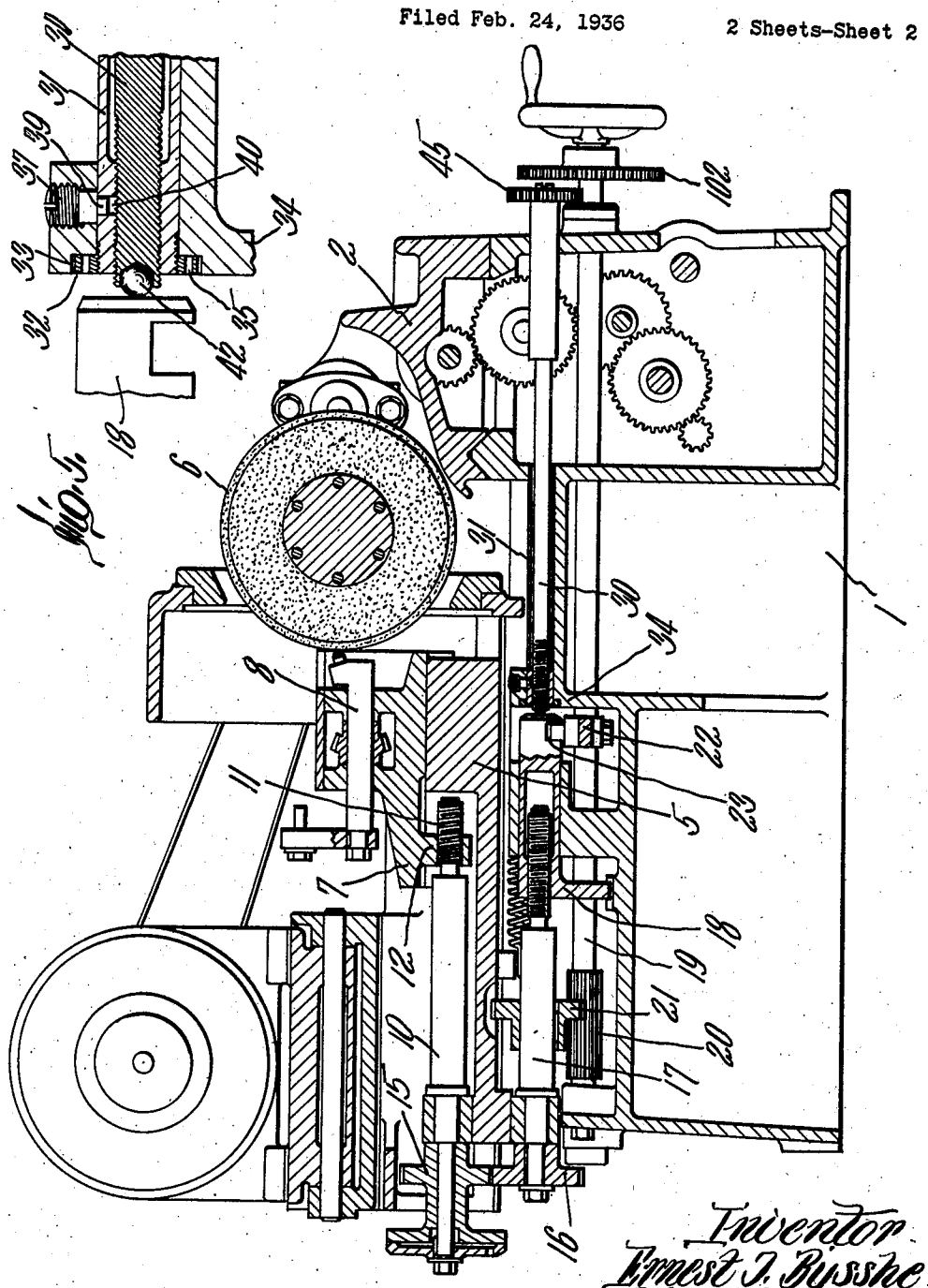


Fig. 1.

Inventor
Ernest T. Bysshe
Robert R. Finn
by Wright Brown Quinby & Clay
Attys

Patented July 20, 1937 2,087,662

UNITED STATES PATENT OFFICE

2,087,662

GRINDING MACHINE

Ernest T. Bysshe and Robert R. Finn, Springfield, Vt., assignors to Jones & Lamson Machine Company, Springfield, Vt., a corporation of Vermont

Application February 24, 1936, Serial No. 65,198

7 Claims. (Cl. 51—95)

This invention relates to grinding machines and has for its chief object to provide for separate adjustment of the feed of the truing device relative to the wheel and of the feed of the wheel itself relative to the work, but with these feeds so related to each other that no matter what the extent of truing feed is, the final feed position of the wheel will bring its cutting portion to the same point, so that the accuracy of size of the finished work is not affected by changes in the extent of truing of the wheel.

A further object is to provide a grinding machine having separate adjustments of feed and truing and in which, if desired, truing of the wheel may be effected at predetermined times during the grinding operation prior to approaching final size of the work. This is of particular advantage when it is desired to cut threads, or the like, from solid stock, in order that the grinding wheel may be maintained in proper contour throughout the grinding operation. When grinding from solid stock, the wheel might otherwise become badly misshapen before reaching final truing position.

A further object of this invention is to provide for decreasing the extent of wheel and truing feed as the work approaches final finished size so as to provide for a finishing grinding cut, and the maintenance of accurate contour of the wheel by the truing action.

Further and advantageous constructions will appear from a more complete description of an embodiment of this invention shown in the accompanying drawings, in which

Figure 1 is a fragmentary front elevation of a grinding machine of the type shown in the Flanders Patent No. 1,739,753, granted December 17, 1929, and in which this invention is embodied.

Figure 2 is a fragmentary top plan showing portions of the wheel and truing device feed mechanisms with their connections.

Figure 3 is a detail section on line 3—3 of Figure 1.

Figure 4 is a vertical cross section on line 4—4 of Figure 1.

Figure 5 is a sectional detail to a larger scale of parts shown in Figure 4.

Referring to the drawings, at 1 is indicated the base of the grinding machine on which is mounted for reciprocation a work carriage 2 having suitable head and tailstocks for supporting work. This carriage may be reciprocated by means completely shown and described in the Flanders Patent No. 1,739,753, to which reference has previously been made. Likewise, in accordance with the disclosure of this patent, there is provided a wheel carriage or slide 5 on which is mounted for rotation, and adjustable angularly relative thereto, a grinding wheel 6. This carriage 5 also carries a second carriage 7 which supports a truing device indicated generally at 8. The carriage 7 moves parallel to the carriage 5, and movement relative thereto is shown as produced by rotation of the shaft 10 having threaded connection at 11 with a portion 12 depending from the carriage 7. This shaft 10 is journaled for rotation in but held against axial movement relative to the slide 5, and a gear 15 secured thereto may be rotated through a gear 16 meshing therewith, this gear 16 being secured to a shaft 17 also journaled in the carriage 5.

The inner or forward end of the shaft 17 has threaded connection with a slide 18 mounted in the bed 1 for movement parallel to the carriages 5 and 7. The shaft 17 is shown as rotated by the rotation of a shaft 19 through a long gear 20 secured to the shaft 19 meshing with a gear 21 keyed to the shaft 17. Threaded connections between the shaft 17 and the slide 18 and between the shaft 10 and the slide 7 are so related to the sizes of the intermeshing gears 15 and 16 that any sliding motion of the carriage 7 by rotation of the shaft 10 is accompanied by an equal sliding motion in the same direction of the carriage 5, assuming that the slide 18 is stationary, so that as the truing device is moved toward the wheel face, reducing the radius of the grinding wheel after contacting therewith, the wheel is moved a corresponding distance toward the work. Thus the amount removed from the wheel by the truing device plus the amount of wear of the wheel between successive truings, is compensated for by feed of the wheel toward the work, so that no matter how much truing is effected, the position of the grinding face or edge of the wheel with respect to the work is unaffected by the truing operation.

As shown also in the Flanders Patent No. 1,739,753, the grinding wheel may be retracted during one direction of traverse of the work by means which acts upon the slide 18 to retract it. For this purpose a lever shown at 22 may be employed which has a portion engaging in a cut out 23 in the slide 18. This lever 22 may be actuated in suitable timed relation by a cam on the vertical cam drum indicated generally at 25 in Figure 1 and more specifically shown and described in the Flanders patent. The general arrangement of the machine shown is precisely like

that of the Flanders patent with the following exceptions. In place of the fixed abutment shown at 202 in the Flanders patent, and against which the slide 18 is yieldingly held by a spring, is positioned a movable abutment, shown best in Figures 4 and 5, and means are provided by which this movable abutment may be moved during the operation of the machine at suitable times in order to produce by the action of the feed spring, a feed of the wheel into the work as this abutment is retracted without, however, moving the truing device relative to the wheel. The mechanism for producing such retraction and the interconnection between these means and the truing feed which actuates the shaft 19 corresponding to the shaft 207 in the patent, constitutes the novel construction shown in the present application.

As shown best in Figure 5, the movable abutment comprises a shaft 30 having threaded connection at its rear end with an internally threaded sleeve 31 which forms a nut for this shaft 30. This nut 31 is secured in fixed position in the frame of the machine. It is shown as externally threaded at its rear end for the reception of a securing nut 32 which normally rests in a recess 33 in the adjacent frame part 34 and is provided with holes 35 at angular intervals for the reception of a tool by which it may be turned. The sleeve or nut portion 31 is held against rotation as by means of a set screw 37 threaded into a portion of the frame and having an extremity 39 seated in a hole 40 in the sleeve 31.

In the end of the shaft 30 is mounted for rotation a ball 42 with which the end of the slide 18 directly engages when it is permitted to do so by the lever 22. The shaft 30 extends through the forward face of the machine and has secured thereon a gear 45. This gear 45, as shown best in Figures 1 and 2, meshes with a similar gear 46 journaled on a stub shaft 47, which is secured in fixed position, as shown in Figure 3, as by the set screw 48. The gear 46 is provided with a hub portion 50 on which is journaled the hub portion 51 of a rock arm 52. At its outer end this rock arm carries a stub shaft 53 on which is journaled a pawl 54, the end of which engages normally in ratchet teeth on the perimeter of a ratchet disk 55. This ratchet disk 55 is keyed to the hub 50 so that rocking of the arm 52 causes an intermittent rotation of the ratchet disk 55 with a corresponding rotation of the gear 46, and a corresponding rotation of the shaft 30 in a direction to retract this shaft and permit the grinding wheel to approach nearer to the axis of the work. Frictionally held on the hub 53 is a cam disk 60 having one portion of reduced diameter at 61 and a portion of larger diameter at 62. This disk may be clamped in any desired adjusted angular relation to the hub 50 by means of a clamping nut 65 threaded on the outer end portion of the hub 50 and arranged to press the disk 60 against a friction disk 66 interposed between the disk 60 and the ratchet disk 55. This friction disk 66 is provided with an extension 67 whose outward extremity is turned over the ratchet face of the ratchet disk 55, as shown in Figure 1, so that when the arm 67 has been turned to proper angular position, it rides under the pawl 54 and prevents this pawl from engaging with the ratchet teeth so that further oscillation of the arm 52 fails to turn this ratchet disk so that the feed rotation of the shaft 30 stops. The angular position of this arm 67 thus determines the limit of feed of the wheel toward the work as determined by variations in the position of the ball abutment 42. The rocking of the arm 52 to effect this feed motion of the shaft 30 is shown as produced by the rocking of an arm 70 clamped to a rock shaft 71. This rock shaft 71 is the same as the shaft marked 223 in the Flanders Patent No. 1,739,753, and is actuated at suitable times by a cam 72 on the cam drum 25, the cam 72 being similar to the cam 220 shown in the Flanders patent.

In back of the arm 70 and clamped to the shaft 71, is an arm 700, in the upper end of which is carried a crank pin 75 adjustable from and toward the axis of the rock shaft 71 and this crank pin is connected to a crank pin 76 (see Figures 1 and 3) on the arm 52 as by means of a link 77. Thus as the rock shaft 71 is rocked, the feed arm 52 is also rocked to an extent determined by adjustment of the crank pin 75 from and toward the axis of the rock shaft 71, thus to determine the rate of normal feed of the abutment shaft 30. The arm 70 is extended below the rock shaft 71 and is shown as provided with an adjustable abutment screw 79, the inner end of which is positioned opposite to the cam disk 60. When the portion of small diameter 61 of this disk is opposite to the abutment screw 79, a relatively large rocking angle of the shaft 71 is permitted, thus to determine a maximum feed motion of the shaft 30 for each rocking of the arm 70. When the larger diameter portion 62 comes opposite to the abutment screw 79, however, the amplitude of rocking of the shaft 71 is substantially decreased, thus to decrease the rate of feed produced by retraction of the abutment screw 30 as the work approaches its final size, this lower rate of feed continuing until the arm 67 rides beneath the pawl 54 and prevents further feed motion of the shaft 30.

As fully shown and described in the Flanders patent, the shaft 19 herein shown and corresponding to shaft 207 of the patent is rotated from the shaft 100, corresponding to the shaft 228 of the patent, through the two gears 101 and 102. The shaft 100 is provided on its outer end with an adjustable ratchet feed mechanism comprising a rock arm herein shown at 80 provided with a pawl 81 engageable with the ratchet teeth of a wheel 82, this arm 80 being connected through a link 83 with an arm 84 secured to the rock shaft 71. Rocking of the rock shaft 71 turns the shaft 100. The extent of rotation of the shaft 19, which produces feed of the truing device relative to the wheel and a corresponding equal feed of the wheel relative to the work, is controlled by the pawl lifter arm 85 which is angularly adjustable about the axis of the shaft 100 by the turning of an adjusting gear in the internal teeth 87 of the ratchet wheel 82, all as clearly shown and described in the Flanders' patent.

From the foregoing it will be seen that the extent of feed of the truing device against the wheel through the initial angular adjustment of the pawl lifter 85, with a corresponding feed of the wheel relative to its slide 18 is adjustable regardless of any adjustment of the extent of feed motion of the shaft 30, and that the extent of feed motion of the shaft 30 is likewise adjustable by the adjustment of the initial angular setting of the arm 67 with reference to the pawl 54, without reference to the extent of feed of the truing device, but that the parts are so related that when the feed motion of the shaft 30 stops,

any further feed of the truing device against the wheel is accompanied by a corresponding and equal feed movement of the wheel relative to the work, so that its cutting edge is maintained in the same position as though the truing device feed had also been stopped at the same time. The actuating cam 72, or, if desired, more than one such cam, which produces the feed of the wheel relative to the work independent of the truing and also the feed of the truing device with a corresponding and equal feed of the wheel, may be so set as desired with relation to the traverse of the work, that feed may be effected at either one or both ends of traverse, or at any desired time relative to the traverse movements, and it is also evident that the parts may be so set that the truing device is brought into action at any time desired with relation to the wheel feed as determined by the axial position of the shaft 30. Thus truing may be produced early in the grinding operation of the machine so as to maintain the wheel at the proper contour in grinding from solid work, and it may be maintained accurate up to the final work sizing. The slowing down of the feed at the end, as produced by the action of the larger diameter portion of the cam disk 60, increases the accuracy of contour of the wheel for the final sizing grinding.

The wheel feed mechanism may be initially set for a grinding operation, as by turning the shaft 30 through engagement with the hub 50 of the gear 46 by a suitable handle or hand wheel, the outer end of this hub portion being shown as provided with diametrically opposed slots 90 to receive a suitable part of the wheel or handle. This facilitates the initial setting of the shaft 30 axially inwardly to determine the initial grinding position of the wheel, and the arm 67 may be so set angularly with relation to this hub that the desired amount of feed may be produced before the wheel feed stops when the work has been ground to proper size.

Likewise the total amount of wheel truing may be determined by the angular setting of the arm 85 with reference to the pawl 81. It will likewise be noted that when the feed of the wheel relative to the work is decreased for the final sizing grinding, the amount of truing at each actuation is also correspondingly reduced since the impingement of the abutment screw 80 on the larger diameter portion 62 of the hand disk decreases the amplitude of rocking of the rock shaft 71, and thus the extent of rocking of the arm 80 as well as of the arm 52 at each actuation. While the wheel shown is arranged for cutting threads, of course it should be evident that the machine is not restricted to thread grinding, but may be employed to grind other work, selecting the proper type of wheel and the adjustment of the traverse and feed mechanisms relative to each other.

In operation of the machine the arm 67 is adjusted and fixed at such a position that the work would be correctly sized were there no wear or truing of the wheel when the arm moves to such a position as to throw out the feed pawl 54, and the disk 60 and the stop screw 79 are set to determine the time when the finish slow feed is to begin, and the amount of such feed at each actuation, respectively. The pawl lifter arm 35 is also adjusted in its angular spacing from the pawl 81 in accordance with the total amount of the wheel wear and the desired truing. At each actuation in one direction of the arm 70 by the cam 72, the feed shaft 30 is retracted to permit the wheel a feed motion toward the work axis, the extent of each feed motion being decreased as soon as the high portion 62 of the cam 60 rides beneath the screw 79. This continues until the pawl lifter arm 67 lifts the pawl 54 to inoperative position, stopping the step by step rotation of the ratchet disk 55. Rocking of the rock shaft 71, which turns the feed shaft 30 as just described, also rocks the ratchet feed arm 80 through its connections and this rotates the shaft 100 and the shaft 19 which produce a feed of the wheel carriage relative to the slide 18 and thus produces a feed of the wheel slide by an amount additional to that produced by motion of the slide 30, but this additional feed of the wheel is accompanied by an equal feed of the truing device relative to the wheel, so that the position of the cutting edge of the wheel with reference to the work is not changed by the motion of the wheel slide produced by movement of the shaft 100. The effective feed of the wheel relative to the work is thus controlled by the motion of the shaft 30 while the extent and time of commencement of truing is determined by the initial spacing of the truing device from the wheel and the extent of rotation of the shaft 100 in its step by step motion.

It also will be evident from the foregoing description of an embodiment of this invention that various other changes and modifications may be made without departing from the spirit or scope of this invention as defined by the appended claims.

We claim:

1. In a grinding machine, a work holder, a grinding wheel, a wheel truing device, means for relatively moving said wheel and work holder to feed the wheel into the work, means for moving said device relative to the wheel to true the wheel, means for adjusting the total amount of truing device feed, means independent of said truing device feed adjustment for adjusting the amount of wheel feed, and means causing truing device feed to produce an additional wheel feed to compensate for wear and truing of the wheel.

2. In a grinding machine, a work holder, a grinding wheel, a wheel truing device, means for moving said wheel toward the work, means for adjustably determining the extent of motion of said wheel-moving means, means for feeding said device toward said wheel and said wheel forwardly toward the work and relative to said wheel-moving means by the amount of said device feed, and means for adjustably determining the total amount of said device feed.

3. In a grinding machine, a work holder, a grinding wheel, a wheel truing device, means for effecting traverse between said wheel and work on said holder, means acting at a predetermined point in each traverse to produce a feed of the wheel relative to the work, means for predetermining the total amount of said wheel feed, means acting at a predetermined point in each traverse to produce a feed of said device to true the wheel, and means for adjusting the total amount of said truing device feed independently of the adjustment of said wheel feed.

4. In a grinding machine, a work holder, a grinding wheel, a wheel truing device, means for effecting traverse between said wheel and work on said holder, means acting at a predetermined point in each traverse to produce a feed of the wheel relative to the work, means for predetermining the total amount of said wheel feed, means acting at a predetermined point in each traverse to produce a feed of said device to true

the wheel, and an equal feed of said wheel relative to said wheel-feeding means, and means for adjusting the total amount of said truing device feed independently of the adjustment of said wheel feed.

5. In a grinding machine, a work holder, a grinding wheel, a wheel truing device, means for effecting traverse between said wheel and work on said holder, means acting at a predetermined point in each traverse to produce a feed of the wheel relative to the work, means for predetermining the total amount of said wheel feed, means acting at a predetermined point in each traverse to produce a feed of said device to true the wheel, means for adjusting the total amount of said truing device feed independently of the adjustment of said wheel feed, and means acting to reduce the extent of wheel feed at each traverse as the work approaches finished size.

6. In a grinding machine, a work holder, a grinding wheel, a wheel truing device, a wheel carriage movable toward and from work on said holder, an abutment for limiting the approach of said wheel carriage toward the work, a truing device carriage movable on said wheel carriage toward and from said wheel, means for periodically moving said device carriage toward said wheel and said wheel carriage relative to said abutment by an equal amount, means for determining the total amount of such device feed, yielding means holding said wheel carriage against said abutment, means for periodically retracting said abutment to cause feed of said wheel relative to the work, and means for determining the total amount of the retraction of said abutment.

7. In a grinding machine, a work holder, a grinding wheel, a wheel truing device, a wheel carriage movable toward and from work on said holder, an abutment for limiting the approach of said wheel carriage toward the work, a truing device carriage movable on said wheel carriage toward and from said wheel, means for periodically moving said device carriage toward said wheel and said wheel carriage relative to said abutment by an equal amount, means for determining the total amount of such device feed, yielding means holding said wheel carriage against said abutment, means for periodically retracting said abutment to cause feed of said wheel relative to the work, means for determining the total amount of the retraction of said abutment, and means for retracting said wheel carriage from said abutment to withdraw said wheel from the work.

ERNEST T. BYSSHE.
ROBERT R. FINN.