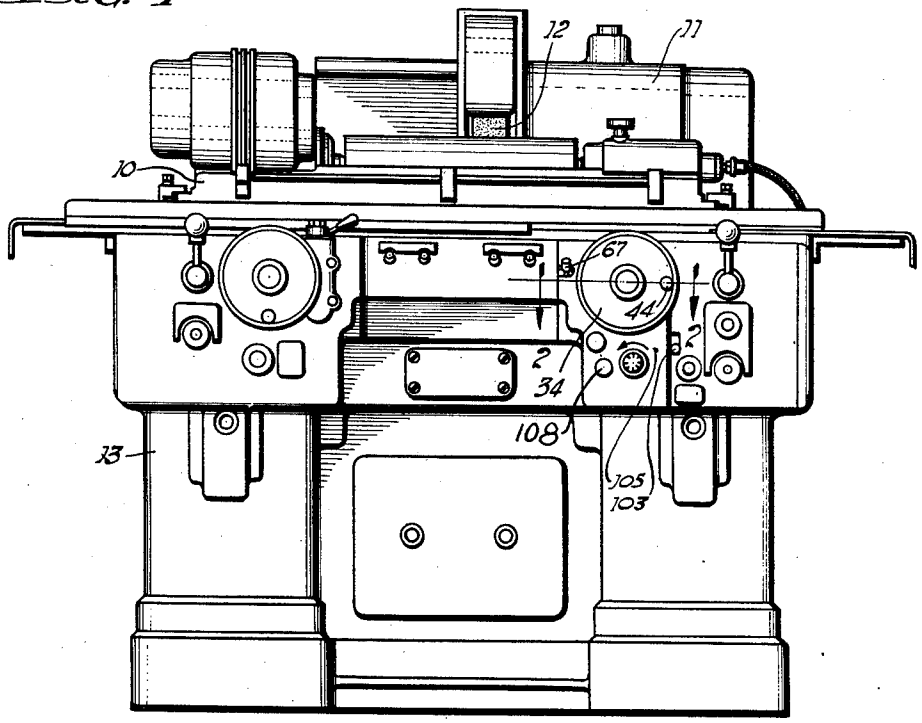
Dec. 12, 1944. J. DECKER 2,365,059

FEED MECHANISM FOR GRINDING MACHINES

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Fig. 1



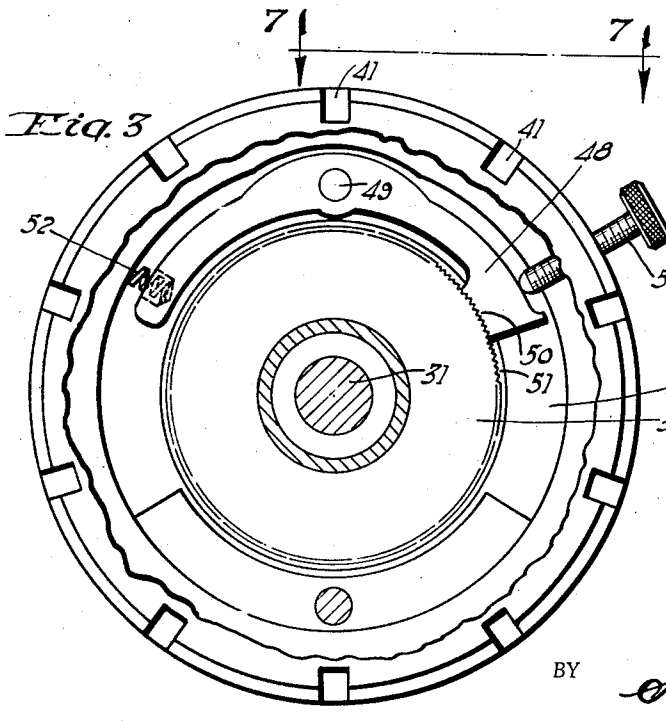


Fig. 3

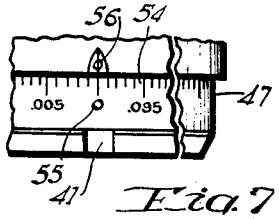


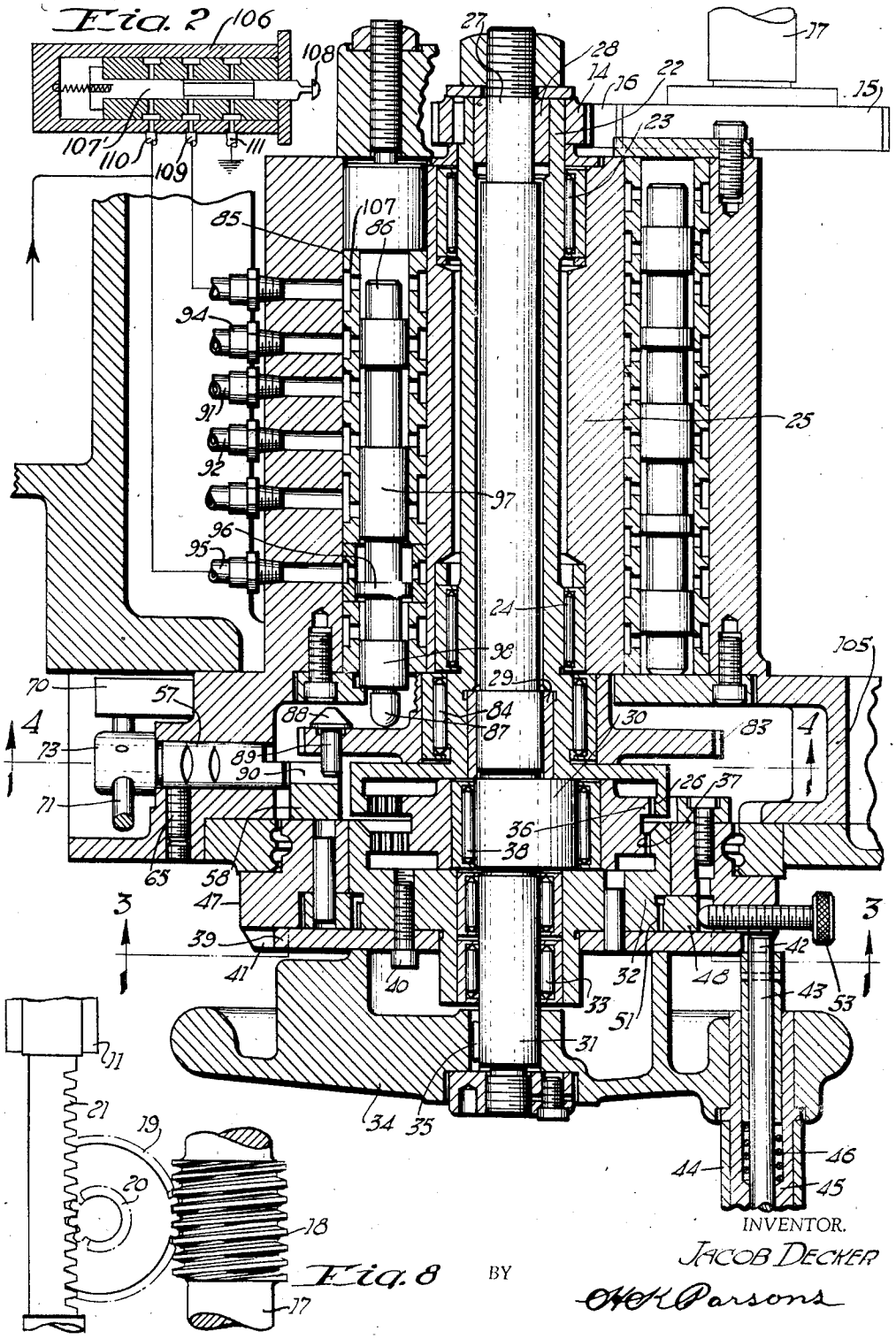
Fig. 7

INVENTOR.
JACOB DECKER
BY
Parsons

Dec. 12, 1944. J. DECKER 2,365,059

FEED MECHANISM FOR GRINDING MACHINES

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INVENTOR.
JACOB DECKER
BY
H. K. Parsons

Dec. 12, 1944. J. DECKER 2,365,059

FEED MECHANISM FOR GRINDING MACHINES

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Fig. 4

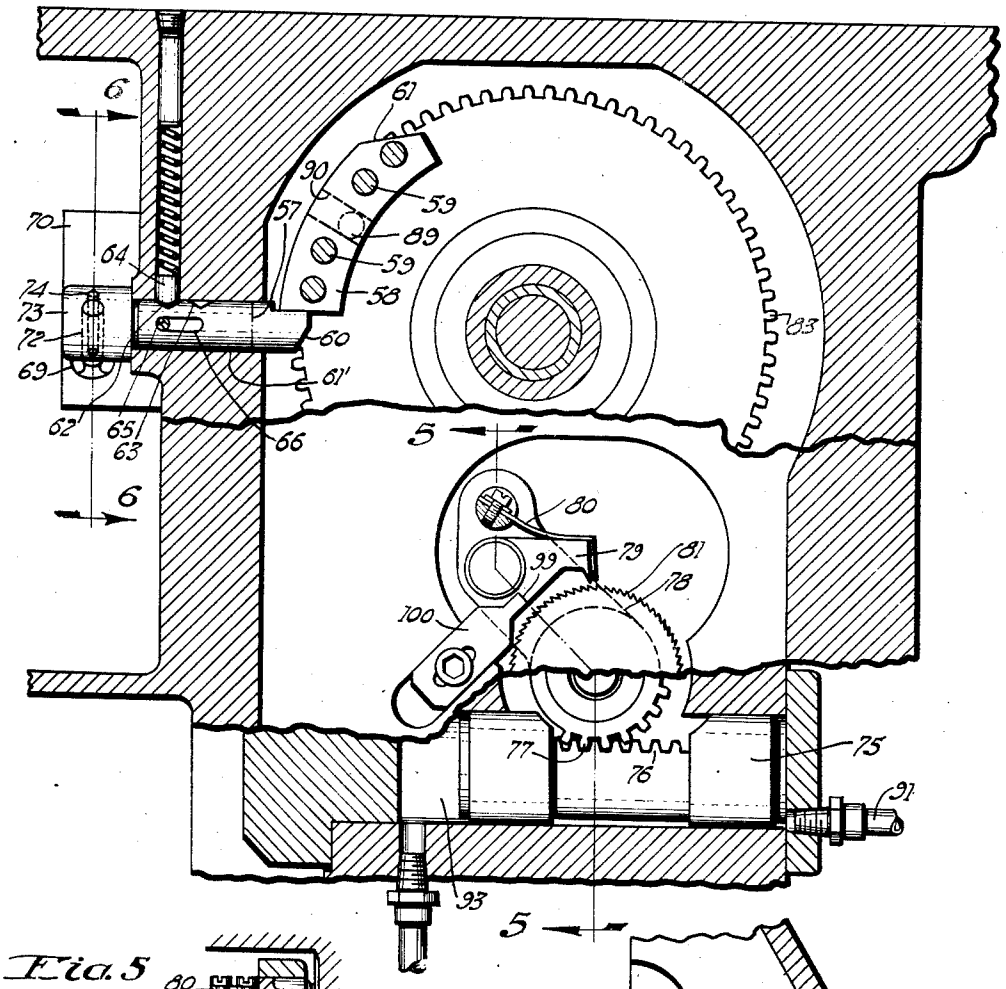
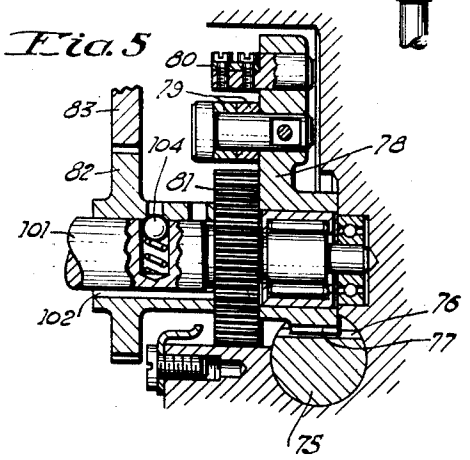


Fig. 5



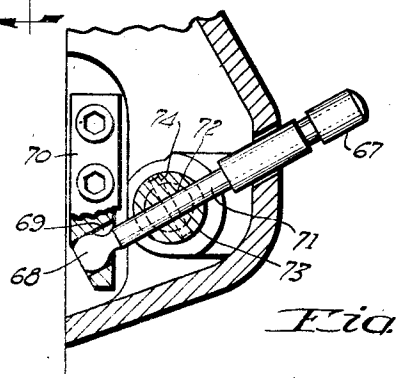


Fig. 6

INVENTOR.
JACOB DECKER

BY

H. K. Parsons

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UNITED STATES PATENT OFFICE

2,365,059

FEED MECHANISM FOR GRINDING MACHINES

Jacob Decker, Cincinnati, Ohio, assignor to The Cincinnati Milling Machine Co., Cincinnati, Ohio, a corporation of Ohio

Application June 26, 1942, Serial No. 448,559

14 Claims. (Cl. 51—165)

This invention relates to machine tools and more particularly to grinding machines.

One of the objects of this invention is to provide improvements in a cross feed mechanism for a grinding machine.

Another object of this invention is to provide an improved pick feed mechanism which is so constructed and arranged that it may be totally enclosed and thereby eliminate moving parts from the front of a machine.

A further object of this invention is to provide improved means for precisely indicating the relative relation of the grinding wheel with respect to the work so as to facilitate the sizing of the work.

Another object of this invention is to provide improved stop means for limiting the cross feed movement regardless of whether it is effected manually or by power, and to associate therewith a graduated dial means to indicate the movement necessary to reach said stop means and which will always have a zero reading when the stop has been reached.

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 forming a part thereof 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.

Referring to the drawings in which like reference numerals indicate like or similar parts:

Figure 1 is an elevation of a machine tool embodying the principles of this invention.

Figure 2 is a section on the line 2—2 of Figure 1.

Figure 3 is a section on the line 3—3 of Figure 2, showing the dial locking means.

Figure 4 is a section on the line 4—4 of Figure 2, showing the positive stop means.

Figure 5 is a section on the line 5—5 of Figure 4, showing a cross section through the pick feed mechanism.

Figure 6 is a section on the line 6—6 of Figure 4.

Figure 7 is a detail view of a portion of the graduated dial means as viewed on the line 7—7 of Figure 3.

Figure 8 is a detail view of means for connecting the mechanism of this invention to a wheel slide.

This invention is particularly adaptable for effecting relative approach and retractive movements between a grinding wheel and a work support, which movements are known in the art as cross feeding movements.

In Figure 1 of the drawings is an exemplification of a grinding machine to which this invention is particularly adaptable and which will serve to illustrate the principles and advantages thereof.

In this machine there is a work support 10 and a grinding wheel support 11, the latter having a grinding wheel 12 rotatably mounted thereon. These supports are mounted on a bed 13 for relative movement and in this instance the work support may be traversed parallel to the axis of the grinding wheel for traverse grinding, while the wheel support may be cross fed toward the work support for grinding and sizing purposes. It will be understood, however, that this invention is equally applicable to machines in which the other arrangement prevails, i. e., that the work support is adjustable toward and from the grinding wheel support.

Referring to Figure 2 a drive gear 14, forming the output member of the mechanism of this invention, is connected by a suitable motion transmitting train to the cross slide which in this case is the grinding wheel support 11. This train may be of any suitable construction such as that shown in Figures 2 and 8. The gear 14 drives a gear 15 through an intermediate idler gear 16. The gear 15 is attached to the end of a shaft 17 which, as shown in Figure 8, terminates in a worm 18. The worm meshes with a worm gear 19 that has an integral pinion 20 which meshes with a rack 21. The rack 21 is connected to the cross slide 11 whereby it will be evident that upon rotation of the gear 14 the worm will be rotated, thus driving the pinion 20 which will transform rotary motion into reciprocating motion of the cross slide.

This invention is directed more particularly to means for advancing the gear 14 in very small increments for precision grinding purposes, or at a fast rate for major adjustment and set-up purposes. To this end the drive gear 14 is attached to the end of a sleeve 22 which is journaled at 23 and 24 in a fixed part 25 of the machine. The sleeve terminates in an internal gear 26. A shaft 27 extends through the bore of the sleeve and is journaled at opposite ends in bushings 28 and 29 for rotation independently of the sleeve. The shaft 27 has an integral eccentric portion 30 and a concentric portion 31.

A second internal gear 32 is supported by anti-

friction bearings 33 on the concentric portion 31 for independent rotation relative to the shaft. A hand wheel 34 is keyed at 35 to the shaft 31 for effecting rotation of the eccentric portion 30 relative to the sleeve, it being understood that the sleeve in such a case would be held against rotation by its gear train connection to the cross slide. The eccentric portion has a pair of gears 36 and 37 supported thereon by anti-friction means 38 and these gears intermesh with the internal gears 26 and 32 respectively. The gears 36 and 37 are slightly different in diameter and the ratio between the different pairs of intermeshing gears is such that one rotation of the eccentric will advance or retard one of said internal gears relative to the other one-hundredth of a revolution.

The internal gear 32 has a notched plate 39 attached to the face thereof as by screws 40 and this plate has a series of notches 41 cut in the periphery thereof for engagement by the end 42 of a spring pressed plunger 43 which is positively connected to a handle 44 carried by the hand wheel 34.

The notches are ten in number as shown in Figure 3 which means that the distance between each notch corresponds to one-thousandth of a revolution of the internal gear 32. The handle 44 is telescopingly slidably mounted on a tubular member 45 which is fixed to the hand wheel and projects therefrom in a direction parallel to its axis of rotation. A spring 46 is interposed between the fixed member 45 and the plunger 43 for continually urging it in a direction toward the notched plate. It will be obvious that the end 42 must fit the slots without lost motion if precision grinding results are to be obtained.

Since the plate 39 is integrally connected to the internal gear 32 it will be obvious that when the plunger 42 is in engagement with the plate 39, that the hand wheel 34, the internal gear 32, the shaft 31, the gears 36 and 37, and the internal gear 26 are connected for joint rotation. In other words, all of these parts will rotate as a unit, whereby one rotation of the hand wheel will effect one rotation of the gear 14.

A graduated dial in the form of a ring 47 surrounds the internal gear 32 and is connectible thereto by the means shown in Figure 3.

This means comprises a locking member 48 which is pivotally supported on a pin 49 which is carried by the dial 47 and therefore movable therewith. The locking member 48 is provided on one end with a series of notches or teeth 50 which are adapted to be pressed into engagement with the toothed periphery 51 of the internal gear 32. The locking member is somewhat semi-circular in shape and at the other end a spring 52 is interposed between the clamping member 48 and the interior of the dial ring 47 which tends to urge the locking member out of engagement with the internal gear. A clamping screw 53 is radially threaded in the dial for engagement with the notched end of the clamping member for locking the same into engagement with the teeth 51 whereby the dial is clamped for rotary movement with the internal gear 32.

The dial 47 is provided with graduation marks generally indicated by the reference numeral 54, Figure 7, and these graduation marks extend completely around the periphery of the dial and are spaced apart equal distances, each graduation mark being equivalent to .0005" infeed or .001" as respects the diameter of the work. The graduation marks are numbered counterclockwise around the dial beginning with a zero mark which is indicated by the reference numeral 55. A cooperating zero mark 56 is placed on a fixed part of the machine. It will now be apparent that upon counterclockwise rotation of the hand wheel, which is the direction for effecting infeed, that the dial reading will progressively decrease until the zero marks 55 and 56 register.

This is the arrangement utilized for effecting actual rotation of gear 14 and bodily movement of the cross slide. When the pin or plunger 44 is withdrawn and the hand wheel rotated, a different effect is produced. There is no bodily movement of the slide this time but, instead, the gear 14 is held stationary by the friction of the slide and the gear 32 becomes the driven member. The purpose of this will become apparent as the description progresses.

The chief reason for any grinding operation is to size a work piece with precision and in order to facilitate this in production grinding a positive stop means is provided comprising a positive stop 57 which is slidably mounted in a fixed part of the machine. The dial 47 carries a stop plate 58 attached to one face of it as by screws 59 as shown in Figures 2 and 4. The stop plate is attached to the dial in such relation that when the plate is in engagement with the positive stop 57 the zero graduations 55 and 56 are in registry.

Although a positive stop is provided and may serve to size several work pieces in succession it must be remembered that the grinding wheel is continuously wearing away, even although at a very slow rate and therefore adjustments must be made from time to time to compensate for this wear by providing means for permitting additional movement of the feeding mechanism so that the periphery of the wheel may be brought to the same position. The amount of adjustment to be made has to be determined by the operator by comparing the actual size of the work piece with the desired size. The amount of this difference will vary but for wheel compensating purposes it will be very small and that is why the precision adjusting mechanism for the dial is provided, whereby the dial may be rotated as small an amount as .0001" as respects work diameter. In other words, by withdrawing the pin 42 and rotating the hand wheel 34 the dial 47 is moved independently of the rest of the mechanism, i. e., with respect to the drive gear 14 to move the stop plate 58 a predetermined distance equal to the amount of said difference for instance, away from the positive stop 57. The stop plate 58 is moved in a clockwise direction as viewed in Figure 4 whereby after the hand wheel is locked again to the plate 39 the gear 14 may be rotated an additional amount in a counterclockwise direction until the stops engage, thus moving the wheel an additional precision amount toward the work.

After the work piece has been ground the wheel 34 is rotated in a clockwise direction to effect retraction of the grinding wheel. If the hand wheel is rotated in a clockwise direction more than one revolution, it will be obvious that the stop plate would collide with the positive stop. Means are provided whereby the positive stop may be withdrawn manually by the operator, or automatically withdrawn by rotation of the wheel should the operator forget. The automatic withdrawal is effected by providing a beveled surface 60 on the stop 57 and a beveled surface 61 on the stop plate 58 so that when these surfaces

collide, the stop 57 is moved by a wedging action out of the path of the stop plate.

The stop 57 is slidably mounted in a bore 61' and is provided with a pair of V-notches 62 and 63 which are alternately engaged by a spring pressed detent ball 64. A limit pin 65 is secured in a fixed part of the machine and projects into an elongated slot 66 in the stop 57 to limit the movement of the stop in either direction. The stop is moved manually by a lever 67, Figure 6, which has a ball-shaped end 68 fitting in a socket 69 formed in a fixed plate 70. The intermediate portion 71 of the lever passes through a bore 72 formed in the enlarged head 73 formed on the end of the stop 57. The lever is supported by a pin 74 which passes through the head 73 and the reduced portion 71 of the lever, while the lower end is anchored in the bore 69, whereby when the handle is oscillated it will move the stop 57 in one direction or the other.

For traverse grinding operations in which it is the usual practice to feed the grinding wheel toward the work a predetermined amount at each reversal of the worktable, a pick feed mechanism has been provided which is totally enclosed so as to eliminate exposed moving parts.

The pick feed mechanism comprises a power reciprocable piston which is adapted to be operatively connected to a table reversing mechanism in such manner that the piston will effect a complete reciprocation each time the table is reversed. The manner of connecting this piston forms no part of the present invention. The piston which is indicated by the reference numeral 75 is provided with rack teeth 76 which intermesh with gear teeth 77 formed integral with a lever 78, Figures 4 and 5, which carries a pair pawls 79. Springs 80 urge the pawls into engagement with a ratchet wheel 81 which is integrally connected to a pinion 82 that meshes with a gear 83. The gear 83 is supported for free rotation on the sleeve 22 by anti-friction bearings 84.

Although the gear wheel 83 drives the sleeve 22 it is not directly connected to it, but rather is connected through the dial 47 and the differential gearing to the sleeve. This is because the gear wheel carries means for automatically stopping the pick feed piston when the stop members 57 and 58 engage and since it is necessary that this be timed with zero reading of the dial, it is necessary that the gear wheel 83 always be in step with the dial, whether operating power comes from the pick feed piston, or from manual rotation of the eccentric 30 at which time the sleeve is stationary.

The automatic stopping of the pick feed is accomplished by providing a stop valve 85 which is mounted in the housing parallel to the shaft 31 and this valve has a plunger 86 upon the end of which is formed a contact button 87 which is adapted to be engaged by a stop button 88 carried by the gear 83. Since the gear 83 is mounted for free rotation on the sleeve 22 it is necessary to provide a driving connection between the gear 83 and the sleeve and still make it possible for the stop button 88 to be adjusted independently of the sleeve so as to arrange for automatic stopping of the wheel head in any position. This connection is, therefore, made through the dial to the sleeve and to this end the button 88 has a reduced elongated shank 89 by which it is mounted in the gear and which projects beyond the opposite face thereof a sufficient distance to engage a slot 90 formed in the back face of stop plate 58. Thus, the gear 83, the stop plate 58 and the dial 47 are positively connected together at all times for joint rotation.

It is, therefore, possible to position the stop button 88 circumferentially on the gear 83 in such position that the stop button 88 will engage and shift the valve plunger 86 at the same moment that the stop plate 58 engages the positive stop 57.

The valve 85 is serially connected in a control line for the pick feed piston, comprising branches 91 and 92. The branch 91 leads to one end of cylinder 93 and the other branch 92 to a control source whereby in one position the line 92 is connected to the line 91, and in the other position the branch 91 is connected to exhaust line 94. The valve is provided with a hydraulic detent comprising a pressure port 95 which is positioned adjacent an enlarged spool 96 formed on the valve plunger 86 to provide a differential area with respect to the adjacent spools 97 and 98 whereby after the plunger passes through a midposition the hydraulic pressure will enter the opposite side of the spool 96 and complete the shifting movement.

The valve plunger 86 is reset to the position shown in Figure 2 by connecting fluid pressure through the medium of a manually operable pilot valve 106 to port 107 of valve 85. The pilot valve has a plunger 107' which is spring held in the position shown. Upon manual operation by depressing knob 108, port 109 is connected to pressure port 110 and upon return of the plunger port 109 is connected to exhaust port 111. The valve is mounted on the front of the machine near the hand wheel 34 as shown in Figure 1 and thus is readily accessible to the operator.

Attention is invited to the fact that the arm 78 is normally in its return position and that the pawls 79 are provided with heels 99 that engage a stop 100 to move the pawls out of engagement with the ratchet wheel whereby any rotation by the hand wheel 34 which would cause rotation of the gear 83 will not be interfered with because of engagement of the pawl with the ratchet wheel.

Another manner of preventing interference by the ratchet teeth is to slidably mount the gear 82 on its supporting shaft 101, the shaft having a spline 102 which interconnects the ratchet wheel 81 with the gear 82. By sliding the gear 82 to the left as viewed in Figure 5, it may be disconnected from the gear 83. The disconnection may be effected by a gear shift control lever 103 mounted on the front of the machine as shown in Figure 1. A spring pressed ball detent 104 is utilized for holding the gear in either one of its two positions.

It will be noted that double pawls 79 are provided and that one is set slightly ahead of the other a distance equal to one-half of the circumferential pitch of the teeth on wheel 81, and this is for the purpose of attaining a finer adjustment and pickup.

The entire pickfeed mechanism is enclosed within a housing 105 as shown in Figure 2 which is attached to the front of the bed of the machine as shown in Figure 1. This serves to protect the parts against accidental breakage as well as eliminate any danger from oscillating or reciprocating parts on the front of the machine.

The utility of the present structure should be apparent from the foregoing description from which it will be seen there has been provided a compact mechanism for feeding purposes comprising an infeed actuator such as the gear 14

which may be alternatively rotated by either hand or power means; stop means for determining a limit to the rotation and thereby a final size of the work; graduated means for indicating the prospective amout of stock to be removed before the stops engage; and means for micrometrically resetting the stops independent of the actuator to permit additional movement of the actuator should the final size of the work as first determined by the stops prove to be too large.

It is important to note that in the operation of a grinding machine it is the customary practice to provide some form of positive stop means and then to feed against that stop so that repetitive grinding operations may be performed without requiring a lot of attention on the part of the operator. It is always of interest to the operator in setting up a machine and after bringing the grinding wheel into engagement with the periphery of a work diameter to be able to conveniently set the machine, so as to take off a prescribed amount of stock and thus reduce the work immediately to the desired size. That is why the dial means involved in this invention is so graduated that the operator may read directly the amount of reduction in work diameter that will be effected for any given angular movement of the infeeding mechanism, it being understood that the grinding wheel is in contact with the periphery of the work at the time the feeding movement starts.

It is also customary or desirable in the operation of grinding machines to have the operating handle such as the handle **44** in substantially the circumferential position that it is in in Figure 1 at the time that the grinding operation is completed because in this position it is more convenient to start the clockwise rotation of the hand wheel when retraction of the grinding wheel has to be effected. To permit this to be obtained without disturbing the setting of all the other parts the locking screw **53** may be backed off and the dial ring **47** held against the positive stop as by the screw **53** and then the handle **44** withdrawn from engagement with the slots **41** and the hand wheel **34** rotated to bring the handle **44** to the desired position. This movement will neither cause actuation of the gear **14** nor rotation of the dial **47** whereby all of the essential operating parts remain in their same position with the exception that the handle **44** is relocated to a more convenient position for repetitive grinding operations.

What is claimed is:

1. In a grinding machine having a fixed support, and a grinding wheel head reciprocably mounted on said fixed support, the combination of means for feeding said wheel head including a rotatable member mounted in said fixed support and operatively connected for transmitting motion to said wheel head upon rotation of the member, a graduated dial surrounding said member, means for operatively connecting said dial to the member for rotation therewith, a gear fixed with said member, a fluid operable pick feed mechanism operatively connected for transmitting intermittent movements to said gear, a stop valve for controlling operation of said pick feed mechanism, fluid operable means for holding said valve in a running position, cooperating zero marks carried by the dial and the fixed support, and means carried by the gear for shifting said stop valve to a stop position when said zero marks are in register.

2. In a grinding machine having a bed, a work support and a grinding wheel support reciprocably mounted on said bed, one of which is capable of movement toward and from the other, the combination of means for effecting said movement including a rotatable shaft, a power operable pick feed mechanism for imparting rotation to said shaft, a start and stop control for said pick feed mechanism, cooperating stop abutments carried by the shaft and the bed for limiting rotation of the shaft, and a trip member carried by said shaft in definite relation to said abutment whereby said control will be tripped to stop when said abutments engage.

3. In a feeding mechanism for the wheel head of a grinding machine, the combination of a rotatable member operatively connected for imparting movement to the grinding wheel, a gear attached to said member, a power operable pick feed mechanism for imparting intermittent movement to said gear, and a shiftable gear for selectively connecting or disconnecting said automatic pick feed mechanism to or from said first-named gear.

4. In a grinding machine having a reciprocating work table and a grinding wheel support carrying a rotatable grinding wheel, the combination of means for reciprocating said table including an automatic reversing mechanism, a power operable pick feed mechanism for feeding said grinding wheel support, means permanently connecting said pick feed mechanism with said reversing mechanism whereby said pick feed mechanism will be actuated upon each reversal of the table, means to selectively connect said pick feed mechanism to the grinding wheel support for intermittent actuation thereof, a stop control for said pick feed mechanism, and means operable by said pick feed mechanism for effecting trip actuation of said stop control.

5. In a pick feed mechanism for the grinding wheel support of a grinding machine, the combination of a fluid oscillated piston, ratchet means operatively connecting said piston for imparting an increment of movement to said wheel head upon each reciprocation of said piston, means to supply fluid to said piston including a start and stop valve, means operable by the pick feed mechanism for effecting trip operation of said valve to a stop position, a fluid detent mechanism for holding said valve in a stop position and a manually controlled pilot valve for effecting fluid shifting of said stop valve to a running position.

6. In a feeding mechanism for the wheel head of a grinding machine, the combination of an actuator having motion transmitting connections with said wheel head, a fixed stop, a movable stop, selective means for connecting the movable stop for simultaneous movement with the actuator and toward the positive stop to determine the limit of feeding movement by said actuator, or for adjusting said movable stop relative to said actuator and away from said positive stop to permit additional movement of the actuator, a graduated indicator operatively connected for joint movement with said movable stop, said indicator being graduated in terms of work diameter reduction whereby the movable stop may be set in accordance with the reduction in work diameter to be effected by said actuator.

7. In a feeding mechanism for the wheel head of a grinding machine, the combination of a hand wheel for operating said mechanism, a positive stop, an adjustably positionable stop, means to operatively connect the adjustable stop to the

hand wheel for limiting rotation thereof in a feeding direction by engaging the positive stop, means to adjust the movable stop after engagement with the positive stop relative to the hand wheel and in a direction away from the positive stop, and a graduated scale movable with the movable stop having graduations indicating reduction in work diameter that will be effected upon return movement of the movable stop with the hand wheel into engagement with the positive stop.

8. In a feeding mechanism for the wheel head of a grinding machine, the combination of a fixed stop, an adjustable stop, a hand wheel for operating said mechanism, means to utilize the hand wheel to effect relative spacing adjustment between said stops without actuation of said mechanism to vary or determine the potential movement of said mechanism, a graduated indicator integral with the adjustable stop to indicate the work diameter reduction effectable by said potential movement, and means to connect the movable stop and the hand wheel directly to said mechanism for joint actuation in a direction to effect said reduction.

9. In a feeding mechanism for the wheel head of a grinding machine, the combination of a hand wheel for actuating said mechanism, means to connect the hand wheel direct to said mechanism, a pair of stop members for limiting said actuation, one of which is fixed and the other movable with said mechanism, means to disconnect the hand wheel from said mechanism, reduction gearing rendered effective upon said disconnection for connecting the hand wheel for micrometrical adjustment of said movable stop.

10. In a feeding mechanism for a grinding machine, the combination of an intermittently operable pick feed gear, a graduated ring dial and a hand wheel supported in coaxial relationship and connected together for joint rotation, a final drive gear, means operatively connecting the dial to the drive gear, a positive stop, and a cooperating stop carried by the dial to limit rotation of the drive gear regardless of whether the rotation is effected by the hand wheel or the pick feed gear.

11. In a feeding mechanism for a grinding machine, the combination of an intermittently operable pick feed gear, a final drive gear, a graduated ring dial and a hand wheel all mounted in coaxial relationship, means connecting all of the parts together for joint rotation, a fixed reference mark, graduations on the dial including a zero mark movable with respect to said reference mark, a positive stop, and a cooperating stop carried by the dial to limit rotation of the drive gear regardless of whether the rotation is effected by the hand wheel or the pick feed gear, said graduations being so positioned that the zero mark will register with the reference mark when said stops are in engagement.

12. In a feeding mechanism for a grinding machine, the combination of a final drive gear, an intermittently operable pick feed gear, a graduated ring dial and a hand wheel all supported in coaxial relationship and connected together for joint rotation, power operable means for intermittently actuating said pick feed gear including a start and stop control member, a positive stop, a cooperating stop carried by the dial, a trip member for said stop control carried by said dial, said trip member and said stop member being so positioned on the dial that they will engage the respective elements simultaneously.

13. In a feeding mechanism for a grinding machine, the combination of a final drive gear, an intermittently operable pick feed, a graduated dial ring, and a hand wheel all supported in coaxial relationship and connected together for joint rotation, a fixed reference mark, graduations on the dial including a zero mark movable with the dial with respect to said reference mark, power operable means for intermittently actuating said pick feed gear including a start and stop control member, a positive stop, a cooperating stop carried by the dial, a trip member for said control member also carried by said dial, said trip member, cooperating stop and zero mark being so positioned on the dial that the zero mark will move into registry with the reference mark when said trip member and cooperating stop engage respectively the stop control member and the positive stop.

14. In a feeding mechanism for the wheelhead of a grinding machine, the combination with a support, of a sleeve rotatably mounted therein having gears on opposite ends thereof, means operatively connecting one of said gears to the wheelhead, a shaft rotatably mounted in the sleeve and having a portion projecting beyond one end thereof, said projecting portion comprising an eccentric portion and a concentric portion, a dial rotatably mounted on the concentric portion and having a gear formed on one end thereof, a gear couplet mounted on said eccentric portion and interengaging gears on said sleeve and dial, a handwheel keyed to the shaft, a fixed stop mounted in the housing, a cooperating stop carried by the dial, a locking pin carried by the handwheel for interengagement with the dial whereby when the pin is engaged all of the parts rotate in unison and movement of the wheelhead is effected and when said pin is disengaged rotation of the dial is effected and the wheelhead remains stationary.

JACOB DECKER.