

OPERATOR'S INSTRUCTION BOOK



MONOSET CUTTER AND TOOL GRINDER



Publication No. M-1447-1

This Booklet should be Filed in the Tool
Crib and Issued by Tool Check only

MILLING MACHINE DIVISION
THE CINCINNATI MILLING MACHINE CO.
CINCINNATI, OHIO 45209

THIS booklet was written for the purpose of instructing the operator of a CINCINNATI Monoset Cutter and Tool Grinder in the proper care and operation of his machine. Operating instructions are briefly listed, and adjustments explained to aid in maintaining accuracy.

The proper application of the few simple instructions outlined in this booklet should greatly aid the continued usefulness and long life of this machine. At the time of writing, this booklet was completely up to date. However, due to continual improvements in design, it is possible that descriptions contained herein may vary to a slight extent from the machine delivered to you. This would imply nothing more than the fact that the machine has been improved to better fulfill your requirements.

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ILLUSTRATION REFERENCE NUMBERS

For your convenience in quickly finding illustrations referred to in the text, we have given all illustrations the same number as the page on which they appear. For example, Figs. 15A and 15B are both on page 15.



P A T E N T N O T I C E

The machines and attachments illustrated and described in this booklet are manufactured under and protected by issued and pending United States and Foreign Patents.

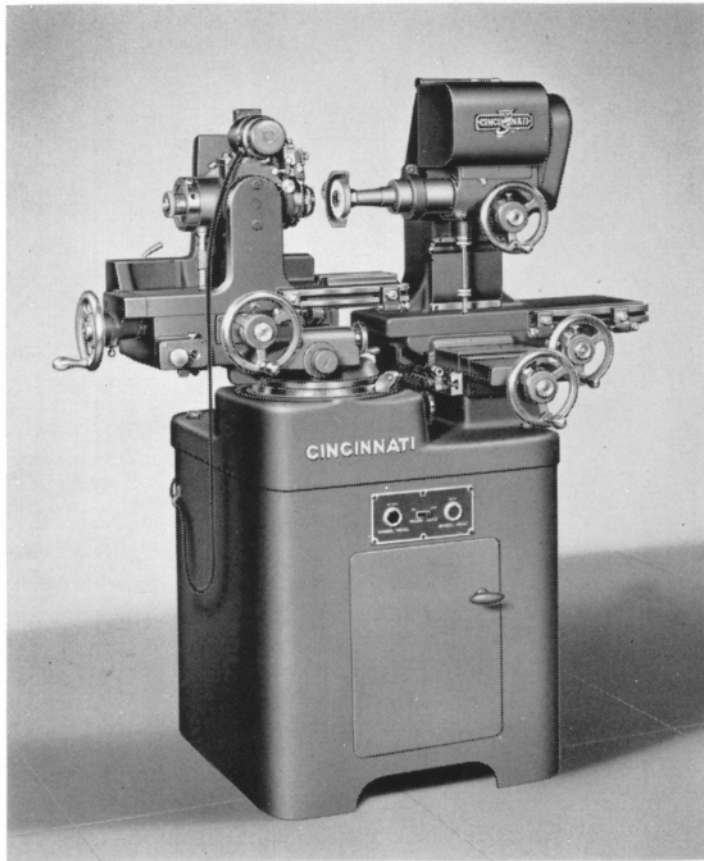
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The design and specifications of these machines are subject to change without notice.

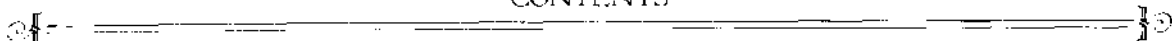


S E R I A L N U M B E R

The serial number is stamped on the front of the bed below the name CINCINNATI.



The Cincinnati Monoset Cutter and Tool Grinder



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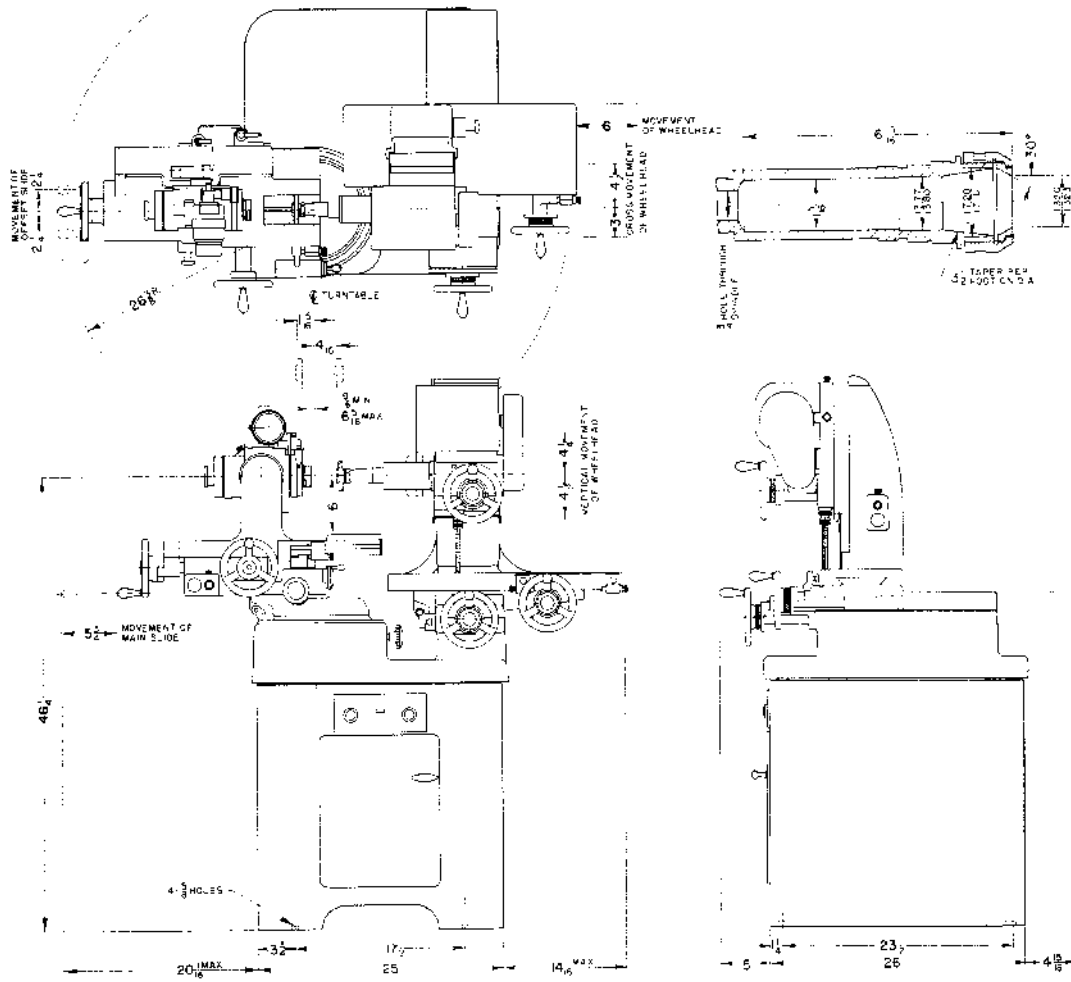


Figure 6
Dimensional Drawing

GENERAL SPECIFICATIONS (MODEL OE)

Capacity	
Swing over main slide.....	12"
Length, between spindle nose and tailstock (max.).....	6"
Maximum wheel diameter (6000 ft. per min., approx.).....	3½"
Maximum collet work diameter.....	1¼"
Minimum collet work diameter.....	⅛"
Range	
Longitudinal movement of main slide.....	5¾"
Offset slide movement (Either side of center).....	2¼"
Vertical slide travel of wheelhead	
Above center.....	4¼"
Below center.....	4½"
Transverse slide travel of wheelhead.....	7½"
Longitudinal slide travel of wheelhead.....	6"
Angular range of workhead	
In horizontal plane (Workhead swivel base).....	235 deg.
In vertical plane (Workhead angular adjustment), Above and below center position.....	40 deg.
Speeds	
Grinding wheel spindle, two speeds (approximate).....	6000 and 8000 rpm
Internal attachment spindle (approximate).....	33,000 rpm
Workhead spindle.....	287 rpm
Electrical Equipment	
Spindle drive motor.....	1/3 hp
Workhead motor.....	1/15 hp
Principal Dimensions	
Size of base.....	25" x 26"
Floor space required (Including swivel and overtravel movements).....	53" x 60"
Height from floor to center of workhead spindle.....	46¼"
Weight	
Net weight.....	1350 lbs.

INSTALLATION INSTRUCTIONS

The successful installation and operation of the machine requires that the following instructions be carefully observed.

Foundation. A special foundation is not required. Any substantial floor, wood or concrete, fairly flat, and sufficiently heavy to withstand the weight of the machine, will be satisfactory. However, do not locate the machine close to vibrating equipment, as vibration transmitted to the machine will result in a poor finish on the cutting edge of the tool being sharpened.

The effects of a vibrating foundation may be reduced or entirely eliminated by mounting the machine on a rubber base $\frac{3}{8}$ " or $\frac{1}{2}$ " thick. This base may be made by placing a good grade of oil proof rubber between two thin pieces of sheet iron. Of course the rubber selected should have sufficient unit strength to withstand the weight of the machine, which may be as much as 1500 pounds.

Lifting the Machine. The machine may be lifted by a crane with a rope sling placed through the toe holes at the bottom of the base, as shown in Figure 8. Before lifting the machine be sure that all slides are moved to their innermost positions and are securely clamped.

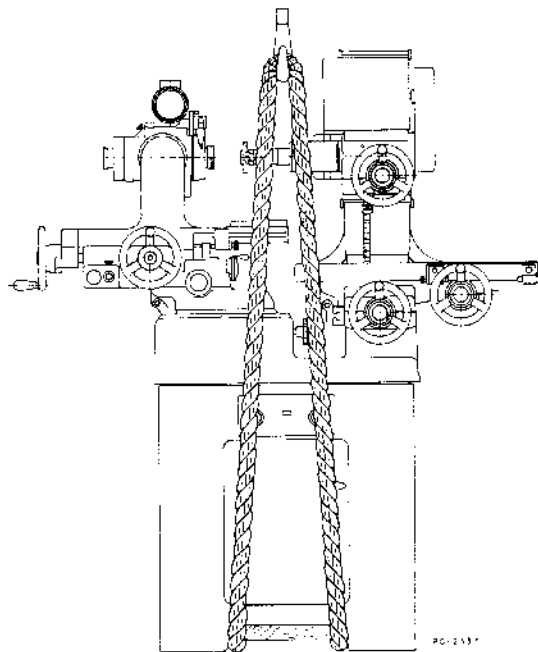


Figure 8
Method of Lifting

Cleaning the Machine. After the machine has been set in place, wash off the slushing oil, and the dirt accumulated in transit, with naphtha or a similar solvent of grease. Do not use caustic type cleaners.

Leveling the Machine. After the machine has been placed in position and cleaned, it must be carefully leveled. Use an accurate micrometer level for this operation. A carpenter's level, or the bulb in a machinist's combination square, is not good enough. The machine can be checked for level by placing the leveling instrument on the finished top surface of the tee-slot pad, on top of the main slide. The swivel may then be rotated to check for level both longitudinally and transversely. Be sure that the finished pad is clean and the leveling instrument free from burrs.

The machine may be bolted to the floor if desired, by use of the four hold-down bolt flanges, located inside each corner of the base.

Starting the Machine for the First Time. After cleaning and leveling the machine, fill all oiling stations with the grade of lubricant specified, in accordance with the instructions on page 11. Be sure that the oil used in the grinding wheel spindle is of the correct grade and is sparingly applied.

The grinding wheel spindle may now be started by pushing the wheelhead "START" button. Immediately note the direction of rotation of the spindle drive motor. It must rotate in the direction indicated by the arrow in Figure 9. *Be sure no wheel is on the spindle before starting.*

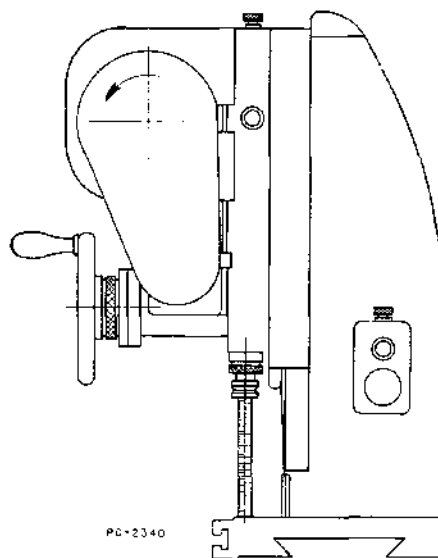


Figure 9
Direction of Rotation of
Wheelhead Motor

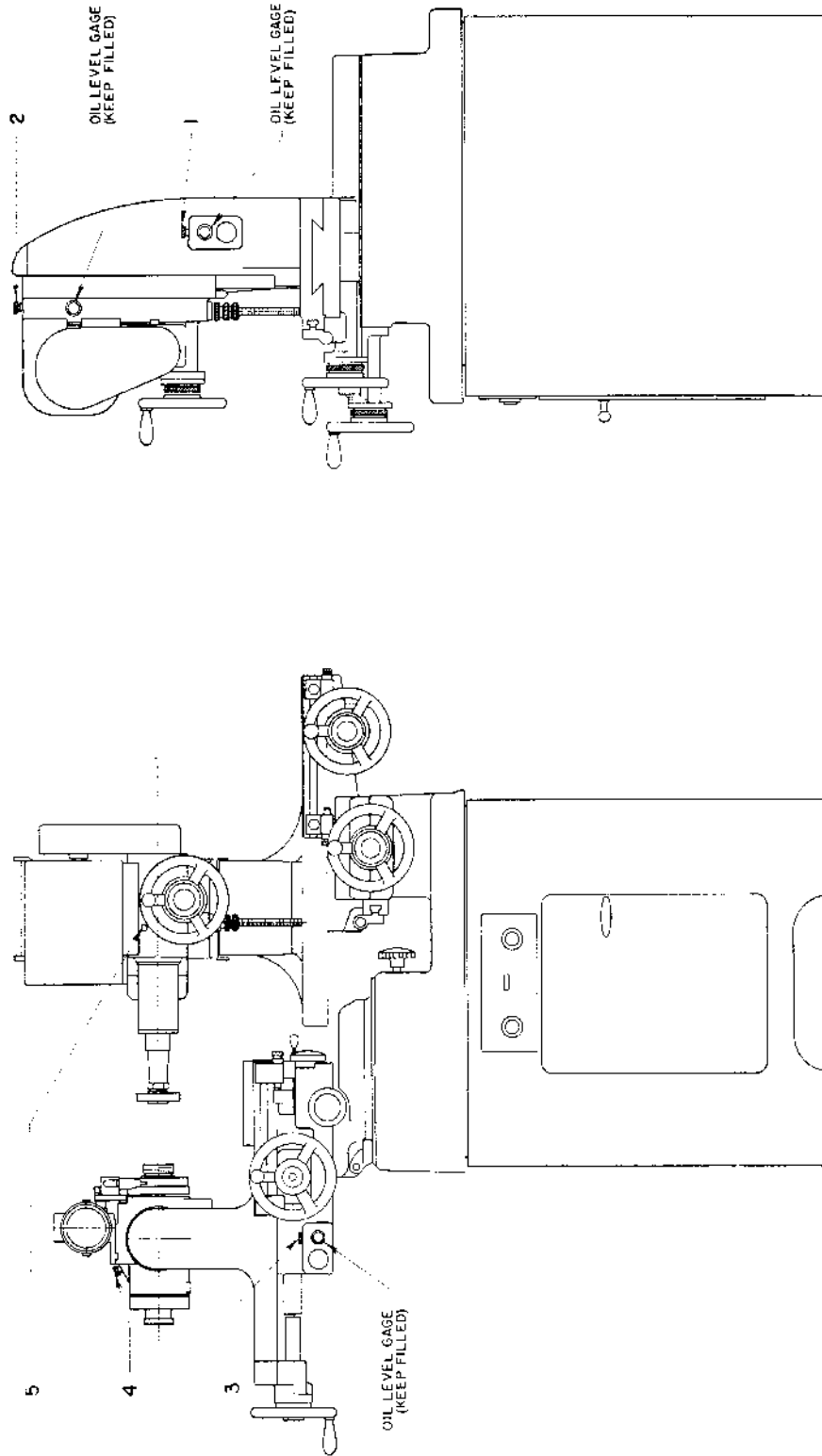


Figure 10
Lubrication Diagram

LUBRICATING INSTRUCTIONS AND SPECIFICATIONS

When To Oil	Station Number	Parts Lubricated	Lubricating Instructions	Specifications
Operate plunger once a day. Add oil when necessary	1	Wheelhead transverse and longitudinal slide lead screws and bearings	Keep sight gage filled. Pull plunger knob out to full length of stroke and allow plunger to <i>return itself</i> to inner position once every 24 hours	P-47. A compounded medium-heavy oil for machine tool slideways. Viscosity 300 to 350 S.U.S. @ 100°F.
	3	All bearings (except spindle) in workhead unit		
When Necessary	2	Wheelhead vertical slide lead screw and bearing	Keep sight gage filled	P-45. Rust and oxidation inhibited paraffin base oil. Viscosity 100 to 110 S.U.S. @ 100°F.
	4	Workhead spindle		
Monthly	5	Grinding wheel spindle	Oil with bench oiler. Apply approximately 10 drops, NOT MORE, once a month	M-1447-1
	Internal grinding attachment spindle, when supplied			

Lubricate motors in accordance with manufacturer's recommendations.

OPERATING INSTRUCTIONS

Motor Control Panel. A panel on the front of the machine base is equipped with two switches for controlling the motor drives to the workhead and grinding wheel spindles. A toggle switch is provided for the workhead motor, and "START-STOP" push buttons are provided for the grinding wheel drive motor. A plug-in receptacle is provided on the rear face of the base for connecting or disconnecting the workhead motor. The machine is also equipped with another receptacle on the rear of the base to provide an outlet if necessary.

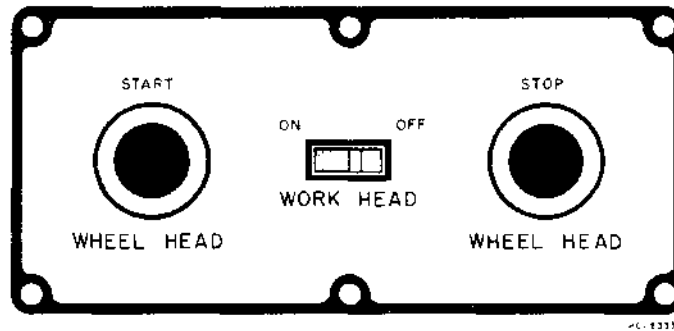


Figure 12
Motor Control Switches on Front of Base

Main Slide. The main slide of the workhead is provided with dual control. A pair of handwheels, one at the front, and one at the left-hand end of the slide, allows you to choose the most convenient position for shifting the main slide, depending upon the nature of the job being performed. The front handwheel will be used for the majority of operations. However, when the workhead is swiveled to extreme angle the end handwheel becomes more convenient.

Each handwheel is equipped with clamping screws, located in the bracket directly behind the handwheel, to lock the slide in position after adjustment has been made. If it is desired to move the main slide with the front handwheel, loosen the clamping screw behind this handwheel and tighten the clamping screw for the end handwheel. If it is desired to move the main slide with the end handwheel, loosen the clamping screw for the end handwheel and tighten the clamping screw for the front handwheel. Clockwise rotation of either handwheel moves the main slide toward the grinding wheel spindle.

Offset Slide. The offset slide is that portion of the workhead which provides means for offsetting the centerline of the workhead spindle in relation to the center of the workhead swivel. It will be noted that a scale has been

OPERATING INSTRUCTIONS

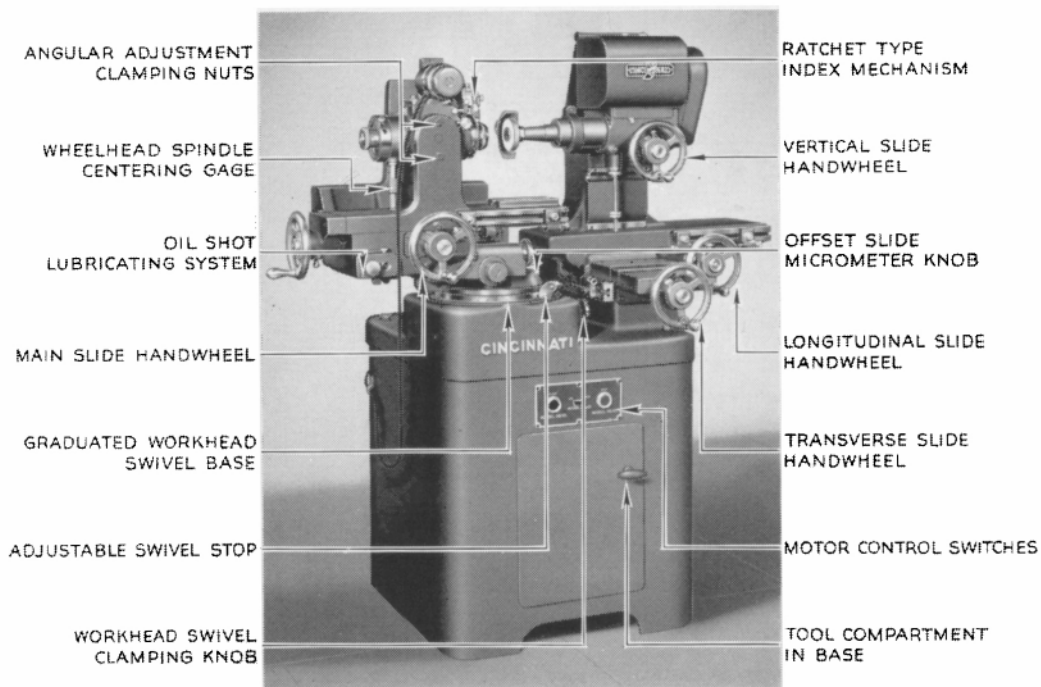


Figure 13A
Functional Diagram (Front View)

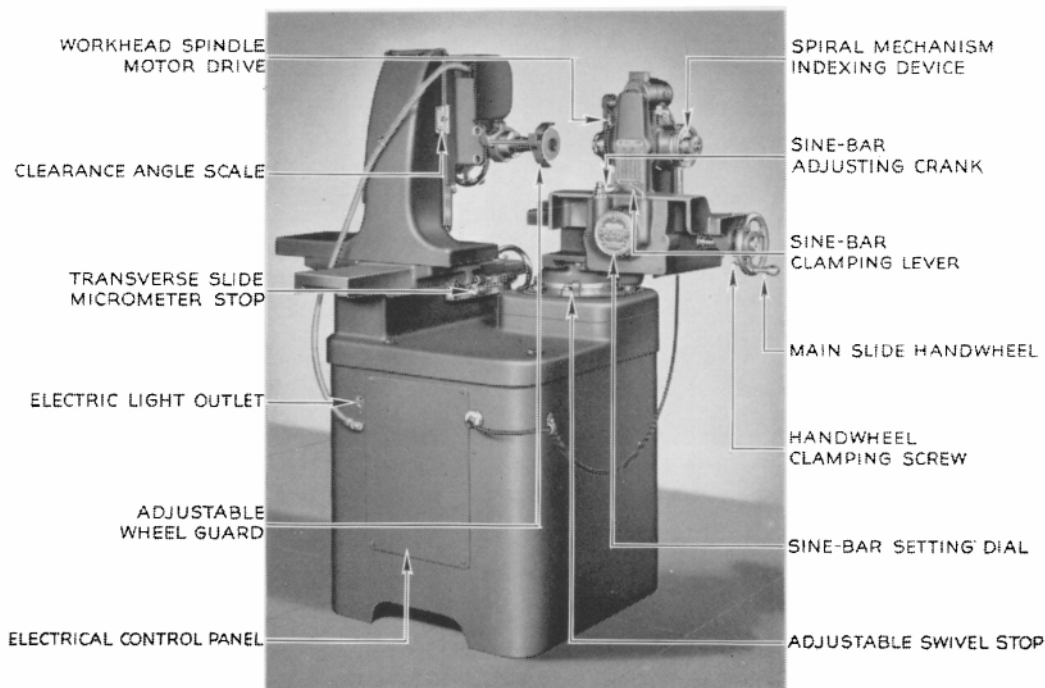


Figure 13B
Functional Diagram (Rear View)

provided on the slide, with fractional graduations. Adjacent to the micrometer handwheel, which operates this slide, is a dial carrying 100 graduations, each representing .0001" movement of the slide. One turn on this handwheel will therefore move the slide .010". This makes it possible to accurately locate the centerline of the workpiece in relation to the center of the workhead swivel for generating concave or convex radii (see "Radial Form Grinding", pages 26-31).

Workhead Swivel. The whole workhead assembly is mounted on a large ball bearing swivel which can be securely clamped in any angular position with the "workhead swivel clamping knob" (see Figure 13A). In addition, the swivel motion of the workhead makes possible a convenient, accurate method of generating radii on the workpiece (See "Radial Form Grinding", pages 26-31). If the swivel works too freely a slight amount of tension may be applied by tightening the clamping knob. The swivel base is graduated 180° in both directions from the neutral longitudinal position of the main slide. Two adjustable stops are provided for limiting the motion of the swivel. These stops are mounted in a circular tee-slot around the base of the swivel. Accurate adjustment is obtained by means of the adjusting screw carried by each stop.

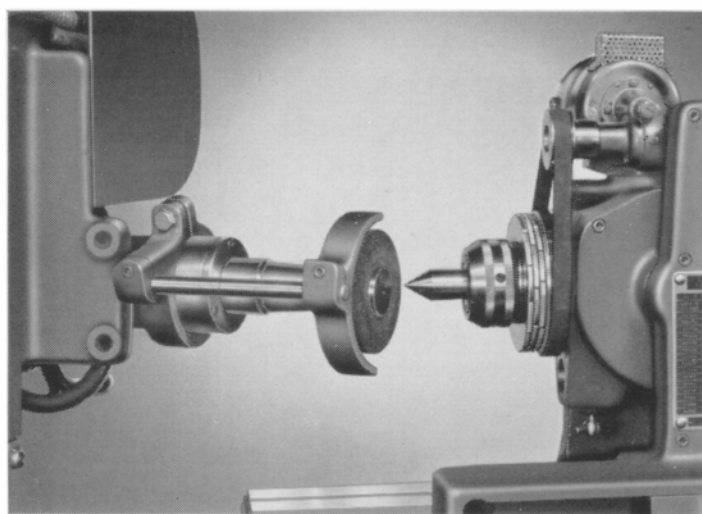


Figure 14

Grinding a lathe center, a typical job for the workhead swivel. Swing workhead to desired angle and clamp. Feed wheel across work. This job could also be done with "workhead spindle angular adjustment", in which case wheel can be fed across work or work fed across wheel, whichever is most convenient.

Workhead Spindle Angular Adjustment. The workhead spindle housing is mounted on the main slide in such a fashion that it may be swiveled in a vertical plane. It is clamped firmly to the main slide by the

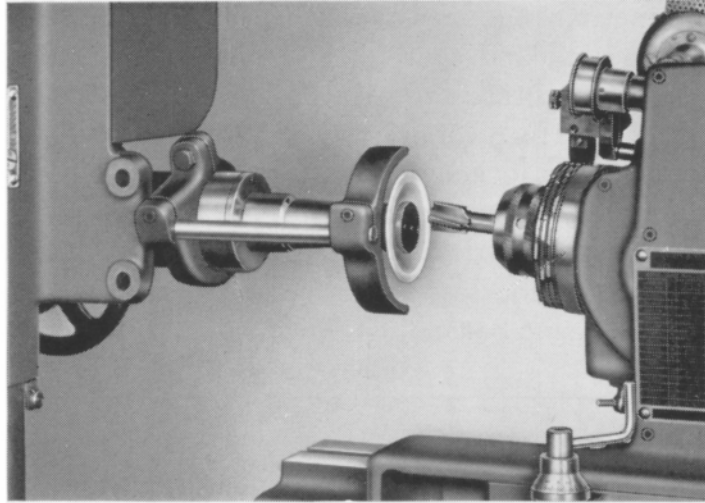


Figure 15A

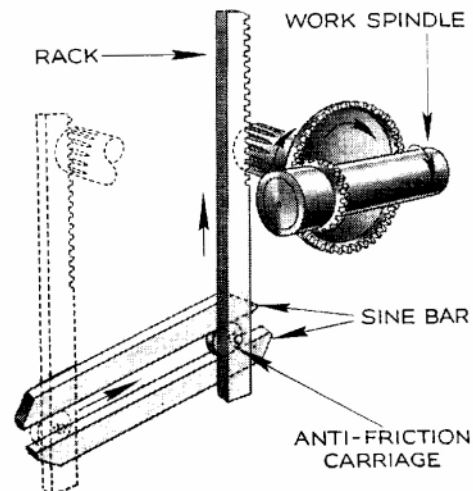
Grinding the end clearance of a counterbore using the "workhead spindle angular adjustment". Spindle housing has been swiveled vertically to the desired clearance angle. Wheel is fed transversely, back to front, positive stop on transverse slide accurately limiting the forward stroke.

two "workhead angular adjustment clamping nuts" (Figure 13A). To swivel the workhead spindle, loosen the clamping nuts, swivel the workhead by hand to the desired position, and reclamp firmly with the clamping nuts. Returning the workhead spindle to the "zero", or horizontal, position is simplified by using the centering gage supplied. This gage is placed on the finished pad on top of the main slide and engages a similar pad on the under side of the workhead spindle housing (see Figure 13A).

Spiral Lead Mechanism. Spirals may be ground on this machine by means of the spiral lead mechanism, located in the rear portion of the auxi-

Figure 15B

Diagrammatic explanation of spiral lead generating mechanism. As main slide is shifted, anti-friction roller moves between guiding surfaces of sine bar. Vertical movement thus translated to rack causes rotation of spindle through the bevel gears.



liary slide. The mechanism consists of a sine-bar arrangement, connected to the spindle by a rack and gear train, which may be adjusted to cause the workhead spindle to rotate when the main slide is moved. Adjustments of the sine-bar are made by means of the "sine-bar adjusting crank", and the mechanism may be firmly locked in any position with the "sine-bar clamping lever" (See Figure 16). The angular setting of the sine-bar is indicated on the graduated dial mounted on the rear surface of the offset slide. Accurate adjustment of the sine-bar is made possible by the micrometer dial mounted on the sine-bar adjusting crank. The micrometer dial is

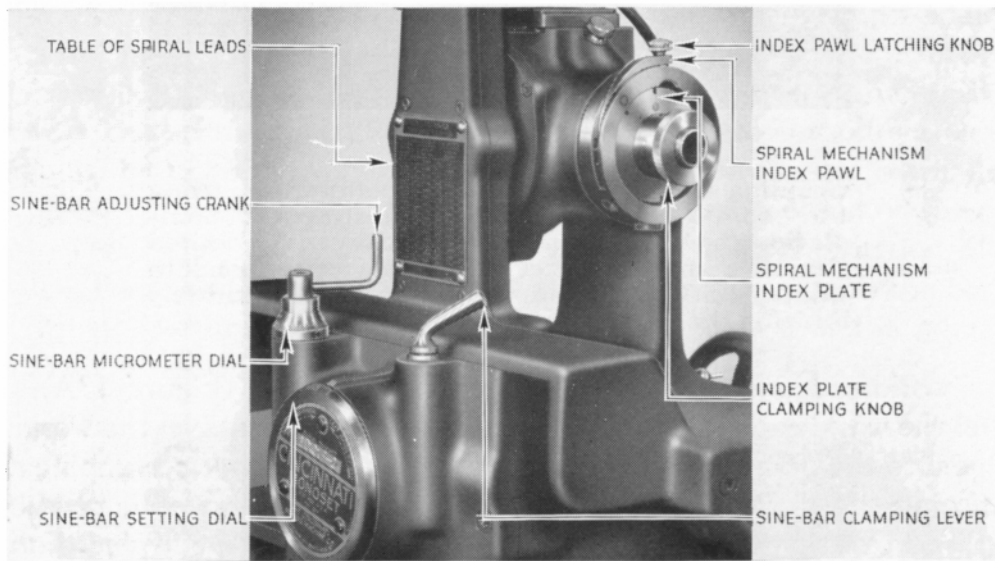


Figure 16
Spiral Lead Mechanism Controls and Indexing Device

graduated in two-minute increments and one turn of the crank moves the dial 6° . Always release the sine-bar clamping lever before making an adjustment, and reclamp after the adjustment has been made. Rotate the adjusting crank in a clockwise direction, as viewed from above, to adjust the mechanism for a right-hand spiral; counterclockwise for a left-hand spiral. When adjusting the mechanism for a right-hand spiral, release the clamping lever and turn the adjusting crank in the direction of a left-hand spiral (counterclockwise) a small amount in order to release the wedging action of the clamp.

The spiral lead mechanism is inter-connected with the workhead spindle by means of the "spiral lead mechanism indexing device" at the left-hand end of the workhead spindle. The outer ring, which carries the "index pawl" is rotated by the spiral lead mechanism, and, when the pawl is engaged in one of the notches in the "index plate," the spindle will, in turn, be rotated.

When not using the spiral lead mechanism, always disengage the pawl from the index plate and latch in this position by means of the small knurled "pawl latching knob" on the end of the pawl.

It must be remembered that the readings obtained from the graduated dial, and the micrometer dial on the sine-bar adjusting crank, refer only to the angular position of the sine-bar and have no relation to the helix angle of the spiral. The setting of the sine-bar for any desired lead may be determined by the following formula:

$$\tan \text{ sine-bar angle} = \frac{1.767}{\text{lead}}$$

A table of leads, with the corresponding sine-bar settings sufficient for most jobs is located on the rear of the rack housing, adjacent to the sine-bar adjusting crank. Interpolation for intermediate leads will be sufficiently accurate for practical purposes.

A pair of index lines scribed on the rear of the sine-bar housing and the main slide, simplify adjustments of the sine-bar for helical cutters of unknown lead. To make this adjustment, proceed as follows:

1. Mount the cutter in the workhead spindle.
2. Adjust the sine-bar setting dial to the zero position.
3. Adjust the main slide until its index line lines up with the one on the sine-bar housing, to the right of the sine-bar clamping lever.
4. With the workhead swivel base set on 0°, position the grinding wheel so that it is almost touching the rear side of the cutter, near its outer end.
5. Place a mark on the side of the grinding wheel adjacent to the edge of one tooth, being careful not to move the wheel after it is marked.
6. Move the main slide to the right an amount not exceeding the lead of the cutter teeth.
7. Rotate the sine-bar adjusting crank until the same tooth of the cutter is again aligned with the mark on the wheel. Clamp the sine-bar and move the main slide back and forth to observe how well the cutting edge of the tooth follows the mark.
8. Center up a tooth of the cutter, raise or lower the grinding wheel to establish the desired clearance, and proceed to grind.
9. Check the cutter for taper. If the shank end of the cutter is large the sine-bar angle must be reduced slightly. If the cutter is small at the shank end, the sine-bar angle must be increased.

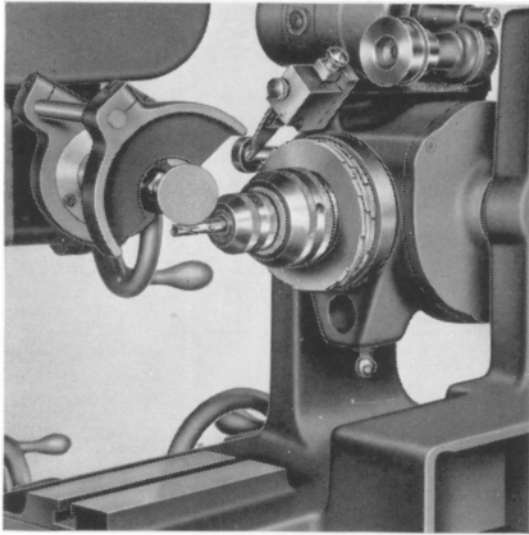


Figure 18

Typical application of spiral lead mechanism;—gashing out spiral flutes of a special cutter being ground from the solid. Workhead is swiveled to helix angle of flute and wheel is formed to give desired flute shape. Small mounted wheel is held in collet adapter, available at extra cost.

Workhead Spindle Indexing Mechanisms. The workhead spindle is equipped with two separate indexing devices to provide accurate indexing for either straight or spiral tooth cutters.

The indexing device on the left-hand end of the workhead spindle is for use in conjunction with the spiral lead mechanism. (see Figure 16). It provides the driving member between the spiral lead mechanism and the workhead spindle and permits the spindle itself to be accurately indexed in relation to the spiral lead generating mechanism. The spring pressed "index pawl" is mounted on a pivot in the outer, ring-shaped member to provide instant, one hand disengagement of the index tooth.

A set of three interchangeable index plates having 8, 10 and 12 equally spaced notches respectively, are supplied with the machine. Additional index plates, having 15, 18, 20, 22, 24 and 28 positions, are available at extra cost. To interchange index plated it is only necessary to remove the knurled "index plate clamping knob" at the left-hand end of the spindle.

For jobs on which the spiral lead generating mechanism will not be used, the index pawl should be disengaged from the notched plate. This disengages the workhead spindle from the spiral lead generating mechanism and permits the spindle to be freely rotated. The index pawl is provided with a knurled latching knob to accomplish this. Simply depress the pawl, rotate the knob a quarter of a turn, and the pawl will remain disengaged.

For grinding straight fluted cutters or other simple indexing jobs a simple ratchet type indexing mechanism is provided (see Figure 19). This device consists of an "index plate" on the workhead spindle and a spring pressed "index blade" which engages the notches of the "index plate". The "blade

holder slide" is adjustably mounted in the workhead spindle housing to permit the "index blade" to be engaged with any desired row of notches.

The "index plate" is really three index plates in one since there are three rows of notches having 10, 12 and 14 evenly spaced notches respectively. The 12 notch row is also provided with four additional notches to permit indexing of eight-tooth cutters. To change the "index blade" from one row of notches to another, merely loosen the "blade holder slide clamping screw" shift the entire blade holder assembly until blade lines up with desired row of notches, and retighten the clamping screw. The "index blade" is attached to a spring pressed member which is mounted on a pivot in the "blade holder". The action of the spring keeps the "index blade" firmly engaged with the "index plate". If it should be desired to momentarily disengage the "index blade" from the "index plate" to permit free rotation of the spindle, it is only necessary to lift the blade away from the plate, against the action of the spring, and tighten the "blade pivot locking screw". Releasing the locking screw will again engage the blade with the plate.

The "blade holder" is adjustably mounted on the "blade holder slide" to permit proper positioning of the cutter tooth in relation to the grinding wheel, *after* the cutter is clamped in the workhead collet. Thus the "index blade" may be advanced or retracted while engaged in one of the "index plate" notches, until the cutter tooth has been rotated into proper position in relation to the grinding wheel, as determined by the centering gage. The "blade holder" may be firmly clamped in any position by means of the "blade holder clamping screw". When this clamping screw is released, adjustment of the blade holder is accomplished by rotation of the "blade holder adjusting screw".

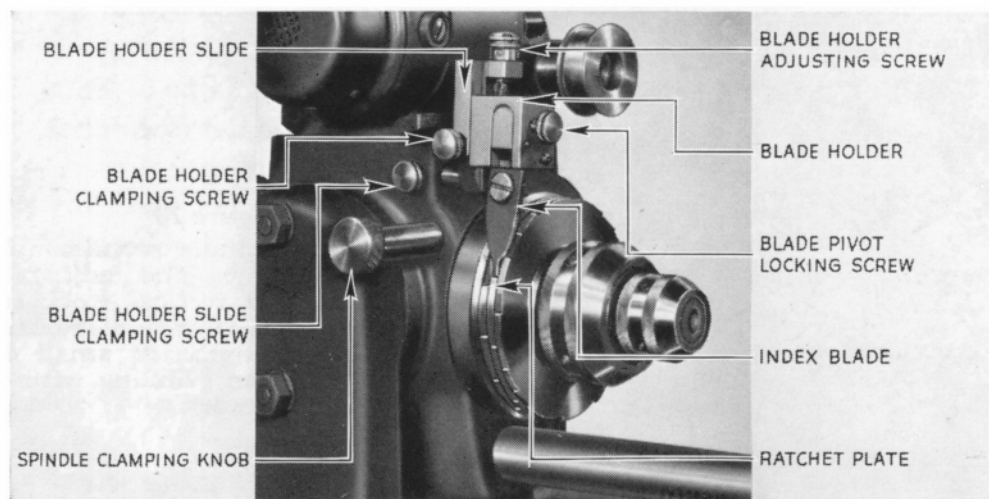


Figure 19
Ratchet Type Indexing Mechanism

Work Holding Collets. Thirteen straight hole collets and six taper hole collets are supplied with the machine. The straight hole collets range in size from $\frac{1}{8}$ " diameter to $1\frac{1}{4}$ " diameter holes. The taper hole collets are Nos. 5, 7, and 9 Brown and Sharpe and Nos. 2, 3, and 4 Morse tapers.

The straight hole collets from $\frac{1}{2}$ " diameter to $1\frac{1}{4}$ " diameter, and all of the taper hole collets, are mounted directly in the workhead spindle; the smaller size collets are mounted in a collet adapter which is in turn mounted in the spindle in a similar manner to the larger collets (see Figure 21A). To mount one of the larger collets in the workhead spindle; remove the knurled collet clamping nut from the nose of the spindle, insert the desired collet, and replace the clamping nut. To mount one of the smaller collets; mount the collet adapter in the workhead spindle, and insert the desired collet in the collet adapter in the same fashion as mounting the larger collets in the spindle:—the collet adapter is equipped with its own collet clamping nut for this purpose.

Always lock the workhead spindle by means of the "workhead spindle clamping knob" Figure 19 when loosening or tightening the collet clamping nut.

Care should be exercised to see that all mating surfaces of the spindle, collet, collet adapter, and work are perfectly clean before mounting in position. The presence of dirt or grit may cause the work to "run-out", or may permanently damage the proper fit of these members.

Workhead Spindle Motor Drive. To rotate the workhead spindle by means of the $1/15$ h.p. motor, the belt supplied with the machine should be placed over the motor pulley and around the index plate on the right end

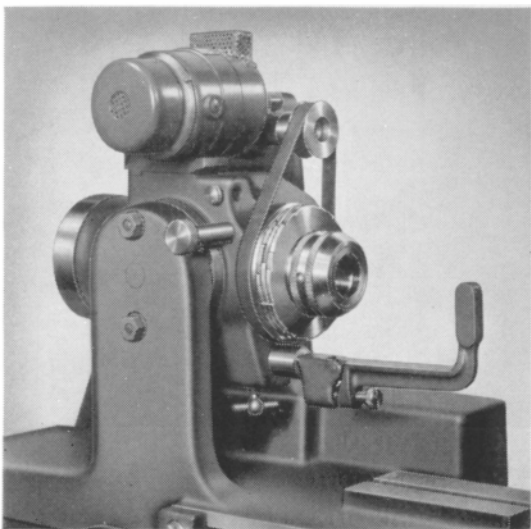


Figure 20

Belt drive to spindle permits cylindrical grinding. The adjustable, spring-tensioned vertical stock support, mounted in the spindle housing, is useful for supporting small diameter work when grinding with the wheel above the work.

of the workhead. When using the motor to drive the workhead, the lead mechanism index pawl must first be disengaged from the index plate at the left-hand end of the spindle and the "spindle clamping knob" must be released. The workhead motor is started with the toggle switch on the motor control panel. The spindle rotates at 200 r.p.m.

Although the blade of the ratchet type indexing device may merely be latched out of contact with the index plate to permit the use of the motor drive, it is usually more convenient to remove the whole blade holder assembly from the workhead.

Tail Center Support. The machine is provided with a bar-type tail center support to help prevent deflection when grinding long work that is centered. The workhead spindle housing is provided with a hole located directly beneath the spindle, into which the bar portion of the support may be inserted, and a clamping screw to lock the bar firmly in place after it is properly positioned. The center support, located at the outer extremity of the bar, may be removed by releasing the clamping screw. A key in the bar engages the keyway in the support to assure accurate relocation of the center when replaced.

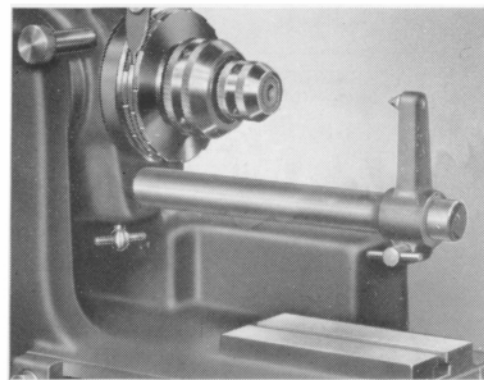


Figure 21A
Adjustable tail center support. Method of mounting permits its use even when spindle is tilted.

Stock Rests. The machine is provided with both vertical and horizontal spring-tensioned stock rests to assist in supporting uncentered stock (see Figures 20 and 21B). The vertical stock rest is mounted on the workhead spindle housing in the same manner as the tailstock bar; by inserting in the hole beneath the workhead spindle and locking in place with the clamping screw. The horizontal stock rest is combined with the diamond truing tool holder, and is mounted in the tee-slot on top of the right-hand portion of the main slide. Both stock rests consist of a hinged lever, the adjustment of which is controlled by a knurled thumb screw.

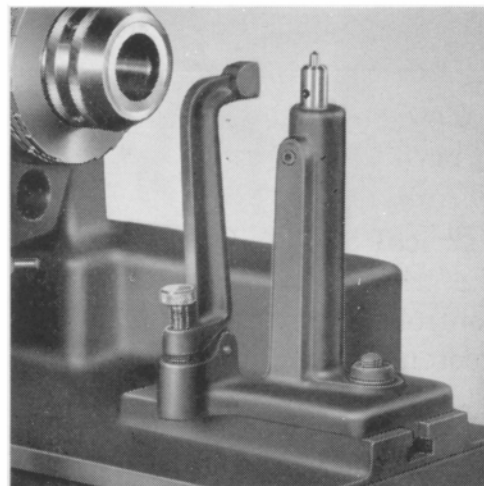


Figure 21B
Combined horizontal stock rest and diamond holder showing method of mounting.

Transverse Slide. The transverse slide is the primary means of adjusting the grinding wheel in relation to the work. The "transverse slide handwheel" (Figure 22) controls the movement of the slide, and clockwise rotation of the handwheel moves the slide to the rear. The "transverse slide micrometer stop" (see Figure 22) provides an adjustable positive stop to simplify accurate repositioning of the slide after it has been retracted to the rear.

Longitudinal Slide. The longitudinal slide is that portion of the wheelhead mounting which makes possible longitudinal adjustment of the grinding wheel, toward or away from the workhead: Clockwise rotation of the "longitudinal slide handwheel" (Figure 22) moves the slide to the right. Two micrometer stops are provided on this slide to accurately limit the movement in both directions.

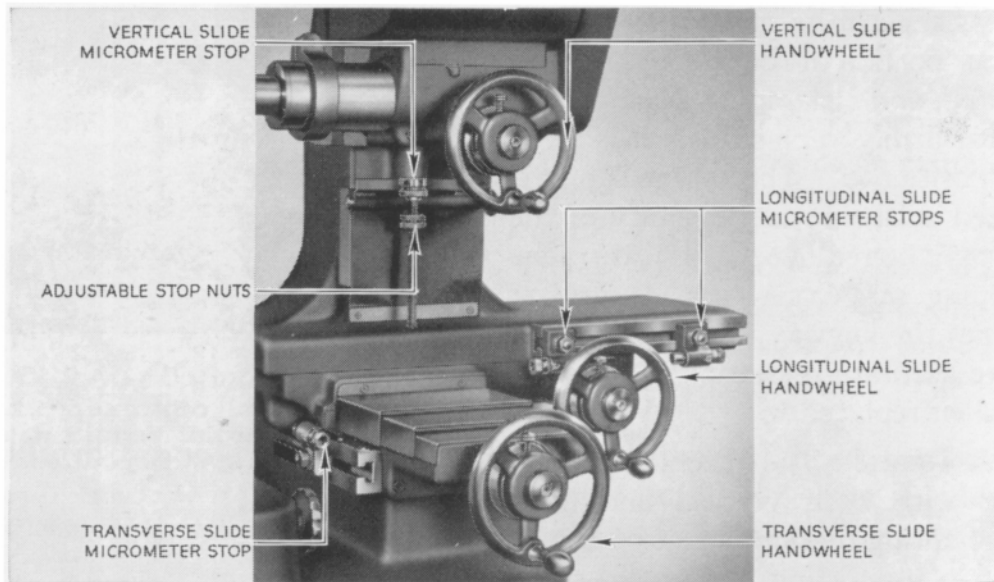


Figure 22
Wheelhead Controls

Vertical Slide. On the face of the column is the vertical slide, carrying the grinding wheel spindle housing and spindle drive motor. This slide is controlled by the "vertical slide handwheel" (Figure 22), provided with micrometer dial. For accurate depth control, the vertical slide is equipped with a micrometer stop located below the spindle housing. The rough adjustment for this stop consists of a pair of knurled nuts mounted on a vertical screw (see Figure 22). The upper nut is the stop nut; the lower nut being used to lock the stop nut in position. Accurate adjustment is made by means of the adjustable sleeve, fitted with a micrometer dial, located beneath the grinding wheel spindle housing.

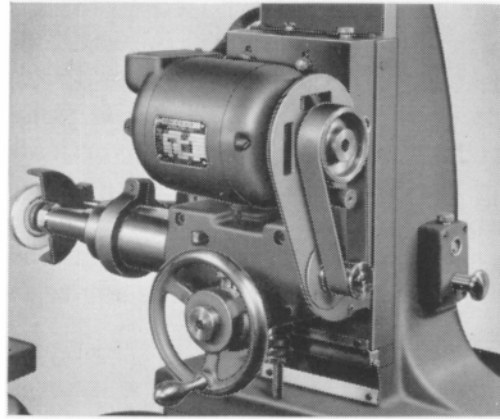


Figure 23
Grinding Wheel Motor Drive with
Covers Removed

Grinding Wheel Spindle Drive. The grinding wheel spindle is driven by a flat belt from a pulley on the shaft of the driving motor (see Figure 23). Two different sized motor pulleys, with driving belts to match, are supplied to provide two speeds for the grinding wheel spindle. The larger pulley drives the spindle at 8000 r.p.m., the small pulley drives it at 6000 r.p.m. The sheet metal belt guard is held in place by the single socket head screw in the center of the guard.

Dressing the Wheel. The grinding wheel must be dressed occasionally to obtain a good finish on the clearance angles of the cutter, for a good finish makes a keen cutting edge. A piece of carborundum stick or part of a broken grinding wheel may be used for ordinary dressing of the straight or dished wheels. For accurate truing, as required for cylindrical or form grinding the wheel truing attachment should be used. This attachment is combined with the front stock support and mounted in the tee-slot on the main slide. The wheel can be moved across the face of the diamond or the diamond across the face of the wheel as desired. Used in conjunction with the workhead swivel base it is a simple matter to generate a wide variety of shapes in the grinding wheel. The diamond holder bar is provided with two diamond nib mounting holes which permit the wheel to be trued from either the front or the bottom, whichever is more convenient.

Clearance Angle Scales. To simplify the settings required to grind the "back-off" or clearance angle of a cutter, the vertical and transverse slides are provided with pointers, and scales graduated in degrees, which indicate the positions of the grinding wheel spindle for obtaining various clearance angles when grinding above or behind the work. The graduations extend from zero to twenty-five degrees in both directions. Naturally,

an adjustment such as this must be based upon a fixed grinding wheel diameter which, in this case, is 3". Since the wheel diameter changes with wear it is essential that you bear in mind that an allowance will have to be made to correct the error so produced. The pointer for the clearance angle scale on the vertical slide is adjustable vertically so that it can still be used when grinding below the usual center position. Lower the pointer until it registers with one of the graduations on the scale. This graduation can then be used for a zero line, and the clearance angle selected accordingly. The pointer slide is provided with a zero line for repositioning the pointer after being used as described above.

It is possible that, in extreme positions, the scale will not provide for sufficient adjustment to indicate the desired clearance angles. When such a condition exists, the clearance angle can be obtained by adjusting the grinding wheel spindle .026" in the desired direction for each degree of "back-off" required, using, of course, the initial wheel position as a starting point.

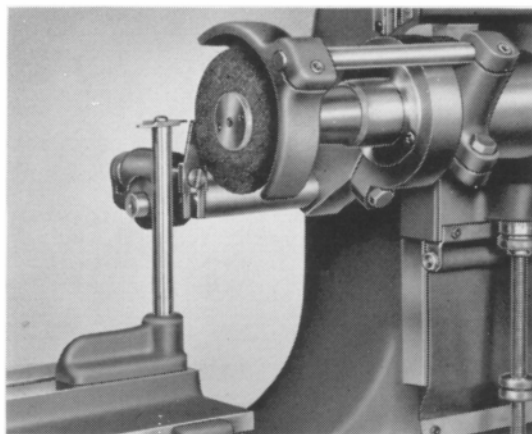


Figure 24
Tooth Rest on Grinding Wheel Spindle
Housing, Showing Use of Centering Gage

Tooth Rest. For rapid accurate regrinding of spiral fluted cutters, without recourse to the spiral lead mechanism, a simple, adjustable tooth rest is supplied with the machine. This attachment mounts on the polished outboard portion of the grinding wheel spindle housing. Remove the grinding wheel, and shift the wheel guard back further on the grinding wheel spindle housing, if necessary, before mounting this attachment in position. Locate the attachment so that the tip of the tooth rest blade is roughly centered and then clamp in position by tightening clamping screw "D" (Figure 25A).

The grinding wheel may now be replaced on the spindle and the blade accurately positioned in relation to the wheel. To adjust the blade transversely, toward or away from the wheel, loosen clamping screw "A", adjust

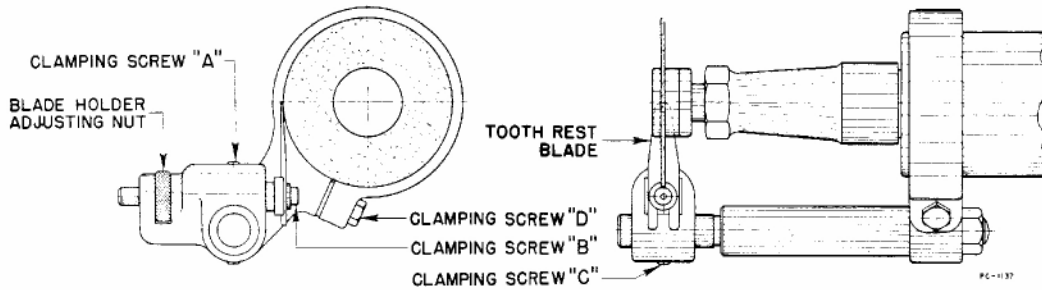


Figure 25A
Tooth Rest on Grinding Wheel Spindle Housing

to proper position by rotating the blade holder adjusting nut, and reclamp. To adjust the blade longitudinally, loosen clamping screw "C", shift the blade holder assembly into the proper position and reclamp. To adjust the blade vertically, loosen clamping screw "B", raise or lower the blade into the proper position as indicated by the centering gage supplied with the machine, and reclamp.

Internal Grinding Attachment. The machine may be equipped with an internal grinding attachment, supplied at extra cost, which mounts on a bracket on the grinding wheel spindle housing. When mounting this attachment, first remove the grinding wheel and the grinding wheel guard, and slip the attachment over the grinding wheel spindle housing, aligning the mounting bracket of the attachment with the bracket on the rear portion of the spindle housing.

Locate the internal grinding spindle at the proper height in relation to the workhead spindle by means of the centering gage supplied (see Figure 25B). The next step will be to mount the belt guard in place before mounting the

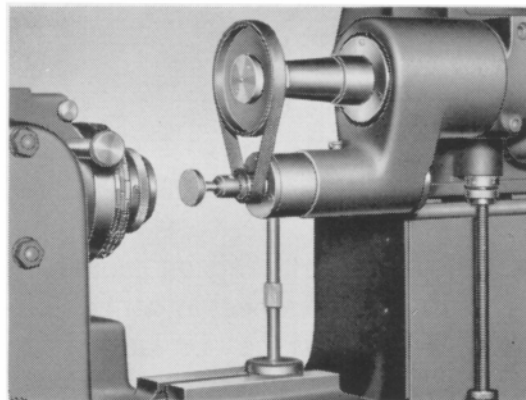


Figure 25B
Internal Grinding Attachment with
Belt Guard removed, showing Use
of Centering Gage

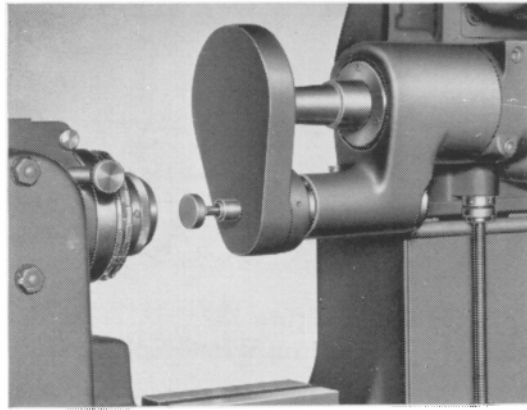


Figure 26
Internal Grinding Attachment
with Belt Guard in Place

driving pulley and belt. The belt guard is made in two parts to facilitate the mounting of the driving pulley and belt. Remove the two socket head screws which hold the two parts of the guard together, and slip the flanged portion of the guard over the finished portion of the internal attachment spindle housing. Mount the driving pulley in place on the grinding wheel spindle and place the fabric belt over the pulleys. The belt guard has been made as compactly as possible in order to avoid interference, and, while the space inside is sufficient, it does not provide for careless adjustment. Be sure that the guard is properly centered over the pulleys and then lock it in position by tightening the set screw in the mounting flange. The cover portion of the guard may now be attached by means of the two socket head screws.

The collets for the internal wheels are made with a left-hand thread to prevent them from loosening while running.

The spindle is started by pushing the grinding wheel spindle "START" button and rotates at 33,000 r.p.m. When the internal attachment is not in use it should be stored in a horizontal position; never stand it on end.

Radial Form Grinding. The grinding of geometrical forms requires a multiple of movements of work and wheel in controlled relationship to each other, so that any fixed point or axis may be located for presentation to the work. The micrometer stops, with which the various slides are equipped may be used in conjunction with gage blocks to accomplish this.

Male and female radii, plain cylindrical, tapered, or angular surfaces may all be generated on the work piece in one chucking.

To generate a plain cylindrical surface the workhead spindle should be set in exact parallel relationship to the grinding wheel spindle. This may be accomplished by setting the workhead swivel, and the workhead spindle angular adjustment, to the zero lines on their respective graduated scales. The correctness of the settings may be checked by making a test grind. Bring the wheel into position on top of the work and make the cut by shifting either the main slide or the longitudinal slide; that is, by passing the work across the wheel, or the wheel across the work.

Taper shapes may be generated by tilting the workhead spindle (see "Workhead Spindle Angular Adjustment", pages 14-15), or by swiveling the workhead to the required angle (see "Workhead Swivel", page 14).

Male or female radii may be generated with the workhead swivel in much the same fashion as drawing an arc with a compass; the axis of the workhead swivel would represent the center point, and the grinding wheel would represent the pencil point.

Advancing or retracting the grinding wheel would vary the radius of the arc generated, in the same fashion that opening or closing the compass would effect the size of the circle. The center of the radius to be generated must be located on the axis of the workhead swivel; that is, directly above the center of rotation of the workhead swivel. Since the center of the desired radius will seldom fall upon the centerline of the workpiece, it is necessary to be able to offset the workhead spindle from the axis of workhead swivel in order to do this. This offset movement is provided by the "offset slide"

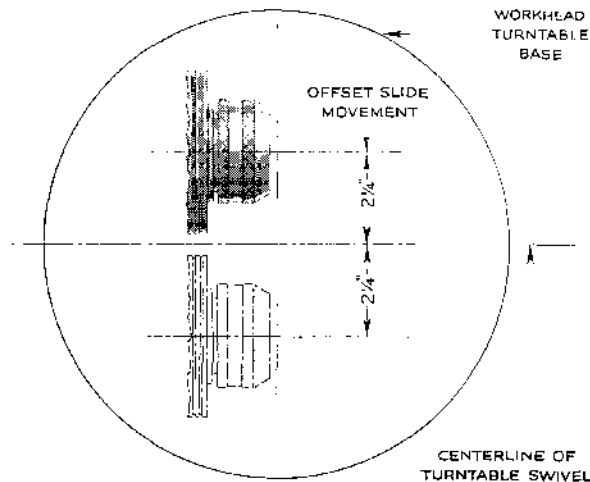


Figure 27
Offsetting of Work Spindles in Relation to Axis of Swivel is Basic Adjustment for Positioning Center of Desired radius

(see page 12). Shift the offset slide an amount equal to the distance from the center of radius to the centerline of the workpiece.

When grinding a radius in the conventional manner, with the wheel behind the work, if the center of the radius lies to the rear of the axis of the workpiece (see Figures 28 and 29A), it will be necessary to shift the offset slide toward the front of the machine. If the center of the radius lies to the front of the axis of the workpiece (see Figure 29B), it will be necessary to shift the offset slide toward the rear.

To help locate the workpiece when grinding radii, an index line is provided on the front face of the wheelhead longitudinal slide dog slot. The top surface of the boss, which acts as the positive stop member for the dogs, is provided with a similar index line. When the two index marks are aligned with each other, the left-hand end of the grinding wheel spindle will be in alignment with the axis of the workhead swivel.

This location of the spindle end may then be used as a reference point to roughly locate the workpiece in the desired position, with the center of the radius on the axis of the workhead swivel.

It is generally necessary, when grinding radii, to true the grinding wheel to a matching radius; that is, when grinding a female radius true the grinding wheel to a similar male radius, and vice versa. Truing a radius on the grinding wheel is accomplished with the workhead swivel in much the same fashion as just described for generating a radius on the workpiece. The axis of the workhead swivel acts as the center of the radius and the location

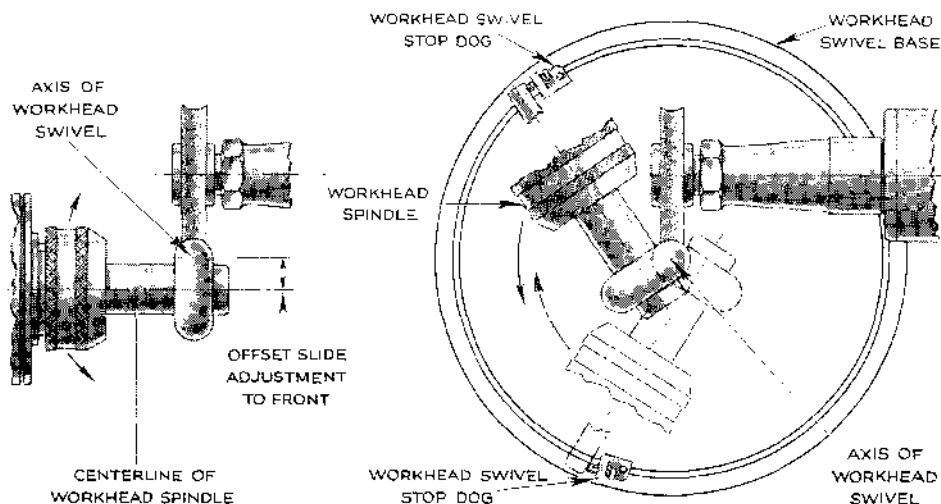


Figure 28

Centerline of workpiece has been shifted forward, by means of the offset slide, an amount equal to the distance from work centerline to center of desired radius. This accurately locates center of radius in relation to axis of swivel.

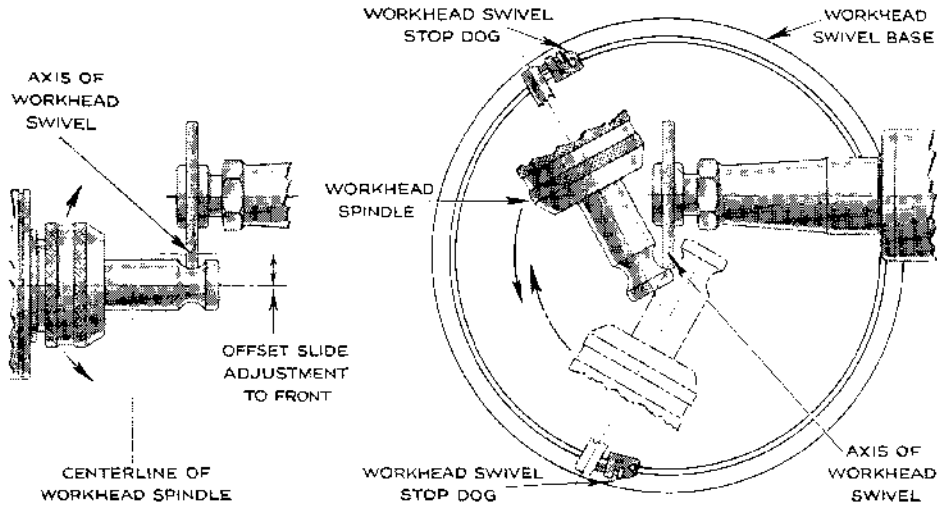


Figure 29A

Position of grinding wheel governs shape and size of radius. Wheel behind axis of swivel generates convex radius; wheel in front of axis generates concave radius. In this illustration, workpiece is located same as Figure 28, but forward position of wheel generates concave radius.

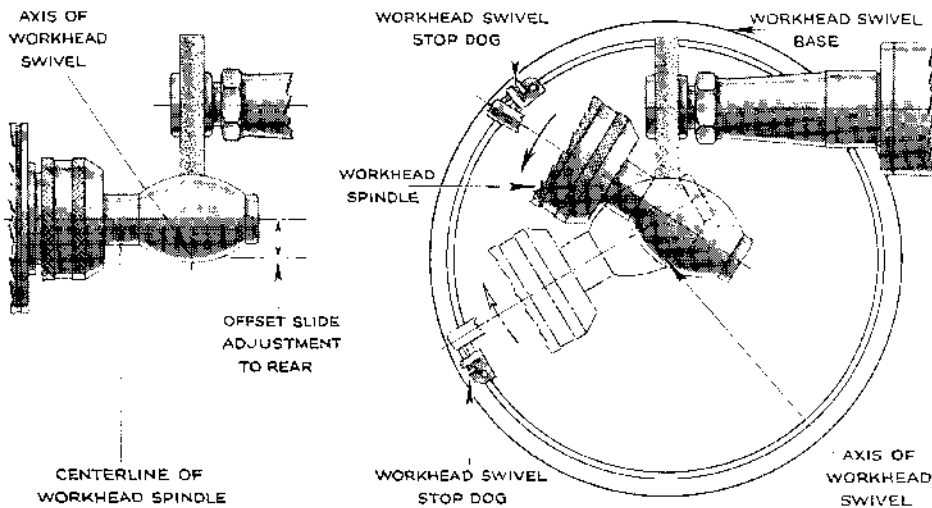


Figure 29B

Position of center of radius necessitates shifting offset slide to rear. Distance between grinding wheel face and axis of swivel determines size of radius generated. Adjustable stop dogs accurately limit swivel movement of workhead.

of the diamond in relation to the axis controls the size of the radius. Position the diamond by means of the offset and main slides, and shift the grinding wheel into the proper position in relation to the axis of the workhead swivel by means of the wheelhead slides. After truing the radius on the wheel, the wheel may be backed-away with the transverse slide. However, do not shift the wheel laterally, with the longitudinal slide, as the lateral position of the wheel will later serve as a guide in locating the workpiece in relation to the axis of the workhead swivel.

Most jobs will permit the wheel truing attachment to remain in position on the main slide while grinding. If this is not possible the wheel should be trued to the desired radius before chucking the workpiece.

Next, using the grinding wheel as a guide, advance or retract the main slide to locate the center of the radius on the axis of the workhead swivel. This position may be determined by bringing the wheel up close to the work, swinging the workhead through its arc of travel, and, at the same time adjusting the main slide until the center has been properly located. After properly locating the main slide it is advisable to adjust the main slide micrometer stop so that subsequent operations may be accurately located from the center of the radius.

When grinding radii it is advisable to accurately limit the arc of travel of the workhead swivel by means of the adjustable swivel stops, (Figures 13A and 13B), carried by the graduated swivel plate. Care should be exercised, when swinging the workhead, to avoid bumping these stops, as such an action might set up a momentary swinging vibration of the workhead which would cause the wheel to nick the work. If the workhead swivel swings too freely it is difficult to avoid bumping the stops. A slight amount of tension or resistance may be applied to the swivel movement by adjusting the "workhead swivel clamping knob" (Figure 13A), until the proper "drag" is obtained. This adjustment should not be carried to the point where it becomes necessary to exert any considerable force to swing the workhead through its arc of travel.

If a female radius is to be ground, the center of which lies too close to a projecting shoulder to permit the work to be swung completely through the arc of the radius (see Figure 31), a wheel must be selected which is sufficiently thinner than the diameter of the radius to permit a sufficient portion of this radius to be dressed on the wheel to complete that portion of the grind which will not permit swinging of the work. If the nature of the radius is such that by using a thin wheel the radius may be produced sectionally; that is, if the width of the wheel is less than the diameter of the radius to be ground, the work may be shifted so that various portions of the radius may be presented as required and the different sections blended to complete the radius. This method can be used advantageously when the center of the radius to be ground lies flush with or below the O.D. Care should be exercised to finish as great a portion of the radius as can be ground with each wheel passage.

Then the work may be shifted and the portions of the radius which cannot be ground at a single pass blended to that portion previously ground.

Many jobs, such as shoulder fillets, necks, etc., not requiring the extreme accuracy of a generated radius, may be ground quickly by truing the grinding wheel to the required radius and grinding in the conventional manner, without the use of the workhead swivel.

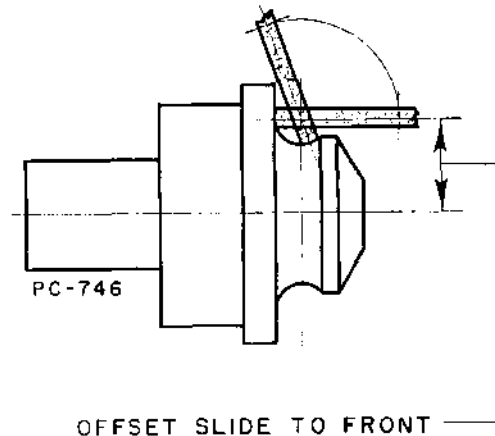


Figure 31
Female Radius Close to
Projecting Shoulder

SAFETY PRECAUTIONS

Protective Hoods. Protection hoods shall always be used with wheels which are not provided with protection flanges, chucks, or bands.

Flanges, Washers, and Nuts. All abrasive wheels shall be mounted between flanges, except those which are mounted in chucks.

Washers or flange facings of compressible material shall be fitted between the wheel and its flanges. If blotting paper is used, it should not be thicker than .025". If rubber or leather is used, it should not be thicker than $\frac{1}{8}$ ". If flanges with babbitt or lead facings are used, the thickness of the facing should not exceed $\frac{1}{8}$ ". The diameter of the washer shall be the same size or slightly larger than the flange diameter.

All surfaces of wheels, washers, and flanges in contact with each other should be free from foreign material.

Inspection and Storage of Wheels. Competent men shall be assigned to the mounting, care, and inspection of grinding wheels.

Immediately upon receipt, all wheels should be closely inspected to be sure that they have not been injured in transit. Inspect for cracks by tapping gently (while suspended) with a light implement, such as the metal handle of a screw driver. Wheels must be dry and free from sawdust when applying this test. If they sound cracked they must not be used. Note that organic bonded wheels do not emit the same clear metallic ring as do vitrified and silicate wheels.

Extreme care should be exercised in the storage of wheels. They should be stored in a dry place and should be supported by pegs in racks.

Operating Rules and General Data. Run all new wheels at full operating speed for at least one minute before applying the work, during which time the operator should stand at one side.

Never force the work against a cold wheel. Apply the work slowly, giving the wheel a chance to warm up gradually, thereby minimizing the danger of breakage from rapid heating. This applies to starting work in the morning in cold rooms, and to the use of new wheels which have been stored in a cold place.

Straight wheels are designed for grinding on the periphery *only*. Grinding with the sides of such wheels is extremely hazardous and should not be attempted.

When tightening the grinding wheel spindle end nut, care should be taken to tighten it just enough to hold the wheel firmly; otherwise the clamping stress is liable to damage the wheel or associated parts.

Do not use wheels of a larger diameter or a greater thickness than specified for this machine. The use of wheels larger than the specified diameter will result in excessive peripheral speed of the wheel. The use of wheels wider than specified results in an excessively long line of contact of wheel with work. Either of these conditions may cause burning of the cutter teeth.

The space about the machine should be kept light, dry, and as free as possible from obstructions.

All machines should be attached to a dust exhausting system.

Goggles should be provided for the use of operators to eliminate danger of eye injury.

A wheel guard should be used for every grinding operation.

A guard is provided for all types of wheels included with the machine, except those used on the internal grinding attachment.

ADJUSTMENTS

Adjusting the Gibs. Adjustable taper gibs are provided on all slide to compensate for wear. All slides except the wheelhead vertical slide are provided with head type gibs; the wheelhead vertical slide is provided with a headless type gib adjustment. Clean the bearing surfaces occasionally to avoid excessive wear on the ends of the gib. To adjust for wear with a head type gib proceed as follows (see Figure 33A):

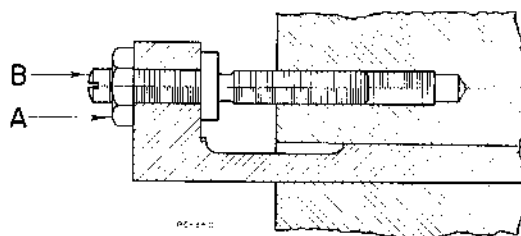


Figure 33A
Head Type Gib

1. Loosen nut "A".
2. Turn screw "B" in a clockwise direction for two or three turns.
3. Turn nut "A" in a clockwise direction until the gib is tight, then back it away two or three turns.
4. Now turn screw "B" in a counter-clockwise direction until the flange touches the gib head, then continue turning in the same direction about one turn.
5. Lock the gib and screw in position by tightening nut "A".

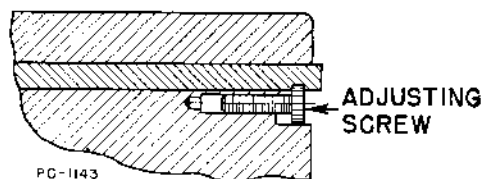


Figure 33B
Headless Type Gib

To adjust the headless type gib on the wheelhead vertical slide it will be necessary to remove the cloth roller-type guard from the top of this slide. Remove the clamping strip to disengage the cloth roller from the top of the wheelhead housing and lift the removable guard strip from across the top of the bearing ways to expose the gib and adjusting screw.

To adjust this gib for wear (see Figure 33B), turn adjusting screw in a clockwise direction until the gib is tight and then back the screw away until the slide moves freely without shake.

Do not adjust the gibs too tightly. Tight adjustment squeezes out the oil film, causing scoring and untimely wear.

Vertical Rack and Pinion Backlash Adjustment. Wear at this point should be very slight, but if an adjustment should seem necessary proceed as follows (see Figure 34):

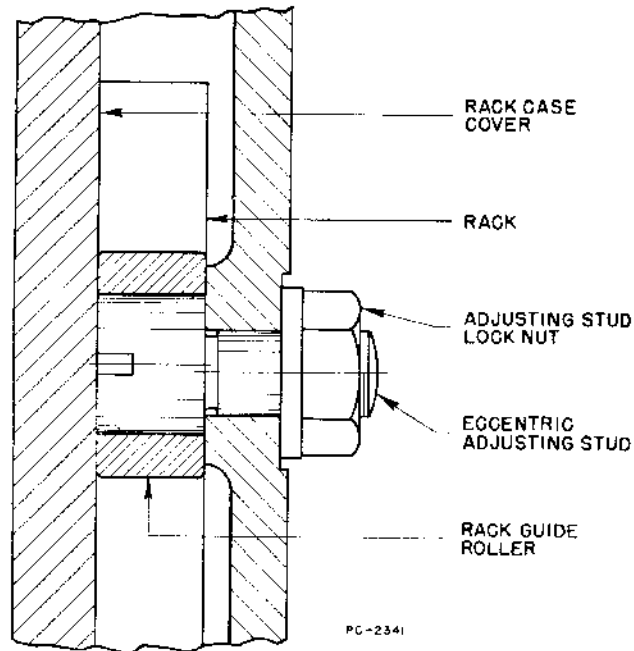


Figure 34
Rack and Pinion Backlash Adjustment

1. Remove the cover from the rack case, located directly behind the spindle. This cover is held in place by six socket head screws.
2. Adjustment is by means of a rack guide roller mounted on the eccentric adjusting stud. Loosen the adjusting stud locking nut.
3. Adjust by rotating the adjusting stud with a screw driver until the desired backlash is obtained.
4. Clamp the adjusting stud rigidly in position with the locking nut. Again check the backlash. Care should be exercised to see that a slight amount of backlash is always present.
5. Replace the cover.

ORDERING REPAIR PARTS

You will receive quicker service when ordering repair parts if you will adhere to the following procedure:

1. **State amount wanted.**
2. **Give part number and name or description of part.** If ordering parts by number, state source of number.
 - (a) Part number stamped on part.
 - (b) Prior invoice.

If part number has worn off, send a sketch of part.

3. **Give complete serial number of machine.** This number will be found stamped on the name plate on the back of the spiral mechanism case.
4. **Specify each individual piece required.** If only certain parts of a unit are required, never use the word "complete"; it always raises the question as to how much of the unit to supply. However, in some cases, due to the nature of the parts, it will be necessary and less costly to you, for us to supply additional related pieces, especially if part wanted is obsolete.
5. **Specify how and where to ship.** Do not say "Ship quickest way". Be definite and state the agency desired, that is—Air Mail, Parcel Post, Special Delivery, Express, Motor Freight, Rail Freight etc.



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