

Operator's Manual
Model 200
End Mill Sharpening Fixture



Introduction

Weldon's Model 200 air bearing end mill sharpening fixture, designed and built to Metric standards, simplifies the resharpener of peripheral cutting edges and end teeth of end mills with Inch or Metric diameter straight shanks and tools with #1, 2, 3 and 4 Morse tapered shanks. Featuring heavy-duty construction of durable cast iron, with hardened and ground precision parts where necessary, the Model 200 is built to provide long-lasting service and quality performance. Its simplicity of set-up and ease of operation is fully explained in this easy-to-understand Operator's Manual.

Table of Contents

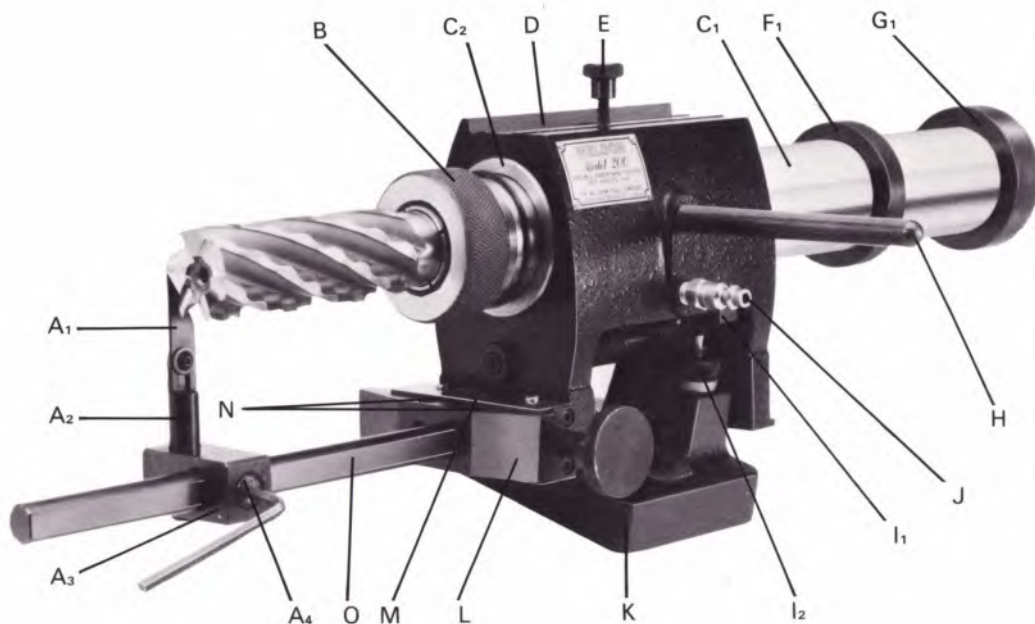
| | <i>Page</i> |
|--|-------------|
| Basic Fixture Parts | 1 |
| Fixture Parts Identification | 1 |
| Assembly Instructions | 2 |
| Set-Up Instructions | 3, 4, 5, 6 |
| Operating Instructions | |
| Grinding Primary Relief | 7 |
| Grinding Secondary Clearance | 8 |
| Controlling Reground Tool Diameters | |
| Initial Setting of Micrometer | 9 |
| Resharpener to Predetermined Diameter | 10 |
| Resharpener End Teeth | 11, 12 |
| Resharpener Crest-Kut End Mills | 13 |
| Resharpener Left-Hand End Mills | 13 |
| Sharpening Data for Conventional End Mills | 14 |
| Sharpening Data for Crest-Kut End Mills | 15 |
| Replacement Parts List | 16, 17 |
| Periodic Inspection and Service | 18 |

THE WELDON TOOL COMPANY WARRANTY AND LIMITATION OF LIABILITY

The Weldon Tool Company warrants each new product manufactured and sold by it or one of its authorized dealers only against defects in workmanship and/or materials under normal service, proper installation and use. This warranty is limited to repair or replacement of verified defective products and excludes any and all implied warranty of merchantability and all risk and liability whatsoever resulting from any use of said products, including incidental and consequential damages. The provisions of this warranty and limitation of liability shall not be modified in any respect except by written document signed by an officer of The Weldon Tool Company.

CAUTION—EYE PROTECTION AND PROPER GRINDING WHEEL GUARDS MUST BE USED DURING ALL GRINDING OPERATIONS.

Copyright ©1981 The Weldon Tool Co.



Parts Identification

ID. Code Description

- A. Finger Bracket Assembly
 - A1. Finger Blade
 - A2. Finger Post
 - A3. Finger Block
 - A4. Finger Block Set Screw
 - A5. Finger Post Set Screw
- B. C-10 Collet Nut
- C1. Air Spindle
- C2. Air Sleeve
- D. Rocking Head
- E. Knurled Knob
- F1. Stop Collar
- F2. Stop Collar Set Screw
- G1. Spindle Knurled Ring
- G2. Spindle Knurled Ring Set Screw
- H. Rocking Handle
- I1. Rocking Head Stop Pad
- I2. Rocking Head Stop Assembly
- J. Air Filter Nipple
- K. Fixture Base
- L. Positive Finger Control Assembly
- M. Positive Finger Control Locking Screw
- N. Finger Bracket Arm Mounting Set Screw
- O. Finger Bracket Arm
- P. Retaining Ring
- Q. C-4 Step Down Collet Assembly (See Fig. 8)
- R. Sleeve Retaining Set Screw
- S. Cam Follower
- T. Positive Finger Control Mounting Screw
- U. Angle Setting Cam
- V. Rocking Head Torsion Spring
- W. Rocking Arbor
- Y. Screw Center
- Z. Screw Center Locking Nut

Model 200 Fixture



STANDARD PARTS FURNISHED WITH FIXTURE

| | |
|---|---|
| Positive Finger Control Assembly | Metric Microscope (SPECIFY) Model 200 M |
| Spindle & Sleeve Assembly | Metric Micrometer (SPECIFY) Model 200 M |
| C-10 Collet Nut (Collets Not Included) | Inch Microscope (SPECIFY) Model 200 I |
| C-10 Collet Extractor | Inch Micrometer (SPECIFY) Model 200 I |
| C-4 Step Down Chuck (Collets Not Included) | Microscope Mounting Block |
| C-4 Collet Extractor | Micrometer Mounting Block |
| Air Filter | Master Setting Bar |
| Rocking Handle | 2.5 mm Metric Allen Wrench |
| Finger Height Block | 5 mm Metric Allen Wrench |
| Finger Bracket Assembly | Metal Carrying Case |
| Finger Bracket Arm | |
| For Collets and Other Accessories see Replacement Parts List, Page 17 | |

NOTE: See pages 16 and 17 for order numbers of all parts.

Assembly Instructions

IMPORTANT

Model 200 End Mill Sharpening Fixture and End Tooth Sharpening Attachment are built to *Metric Standards*. All screws and screw threads are metric and require metric wrenches.

Do not replace original metric screws with inch-size screws. Refer to Replacement Parts List (Pages 16 and 17) for proper metric replacement screws.

BASIC INSTRUCTIONS PERTAIN TO SHARPENING RIGHT-HAND-CUTTING END MILLS. SEE PAGE 13 FOR SHARPENING LEFT-HAND-CUTTING END MILLS.

STEP I: Bolt Rocking Head and Base Assembly to Grinding Machine Table.
Turn angle-setting cam to 0°. (Fig. 1)



Fig. 1 Assembly Bolted to Table

STEP II: Install Positive Finger Control Assembly (L). Two metric hex head cap screws (T) with washers are provided. Use 10 mm wrench to tighten. (Fig. 2)



Fig. 2 Mounting Positive Finger Control

STEP III: Install Rocking Handle (H). (Fig. 3)

STEP IV: Install Spindle (C-1) in Rocking Head (D).

NOTE: Remove sleeve bore protectors and save for further use. Be sure that surface of spindle and bore of sleeve are clean.

Carefully insert back (unthreaded) end of spindle (C-1) into sleeve from side of rocking head to which positive finger control is mounted. (Fig. 3)

STEP V: Install Stop Collar (F-1) on Unthreaded End of spindle. Do Not Tighten Set Screw (F-2).

STEP VI: Install Knurled Ring (G-1) on Spindle.
Tighten Set Screw (G-2) on Flat. (Fig. 3)

STEP VII: Connect Air Hose to Filter.

Connect hose from available air supply (dry air, 75 to 100 psi) to barbed hose fitting on filter. Coupling on filter acts as air shutoff valve. Do not install unit to fixture at this time.

STEP VIII: Install Finger Bracket Arm (O) and Finger Bracket Assembly (A).

A. Insert finger bracket arm (O) into hole on front of positive finger control (L). Tighten set screw (N) securely on flat. Arm should be in hole farthest from finger control knob to sharpen end mills exceeding 1-1/4" in diameter. For smaller tools, arm should be in hole closest to finger control knob.

B. Carefully hand-hone or stone sharp point from tip of finger blade to a slight, smooth radius not exceeding 1/64".

C. Install finger bracket assembly (A) onto finger bracket arm (O). Set screw (A-4) locks bracket to arm.



Fig. 3 Spindle, Stop Collar, Knurled Ring Installed

Set-Up Instructions

NOTE: All setting-up should be done with air off and grinding wheel not operating.

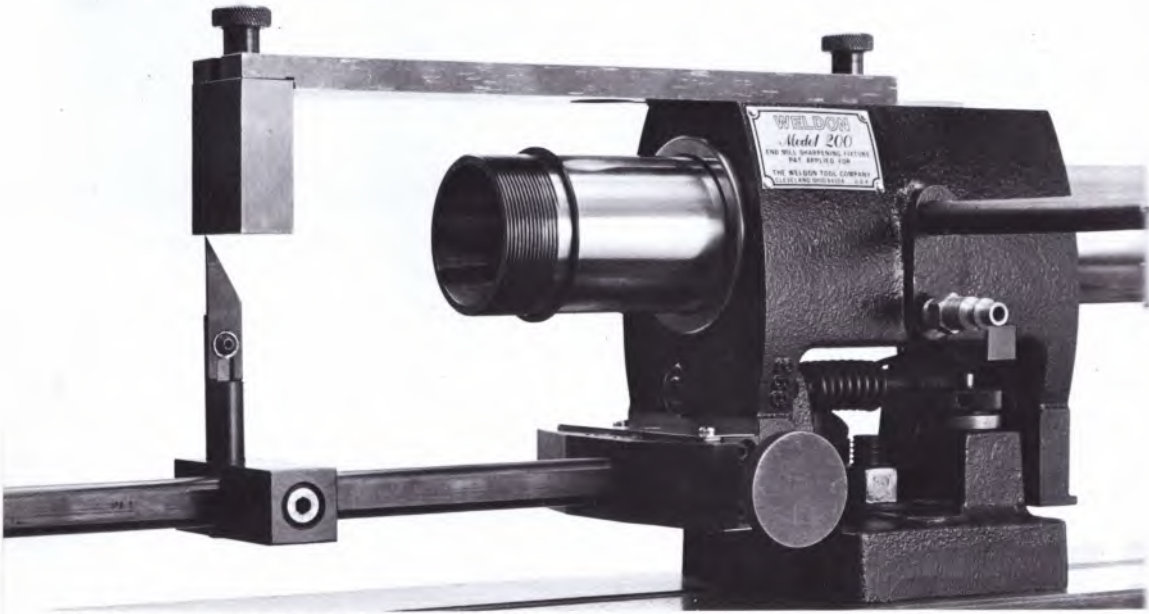


Fig. 4 Tip of Finger on Spindle Horizontal Centerline

STEP I : Setting Tip of Finger on Spindle Horizontal Centerline.

A. Withdraw spindle to minimum front overhang. Install knurled knob (E) to stud on top of rocking head. Attach master setting bar to top of rocking head (D) in contact with shoulder and with undercut down and extended over finger bracket arm. Snug down knurled knob (E).

B. Install finger height block to undercut end of master bar, as shown in Fig. 4. Tighten securely.

C. Loosen master bar knurled knob (E). Slide bar with height block until block overhangs front of rocking head about 6". Tighten knob (E).

D. Loosen finger block set screw (A-4). Position bracket so that top of finger is under height block. It may be necessary to

loosen finger post screw (A-5) to lower finger, and loosen screw (M) to adjust positive finger control in order to bring finger into position under block.

E. Tighten screws (A-4) and (M). Be sure screw (A-4) is properly seated on flat of finger bracket arm. Raise finger post until tip of finger is gently making contact with bottom surface of height block. Lock finger post in this position by tightening screw (A-5).

F. Loosen knob (E). Slide bar so that block is away from finger. Remove height block from master bar. Remove master bar from rocking head. Store safely in carrying tray.

G. Loosen screw (A-4). Slide finger bracket assembly to far end of bracket arm so it is out of the way of succeeding set-up operations.



Fig. 5 C-10 Collet Nut Assembly



Fig. 6 C-4 Collet, Nut and Adapter Assembly

STEP II: Holding The End Mill.

NOTE: Be sure that collets and collet nut assemblies are clean before using.

Two collet nuts are provided:

A. C-10 Collet Nut Assembly (Fig. 5)—for use with following diameter collets: 16.0 mm, 20.0 mm, 25.0 mm, 31.5 mm, 32.0 mm and 5/8", 3/4", 7/8", 1", 1-1/4".

B. C-4 Collet Nut Assembly (Step-Down Collet) (Fig 6)—for use with following diameter collets: 4.0 mm, 5.0 mm, 6.0 mm, 6.3 mm, 8.0 mm, 10.0 mm, 12.0 mm, 12.5 mm, and 1/8", 3/16", 1/4", 5/16", 3/8", 1/2".

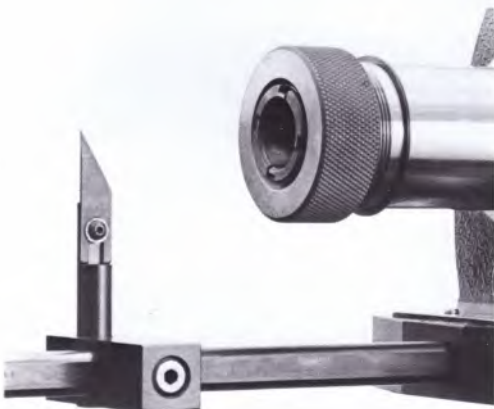


Fig. 7 C-10 Collet Nut on Spindle

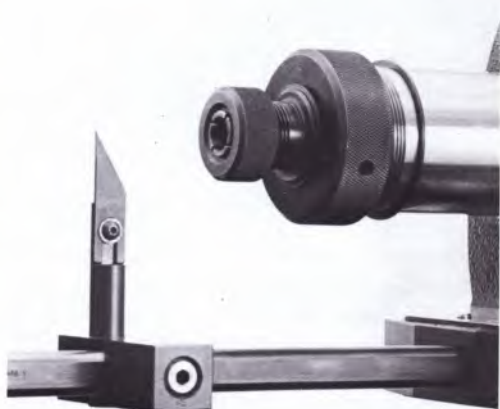


Fig. 8 C-4 Collet, Nut and Adapter on Spindle

Collet Extractors

C. Collet extractors are furnished for both C-10 and C-4 size collets. Simply pushing extractor over collet taper will collapse collet enough to allow head to slip easily into or out of nut.



Fig. 9 Collet Extractors

D. After properly inserting collet into nut, screw nut onto spindle or adapter far enough to hold assembly in place without fully seating collet. Insert about three-quarters of end mill shank length into collet and firmly hand-tighten nut.

IMPORTANT:

Before inserting collet into C-10 collet nut, be sure thrust bearing and thrust washer are positioned within nut as shown in Figure 5.

Flat thrust washer installed on nose end of each C-4 collet must also be in place whenever inserting collet into C-4 nut. (Fig. 6)

STEP III : Positioning Stop Collar.

A. Axially position spindle so that distance from stop ring on spindle to face of sleeve is about the same as total length of end mill extending from collet. With spindle held in this position, slide stop collar forward until contact is made with sleeve. Tighten collar set screw snugly, but not excessively. (Fig. 10)

STEP IV Positioning Finger to End Mill.

A. Move spindle forward until stop collar contacts rear face of sleeve. Slide finger bracket assembly from front of bar toward shank of end mill. If finger interferes with end mill, loosen screw (M) and adjust positive finger control until finger is radially clear of tool on grinding wheel side. DO NOT DISTURB PREVIOUSLY ADJUSTED HEIGHT OF FINGER. Position bracket assembly so that finger point is adjacent to end of originally relieved cutting edge where flutes and shank meet. Tighten screw (A-4). Make sure it is properly and firmly seated on flat of finger bracket arm.

B. Rotate spindle slightly so a flute opening in end mill is adjacent to finger point. Turn positive finger control knob and radially position point of finger in flute opening so that when spindle with tool is rotated toward finger, face of end mill tooth makes contact with finger about 1/64" inside cutting edge. Tighten screw (M). (Fig. 11)



Fig. 10 Spindle Stop Collar Positioned

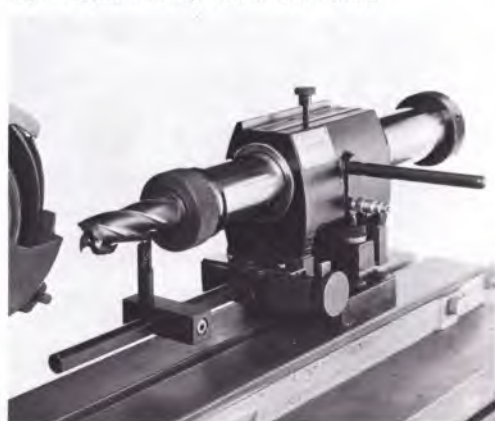


Fig. 11 Finger and End Mill in Proper Position

STEP V : Selecting Primary Relief Angle.

A. Withdraw spindle until tool is off and away from finger. Spindle front stop ring should be against sleeve. Position grinding machine table so fixture is amply clear of grinding wheel spindle. Rock head slightly to raise cam follower from angle setting cam and turn cam to correct primary relief angle for tool to be sharpened. See Pages 14 and 15. (Fig. 12)



Fig. 12 Setting Primary Relief Angle

STEP VI : Adjusting Rock Stop.

A. With cam follower in contact with cam set at proper angle, adjust rock stop so that screw end is about 1/8" away from stop pad to limit rocking distance. (Fig. 13)



Fig. 13 Rock Stop Adjustment

STEP VII : Positioning Finger to Grinding Wheel

A. Mount 5" or 6" diameter cup grinding wheel of A60-J7-VBE designation (or equivalent). Wheel must rotate clock-wise. With wheel guards and eye protection in place, dress OD and cup edge, as shown in Figure 14-A. Turn off power to wheel spindle motor. Pivot wheel head or fixture base to establish approximate 5° angular relationship as shown in Figure 14-B and lock in this position. Adjust wheel head vertically so axis of wheel spindle is approximately same height as axis of fixture spindle.

B. With fixture spindle still in withdrawn position, and rocking head pivoted to primary relief angle setting, adjust grinding machine table longitudinally and laterally until tip of finger and wheel relationship is as shown in Figure 14-C. Lock longitudinal table movement when adjustment is completed.

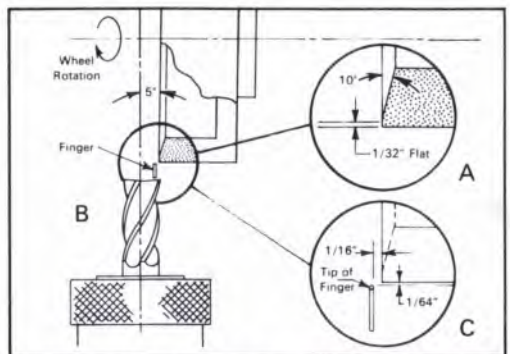


Fig. 14 End Mill, Finger, Grinding Wheel Relationship

Operating Instructions

STEP I : Grinding Primary Relief.

IMPORTANT

Before starting grinding operation, be sure that grinding wheel is properly guarded and eye protection is in use. All machine adjustments except table cross feed should be locked.

A. Activate fixture spindle by installing air filter unit. Activate wheel spindle by turning on power.

B. Rock fixture head away from wheel until rock stop makes contact. Hold head against stop. Slowly rotate spindle while moving it forward until finger enters a flute opening. Continue forward rotating movement to permit finger to follow flute helix until spindle stop collar contacts sleeve. Finger is now at initial set point in flute area near shank, and is at end of originally relieved cutting edge.

C. Turn spindle to bring tooth face into contact with tip of finger and then allow rocking head to return to primary angle position. First cutting edge to be resharpened will now be close to narrow cup edge of grinding wheel, ready for primary angle grind. (Fig. 15)

D. While holding rear spindle stop against sleeve—exerting slight rotational pressure to keep tooth face on finger—carefully turn grinding table cross feed hand wheel until cutting edge contacts grinding wheel and sparks are observed. At this point, turn hand wheel to feed edge into grinding wheel about .002" and then start grinding operation by drawing back spindle smoothly. Contact between tip of finger and helical tooth face will automatically rotate spindle as it is drawn back. Very slight hand pressure to resist spindle rotation, as well as downward grinding direction, will assure tooth face and finger contact.

E. Since tip of finger was previously set 1/64" from OD of wheel, tool edge being ground will be out of contact with wheel just before tooth face comes off tip of finger. This assures grind of entire length of cutting edge.

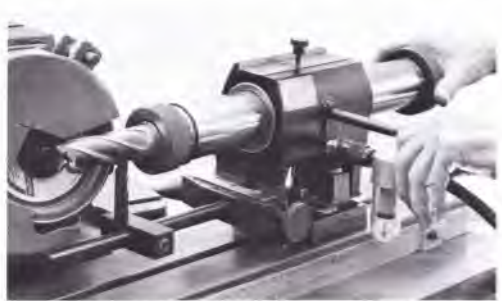


Fig. 15 Tool in Position for Primary Angle Grind

After grinding first cutting edge, retract spindle until tool is away from finger. Rock head to stop. Repeat forward-rotating spindle motion with finger in flute adjacent to first ground edge until stop collar makes contact. Do not change machine table cross feed setting. With finger in contact with second tooth face, allow head to return to primary angle position.

F. Second cutting edge will contact grinding wheel at same point as first edge. Repeat grinding operation, from rear to front, by drawing back spindle smoothly, as before. Continue same procedure with each tooth until all cutting edges of end mill have been ground. Then withdraw spindle until tool is away from finger. Visually inspect all edges. (Do not remove tool from fixture spindle. Simply rotate spindle slowly while inspecting.)

G. If all wear lands and/or damaged areas have not been removed by first grind, feed table cross slide in another .002". Repeat operations in proper sequence on all teeth. Repeat again, if necessary. When inspection reveals all edges ground to satisfactory condition, feed cross slide in .0002/.0004" and grind all edges to final finish using a smooth, slow spindle draw-back motion.

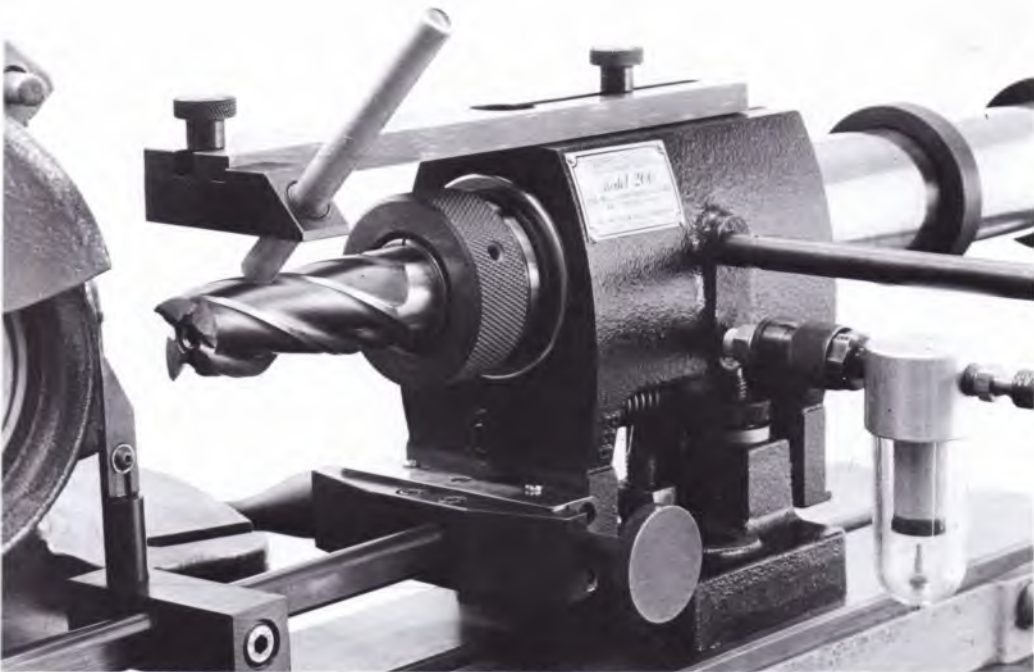


Fig. 16 Microscope in Position to Measure Primary Land Width During Secondary Grind

STEP II : Grinding Secondary Clearance.

- A. Use machine cross feed control only and position tool about one inch from front face of grinding wheel. Do not change any other adjustments. Rock head to raise follower from cam and turn cam to correct secondary clearance angle for tool diameter being sharpened. (See pages 14 and 15.) Allow head to return follower to cam and adjust rock stop to limit rock to 1/8".
- B. Proceed to grind secondary clearance on all teeth in same manner as when grinding primary relief except grinding motion can be slightly faster since surface finish is not critical.
- C. To measure critical width of primary lands during secondary grind, withdraw spindle until tool is away from finger and front stop ring is against sleeve.
- D. Attach microscope bracket (Fig. 16) to master bar and install bar to rocking head with bracket bore over cutting edges of tool. Secure bar in this position.

- E. Insert counterbored end of microscope tube into bracket bore and push tube in until end is about 3/4" from tool. Peer through microscope and turn spindle slowly until portion of one tooth can be seen. Stop turning spindle.
- Adjust scope in-or-out for focus to obtain clear view and turn spindle slightly until cutting edge appears central in field of vision. Rotate microscope tube and read width of primary land at approximately 90° to tooth face. (See pages 14 and 15 for proper widths.)
- F. Grind secondary clearance on all teeth until primary lands are within specifications.
- Remove microscope bracket with scope tube intact to simplify set-up at next use. Remove master bar.

Controlling Reground Tool Diameters

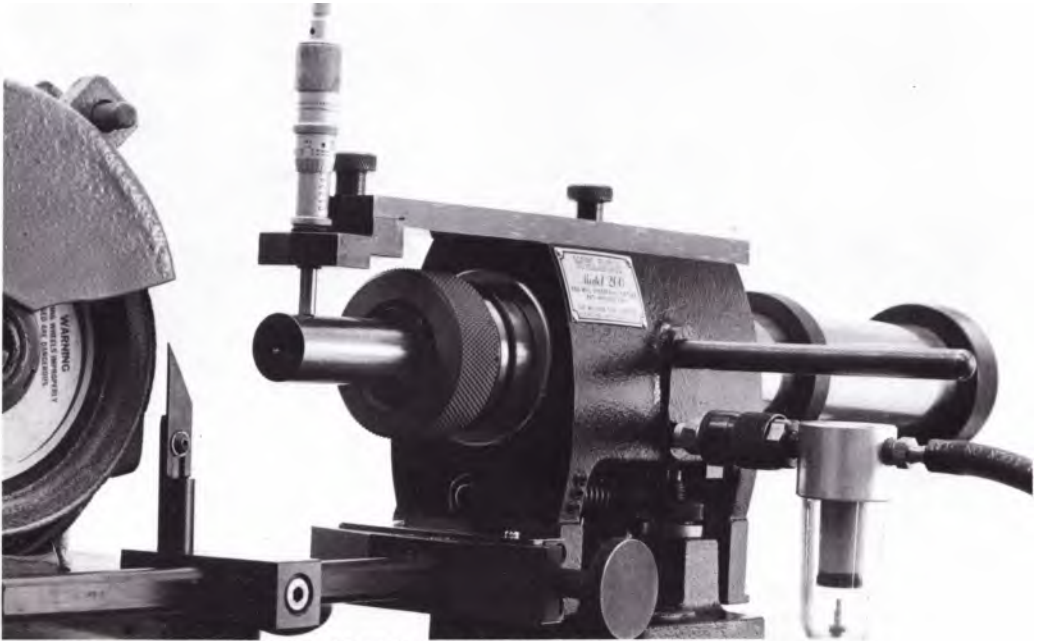


Fig. 17 Micrometer and Cylindrical Test Gage in Position for Initial Setting.

STEP 1 : Initial Setting of Micrometer.

A. For convenience and safety, adjust fixture angle-setting cam to 0°. Turn off fixture spindle air and power to grinding wheel spindle.

B. Select cylindrical gage or end mill shank of known diameter to use as a setting gage (inch or metric size, depending on mic to be set). Install in fixture spindle using proper collet. Allow approximately 1" of gage length to extend out of collet.

C. Firmly tighten collet nut. Withdraw spindle until front stop ring is against sleeve.

D. Attach master bar with under cut down and end of bar extended about 4" beyond front of spindle. (Fig. 17)

E. Install micrometer mounting bracket securely to undercut end of bar. Adjust bar so that mic mounting hole in bracket is directly over setting gage. Tighten knurled knob. (Fig. 17)

F. Adjust mic to read approximately one-half

the diameter of gage. Then insert mic into hole of mounting block with O-ring on mic mounting diameter between knurled ring and block. End of mic will contact gage. Turn mic assembly so that its graduations can be conveniently read from operator's side. (Fig. 17) Turn on air to activate spindle. Hold mic body to prevent turning and, with mic spindle end in contact with gage, adjust mic thimble to read EXACTLY ONE-HALF of gage diameter.

Snugly tighten set screw which holds mic in bracket. DO NOT TIGHTEN SCREW EXCESSIVELY as overtightening will cause mic spindle to bind.

G. Recheck mic setting several times after mounting to make sure reading is correct. To avoid excessive mic pressure when checking, rotate fixture spindle and gage with spindle air on. As soon as end of mic spindle contacts setting gage, free motion of spindle will be affected and mic reading can be noted.

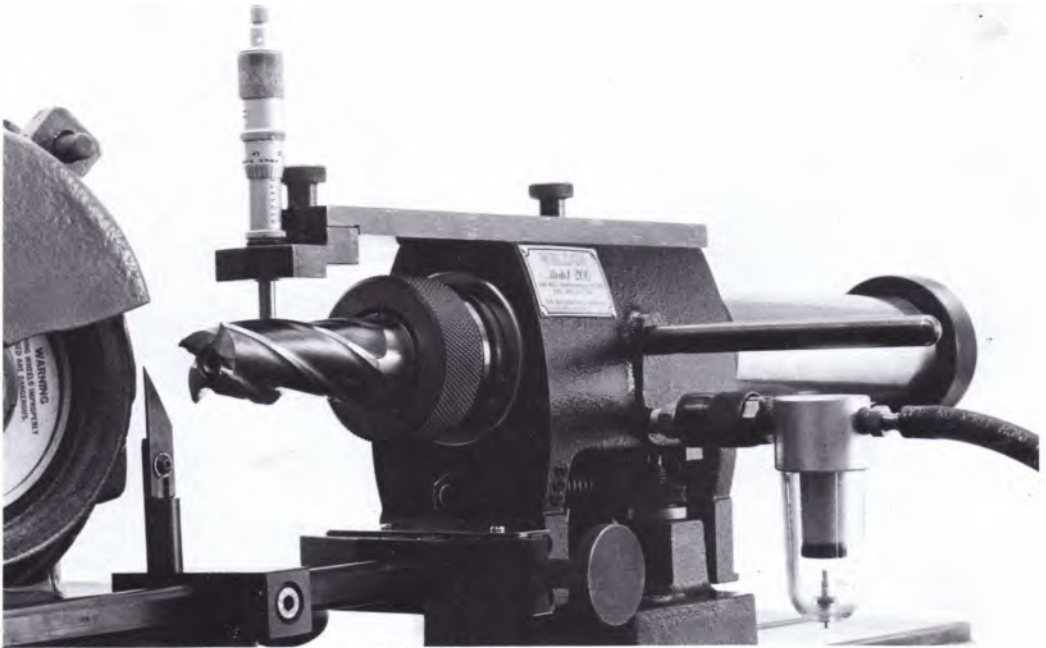


Fig. 18 Measuring Diameter of Reground End Mill

STEP II : Resharpener to Predetermined Diameter.

NOTE: Examine all cutting edges of dull tool before resharpener to judge the approximate amount of diameter reduction necessary to return tool to satisfactory condition. Allow an additional .005" below this estimate when predetermining final size desired

A. Follow proper procedures to initially grind primary relief on all teeth until edges are in satisfactory condition. Do not change machine table cross feed adjustment after completing grind.

B. Withdraw fixture spindle until front stop ring is against sleeve. Install master bar and bracket with micrometer. (See page 9 for instructions on initial setting of micrometer.) Axially adjust bar so that mic spindle is over end mill about central of its flute length. Tighten knurled knob holding master bar.

C. With spindle air on, slowly rotate spindle and carefully turn mic thimble to advance mic

spindle toward tool. When mic spindle end touches tool cutting edge, contact will be felt immediately in spindle rotation due to sensitivity of spindle air bearing. Note mic reading when contact is made. Multiply reading by 2 to establish tool diameter.

D. Remove micrometer mounting bracket from master bar. Compute difference between resharpener tool diameter and required diameter. Feed machine table cross slide toward grinding wheel in increments not exceeding .002" Repeat proper grinding procedure to grind all edges at each increment until tool is within .0005" of required size. Remove last .0005" as a final finish and size grind. Install mic mounting bracket on master bar. Confirm final size of tool before proceeding.

E. Remove mic mounting bracket and master bar. Prepare to grind secondary clearance. (See Page 8)

Resharpener End Teeth

GENERAL NOTES:

For efficient use of machine setups, segregate tools into groups having common shank diameters and the same numbers of teeth. Further subdivide these groups into center-cutting and non-center-cutting types with regular, long or extra long cutting lengths. Examine all tool ends. Those with excessively

worn or damaged corners and ends should be carefully rough end ground by hand on a conventional emery wheel or bench grinder to remove all damage. Use care when hand grinding to avoid personal injury as well as damage to tools by overheating. Grinding wheels should be properly guarded and eye protection worn by operators.



Fig. 19 Fixture Correctly Mounted



Fig. 20 End Mill Properly Positioned—Bore Protectors in Place



Fig. 21 Four Fluted Tool Ready for Primary Relief End Grind



Fig. 22 Six Fluted Tool Properly Positioned Above Wheel Center



Fig. 23 Two Fluted Tool Positioned For Secondary Grind



Fig. 24 Freehand Gashing and Notching

I Set-Up and Operating Instructions.

A. Disconnect air and turn off power to grinding wheel spindle.

B. Adjust machine table so fixture is completely away from, and to the left of, grinding wheel. (Fig. 19)

C. Turn angle setting cam to 0° and adjust rock stop until cam follower is locked against cam.

D. Mount end grinding fixture to top of head

with spindle bore toward grinding spindle. (Fig. 19)

E. Remove air spindle and insert sleeve bore protectors. Install and dress grinding wheel. For center cutting two or three-fluted tools and four-fluted non-center-cutting tools, a cup or saucer style wheel of any diameter up to 6" may be used. For center-cutting four-fluted tools and six or eight fluted center or non-center cutting types, a 3" diameter flaring cup

wheel is most suitable. Wheel rotation must be counter-clockwise and proper guarding in place around wheel.

F. Clean fixture spindle bore and insert proper collet to hold shank of tool to be sharpened. Use same collets, collet nuts and/or adapters as used in air spindle.

G. Select index for tool to be ground by turning spindle (1) of fixture so set screw (6) in knurled ring (5) is in top position. Loosen lock screw (3) on top of head casting (2) and push spindle unit (4) forward into index detent for tools with 2, 3, and 6 teeth. Pull unit (4) outward into detent for 2, 4 and 8 teeth. Tighten lock screw (3) after selection is made. DO NOT OVER TIGHTEN.

H. Insert total length of tool shank into collet and with spindle knurled ring set screw (6) in "up" position, rotate tool shank in collet until, by simple sighting, end tooth adjacent to grinding wheel is in horizontal position. (Fig. 20) Tighten Collet nut firmly.

J. Loosen rock stop and turn cam to proper end primary relief angle. (Fig. 26) Turn rock stop to lock follower against cam.

K. Loosen bolt holding basic fixture to machine table and pivot fixture correct amount and in proper direction to provide concavity (dish) in end teeth. (Fig. 27) Tighten bolt securely.

L. Adjust machine components vertically and laterally to bring end teeth into position for grinding. For center-cutting two and three-fluted tools and non-center-cutting four-fluted tools, center of tool end should be positioned on approximate center height of grinding wheel. (Fig. 20 and Fig. 21) For four-fluted center cutting and six or eight-fluted center or non-center-cutting types, tool end must be positioned sufficiently above wheel center to avoid damage to adjacent tooth. (Fig. 22)

M. Grind end primary relief using spindle index from tooth-to-tooth. Use longitudinal table stops to avoid damage to ends by traveling too far, especially on center-cutting tools.

N. Grind end secondary clearance following same procedures but with cam set at proper secondary angle. (Fig. 23 and Fig. 26) End gashes and center notches can be ground by freehand methods using a bench grinder or other simple grinder with properly dressed wheel. (Fig. 24) If preferred, secondary clearance can also be ground freehand. See Figure 26 for approximate width of primary land remaining after secondary is ground.



Fig. 25 Attachment Parts Identification—See Page 17 for Order Numbers of all Parts

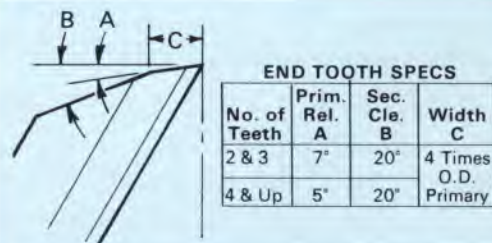
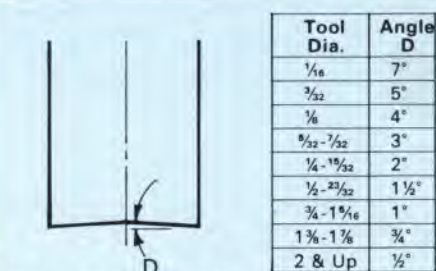


Fig. 26 End Tooth Primary, Secondary and Land



Note: All Crest-Kut Non-Center-Cutting End Mills Have 5° Concavity (D)

Fig. 27 End Tooth Concavity (Dish)

Resharpener Crest-Kut End Mills

I. Grinding Primary Relief

A. **IMPORTANT**—Point of finger must be stoned smooth with a radius **NO LARGER THAN 1/64 OF AN INCH! (0.4 mm)**

II. Grinding Secondary Clearance

A. Follow normal procedure (Page 8, Paragraph A) in preparation to grind secondary.

B. **IMPORTANT**—After completing A, unlock longitudinal movement of machine table to which fixture is fastened and move table in direction to position finger point about 1/32" (0.8mm) **AWAY FROM OUTSIDE DIAMETER OF GRINDING WHEEL!** (Fig. 28) Lock table.



Fig. 28 Finger-wheel Position for Secondary Grind

C. Grind secondary angle on one tooth allowing wider - than - normal primary land to remain. Inspect land by eye to determine if width is parallel to tooth face wave with no more than 20% total variation.

D. If parallelism varies excessively by being too

B. Grind primary relief on all teeth following same procedures detailed on Pages 3, 4, 5, 6 and 7. (See Page 15)

narrow on side of wave toward front of tool, unlock and move machine table in longitudinal direction to slightly **INCREASE** distance between finger and grinding wheel. If narrow area is on side of wave toward shank, move table to slightly **DECREASE** distance.

E. When trial adjustments and grinds produce satisfactory primary land parallelism, lock longitudinal table movement and complete secondary clearance grind (Page 8) on all teeth. (See Page 15)

III. Grinding End Teeth

A. End tooth specifications are same as shown on Page 12 except that all Crest-Kut tools with non-center-cutting ends have 5° concavity.

Resharpener Left-Hand End Mills

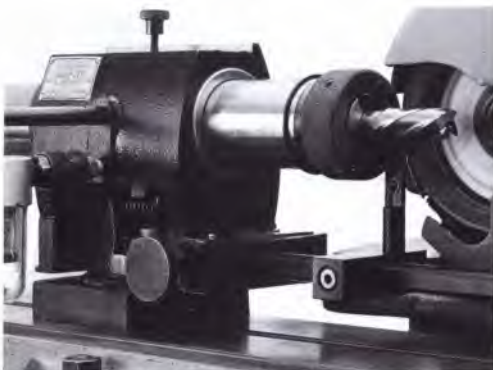


Fig. 29 Set-Up for Left Hand Mills

I. To change from right-hand mills to left-hand—(See Fig. 29)

A. Remove finger bracket assembly from finger bracket arm.

B. Remove knurled ring and stop collar from spindle and carefully remove spindle from sleeve.

C. Remove positive finger control assembly from rocking head.

D. Move fixture assembly to left hand side of machine table and to left of grinding wheel.

E. Mount positive finger control on right-hand side of rocking head.

F. Carefully insert spindle into sleeve from side of head to which positive finger control is mounted and install stop collar and knurled ring.

G. Install finger bracket assembly to finger bracket arm.

H. Remove finger blade from finger post and re-mount with angular side away from grinding wheel.

J. Reposition wheel guards, reverse direction of wheel rotation to counter-clockwise and reposition 5° angle between wheel and spindle.

K. Follow all other instructions on pages 3, 4, 5, 6, 7 and 8 to complete set-up and operations to resharpen left-hand end mills.

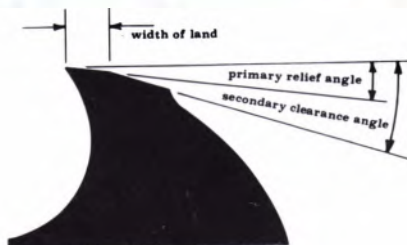
II. Resharpener Left-Hand End Teeth

A. Position and mount fixture to the **RIGHT** of grinding wheel instead of to left as shown in Figs. 19 thru 23. Wheel rotation clockwise.

Follow all other instructions on Pages 11 and 12 to complete end grind.

Sharpening Data for Conventional Inch and Metric End Mills

| End Mill Diameter | | Primary Relief Angle | Secondary Clearance Angle | Primary Land Width | |
|-------------------|--------------|----------------------|---------------------------|--------------------|--------------|
| Inch | Metric | | | Inch | Metric |
| 1/16" | | 22° | 32° | .005/.007 | |
| 3/32" | | 18° | 28° | .005/.007 | |
| 1/8" | | 16° | 28° | .005/.007 | |
| 5/32" | 4.0 mm | 15° | 26° | .007/.009 | 0.18/0.23 mm |
| 3/16" | 5.0 mm | 14° | 26° | .007/.009 | 0.18/0.23 mm |
| 7/32" | | 13° | 24° | .007/.009 | |
| 1/4" | 6.0-6.3 mm | 12° | 22° | .007/.009 | 0.18/0.23 mm |
| 9/32" | | 12° | 21° | .009/.012 | 0.23/0.30 mm |
| 5/16" | 8.0 mm | 12° | 21° | .009/.012 | 0.23/0.30 mm |
| 11/32" | | 11° | 19° | .009/.012 | |
| 3/8" | | 11° | 19° | .009/.012 | |
| 13/32" | 10.0 mm | 11° | 19° | .012/.016 | 0.30/0.41 mm |
| 7/16" | | 11° | 19° | .012/.016 | |
| 15/32" | 12.0 mm | 10° | 19° | .012/.016 | 0.30/0.41 mm |
| 1/2" | 12.5 mm | 10° | 18° | .012/.016 | 0.30/0.41 mm |
| 9/16" | 14.0 mm | 10° | 18° | .016/.020 | 0.41/0.51 mm |
| 5/8" | 16.0 mm | 10° | 18° | .016/.020 | 0.41/0.51 mm |
| 11/16" | 18.0 mm | 9° | 18° | .016/.020 | 0.41/0.51 mm |
| 3/4" | 20.0 mm | 9° | 17° | .016/.020 | 0.41/0.51 mm |
| 13/16" | | 9° | 17° | .020/.025 | |
| 7/8" | 22.0 mm | 9° | 17° | .020/.025 | 0.51/0.64 mm |
| 15/16" | | 8° | 16° | .020/.025 | |
| 1" | 25.0 mm | 8° | 16° | .020/.025 | 0.51/0.64 mm |
| 1-1/8" | 28.0-30.0 mm | 8° | 14° | .025/.030 | 0.64/0.76 mm |
| 1-1/4" | 32.0 mm | 7° | 14° | .025/.030 | 0.64/0.76 mm |
| 1-3/8" | 36.0 mm | 7° | 13° | .025/.030 | 0.64/0.76 mm |
| 1-1/2" | 38.0-40.0 mm | 7° | 13° | .025/.030 | 0.64/0.76 mm |
| 1-5/8" | | 7° | 13° | .030/.035 | 0.76/0.89 mm |
| 1-3/4" | 45.0 mm | 6° | 12° | .030/.035 | 0.76/0.89 mm |
| 1-7/8" | | 6° | 12° | .030/.035 | |
| 2" | 50.0 mm | 6° | 12° | .030/.035 | 0.76/0.89 mm |
| 2-1/4" | 56.0 mm | 5° | 11° | .035/.040 | 0.89/1.02 mm |
| 2-1/2" | 63.0 mm | 5° | 11° | .035/.040 | 0.89/1.02 mm |
| 2-3/4" | 70.0 mm | 5° | 11° | .035/.040 | 0.89/1.02 mm |
| 3" | 75.0 mm | 5° | 11° | .035/.040 | 0.89/1.02 mm |
| 3-1/2" | 80.0 mm | 5° | 11° | .035/.040 | 0.89/1.02 mm |
| 4" | 100.0 mm | 4° | 10° | .040/.045 | 1.02/1.14 mm |
| 5" | 125.0 mm | 4° | 10° | .040/.045 | 1.02/1.14 mm |
| 6" | 160.0 mm | 4° | 10° | .040/.045 | 1.02/1.14 mm |



Sharpening Data for Crest-Kut Inch and Metric End Mills

2 FLUTES

| End Mill Diameter | | Primary Relief Angle | Secondary Clearance Angle | Primary Land Width | |
|-------------------|--------------|----------------------|---------------------------|--------------------|--------------|
| Inch | Metric | | | Inch | Metric |
| 1/2" | 12.0 mm | 13° | 29° | .012/.016 | 0.30/0.41 mm |
| 5/8" | 14.0-16.0 mm | 13° | 29° | .016/.020 | 0.41/0.51 mm |
| 3/4" | 18.0-20.0 mm | 12° | 28° | .016/.020 | 0.41/0.51 mm |
| 7/8" | 22.0 mm | 12° | 27° | .020/.025 | 0.51/0.64 mm |
| 1" | 25.0 mm | 11° | 26° | .020/.025 | 0.51/0.64 mm |
| 1-1/8" | 28.0-30.0 mm | 10° | 25° | .025/.030 | 0.64/0.76 mm |
| 1-1/4" | 32.0-36.0 mm | 9° | 23° | .025/.030 | 0.64/0.76 mm |
| 1-1/2" | 38.0-40.0 mm | 9° | 21° | .025/.030 | 0.64/0.76 mm |
| 1-3/4" | 45.0 mm | 8° | 20° | .030/.035 | 0.76/0.89 mm |
| 2" | 50.0 mm | 8° | 20° | .030/.035 | 0.76/0.89 mm |
| 2-1/4" | 56.0 mm | 7° | 18° | .035/.040 | 0.89/1.02 mm |
| 2-1/2" | 63.0 mm | 7° | 18° | .035/.040 | 0.89/1.02 mm |
| 2-3/4" | 70.0 mm | 7° | 18° | .035/.040 | 0.89/1.02 mm |
| 3" | 75.0 mm | 7° | 18° | .035/.040 | 0.89/1.02 mm |
| 3-1/2" | 80.0 mm | 7° | 18° | .035/.040 | 0.89/1.02 mm |
| 4" | 100.0 mm | 6° | 16° | .040/.045 | 1.02/1.14 mm |
| 5" | 125.0 mm | 6° | 16° | .040/.045 | 1.02/1.14 mm |
| 6" | 160.0 mm | 6° | 16° | .040/.045 | 1.02/1.14 mm |

4 OR MORE FLUTES

| | | | | | |
|--------|--------------|-----|-----|-----------|--------------|
| 1/2" | 12.0 mm | 10° | 18° | .012/.016 | 0.30/0.41 mm |
| 5/8" | 14.0-16.0 mm | 10° | 18° | .016/.020 | 0.41/0.51 mm |
| 3/4" | 18.0-20.0 mm | 9° | 17° | .016/.020 | 0.41/0.51 mm |
| 7/8" | 22.0 mm | 9° | 17° | .020/.025 | 0.51/0.64 mm |
| 1" | 25.0 mm | 9° | 17° | .020/.025 | 0.51/0.64 mm |
| 1-1/8" | 28.0-30.0 mm | 9° | 17° | .025/.030 | 0.64/0.76 mm |
| 1-1/4" | 32.0-36.0 mm | 9° | 17° | .025/.030 | 0.64/0.76 mm |
| 1-1/2" | 38.0-40.0 mm | 9° | 17° | .025/.030 | 0.64/0.76 mm |
| 1-3/4" | 45.0 mm | 8° | 16° | .030/.035 | 0.76/0.89 mm |
| 2" | 50.0 mm | 8° | 16° | .030/.035 | 0.76/0.89 mm |
| 2-1/4" | 56.0 mm | 7° | 15° | .035/.040 | 0.89/1.02 mm |
| 2-1/2" | 63.0 mm | 7° | 15° | .035/.040 | 0.89/1.02 mm |
| 2-3/4" | 70.0 mm | 7° | 15° | .035/.040 | 0.89/1.02 mm |
| 3" | 75.0 mm | 7° | 15° | .035/.040 | 0.89/1.02 mm |
| 3-1/2" | 80.0 mm | 7° | 15° | .035/.040 | 0.89/1.02 mm |
| 4" | 100.0 mm | 6° | 13° | .040/.045 | 1.02/1.14 mm |
| 5" | 125.0 mm | 6° | 13° | .040/.045 | 1.02/1.14 mm |
| 6" | 160.0 mm | 6° | 13° | .040/.045 | 1.02/1.14 mm |



Model 200-Relacement Parts List

| Identification Code | Description | Order No. |
|---------------------|--|-----------|
| Complete Fixture | Model 200 I (Inch) | 96-159 |
| | Model 200 M (Metric) | 96-159 |
| A. | Finger Bracket Assembly (Assembly includes the following items) | 96-780 |
| A1. | Finger Blade | 96-308 |
| | Finger Blade Socket Head Screw | 96-762 |
| | Finger Blade Washer | 96-763 |
| A2. | Finger Post | 96-761 |
| A3. | Finger Block | 96-760 |
| A4. | Finger Block Set Screw | 96-765 |
| | Locking Pin | 96-799 |
| A5. | Finger Post Set Screw | 96-764 |
| B. | C-10 Collet Nut | 96-752 |
| | Thrust Bearing | 96-753 |
| | Thrust Washer | 96-754 |
| C2. | Air Spindle (Sold together only) | 96-700 |
| | Air Sleeve | |
| | (2) "O" Ring | 96-750 |
| D. | Rocking Head | 96-710 |
| E. | Knurled Knob | 96-728 |
| F1. | Spindle Stop Collar | 96-755 |
| F2. | Collar Set Screw | 96-756 |
| | Spindle Knurled Ring | 96-793 |
| G2. | Ring Set Screw | 96-764 |
| H. | Rocking Handle | 96-713 |
| I1. | Rocking Head Stop Pad | 96-712 |
| I2. | Rocking Head Stop Assembly (Sold only as a unit) | 96-719 |
| J. | Air Filter Nipple | 96-745 |
| | Air Filter Coupler | 96-744 |
| | Air Filter | 96-520 |
| | Barbed Hose Fitting | 96-746 |
| K. | Fixture Base | 96-718 |
| L. | Positive Finger Control Assembly (Sold only as a unit) | 96-230 |
| M. | (2) Positive Finger Control Locking Screws | 96-781 |
| N. | (2) Finger Bracket Arm Mounting Set Screws (M10 x 1.5 x 10 lg. Flat Point) | 96-758 |
| O. | Finger Bracket Arm | 96-733 |
| P. | Spirolox Retaining Ring | 96-751 |
| Q. | C-4 Step Down Collet Assembly (Sold only as a unit) | 96-766 |
| R. | M8 Sleeve Retaining Set Screw Nylon-Slotted | 96-723 |
| S. | Cam Follower | 96-711 |
| | Set Screw- M3 x 0.5 x 6 mm | 96-720 |
| | Brass Plug | 96-721 |
| T. | (2) Positive Finger Control Mounting Screw (M6 x 1 x 20 lg.) | 96-785 |
| U. | Angle Setting Cam | 96-724 |
| | Socket Head Shoulder Screw | 96-725 |
| | Metric Ball Plunger | 96-726 |
| V. | Rocking Head Torsion Spring | 96-717 |
| W. | Rocking Arbor | 96-716 |
| Y. | (2) Screw Centers | 96-714 |
| Z. | (2) Screw Center Locking Nuts | 96-715 |

OTHER MODEL 200 REPLACEMENT PARTS AND ACCESSORIES

| Identification Code | Description | Order No. |
|-------------------------------|--------------------|-----------|
| END TOOTH ATTACHMENT ASSEMBLY | | 96-240 |
| 1. | Spindle | 96-792 |
| 2. | Housing | 96-790 |
| 3. | Lock Screw | 96-764 |
| 4. | Sleeve | 96-791 |
| 5. | Knurled Ring | 96-793 |
| 6. | Knurled Ring Screw | 96-764 |
| 7. | Mounting Screws | 96-794 |
| | Ball Plunger | 96-795 |
| | Retaining Ring | 96-751 |

MEASURING EQUIPMENT

| | |
|--------------------------------------|--------|
| Master Setting Bar | 96-734 |
| Finger Height Block and Stud | 96-735 |
| Microscope Mounting Bracket and Stud | 96-736 |
| Microscope Retaining Seal | 96-737 |
| Micrometer Mounting Bracket and Seal | 96-738 |
| Inch Microscope | 96-742 |
| Metric Microscope | 96-741 |
| Inch Micrometer | 96-740 |
| Metric Micrometer | 96-739 |

ACCESSORIES

| | |
|------------------------|--------|
| Hex Wrench-2.5 mm | 96-768 |
| Hex Wrench-5.0 mm | 96-769 |
| C-10 Collet Extractor | 96-759 |
| C-4 Collet Extractor | 96-767 |
| Sleeve Bore Protectors | 96-800 |

COLLETS—Inch—C-4

| Description | Order Number |
|-------------|--------------|
| 1/8" | 96-170 |
| 3/16" | 96-186 |
| 1/4" | 96-172 |
| 5/16" | 96-173 |
| 3/8" | 96-187 |
| 1/2" | 96-188 |

COLLETS—Metric—C-4

| Description | Order Number |
|-------------|--------------|
| 4.0 mm | 96-179 |
| 5.0 mm | 96-180 |
| 6.0 mm | 96-199 |
| 6.3 mm | 96-181 |
| 8.0 mm | 96-182 |
| 1 0.0 mm | 96-183 |
| 1 2.0 mm | 96-184 |
| 1 2.5 mm | 96-185 |

COLLETS—Inch—C-10

| Description | Order Number |
|-------------|--------------|
| 5/8" | 96-194 |
| 3/4" | 96-195 |
| 7/8" | 96-196 |
| 1" | 96-197 |
| 1-1/4" | 96-198 |

COLLETS—Metric—C-10

| Description | Order Number |
|-------------|--------------|
| 1 6.0 mm | 96-189 |
| 20.0 mm | 96-190 |
| 25.0 mm | 96-191 |
| 31.5 mm | 96-192 |
| 32.0 mm | 96-193 |

ADAPTERS

Metric

| Description | Order Number |
|--|--------------|
| #1 Morse Taper Shank Adapter-32 mm Shank | 96-931 |
| #2 Morse Taper Shank Adapter-32 mm Shank | 96-932 |
| #3 Morse Taper Shank Adapter-32 mm Shank | 96-933 |
| #4 Morse Taper Shank Adapter-Assembly | 96-934 |

Inch

| Description | Order Number |
|---|--------------|
| #1 Morse Taper Shank Adapter-5/8" Shank | 96-919 |
| #2 Morse Taper Shank Adapter-1-1/4" Shank | 96-920 |
| #3 Morse Taper Shank Adapter-1-1/4" Shank | 96-921 |
| #4 Morse Taper Shank Adapter-Assembly | 96-934 |

Periodic Inspection and Service

1. After approximately each 80 hours of use, **remove** spindle from sleeve. Loosen sleeve **retaining** screw and, with fingers firmly inserted into both ends of sleeve bore, rotate **sleeve** in rocking head about 90° (**1/4** turn) **to evenly** distribute possible long-term wear in **sleeve** bore. Always turn sleeve in same **direction**. **Tighten retaining screw and install spindle.**

2. Two "O" ring seals are located at ends of outside diameter of air sleeve to seal air between housing and sleeve and insure proper operation of air spindle. Should total removal of sleeve become necessary, "O" rings must be inspected and replaced if damaged.

PROPER PROCEDURE FOR REMOVING SLEEVE:

A. Remove spindle.

B. Remove sleeve retaining screw.

C. Push sleeve at either end with fingers or wood block just far enough to fully expose "O" ring at opposite end.

D. Carefully remove exposed "O" ring from sleeve groove.

E. Push sleeve from end where "O" ring was removed until sleeve is extended sufficiently at opposite end to permit removal by hand.

E. Inspect seals for possible nicks, cuts, bruises or fold-overs and discard if damaged.

F. PROPER PROCEDURE FOR REINSTALLING SLEEVE:

A. Apply very light film of oil to outside of sleeve and insert sleeve without "O" rings into bore almost full depth. Stop when one "O" ring groove is about 1/4" exposed from side of head casting.

B. Cover "O" ring with light film of oil and install carefully in exposed groove.

C. Gently push sleeve and "O" ring into bore just far enough to expose ring groove at opposite end.

D. Oil and install second ring in exposed groove.

E. Push on end of exposed sleeve until "O" ring enters bore and sleeve is centered in head casting.

F. Install and tighten sleeve retaining screw.

G. Carefully insert spindle into sleeve bore and install stop collar and knurled ring.

3. Rocking head should pivot snugly and smoothly on screw centers with no looseness or "play." If play exists, loosen screw center locking nut on side opposite positive finger control and carefully adjust screw center until all play is eliminated. Do not adjust to excessive tightness as this will cause bind in rocking head motion. Hold screw center to prevent loss of adjustment when re-tightening locking nut. Loose pivot bearings can result in tapered diameters on resharpened end mills.

4. To compensate for normal finger point wear during extended use of fixture, check finger height often and re-adjust to center when necessary. (See page 3)

5. Periodically remove finger blade from finger post and carefully regrind pointed end **to original shape**. After regrinding, stone point **tip to a smooth** radius no larger than 1/64".

6. **Uncouple** air filter from fixture nipple periodically **and, after moving away** from machine **area, drain accumulated moisture** from filter **bowl by depressing valve in bottom of bowl. Do this while air pressure to filter is on.**

7. Dress grinding wheel often to compensate for wear and to maintain wheel shape "A" in Figure 14 on Page 6. All dressing should be done on front edge of cup wheel, not on outside diameter.

8. Fixture should always be covered when dressing or trueing grinding wheel to minimize damage from abrasive grit. **ALWAYS WEAR EYE PROTECTION WHEN DRESSING GRINDING WHEELS AND WHEN GRINDING TOOLS.**

9. Periodically check grinding machine wheel spindle for radial looseness and/or excessive end-play and correct if necessary. Properly operating, smooth running machine spindle assures quality end mill resharpening.