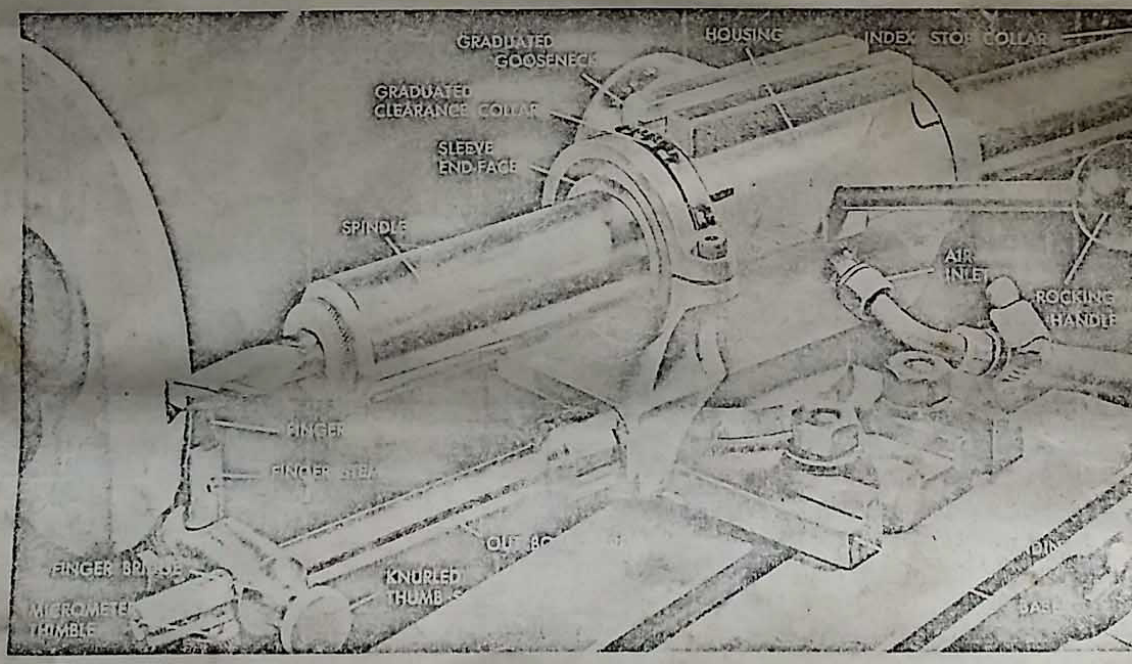
INSTRUCTION MANUAL

HARIG AIR-FLO END-MILL SHARPENING FIXTURES



SHARPENING THE PERIPHERY ------
CUP WHEEL METHOD:

a. Bolt the fixture on the table of the grinding machine as in figure (1) and mount a cup wheel. Absolute alignment with the table ways is unnecessary, since straightness comes from the stroke of the sliding spindle not the machine ways. The operator stands behind the Air-Flow spindle.

b. The sliding spindle should be centrally balanced if the length of the end-mill permits. On some grinders a slight compounding of the table may be necessary to reach the wheel.

c. Select the bushing for the end-mill and secure in the mouth of the spindle.

d. Position the clearance collar to the zero mark and loosen the outboard finger arm so it can be moved along the dovetail. Now by manipulating both the outboard arm and micrometer thimble adjustments, bring the finger blade-rest (hereafter referred to as "finger") to the position shown in figure (2) which is the center line of the end-mill. This can be done by sighting. If desired, a more exact setting on center can be made by using the Air-Flow center gage or by inserting a male center in place of the end mill. When the finger is centered, secure the outboard arm and also the finger stem by tightening the knurled thumb screw.

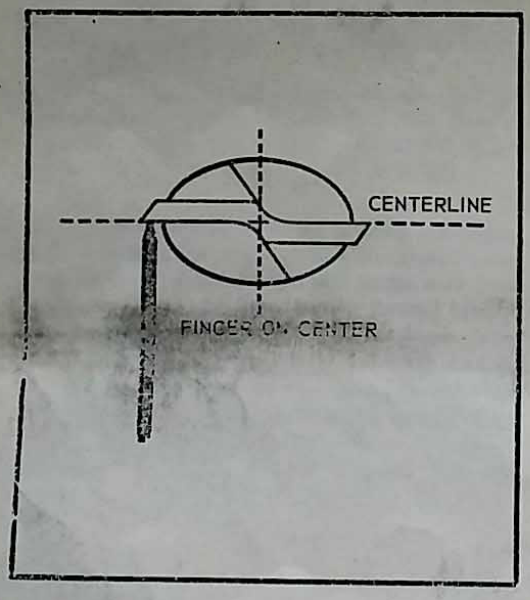


Figure 2.

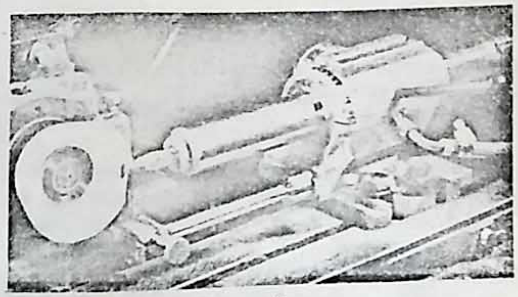


Figure 1.

e. Now center the end mill to the grinding spindle so that its axis and that of the wheel spindle are at the same height.

f. If the end mill is to cut steel, rotate the clearance collar 5 degrees clockwise (viewed from operator's position) and resecure. For other materials, 7 degrees or any degree which works well may be used for the primary clearance.

g. Bevel the grinding area of the wheel to the approximate shape in figure (3), a narrow contact but not too narrow.

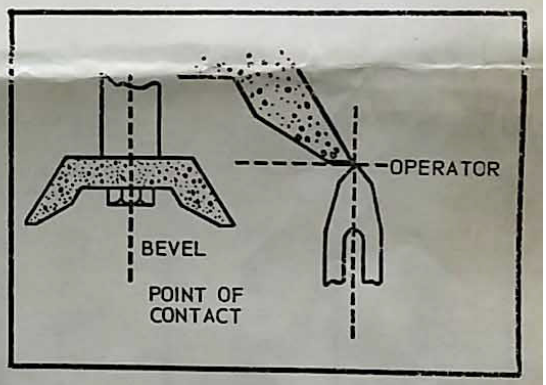


Figure 3.

h. With the cross feed and longitudinal feed of the machine, move up close to the wheel almost to the point of contact with the finger either exactly at the apex of the bevel or 1/16" nearer to the operator.

Refer to figure (3). Now lock the longitudinal table movement; as grinding continues keep the wheel shaped the same way and the finger in the same relative position as the starting position. Positioning the finger nearer to the operator assures him that as he passes the end mill flutes across the finger it will still be moving on a helical path-way

as it leaves the wheel and will not fall down suddenly and nick the ends. The set-up will now resemble figure (4).

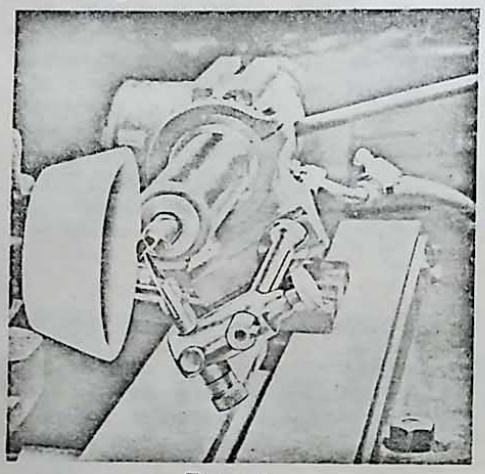


Figure 4.

COMMENCING TO GRIND THE PRIMARY CLEARANCE:

The grinding cycle is as follows for the primary clearance angle:

a. Grasping the rear end of the spindle, slide and rotate the spindle forward until the finger rests on the flute at the rear end (towards the shank). The stop collar is then secured on the spindle in this position so as to prevent over-stroking from here on.

b. Now turn on the air so the spindle floats. Pull the spindle back causing the end mill flute to pass smoothly across the finger. Use gentle finger pressure clockwise as the spindle is pulled.

c. Now that the end mill is pulled back off the finger, rock away from the grinding wheel by grasping the hand knob and index the end mill to the next flute at the rear end of the flute, holding forward against the stop collar, resting securely on the finger. Now let up on the rocker-arm slowly and make contact with the grinding wheel on this flute. Do not slam into the wheel. Now pull back on the spindle again for this flute and sharpen it. Notice how much easier it is to control the winding stroke when the pull back is only against the incline of the helical flute.

d. Keep feeding into the wheel with the cross feed and grind as much as is needed to sharpen the cutting edge.

GRINDING THE SECONDARY CLEARANCE:

a. Loosen and rotate the clearance collar further clockwise to 10 or 15 degrees approximately. Resecure the collar.

b. Notice how step (a) has lowered the finger height so that when one now rests the end mill on the finger, one has lowered the cutting edge and is now exposing the heel of the land to the grinding wheel. Now, move into the wheel and grind the heel until only 1/16" or less of primary margin remains. Repeat for as many flutes as are on the end mill.

ALTERNATE METHOD FOR SETTING FINGER FOR CLEARANCE ANGLES:

Another means of setting the finger downward for various clearance angles is as follows:

a. Center the finger as in figure (2).

b. Lower the finger for primary and secondary clearance angles using the micrometer adjustment. The amounts by which to lower the finger from center line for 5 degrees and 7 degrees (the two most popular angles) are shown in the chart below:

Dia. of End Mill or Shell Mill	For 5° Drop Finger Amount Shown	For 7° Drop Finger Amount Shown
1/2	.022	.030
3/4	.033	.045
1"	.044	.060
1-1/2	.066	.090
2	.088	.120
2-1/2	.110	.150
3	.132	.180
3-1/2	.154	.210
4	.176	.240
4-1/2	.198	.270
5	.220	.300
5-1/2	.242	.330
6	.264	.360

Figure 5.

For checking for peripheral relief angles by indicator lift method, a chart is available from the Barber-Colman Company. They also have a chart for determining maximum width of land possible for a given diameter end-mill so as not to drag.

SHARPENING THE PERIPHERY .....
PLAIN WHEEL METHOD:

The plain wheel method, as in figure (5), takes exactly the same steps as the cup wheel method except that every time one lowers the finger either by rotating the clearance collar clockwise or by retracting downward with the micrometer feed one must recenter to the grinding wheel spindle axis. WITH THE PLAIN WHEEL METHOD ONE MUST GRIND ON CENTER LINE OF THE GRINDING WHEEL. Deviation from this can be done only by operators with experience in compensating.

ALTERNATE METHOD FOR RADIAL RELIEF:

By using the plain wheel method with a broad instead of narrow contact, radial relief also can be obtained. Cleveland Twist Drill charts such a method. Further information can be had from Harig.

GRINDING TAPERED END MILLS BY MOVING THE LONGITUDINAL TABLE:

Figure (6) shows the set-up for grinding tapered endmills. Notice the two index stop collars are secured to the spindle to prevent longitudinal movement to the spindle, acting as thrust collars. A solid finger of the type found on any tool and cutter grinder is then placed in position next to the grinding wheel on center. This finger assembly is bridged off from the grinding wheel column and is not connected to the Air-Flow fixture, so it is independent of table movement.

The swivel base on the Air-Flow fixture should be bolted perpendicular and parallel to the machine ways first, then swiveled to 1/2 the included angle of the taper on the end-mill.

With the Air-Flow fixture acting as a free work head, the operator now passes the spiral flutes back and forth on the finger (without rocking), by moving the longitudinal table feed with his left hand and by keeping light finger pressure clockwise with his right hand on the Air-Flow spindle, taking care by feel and observation that the cutting edge is always resting on the finger during the motion. Coordination soon becomes second nature.

SHARPENING THE END TEETH ------
FINGER AND STOP COLLAR METHOD:

Figure (7) shows the position for sharpening the primary and secondary clearance on the end teeth of an end mill. The housing is swiveled downward to 5 degrees for the primary clearance and the finger rest is brought by sight to the same position as in figure (2). The end mill is then raised above center on the grinding wheel somewhat so the operator may sharpen the edge right to center without colliding with the next cutting edge. 3- or 4-fluted tools need closer setting. The longitudinal table feed is used to stroke across the cutting edge. After each stroke the end mill is indexed to the next tooth. When indexing, the operator pulls the spindle back a minor fraction of an inch to escape to the next tooth and, during grinding, holds firm pressure on the stop collar to resist grinding pressure. The snap finger may be placed either above or below and the housing may be tipped either up or down, for either right-hand or left-hand end mills, according to the operator's preference.

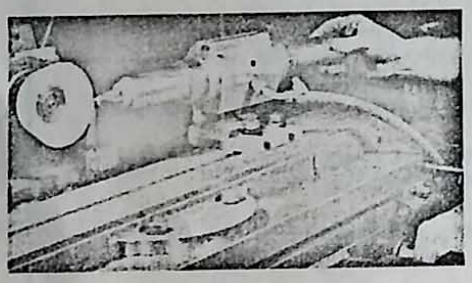


Figure 6.

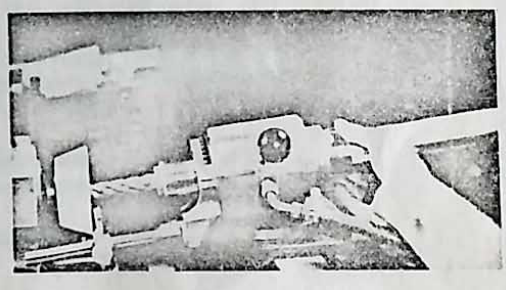


Figure 7. Sharpening End Teeth

NOTCHING THE END TEETH:

Notching the end teeth for chip room is done in the general position shown in figure (8) with a snap finger cooperating with an index collar. Here there is no finger on the end mill itself. The housing is tipped up, the wheel is dressed square and the longitudinal table movement is used to plunge into the ends and form notches, the style of which can be seen on a new end mill. A table stop is used to prevent over-stroking and control the depth of the plunge cut.

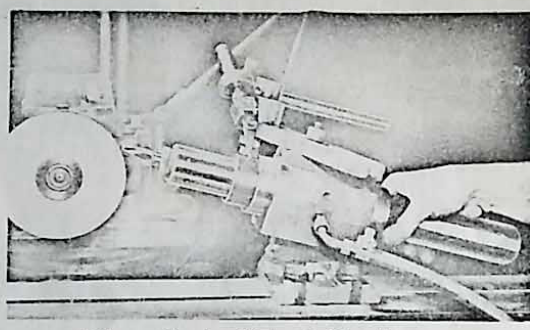


Figure 8. End Teeth Notching

MAINTENANCE INSTRUCTIONS

1. Before commencing operation, remove the spindle carefully and wipe clean of any oil film, using acetone as cleaning agent. Insert spindle carefully in sleeve; use gentle alignment, not force.

2. Never use kerosene, oil, or any lubricant. It is not necessary to use glass wax or other types of protective coatings.

3. Before operation, excessive moisture in air-line should be blown out. It is recommended to use a dirt and moisture filter on air-line, especially in extremely moist atmospheres.

4. After operation, the spindle may be removed from sleeve and wiped clean and dry for storing. Removal is recommended if work is in a dirty, oily, or moist atmosphere.

5. Do not operate except under approximately 100 p.s.i. of compressed air, CO_2, or other inactive gas.

6. Do not overtighten split-ring collar on housing.

HARIG AIR-FLO END-MILL SHARPENING FIXTURES

REPLACEMENT PARTS

Effective January 1, 1966	PART NO.	DESCRIPTION
	96-01	Housing
	96-03	Rocking Handle and Knob (49006)
	96-07	Air Fitting
	44104	O-Ring for Air Fitting
	96-1010	Index Finger Assembly
	96-57	Index Finger Blade
	96-1002	Rocker Assembly
	30000	Rest Pin
	96-21	Graduated Gooseneck
	96-1004	Base Assembly
	96-1007	Split Ring Clearance Collar Assembly
	96-UA01	Finger Assembly Unit (consists of everything forwardly) (Attached to Split-Ring Collar)
	96-1008	Outboard Arm (Sub Assembly)
	96-1011	Bridge (Sub Assembly)
	96-1012	Micrometer Thimble (Sub Assembly)
	96-1005 & 06	Index Collar (Specify 4 or 6 groove)
	96-1009	Model 'A' Spindle and Sleeve Assembly With Trade-in of old Sleeve and Spindle
	96-2009	Model 5CA Spindle and Sleeve Assembly With Trade-in of old Sleeve and Spindle
		Standard Bushings from Model 'A' set Includes: 3/16, 1/4, 3/8, 1/2, 5/8, 3/4, 7/8, 1".
		Taper Shank Bushing For Model 'A' Fixture Morse #1, 2, 3, Brown and Sharpe #7, 9
		Taper Shank Collets for Model 5CA Fixture Morse #1, 2, 3 Brown and Sharpe #7, 9
		Adaptor to hold Oversize Shanks (Models A & 5CA) for 1-1/2", 2", 2-1/2" Diameter Shanks
	96-82	Drawbar
	96-89	Stub Arbor (Model A or 5CA)

Harig Products, Inc.

1875 Big Timber Rd. • Elgin, Ill. 60120 • Phone (312) 695-1000

Printed in U.S.A.