RADIUS GRINDING ATTACHMENTS

OPERATING INSTRUCTIONS

4.13 Grinding Spherical and Corner Radii

Two radius grinding attachments are available for the No. 2 Cutter Grinder: The No. 1 Radius Grinding Attachment should be used to grind radii up to 50 mm (2 in.) on cutters as large as 100 mm (4 in.) in diameter. The No. 2 Radius Grinding Attachment will accommodate cutters up to 305 mm (12 in.) in diameter. Radii from 0 to 25 mm (1 in.) can be ground if the setup is made with the micrometer setting gauge.

Experienced operators can grind larger diameters. However, the micrometer gauge is not used; therefore, the cutter configuration and the range of the attachment slides become the size limiting factors. The following pages provide brief setup instructions for both attachments.

4.13.1 No. 1 Radius Grinding Attachment (Fig. 27/4)

For quickly and accurately sharpening small ball-end cutters, double-end cutters, and die-sinking cutters having straight or helical flutes. With the addition of motor drive parts, it may be used for cylindrical grinding straight or taper tracer fingers for die-sinking machines and many other parts.

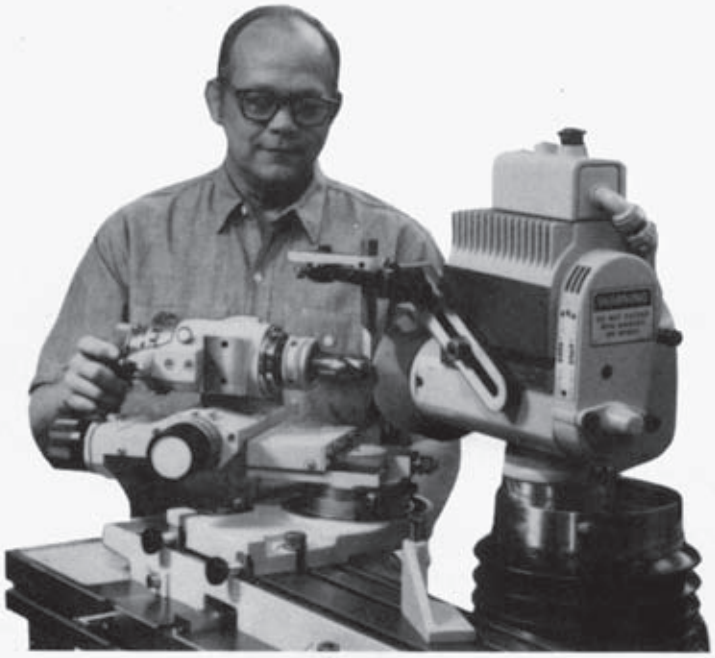

Figure 27/4 No. 1 Radius Grinding Attachment

(a) **Grinding Spherical Radii**

Adjust knob "L" to bring the end of the cutter against the setting gauge (Fig. 28/4). Set the dial to zero. The attachment is fitted with a stop for setting the cross slide to zero. Set the slide to the positive stop or zero by adjusting knob "H", then lock in position. The centre of the cutter is now in line with the pivot point, and set for zero radius. Remove the setting gauge and adjust knob "L" to the desired radius. For example, if a ball end is to be ground on a 25.4 mm (1 in.) diameter cutter, adjust the knob to bring the end of the cutter 12.7 mm (½ in.) beyond the pivot point. Knob "H" must remain at the zero setting.

(b) **Grinding a Corner Radius**

To grind a radius between the periphery and face of a cutter, first make the preliminary settings as required for grinding ball end cutters; that is, adjust knob "B" to bring the end of the cutter against the setting gauge and adjust knob "A" to bring the cross slide against its stop. Then set the two slides for the grinding operation.

To grind a 6.35 mm (¼ in.) corner radius on a 31.75 mm (1¼ in.) diameter cutter:

(a) Adjust knob "L" to the desired radius in this case: 6.35 mm (0.25 in.).

Note: Knob "L" is always adjusted an amount equal to the radius to be ground.

(b) Adjust knob "H" 9.52 mm (0.375 in.) which will bring the outside edge of the cutter 6.35 mm (0.250 in.) from the pivot point.

Note: The amount knob "H" is adjusted depends upon the diameter of the cutter and size radius to be ground.

The amount of adjustment for knob "H" may be calculated from the following equation:

$$\text{Adjustment of knob "H"} = \frac{\text{Cutter diameter}}{2} - \text{required radius}$$

Radii may also be ground on cutters from 100 mm (4 in.) to 190 mm (7½ in.) diameter but the minimum radius is limited. It may be calculated in this manner:

$$\text{Minimum radius (I)} = \frac{\text{Cutter diameter}}{2}$$

Key to Figure 28/4

A – Stop collar
B – Index plate - 24 divisions
C – Adaptor
D – Ball end mill
E – Setting gauge
F – 114.3 mm (4.5 in.) max.
G – Collet for straight shank cutters
H – Knob "H"
I – Motor
J – For locking to spindle
K – For locking to sleeve
L – Knob "L"

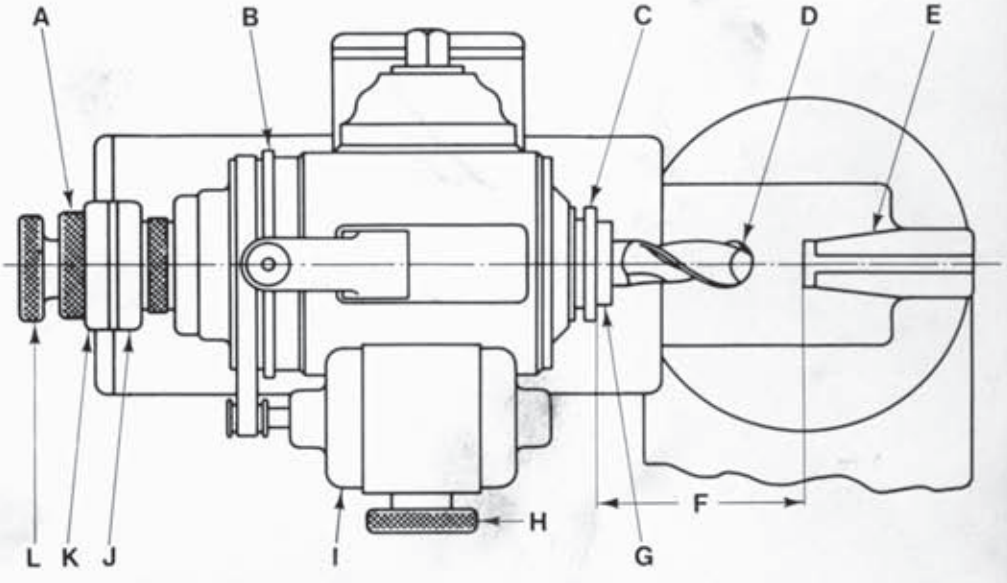

Figure 28/4 Functional Diagram – No. 1 Radius Grinding Attachment

To grind larger radii on cutters greater than 100 mm (4 in.) diameter, calculate the adjustment for knob "H" from the following formula:

Adjustment of knob "H" = 2 – (R – r)
where R = required radius
r = minimum radius calculated from above.

4.13.2 **No. 2 Radius Grinding Attachment (Fig. 29/4)**
This attachment is designed for grinding radii on the teeth of shell end mills, face mills and similar cutters. It has a capacity of up to 305 mm (12 in.) diameter cutters, and will grind radii of 0 to 25 mm (1 in.) through a 90 degree arc.

However, larger radii can be ground by adjusting the attachment slides beyond the range of the micrometer. The cutter can be ground while mounted in the attachment as illustrated in Fig. 29/4. The periphery, radius and face grinding operations of the cutter can all be performed with the same setup. In this way, an accurate radius and perfect blend will be obtained. Assuming we are going to grind a 6.35 mm (¼ in.) radius on a 150 mm (6 in.) diameter shell end mill, proceed as follows:

Key to Figure 29/4

"A" – Stop pin
"B" – Knob
"C" – Stop pin
"D" – Knob
"E" – Button
F – Standard workhead
G – Micrometer gauge
H – Table stop

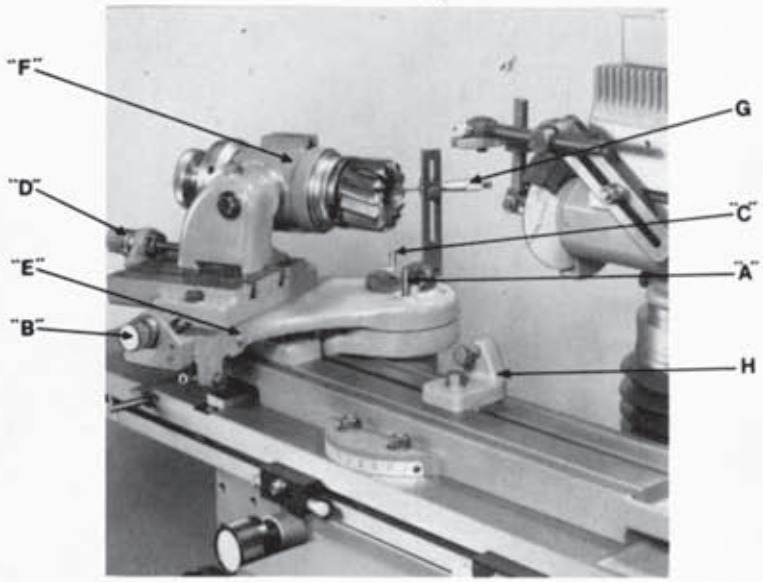

Figure 29/4 Functional Diagram – No. 2 Radius Grinding Attachment

1. **Mounting Attachment and Cutter.** Mount attachment on left end of table with standard workhead housing in horizontal position. Fasten cutter securely in workhead housing with draw-in bolt.

2. **Centering Cutter.** Position attachment so face of cutter is toward wheelhead. Using the centering gauge from top of the eccentric swivel plate, raise or lower wheelhead until pointer on centre gauge is approximately in centre of cutter. Position centre gauge so pointer contacts corner of cutter tooth. Turn pointer around (180 degrees) and move centre gauge so pointer contacts corner of cutter tooth directly opposite the tooth previously gauged. By slightly turning cutter and raising or lowering the wheelhead it is possible to level the two teeth on the centre line of the workhead spindle. Tighten workhead spindle clamping screws, then place centre gauge on the table and raise or lower wheelhead until the wheelhead and centre gauge are on the same centre line.

3. **Mounting Tooth Rest Assembly.** Using the saddle and table controls of the machine, position the attachment so corner of cutter tooth is approximately 0.4 to 0.8 mm (1/64 in. to 1/32 in.) from face of wheel. Mount tooth rest assembly from T-slot on wheelhead, adjust the blade to contact cutter tooth as close to face of grinding wheel as possible. The point, or portion, of the blade upon which the cutter tooth slides must be directly in front of the grinding wheel and should be the only portion in contact with the cutter tooth. This is very important if the cutter is to mill a true radius after it is ground. The contact portion of the tooth rest must be on the wheelhead spindle centre line. This is accomplished by backing the wheelhead away from the cutter; then using the centre gauge from the table, position the tooth rest contact point and the centre line mark on the spindle to the same height.

Bring the cutter back toward the wheelhead, then raise the wheelhead until the tooth rest and cutter tooth contact. At this point the cutter, wheelhead and tooth rest are all on the same centre line.

See Fig. 30/4 for a good tooth rest blade configuration for radius grinding. It can be made by altering a standard blade.

Key to Figure 30/4

R – R
r – r
A – Wheel
B – Angle must be 5° to 8° greater than helix angle of cutter

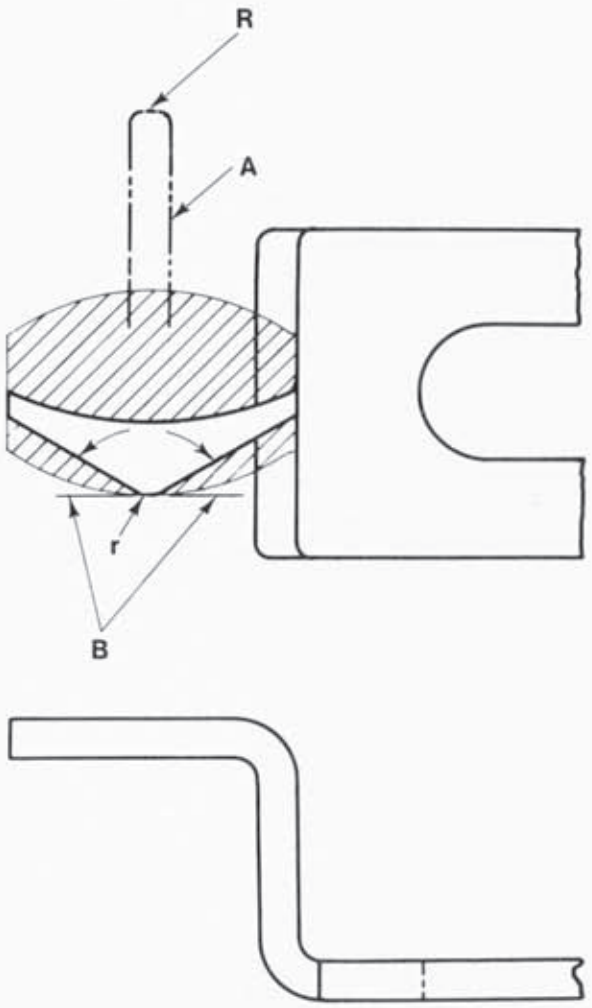

Figure 30/4 Tooth Rest Recommended for No. 2 Radius Grinding Attachment Setups

4. **Selection of Clearance Angle.** Select proper clearance angle. (Refer to table, Sect. 4.2.6).

   EXAMPLE: To grind a 5° clearance with a 6 in. diameter wheel, lower or raise the wheelhead 0.261 in. This means that the centre of the grinding wheel is 0.261 in. below or above the centre line of the cutter and arc ground behind the cutting edge will be equivalent to a 5° clearance angle.

5. **Grinding Periphery.** Position attachment so grinding wheel is perpendicular to periphery of cutter and tighten locking screw on rear of base plate. Start machine and move saddle handwheel until wheel contacts periphery. Proceed to grind periphery as you would any helical cutter.

6. **Positioning Cutter for Radius.** Stop machine, move cutter away from grinding wheel using machine controls, and back up attachment slides far enough to allow micrometer gauge to be mounted in tapered hole of attachment. Tapered hole should be thoroughly cleaned before using micrometer gauge. Locate against stop pin "A" (Fig. 29/4). Set micrometer barrel to proper height (use centering gauge) and adjust to desired radius (for a ¼ in. radius set micrometer at 0.250 in.). Turn crank "B" until periphery of cutter contacts spindle of micrometer (Fig. 29/4). Set graduated dial on crank "B" to zero and lock. Turn micrometer gauge 90 degrees against other stop pin "C" (Fig. 29/4). With micrometer still set at 0.250 in., turn crank "D" until face of cutter contacts micrometer spindle. Set graduated dial on crank "D" to zero and lock. Remove micrometer gauge and replace with tapered plug.

7. **Positioning Table and Saddle.** Loosen screw on rear of base plate swivel trunnion and position table and saddle of machine so point of cutter tooth swivels on tooth rest blade directly in front of grinding wheel (Fig. 29/4). Set left hand table dog so table cannot be traversed further to the right.

8. **Contacting Grinding Wheel.** Position attachment so grinding wheel is perpendicular to periphery of cutter. Tighten screw on rear of base plate. Contact one cutter tooth with tooth rest blade and tighten workhead spindle locking screw. Start machine. Hold a thin piece of tissue paper between cutter and grinding wheel. Turn saddle handwheel slowly until grinding wheel tears paper.

9. **Grinding Radius and Face.** Do not move saddle handwheel except to compensate for wheel wear. Back off crank "D" a few turns and loosen base plate and workhead spindle locking screws. Mount and position adjustable stop bracket on table of machine so knurled screw will contact button "E" in attachment (Fig. 29/4). With cutter tooth on tooth rest blade, swivel attachment 90 degrees and feed in with crank "D" until the cutter contacts the grinding wheel. Grind all teeth at this setting. After all teeth are ground, rotate cutter 180 degrees from first tooth and move in with crank "D" a small amount.

Continue to grind cutter in this manner until zero on dial is reached. At this point, compensate for wheel wear in the same manner as discussed in step (8). Back off crank "D" several thousandths of an inch. Loosen base plate and workhead spindle locking screws. Move table in with grinding wheel perpendicular to cutter until table dog contacts stop pin. Swivel attachment and again turn crank "D" until cutter contacts the grinding wheel. Advance swivel attachment against adjustable stop and back table out to grind face of cutter (see Note 1). Move table back in against stop pin, swivel attachment back approximately 85 degrees, or just before the lines on the attachment coincide; then back table out. This will eliminate the nick on the periphery caused by bumping the attachment swivel against the stop. Check cutter (face) bearing. (See Note 2).

Note 1: Wheel will not start cutting on face of cutter until zero reading at crank "D" is reached. Feeding beyond zero reading is necessary to grind cutter face and will not change the radius.

Note 2: Cutter bearing can be checked as follows: Coat a small surface plate with red lead. Carefully hold it against face of cutter. Rotate backwards, remove plate and observe red lead on cutter teeth. The cutter bearing should be slightly heavier toward radius, tapering off to a very thin bearing toward centre of tooth. The setting of the adjustable stop should be changed to suit cutter bearing.