CONQUEST INDUSTRIES

Always be sure to mail in your warranty card. If your purchase is not registered with us then we cannot provide service on warranty-related issues.

When calling for technical support, please have the model number and serial number of your machine available.

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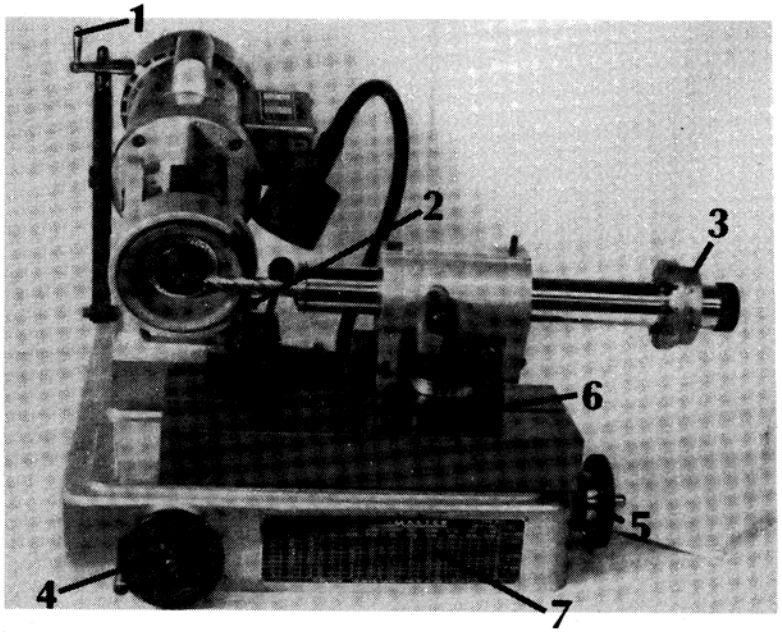
Please check our website for information on new product and accessory releases, updates, and other items.
Our web address is www.cuttermaster.com.

CUTTERMASTER
Operator's Manual



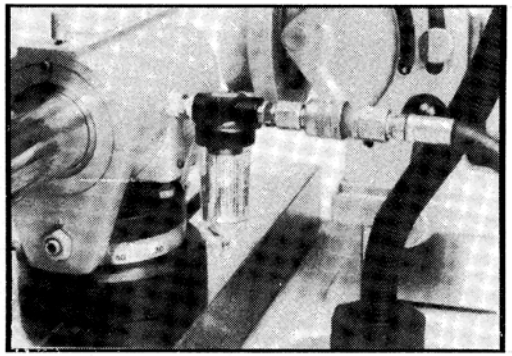
1 – Clearance Adjustment Handle
2 – Stylus
3 – Indexing Ring
4 – Y-axis handle
5 – X-axis handle
6 – Air Bearing Swivel Base
7 – Clearance Angle Chart

IMPORTANT INSTRUCTIONS CONCERNING EVERYDAY SETUP AND USE

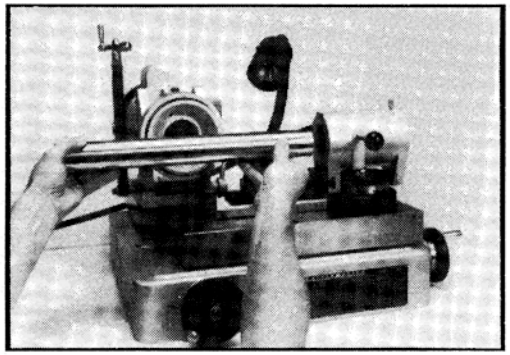
1. Read all instructions in this book before operating the machine.
2. Never use a grinding wheel with an rpm rating below 3450 rpm.
3. Always use safety glasses, and never operate the machine without the proper wheel guard in place. Never use a grinding wheel that is cracked or with any kind of defect. Prior to turning the motor on, always insure that the wheel hub nut (part number M-05) is secure and tight. When using a new grinding wheel for the first time, start the motor from the rear of the machine and let it run for a minute, in case of cracks or damage to the grinding wheel which may occur in shipping.
4. Always plug the electric cord into a 3-pole outlet only. Do not plug the cord into a 2-pole outlet. Do not modify the plug or cord in anyway. Always insure that the motor start switch is in the "off" position before plugging the motor in. Always turn the motor off when it is not in use, or if a setup change is in process.
5. Don't use the machine in a wet, or dimly lit area. Do not wear ties, loose clothing or any item that could possibly become caught up or entangled in the grinding wheel.
6. Never move the air bearing without a minimum of 90 psi. Do not use the air bearing in temperatures below 65 degrees; metal expansion caused by colder temperatures causes a loss of operating clearance.

When you first open your Cuttermaster:

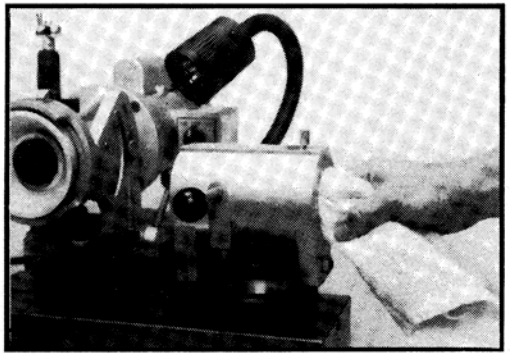
- Slide the air bearing fixture on the x-axis table, by aligning the 2 guidepins into the t-slot. Position the right hand side of the air bearing's black swivel base approximately 1½" (40mm) from the right end of the table. Set the angle of the swivel base to 2 degrees to the left side of zero, (to facilitate a 2 degree angle fishtail on the end teeth) and securely tighten the retaining nut that is on top of the black swivel base. If you want a flat bottom end on the end mill, set the air bearing swivel base angle to zero, or whatever angle you wish.



- Attach the air filter that came with the machine to the brass fitting on the back side of the air bearing fixture; the arrow that indicates air flow direction on the air filter should be pointing towards the air bearing after installation. Use teflon tape to reduce air loss. Connect an air supply with a minimum of 90 psi to the air filter using the proper air fittings (not supplied). Note – the air filter supplied is a water trap *only*. Never put any kind of oil or lubricant in either the air filter or the air bearing fixture itself. Never move the air bearing without at least 90 pounds of air pressure applied.

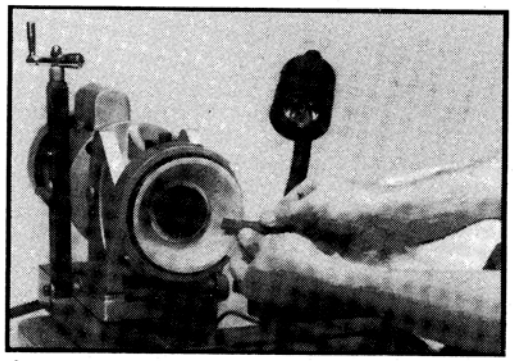


- Slide the stylus bracket assembly in the slot on the front face of the air bearing, and tighten it.

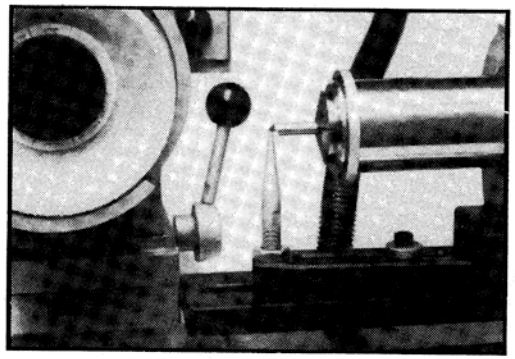


- Clean the air bearing fixture out thoroughly. Remove the spindle carefully, leaving the air on. This allows any dust or debris that may have settled in the air spindle housing during the packing/shipping process to be blown out of the air ports. Keep the air on; clean the inside of the air bearing housing with a cleaning solution that leaves no residue, such as Acetone or MEK. Do not use WD-40, glass wax, or any other type cleaner. After cleaning the inside manifold, keep the air on for a minute (to allow the cleaning solution to fully evaporate) and then wipe the inside again with a clean, dry cloth. Clean the air spindle with the same solution, and carefully replace the spindle back into the housing. It is important to periodically clean the air spindle in this manner to insure long life. Thoroughly wipe out the inside of the air bearing spindle, where the collet goes. Debris that comes between the collet and inner spindle surfaces will affect concentricity.
- Place the grinding wheel over the hub, and tighten the wheel hub nut over the wheel using the 3 screws provided. Follow the guidelines mentioned in the "Important instructions concerning everyday setup & use" section for using a new grinding wheel.

Sharpening standard end mills

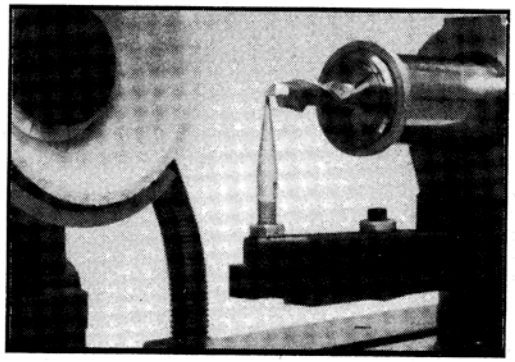


1. If you're using the pink aluminum oxide grinding wheel that was supplied with the machine, you'll need to dress the wheel. We suggest that you cover the air bearing fixture while dressing the wheel. Manually dress the wheel at a 10 - 20 degree angle, using a dressing stick. The angle itself is not important - what you're doing is creating a sharp edge. (It's always best to use a CBN or diamond wheel, as these do not require dressing, there's no wheel breakdown, and they have the best finish).



2. The height of the stylus that the end mill rides on is to be kept at the same height as the centerline of the air bearing spindle. Check this by placing a piece of drill rod, that has been center-punched on one face (indicating the centerline of the drill rod) in the air bearing by using a 5c collet, and then raise the stylus to match the mark. If the stylus height is not set correctly you will not obtain the correct clearance angles.

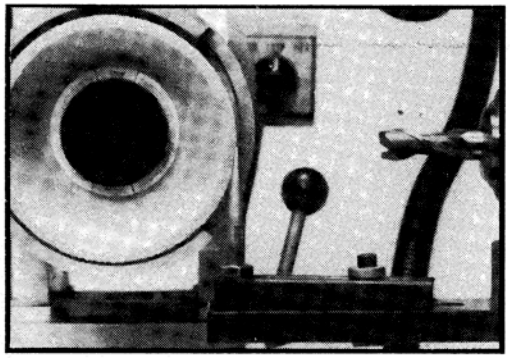
3. Using a clean 5C collet, mount the end mill in the air spindle. Tighten the drawbar, insuring that the end mill will not come loose.



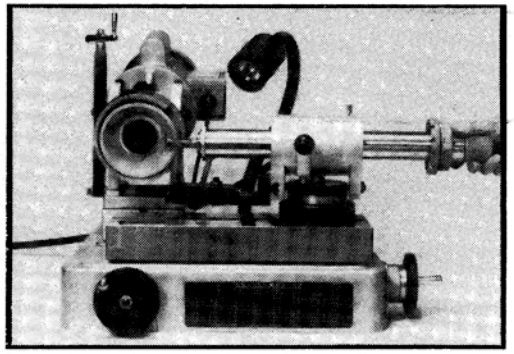
4. Maneuver the stylus inside the flute of the end mill. You want the stylus as close to the outside edge of the end mill o.d. as possible, without being too far out so that the grinding wheel will come in contact with the stylus instead of the end mill. Tighten the set screw.

5. Check the o.d. of the end mill, and obtain the primary clearance angle (listed under first grind) for that diameter from the Clearance Angle Chart on the front of the

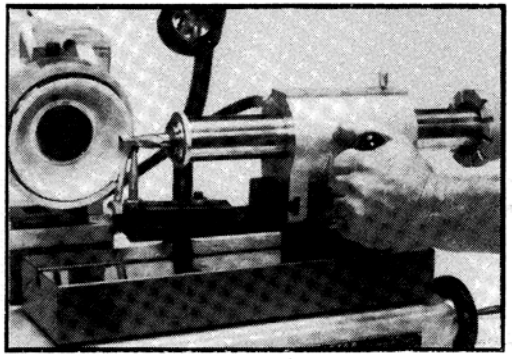
machine. Crank the clearance adjustment handle and raise the motor/spindle until the proper angle is set on the vernier scale which is on the side of the motor. If you are machining harder materials you may want to adjust this angle to 1 or 2 degrees less than the angle given on the clearance angle chart. Materials such as aluminum would require increasing the clearance angle 1 or 2 degrees. We do have an optional pneumatic finger attachment available that eliminates the cranking up and down of the motor to set the clearance angle; clearance angles are set by flipping a switch.



6. Using the machine's x and y axis handles, position the stylus directly in front of the right edge of the grinding wheel. The middle of the stylus should be in front of the highpoint of the grinding wheel's edge. Position the stylus roughly ½" (13mm) in front of the wheel.

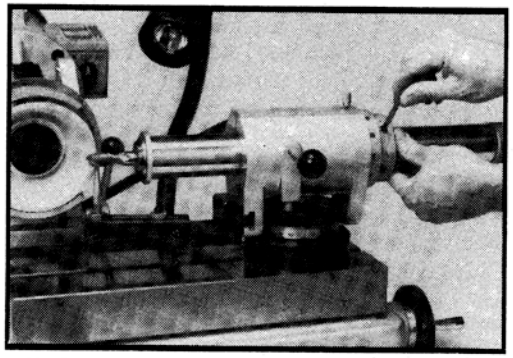


7. Slide the indexing ring all the way to the right of the air spindle, and lock the set screw. (To avoid denting the spindle don't bear down.) Place the end mill on the stylus, as far right towards the shank-end of the end mill as it will go. When grinding end mills with a standard spiral, you will always pull the spindle to the right; never push the end mill to the left as this will cause the end mill to jump on the stylus. It's very important to keep the end mill on the stylus at all times while you're grinding. If the end mill jumps this will cause gouging on the o.d.. When pulling the end mill during the grinding process you want a slow, smooth movement to obtain a clean finish. After positioning the end mill on the stylus, turn the motor on with your left hand. Advance the grinding wheel (y-axis) until the wheel touches the o.d., and then feed in another .002 – .003 (.04 – .06mm). Pull the air spindle to the right, being sure to keep the tool on the stylus, using a slow, steady movement. It may take a little practice to get the feel of this. One suggestion is to take an old end mill and practice pulling the o.d. a few minutes before trying your everyday use cutters.

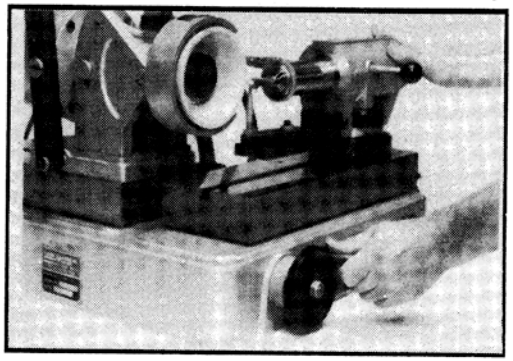


8. After you pull the end mill off the stylus, rock the air bearing back towards you, and position the next flute on the stylus in the starting position. Slowly lower the air bearing back down into the wheel, and pull the end mill back as before. Repeat this with all remaining flutes. For a little better finish you can take a .001 (.02mm) cleanup pass on all the flutes.

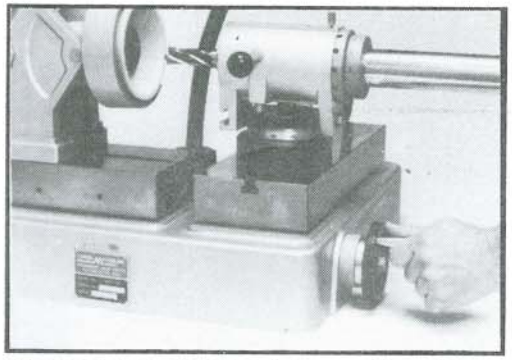
9. Obtain the secondary clearance angle from the clearance angle chart, and set the angle on the motor/spindle vernier accordingly. Proceed to grind the secondary in the same manner as used to sharpen the primary. To save time, the best way to do this is to grind one secondary clearance angle on one flute, until the width of the primary angle is the proper size. Then proceed to sharpen the remaining flutes. Be careful that you don't take too much off, and wipe out the primary, or burn the end mill. The secondary grind is only necessary if the primary is too wide; it's not a necessity to do the secondary grind if the primary is already ground to the width desired.



10. To grind the end, or face, from the same setup, begin by setting the motor/spindle angle to zero on the vernier. When the motor is set at zero, the air spindle centerline is ½" below the centerline of the grinding wheel; this provides a 7 degree clearance angle off of the radius of the wheel o.d.. Remember that the angle that is preset on the air bearing swivel base is the angle that the end teeth will have. Loosen the indexing ring and bring it flush to the back end of the air bearing housing. Push the pin which is on the top center of the right side of the air bearing into a slot in the indexing ring that is marked with a number which matches the number of flutes on the end mill. While holding the index ring firmly against the housing, push the spindle so that the end mill is past the stylus at least ½", and then align 2 parallel flutes until they are square to the table. Tighten the set screw in the index ring. When you grind you will be maintaining steady pressure of the index ring against the air bearing housing, so that the end mill is not pushed back when in contact with the grinding wheel. (Some users may prefer to push the air bearing spindle all the way to the right, set the flutes square and then lock the index ring in place, so that they don't have to hold the air spindle in place, however this will entail either cranking the table forward a distance to compensate, or repositioning the air bearing forward by loosening the swivel base nut and sliding the air bearing forward.) Maneuver the grinding wheel with the y-axis handle so that the edge of the wheel is about ½" in front of the center of the first end tooth that will be ground. Using the x-axis handle, feed the end mill forward until the end mill touches the wheel. Back the wheel away from you, off of the flute, using the y-axis handle. With the x-axis handle, feed the table forward (to the left) .002 - .003 (.04mm - .06mm), and then with the y-axis handle feed the tooth across the wheel, to the center of the end mill, and back. You'll know when you hit the center of a center cutting end mill, as the grinding sound fades due to the fact that there is less material being sharpened at center. Index to the next flute, and

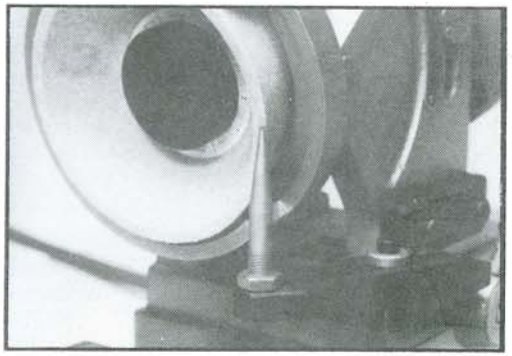


repeat the process until all flutes are done. If you wish to sharpen the secondary clearance angle of the end teeth, drop the motor/spindle angle down to negative 8 degrees, and repeat the same procedure as before. You can sharpen the ends of all 2 flute end mills, 3 flute, and 4-flute non center cutting using this method, off of the o.d. of the wheel.

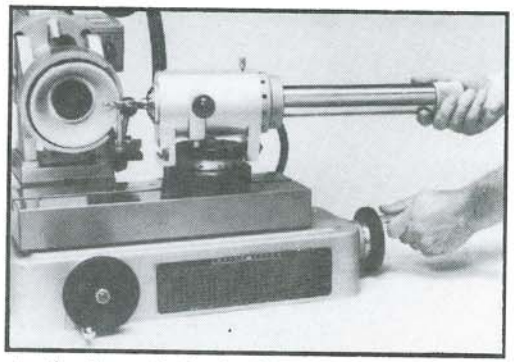


11. For 4 flute center cutting and 6 flute non center cutting end mills, the ends must be sharpened off of the face of the grinding wheel, instead of off the o.d.. To do this, remove the stylus base assembly from the air bearing. Slide the motor back, about halfway on the y-axis table. Loosen the swivel base nut, rotate it 90 degrees clockwise, and slide the air bearing fixture to the left so that the end mill now faces the wheel. Set the motor/ spindle angle to negative 4 degrees. Repeat the same procedure as before, setting the flutes square to the table, setting the indexing ring, and feeding the end mill across the wheel.

Tapered end mills



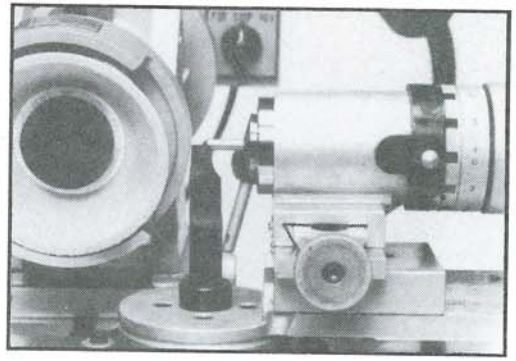
1. Bolt the taper attachment onto the right side of the motor/spindle, in the 2 threaded holes beneath the angle vernier.
2. Remove the complete stylu/ /bracket assembly from the air bearing by sliding it out of the t-slot.
3. Remove the stylus along with the bracket that it is screwed into, from the larger main bracket which fits into the air bearing. Bolt it on the taper attachment, by inserting the sleeve ths/Egh the stylus bracket, dropping the bolt through the sleeve, and then loosely hand-tightening the bolt. Adjust the center height of the stylus to the centerline of the air bearing spindle, using the same method as when it was mounted on the air bearing.
4. Set the primary clearance angle on the motor spindle to a clearance angle that is midway between the small and large diameters of the tapered end mill. Example – if the small diameter is 3/8", and the large diameter is 3/4", use the clearance angle for 9/16".
5. Maneuver the stylus in front of the grinding wheel, as close to the wheel as you can get it without hitting the wheel when it turns. Tighten the bolt on the taper attachment.



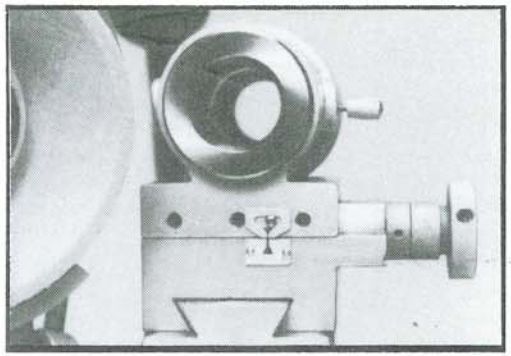
6. Place the tapered end mill in the appropriate collet, and insert it in the air bearing spindle as usual. Set the angle of the air bearing swivel base to the same angle as the taper of your end mill. So that you don't have to crank the table as much, slide the air bearing fixture 1 – 2" to the left before you tighten the swivel base nut. Push the air spindle all the way to the right, and bring the indexing ring all the way to the left. Don't push the indexing ring firmly on the back of the air bearing housing, but leave it slightly loose so that the air bearing can spin freely. Tighten the screw in the indexing ring.
7. Using the x-axis machine handle, feed the table to the right, until the front end of the end mill is in front of the stylus. Using the y-axis handle, bring the wheel forward, until the front of the end mill rests on the stylus. Turn the motor on, and feed the grinding wheel forward until you spark off. Unlike the grinding procedure for a straight end mill, you will be feeding the tool forward, instead of pulling it back. What you are going to do is crank the x-axis handle with one hand, and keep the end mill riding on the stylus by using your other hand to keep **light** clockwise pressure on the air spindle. This will move the end mill forward. When you finish grinding the first flute, rock the air spindle back towards you, and while keeping it rocked back, crank the x-axis handle so that the table moves back to the right. Set the air bearing down gently on the front end of the flute, and repeat the same procedure on all flutes.

Grinding radius end mills

Calibration



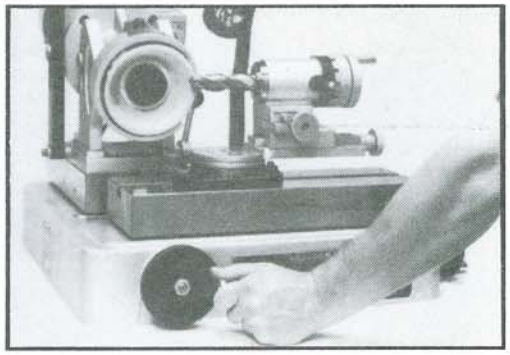
1. Place the 1/4" setting pin with a flat in the fixture, using a 1/4" 5C collet. The pin's flatside should be down, and horizontal to the table. Remove the black plug from the pivot hole. Loosen the screw in the setting ring on the center finder, and set the center finder to the height of the fixture's spindle centerline by bringing the top of the center finder to touch the underside of the setting pin. Tighten the screw in the setting ring.



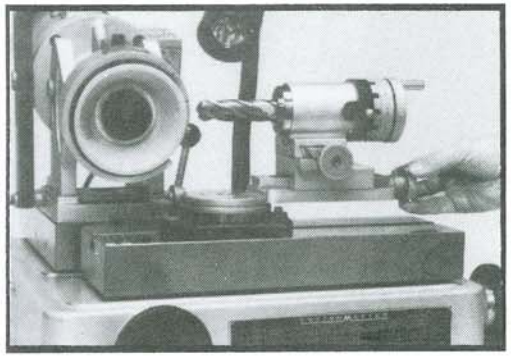
2. Rotate the setting pin so that the flatside is now vertical. Turn the cross slide dial until the center finder touches the flatside. If the crossfeed dial does not read zero at this point, loosen the 2 sets screws in the dial, rotate it until it reads zero, and tighten the set screws. Adjust the indicating arrows on the face of the cross slide (underneath the collet opening) so that they line up when the dial is at zero.

Grinding a full ball end mill

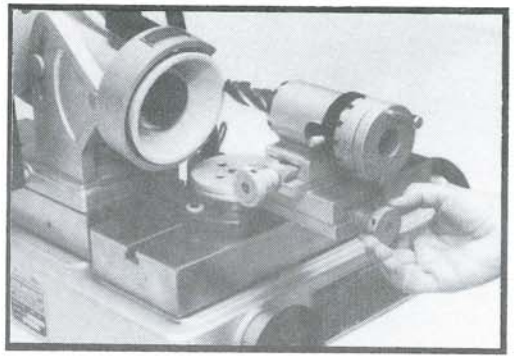
1. You need to use a cup wheel, with a freshly dressed sharp edge on the corner. (It's always best to use a CBN or diamond wheel, which do not require dressing). Remove the center finder, and set the cross slide to zero. Insert your end mill into the fixture, with the flutes parallel to the table, and with the index pin pushed into a slot with the corresponding number of flutes.



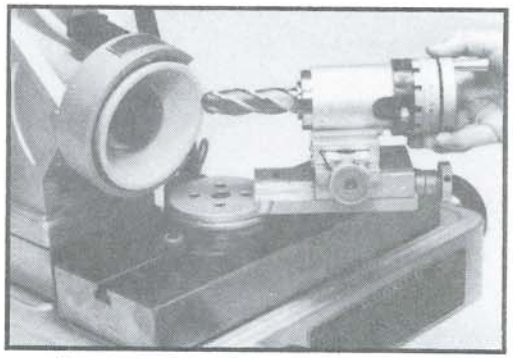
2. Set the clearance angle of the motor/spindle to the appropriate primary (first grind) angle. A secondary will not be necessary. Using the machine's y-axis handle, touch the grinding wheel to the o.d. of the end mill. Do not touch this handle for the duration of the process.



Back the end mill away from the wheel to the right side, using the fixture's "x" feed handle until you can swing the fixture 90 degrees without hitting the wheel.

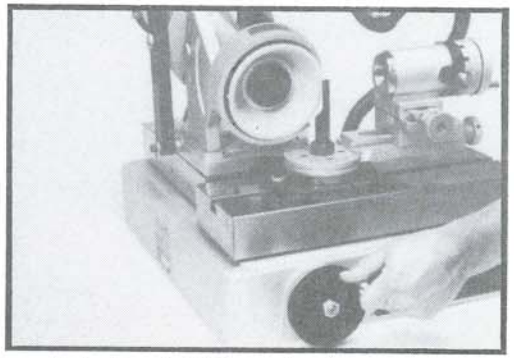


3. Now swing the radius attachment 90 degrees, so that the end mill now faces the wheel. The 90 degree stop pin will stop it at the correct position. Using the machine's x-axis handle, maneuver the table until the center of the end mill is in front of the edge of the grinding wheel. Turn the motor on.



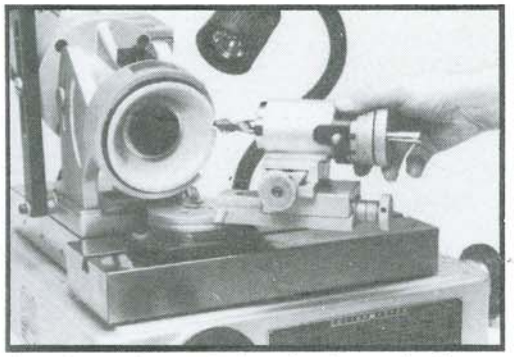
Slowly advance the tool to the wheel, using the fixture's "x" handle, and swiveling the fixture back and forth at the same time. When you start making contact stop advancing, and swing the radius the full 90 degrees. Feed into the wheel until you are grinding on all sides of radius. Do not take too much off. At this point, note the dial reading on the fixture's "x" handle, and bring the end mill away from the wheel 1 or 2 turns. Index to the next flute, and sharpen the other side, remembering not to feed past the dial reading that you stopped at on the first flute.

Grinding a corner radius on a standard end mill



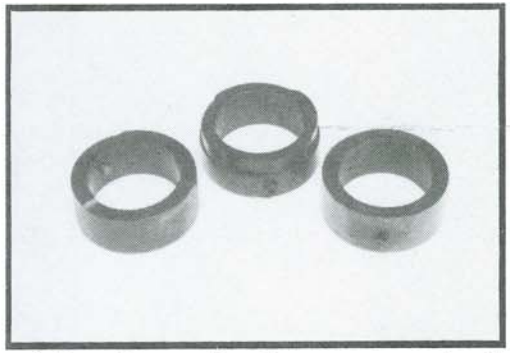
1. Set the motor/spindle clearance angle to the primary (first grind) clearance angle, which corresponds with your end mill's diameter. Insert the center finder in the pivot hole of the fixture. Using the machine's x & y handles, maneuver the fixture so that the corner of the carbide portion of the center finder touches the wheel. Now dial away from the wheel, using the machine's y-axis handle, the same distance as the corner radius that you desire to grind. (Example - if you want to put a .065 corner radius on the end mill, dial .065 back from the wheel.) Do not move the machine's y-axis handle again. Remove the center finder.

2. Insert the end mill in the collet, with the flutes square (very important) to the table and the index pin engaged in the proper slot which corresponds to the number of flutes. Use the fixture's y-axis handle to touch the o.d. of the end mill to the grinding wheel. Do not touch the fixture's y-axis handle again. Back the fixture away from the wheel using the fixture's "x" handle, until you can swivel the fixture 90 degrees without hitting the wheel.



3. Turn the motor on. Swivel the fixture 90 degrees until it hits the stop pin. Using the machine's x-axis handle, maneuver the fixture so that the right corner of the wheel is in front of the flute on your right hand side. Your initial contact point on the wheel will be the size of the radius, away from the o.d. of the end mill, on the face. In other words, if your radius is .100, your initial contact will be on the face of your right flute, .100 from the the o.d.. Feed towards the wheel using the fixture's "x" handle. When you are close to the wheel, begin swinging the fixture until you begin to make contact. Once contact is made, swivel the fixture completely around until the radius blends into the o.d.. Once it blends in stop grinding that flute, note your reading on the fixture's "x" handle, and back away from the wheel 1 or 2 revolutions. Index to the next flute, and repeat the procedure.

Countersinks & Taps



There are 2 types of cams. Countersink cams have axial relief on the face of the cam. There are 4 different countersink cams available; 2 cams for uniflute countersinks, and 1 cam each for 3 or 6 flute multiflute countersinks, and 4 or 8 flute multiflute countersinks. Tap cams have radial relief on the o.d. of the cam. There are 6 various tap cams available.

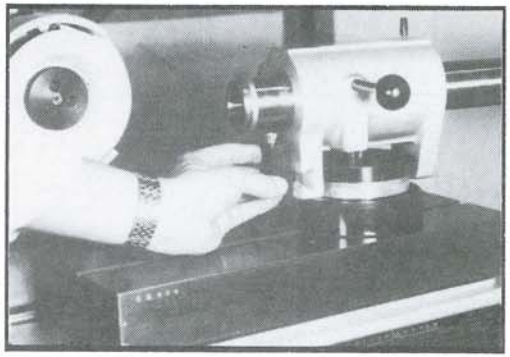
Countersink cam specifications are as follows. The number shown corresponds with the number that is marked on the cam.

#1 - Uniflute countersinks from 0-1/2" in diameter
#2 - Uniflute countersinks from 1/2" - 1" in diameter
#3 - 3 or 6 flute multiflute countersinks, up to 1" in diameter
#4 - 4 or 8 flute multiflute countersinks, up to 1" in diameter

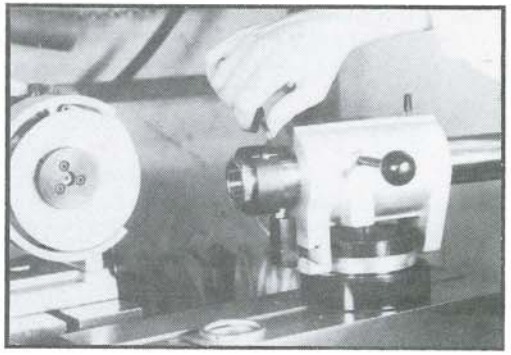
The following chart shows which tap cam to use when grinding taps. The number of the tap cam corresponds with the number that is stamped on the cam. If more clearance is desired, use the next larger size of tap cam, if less clearance use the next smaller size.

Tap size	2 flute	3 flute	4 flute	Tap size	2 flute	3 flute	4 flute
1/4-20	21	32	41	1/2-20		32	41
1/4-20	21	31	41	5/8-11		32	43
5/16-18	21	32	41	5/8-18		32	41
5/16-24	21	31	41	3/4-10		32	43
3/8-16	21	32	42	3/4-16		32	42
3/8-24	21	31	41	1-8			43
1/2-13		32	42	1-14			42

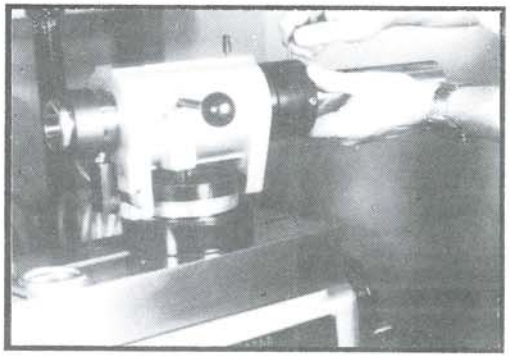
Grinding Countersinks



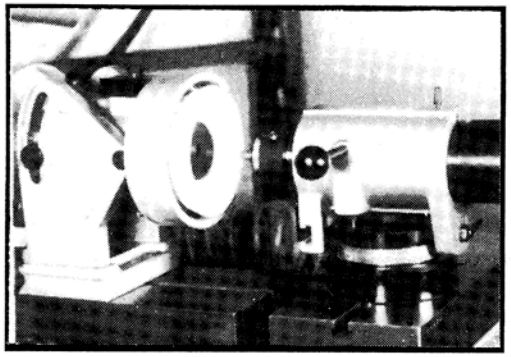
1. Remove the air bearing's stylus/bracket assembly. Slide the axial follower in the t-slot, and line it up so that the center of the follower is under the center of the air spindle.



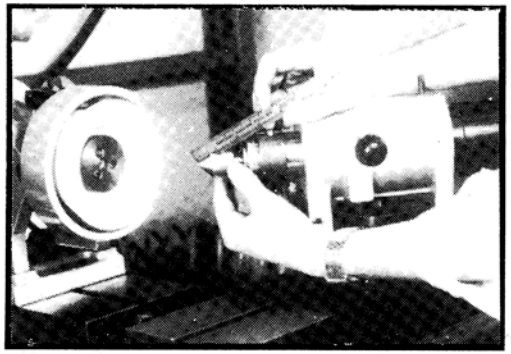
2. Install the appropriate cam, by removing the the retaining ring and sliding the cam over the quill. The side of the cam that has relief will be on the follower.



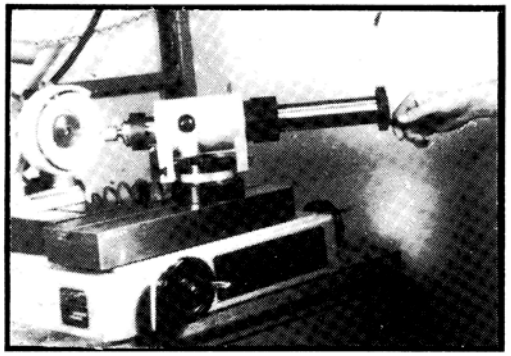
3. Remove the air bearing's indexing ring and drawbar. Slide the spring housing over the quill. Compress the spring housing approximately 3/8" – 1/2", so that the cam is pulled into the follower. Replace the drawbar, and in the spindle, and install the handle over the knurled end of the drawbar by tightening the 2 set screws.



4. You'll need to use the 5" cup wheel that has a 3/4" wide face. Set the motor/spindle angle at zero. To dress the wheel, set the air bearing at 90 degrees, place a diamond in the appropriate collet, and traverse the table past the wheel. Of course, if you're using a CBN wheel this isn't necessary.



5. Set the air bearing's swivel base angle to one half of the countersinks' included angle. For example, if you have an 82 degree countersink, set the swivel base angle to 41 degrees. Place the countersink into the spindle using the appropriate size collet. Align the cutting edge with the centerline of the cam's set screw. This is important for the timing of the drop.

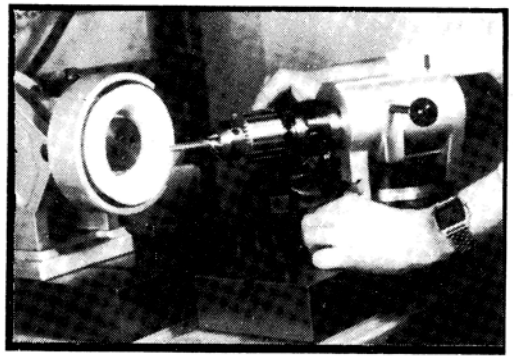


6. While rotating the air bearing, and feed the countersink into wheel. Keep grinding until you've achieved a uniform finish around the cutting edge.

7. If you are using the multi-flute countersink cams, for example the 3/6 flute cam. Align the cutting edge as before, and sharpen the first 3 flutes. After sharpening the first 3 flutes, rotate the cam to align with a cutting edge of the second 3 flutes that have not been sharpened, and repeat the process. The procedure is the same for the 4/8 flute cam.

Taps

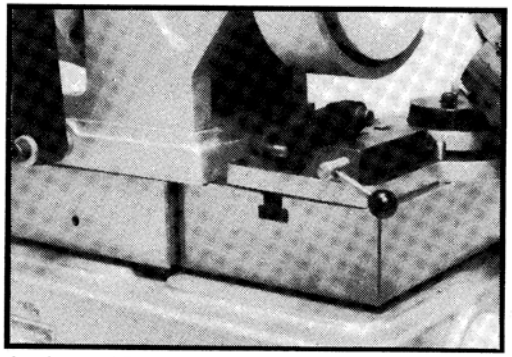
1. Install the appropriate cam, spring housing, axial follower, and handle on the air bearing the same as you would to set up for a countersink. The motor/spindle clearance angle remains at zero. Set the air bearing's swivel base to the same angle as the lead of the tap that you will be grinding.



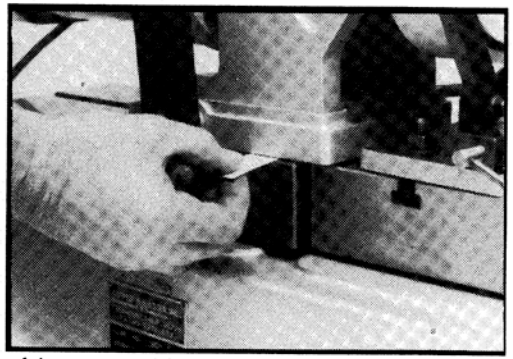
2. Install the radial follower by placing it on the table, in front of the air bearing, and loosely bolting it to the table with the t-bolt and nut supplied. The roller portion of the radial follower must be at the height of the centerline of the air spindle. Adjust the height of the arm by rotating the post that the follower is set on, and then tighten the nut. After setting the follower's roller height, rotate the cam until the lowest point of the cam's relief is in front of the roller. Pull the radial follower into the cam, and then tighten the t-bolt which fastens the follower to the table.

3. As tap shank o.d.'s are not readily compatible with standard 5C collet sizes, we suggest that you mount the tap in an accurate drill chuck that has a straight shank arbor, and mount the drill chuck's shank in the appropriate collet. The grinding procedure is then the same for taps as it is for countersink - rotating the spindle until the lead has been completely ground.

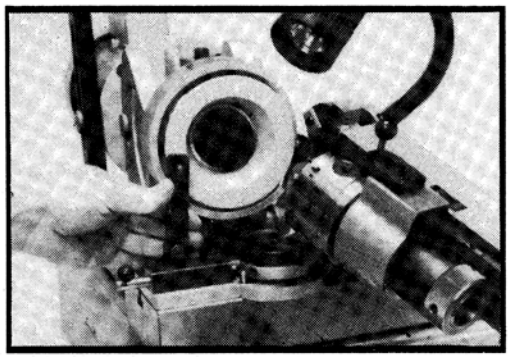
Grinding Drills



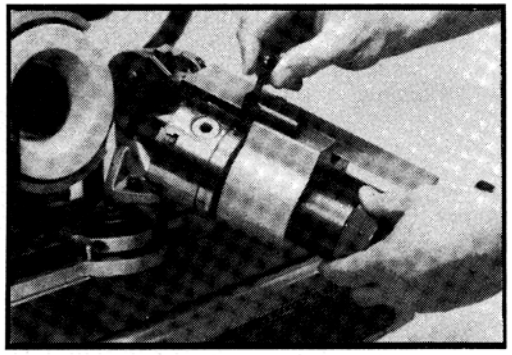
1. Remove the air bearing from the machine. Slide the drill attachment onto the table; the left corner of the attachment's bottom plate should be flush with the left side of the table. You'll need to use the 60 grit pink aluminum oxide wheel with the 3/4" wide face. The CBN wheel will provide the best finish. If you're using the aluminum oxide wheel, dress it by inserting a diamond in the chuck of the fixture, and then by traversing the diamond across the face of the wheel.



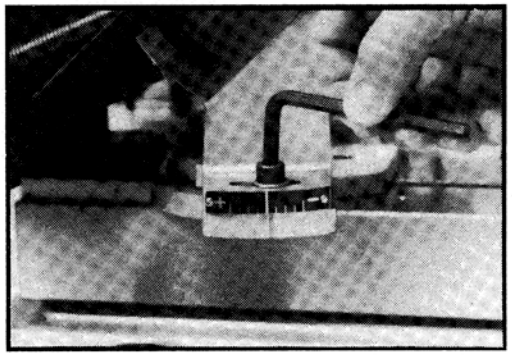
2. Position the motor spindle assembly so that the base plate of the motor hangs over the y-axis table as far as it will go without exposing the guidepin. Using the machine's y-axis handle, bring the wheel towards you to see if the motor/spindle table easily moves past the point where the motor base will be hanging over the x-axis table. If the motor base hits the x-axis table, place a thin shim underneath the motor base, on top of the y-axis table so that the base can clear the x-axis table. This step is necessary for point-splitting which will be done later.



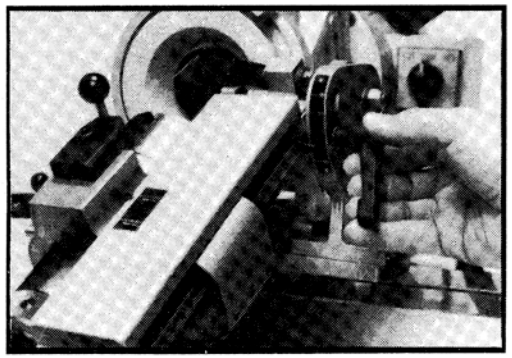
3. Swing the wheel location arm up, and touch the wheel to the locator pin, by turning the machine's y-axis table. Swing the arm down. Do not move the y-axis handle until you are done sharpening the point. (It may be moved when you split the point.)



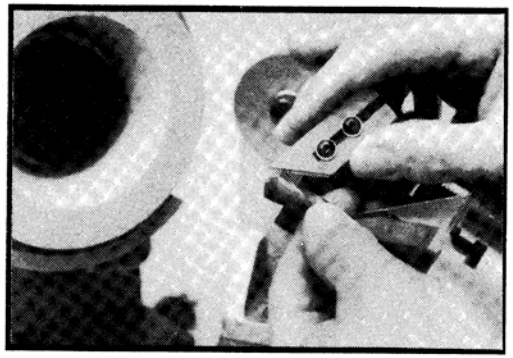
4. Pull the chucks' index selection pin out, rotate the chuck, and set the pin into the slot with 2 green dots, and 1 blue.



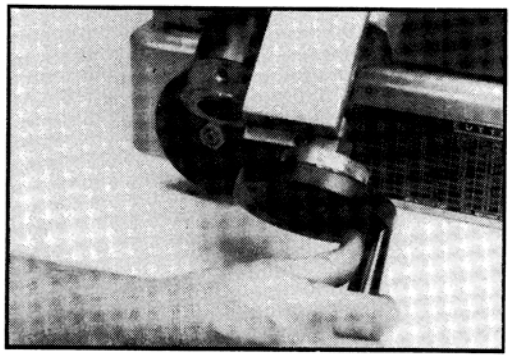
5. If you want more clearance on the drill, move the clearance adjusting slide towards the + sign, if you want less clearance, move it towards the - sign. The fixture's standard clearance angle, when set at the halfway point, will be between 10 and 12 degrees.



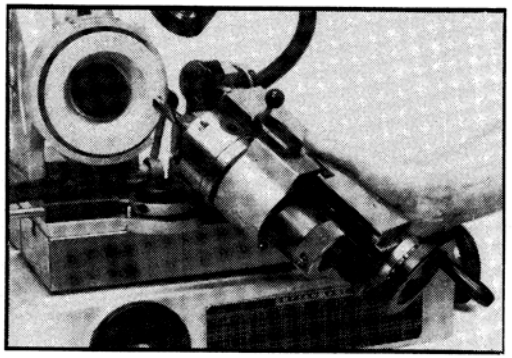
6. Set the desired point angle by loosening the point angle adjusting lever, and raising or lowering the fixture to the angle as needed. Tighten the lever.
7. If your drill's o.d. is between 0 - 1/2" (0-13mm) line up the o.d. indicator with the first mark on the drill size indicator plate by turning the fixture's main feed handle. If it is between 1/2 - 1" (13-26mm) set it to the second mark.



8. Place the drill into the chuck, and hold it with one hand. With your other hand, close the chuck's jaws around the drill, but not so tight that you still can't move it. Drop the drill setting blade into position, and rest the cutting edge of the drill on the the lip of the setting blade. Now tighten the chuck so that the drill cannot move. Lift the setting blade out of the way. Note - if your drill is 1/2" (13mm) or above, you must use one of the alignment extensions to center the back end of the shank in the chuck. To do this, before tightening the chuck completely, place the appropriate extension into the back end of the chuck, and push it forward so that it centers the drill.



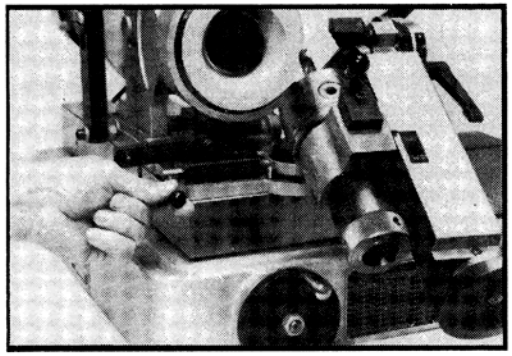
9. Turn the motor on. Use the fixture's main feed handle to move the drill toward the wheel. As you near the wheel, begin swinging the fixture. If you need to, you can move the x-axis table to line the drill up so that it is in front of the wheel.



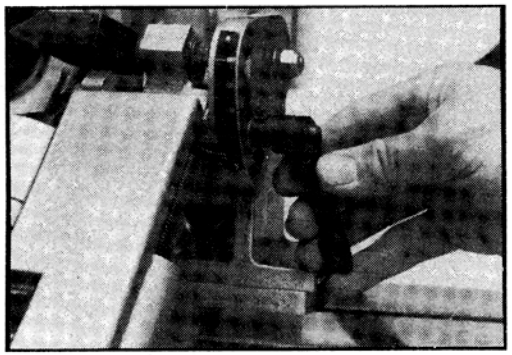
Once you make contact with the wheel, feed in a few graduations more, and swing the drill. So that you don't burn the next flute, swing the fixture to the right side of the wheel (so that you don't hit the wheel when you index) and index the chuck to the next flute. Swing the 2nd flute, and feed in several more graduations. Continue this process with both flutes, until the point is completely ground.

To split the point:

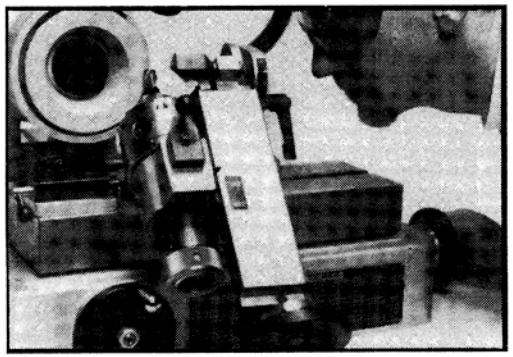
1. After sharpening the point, move the drill back from the wheel one complete rotation of the fixture's feed handle.



2. Lock the fixture in place by engaging the stop pin.



3. Loosen the point angle adjusting lever, and drop the fixture as far down as it will go. Tighten the lever.
4. Index the chuck 90 degrees, to one of the single green dots.



5. The point is split by feeding the drill with the machine's 5. x-axis handle across the wheel, until you hit center. Feed back off of the wheel, and index to the other single green dot. Feed the other flute across the wheel. Be careful that you don't go too far, or take too much off.

To sharpen 4 flute drills – The procedure is the same as for 2 flute drills. When indexing, you'll use the in the chuck holes that have greed dots (1 every 90 degrees). The setting blade is not used. Instead, you'll set one cutting edge so that it points straight up vertically.
To sharpen 3 flute drills - When indexing, use holes that have blue dots only (1 every 120 degrees.) To set the drill, the setting blade is not used, and one of the cutting edges is set to approximately 20 degrees above the parallel plane.

Notes on sharpening other types of cutting tools:

End mills with larger shanks – Special 5C end mill holders are available for tools with shanks of 1¼", 32mm, 1½, 40mm, 2" and 50mm.

End mills with long flute lengths – We offer an optional stylus bracket extension for tools with long flute lengths. The stylus is set in front of the left side of the wheel instead of the right side, and the motor is run in the direction reversed to what you normally run it in. Set the air bearing's swivel base to approximately

Reamers – to sharpen the chamfer on the nose, set the air bearing fixture to 45 degrees (or whatever angle of the chamfer may be.) Use the machine's x-axis handle to feed the chamfer past the wheel. To size the o.d., sharpen the reamer's o.d. in the same manner as an end mill. You may need to modify the stylus slightly so that it doesn't hit any of the flutes that are lower than the one being sharpened.

Milling Cutters & shell mills (Wheel type Cutters with arbor holes) – You'll need to purchase a straight shank arbor that matches the arbor hole in the cutter. Place the arbor through the cutter's arbor hole, and then insert one end into either a 5C Collet or end mill holder. The flutes are set on the finger, and pulled past the wheel. The finger may need to be modified so that it is thin, like a blade, so that the lower flutes do not interfere with the finger.

Straight fluted tapered end mills (also known as draft cutters) – There is no need to use the taper attachment. Set the first flute to be sharpened parallel to the table. The air bearing's swivel base is set to the angle that matches the end mill's taper, and the index pin is locked into the same slot that corresponds with the number of flutes. Use the machine's x-axis handle to feed the flutes across the wheel.

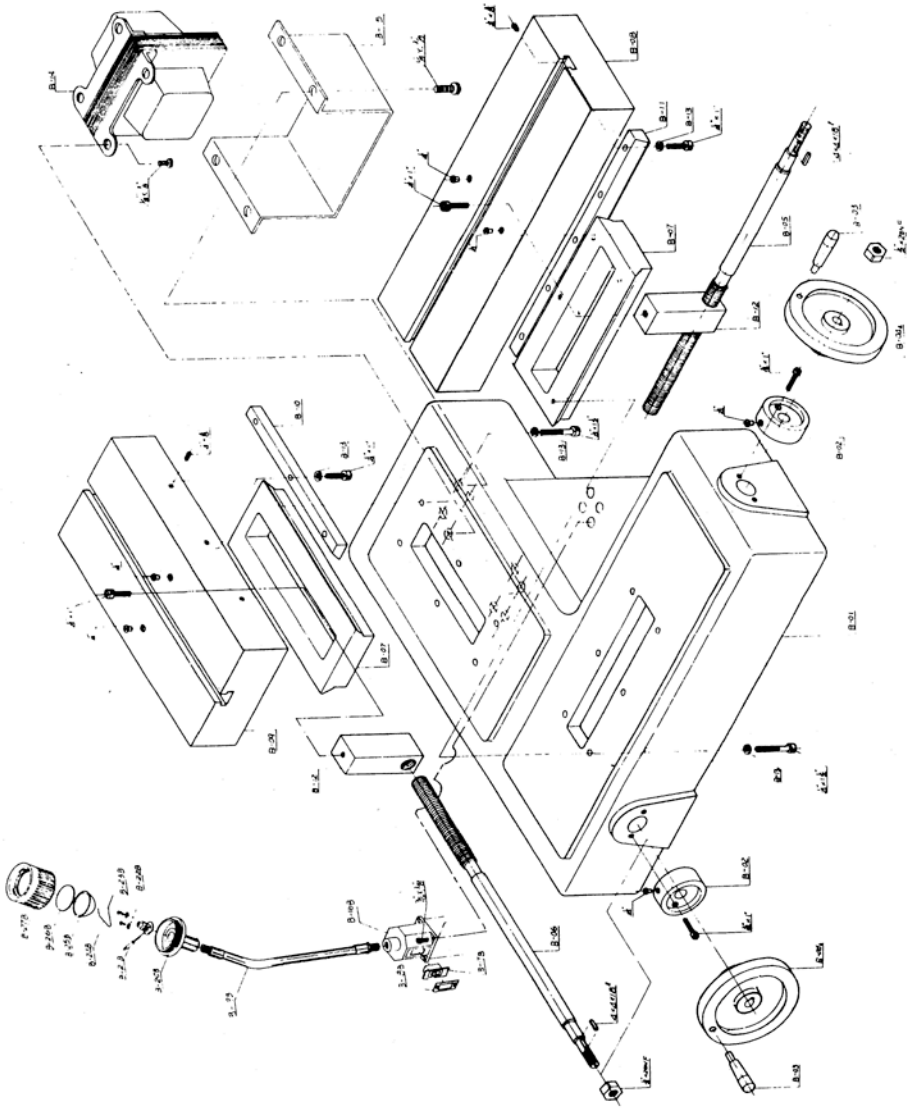
Carbide Tools – are easily sharpened with a diamond wheel. Do not take heavy feeds when sharpening carbide.

Roughing end mills, and fluting – are sharpened by using the z-axis attachment, which is not shown in this manual.

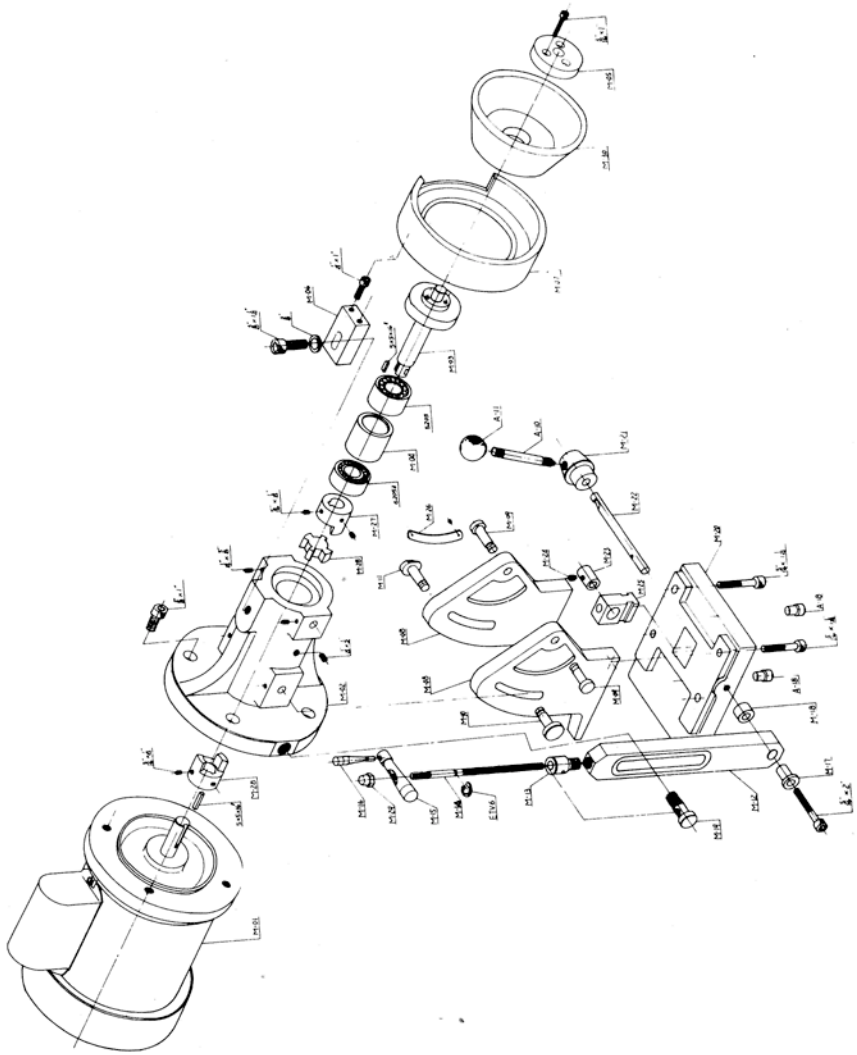
Left handed end mills - Switch the air bearing fixture to the y-axis table, and the motor/spindle assembly to the x-axis table.

Form tools, lathe bits - are sharpened by using the workholding fixture, which is not shown in this manual.

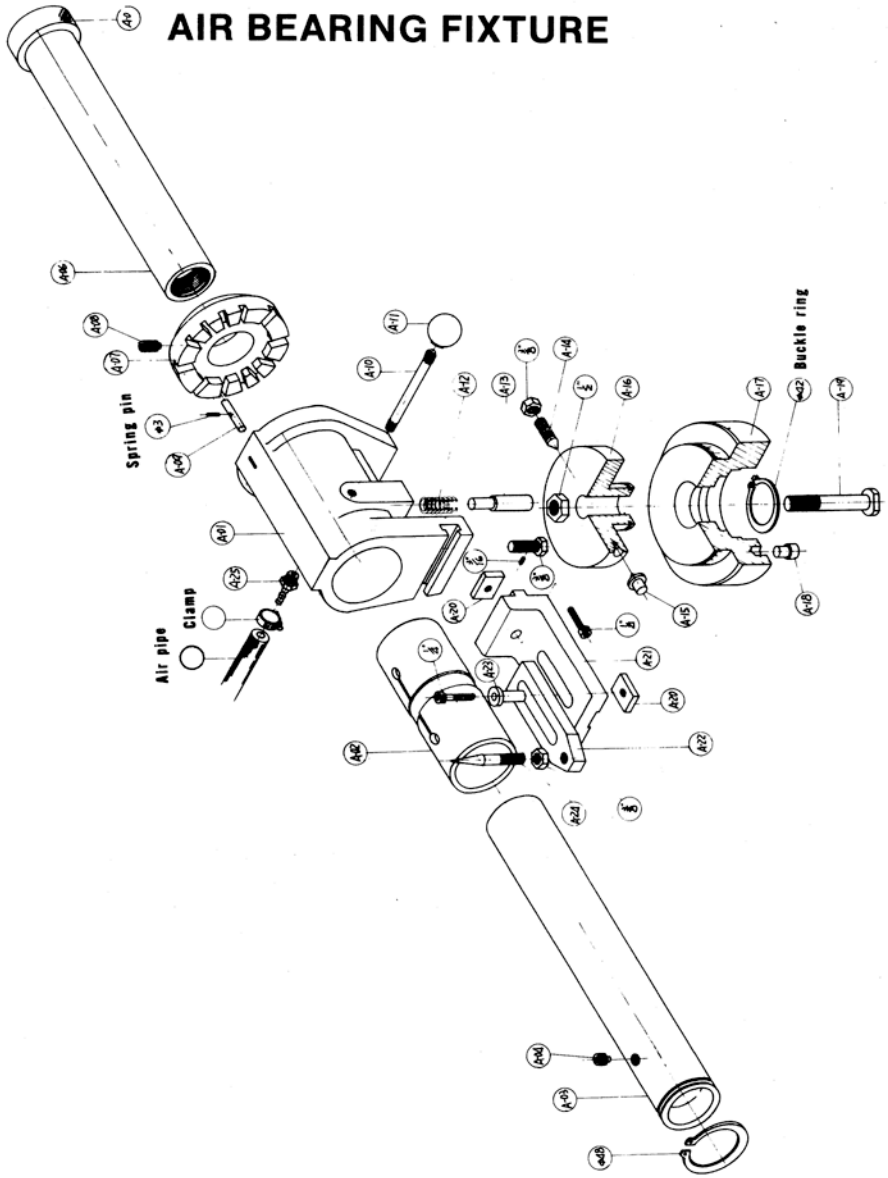
BASE ASSEMBLY



MOTOR & WHEEL SPINDLE



AIR BEARING FIXTURE



General Troubleshooting

Problem	Cause	Solution
End mill does not cut properly	1. The stylus height is not set to the centerline of the air spindle	Reset stylus height
	2. The clearance angles need to be adjusted to the material you're cutting.	If you're cutting harder materials,use 1-2 degrees less clearance. If softer materials, use 1-2 degrees more.
	3. The stylus is too far inside of the flute, causing the end mill to tip down, changing the clearance angle.	Be sure that the stylus is as close to the outside edge of the flute as possible.
End mill is not concentric	1. Inner air spindle area where the collets seats are not clean.	Clean both the collet, and the inner air spindle.
	2. Machine components may be loose, causing movement during the grinding process.	Check the air bearing pivot screws, gib screws (backside of the table), and the bolts in the middle of the t-slots; adjust or tighten as needed.
	3. Collet is not concentric.	Check the runout of the collet, and replace it as necessary.
Air Spindle movement is not free	1. Dirty air bearing 2. PSI lower than 90. 3. Too cold	Clean it **regularly** !! Increase the air pressure Warm the air bearing up, or relocate it to a warmer climate.
Machine vibration	1. Wheel out of balance	Replace the wheel
Flutes have chatter marks when grinding, or poor finish.	1. The end mill is being pulled past the wheel too fast when ground.	Use a steady, slow, smooth movement.
	2. The wheel needs dressing	Dress the wheel
	3. Machine components have come loose, causing movement during grinding.	Check components as shown above
	4. Need a better wheel	CBN wheels provide the best finish.

Parts lists

Air Bearing Parts		Base Parts	
Part No.	**Description**	**Part No.**	**Description**
CM-A01	Main Housing	CM-B01	Base
CM-A01B	Adjusting Screw	CM-B02	Bearing retainer
CM-A02	Sleeve	CM-B03	Handle
CM-A03	Spindle	CM-B04	Dial (inch)
CM-A03R	Retaining ring	CM-B04	Dial (metric)
CM-A06	Drawbar	CM-B05	X-axis lead screw (inch)
CM-A07	Indexing ring	CM-B05M	X-axis lead screw (metric)
CM-A07B	Blank indexing ring	CM-B06	Y-axis lead screw (inch)
CM-A08	Indexing ring set screw	CM-B06M	Y-axis lead screw (metric)
CM-A09	Stop pin	CM-B07	Dovetail way
CM-A09A	Stop pin handle (Spring pin)	CM-B08	X-axis table
CM-A10	Handle lever	CM-B09	Y-axis table
CM-A11	Handle knob	CM-B10	Y-axis gib
CM-A12	Rocker spring	CM-B11	X-axis gib
CM-A13	Rocker push pin	CM-B12	Lead screw nut (inch)
CM-A14	Pivot screw	CM-B12M	Lead screw nut (metric)
CM-A15	Pivot head	CM-B14	Transformer cover
CM-A16	Swivel base top plate	CM-B15	Transformer
CM-A17	Swivel base	CM-B16	Halogen light
CM-A17B	Buckle ring	CM-B17	Halogen light bulb
CM-A18	Guide pin	CM-B17A	Halogen light lens
CM-A19	T-bolt	CM-B20	Oil inlet
CM-A20	Square nut		
CM-A21	Stylus base		
CM-A22	Stylus bracket		
CM-A23	Screw sleeve		
CM-A24	Stylus		
CM-A25	Air inlet		
CM-50	Air filter		

Motor/spindle parts

Part no.	Description	Part no.	Description
CM-M01	Motor	CM-M18	Spacer
CM-M02	Spindle housing	CM-M19	Elevation screw bolt
CM-M03	Spindle	CM-M20	Motor base plate
CM-M04	Bearing spacer	CM-M21	Handle cam lock
CM-M05	Wheel hub plate	CM-M22	Handle axle
CM-M06	Wheel guard block	CM-M23	Handle axle cam
CM-M07	Wheel guard	CM-M24	Handle axle cam screw
CM-M08	Spindle side plate	CM-M25	Anchor block
CM-M09	Support axle	CM-M26	Angle vernier
CM-M10	Rear support axle	CM-M27	Motor coupling
CM-M11	Indicating support axle	CM-M28	Coupling joint
CM-M12	Elevation arm	CM-M29	Handle nut
CM-M13	Elevation arm sleeve	CM-M35	Electric power cords
CM-M14	Elevation screw	CM-M50	Complete motor/spindle assembly
CM-M14E	Etv-6 clip	CM-M52	Spindle bearing # 5205z
CM-M15	Elevation handle	CM-M62	Spindle bearing # 6205z
CM-M17	Bottom elevation arm sleeve		

ACCESSORIES

Part no.	Description	Part no.	Description
CM-02	Cuttermaster air bearing	CM-22	5" cup blue ceramic wheel
CM-03	Radius attachment	CM-23	5" cup pink alum. oxide wheel with 3/4" face
CM-04	Center finder	CM-25	6" dish blue ceramic wheel
CM-05P	Pneumatic finger	CM-26	6" dish pink alum ox. wheel
CM-06	Drill attachment	CM-30	5" cup diamond wheel
CM-08	Taper attachment	CM-31	5" cup CBN wheel
CM-10	Deluxe 2 door cabinet	CM-32	5" cup CBN wheel with 3/4" wide face
CM-11	Workholding fixture	CM-33	6" dish diamond wheel
CM-12	Diamond dresser	CM-34	6" dish CBN wheel
CM-15	Z-axis	CM-C1	Cam attachment, for uniflute countersinks
CM-20	5" cup pink aluminum oxide wheels	CM-C1P	Cam attachment, for countersinks & taps
CM-21	5" cup alum. oxide wheel with 3/4" face	CM-M70	Spindle extension