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Tips for using small lathes

This machine tool can add crispness to scratchbuilt or reworked parts

BY PAUL BUDZIK

PRECISION is important in top-quality modeling, and modelers who purchase precision machine tools usually start with a lathe. If you do a lot of scratchbuilding or kit modification a small modeler's lathe may be an extremely useful addition to your shop.

If you're thinking about buying a

lathe — or already own one, but aren't using it much — I'd like to share some ideas. What I have to say doesn't replace the owner's manual. On the contrary, the manual that came with your machine should be studied from cover to cover. My tips are merely a supplement to help you adapt your machine (and yourself) to model machining.

What a lathe does. Figures 1 and 2

show two typical modeler's metalworking lathes. The basic principle of operation is that the material to be machined is mounted on the spindle of the lathe and rotated against a cutting tool. Handwheels attached to threaded rods allow the cross slide, where the cutting tool is mounted, to be moved parallel or perpendicular to the axis of rotation. Making round parts with a lathe is only its most obvious use; different setups and cutting tools (most of them beyond the scope of this article) allow a variety of machining operations.

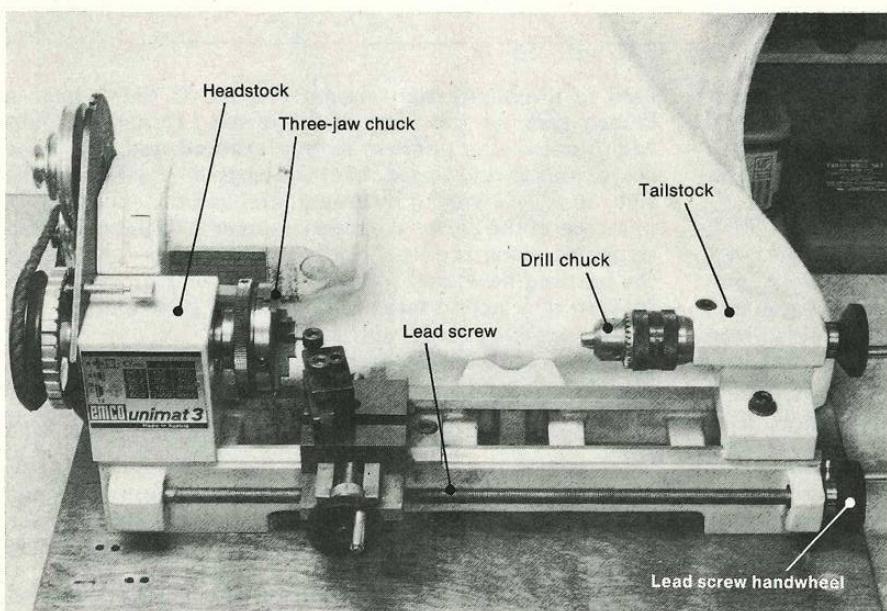
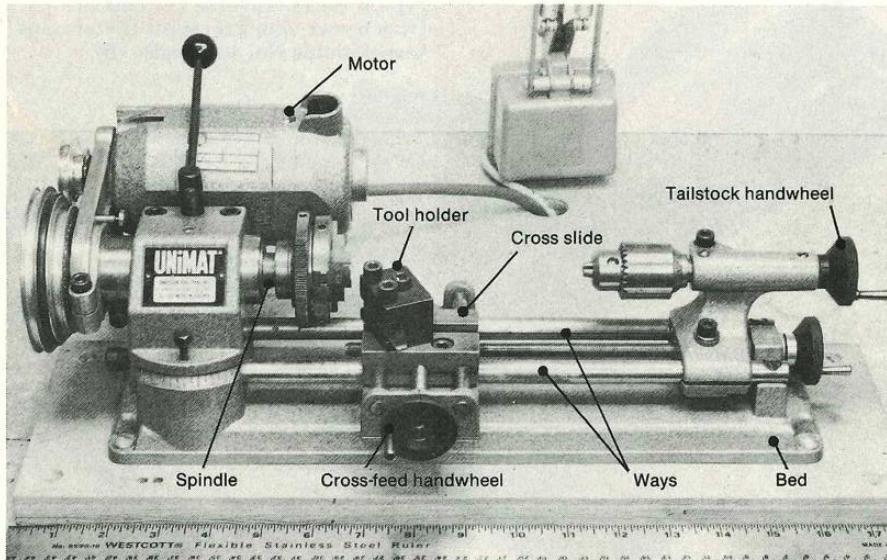
One basic use of the lathe in modeling is to clean up kit parts, Fig. 3. On the lathe you can make a multi-part gun barrel truly round, and turn all the road wheels of a tank to exactly the same diameter. In addition, you can eliminate the side-to-side taper on road wheels required by the injection-molding process.

Selecting a lathe. The first consideration in choosing a lathe is how large a machine you need. Unless you work in very large scales, any of the miniature modeler's metalworking lathes is big enough. (You can do small work on a large machine, but the overall size can be cumbersome.)

The most common modeler's lathe is the Unimat, which has been around for years. Used Unimats can even be found, occasionally, at flea markets and rummage sales. A broad range of parts and accessories is available. I own three Unimats, and if you want a recommendation, the most useful machine for the money today is the old Unimat SL, which can be set up as a vertical mill with little additional expense. My only gripe with the SL is the rigidity of the machine.

The precision of a lathe depends on the strength of the bed and ways. The bed of a lathe is the base; the ways are the guides that the cross slide rides on. The Unimat SL uses a cast base, but the ways are bolted-on steel rods. The rods are slightly flexible, which allows a certain amount of bounce in the ways.

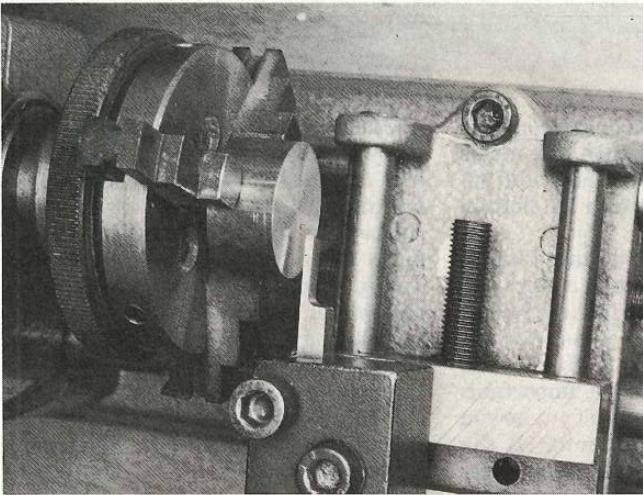
A few years ago Unimat introduced the Unimat 3, which eliminates the flaws of the SL. The bed and ways are cast integrally, eliminating bounce, and the spindle size is larger, which adds strength and allows long lengths of larger diameter stock to be mounted



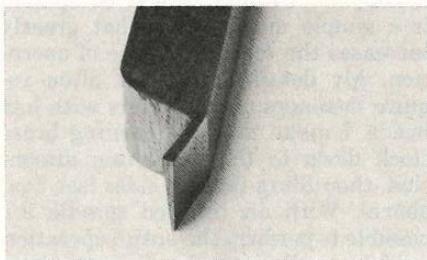
Figs. 1 and 2. Author Budzik owns several small lathes, among them a Unimat SL (top) and a newer Unimat 3 (above). Both are sufficiently compact to be stored in a cabinet.



Fig. 3. Paul used the lathe to clean up many of the kit parts on this 1/12 scale motorcycle, including the mufflers and brake disc. The mounting studs for the fairing and the brake line connections were turned from brass.



Figs. 5 and 6. Spade cutting tools ground from $\frac{3}{16}$ "-square tool stock. The angle of the cutting portion to the body of the bit on the tool (below) allows the bit to be moved close to the chuck without interfering with it. The straight bit (above) is a long spade for cutting through large-diameter stock.



in the lathe. The lathe portion of the Unimat 3 is a little more expensive than the SL, and setting it up as a vertical mill requires purchasing an additional column and motor unit. But as a separate lathe the Unimat 3 is the machine of choice.

The essential accessories. To use the lathe you'll need a few accessories, Fig. 4. First on the list is a three-jaw chuck. This is a self-centering chuck, used to hold work in the headstock spindle, the part of the lathe that turns. You will probably use the three-jaw chuck to hold 99 percent of your work. The second most-needed item is the drill chuck. This usually stays on the tailstock spindle, and is used when performing drilling operations.

I use my four-jaw chuck infrequently, but when it's needed, nothing else will do. It allows square stock to be chucked and centered, and because each jaw moves independently it makes it possible to turn off-center work, such as cams. My four-jaw chuck also often serves as a nifty vise for the drill press.

Measuring tools. Prerequisites for any machine work are vernier calipers and a 1"-capacity micrometer. Since we're after precision with the lathe, we have to be able to accurately measure

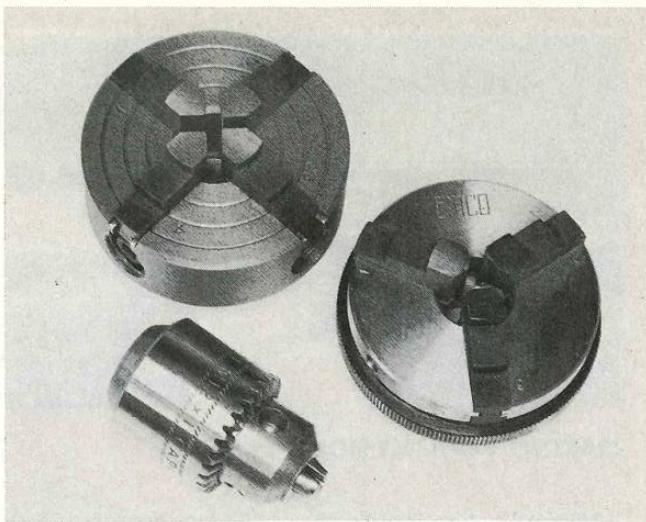
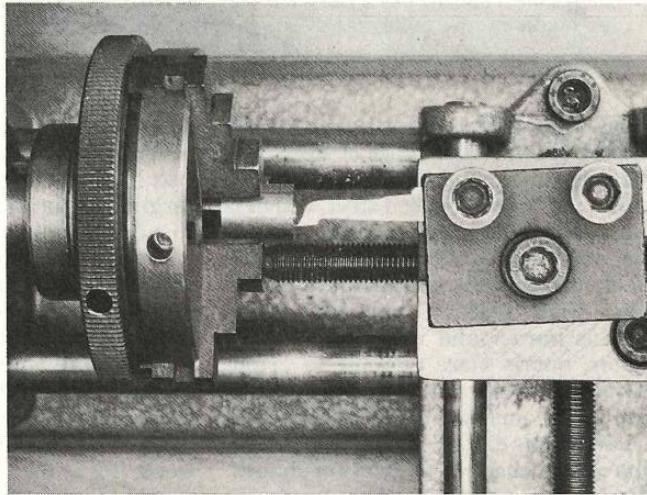
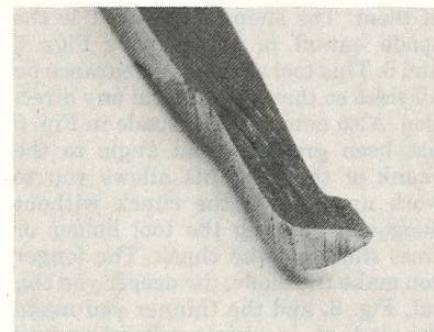


Fig. 4. Chucks are essential lathe accessories. From top left, a four-jaw independent chuck, three-jaw self-centering chuck, and drill chuck. Both of the large chucks have reversible jaws for holding large-diameter work.

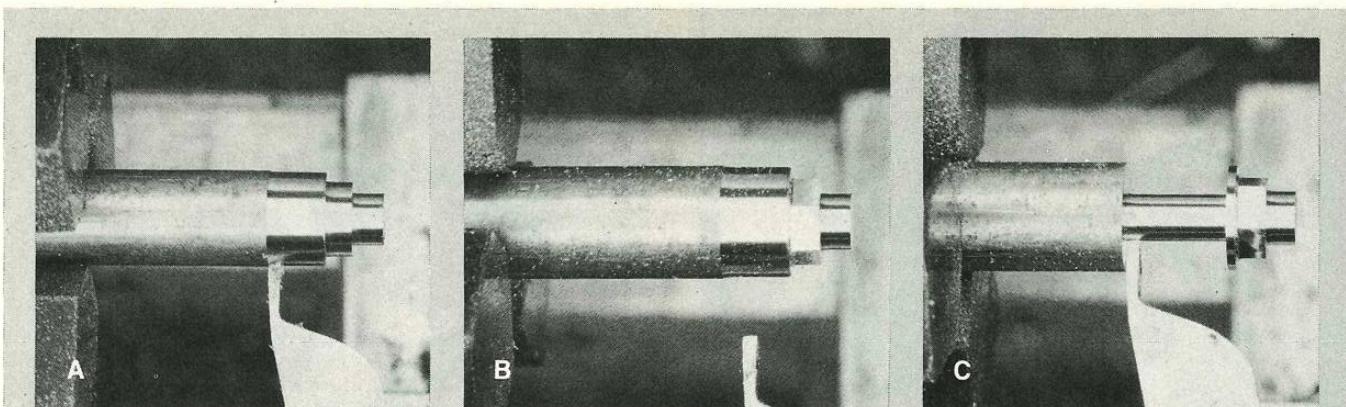


Figs. 7 and 8. Two inside-turning tools. Both cut by removing material as they are moved outward from the center of the work, toward the operator.



our work — "eyeballing it" isn't good enough. Relatively inexpensive tools will do the job; I discussed them in some detail in the January/February 1984 FSM.

Cutting tools. Lathe cutting tools are usually square steel bars ground to a



MAKING A DUMMY BOLT HEAD

Let's make one of those dummy bolt heads from brass. Start by chucking some stock a little larger in diameter than the size of the bolt, in this case .040". Use the three-jaw chuck and have the material project as little as possible from it to minimize flexing. Begin the turning operation and reduce an appropriate amount of the end of the stock to .040" in diameter (A).

Now stop the machine and reach for a flat jeweler's or Swiss pattern file. I usually use a No. 6 cut file. Line up one of the index marks on the pulley (see text) with the indicator on the

headstock. With your filing hand firmly supported on either the back of the cross slide or the lathe ways make a pass or two across the work with the file. Then, without moving your filing hand, rotate the pulley to the next index mark and file again, being careful not to change the angle of the file (B). Repeat until you have filed each flat — I count each out loud so I don't file the first flat twice.

Now start the lathe and cut the pin behind the bolt head. Begin the cut at a point which will leave the appropriate amount of head exposed when it is finally mounted — I usually cut to a depth of .020" to .025" for a length of about .075" (C). Finally, cut the bolt head and pin free.

point. Like drill bits, cutting tools are made from different types of steel. The most common and most suitable for modelwork is high-speed steel, which is hard enough for most modeling materials, yet easy to sharpen. High-speed steel cutting tools are also less brittle than other types. Cobalt high-speed steel is harder and will hold an edge better, but is more difficult to grind. Carbide cutters are very hard, but I find them unsuitable for modelwork. Cutting tools can be ground from blank bits or purchased in a variety of shapes. Even if you purchase pre-ground bits you'll have to sharpen them periodically, so you'll need to have the use of a grinder.

There are dozens of tool shapes, but I handle most turning jobs with only two of them. The shape I use most is the spade, cut-off, or parting tool, Figs. 5 and 6. This tool shape has clearance on all sides so that it can cut in any direction. Also note that the spade in Fig. 5 has been ground at an angle to the shank of the bit. This allows you to work up close to the chuck without danger of running the tool holder or cross slide into the chuck. The longer you make the blade, the deeper you can cut, Fig. 6, and the thinner you make the blade the easier it will cut toward the center. However, long, thin blades are prone to break, especially if you try full-depth cuts, feed the tool with too much force, or fail to keep it sharp.

The other tool I use is for inside turning, Figs. 7 and 8. The smaller you make the head of this tool the smaller the diameter you can work. I usually

take out as much material as I can with a drill, then finish up with the inside turning tool. It's also excellent for enlarging a hole and cutting a flat bottom in a drilled hole.

I make tools from $\frac{3}{16}$ "-square blanks, which means I have to add a shim under the tool in the Unimat tool holder to raise the cutting edge level with the center of the work, Fig. 9. Having the edge at the center height is important: If the tool is too high it won't cut as you move it in toward the center of the work; if it is too low it will leave material in the center when you cut across the face of the work.

If you read about lathe tools you'll come across the term "rake," the angle of the top surface of the tool bit. For material such as hard steel the tool must have rake, but for brass, aluminum, plastic, and soft steels the bit should have zero rake, that is, be flat. If you grind all your tools from the same size blanks and with zero rake, changing from one tool to another is simpler, since all tools will require the same shim to position the cutting edge at center.

Grind tool bits slowly, dipping the blank into cold water frequently. When the water evaporates from the bit remove it from the wheel and dip it in the water again. The thinner the tool the easier it is to heat up and burn the tip, so as you near the final shape, grind cautiously.

Keep your lathe tools sharp — sharp tools cut easily, dull ones lend themselves to being forced (and we all know what happens when you force things).

Materials for machining. The material you choose to machine is as important as the shape and sharpness of the cutting tools. Brass is the easiest material to turn, but be sure you obtain material meant for machining, not brass welding rod. Brass also is easy to solder, which is important because most finished parts are made from several smaller components. Other easy-to-machine materials are plastic, aluminum, and soft steel. I usually make plastic parts from Plexiglas rod, but styrene also machines well.

Aluminum turns well, but has a tendency to build up on the cutting tool. Aluminum is also next to impossible to solder, which is the reason I don't often make parts from it. I work brass and aluminum at high speed, plastic and steel at low speed.

A useful Unimat modification. Indexing the Unimat headstock spindle is a simple modification that greatly increases the machine's ease of operation. My detailing projects often require fasteners or connectors with hex heads. I make them by turning brass stock down to the maximum dimension, then filing the flat sides (see box, above). With an indexed spindle it's possible to perform the entire operation quickly and precisely, right in the lathe chuck.

Index the spindle by marking the pulley at the desired increments, then make a simple pointer, attach it to the headstock, and align it with the marks. I indexed my spindle in a slightly more elaborate manner by drilling shallow holes in the side of the pulley and mak-

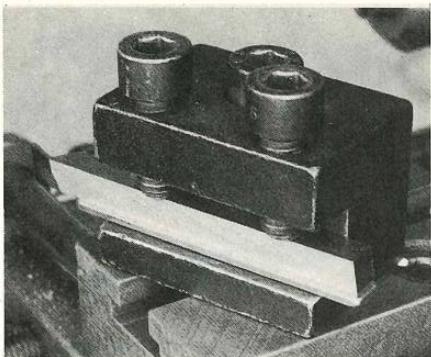


Fig. 9. A $\frac{3}{16}$ "-square tool bit mounted in the standard Unimat tool holder. Note the shim required under the bit to raise the cutting edge to the center of the work.

ing a spring-loaded detent for the headstock, Fig. 10. I divided the circumference of the pulley into 36 equal divisions, then highlighted the most-used increments of 4 and 6 with different colors of paint.

Drilling in the lathe. Drilling operations on the lathe seem a little strange at first, because the drill is stationary in the drill chuck while the work is turned, Fig. 11. Before drilling make sure that the stock is faced off cleanly — there should not be any small burrs in the center. To prevent the drill from wandering always use a center drill, Fig. 12, to spot the hole.

After spotting the hole, switch to a twist drill and feed it into the work slowly, withdrawing it periodically to clear the chips. When drilling with the smallest drills, Nos. 76 to 80, put a drop or two of light cutting oil on the drill and at the drilling site to facilitate chip clearance.

Drilling in a lathe has a different "feel" than drilling in a drill press, and it's easy to force a dull bit and break it. Drills should feed easily with even pressure. If you meet resistance back

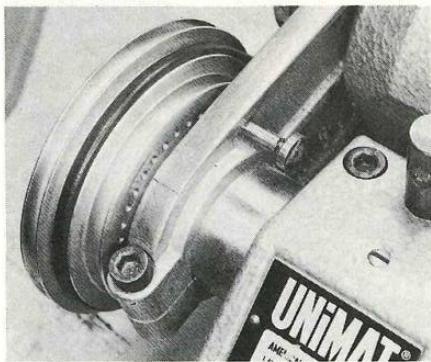


Fig. 10. Paul modified his Unimat SL by adding an indexing feature. He divided the inner face of the spindle pulley into 36 10-degree increments, then drilled shallow holes for each. The spring-loaded detent locks the spindle in position for filing bolt head faces or similar operations.

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