



## Duplication

I met Matthew Burak twenty years ago. He was making custom furniture in Vermont and was frustrated by the fact that the turned legs offered in catalogs were poorly designed.

After we started making legs from his designs, he got the idea that there was room in the marketplace for a company that could supply well designed legs in small quantities for furniture makers who did not have the ability to turn their own. For a few years, I made a variety of

legs for Matt, usually in quantities of 40 or more. Inevitably, Matt moved on to more mechanized production, and today Classic Designs by Matthew Burak has 30 employees and sells millions of dollars of legs each year. For me it was a period when I honed my skills at duplication, and what I learned has served me well in my spindle turning career.

In my classes, by far the most frequently asked question is, “How do I make four legs that look alike?” And the short answer is, “Make more than

four, and use the four that look the most alike.” This is good advice for a beginner who needs the practice. A set of legs is definitely a milestone in the beginner’s repertoire, especially anyone interested in furniture, yet none of the woodturning books in my library have a section on duplication.

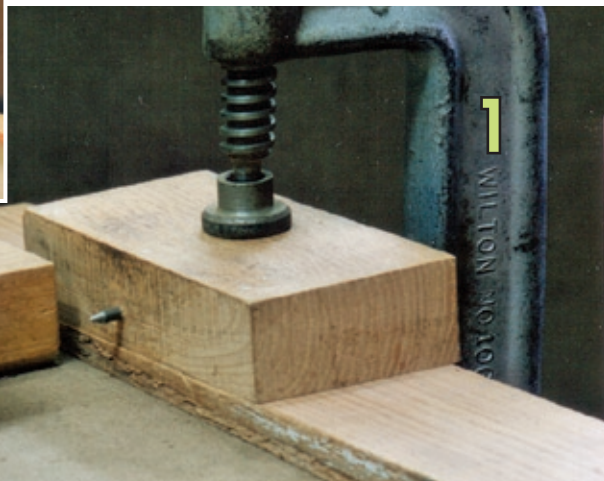
Before the turning can start, there are some marking jigs you can set up on your bench that speed things along and help avoid mistakes. These jigs take time to set up, but pay off on jobs of a dozen or more pieces.

The centering jig is shown in photo 1. Slide the work along the bench and fence and into the pin four times, rotating the work a quarter turn each time. A wedge under the pin block makes it easy to adjust for different stock sizes. The pin is actually a wood screw with its head sawn off and filed or ground to a point.

Mark the location of transition cuts with another bench mounted jig – photo 2. The handscrews themselves become the marking guide. Use a soft pencil, but sharpen it regularly to avoid the error caused by a rounded point.

After the pieces are centered and marked they are still not ready for the lathe. Now is the time to put the final finish on the square parts (pommels), because it is difficult to plane, scrape, or sand these surfaces later without damaging the turning. The transition marks show us where to work. After this step, the transition marks are all but gone. No problem, we have our jig to mark them again. This system may seem inefficient because it requires marking twice, but after much experimentation, I have found it is still the best way.

There are methods you may use for repetition work that you would not use for a short run, and mostly this involves setting up jigs. Perhaps more importantly, there is a momentum and



Centering Jig – Slide the work into the pin four times, making  $\frac{1}{4}$  turn each time.



**Transition Points Marking Jig** – The turning square is slightly thinner than the fence so it slips easily under the handscrews, which act as marking guides.

muscle memory that kicks in after about six or eight pieces, and you may never experience this if you are only making four. In any event, success depends on a combination of taking measurements in a few critical places, then depending on your powers of observation.

Learning how to visualize curves was covered in a previous article on the “S-curve”, and if you recall it involves paying attention to inflection point locations and end point angles. The inflection point is where the curve changes from convex to concave and the end point angle is simply the angle of a line tangent to the curve at its end point.

### Work in Short Steps

If there is one single piece of advice I can give you for successful duplication, it is to break up the job into many short operations. Do the first step, remove the workpiece and replace it with the next one. Working in this way there are fewer operations to memorize, fewer chisels out at one time, fewer calipers to use (reducing the chance of taking the wrong one and making an error), fewer changes of the tool rest and/or steady rest (one time for each step) and quicker development of “muscle memory”.

I see many people who hesitate to remove the workpiece in progress from the lathe, because they fear that they will never get it back in the center again. This causes them to attempt to turn the entire piece from start to finish in one step, which is definitely the hard way. This procedural error is brought about by faulty lathe centers.

### Repeatability

When machinists speak of repeatability, they mean the ability to remove a workpiece or tool from a chuck, vise, collet, or jig, and replace it, or an identical part, in exactly the same location again. This concept is of the utmost importance in the machine shop where making precision multiple parts is so often at hand. We can learn from these principles even for our wood lathe projects when we embark on the production of multiples. In this case the workholding jig is simply the pair of opposing lathe centers.

While working in short steps, it may be necessary to remove and replace the workpiece five or more times in the process. Of course this requires that your centers be well tuned. It should be possible to remove, replace, or turn end-for-end an infinite number of times and have the workpiece return to the exact center every time without fuss and without fail. With a spring center point, it is possible to do this without stopping the spindle. But whatever kind of centers you have, you must be able to get “repeatability” or relocation of concentricity every time the work is removed and replaced. If you do not have this, then you are operating at a great disadvantage, and you should fix your centers.

The only exceptions to the “working in steps” method is with very heavy workpieces, such as porch posts, or hollow columns where a single set of end plugs are used.

### Planning Steps to Minimize Vibration

Working in steps does not mean you should start at one end and work toward the other. Very often you need to start in the middle. In most furniture work, workpiece vibration is a problem. A steady rest is frequently necessary, and this will be covered in the next article. Regardless of the steady rest, if there are details near the middle, start there, because this is where the amplitude of workpiece vibration will be the greatest. Leave the foot for last, because you will not experience much vibration in that area.

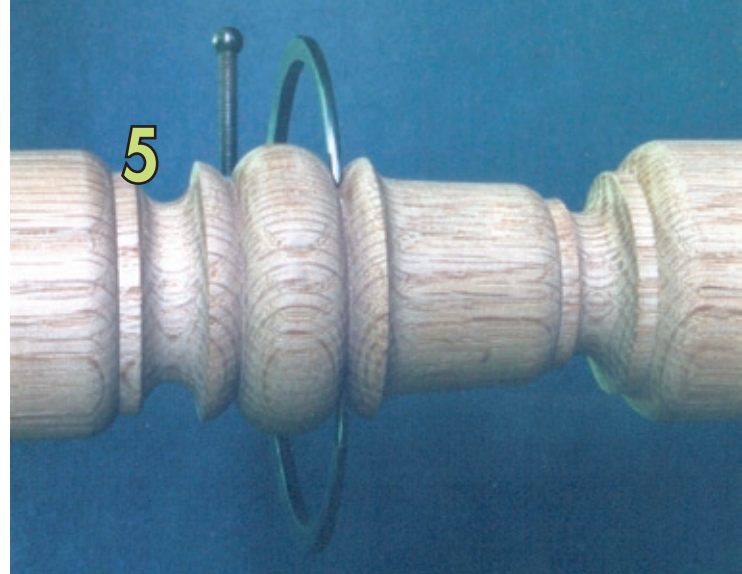
If you only have four legs to make you can mark out directly from the drawing as shown in my last article (*Drafting for Woodturning*). If you have a dozen or more, I suggest you use a marking stick. This has notches in the edge to locate the pencil for quick and accurate marking of the work in motion – photo 3. Make the notches with a triangular file.

You should decide how many steps the job requires. Here are some guidelines. It is practical to make transition cuts, rough out and marking in a single step. This step requires two chisels (skew and spindle roughing gouge), a pencil and marking stick. Next proceed to the groups of details, and these require two or three steps on average. During each of these steps you would commonly have two or three chisels, and one or two calipers.

As you approach each group of details, you will have two or three lines to make starting cuts. Simply cut in on



**Marking after Rough Out** – Hold the marking stick against the rotating work, and use a pencil in each of the notches.



**Calipers** – Hold the parting tool in one hand and the calipers in the other. Be prepared to stop as soon as the calipers fall through.

**Vee-Calipers** – Special calipers have tips shaped to measure a vee.

these lines with a parting tool, or make a vee cut with a skew chisel, and the axial measurements are thus established. Usually these are made with a parting tool, because you can slide the caliper in the parting tool slot while the cut is being made. This is an essential skill to have. It requires holding the parting tool in one hand, and the caliper in the other – photo 4. It is much harder to measure the diameter of a vee cut, and should not be attempted while the work is rotating, as the calipers may catch. Calipers for measuring the diameter of a vee have the tips ground to a narrow edge, but not quite to a sharp point – photo 5.

not need very many measured points to achieve consistency. The most important diameter is at the bottom of the coves, because variations here are noticeable even at a distance.

Another FAQ is, “Do you use templates?” I only use templates in two situations: straight lines (for cylinders and cones) and circles (for balls). I think it’s pretty simple to use a straight edge, usually wood, to assist in making a straight line. I find this method works well on every scale, from porch columns to pool cues. Making and using ball templates is worthy of a separate article.



Duplication requires the establishment of certain points in the correct measured location. After that, you simply “connect the dots”. There are many variations of this method, but in general I think you will find that you do

After the turning is complete, sanding is the final step. Remove the tool rest with its base, and the steady rest completely off the lathe bed, so they will not interfere with your hands, nor do you want sanding grit in any of that mechanism. ■

**Mahogany Ball Finials** – 28” high furlong markers for Belmont Park race track (Belmont Stakes) received gold leaf.

