Segmented Turning

Swirling patterns by cutting and reassembling a single board

by Michael Shuler

I've always been fascinated with turned forms, even before I knew what a lathe was. When I was 14 years old, I made miniatures on a makeshift lathe from birch dowels. A pocketknife was my only tool, but I was turning wood, and that was all that mattered. Later, in high school, I turned candlesticks, then chair legs, lamps and other creations, searching for a way to make the lathe a tool for artistic expression. Then one winter, sick in bed with a cold. I read some back issues of a woodworking magazine a friend had given me and discovered the work of turning greats like Frank Knox and Ed Moulthrop, as well as the wealth of different things the lathe could do, including segmented turning.

Segmented work and the design possibilities it offered met my needs for artistic expression, but most segmented vessels tended toward strong contrasts, with some makers using half a dozen or more different woods in a single piece to achieve a colorful effect. I wanted to see what could be done by segmenting a single kind of wood in a bowl. After experimenting with different geometric patterns and methods of gluing up segments, I discovered a way to create a striking look in a turned vessel that didn't require the use of several colored woods to achieve pattern and contrast.

I start with a single board, take it apart, reorganize the figure and put it back together in the form of a bowl. The pattern that's formed by the grain of the reassembled board flows almost continuously through the bowl from top to bottom. The segments grow proportionally smaller; all the way from the rim down to the base. Inside, the bowl, the wedge-shape segments meet at their points, forming a radial geometric pattern. The combination of the decreasing size of segments and the grain of the wood makes looking into some of these bowls feel like you're someplace in the sky looking down at a hurricane or looking into the iris of an eye. Before going through the specific steps involved in making bowls like the ones pictured above, I'll generally discuss how this segmentation method works and how the designs develop.

Segmentation strategy—When finished, one of the large bowls looks as if it's been tediously glued up from hundreds of separate pieces, but these pieces aren't cut and glued up individually. The process revolves around the cutting of thinly tapered wedges that are glued up into discs: a large one for the body of the bowl and a smaller one for the base. For the larger disc, wedges are first glued up into two half discs, which are bandsawn apart into concentric half rings. Then the matching pairs of half rings are glued together; these rings are stacked atop the base disc and glued into a cone-shape bowl blank. The vessel is then turned to final form and finished.

Photo this page: Michele Russell Slavinsky, all other photos Susan Helgeson

Wedges are the bowl's basic building blocks and provide an economical way to glue up the large number of pieces needed for a complex segmented pattern. Although any number of wedges may be used for the body and base discs, I've settled on 104, because it results in segments that are about ⅜ in. wide on the outer rim of a 12-in. bowl, an arrangement pleasing to my eyes. Also, 104 is evenly divisible by many other numbers: 52, 26, 13, 8. Divisibility isn't important for your first bowl, but it allows me to divide the rings into sections and play with the order of wedges in these sections to get special grain effects and contrasts. I typically use figured woods or exotics, but even plain-grained woods become attractive when segmented by this method.

Cutting the wedges—The first step is to cut a board into the two kinds of wedges needed for each bowl. The wedges that make up the large disc for the body are crosscut, so the figure of the side grain shows on the bowl's sides. The wedges for the base disc are ripcut, because these must taper to a pinpoint and converge at the center of the bowl. It's practically impossible to cut these fine points across the grain.

If you start with a board that's ¾x5⅜x60 in., you can produce a large and a small bowl at the same time. The disc glued up from the crosscut wedges yields the body of a 12-in.-dia. bowl and part of a 4½-in.-dia. bowl. Two base discs must be made from ripcut wedges—one for each bowl. Mark a line on one side of the board, to help later in orienting the wedges in the large disc. Crosscut the 5-ft. length to get two 18-in. lengths for the body, four 2½-in.-long crosscut strips for the base of the larger bowl and two 1½-in.-long strips for the base of the smaller bowl.

To cut the wedges, I built a special sliding taper jig that rides in the tablesaw's miter-gauge slots. The jig has two stations: one for crosscut wedges and the other for ripcut wedges. An adjustable fence and two stops reference the stock for the acute-angle cuts. Two DeStaCo quick-action clamps (one for each wedge-cutting station) clamp the board directly over the blade to ensure that the board is perfectly flat and doesn't budge during the cut (see the photo at the top of this page). These clamps are available from Woodcraft Supply, 41 Atlantic Ave., Box 4000, Woburn, Mass. 01888; (800) 225-1153. An 80-tooth, triple-chip-grind (TCG) carbide blade leaves a smooth surface on each wedge that's ready for gluing. The sawblade passes through a block fastened to each clamp, which helps keep splintering on top of the cut to a minimum.

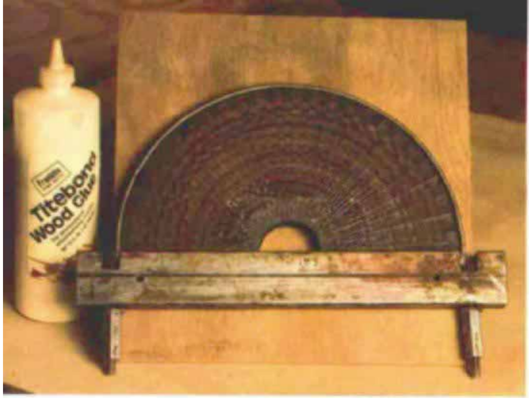
Before cutting begins, carefully adjust the position of the stops and fence so the crosscut station will yield 5⅜-in.-long crosscut wedges that have a .062-in. taper. This means that for the large bowl, the body wedges taper from .37 in. on the fat end to .037 on the skinny end. Because the ripcut station uses the same fence, the wedges for the base have the same taper as the body wedges. However, a spacer screwed to the fence makes it possible for the blade to take thinner cuts: The 2½-in.-long ripcut wedges are .15 in. on the fat end, tapering to a sharp point at the other end. Check the wedges with a micrometer to verify the measurements and tweak the fence's final position accordingly. Also, make sure the sawblade is dead square to the jig. These steps are necessary if wedges are to glue up into a disc without gaps in any of its 104 seams.

Cut the crosscut wedges first, placing the end of the board against the fence and clamping it down. After cutting off a wedge, slide the jig back, well away from the blade, before unclamping and removing the wedge. Flip the board edge for edge before each successive cut, and arrange the wedges on a separate table in a circle, with the same side up as they came off the saw. I usually count the number cut and mark the halfway point of the disc with a strip of paper. When all 104 wedges are cut, set the dry-assembled disc aside.

Above: A sliding jig on the tablesaw makes both crosscut and ripcut wedges—the basic building blocks for the author's segmented bowls. Two quick-action clamps hold the stock securely during cutting to help maintain the high accuracy required for flawless glue-ups. Below: The wedges for the small disc, which makes the base of the bowl, are glued up using a band clamp, like the ones used in plumbing. While the base wedges are assembled in random order, the body wedges are left dry-assembled in the order they came off the board (seen here in the background) before glue-up.

Cut the ripcut wedges for the base the same way as described above, only using the second station on the sliding jig. These wedges don't have to be as carefully ordered and oriented as the ones for the body, so I just cut them off and collect the 104 I need in a coffee can. The base for the small bowl only needs 20 wedges, because it's much smaller; these are cut as described earlier, only using another sliding taper jig made specifically for this operation set to cut at 18°

Gluing up the discs—Instead of trying to glue up all the wedges for a bowl in one step, glue up a small disc for the base, then glue up two half discs for the body. The disc for the base is glued up in a band clamp, like the hose clamps sold in hardware stores for plumbing or exhaust systems (see the photo above). Buttering one side of each ripcut wedge liberally with yellow glue, assemble them in the clamp in a random order, aligning the points in the center as you go. The points pretty much align themselves, but you'll have to squish the wedges around occasionally to get the points to meet perfectly in the center. When all 104 wedges are in place, tighten the clamp with a box wrench until the joints are snug. Be warned that this glue-up is hectic: You only have five or 10 minutes before the glue sets, and you won't know how the disc



Above: The wedges for the body of the bowl are glued into half discs in a special clamping jig made by the author. The steel clamping strap is tightened with a wrench to close the joints between all the wedges. Right: With the table set to 45°, half rings are bandsawn from the half discs following concentric lines scribed on earlier with a large pair of dividers. Below: After matching pairs of half rings are glued together, the seven largest rings are stacked to form the bowl body. The pattern of segmentation is changed by rotating the rings in relation to each other.

Above: The ring layers of the bowl are glued up, two at a time, in a press welded up from rectangular steel tubing. Here, the author tightens the press screw, which bears on a waste block glued to the bowl's base disc. Right: With, the lathe rotating at 1,200 RPM, the author turns the outside of his segmented bowl to final shape. When the walls approach ⅛ in. to 1/16 in. thickness, he supports the rim of the bowl with three fingers, to keep the cut from chattering.

will come out until after the glue-up. Any small error in wedge angle is multiplied 104 times, so the wedges need to be extremely accurate to form a perfect disc. But don't be discouraged if your discs don't come out perfectly: Keep an extra length of bowl stock on hand, in case you need to make another base.

I glue the half discs using a clamping jig I made from a ⅛-in. by 1-in. steel strap with a short section of threaded rod welded to each end. The rods are slipped through holes in a 1x2x15-in. rectangular steel tube that's slotted to allow clearance for the ends of the strap (see the top, left photo on the facing page). The gluing operation is simple, but it must be done quickly before the glue sets up. One side of each wedge is buttered as before and placed in the clamping jig in the same order and orientation as it was dry-assembled. When all 52 wedges are in the jig, the strap is tightened by torquing nuts on the threaded rods with a box wrench. Two small steel plates are bolted to either side of the half disc through the hole in the middle, to keep the center area flat during tightening. Snug up the strap a little, bolt on the plate and then finish tightening the strap. Considerable force will be needed to get the joints between all the wedges tight. Again, this is a hectic process, but it shouldn't take more than five minutes from start to finish.

Wait a couple of days for the glue to cure, and carefully break the discs out of their steel clamps by tapping the edges of the straps with a hammer. Waxing the steel ahead of time helps keep the glue from sticking. Face off the base discs on a three-jaw chuck on the lathe, making both sides flat and true. Flatten both sides of the two half discs using a ¾-in. straight bit in a router-rail jig, similar to the one described by Giles Gilson in *FWW Techniques 4,* p. 52. The jig supports the router a fixed distance above a table that holds the half disc in place. It takes many passes with the router to surface the half disc, sliding the router both sideways and front to back on the rails, but the jig brings the thickness of the two halves to within .003 in. of each other. Flatten one side of each disc, then the other, removing about 1⁄16 in. of material per side to wind up with a final thickness of about ⅝ in. An overarm router or abrasive planer can also do the surfacing, provided both half discs are made uniform in thickness.

Next, lay the two half discs on a scrap of plywood so they form a circle, and match up the grain so the wedges are in the same contınous order as they came off the saw. Tape the outer edges to the plywood so the discs can't shift, and drive a finish nail into the plywood at the middle of the disc so the end of the nail sticks up about ½ in. Now place the point of a divider in the dimple in the nail's head and scribe a series of concentric circles on the discs that are ⅝ in. apart (the same distance apart as the thickness of the disc). Starting with the largest circle just at the outer rim, you should be able to scribe nine or 10 circles. Remove the half discs from the plywood and take them to the bandsaw. With the bandsaw table set to 45°, saw each half disc into a series of half rings, following the scribed lines. Next, true up the ends of each half ring on the disc sander—just a touch—until they are clean of glue and square.

Glue the two halves of each ring together by taping them down to a flat surface and using the tape to keep the mating edges pressed together. A slab of Corian works well as a gluing surface, but any really flat surface that glue doesn't stick to will suffice. Once the rings have dried, do a little touch-up sanding to remove any glue squeeze-out and to ensure ring flatness. For this, I use another slab of Corian on which I mount four sheets of 60-grit, closed-coat, silicone-carbide paper. With a light touch, I move each disc back and forth on the sandpaper, occasionally rotating it.

Gluing up the rings—All the rings from the large disc, except the smallest one, are stacked on top of the 5-in. base disc to form the body of the large bowl. But before the base disc is ready, it needs to have a ring cut off its outer edge for the smaller bowl. Take the faced-off disc, and with a pair of dividers, score about a 3½-in.-dia. mark on one side. Remount the disc on the three-jaw chuck, and with a narrow parting tool held at 45° to the face of the disc, make a plunge cut at the line and pop out the base of the large bowl. The ring that's left over, combined with the smallest ring from the large disc and the extra, small base disc make up the small bowl.

Back to the large bowl: As you stack the rings into a cone, you'll notice the seam on each ring where the grain in the first wedge meets the grain in the 104th wedge. By rotating each ring slightly and staggering the seam a half a segment between layers, like rows of bricks in a wall, the segments become more visually individual and the bowl's grain pattern is accentuated. To de-emphasize the seam and to get a bowl with an even grain pattern all the way around, start with a board that has grain that's similar at both ends.

To glue up the large bowl, I glue the layers of rings two at a time, using a special press frame I made by mounting a square-threaded screw in a frame welded from the same rectangular steel tubing used for the half-disc clamping jig. First, glue the base disc to a thick waste block, clamping the assembly in the press as shown in the lower, left photo on the facing page. Glue on the layers of rings two at a time, truing the face of the outermost ring after each glue-up. Do this by mounting the waste block on a screw center chucked in the lathe, taking a very light cut. Truing overcomes cumulative errors in the flatness of the rings and keeps the glue joints between layers perfect. The small bowl is glued up one layer at a time, truing faces for flatness between layers.

Turning the bowl—All that remains is to turn the bowl to final shape on the lathe. Remount the assembled bowl to the screw center and rough-turn the outside profile first. Then turn the inside to final shape and return to the outside for the final turning. I like my bowls to be featherlight, so I typically turn the walls down to ⅛ in. to 1⁄16 in. thick. When the walls start to get really thin, I turn with my left hand's thumb (I'm right-handed), guiding the tool while three fingers ride on the outside of the rotating bowl, steadying the rim. Cloth tape on my fingers protects them from friction burns. About 1,200 RPM is a good speed for doing the final turning.

Because there are so many gluelines in these segmented bowls, turning them tends to dull the edges of most lathe tools quickly. I used to turn with a gouge designed by Jerry Glaser made from A-11 steel, but now I find his micro-grain, carbide-tipped gouge tools to be superior (available from Glaser Engineering Co. Inc., 1661 E. 28th St., Signal Hill, Calif. 90806; 213-426-1722). To prevent turner's elbow (a turner's version of tennis elbow), Glaser recommends weighting the hollow handle of lathe turning tools with about 10 oz. of #9 lead bird shot, which helps absorb arm-fatiguing vibrations.

Sand the outside and inside of each bowl down to 320-grit paper, with the bowl on the lathe. Then, French polish the bowl by applying thin coats of shellac while the bowl's still on the lathe (not spinning). When the finish dries, reverse the bowl on the lathe to turn the foot. I mount the bowl on a special chuck consisting of a rounded cone that bears against the inside while a collar presses against the bowl's outside. The collar has three bolts around it that screw into a faceplate that mounts on the lathe. The bowl can be adjusted in this collar, to be accurately recentered within .005 in., something I verify with a dial indicator. To complete the bowl, part the waste block from the bottom and turn and finish the foot. □

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