Building a Chair, Arts-and-Crafts Style

Joinery details make this chair strong and handsome

by Rex Alexander

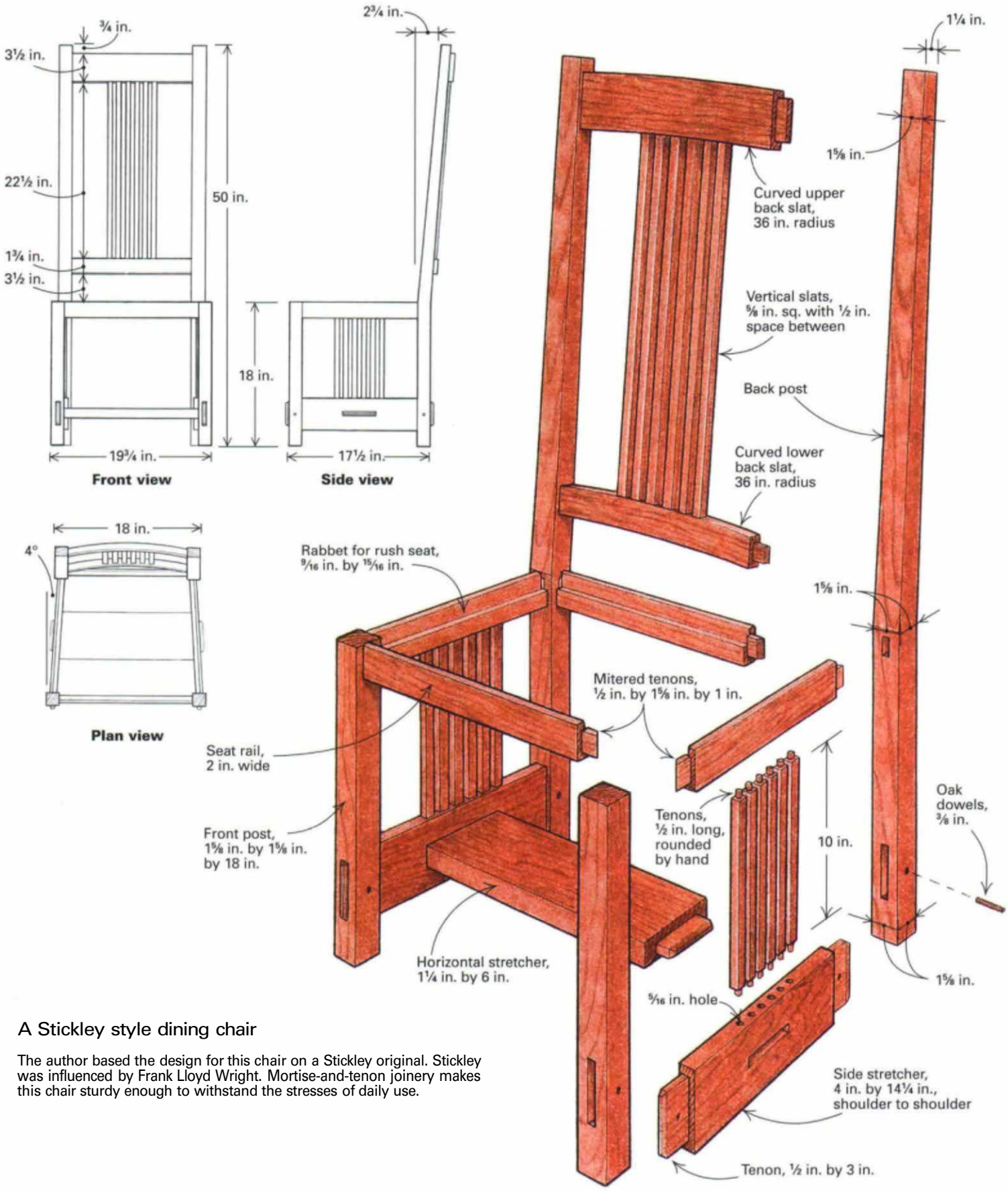
When the curator of Dennos Museum in Traverse City, Mich., asked me to design and build some Arts-and-Crafts style furniture for an upcoming exhibit, I jumped at the chance. We agreed that I'd look for a customer who would buy the furniture after the exhibit. I approached Jay and Sue Wisniewski, who have been steady clients on a number of projects. They were excited by the idea.

I immediately ordered more than $100 worth of books by or about Stickley (see the further reading box on p. 47), Greene and Greene, Roycroft and others. These books gave me a feel for designs of this period. And they told me what type of wood to use and how it should be cut and finished. I studied detailed drawings and proportions to help with the design.

The deal with the museum didn't work out, but my clients gave me the go ahead for a dining table and some chairs. We still had to agree on a final design, and it had to be compatible with a reproduction Frank Lloyd Wright chandelier they had already bought for the dining room.

I learned that Gustav Stickley, in designing his No. 384 chair, was influenced by Wright's work. I knew I had found the inspiration to my design problems. It was this chair (first built in 1905), with its rush seat and vertical slats on both the sides and the back, that I drew upon to arrive at the

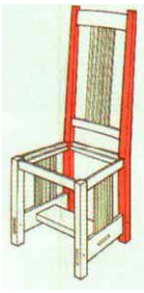
Photos: William Duckworth



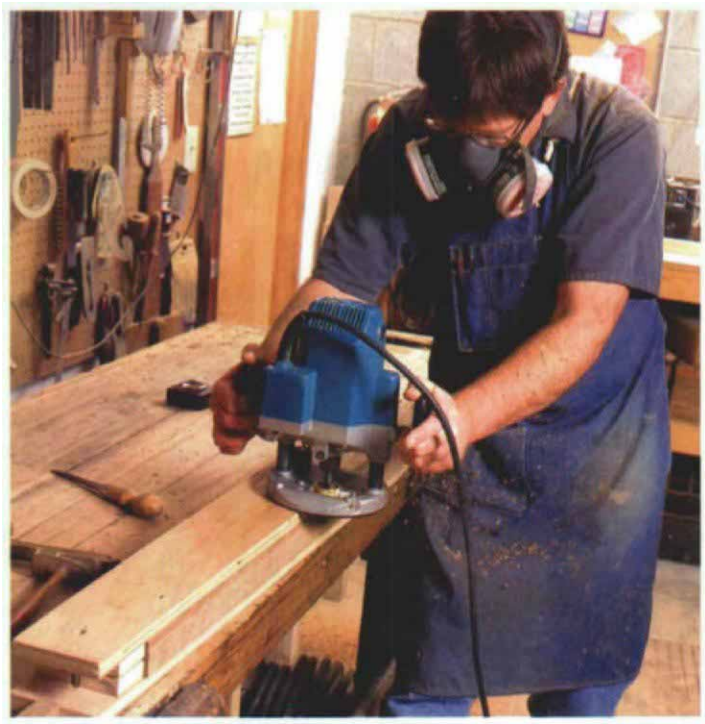
A Stickley style dining chair

The author based the design for this chair on a Stickley original. Stickley was influenced by Frank Lloyd Wright. Mortise-and-tenon joinery makes this chair sturdy enough to withstand the stresses of daily use.

Drawings: Heather Lambert



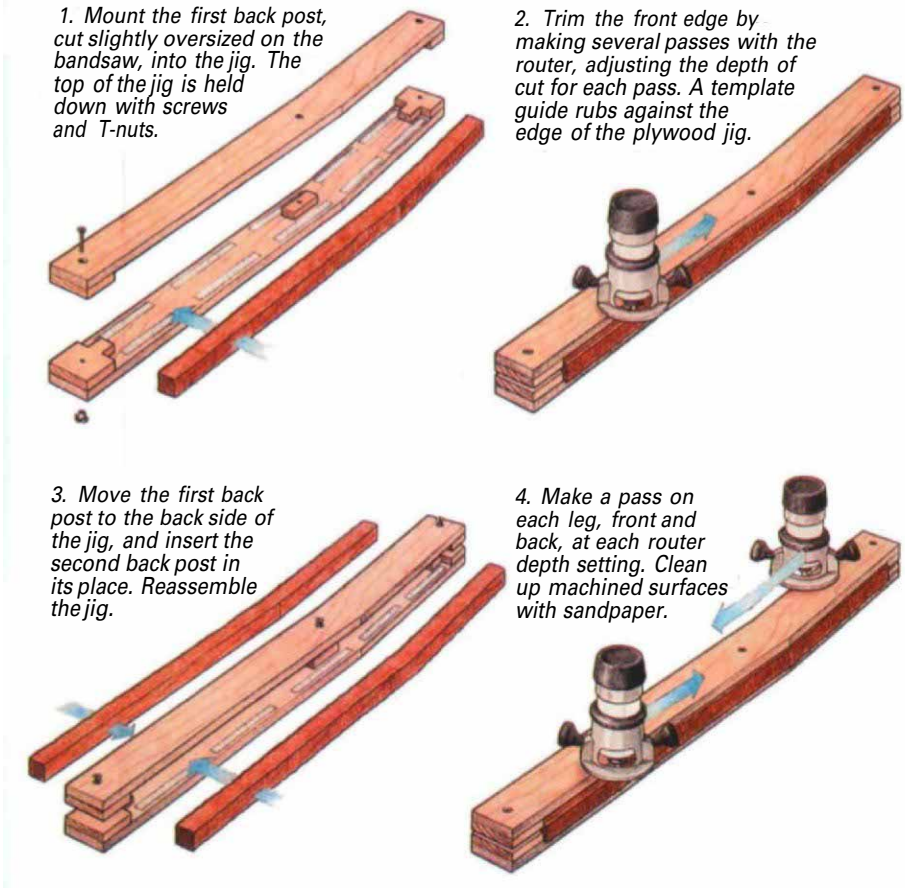
Routing back posts



A plywood jig for shaping the back posts. *A little time invested in this jig guaranteed that all back posts would be the same size and shape. A shaper with a rub collar works as well as a router.*

A jig for trimming the back posts to size and shape

This jig is sized to handle two legs at a time. After cutting the profile for the front of the leg, the author moves the leg to the back of the jig and finishes the profile.



final design for these chairs. The chairs are shown in the photo on p. 42.

Solve problems by building a prototype

I developed a scale drawing of the chair to help determine a materials list (see the drawing on p. 43). For several reasons, I also decided to build a prototype: the joinery is complicated, I had to buy tooling and make jigs, and I wanted to be sure my clients were satisfied with the comfort of this chair. Also, I could use the prototype to verify the proportions and to resolve some of the details of the frame and the fit of the inset rush seat.

Building six chairs is a small production run. A prototype helped me to organize each step and avoid many construction problems. I made the prototype with poplar scraps accumulated from other jobs and assembled it without glue so it could be taken apart. A mistake with poplar at this stage would not be too costly.

Once I was happy with the prototype, I took it apart and measured each piece for a final materials list. Each chair was made from front and back posts, seat rails, side stretchers, a horizontal stretcher, curved upper and lower back slats and vertical slats. There were 35 pans in all, including four oak dowels to pin the stretchers to the front and back posts.

Machining the parts

All the parts started out as 8/4 quartersawn white oak. I could resaw the 2-in.-thick material into ⅞-in. seat rails, stretchers, and slats and still have plenty of material for the 1⅝-in.-sq. front and back posts. For a table, six side chairs and two arm chairs, I ordered 400 bd. ft. I wanted heavily rayed pieces for the sides of the front and back posts, the bottom side stretchers and the curved upper and lower back slats. I chose lightly figured white oak for the seat rails.

Except for the back posts, I rough-cut all the chair parts on a tablesaw and then cleaned them up with a jointer and a planer. Later, after making tenons, I cut out the curved upper and lower back slats on the bandsaw (see the top photo on the facing page), marked with a ¼-in. plywood template made to a 36 in. radius. I cleaned up the bandsaw marks with a spokeshave and a compass plane.

I made a special jig to clean up the back posts after they had been rough-cut to size on the bandsaw (see the photo and drawing at left). The jig is based on one in *Tage*

Frid Teaches Woodworking: Furniture making (The Taunton Press, 1985).

Two legs are sandwiched between two pieces of birch plywood. One side of the jig is shaped for the outside cut and the other for the inside cut. Support blocks on each end and one in the middle of the jig register the pieces to be cut. Machine screws through one side thread into T-nuts in the other side and hold the legs firmly in place. I applied strips of self-adhesive sandpaper to the inside of each piece of the plywood jig to keep the legs from slipping.

I trimmed the legs to size with a 3 hp router equipped with a ⅝-in. template guide and a 4-in. solid carbide up-cut spiral bit. I cut the front of each leg first and then moved it to the other side of the jig against the registration blocks. You can avoid too much stress on the bit and prevent tearout by making several passes with the router, adjusting the depth of cut a little at a time.

Cutting the mortises

All the chair parts except for the vertical slats are connected with ½-in. mortise-and-tenon joints. Years ago, I developed a simple jig to cut the mortises for a batch of screen doors, and I was able to use it again for this project (see photos 1-4 on pp. 46-47). This jig is made of ¾-in. plywood with sides that act as a carriage for the router. A ⅝-in. slot runs down the middle of the jig, stopping 2 in. from each end. Two adjustable stop blocks sit square in the carriage and control the length of the mortise.

I held the piece to be mortised in the jig by clamping it to the underside, below the ⅝-in. slot. I used my 3 hp router with a ½–in. by 4-in. solid carbide up-cut spiral bit, adjusting the depth of cut with stops on the router. Even with the jig, this was a time-consuming process.

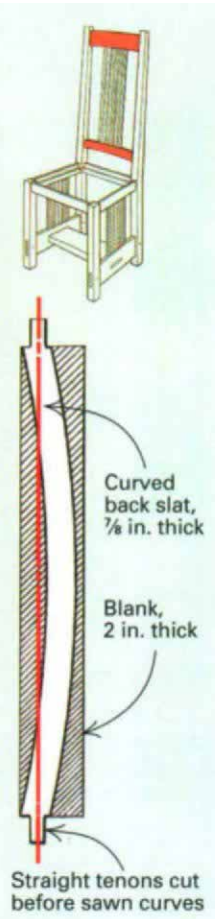
Router bits don't cut square-cornered mortises. Rather than cleaning out all the corners by hand, I devised a method that works really well. I chucked a Lie-Nielsen corner chisel into my drill press (make sure it's unplugged). I clamped an adjustable fence to the drill-press table to rest the stock against and squared the chisel to the fence. The rack-and-pinion force of the drill press pared a clean, sharp corner in the mortise.

Cut the tenons on the tablesaw

All the Stickley chairs that I've seen are wider in front than in back. The side chair in Gustav Stickley's *Making Authentic*

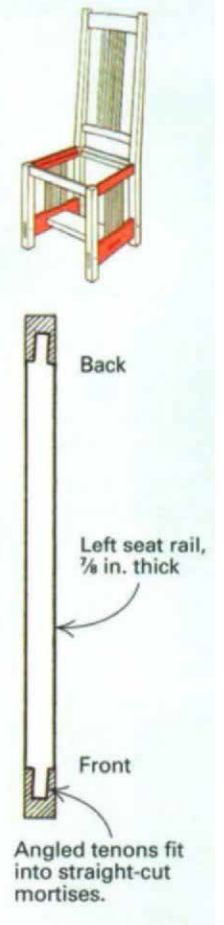
Cutting curved back slats

Cutting the curved back slats—*Convex and concave cuts from 8/4 lumber yielded ⅞-in-thick slats, after the surfaces were scraped clean. These slats are the only curved pieces of the chair.*



Cutting angled tenons

Double-blade tenoning on the tablesaw—*With a custom-made jig, the author cut angled tenons for the side stretchers and side seat rails. Sawblades were set at a 4° pitch to the surface of the saw table and separated by a ½-in. spacer.*



A jig for routing mortises

1. Movable base supports make adjustments easy. *Built for mortising a set of doors, this jig can be adjusted to cut mortises in stock of different widths.*

2. Use chair part to set jig. *After securing one base piece, the author snugs the other one against a side stretcher and screws it in place.*

3. Stop blocks for the router *determine the length of the mortise cuts and keep them all consistent. Pencil lines help to align the stock.*

Craftsman Furniture narrows toward the back by 1¾ in, I built these chairs to that dimension—19¾ in. wide at the front and 18 in. wide at the back, with a seat depth of 17½ in. Because of this design detail, either the mortises or the tenons have to be angled on the seat rails and the stretchers. I decided it was easier to angle the tenons. I used the tenoning jig shown in the bottom photo on p. 45.

By drawing the seat-plan view to fall size on a scrap of plywood, I determined that the front and back of the chair related to the sides by 4° off square, or 86°, so I set the sawblade to that angle. To cut the cheeks of the tenons on the seat rails and bottom stretchers, I used two blades of a dado set with a ½–in. spacer between them. You can adjust the height of the blades off the table to account for tenons of different length.

After cutting all the angled tenons, I straightened the blade mechanism back to 90° to cut all the cheeks for the horizontal stretcher, front and back seat rails, and the upper and lower back slats. The tenons for all these pieces are straight—parallel to the pieces themselves.

Next I removed one of the dado blades from the table and set the remaining blade at 4° to cut half the shoulders of the angled tenons. I used a miter gauge with a positive stop. I lowered the blade, still set at 4°, and moved the miter gauge to the other slot to make the shoulder cuts on the other side.

Then I straightened the blade and adjusted the height for cutting the shoulders of the rest of the tenons, except the horizontal stretcher. That piece has straight tenons, but the ends of the piece are cut to 86° to follow the shape of the chair seat. So the shoulder cuts for the horizontal stretcher are cut at 86° with the miter gauge.

The tenons for all the ⅝-in.-sq. vertical slats were simple to make. To get ⅝-in.-sq. tenons, I cut all four sides at each end with a dado blade. A wooden backer board mounted with double-faced tape held each piece firmly against the miter gauge. I cut each piece slowly to avoid tearout on the corners of the slats. I used a sharp knife to carve the tenons down to a dowel shape to fit ⅝-in. holes drilled in the back slats, the side stretchers and the seat rails.

Fine-tune and dry-fit the parts

Before final assembly with glue, I always like to check the joinery by dry-fitting the parts (see the photo at right on the facing page). It helps me avoid surprises when I can least afford them. I check the fit of every piece and make adjustments as necessary with a chisel or a shoulder plane.

I marked the through-dowel pins for the lower stretchers (⅜ in. dia.) with a homemade gauge at 4 in. up from the bottom of each post. I drilled halfway in from either side with a Forstner bit in the drill press. Scraping and sanding removed all the milling marks and provided a smooth surface for finishing. After a satisfactory dry-fit, I completely disassembled the chair and stained all the parts.

You have to think through the order in which the pieces of a chair go together, but it's really pretty simple. Vertical slats went in first, glued into both the back slats and the side-stretcher and seat-rail assemblies. I assembled whole sides by adding the front and back posts and clamped them to dry overnight. The next day, I put two sides together with the horizontal stretcher, the front and back seat rails, and the back-slat assembly to make a complete chair frame. I let any glue squeeze-out around the joints cure partially before removing the glue with a sharp chisel.

After the glue had cured, I removed the clamps and glued and screwed ⅞-in.-thick corner blocks to the inside bottom of the chair. These add stability to the frame and support the inset rush seat. I go over the chair completely with 400-grit wet-or-dry sandpaper and follow that with a good rubdown using #0000 steel wool.

A finish from Sam Maloof

Oil on wood is really a beautiful finish, bringing out a depth that looks superior to any film finish. But on furniture and cabi-

4. *The depth of the mortise* *is controlled by the plunge mechanism on the router. The author secures stock to the jig with C-clamps.*

Dry-assemble all the pieces. *This dress rehearsal for the final assembly helps the author avoid the costly mistake of glued joints that don't fit.*

nets that come into contact with water, I had been hesitant to use such a finish until I read about Sam Maloof's three-part formula. He mixes equal parts of raw rung oil, boiled linseed oil and polyurethane. The polyurethane prevents this finish from showing water spots.

With the temperature about 50° to 60°F, I sprayed this concoction on the chairs and let it soak in for 10 to 20 minutes. After that, I wiped it off with a rag, using a circular motion. I repeated this procedure two times, letting each coat dry a few days. Then I gave all the surfaces a final buff with #0000 steel wool.

The Maloof technique also calls for another mixture: equal parts tung oil, boiled linseed oil and beeswax. To make this, I melted some beeswax in a double boiler on the stove. While that was still in liquid form, I added the tung and linseed oils, mixing them together. When this mixture cools to a paste, it's easy to apply with a cotton cloth, rubbing in a circular motion. I applied three coats to the chairs. The beeswax gave this finish a nice, satiny glow.

The frame and fiber rush seat

Unlike most chairs made with a rush seat, this one has a separate frame screwed into place after it was woven. Fiber rush exerts a tremendous amount of pressure on a frame, so I decided to use plywood, figuring the multiple alternating layers would hold up better over time. A ¾-in. piece of plywood, cut out in the middle to make a 1½-in.-wide frame, worked best.

To learn how to weave a rush fiber seat, I consulted an article in *FWW#85* (p. 51). As a source book for materials, *The Carter's Handbook* by Bruce W. Miller and Jim Widess came in handy. It is published by Lark Books, 50 College St., Asheville, NC 28801, and it's available from Woodcraft Supply (800) 542-9115 or The Woodworkers' Store (800) 279-4441. The weaving process was time-consuming. Each seat took about a day to complete.

Rex Alexander builds furniture, cabinetry and millwork in Brethren, Mich.

Further reading

Gustav Stickley built many fine examples of Arts-and-Crafts furniture in his factory. He also left a wealth of information in his monthly magazine *The Craftsman* (1901-1916). Much of this information has been republished in two books: *Craftsman Homes, Architecture and Furnishings of the American Arts and Crafts Movement and Making Authentic Craftsman Furniture,* both published by Dover Publications, 31 E. 2nd St., Mineola, NY 11501. These books are available through Manny's Woodworkers Place (800) 243-0713.