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TODAY'S

Issue 48

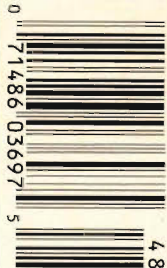
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26 Road Grader

By Dick Dorn

Little construction workers can adjust both the height and the direction of this road grader's blade to tackle snow, gravel or dirt roads.



23 Kaleidoscope

By John English

A package of simple hardware makes short work of a gift with universal appeal ... and the plan is ideal for production runs.

DEPARTMENTS

4 On The Level

Today's Woodworker passes a big milestone, and the Good Wood Alliance puts on a show woodworkers are raving about.

6 Tricks of the Trade

Cutting circles on the table saw, rescuing paint brushes and more.

7 Shop Stumpers

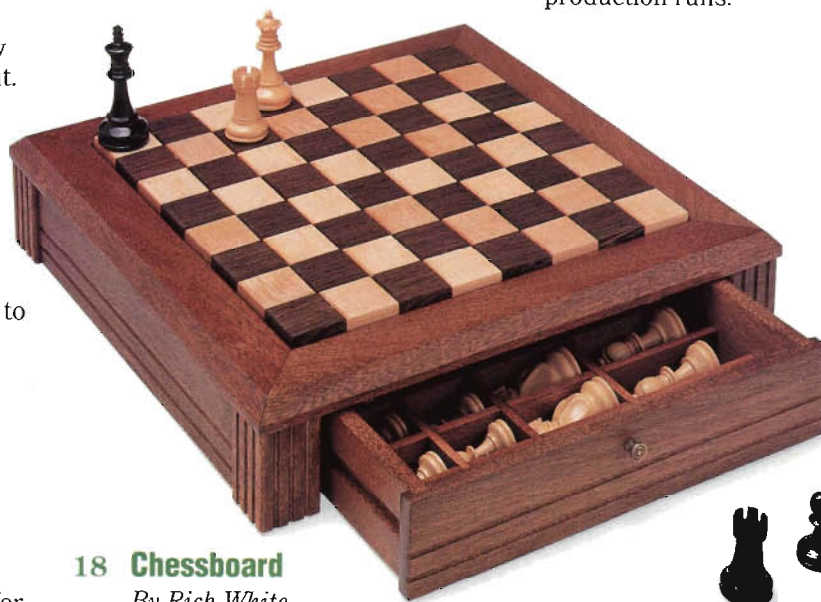
Comparing shapers to routers, and high speed steel to carbide.

8 What's In Store

Notes from the International Woodworking Fair ... baby biscuit joiners and handy clamps ... and exciting news from the World Wide Web.

10 Techniques

Furniture builder Bruce Kieffer shares some professional insights on tuning up and using your jointer.



18 Chessboard

By Rick White

A regal home for your chess pieces, this project features two hidden storage drawers and a warp-free top.



Safety First

Learning how to properly operate power and hand tools is essential for developing safe woodworking practices. For purposes of clarity, necessary safety guards have been removed from the equipment shown in some of the photos and illustrations in Today's Woodworker. We in no way recommend using this equipment without safety guards and urge readers to strictly follow manufacturers' instructions and safety precautions.

12 Chippendale Table

By Carl Spencer

Originally offered in the 1762 Thomas Chippendale catalog as a sideboard table, the author has adapted this piece to fit modern living rooms.



100,000 and Growing!

This issue is a real milestone for Today's Woodworker. I don't know the exact moment, but sometime during the last couple of weeks our circulation passed the magical 100,000 mark! What's particularly satisfying to all of us here is that our family of readers is growing faster than any other major woodworking magazine in America. Add to that the fact that we can now be found in bookstores and on newsstands in over 20 countries around the world (we shipped more than 37,000 copies of this issue to our newsstand suppliers) and you'd have to say Today's Woodworker has arrived! A lot of the credit for this phenomenal growth goes right back to you, our loyal subscribers. We're now getting a steady flow of mail after every issue rolls off the press, providing us with a great feel for what you'd like to see in your favorite magazine.

✦ ✦ ✦

I recently had the great pleasure of attending a meeting of the **Good Wood Alliance** (formerly the Woodworkers Alliance for Rainforest Protection, or WARP). This pioneering group is dedicated to encouraging forest conservation through responsible wood use. To that end, it has just published the **Good Wood Directory**, featuring over 200 manufacturers and distributors of sustainably harvested or recycled solid wood products and veneer. The alliance also is sponsoring Conservation by Design, a touring exhibition which is currently at the Smithsonian's **Renwick Gallery**. The exhibition showcases furniture and sculpted pieces crafted from recycled materials and underused or well-managed wood species. If you're interested in the show or the new directory, give the Alliance a call at 802-862-4448 or visit their new Web site:

<http://www.goodwood.org/goodwood/>



Peter Murkett's chair and Hank Gilpin's desk are both part of the

Smithsonian's stunning Conservation by Design exhibition, sponsored by the Good Wood Alliance. If you're planning a visit to the nation's capital before January 12, be sure to check out the show at the Renwick Gallery.



Speaking of exhibitions, editor Stan Schmidt attended the International Woodworking Fair in Atlanta, Georgia, in late August. For more on that, see What's in Store on page 8. Also in this issue, a picture from a 1762 Chipendale furniture catalog was the inspiration for Carl Spencer's elegant sofa table design. Designer Dan Jacobson didn't have to look back that far for his chessboard inspiration - a clever idea from a James Krenov book got Dan moving in the right direction. Builder Rick White wants all of you to know that this is a great project for intermediate woodworkers who want to stretch a little - it's easier to build than you'd think. The same can be said about John English's kaleidoscope and stand, a great holiday gift ideally suited to production work. Speaking of the holidays, what better way to light up a kid's special day than with Dick Dorn's driveable, workable toy road grader. Dick, an Iowa shop teacher, seems to have a good handle on the type of grades kids really want to talk about.

Everybody here wishes you a happy and safe holiday season and thanks you for pushing us over the 100,000 readers mark!

Larry N. Stojaken

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LARRY N. STOJAKEN
Editor in Chief

JOHN KELLIHER
Art Director

STAN SCHMIDT
Editor

STEVE HINDERAKER
Associate Art Director

JOHN ENGLISH
Associate Editor

NANCY A. AMMEND
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Copy Editor

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JILL ARENS
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NORTON ROCKLER, RICK WHITE,
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Editorial Advisors

TOM CASPAR, MIKE MCGLYNN,
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Contributing Editors

ADVERTISING SALES

WALTER CHRISTIE
Advertising Director

Phone: 770-569-7377; Fax: 770-569-7383

Midwest, **Lisa Kollander**, phone: 612-929-7132; Fax: 612-929-2498. Central States, **Beth Sullivan**, phone: 312-578-8120; Fax: 312-578-8122. West Coast, **Richard Railton**, phone: 714-589-6211; Fax: 714-589-6933. East Coast, **Peter Uhry**, phone: 203-637-5478; Fax: 203-698-1725.

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By Ron Bishop

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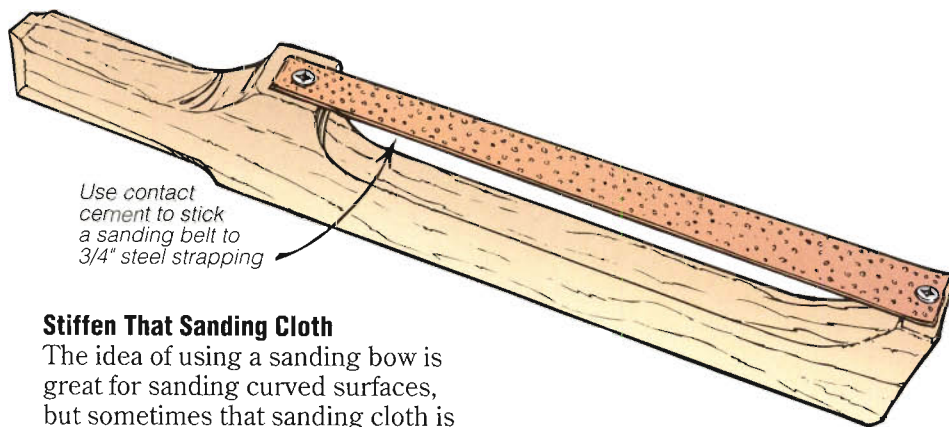
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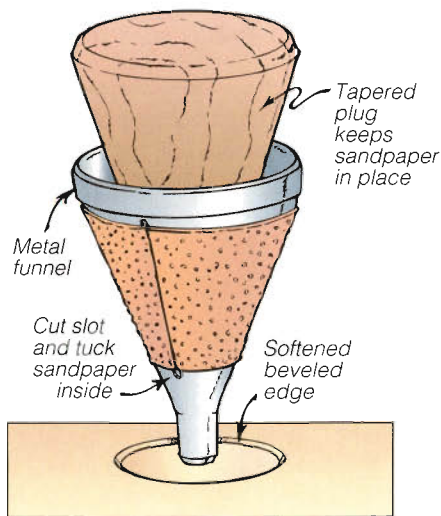
Cutting Circles and Sanding Shapes



Stiffen That Sanding Cloth

The idea of using a sanding bow is great for sanding curved surfaces, but sometimes that sanding cloth is just not quite stiff enough. I find that gluing the cloth to a piece of 3/4" strapping steel with contact cement gives me much greater control, especially if there is any detail in the piece that I'm sanding.

*Michael Burton
Glorieta, New Mexico*



Hole Beveling Sanding Block

Putting a beveled edge on the inside of a hole is easy, if you use a metal funnel. As the sketch above shows, all you need is a funnel with a narrow slot cut in the side. A strip of sandpaper is wrapped around the funnel with an inch or so on each end slipped into the slot. A tapered plug pushed inside the funnel locks the sandpaper in place. To use the sander, just drop it in place and twist it around and around until you achieve the bevel you want.

*R.B. Himes
Vienna, Ohio*

Hinged Board Jacks

Board jacks are used for supporting extra-long boards clamped in a bench vise. I cut two pieces of 5/4 oak and attached one to each front leg of my workbench with 3" butt hinges. I used a straightedge to keep them at the same level as the bottom of the vise. The hinges allow me to swing the jacks out of the way when I don't need them.

*Kevin Hemmingsen
Wabasha, Minnesota*

PICK OF THE TRICKS

Resizeable Circle Cutting Jig for the Table Saw

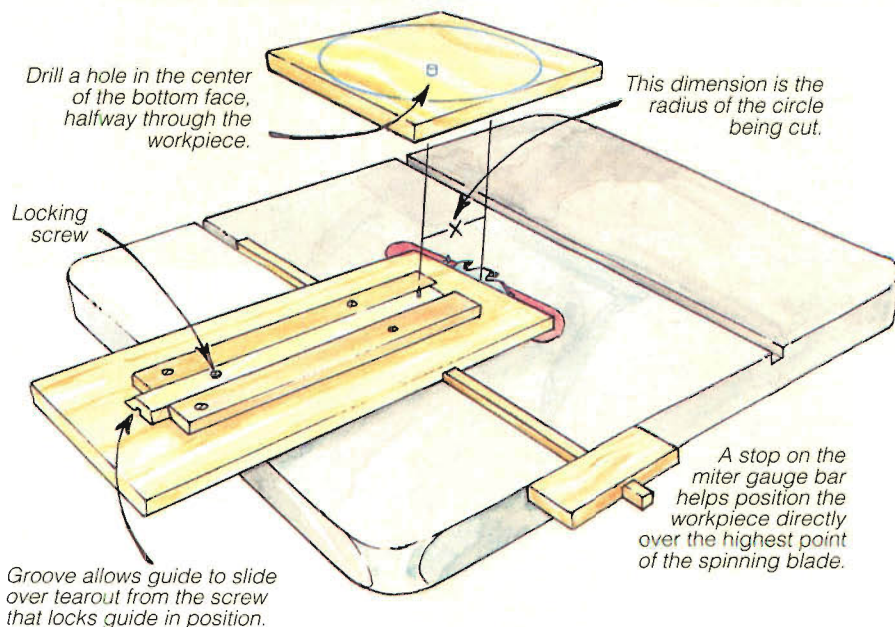
Before I bought my band saw, I used to cut circles on my table saw using this easy-to-build jig. The base of the jig is just a platform with a bar that runs in the saw's miter gauge slot. On top of the platform, a sliding guide can be locked in position with the turn of a screw, allowing you to set any radius.

To cut a circle, begin by drilling a small pilot hole in the center of the workpiece, halfway through the stock. Then set the radius distance (the distance between the pivot nail and the blade) and drop the workpiece upside down on the nail.

Slowly raise the blade (1/16" between each revolution of the workpiece) until it cuts all the way through the wood. As you work, rotate the wood slowly: If it moves too fast, or the cut is too deep, the wood will burn due to side pressure on the blade and teeth. Safety is also an important issue here.

If you're cutting a circle under 12" in diameter, use a push stick near the blade and maintain downward pressure on the wood above the nail. For best results, use a good, sharp carbide blade.

*Michael Trotter
Giebelstadt, Germany*



Routers versus Shapers

Stripper Rescues Favorite Brush

I love to work with wood and do a great deal of remodeling and painting. I recently lent my sash brush to a friend, but when I got it back, only the tip had been cleaned properly. Thinking I had lost the use of my trusted sash brush to any further painting, I used it to apply stripper on my next refinishing project. In seconds, the brush lost its rigidity and the bristles started to bend again.

I usually use real cheap brushes to apply stripper because it tends to loosen the bristles. Knowing this, I worked the stripper into the base of the sash brush, but then cleaned it off as soon as the paint was worked out. I was rewarded with a brush that was as good as it was the day that I lent it out.

*Bill Elmstrom
Tracy, Minnesota*

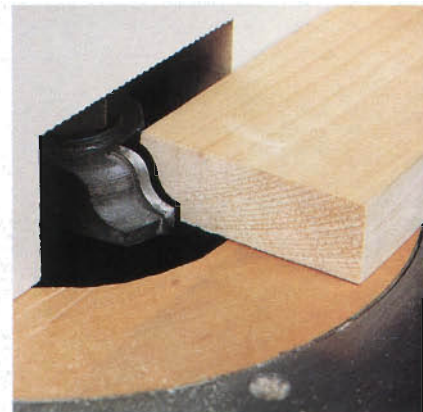
Getting the Glue Out

I always keep a couple of bottles of wood glue handy in my shop, but because I don't use them on a regular basis, I had a problem with the glue drying and clogging up the tip. I easily solved this problem using a two-quart plastic milk container. I cut the top off and placed a little water in the open container.

Now, whenever I use a glue bottle I replace the cap and submerge the tip in the container of water. As long as the tip is submerged, the water prevents air from entering and the glue is ready for instant use. This saves both time and frustration, which, in turn, makes woodworking even more rewarding.

*Howard E. Moody
Upper Jay, New York*

Today's Woodworker pays from \$40.00 (for a short tip) to \$150.00 (for Pick of the Tricks) for all Tricks of the Trade published. Send yours to Today's Woodworker, Dept. T/T, P.O. Box 261, Medina, MN 55340. E-mail: editor@todayswoodworker.com.



Q *I'm considering buying a shaper, but with the power and assortment of router bits, does the shaper have any real advantage over a heavy duty router?*

*Michael D. Miller
Miller2629@aol.com*

A Shapers can claim some advantages over routers, Mike, but most of experts advise home hobbyists to get a router first. They are more versatile and a lot cheaper. Mike McGlynn, a local professional woodworker and editorial advisor to Today's Woodworker, doesn't even consider it an either-or issue.

"One doesn't replace the other by a long shot," explained McGlynn, who has four routers and an industrial shaper in his Minneapolis shop. "A shaper is essentially a profiling machine. And a router can do a lot of things a shaper can't, like mortising and using a dovetail jig. I don't use my shaper that often. It can sit idle for two months or longer. My routers get used almost every day. I definitely would buy a router ahead of a shaper."

The shaper gains its advantages in production work, especially when it comes to manufacturing molding or raised panels or if you're going to shape large parts (chair legs, for example) from a template. A big router can do everything a shaper can - within limits. An industrial shaper equipped with a 1 1/4" spindle can easily handle 4"

stock in one pass; even a 3HP router equipped with a 1/2" collet would need to make several passes to achieve the same profile.

You can buy the world's greatest router for less than \$400, but an industrial shaper - McGlynn says small shapers with 1/2" spindles are "all but worthless because they have no advantages over a router" - will cost thousands of dollars.

Q *Should I buy carbide-tipped router bits or high-speed steel router bits?*

*Skeeter Berg
East Farmington, Wisconsin*

A Carbide bits are the only way to go, says McGlynn, because they last 15 to 25 times longer than steel bits. While most pros echo this viewpoint, furniture builder Bruce Kieffer from St. Paul, isn't convinced: "If the bit I need is made in both carbide and steel," Kieffer explains, "I almost always buy the steel one. They're less expensive and I can resharpen the edge myself. For edge forming, I do like the carbide, but only because they have ball bearing pilots. I also like steel bits because I can grind them to alter their shapes."

Send your Shop Stumpers to Today's Woodworker, P.O. Box 261, Medina, MN 55340. Or e-mail us at: editor@todayswoodworker.com.

Miniature Biscuit Joiner

By Stan Schmidt

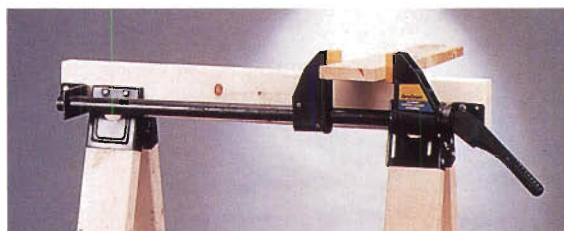


The International Woodworking Fair, held just a week after the Olympic Games, was sort of like visiting Willie Wonka's Chocolate Factory: Just throw a couple of pieces of wood in one end of a huge machine, and it spits out a piece of furniture at the other end. That's a slight exaggeration - but only slight - of some of the 1,200 exhibits that filled Atlanta's Georgia World Congress Center in August, attracting some 43,000 participants from around the world.

There really were some monster, million-dollar-plus machines - one actually turned a sheet of plywood into two knockdown Adirondack chairs in a matter of minutes - but

big wasn't everything: **Ryobi** drew lots of attention with a miniature biscuit joiner that carries a miniscule \$69 price tag. Model DBJ50 uses biscuits that measure only 5/8", 3/4" and 1" long. Putting that in perspective, the smallest commonly used biscuit is 5/8" wide and 1 1/4" long. Ryobi's joiner also comes with a see-through fence, a must when working with small projects like cabinet face frames, moldings, picture frames, decorative boxes and hobby crafts.

Ryobi also unveiled three new routers (1 1/2hp, variable speed, \$145; 2hp, \$129; 2 1/2hp, soft start variable speed, \$159); two 14.4-volt cordless drills, each with two batteries and a one-hour diagnostic charger (center handle, \$165; pistol grip, \$129); three variable speed corded drills (1/2"



hammer, \$75; 1/2" spade handle, \$65; 3/8" chuck, \$39); a 4.8-volt cordless power pen, \$39; a multi-tool with a flex shaft, \$59; an orbital jig saw, \$79; and a 4" angle grinder, \$55.

New and Improved

American Tool Companies is introducing the HorsePower™ Handy Clamp, which turns a sawhorse, workbench, work vehicle or tool box into a clamping center. You supply whatever length of 3/4" black pipe you desire and attach the brackets to your work surface. The jaws and handle rotate at 180° and can create up to 350 pounds of pressure. Street price is \$15.95.

Adjustable Clamp Co. has expanded its **Jorgensen** line of rectangular aluminum bar clamps by adding a deep-reach version (3500-DR) that has a clamp face of 1 1/4" x 3 3/4" (the

regular version has a clamp face of 1 1/2" square). It's available in six opening capacities from 12" to 72." **Jorgensen** also introduced a mini-compound miter saw (\$77.70), with several quick-lock settings for left and right miters from 90° to 22.5°.

Short Takes

Most keyless chucks require two hands to properly tighten or loosen. The **Jacobs Chuck Manufacturing Company** is changing that with its 3/8" capacity, single-sleeve Hand-Tite Evolution chuck for portable drill/drivers ... **Powermatic** has unveiled its new Accu-Fence system, which will be standard equipment on the Model 66 and other Powermatic table saws. Powermatic also is expanding its Artisan product line

with a 14" drill press, a 6" jointer, a 10" table saw and a 14" band saw ... **Milwaukee Electric Tool** has introduced a 38-pound, fold-up, 36" tall miter saw tool stand that features 16-gauge steel and a 500-pound weight capacity ...

Bosch has a new 10-inch slide compound miter saw featuring a 13-amp motor, a 3 1/2" fence and a crown molding bevel stop ... **DeWalt** is recalling 150,000 DW9104 and DW9106 one-hour battery chargers because the plastic housing could separate during a severe impact, exposing electrical components that could present a shock hazard. The chargers are stamped with a date code between 9534 and 9615; they can be returned to a Black & Decker/DeWalt Service Center for free replacement. For more details, call 1-800-540-2626.

Seen on the World Wide Web

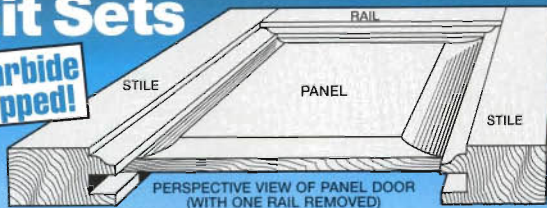
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Today's Woodworker and The Woodworkers' Store have joined forces to provide a comprehensive list of woodworking-related sites on the WWW. This growing page already includes 150 links to catalogs/retailers, clubs/associations, directories, hardware/finishes, magazines/books/TV, news-groups/forums, tool manufacturers, wood/trees/forestry, wood products, woodworkers' home pages and miscellaneous links. If you operate or discover a WWW site that should be included on our links page, please e-mail us at: editor@todayswoodworker.com

WHAT'S IN STORE HOTLINE: If you know of new tools, hardware, books or World Wide Web sites, contact Stan Schmidt at Today's Woodworker, P.O. Box 261, Medina, MN 55340. E-mail: editor@todayswoodworker.com

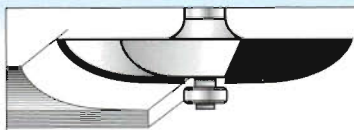
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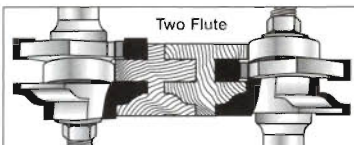


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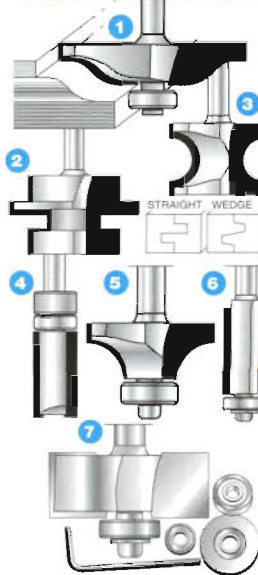
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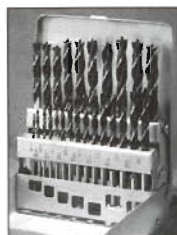
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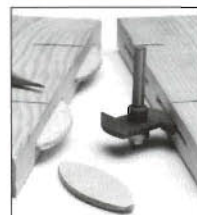
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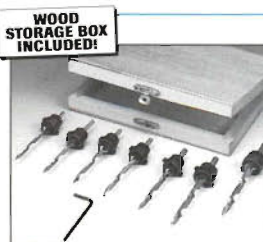
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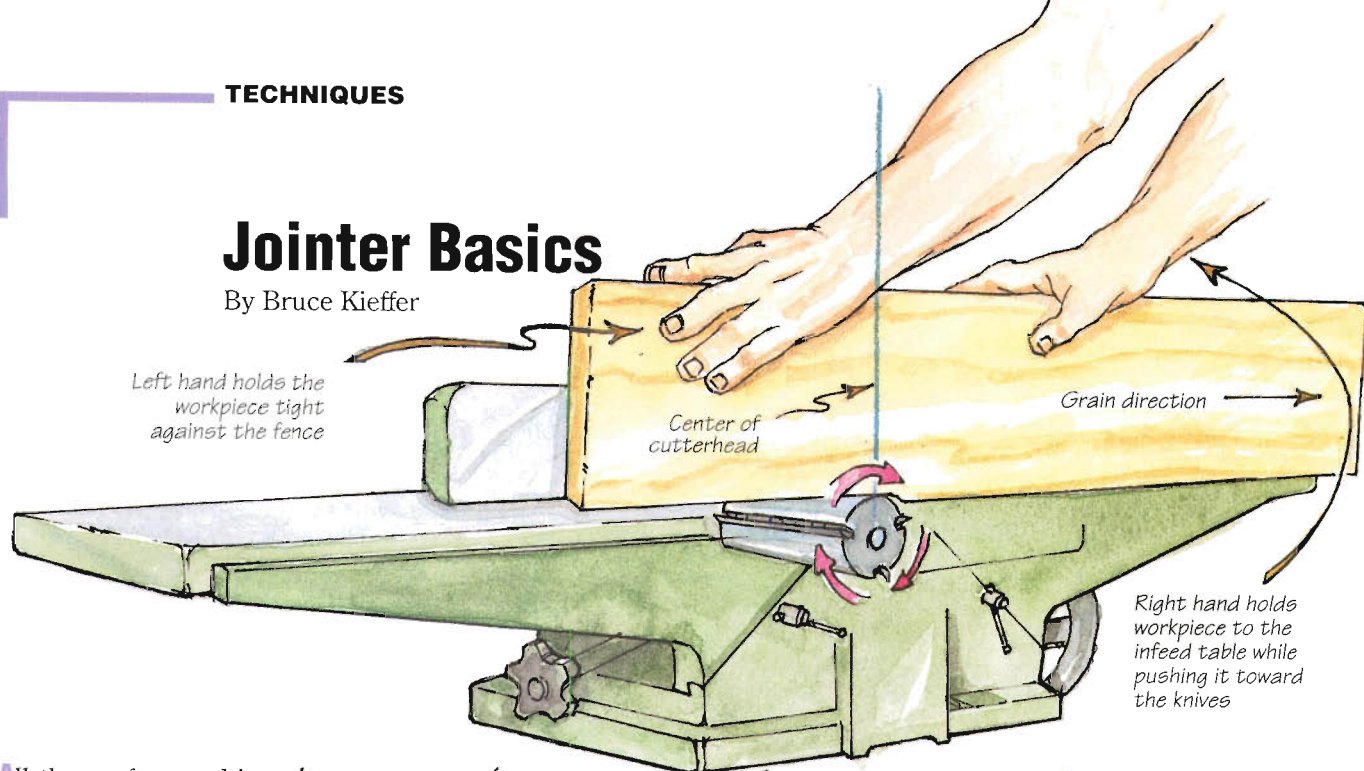
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Jointer Basics

By Bruce Kieffer

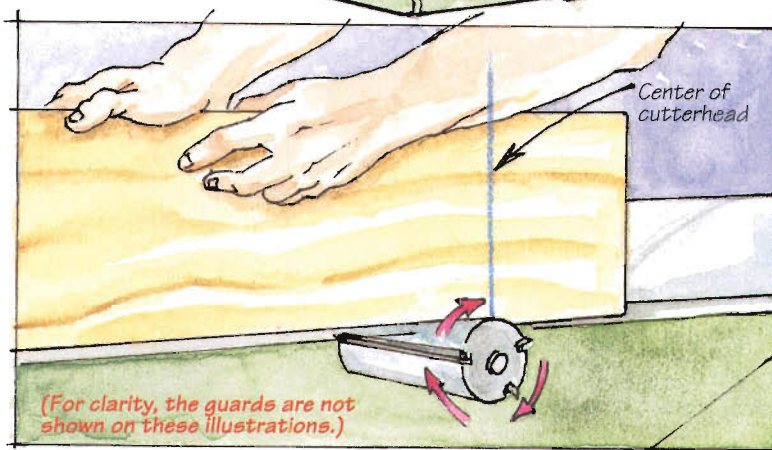


All the craftsmanship in the world won't help you build better projects if the boards you start with are not straight and true. To make them so, most woodworkers usually turn to their jointers. Peter Korn walked us through buying and setting up a jointer back in issue 37 (January/February 1995). In this issue, I'd like to address keeping your jointer in tune, and share a few tips that will help you get the most from this dependable shop workhorse.

Three Steps to Success

Tuning up your jointer won't take very long - there are really only three key steps to it. But before they can be performed, you should be comfortable with the basic operation of the machine. If you've only scanned the manual that came with your jointer, this is an excellent opportunity to give it a thorough read.

While you're reading, have a pro sharpen the knives. I've been a woodworker for more years than I care to remember, and I'm pretty comfortable sharpening just about everything else in the shop. But I leave planer and jointer knives to the experts - it's just too tricky trying to keep those long edges straight without the proper equipment.



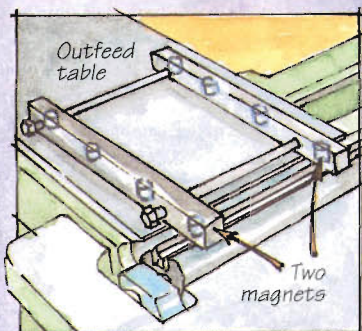
When half the workpiece has crossed over the cutterhead, the right hand will naturally pass over the left. Both continue their roles: The right hand is now pushing down on the outfeed table, while the left maintains pressure against the fence.

Before you reinstall the knives (most jointers have two or three), be safe and unplug the machine. The easiest way to align the knives is with a set of magnetized bars that are available at most hardware stores (see **Step 1** at right). These magnets stick to the outfeed table with one end protruding over the knives. Because they're magnetized, they pull the knives up to the level of the outfeed table and hold them in place while you tighten the set screws.

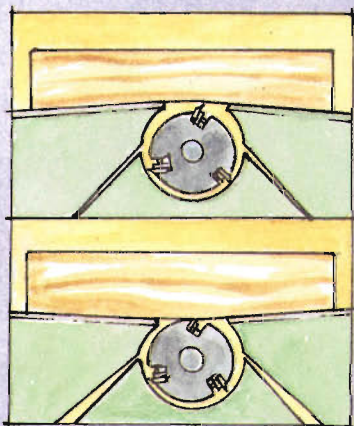
Test your knife installation by placing a straight stick on the outfeed table and then rotating the cutterhead manually (use the pulley to avoid getting nicked by the sharp knives). The stick should move exactly the same distance with each knife. Repeat the process along the full length of each knife to make sure that all the cutters are in line.

To see if the jointer's infeed and outfeed tables are parallel, joint two long boards and hold the jointed edges together: If their centers touch and there are gaps at the ends, one or both of the tables are low near the cutterhead. If the ends touch and there's a gap in the center, then one or both are high near the cutterhead (**Step 2**). Adjust only the infeed table (except in severe cases), then keep testing until the jointed edges rest against each other with no gaps.

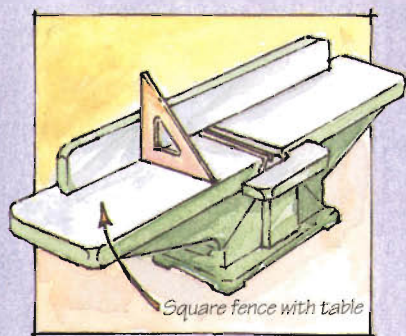
Finally, adjust the fence so it's gauge reads 90° when it makes a 90° cut. Use a square to make the initial fence setting (**Step 3**), then make a test cut on a board and check it with the square. Make necessary adjustments until the fence is set right and the tool is consistently making 90° cuts. When it does, you can adjust the fence pointer to read 90°.



Step 1: Magnetized bars help set the jointer knives flush with the outfeed table. The bars hold the knives in place while the set screws are tightened.



Step 2: You can tell if your infeed and outfeed tables are parallel by jointing test edges on some long scrap. Usually adjusting the infeed table will take care of any problems.

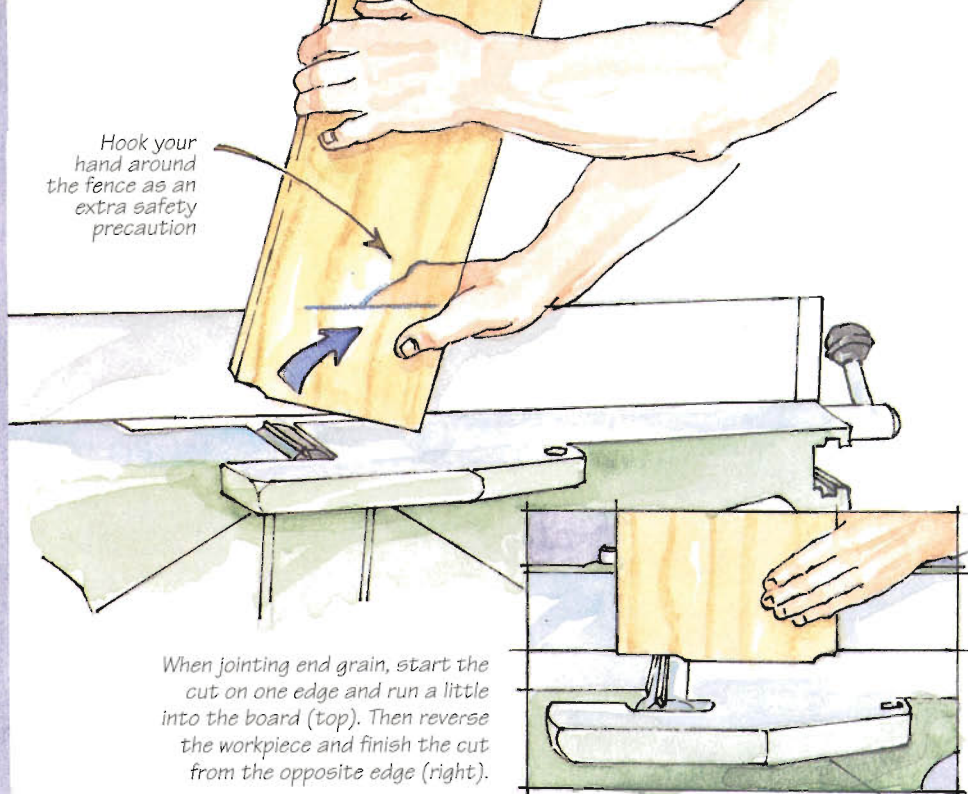


Step 3: Use a 90° triangle to square your fence with the outfeed table. Once it's perfect, adjust the fence gauge accordingly.

A Pro's Quick Fix

Every woodworker enjoys saving a few dollars, especially if doing so doesn't have any impact on the quality of his work. When newly sharpened jointer knives get nicked by an unusually hard knot, there's no need to resharpen them right away. Just move one knife a little to the side so the nicks no longer line up.

Hook your hand around the fence as an extra safety precaution



End Grain, Snipe and Feed Direction

Jointing end grain can be tricky. To do so without tearing a huge chunk out of the trailing edge of a board, stop feeding after an inch or two, reverse the board and complete the cut from the other end. But don't try this with narrow (less than 4") or long (more than 48") boards.

Snipe is the woodshop word for that annoying little concave cut that jointers tend to leave on the end of a pass. Either the outfeed table is lower than the knives (see how to fix

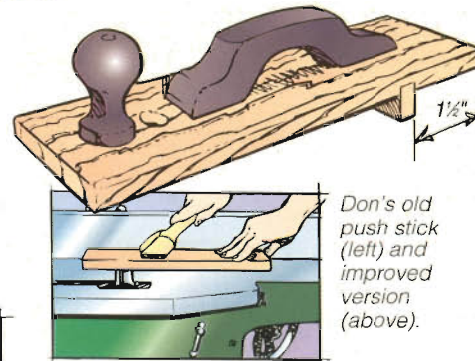
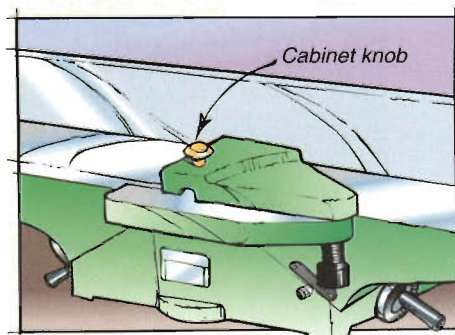
this in the tune-up section above), or the workpiece is too short. In the latter case, just hot melt glue a piece of scrap to the end of the board, let it dry, then make your cut.

Finally, a word about feed direction. To avoid chipping or chatter, make sure you feed the wood into the knives so that the grain pattern widens toward the trailing end.

Bruce Kieffer, a frequent contributor, is a professional furniture builder based in St. Paul, Minnesota.

Two Jointer Tricks from Readers

Ashton Wilson, a reader from Sioux Falls, South Dakota, shared a great tip in issue 39. When he needs to swing the guard on his jointer out of the way for operations like leg tapering (see below), he no longer has to worry about his fingers being too close to spinning knives. That's because he installed a standard cupboard knob on the guard.



Don Kinnaman of Phoenix, Arizona, offered up a nice improvement for a jointer pushstick way back in issue 4 (July/August 1989). Based on a wooden cement float, Don added a hand plane knob at the front end and a friction fitted replaceable stop at the back.

Chippendale Sofa Table

Decorative leg brackets on this classic reproduction are attached to the legs and aprons with mortise and tenon joinery.

By Carl Spencer



Thomas Chippendale just made another sale. My wife wanted a new sofa table for our family room, and after an exhaustive search we finally settled on a design from his 1762 catalog. The sideboard table that caught our eye has certainly proven its timeless appeal, and we found the idea of leg brackets - typical of Chippendale's later work - especially appealing.

Chippendale worked almost exclusively in mahogany throughout his long and illustrious woodworking career, but we built our reproduction out of red oak so that it would match our family room's decor.



In his earlier work, London furniture builder Thomas Chippendale (1718-1779) made extensive use of cabriole legs and ornate carving.

As his craft matured, he turned increasingly toward straight legs and scrollwork.

Chippendale gained lasting fame in 1754 with the publication of his book of furniture designs, "The Gentleman and Cabinet-Maker's Director."

Making the Legs and Aprons

The first step in building this table is to cut all the parts to size according to the dimensions given in the Material List on page 14. With that done, milling can begin with the four legs (pieces 1), which are fashioned from solid stock that is ripped and jointed square to 2 3/4". Use your table saw to cut a 45° chamfer on the inside corner of each leg (see the **Pinup Shop Drawings** between pages 16 and 17 for dimensions), then lightly joint the chamfered face to remove any saw kerf marks. Set the legs aside for a few minutes and move on to the aprons (pieces 2 and 3). Machine tenons on both ends of each apron (see the **Pinup Shop Drawings** for dimensions), using a sharp dado set and your table saw's miter gauge.



Figure 1: Mortises in the legs (they house tenons on the brackets and aprons) are cut on a router table using a 1/4" spiral fluted straight bit.

The mortises that house these tenons will also accommodate the scroll sawn corner brackets, so this is a good time to make those brackets. Refer to the sidebar at right for complete instructions. When your brackets are completed, turn your attention back to the mortises.

Begin by installing a 1/4" straight bit (spiral fluted works best) in your table-mounted router, and set the fence using the dimensions shown in the **Pinup Shop Drawings**. To stop the mortises at the correct length, scribe pencil lines on both the router fence and the legs where each cut starts and finishes (see the **Pinup Shop Drawings** for this dimension). Remove the stock (**Figure 1**) in three passes until the mortise is 5/8" deep. When all four legs are mortised, use the same fence setting and bit to make similar mortises in the bottom edges of the aprons: These will house the tenons on the tops of the brackets, and their dimensions can be found on the **Pinup Shop Drawings**.

Decorative Milling

In the Chippendale tradition, the legs on this table are fluted. The flutes are stopped before they reach the top or bottom of each leg (see the **Pinup Shop Drawings**). To make them, install a 1/8" veining bit in the table router and use the same technique employed to stop the mortises for the brackets: Pairs of matching pencil marks on the router table fence and the workpiece.

Making the Brackets

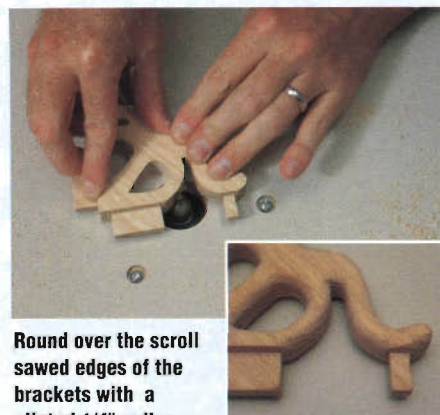
Start making the brackets (pieces 4) by ripping enough straight-grained 5/8" thick lumber (see Material List on page 14) into 3 1/2" wide strips to make eight bracket blanks. Cut the strips into triangles on your table saw using the miter gauge, and make sure the two short sides of each triangle are exactly at 90° to each other or you'll have problems during assembly.



Use your table saw to create tongues on the short sides of the triangular bracket blanks, as shown in the two insets at left. Begin by making a pass to define the tenon (using a sharp blade to combat tearout), then remove the rest of the waste in subsequent passes.

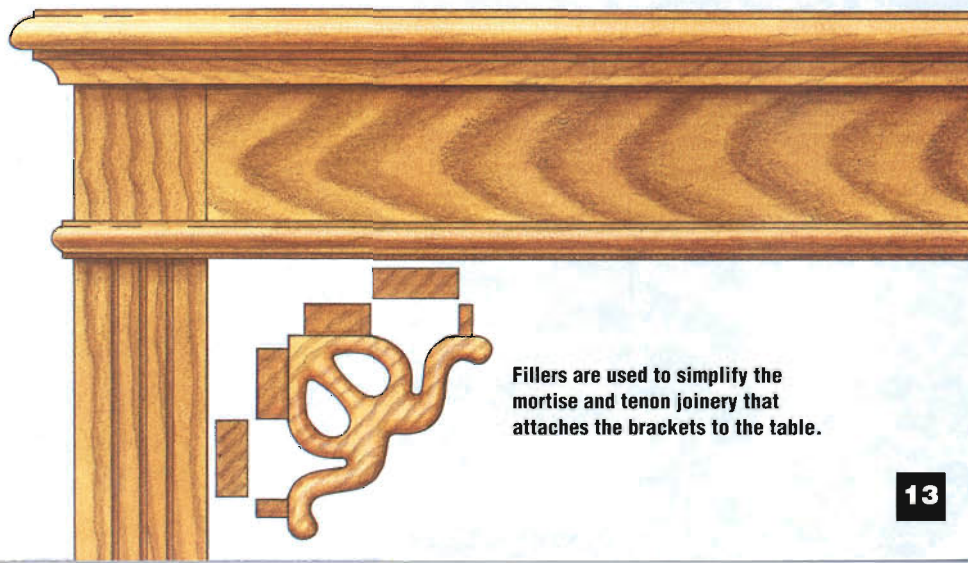


After changing the blade height, use your miter gauge to complete the tenons. The waste between them will be replaced by fillers (pieces 8) during assembly.

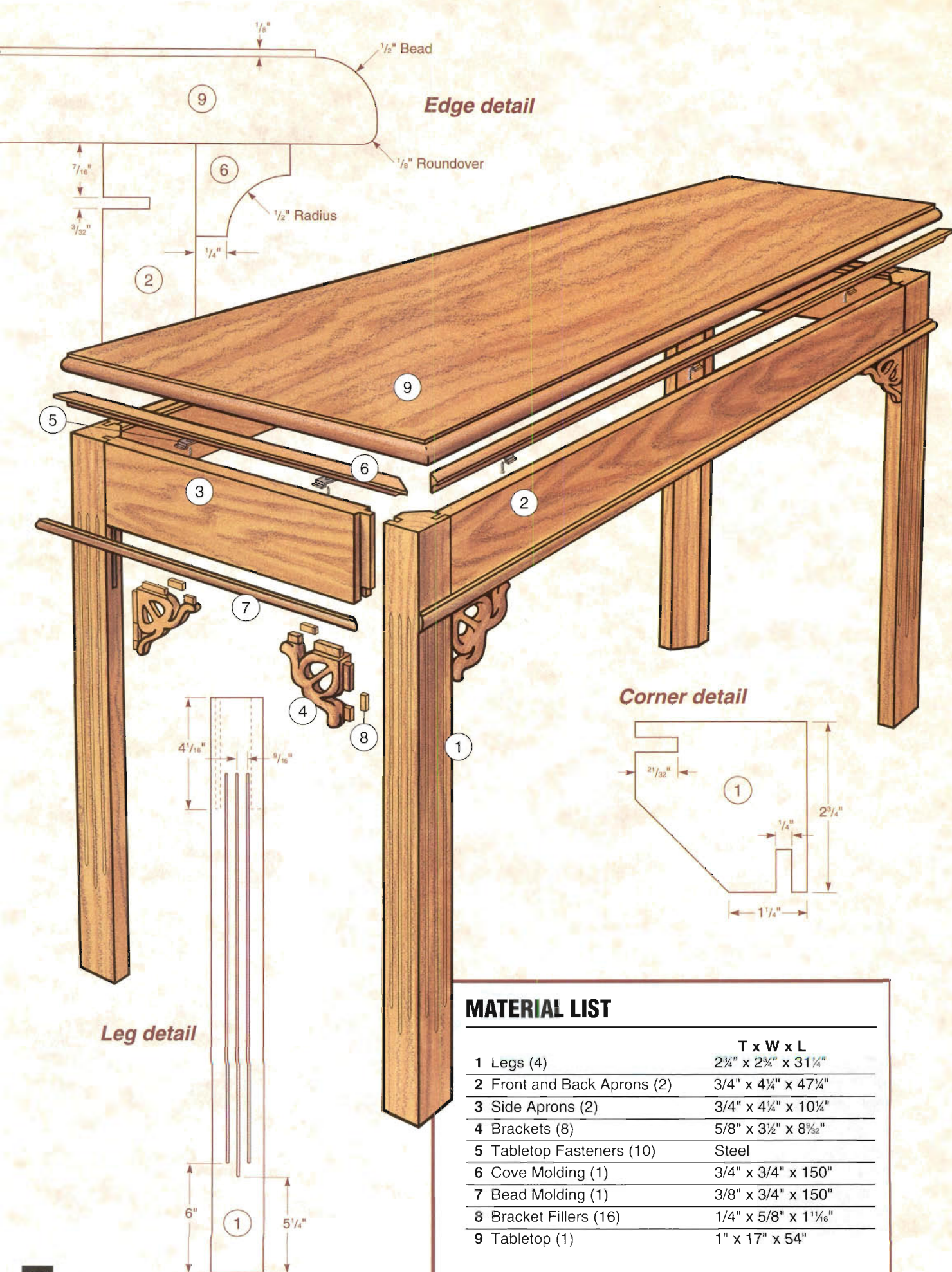


Round over the scroll sawed edges of the brackets with a piloted 1/4" radius roundover bit in a table-mounted router.

The completed brackets will be attached to the rest of the table with mortise and tenon joinery, so stay at your table saw to make tenon shoulders on the two short edges of each triangular blank. Begin by setting your dado blade's height to 3/16" and remove enough material from each side of the blank to leave 1/4" thick tongues, as shown in the top two photos at left (see the **Full-size Pattern** for dimensions). Transform these tongues into tenons (bottom two photos) by adjusting the dado blade height to 5/8" and removing enough waste to define the tenons. Make photocopies of the design (see the **Full-size Pattern**) and glue them onto the blanks with a low-tack spray. Then drill holes through the interior cutout areas and complete the fretwork using a scroll saw or jigsaw. Cutting out the area between the tenons (see below) makes final shaping a lot easier. That shaping (see the two photos above) can be done on your router table with a 1/4" roundover bit.



Fillers are used to simplify the mortise and tenon joinery that attaches the brackets to the table.



MATERIAL LIST

	T x W x L
1 Legs (4)	2 3/4" x 2 3/4" x 31 1/4"
2 Front and Back Aprons (2)	3/4" x 4 1/4" x 47 1/4"
3 Side Aprons (2)	3/4" x 4 1/4" x 10 1/4"
4 Brackets (8)	5/8" x 3 1/2" x 8 7/32"
5 Tabletop Fasteners (10)	Steel
6 Cove Molding (1)	3/4" x 3/4" x 150"
7 Bead Molding (1)	3/8" x 3/4" x 150"
8 Bracket Fillers (16)	1/4" x 5/8" x 1 11/16"
9 Tabletop (1)	1" x 17" x 54"



Figure 2: Ease the bottom edges of the legs with a 1/8" roundover bit. At 31 1/4" long, these legs are short enough to perform this operation while holding each leg vertically on the table.

Stay at the router table to ease the bottom edges of the legs with a 1/8" roundover bit (**Figure 2**), then move to the table saw and create 3/32" grooves for the tabletop fasteners (pieces 5) on the inside faces of the aprons. These are cut with a thin kerf saw blade, and their locations and depths can be found on the **Pinup Shop Drawings**.

Fashioning the Moldings

True to Chippendale's original 1762 design, decorative moldings are used to dress up the apron. A cove molding (piece 6) runs around the top of each apron, while a wide bead molding (piece 7) adorns the bottom edge. The safest way to make these narrow moldings is to shape both

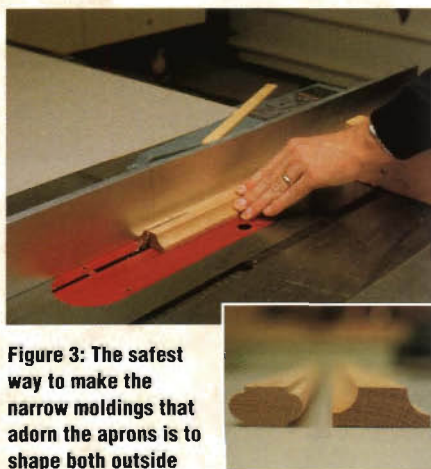


Figure 3: The safest way to make the narrow moldings that adorn the aprons is to shape both outside edges of wider boards, then rip two lengths of molding from each.

edges of a board (see **Figure 3, inset**), and then cut off the shaped piece to the right width, as shown in **Figure 3**. While routing, make several passes, ending up with a last light pass that both eliminates chatter and minimizes sanding.

Frame Assembly

The legs, aprons, brackets, fillers (pieces 8) and moldings can be glued up now. Start by gluing the brackets and fillers to the aprons, lining up the brackets with a combination square while the glue is still wet (**Figure 4**). When aligned, clamp them in place.



Figure 4: When gluing the brackets to the aprons, a combination square helps line up everything while the glue is still wet.

After the glue has dried, assemble the front and back aprons to the legs. To do so, apply glue to their tenons, insert the tenons into the leg mortises, and clamp them in place with pipe clamps (**Figure 5**). To ensure that the legs remain parallel during clamping, insert a spacer between them, down at the bottom. Then, before the glue sets, check the entire assembly for squareness by measuring diagonally.

The two side subassemblies are joined to the shorter apron rail in the same manner, using scrap spacers to ensure parallel joinery. Since the final frame assembly must be checked for squareness on three planes (the top and both ends), you may want to practice this procedure a couple of times until you can do it quickly and accurately, before applying any glue.

After the glue cures, apply masking tape over the legs except where the flutes are, then highlight the flutes with a spray can of flat black lacquer. Remove the masking tape, then sand the entire assembly to 220 grit. You can also give the moldings a final sanding, then trim them to length on your table saw or miter box. Glue the moldings and clamp them in place with spring clamps placed about every five or six inches along their length (see **Figure 6** on page 16).

The Tabletop

The top (piece 9) is made from 1" thick boards of various widths, matched for both color and grain pattern. After jointing their edges, arrange the boards so that the grain patterns on their ends alternate (one crown up, the next down, etc.). For aesthetic reasons, I never like to have a joint running right down the center of the top. Apply a liberal amount of glue to both edges of each joint, and alternate your clamps (one above the top, the next below) to avoid cupping. Tighten the clamps until the joint is snug, but don't over-tighten them or you'll squeeze out too much glue.

When the glue has cured, ask a local cabinet shop owner to run your top through their wide belt sander, taking it down to 3/4". Back at the shop, cut the tabletop to final size on your table saw, then sand a 1/2"

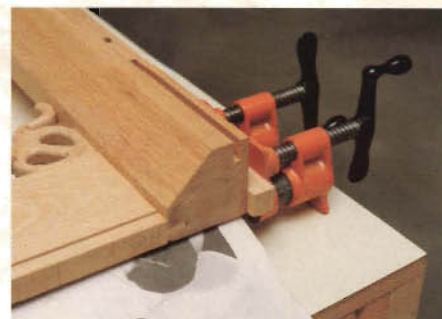


Figure 5: When attaching the legs to the aprons, two pipe clamps will yield a better joint than one. During this process, the author uses scrap paper to keep excess glue off his worktop.

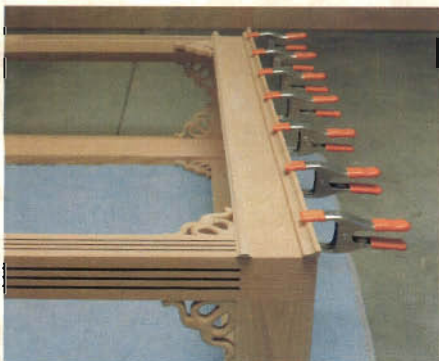


Figure 6: A series of spring clamps is a sure-fire way of providing equal pressure along the length of molding when attaching it to the apron.

radius on the corners with a belt sander. Form the top edges using a 1/2" beading bit in your router, and create the bottom profile with a 1/8" roundover bit. Then sand all the surfaces to 220 grit.

Finishing and Final Assembly

Stain the leg assembly and top with an oil-based stain. Allow it to dry thoroughly, then apply one coat of sealer. Follow up with three topcoats

of brushable semi-gloss lacquer. The bottom surface of the tabletop should receive the same treatment to minimize any tendency to cup during humidity changes. Each coat of lacquer must dry completely before you can scuff sand between coats with 400 grit sandpaper.

After the third coat of lacquer is dry, place the top upside down on a padded workbench. Center the leg assembly on it and mark the locations of the tabletop fasteners. Then remove the leg assembly and predrill holes for the fasteners. With that done, reposition the legs and install the fasteners.

Finally, place your table behind your sofa and top it off with a hard-bound reproduction of Thomas Chippendale's 1754 edition of the "Gentleman and Cabinet-Maker's Director."

Carl W. Spencer is a woodworker from Fort Wayne, Indiana.

Completing the Series

The author was so taken with Chippendale's design that he completed the series with an end table and coffee table. Each can be built using the sofa table instructions, with a few dimensional changes. You'll also need 128" of each molding for the end table, and 164" of each for the coffee table.

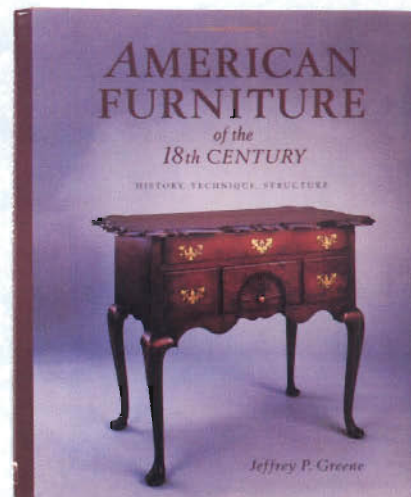


End Table

Legs.....2 1/4" x 2 1/4" x 20 1/4"
Tabletop.....3/4" x 30" x 30"
Aprons.....3/4" x 4 1/4" x 23 1/4"

Coffee Table

Legs.....2 1/4" x 2 1/4" x 16 1/4"
Tabletop.....3/4" x 30" x 48"
Front & Back Aprons.....3/4" x 4 1/4" x 41 1/4"
Side Aprons.....3/4" x 4 1/4" x 23 1/4"



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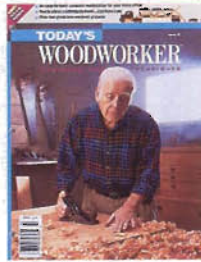
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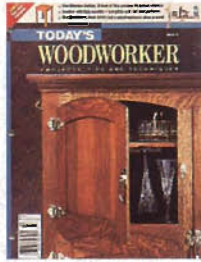
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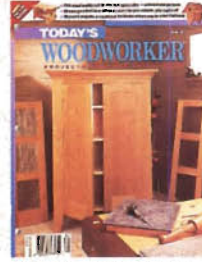
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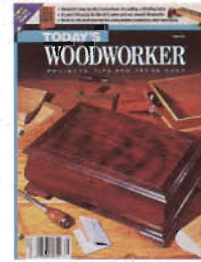
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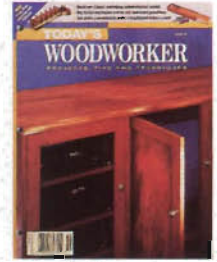
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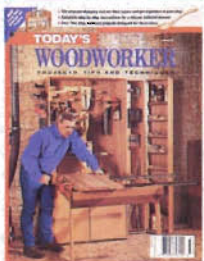
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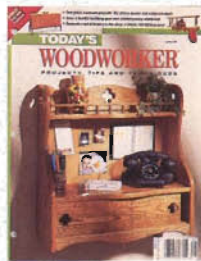
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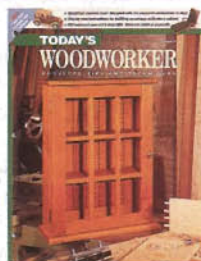
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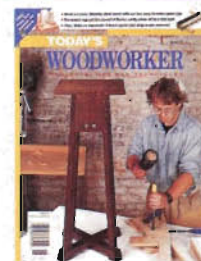
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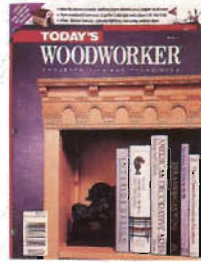
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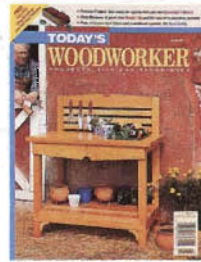
The heirloom blanket chest, a mantel clock, Corky crocodile's desk, outfeed/assembly table. Item 17419 \$4.95

44



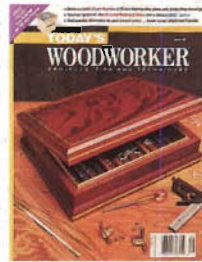
The Itasca bookcase, a toy barn, the golfer's whirligig, a Greene & Greene hall mirror. Item 17287 \$4.95

45



The gardener's bench, a dart caddy, Shaker hall table and a router surfacing jig. Item 17295 \$4.95

46



A classic mahogany humidor, the LEGO® center and an oriental redwood arbor. Item 17302 \$4.95

47



A scroll saw blade caddy, the 4x4 jeep, an heirloom jewelry box, and the steamer trunk II. Item 17310 \$4.95

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back issues
on the
Order Form
and in our
Sourcebook!**

Contest Deadline: March 31

We have extended the deadline for our **Toys for Tots** wooden vehicle competition to March 31, 1997. This contest is based on Dick Dorn's innovative spring suspension system featured in Issue 47. The grand prize is a \$250 gift certificate from The Woodworkers' Store, but the real reward is in helping a great organization enrich the lives of children in need.



4x4 Jeep with Spring Suspension

The hardware kit includes Rubbarider wheels, people, a steering wheel, headlights, taillights and enough dowel to build one Jeep. We've also added a supply of compression springs.

Hardware kit

24092\$4.95

Issue 47

17310\$4.95

Compression Springs

35057 (4)\$4.95

Classic Chessboard

This heirloom chessboard was inspired by a James Krenov design that ingeniously tackles the wood movement problems inherent in using two wood species.

By Rick White





Chess is a derivative of a sixth century game from India called *chaturanga*, although the modern format emerged in Europe around 1400. The first serious strategist was Ruy Lopez de Segura, a 16th century Spaniard. But the game really came into its own with Francois Philidor's "Analysis of the Game of Chess," published in France in 1749. The first international grand master was Adolf Anderssen of Germany.



In 1972, the world was transfixed by two men playing a board game for the unprecedented prize of \$250,000. Bobby Fischer, who at the tender age of 14 had won the U.S.

Chess Open, was locked in combat with the venerable Soviet, Boris Spassky. That event brought chess to main street America, accounting for a massive surge in this ancient game's popularity. Fischer was the last American to become international grand master, and even though he forfeited his title a couple of years later, enthusiasm for the game has remained high.

I've always liked combining two hobbies, so when Today's Woodworker project designer Dan Jacobson wanted to build a chessboard, I was quick to volunteer my wood-

working services. Although Dan's design looks complicated, it's primarily made up of simple moldings. And the clean lines, reminiscent of Art Deco pieces, actually hold two delightful secrets: A pair of almost invisible drawers, and a subtle design theme that I'll reveal at the end of this article (if you haven't already guessed by then).

Making the Squares

Chess players are known for their patience, an attribute that will come in handy when making the squares of the chessboard grid (pieces 1 and 2). Begin this task by ripping two 60" long pieces of stock, one in a dark species - I opted for wenge - and the other light colored, such as the maple that I used for contrast. A simple table saw jig equipped with a toggle clamp makes cross cutting 64 identical 1 $\frac{5}{8}$ " squares safe and easy (see Figure 1).

To accentuate the space between the assembled squares, their edges are slightly chamfered on the top and bottom. The only safe way to do this on such small pieces is on a router table with a 45° chamfering bit. You may have to clamp a thin auxiliary fence to your router table's fence if the opening in the machine's



Figure 1: This cross cutting jig rides in the miter gauge slots of your table saw and is equipped with a toggle clamp to keep your fingers out of harm's way.

fence is large enough to engulf one of these small pieces. Chamfer each square on the top and bottom faces so that, when you assemble the grid, you can choose the best face for the top.

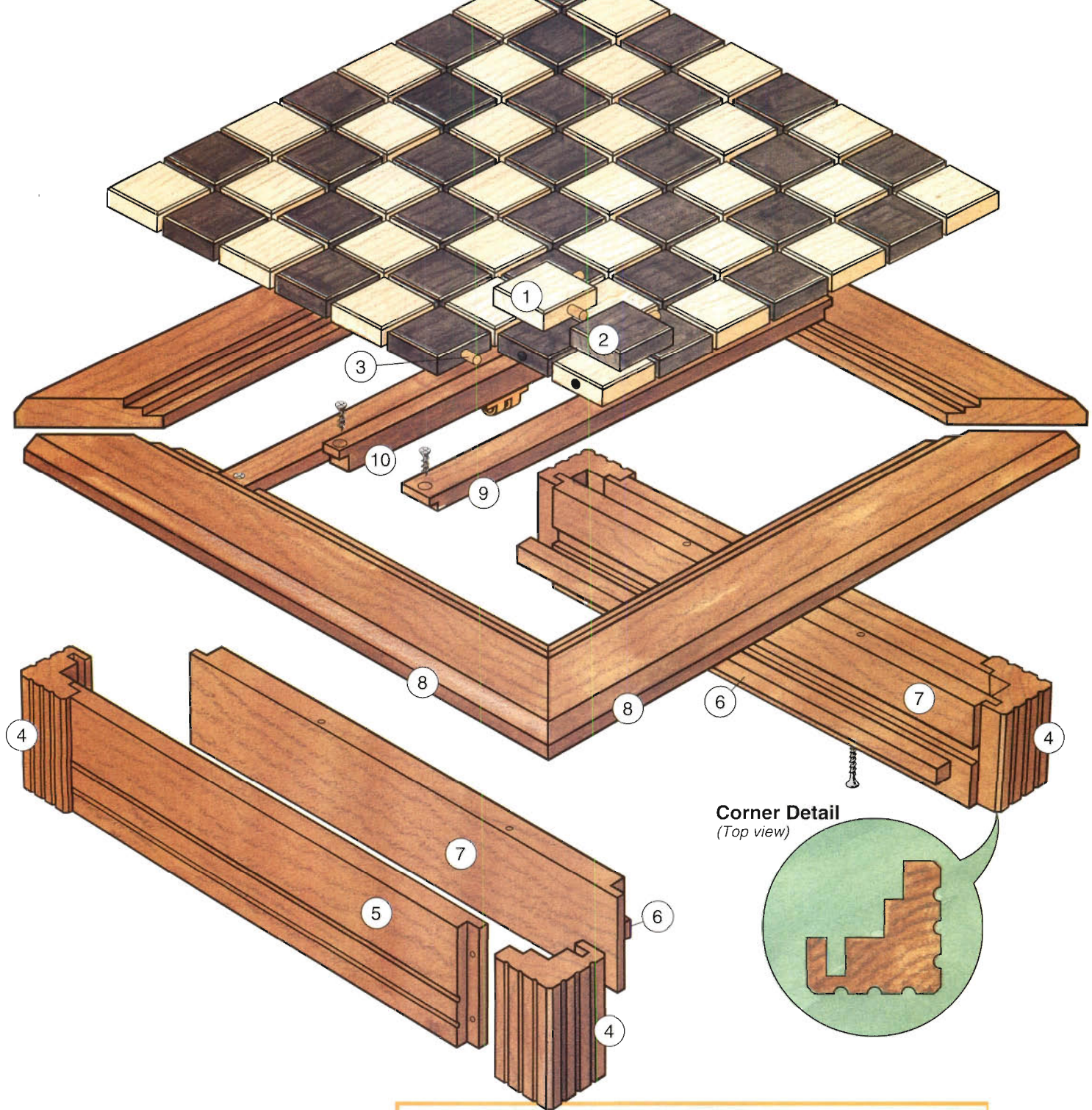


Figure 2: A simple jig facilitates drilling a series of accurate holes for the dowels that hold the chessboard grid together.

Wood Movement Solutions

We all know how wood expands and contracts with the seasons, so you can imagine our concern when we started discussing the chessboard for this project, which features two distinct species. To avert a potential disaster, Dan employed a technique we came across in a book written by renowned woodworker James Krenov: A series of dowel pins (pieces 3) are used to assemble the grid.

A drill press is essential when drilling for these pins, because if the holes (see the **Pinup Shop Drawings** for locations and depths) are the slightest bit off, the assembled grid will not be flat. A simple jig (see Figure 2) clamped to the drill press table lines up each square with the bit. As you drill, make sure there is no chip buildup in the jig, or the holes will be off center. The squares along the outside edges are drilled three times, while those on the corners are only drilled twice (on adjacent edges). The squares in the field, however, receive four holes each.

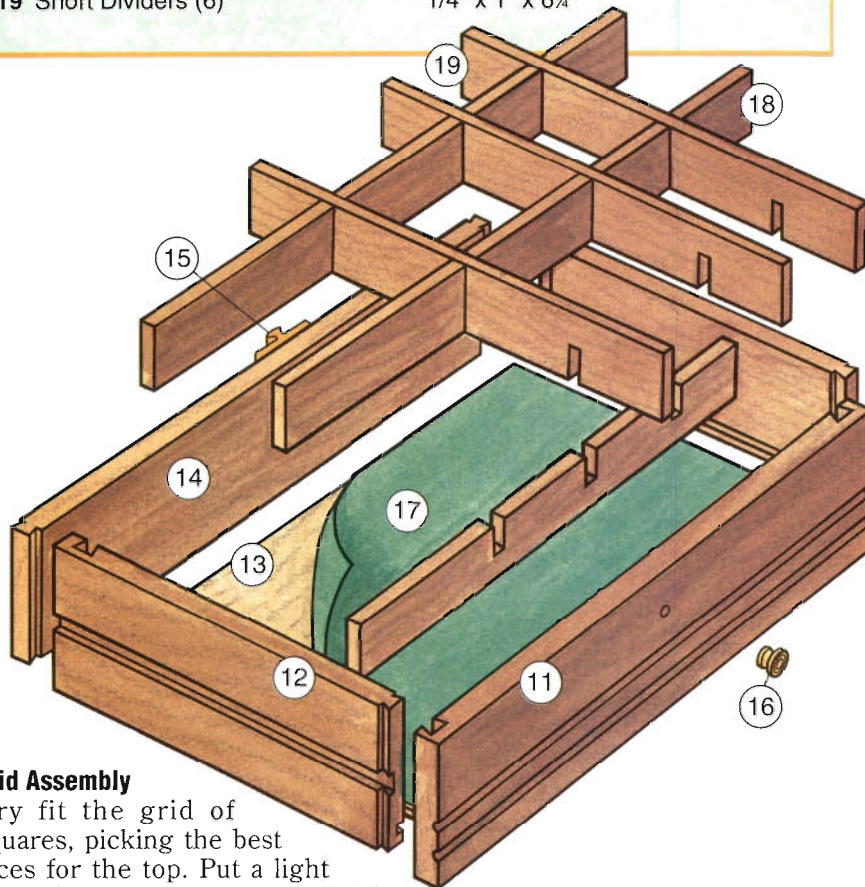


MATERIAL LIST - Chessboard and Case

	T x W x L
1 Light Squares (32)	1/2" x 1 5/8" x 1 5/8"
2 Dark Squares (32)	1/2" x 1 5/8" x 1 5/8"
3 Grid Pins (112)	1/4" x 1" Dowel
4 Corners (4)	1 3/4" x 1 3/4" x 2 7/8"
5 Sides (2)	1/2" x 2 7/8" x 14 3/8"
6 Drawer Slides (2)	1/2" x 1/2" x 15 1/2"
7 Drawer Slide Supports (2)	3/4" x 2 7/8" x 16 3/8"
8 Frames (4)	3/4" x 2 3/4" x 17"
9 Braces (2)	1/2" x 1" x 12 1/4"
10 Drawer Catch Support (1)	1/2" x 3/4" x 12 1/4"

MATERIAL LIST - Drawers

	T x W x L
11 Fronts (2)	1/2" x 2 3/4" x 13 1/4"
12 Sides (4)	1/2" x 2 3/4" x 7 7/8"
13 Bottoms (2)	1/4" x 12 3/16" x 7 5/8"
14 Backs (2)	1/2" x 2 1/4" x 12 1/4"
15 Catches (2)	1/4" x 1 3/4" Brass
16 Pulls (2)	3/8" Diameter Antique Brass
17 Liner (1)	12" x 24" Self-adhesive Green Felt
18 Long Dividers (6)	1/4" x 1" x 11 5/8"
19 Short Dividers (6)	1/4" x 1" x 6 3/4"



Grid Assembly

Dry fit the grid of squares, picking the best faces for the top. Put a light (maple) square in the right-hand corner closest to each player. Run the grain of both species in the same direction to help with wood movement problems. You'll notice that the 1" long grid pins are too short to bottom out in the holes. This is intentional - it allows the wood to move and allows the spacers to set the correct gap.

Make any corrections during your dry fit because, with the chamfer on the squares, you won't be able to sand the grid flat later. Use a straightedge and several plastic laminate spacers (see **Figure 3**) to keep everything in line and spaced perfectly, then glue up eight strips of alternating dark and light squares. When they're dry, glue the strips together to form the complete chessboard grid.



Figure 3: Use several plastic laminate spacers to assure proper alignment when gluing up the squares of the chessboard. Cut a recess in each spacer to fit around the grid pin dowels.

Milling the Corners

The corners (pieces 4) of the chessboard case are milled from one 12" long piece of 1 1/2" square stock that receives decorative fluting and chamfering on two adjacent faces (see **Pinup Shop Drawings** for dimensions and locations). These chamfers are the same as those you already milled on the grid squares, so return to the router table to create them. The flutes are also cut on the router table, using a 1/8" core box or round nose bit. Mark the centerline of each cut (see **Pinup Shop Drawings**) on the end of a piece of 1 1/2" square scrap, then set your fence and make practice passes on the scrap for each flute before milling the workpiece.

The inside is formed on the table saw, using a 1/4" wide dado set. To reveal the stepped profile of this piece, make several passes for both safety and quality reasons. Wrap up by cutting the corners to length.

Case Sides and Drawer Fronts

The case sides (pieces 5) and drawer fronts (pieces 11) are made from the same molding. To make this molding, rip your stock to 2 3/4", then head for the router table. Use your core box bit to cut the two flutes in the molding, then crosscut the molding to the correct lengths and rip the drawer fronts to 2 3/4". Finally, go back to the table saw dado set to cut the rabbets on the ends of the sides (see the **Pinup Shop Drawings**).

Drawer Slides and Supports

The outside edges of the two drawers are quite a distance from the case sides. This presents a problem in that there is nowhere to attach the drawer slides (pieces 6). The solution is to attach supports (pieces 7) to the insides of the corner moldings. Each of these boards features a groove into which the drawer slide is inserted, and both boards can be made at the same time as a single piece of molding.



Figure 4: Use a 14° dovetail bit to form the joints on the drawer sides, fronts and backs.

Making this molding is relatively uncomplicated. Simply cut the stock to the dimensions given in the Material List, then create the grooves and rabbets (see **Pinup Shop Drawings** for dimensions and locations) on the table saw using the dado set.

Now mill the drawer slides, dry fit the corners, sides, drawer slide supports and drawer slides together and, if everything fits, glue and screw (see **Pinup Shop Drawings** for screw locations) the case together.

The Grid Frame

The frame that surrounds the chessboard grid is not only decorative, it's also functional. This frame is used to attach the grid to the case.

Start making the frames (pieces 8) by ripping stock to size, then set your table saw blade to 45° to create the chamfer on the outside edge (see **Pinup Shop Drawings**). Switch to the dado set to cut the two rabbets on the inside edge, then return to your router table to mill the slight chamfer above the top rabbets (also shown on the **Pinup Shop Drawings**). Cut the frames to length at a 45° angle using your table saw's miter gauge, then glue up the frame (make sure it is square by measuring both diagonals and adjusting clamps until the measurements are equal).

The two frame braces (pieces 9) and the drawer catch support (piece 10) are ripped to size, then small rabbets are cut on their ends with the dado set (see **Pinup Shop Drawings**). Predrill and countersink for 1/2" screws, then glue and screw the

braces and catch support in place. When the glue is dry, drill four 3/8" diameter counterbores for 2½" screws in the bottom of the drawer slide supports (see **Pinup Shop Drawings**), then screw the side assemblies to the frame.

Building the Drawers

You've already created the drawer fronts, so now you can cut the rest of the drawer parts to size. Install the dado set on your table saw to make the drawer slide grooves (see **Pinup Shop Drawings**) in the outside faces of the drawer sides (pieces 12). Now cut a 1/4" wide groove on each inside face of the sides and on the drawer fronts for the drawer bottoms (pieces 13). The backs (pieces 14), receive no grooves for the bottoms. Switch to your router table to make the dovetail joints that hold the fronts and backs to the sides, using a 14° bit (see **Figure 4**). Before I use the dovetail bit, however, I always use a straight bit to remove most of the waste. And I always test my

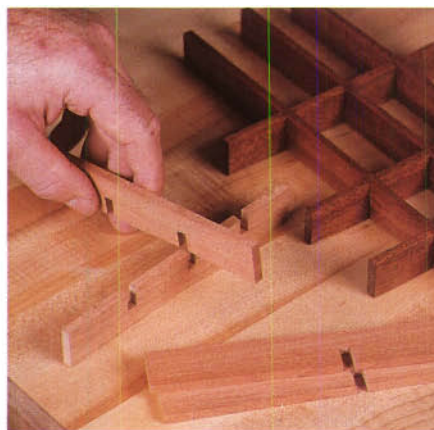


Figure 5: The drawer dividers are ripped and jointed to the correct width and thickness, then held together by half lap joints.

setups on scrap before milling the workpieces.

You can now glue and clamp the drawers together. The drawer bottoms just slide into their grooves and are then tacked to the drawer back with a couple of 3/4" brads, making them replaceable if necessary.

Finishing Up

After sanding the entire project thoroughly, I applied three coats of Danish oil. When your finish is dry, install the drawer catches (pieces 15) and pulls (pieces 16). The catches are simply screwed in place (see the **Pinup Shop Drawings** for locations), though you will need to drill holes for the pulls (these are also shown on the **Pinup Shop Drawings**). To make the drawers glide smoothly, I recommend that you apply friction fighting Nylo-Tape in the four drawer slide grooves.

The inside of each drawer is lined with self-adhesive felt (piece 17), that comes in a sheet. This is simply cut to size and stuck in place. Apply the felt just to the bottom of each drawer. To divide the drawers into individual storage compartments, you can make simple dividers (pieces 18 and 19) spaced out to fit your particular chess pieces. Use your dado set to create half lap joints where the pieces cross, as shown in **Figure 5**.

Finally, I promised earlier to reveal Dan's design inspiration: If you look at the completed project, the overall impression is of a boxing ring, complete with ropes and padded corners. So find a worthy opponent and get ready for round one.

The chessmen shown on page 18 can be ordered from *Games by James of Ridgedale, MN: 1-612-546-5446*.

Chessboard Hardware Kit

A hardware kit is available for this project that includes the drawer pulls, catches, Nylo-Tape and felt drawer liner.

Item #34281.....\$19.95

Chessboard Lumber Kit

The lumber package includes enough wenge and hard maple to make all 64 squares.

Item #34356.....\$24.95

To order kits, call 1-800-610-0883.

Kaleidoscope

Look no further, here's the perfect production project for the holiday season.

By John English



ne of Scotland's most distinguished sons, physicist Sir David Brewster (1781-1868), is credited with inventing the kaleidoscope. Brewster discovered numerous physical laws that govern the behavior of light, including Brewster's Law, which helps define such things as polarized sunglasses. But you don't need to study optics to build this kaleidoscope: Just head for the shop and dig out some 10" long pieces of 2" x 2" hardwood from the scrap bin. This is a great production project, so look for several pieces of stock. If you can't find 2" square blanks in your favorite species, just face glue three pieces of 3/4" stock, then trim the two outside faces evenly so the middle piece is centered.

Once you have your blanks, the first step in construction is to mark one surface of each with random pencil lines. That way you'll always be able to orient the pieces correctly. Next, use a try square to mark off the three sections of each blank, and the 1/8" spaces between them (see the **Full-size Pattern** between pages 16 and 17). Crosscut each blank through the spaces using your table saw's miter gauge, then move to the drill press to start milling.

Milling the Segments

I like to use Forstner bits throughout projects like this: They provide clean walls and flat-bottomed bores.

The lens segment (piece 1) is bored three times, each with a different diameter bit. Set up your drill press so that a 1 1/4" bit is centered on the end of the segment: This is the end that will be glued to the middle segment (piece 2) upon reassembly. Set the depth gauge on your drill

press to stop the bit 1/2" from the other end of the segment, then clamp the workpiece firmly in place as shown in **Figure 1** on page 24, and bore the hole. Now switch to a 1/2" bit and drill 1/4" deeper into the wood, then turn the segment end for end and bore a 1/4" diameter hole all the way through.

Milling the middle segment is a lot simpler: Just bore it all the way through with the 1 1/4" bit, then use the same bit to drill a 2 1/4" deep hole

in the wand segment (piece 3). Drill this hole into the end that will be glued to the middle segment.

There are two more milling operations that should be completed before the segments are reglued. Begin with the 11/16" diameter hole for the wand (see **Full-size Pattern** for location). An 11/16" Forstner bit may be hard to find, so this can be made with a sharp spade bit - if you place a piece of scrap under the exit point to prevent tearout.



Kaleidoscope Hardware Kit

This kit includes the mirror set, the lens, a wand and a pair of O-rings.

Item #34265\$14.95

Hardwood and Hardware Kit

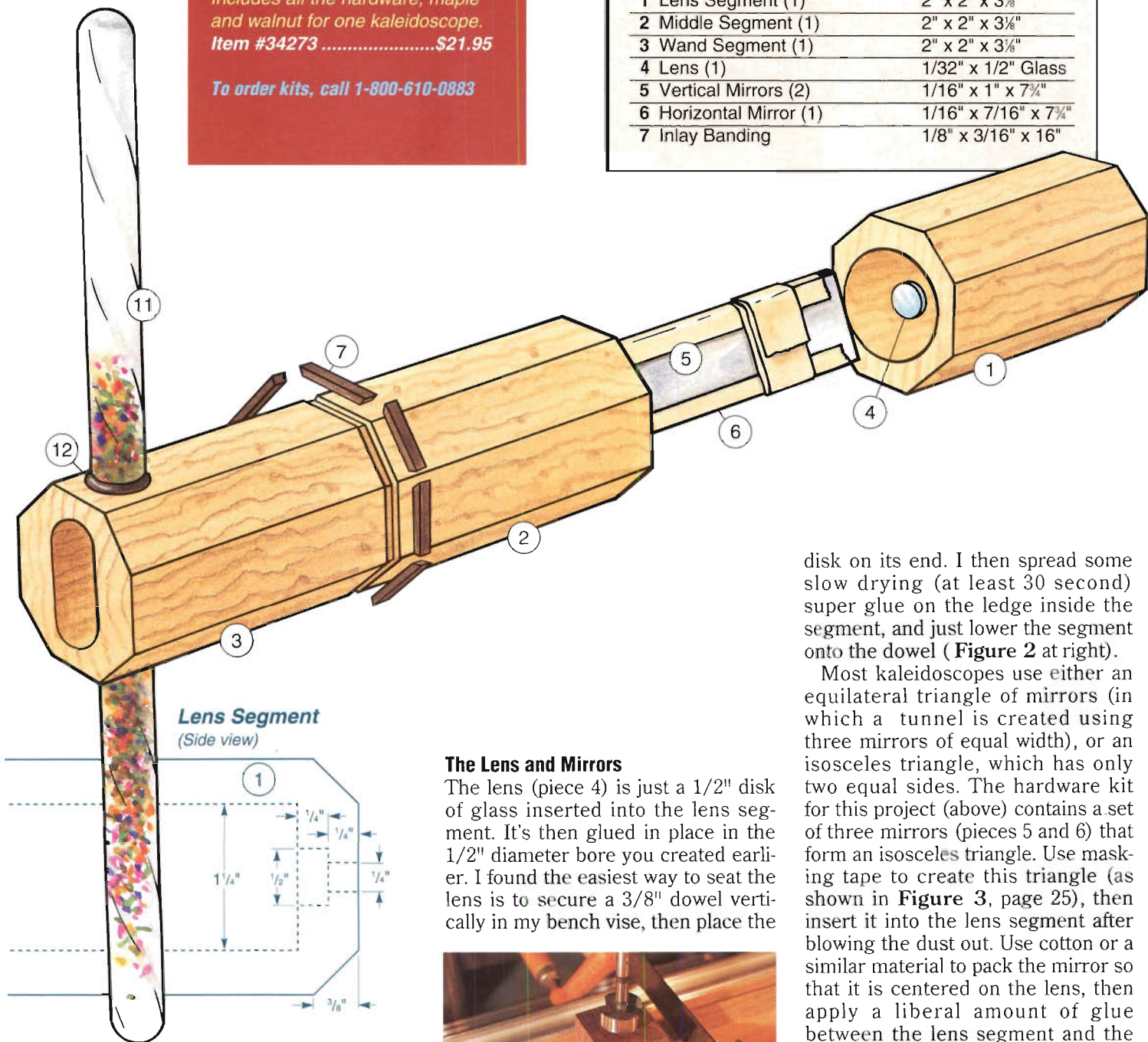
Includes all the hardware, maple and walnut for one kaleidoscope.

Item #34273\$21.95

To order kits, call 1-800-610-0883

MATERIAL LIST - Kaleidoscope

	T x W x L
1 Lens Segment (1)	2" x 2" x 3/8"
2 Middle Segment (1)	2" x 2" x 3/8"
3 Wand Segment (1)	2" x 2" x 3/8"
4 Lens (1)	1/32" x 1/2" Glass
5 Vertical Mirrors (2)	1/16" x 1" x 7/8"
6 Horizontal Mirror (1)	1/16" x 7/16" x 7/8"
7 Inlay Banding	1/8" x 3/16" x 16"



disk on its end. I then spread some slow drying (at least 30 second) super glue on the ledge inside the segment, and just lower the segment onto the dowel (Figure 2 at right).

Most kaleidoscopes use either an equilateral triangle of mirrors (in which a tunnel is created using three mirrors of equal width), or an isosceles triangle, which has only two equal sides. The hardware kit for this project (above) contains a set of three mirrors (pieces 5 and 6) that form an isosceles triangle. Use masking tape to create this triangle (as shown in Figure 3, page 25), then insert it into the lens segment after blowing the dust out. Use cotton or a similar material to pack the mirror so that it is centered on the lens, then apply a liberal amount of glue between the lens segment and the middle segment. Working quickly before the glue sets, pack cotton wool into the middle segment, then apply glue to the joint between it and the wand segment. Make sure the mirror triangle lines up properly with the elongated hole in the end of the wand segment (see Full-size Pattern), then apply clamps and let this assembly dry.

The Lens and Mirrors

The lens (piece 4) is just a 1/2" disk of glass inserted into the lens segment. It's then glued in place in the 1/2" diameter bore you created earlier. I found the easiest way to seat the lens is to secure a 3/8" dowel vertically in my bench vise, then place the

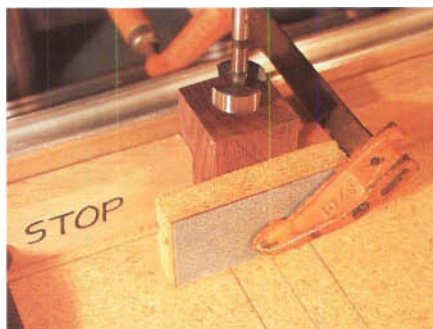


Figure 1: Set up your drill press to bore each of the three segments. Safety is paramount here: Make sure the workpiece is firmly clamped.

Finally, bore a series of 5/8" diameter holes through the undrilled end of the wand segment, creating the hole that allows light into the kaleidoscope (see Full-size Pattern for locations), and use a rasp to straighten the two long sides of this opening.

When it's dry, set your table saw blade to 45°, remove any excess glue from the glued-up body - a scraper or sandpaper block works well for this - then cut all four chamfers (see the **Full-size Pattern** for dimensions). With the blade still set at 45°, this is a good time to chamfer the lens end of the kaleidoscope using your saw's miter gauge. You can find these dimensions on the **Full-size Pattern**, too.

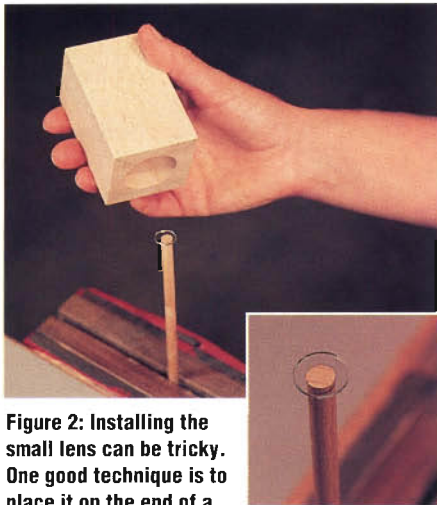


Figure 2: Installing the small lens can be tricky. One good technique is to place it on the end of a dowel that is locked in a vise. Apply glue inside the lens segment, then gently lower the segment onto the lens. You can watch through the lens hole as you align the two parts.

The Inlaid Band

Inlaying the band is a lot simpler than it looks. Set your table saw blade back to 90° and adjust the height for a 1/8" deep cut. Then clamp a stop to the miter gauge fence so that the blade is centered on one of the joints in the kaleidoscope body, and make a series of cuts all the way around.

Repeat this process on the other end, then raise the blade and rip some 1/8" wide strips of a contrasting species for the inlay banding (pieces 7). Cut sections of these strips slightly longer than you need, then sand each end to 22½° with a fine belt on your stationary belt sander. Use super glue to secure the banding in the saw kerfs, then sand off the excess when the glue is dry. A sanding block works better than a power pad sander here: The latter tends to round over the chamfers.

The Stand

The stand is just two pieces of 3/4" square stock (pieces 8), screwed and glued to a base (piece 9). Cut the base to shape according to the **Full-size Pattern**. The tops of the uprights are shaped on a 2" drum sander in the drill press, then the uprights are glued and screwed (pieces 10) in place. Finally, break any sharp edges with sandpaper.

Finishing Up

At this stage, you can insert the wand (piece 11) in its hole, turn the kaleidoscope toward daylight, and test your handiwork. Assuming that everything looks right, remove the wand and mask off all the holes in the body to stop dust getting into the mirror. Then sand all visible surfaces down through the grits to 180. Remove the masking tape and apply three or four coats of oil finish, sanding between coats with 400 grit wet/dry paper, making sure no oil gets into the mirror.

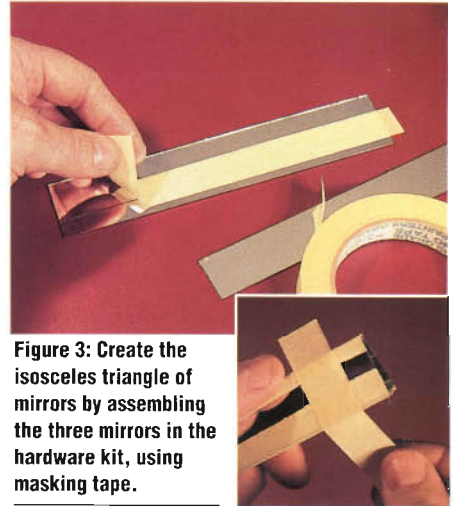


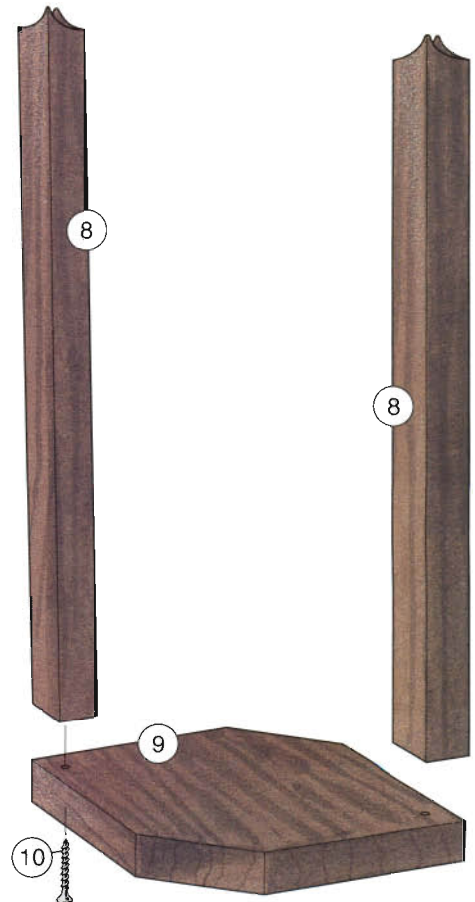
Figure 3: Create the isosceles triangle of mirrors by assembling the three mirrors in the hardware kit, using masking tape.

When the last coat of oil is dry, slip a rubber O-ring (piece 12) onto the wand, insert the wand into the kaleidoscope and install the second O-ring to secure the wand. Now rotate the kaleidoscope so the material inside the wand begins to fall, and watch through the lens.

One last tip: For a more interesting effect, twirl the wand as you watch those magical patterns develop inside your kaleidoscope.

MATERIAL LIST - Stand

	T x W x L
8 Uprights (2)	3/4" x 3/4" x 9"
9 Base (1)	3/4" x 4" x 4"
10 Screws (2)	1 5/8" Sheetrock Screws
11 Wand (1)	11/16" x 11 1/2", Glass
12 Rubber O-Ring (2)	5/8" ID



Road Grader

Here's a terrific weekend project that really makes the grade with the kids!

By Dick Dorn



iving here in Iowa, I get to see road graders year round. All summer

long they resurface our county roads, and during the winter they plow through seemingly unending snowfalls. One day last winter I watched a grader lead a school bus through a particularly high snow drift, plowing a clear, safe path and entertaining two dozen wide-eyed kindergartners in the bargain. That's when I decided to build my toy road grader, and as with most vehicle manufacturers, I began with the infrastructure.

For the chassis (piece 1) of this toy, I chose 1/2" clear walnut. This piece is wide at the front where it supports the cab, and narrow at the rear where it forms a floor for the engine compartment. Refer to the **Full-size Pattern** between pages 16 and 17 for all the dimensions, then cut the chassis to shape on your band saw. Drill the rivet holes at the locations shown on the pattern, then use a 1/4" roundover bit in your router to radius all the edges.

Through-out this project you'll be routing both the top and bottom of 1/2" thick boards with a 1/4" roundover bit. This has to be done on a router table with a fence: Free-hand guided bits won't work because after the first cut is made, the bit's bearing won't have a square surface to ride on while making the second cut.

Make the Main Beam

The second major component of the infrastructure is a long beam (piece 2) that extends almost the full length of the vehicle. For contrast with the walnut elements of the grader, I chose to make this out of clear hard maple. The beam begins as two pieces of 3/4" thick stock face glued together to form a board 1 1/2" thick. When the glue is dry, set your table

saw fence to remove 5/32" from each face. This will give you a board 1 3/8" thick, with an almost invisible seam running down the center.

The profile for the beam can be found on the **Full-size Pattern**. Photocopy this pattern and glue it to your stock, then cut out the beam on your band saw. Sand both the band and table saw kerf marks off the beam, then use a 1/2" radius bit in your router to round over all the edges on the front half (see **Full-size Pattern**). Make sure you don't round over the front end of the beam, or the steering assembly won't seat properly later on. Use a quick setting epoxy to assemble the beam

to the chassis. Using epoxy is a great way to avoid clamping irregularly shaped parts, but if you're unfamiliar with two-part adhesive, I suggest you try it on some scrap first to get the hang of it.

The Engine and Cab

With the chassis complete, move on to the engine compartment. Its sides (pieces 3) are radiused on their back outside edges with a 1/8" roundover bit, then they're epoxied to the back (piece 4). The compartment lid (piece 5) is installed next. This is 1/2" stock, radiused top and bottom on three edges (leave the front edge square). Epoxy it to the sides and back, making sure that all the front edges are flush with each other.

The cab back and front (pieces 6) are also made from 1/2" stock. The windows and the hole for the beam are cut out with a scroll or jigsaw (see **Figure 1**), following the **Full-size Pattern**. Break the edges of the windows and beam recess with sandpaper, then round over the side edges of both with your 1/4" roundover bit (leave the top and bottom edges of the cab front square).

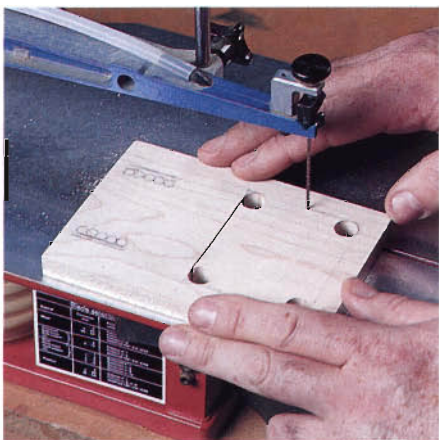


Figure 1: Cut the windows into the cab front and back with a scroll saw or jigsaw, then sand the kerfs and break any sharp edges in the cutouts.

The cab front is milled so that the blade subassembly can be raised or lowered, depending on whether your little driver is tackling snow or gravel. This milling consists of a series of 5/16" holes that are best drilled with

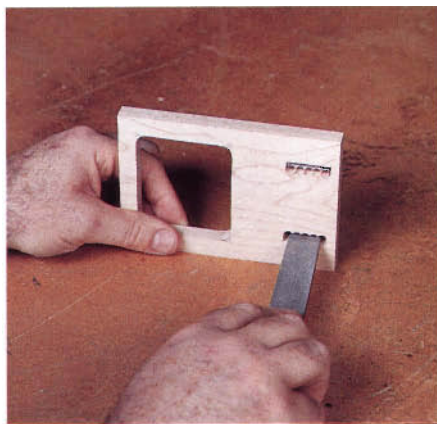


Figure 2: A series of notches in the cab front allow the blade to be raised and lowered. After several holes are drilled, one side is filed flat.

a Forstner bit in a drill press (see the **Full-size Pattern**). Once drilled, the inside edge of each elongated hole is filed in turn with rough and smooth files, as shown in **Figure 2**. Use a round file in the corners.

Dry fit the cab front, the cab back and the engine compartment subassembly to the chassis, and clamp them in place temporarily. Make sure the cab front and back are square to the chassis, then use your 1/8" drill bit to extend the holes you drilled earlier in the floor. Remove the clamps and dry fit the cab rivets (pieces 7) in the holes. When everything looks right, epoxy the cab front, cab back and the engine compartment to the chassis. Epoxy the rivets in place and sand them flush.

The seat sides (pieces 8) can be cut from 1/2" stock and epoxied in place after their front edges are broken with sandpaper. To keep everything in scale, switch to 3/8" stock for the seat top and back (pieces 9 and 10). Using a sander, create a 1/4" radius on the front two corners of the seat top, then round over three edges (leaving the back edge square) with a 1/8" radius bit. When routing small pieces like this, I like to attach a temporary handle to keep my fingers away from the cutter (see **Figure 3**).

The seat back receives the same treatment as the top, except that this time the bottom edge is left square. Epoxy both pieces in place, then install the driver (piece 11). After the cab roof (piece 12) is cut to size, the corners are slightly radiused with a

sander. Then both the top and bottom edges are rounded over on the router table (using a fence). When you're done, drill the four cab rivet holes in the roof: Their locations can also be found on the **Full-size Pattern**. Extend the four rivet holes into the tops of the cab front and back (use the same technique employed earlier for the lower rivets), then epoxy the roof and the rivets in place.

The Steering and Blade Assemblies

To make the steering work, a stationary rack (piece 13) is attached to a moveable axle (piece 14). Cut both pieces to size, shape them on a sander (see the **Full-size Pattern**), then drill the hole in each for the steering assembly bolt (piece 15). Predrill the end of the beam for the screw end of this hanger bolt, then screw it in place.



Figure 3: I like to hot melt glue a temporary handle to small parts when routing them, just to keep my fingers away from the cutter.

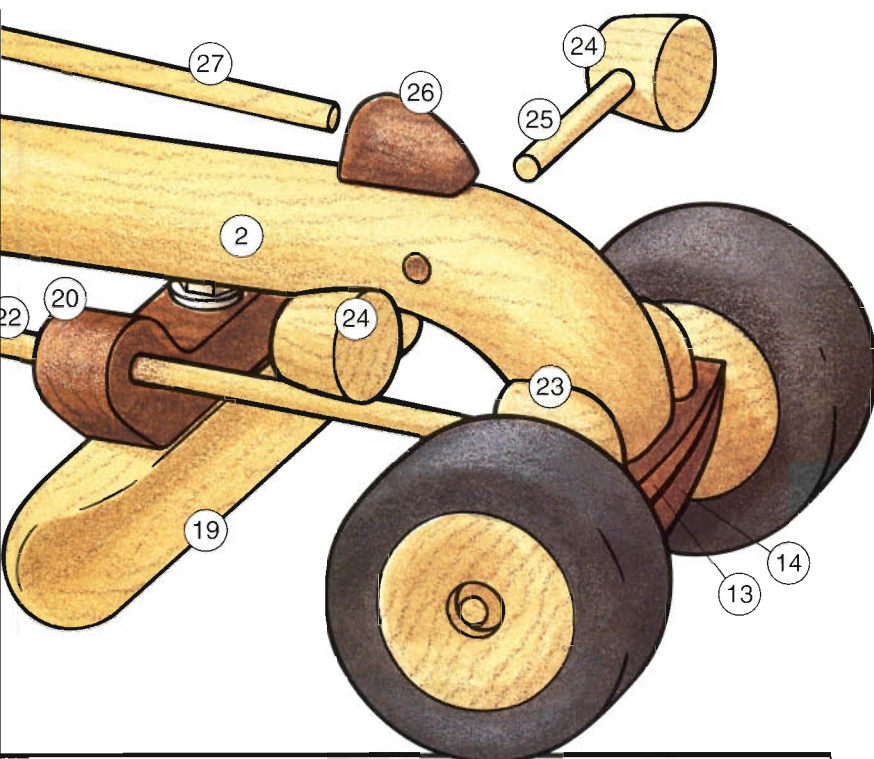
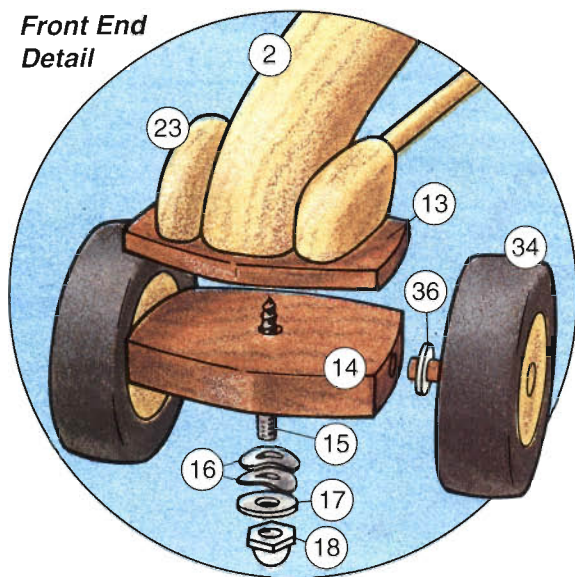
Break the edges of the steering rack, then slip it over the bolt and epoxy it in place. Then slip the axle over the bolt, and install the curved spring washers (pieces 16) and the flat washer (piece 17). Secure everything with a locking nut (piece 18). If your hardware store doesn't carry the curved spring washers, they're available from Sterling Instrument (1-516-328-3300, part #A7Q91W 04911). Don't overtighten the nut: The axle should be able to move easily and remain at its new setting.

A hardware kit is available for this project that includes the cab rivets, the driver, steering wheel, muffler, fuel cap, taillights and the Rubbarider™ wheel assemblies.

Use order form, or call 1-800-610-0863.

28

**Front End
Detail**



The grader's blade (piece 19) is designed to last a long time between sharpenings. Begin shaping the blade (see the **Full-size Pattern**) by cutting a block of stock to the dimensions in the Material List. The blade is attached to a carriage (piece 20) with another hanger bolt (piece 21), and you can drill a pilot hole for the screw end of this bolt while the blade is still a rectangle. The concave front surface of the blade can be formed on a drill press using a 1½" diameter drum sander (see **Figure 4**, below): Remove most of the waste on your table saw first. The back of the blade is formed with a belt sander.



Figure 4: After removing most of the waste with your table saw (workpiece on table), you can form the concave face of the grader's blade with a 1½" drum sander chucked in a drill press.

The blade carriage is cut to shape on a band saw, then two holes are drilled through it at angles (see the **Full-size Pattern** for locations and dimensions). A third hole - for the hanger bolt - is drilled in the center. Assemble the blade to the carriage using two more spring washers, a flat washer and a locking nut.

The blade subassembly is mounted on a pair of long bars (pieces 22), cut from 5/16" hardwood dowels and anchored in a pair of mounts (pieces 23). These are drilled (see the **Full-size Pattern** for hole locations), then cut to shape on the band saw and rounded over with a sanding block. Epoxy the bars into the mounts, then slide them through the angled holes in the blade carriage. Dry fit this assembly, making sure the bars are spread enough at the

	T x W x L
25 Headlight Base (1)	5/16" x 2¼" Dowel
26 Steering Column Mount (1)	1½" x 5/8" x 1¼"
27 Steering Column (1)	5/16" x 7" Dowel
28 Steering Wheel (1)	1" OD Maple Wheel
29 Exhaust Stack (1)	1/2" x 4" Dowel
30 Muffler (1)	1½" Dia. Wooden Oil Drum
31 Fuel Cap (1)	1/8" Axle Pin
32 Taillights (2)	5/8" Walnut Buttons
33 Wheel Rims (6)	Rubbarider™ Kit
34 Tires (6)	Rubbarider™ Kit
35 Axle Retainer Pins (6)	Rubbarider™ Kit
36 Axle Retainer Pin Washers (6)	1/16" x 1/2" Neoprene

cab to lock into the milled oblong holes you made earlier. Clamp the mounts to the front axle rack and mark the location of the carriage nut on the underside of the beam. Then remove the clamps and use a Forstner bit to drill a hole in the bottom of the beam for the blade carriage nut. Finally, epoxy the mounts to the axle rack.

Final Assembly

Several small parts still need to be fashioned. First, drill holes in each headlight (pieces 24) and through the beam for the headlight base (piece 25), then epoxy the lights in place. Make the steering column mount (piece 26) on the band saw. Then drill a 5/16" hole in the front of the cab (see the **Full-size Pattern**), and a matching hole in the steering column mount. Epoxy the mount to the beam, then install the steering column (piece 27) with epoxy. Drill another 5/16" hole in the steering wheel (piece 28), and dry fit this onto the end of the column. Mark the column where it emerges from the wheel, trim it to length, then epoxy the wheel in place.

The exhaust stack (piece 29) is simply a piece of 1/2" dowel with the top cut off at a 30° angle. It is epoxied into a hole in the engine compartment (see the **Full-size Pattern**). The muffler (piece 30) is an oil drum drilled to fit around the exhaust stack and epoxied 1/2" above the engine compartment. While you have some epoxy mixed, install the fuel cap (piece 31) and taillights (pieces 32).

Finishing Up

Apply finish to the entire grader, including the wheel rims (pieces 33) before installing the wheels. The rims, tires (pieces 34), axle pins (pieces 35), and washers (pieces 36) come as a kit. Drill holes for the pins (see the **Full-size Pattern** for locations), then use your drill press and a piece of scrap to push the tires onto the rims. Slip the pins through the rims, slide the washers in place, and epoxy the pins into the chassis and front axle, making sure the wheels turn freely. Then find a gravel road in need of grading and send your favorite little driver off to work.

Dick Dorn teaches woodworking in the Oelwein, Iowa, school system.

Classified Marketplace

Classified Rate: \$40 minimum for 25 words; \$1.50 for each additional word. Payment must accompany order. Send copy and check/money order to: *Classified Marketplace, Today's Woodworker*, Box 261, Medina, MN 55340. Or Fax copy to 612-478-8396 and use credit card. Display classified rates start at \$75 per inch; call Jill Arens, 612-478-8305 for more details. **Deadline for the Jan/Feb issue is Dec. 1, 1996.**

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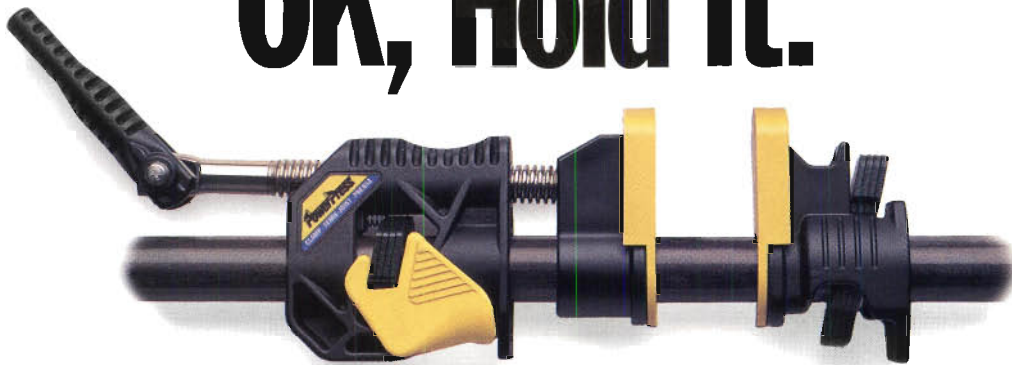
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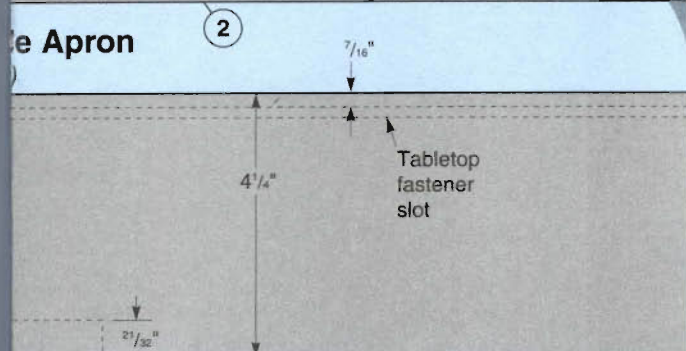
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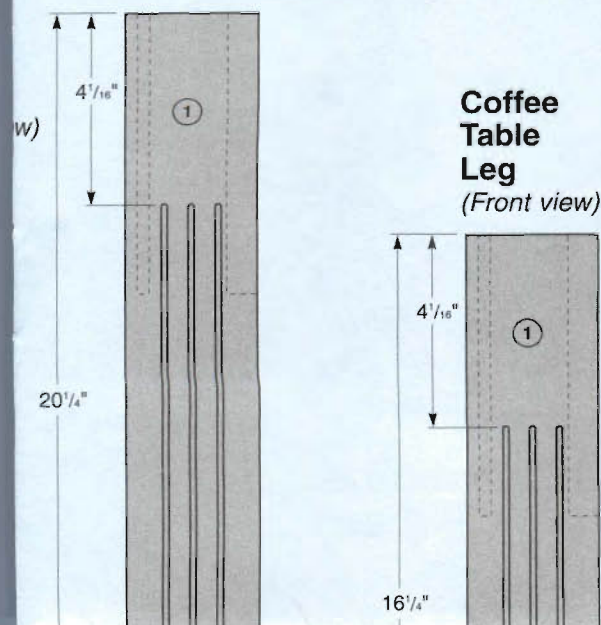
e Apron



MATERIAL LIST

	T x W x L
1 Legs (4)	2 3/4" x 2 3/4" x 31 1/4"
2 Front and Back Aprons (2)	3/4" x 4 1/4" x 47 1/4"
3 Side Aprons (2)	3/4" x 4 1/4" x 10 1/4"
4 Brackets (8)	5/8" x 3 1/2" x 8 3/32"
5 Tabletop Fasteners (10)	Steel
6 Cove Molding (1)	3/4" x 3/4" x 150"
7 Bead Molding (1)	3/8" x 3/4" x 150"
8 Bracket Fillers (16)	1/4" x 5/8" x 1 11/16"
9 Tabletop (1)	1" x 17" x 54"

ting the Series (See page 16)



Full-Size Patterns

PINUP SHOP DRAWINGS

- Open staples carefully, remove pattern and fold staples back in place.
- Use graphite paper (available at art supply stores) or cut and trace full-size patterns onto your stock.
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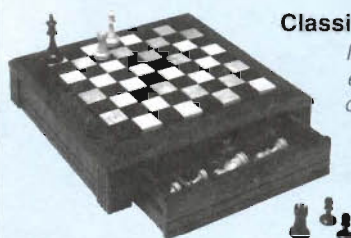
Chippendale Table

Our Pinup Shop Drawings provide you with all the detailed elevations. You also get a full-size pattern for the decorative leg brackets, plus a complete material list.



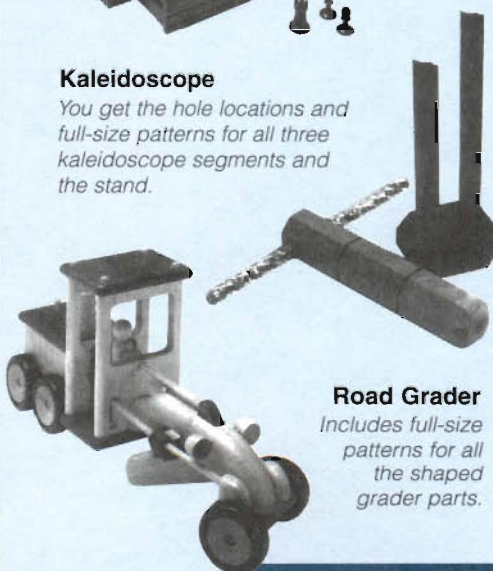
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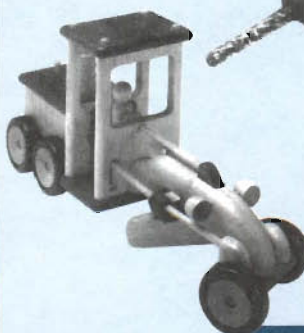
Kaleidoscope

You get the hole locations and full-size patterns for all three kaleidoscope segments and the stand.



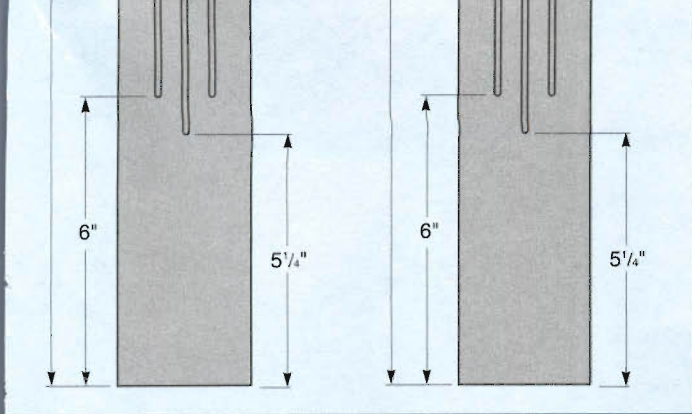
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Includes full-size patterns for all the shaped grader parts.



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worker #48

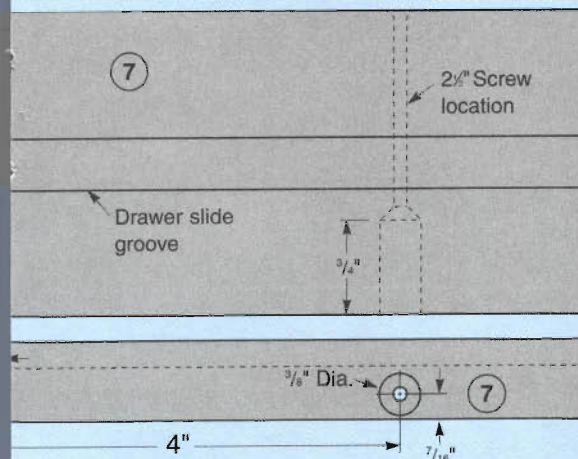
Brace

(Side view)



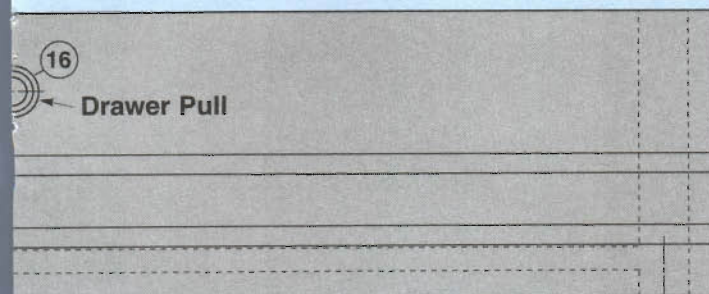
Drawer Support

(Side view)



15 Catch

Note: Position the female half of the catches as shown, then friction fit the male halves. Then insert the drawers and mark the male half locations on the backs.

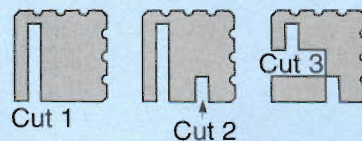


Drawer Pull

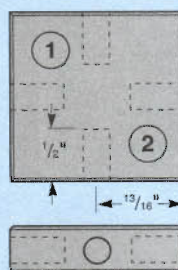
Use 1/2" 14° dovetail bit → 3/8"

MATERIAL LIST

	T x W x L
1 Light Squares (32)	1/2" x 1 1/8" x 1 1/8"
2 Dark Squares (32)	1/2" x 1 1/8" x 1 1/8"
3 Grid Pins (112)	1/4" x 1" Dowel
4 Corners (4)	1 3/4" x 1 3/4" x 2 7/8"
5 Case Sides (2)	1/2" x 2 7/8" x 14 3/8"
6 Drawer Slides (2)	1/2" x 1/2" x 15 1/2"
7 Drawer Slide Supports (2)	3/4" x 2 7/8" x 16 3/8"
8 Frames (4)	3/4" x 2 3/4" x 17"
9 Braces (2)	1/2" x 1" x 12 1/4"
10 Drawer Catch Support (1)	1/2" x 3/4" x 12 1/4"
11 Drawer Fronts (2)	1/2" x 2 3/4" x 13 1/4"
12 Drawer Sides (4)	1/2" x 2 3/4" x 7 7/8"
13 Drawer Bottoms (2)	1/4" x 12 3/16" x 7 5/8"
14 Backs (2)	1/2" x 2 1/4" x 12 1/4"
15 Catches (2)	1/4" x 1 3/4" Brass
16 Pulls (2)	3/8" Diameter Antique Brass
17 Liner (1)	12" x 24" Self-adhesive Green Felt
18 Long Dividers (6)	1/4" x 1" x 11 1/8"
19 Short Dividers (6)	1/4" x 1" x 6 3/4"

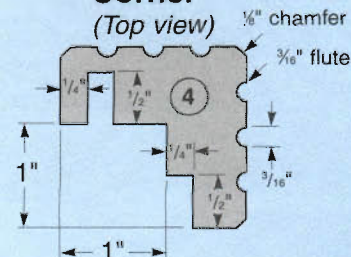


Square
(Top view)

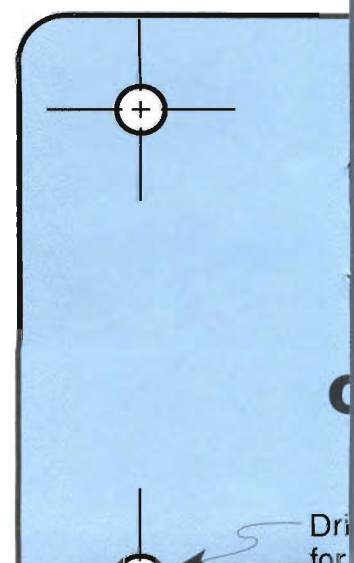
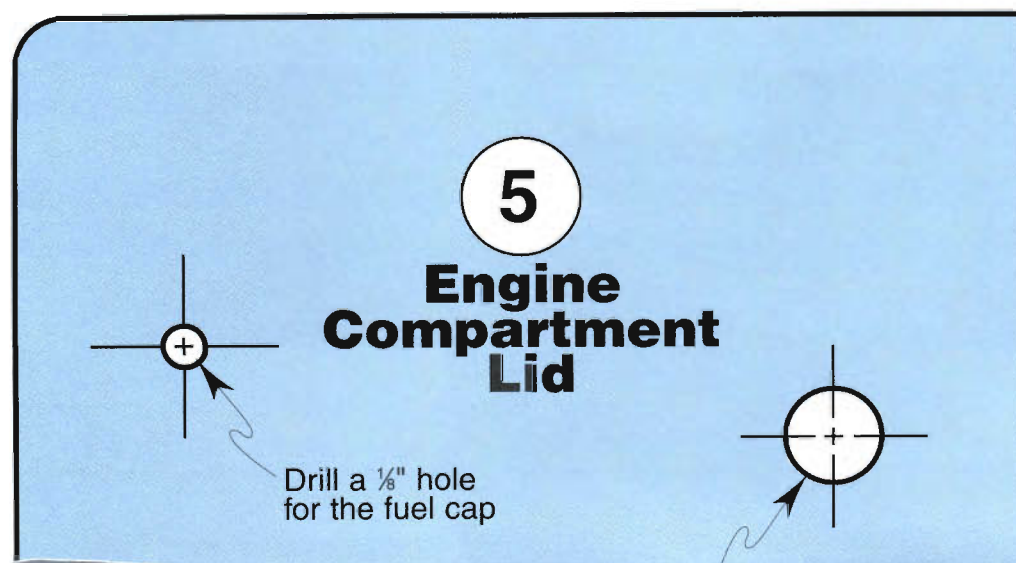
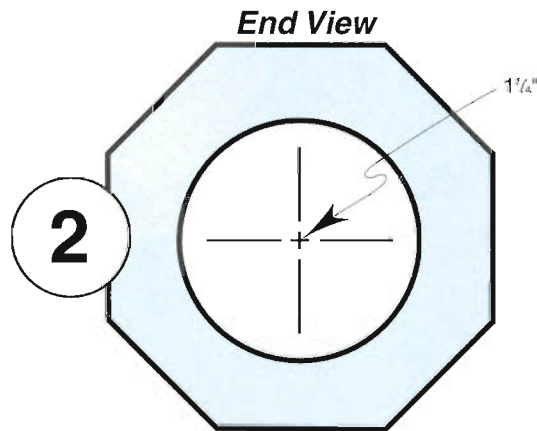
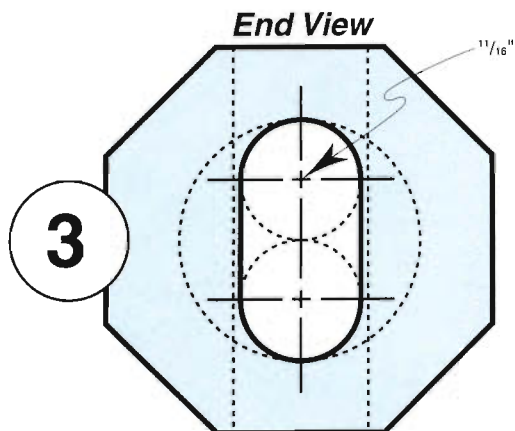
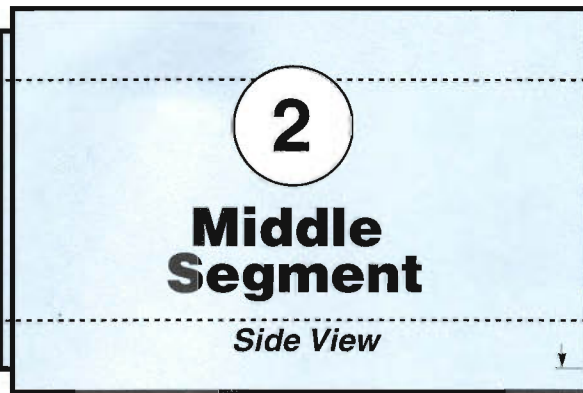
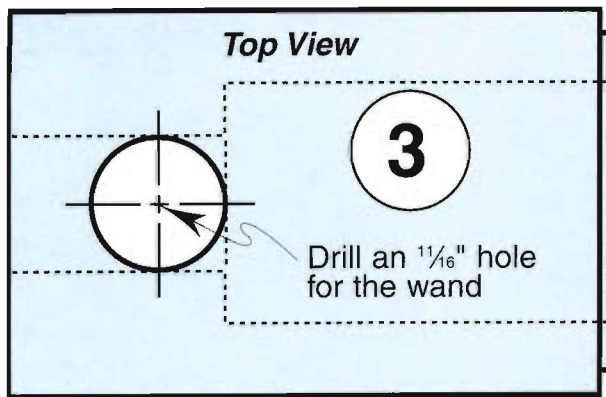


(Side view)

Corner
(Top view)



Kaleidoscope



Drill a $\frac{1}{2}$ " hole
for the exhaust stack

1

Chassis

Axle hole locations (4)

Drill $\frac{1}{8}$ " holes
for the cab rivets

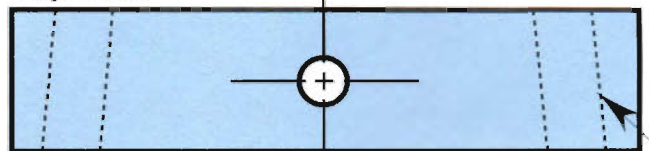
2

Beam

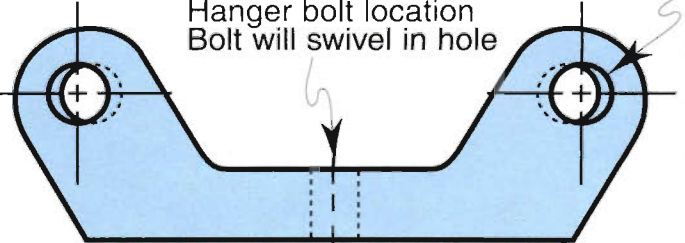
Start the $\frac{1}{2}$ "
roundover
edges here

20
**Blade
Carriage**

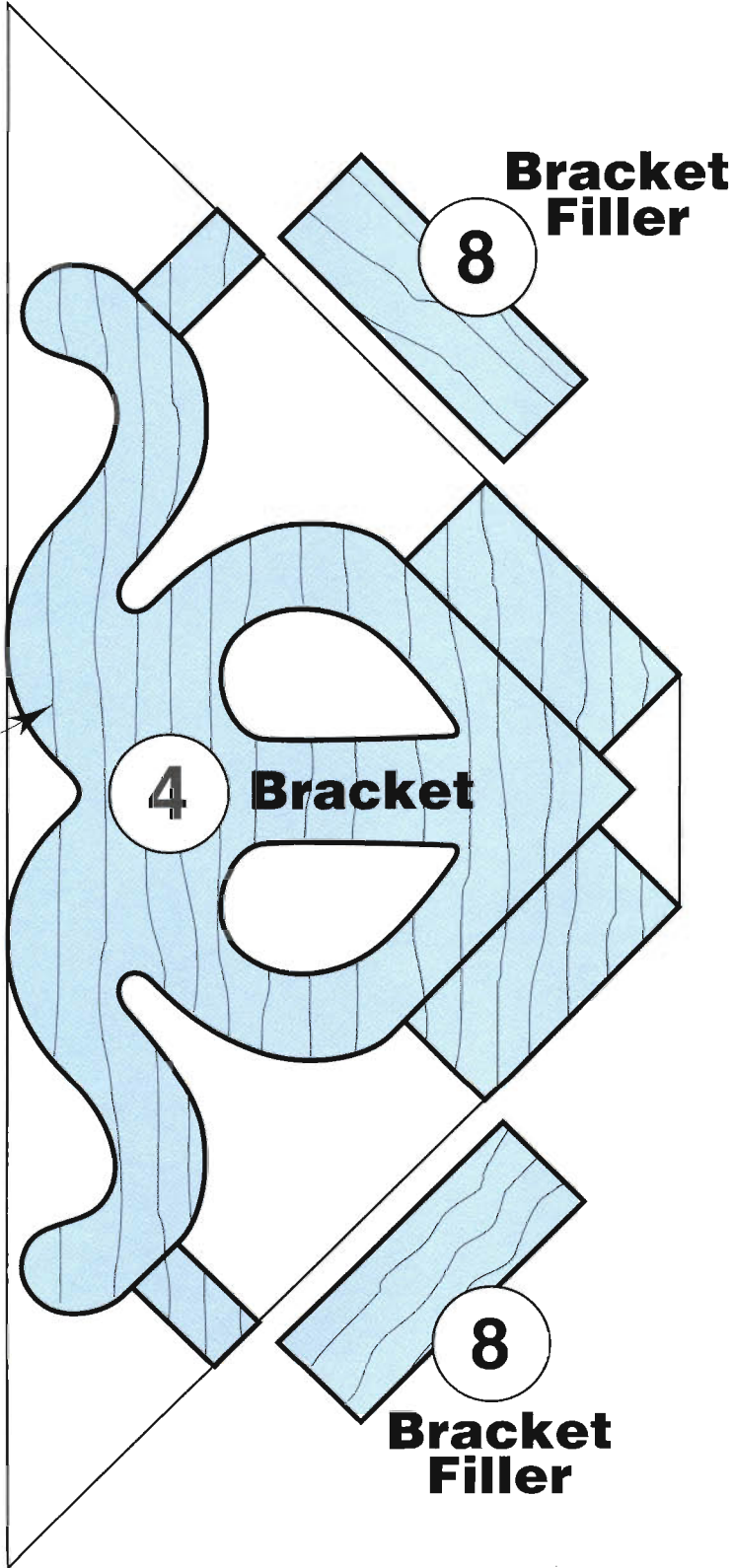
Top View



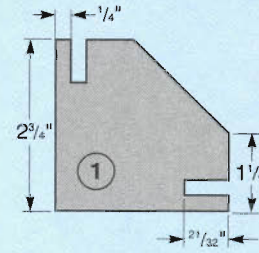
Front View



Chippendale Table

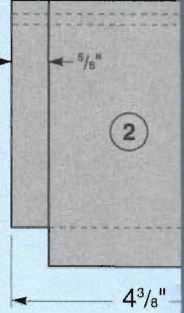


Sofa Table Leg
(Top view)

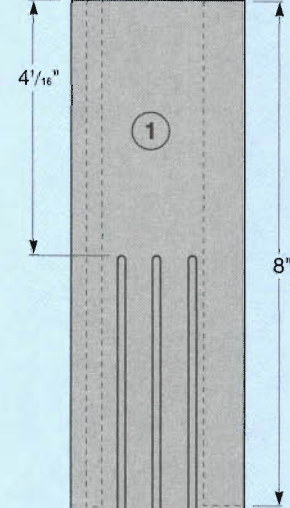


Sofa Table
(Top view)

Sofa Table
(Front view)



Sofa Table Leg
(Front view)



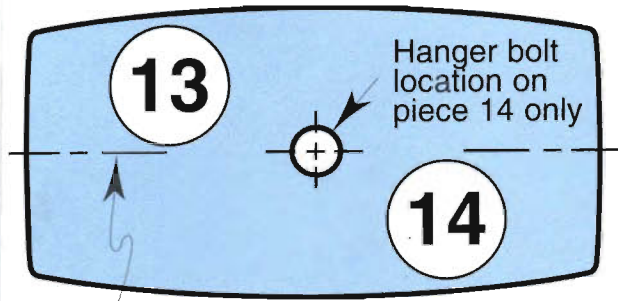
(Note: Middle flute is centered on leg.)

Comple

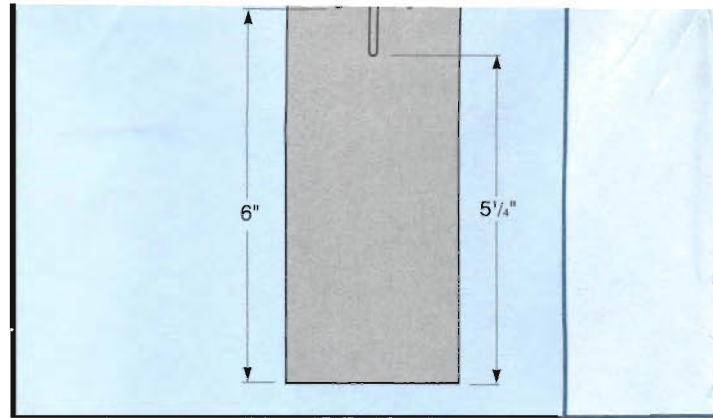
End Table Leg
(Front view)

Axle and Axle Rack

(Piece 13 is 1/4" thick and piece 14 is 1/2" thick)



Axle pin locations on piece 14 only



Pinup Shop Drawings

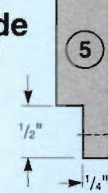
Chessboard

Today's Wood

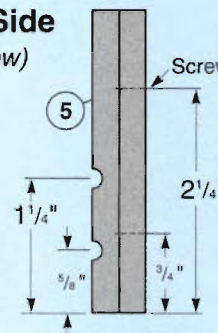
Drawer Side
(Top view)



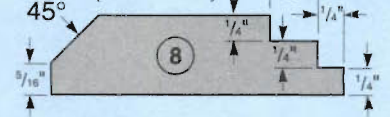
Case Side
(Top view)



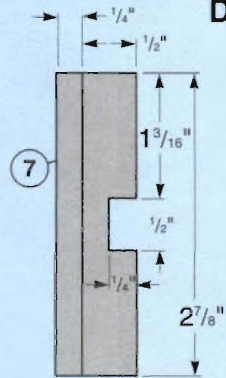
Case Side
(End view)



Frame
(End view)



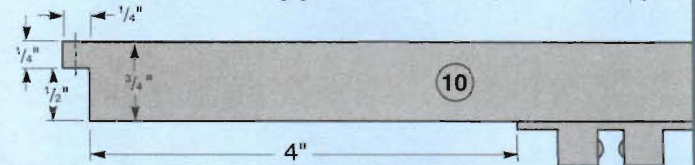
(End view)



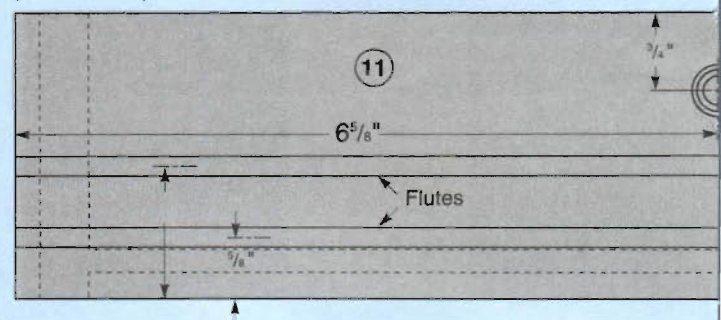
Drawer Slide
(Side)



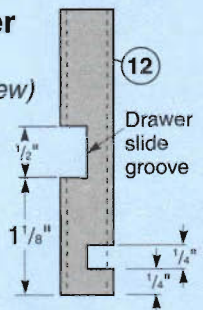
Drawer Catch Support (Side view)



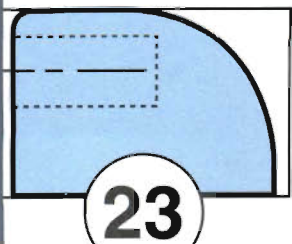
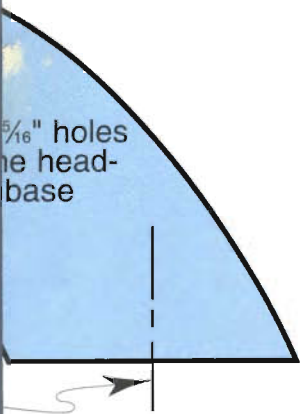
Drawer Front
(Front view)



Drawer Side
(End view)



24 Headlights

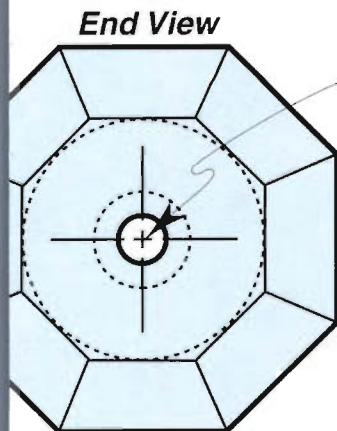
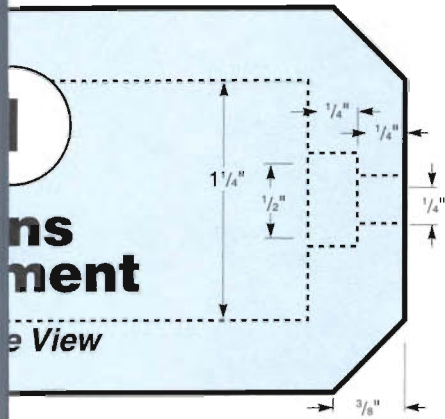
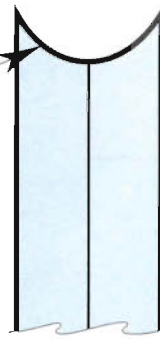


23 Blade Carriage Mounts

Form with a
1½" diameter
drum sander

8

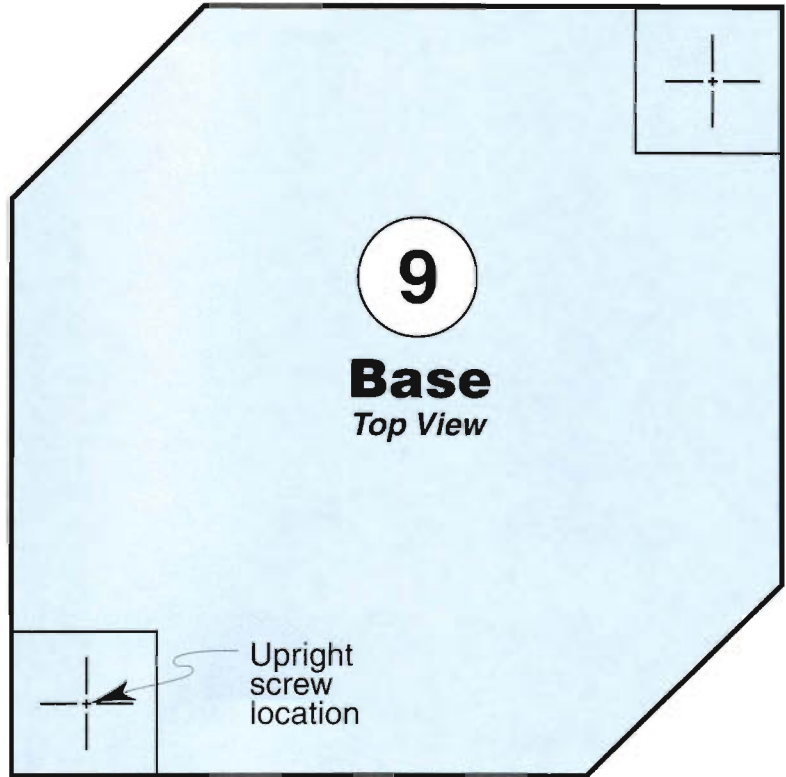
Upright



Center point
for ¼", ½" and
1¼" holes

9

Base
Top View



Upright
screw
location

Note
grain
direct

12

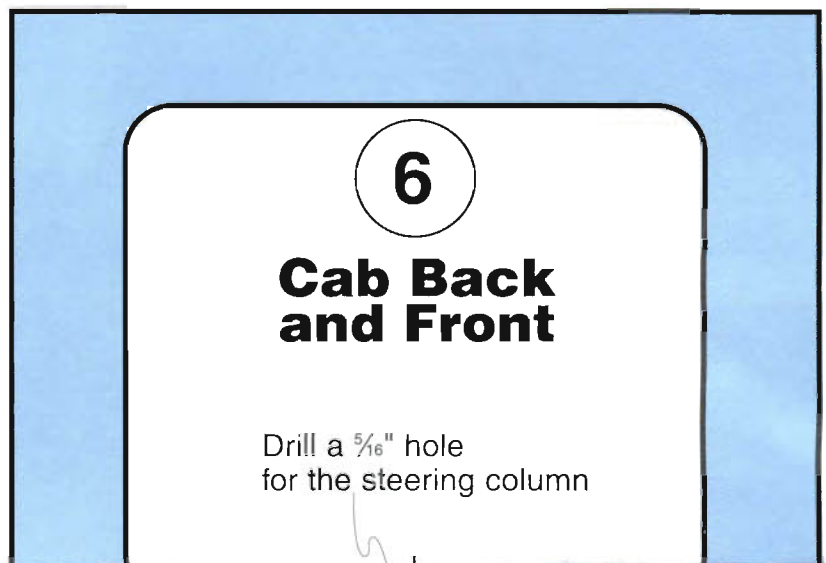
Cab Roof

11 1/8" holes
the cab rivets

6

**Cab Back
and Front**

Drill a 5/16" hole
for the steering column



Road Grader

26

Steering Column Mount

Drill $\frac{5}{16}$ " holes for the blade carriage bars in the cab front only. (The inside edge of each elongated hole is then filed flat.)

Drill a $\frac{5}{8}$ " clearance hole for the hanger bolt's plastic nut

Drill for light

19

Hanger bolt location

End View

Blade

Drill two $\frac{5}{16}$ " angled holes for the blade carriage bars

Drill a pilot hole for the hanger bolt

Front View