PICK THE JUST-RIGHT JIGSAW BLADE p.36 | WORKSHOP FACE SHIELDS p.70

ISSUE 304 SEPTEMBER 2025

WOOD®

10 TOOLS THE *WOOD* SHOP RELIES ON
p.50

HIDEAWAY WORKSHOP

BUILD THIS FULLY FEATURED SHOP THAT FOLDS AWAY INTO THE FOOTPRINT OF A CABINET
p.38

THREE TOOLS FOR LOW-COST LOOSE TENONS
p.64

The sturdy slide-out benchtop features integrated clamping

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PAST ROOTS, FUTURE PROJECTS

THE PATH OF PROGRESS IS PAVED BY THE PAST.

I recently had the singular privilege of meeting *WOOD*® magazine's founding Editor-in-Chief, Larry Clayton. Larry had happily retired and relocated a few years before I came on board *WOOD* 18 years ago, but he recently got back in touch with us seeking plans published during his tenure for projects he wanted to build for friends.

In the ensuing correspondence, Larry and I reminisced that the magazine he founded was celebrating its 40th anniversary. I invited him for a tour the next time he was in town and asked him to bring photos of his current woodworking.

That happy meeting finally happened, and Larry was graciously complimentary of the efforts of the current staff: the beneficiaries of his own work.

Of course, that sent me down a path of nostalgia that saw me getting in touch with several luminaries of *WOOD* magazine's storied history. You can find updates on those longtime friends, many of them my mentors, on *page 6*.

Fortunately, "longtime" does not mean "long-lost." Like Larry, you can still enjoy all of the projects from *WOOD*'s 40-year history. Every woodworking technique, tip, and tool review is preserved and waiting for you, just as relevant today as ever.

That's because, as the culmination of our celebration of 40 years in print, we are rolling out a brand new way for you to subscribe to *WOOD* magazine. We're calling it *WOOD All Access*. See the ad on *page 77* or head to the link *below* to upgrade your subscription to our *WOOD All Access* plan. In addition to a year's worth of print issues in your mailbox, you'll get online access to the complete *WOOD* magazine back catalog, 304 issues–and counting–of insightful woodworking knowledge and project plans that you can take with you out to your own shop on your phone, tablet, or laptop.

And let this be a reminder to touch base with your own mentors. Pay homage to those who paved your path. Pour your knowledge into the next generation. Handcraft your future's history. And get out to the shop to build something. We'll help.

Lucas

LUCAS PETERS
lucas.peters@woodmagazine.com
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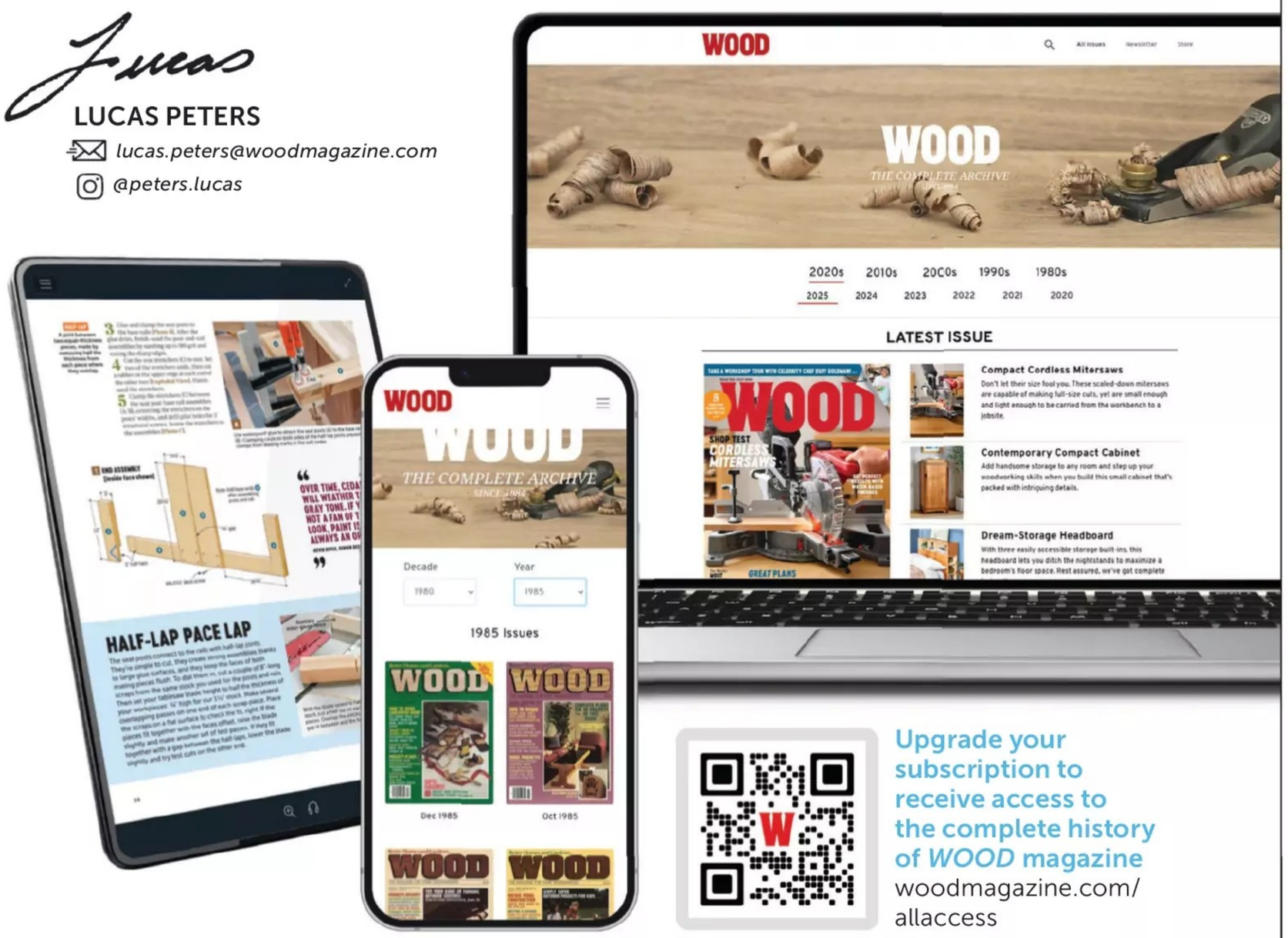

WOOD®
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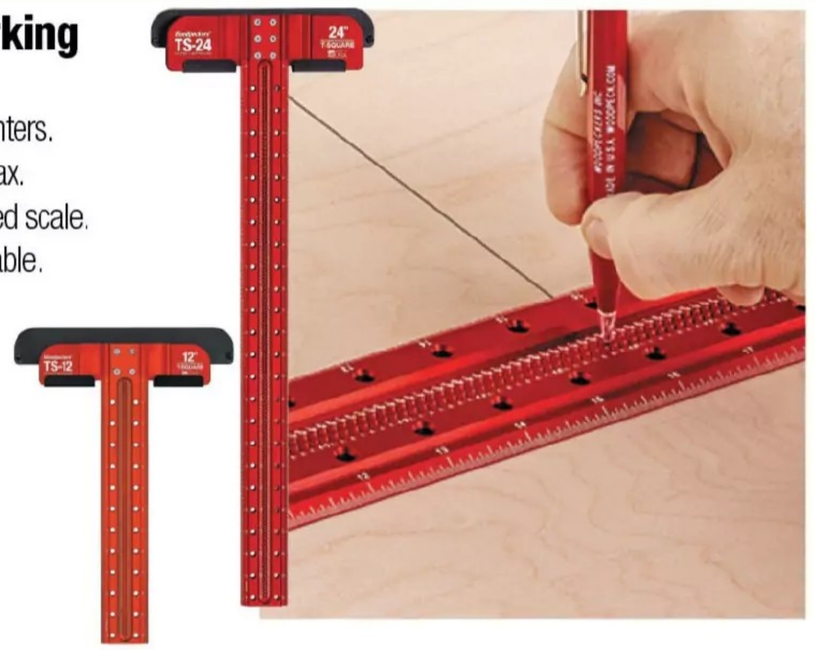

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Issue No. 304 | September 2025

PLANS

ON THE COVER

38

With adjustable shelves, a slide-out workbench, and roomy drawers, this cabinet serves nearly all your shop needs. Plus, it tidies away your tools at day's end behind spacious doors.

TOOLS & TECHNIQUES

DEPARTMENTS

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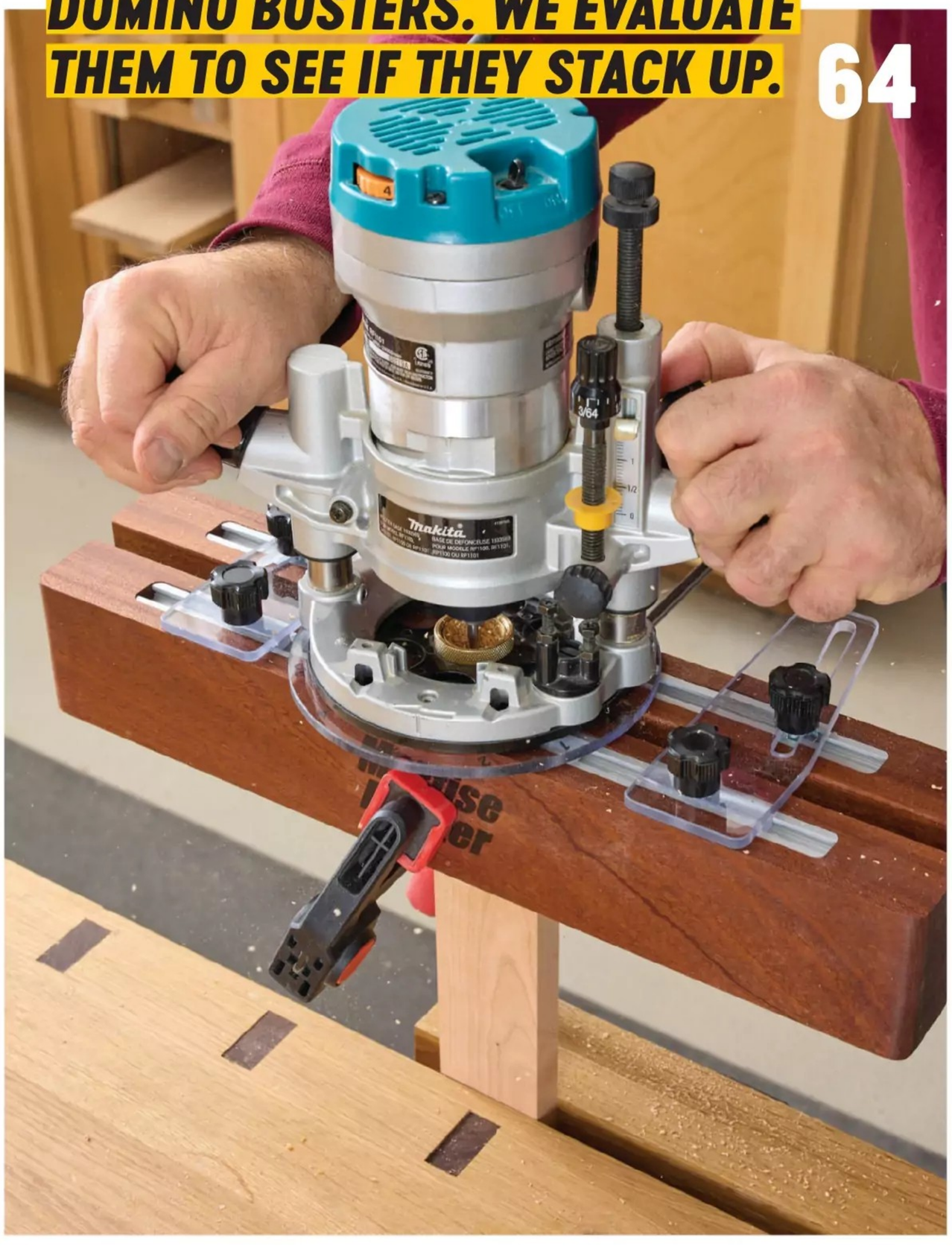

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A STORIED HISTORY

As *WOOD*® magazine crosses the landmark of publishing over 300 issues, we celebrate a long history of talented leadership since 1984. We reached out to our former editors to get caught up on their latest projects.

In 1984, Meredith Corporation took a risk on my idea to publish a magazine for woodworkers. What a great experience it was being a part of something new!

After having worked for Meredith for 31 years, I retired and continued woodworking, bought a small plane and learned to fly, and eventually moved to Cabo San Lucas into a new home designed by my wife.

I still miss the magazine and all the people I met there. In the photo *above*, I'm holding the *Military Memories Display Case* made by Jim Harrold to show off my military medals. I have since made five shadow boxes for Vietnam artillery buddies of mine.

Larry Clayton
Editor-in-Chief 1984–2001

Purchase plans to build the Military Memories Display Case.
woodstore.net/militarycase

My pursuit of Greene & Greene furniture is alive and well in my retirement. I designed and built this Greene & Greene-style crib for our grandchildren from mahogany incorporating ebony buttons. I intend for it to be passed from one family to the next to whoever has the latest newborn.

Marlen Kemmet
How-to Editor and
Managing Editor 1984–2012

Since retiring, I stay plenty busy spending time with family, especially the grandkids. I enjoy going topless—in my convertible—and have been on a quest to take it for a drive at least once a month (a challenge during central Iowa winters).

I still tool around in the workshop whenever I can. I've made several cribbage boards like this one and donated them to charity auctions. This one is made of maple and was crafted on my CNC. This four-track board has about 500 peg holes that would be mind- and arm-numbing to drill by hand.

Dave Campbell
General Interest Editor, Deputy Editor, and Editor-in-Chief 1998–2022

How many can say that their career job dovetails nicely with their favorite hobby or pastime? For me, that was my reality at *WOOD* magazine. My time as a journalist and editor gave me ample opportunity to explore and learn woodworking from every angle.

Thanks to the editor and creator of the magazine, Larry Clayton, I was proud and happy to have played a part in its ongoing success. Today, my passion for woodworking continues as I spend my retirement designing and making projects for sale at art shows on the Big Island in Hawaii. Obviously, *WOOD* has left an indelible impression on this craftsman's somewhat dusty journey.

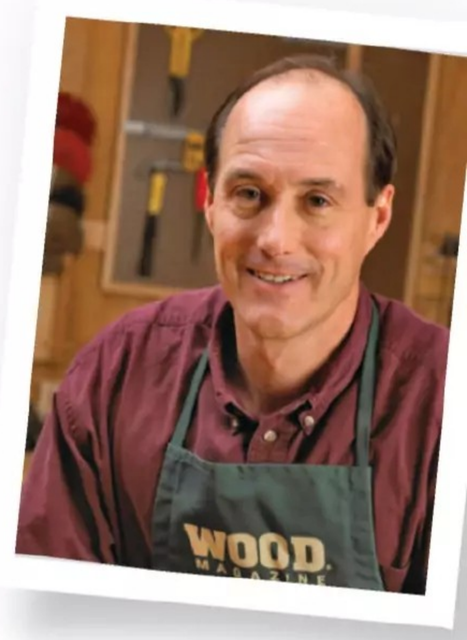
Jim Harrold
Managing Editor and Executive Editor 1991–2007

PHOTO CREDIT: NICOLE LAING PHOTOGRAPHY

Since my time at *WOOD* magazine, I've been working on my daughters' homes. On one, I completely remodeled the interior, including lots of finish carpentry: cabinets, crown molding, base and window trim.

One of my more interesting hobbies is refurbishing and selling vintage industrial lighting fixtures around the world to movie studios, restaurants, and bars.

In short, I've been thoroughly enjoying retirement!



Bill Krier
Tools & Techniques Editor and Editor-in-Chief 1988–2012

CALVIN CASSADAY of Mesa, Arizona, crafted this steam engine, tender, and passenger car, dedicating over 240 labor hours to the project. He works with a combination of hard and soft woods such as alder, aspen, beech, iroko, limba, Spanish oak, tigerwood, and walnut.

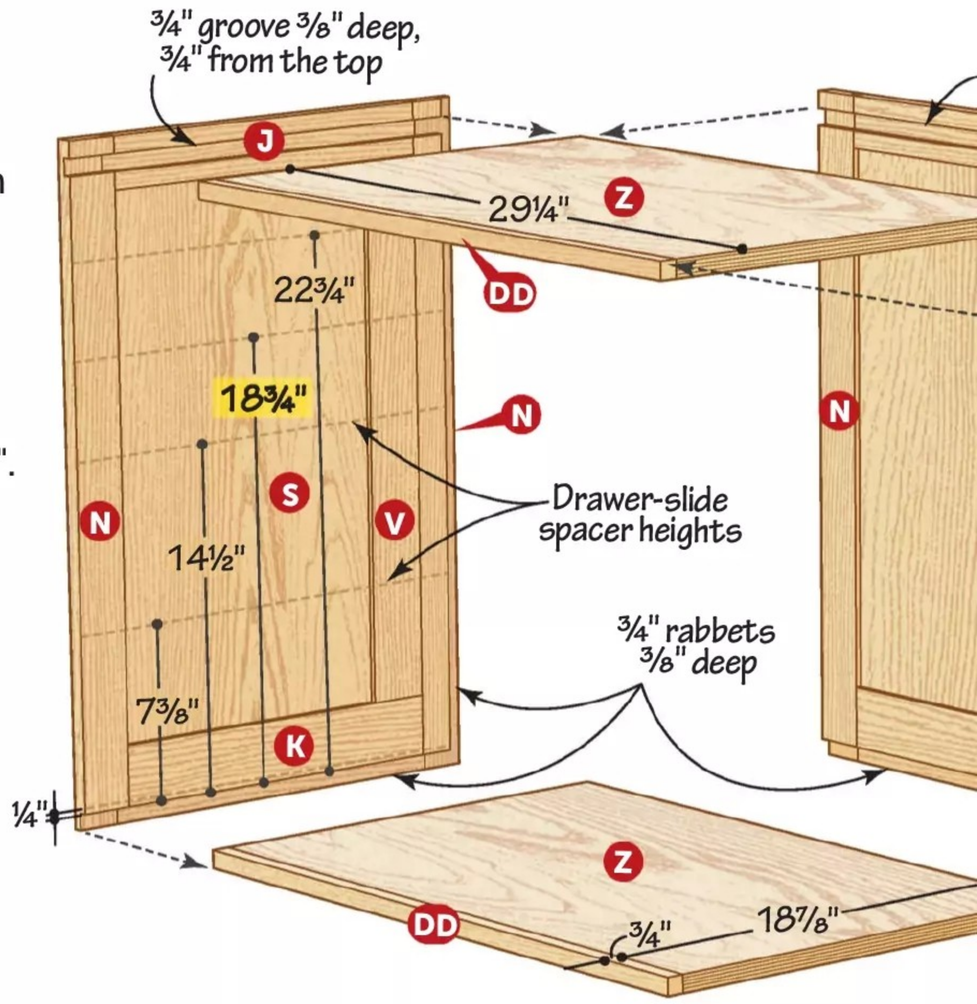
Though he is new to woodworking, **STEPHEN THOMPSON** of Colleyville, Texas, designed and built this 36"-diameter, 19"-high coffee table on wheels to display memorabilia such as family photos and souvenirs. He used red oak for the bulk of the construction with a tray of pine. A piece of 24"-diameter glass covers the painted, recessed tray.

CHRISTINA AND ANDY HAAF of St. Charles, Illinois, came up with this unique corner decoration for small boxes. It combines a spline joint with rabbeted box corners to form a cross.

CORRECTION

An observant reader pointed out an error in the *Floor-Standing Tool Chest* in issue 301 (March 2025).

Drawing 4 on *page 41* shows the height of the spacers used to locate the drawer slides. The 19¾" dimension should read 18¾".



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VINTAGE TOOLS. MODERN SHOP.

A batch of project plans, a pile of pegboard, and a bunch of antique tools transform a bare-bones building into a medal-worthy woodshop.

WRITER: RANDY MAXEY

Unobstructed floor space allows flexible tool placement with plenty of space between. White walls and plenty of lighting create a bright, comfortable workspace.

Karl served for over 28 years in the United States Army, retiring from active duty as a lieutenant colonel.

SHOW US YOUR SHOP

Send high-resolution digital photos of your shop to ***woodmail@woodmagazine.com*** and we may showcase it in the magazine!

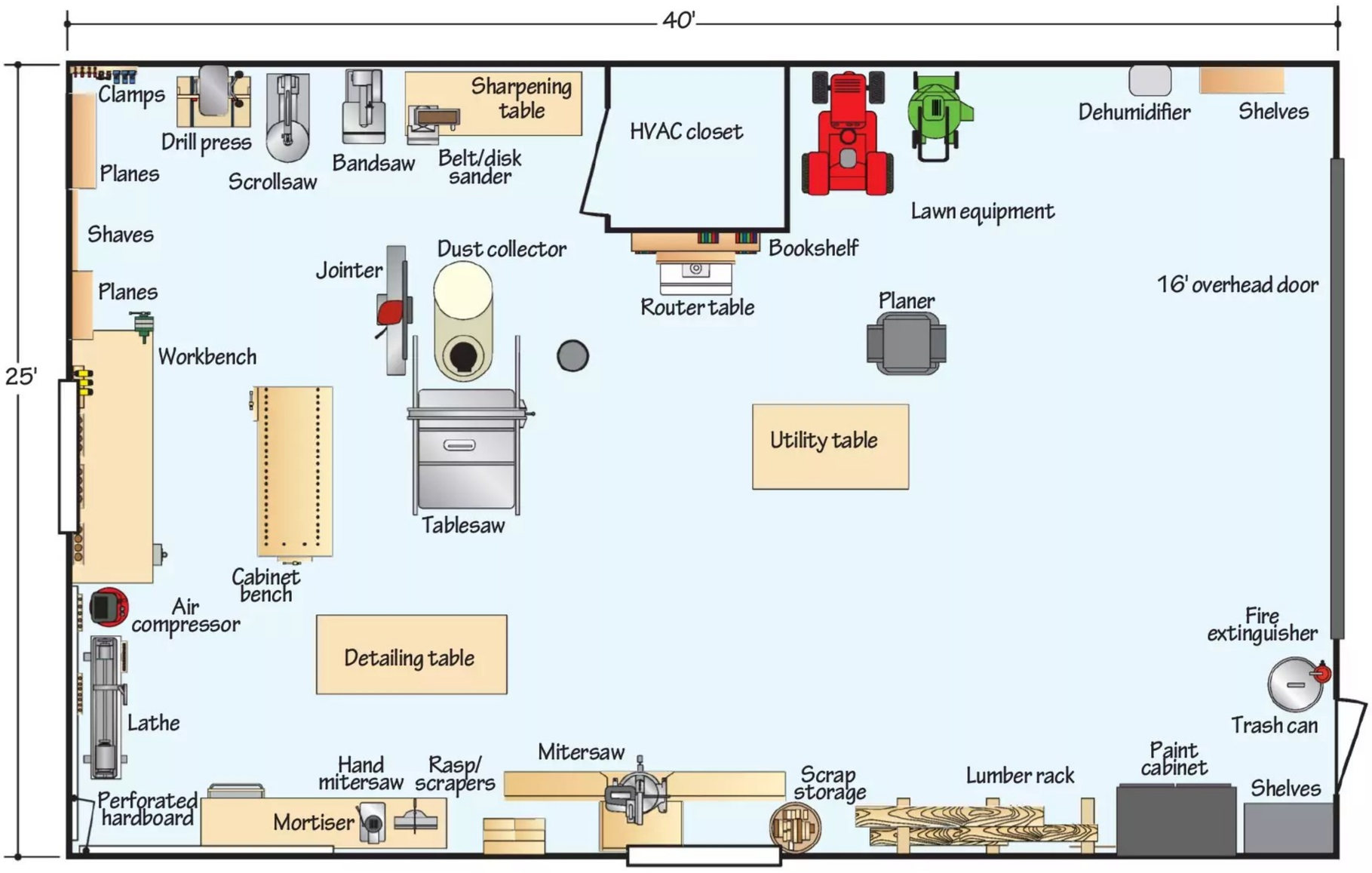
After retiring from 28 years in the US Army, Karl Zetmeir and his wife purchased property in Leavenworth County, Kansas, that features a beautiful pond overlooked by a 25×40' building Karl could make into a shop. The building had great bones, with a concrete floor plus a garage door and passage door, but nothing more.

Karl started its transformation from a blank slate into a fully functioning woodworking shop with electricity supplied by a subpanel to power multiple 20-amp circuits. A batch of ceiling-mounted fluorescent fixtures and new windows provide plenty of light. Next, he added insulation, drywall, and a heat pump for heating and cooling.

To outfit it, Karl didn't simply make purchases from catalogs. He relied on lessons learned from his old basement shop and inspiration from woodworking publications. Karl built and uses many projects gleaned from *WOOD*® magazine, such as his router table, which combines two projects into one (*page 12*).

"The pegboard walls were a quick way to get my shop operational," he said. "Then I moved tools and benches around until I liked the layout."

PHOTOGRAPHER: KARL ZETMEIR; **ILLUSTRATORS:** ROXANNE LEMOINE, LORNA JOHNSON



"BUY GOOD QUALITY TOOLS, BUILD PROJECTS YOU'RE EXCITED ABOUT, BE A SAFE WOODWORKER AS WELL, AND MARK YOUR WORK FOR FUTURE GENERATIONS."

-KARL ZETMEIR, SHOP OWNER

When Karl inherited, then restored, his grandfather's hand tools, he became fascinated with vintage tools, especially after finding the Facebook page "Fans of Old Woodworking Machines (OWWM)." Because of this newfound interest, he began purchasing older equipment for the shop space, as well. "I chose vintage Delta machines because I wanted to stay within the same era as my granddad's hand tools," he says.

Pegboard panels proved the perfect solution for keeping hand tools organized and easily accessible. Karl says installing these was the first step in organizing the shop.

Karl's wife bought this vintage workbench at a local antique mall for $150. The V-notched block on top works as a stop to hold a board on edge for planing. The leg vise is original and still operational.

A restored but barely used 1953 model 22-101, 13" Delta planer was his first vintage machinery purchase. Soon after, Karl bought a 1942 Delta-Milwaukee 6" jointer from a nearby farmer. The stand was pretty beat up, so he hammered out as many dents as possible, added a dust port, repainted it, and added the logo.

Karl's 1937 Delta model 1200 scrollsaw, complete with the original incandescent light, hums like a sewing machine. The 1950s-era Craftsman-Seeley lathe came from a man whose father bought and rebuilt it, but never used it. Like all of the vintage tools that came before it, he found it on Facebook Marketplace.

While the workshop takes up most of the building, it does share space with lawn maintenance equipment and supplies for Karl's two other hobbies: beekeeping and fishing.

Karl says that his shop is a dream come true. "I get to use tools that have been in my family for over a century, and every day I count my blessings!" Karl's grandson Jackson, age six, loves helping "Opa" in the shop and using great-great-grandpa Emil's Stanley No. 4 hand plane. "I think 'old Dutch' would like that," Karl says with a smile.

Mitersaw station wings support long stock, yet fold down for compact storage. Casters allow it to roll outside during nice weather. Find the plans at **woodstore.net/miterstation**.

Tackle the Tilt-Top Router Table
woodstore.net/tilttop

After building the tilt-top router table, Karl decided he wanted a different fence, so he adapted the fence design from the benchtop router table in *WOOD* issue 138 (December 2001).

Karl stores his rasps, files, scrapers, and other small tools in this custom-made cabinet. The stacked doors provide plenty of storage without taking up extra wall space.

Spokeshaves, a drawknife, as well as Stanley 98 and 99 side-rabbet planes inherited from Karl's grandfather reside prominently between two cabinets equipped with hand-plane tills.

Q: DRILLING SPEEDS

I recently purchased a new drill press with 16 speeds. The owner's manual covers how to change the belts for different speeds, but doesn't really say anything about how to choose the right speed. Do you have any suggestions?

Fred Bosley
Strongsville, Ohio

A: When choosing a drilling speed, Fred, you need to factor in the size and type of bit and the material you are drilling. The simplest approach is to consult a drilling speed chart, such as the one listed in the margin, for guidance. To gain a general understanding of which speeds to use, it helps to drill down (pun intended) a little farther into the subject.

More than any other tool in the shop, a drill press lends itself to working with a wide variety of materials, such as wood, metal, and plastic, as well as with different types of bits, cutters, and accessories. That's why most drill presses offer a range of spindle speeds, anywhere from 250 to 3000 revolutions per minute (rpm). As a general rule, harder materials and larger-diameter drill bits call for slower drilling speeds.

In our shop, we leave our drill press at a speed of approximately 900 rpm most of the time. This speed works well when using brad-point bits or twist bits to drill holes between ¼" and ½" in hardwoods, which covers much of the drilling we do. Softwoods can be drilled at roughly one and a half to two times the speed of hardwoods, from 1500 to 2000 rpm for ½" and smaller holes.

When using larger-diameter bits, as well as Forstner bits, holesaws, or wing cutters, slow the speed down to between 250 and 500 rpm, depending on the size of the bit.

Also use lower speeds when drilling ¼" or larger holes in steel. (Make sure to securely clamp your workpiece and use cutting oil.) Aluminum and brass can be drilled at speeds similar to those for hardwoods.

Use higher speeds (1000–2500 rpm, depending on the material) when drilling small holes in wood or metal. When using nondrilling accessories, such as flap sanders and drum sanders, set the speed between 1000 and 2000 rpm.

When in doubt about the best drill speed, always start slow and then increase the speed if necessary. There's little danger in selecting a speed that is too slow, aside from poor chip ejection. But using a speed that is too fast may lead to burning, ragged holes, damaged bits, or potential injury. Now you know more of the hole-boring story.

Download a drill-press speed chart at:
woodmagazine.com/drillspeedchart

Have a question? Drop us an e-mail.
askwood@woodmagazine.com

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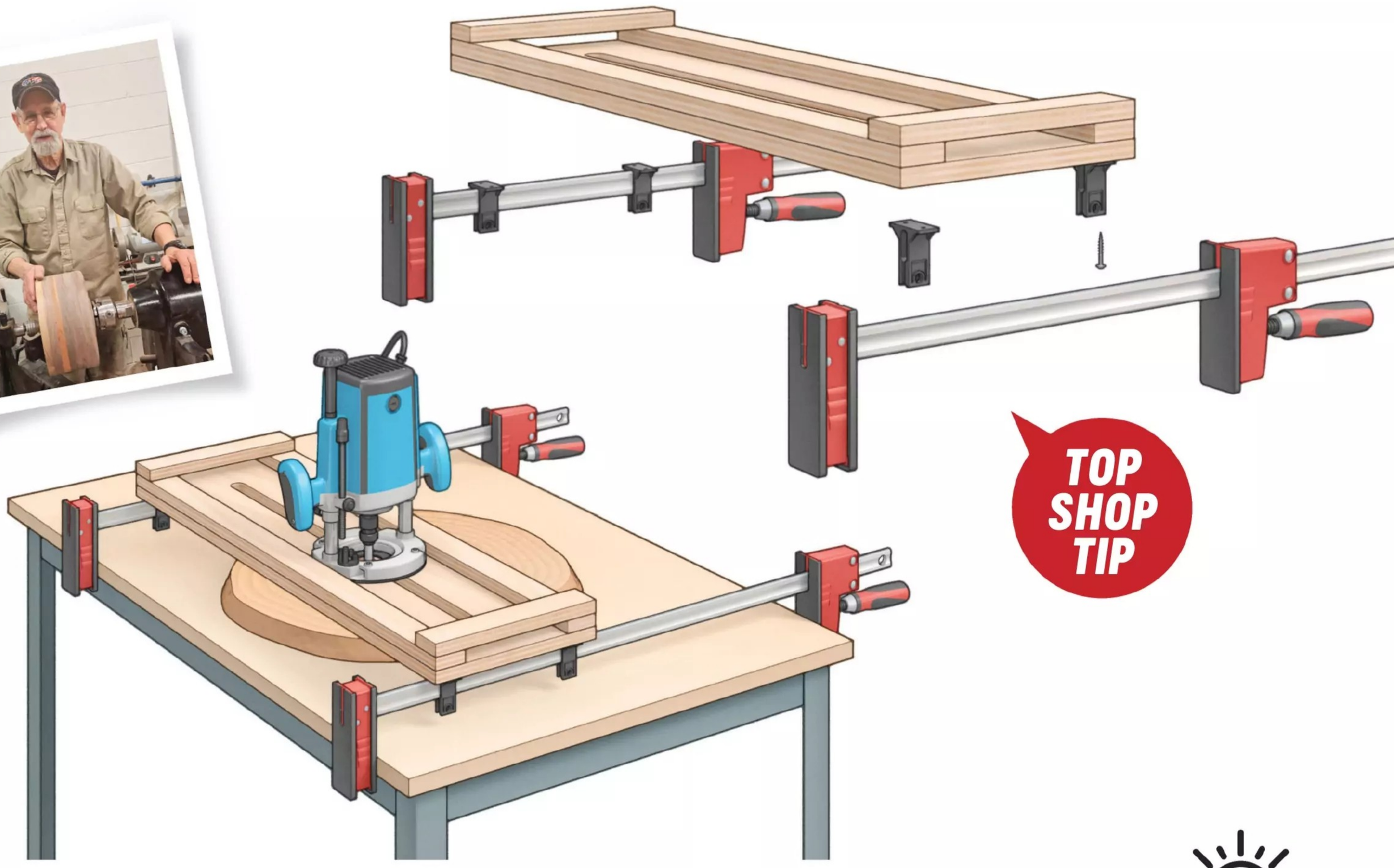

CLAMP-ON SLAB-FLATTENING SLED

I recently needed to flatten a slab, but I didn't want to invest in a sled. Instead, I made my own using my parallel-jaw bar clamps, the clamp-rail protection pads they came with, and a shopmade sled. (My clamps are from Bessey, but many others of this style come with similar pads.)

I made the sled from ½" plywood, making it extra long to let the router bit traverse the full width of my slab, then added a slot for the bit. Rails flank the router base to guide it along the sled while a stop block at each end keeps the router corralled. I screwed two clamp-rail pads flush with each end on the bottom of the sled. Then I snapped the clamp bars into the pads.

The clamp bars must be positioned parallel to the benchtop with their tops just higher than the slab's thickness. To do that, I rested the clamp bars on temporary risers of surfaced boards before securing the clamps to the workbench. Using a large-diameter straight bit, I took light passes until the slab was flat. This setup worked great and cost me nothing to make.

Dustin Davis
Cumberland, Maryland

For his tip, Dustin wins a Kreg MortiseMate and tenon package worth $328 from **thewoodsmithstore.com.**

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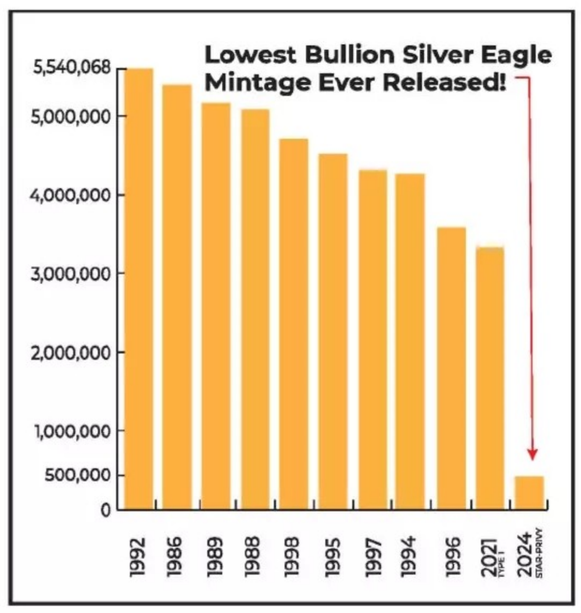
ILLUSTRATOR: CHRISTOPHER MILLS

continued on page 18

A World's First Creates The Lowest Mintage Silver Eagle…Ever!

The American Silver Eagle is arguably the most popular coin on the planet. First struck in 1986 for US citizens to own physical silver bullion, the Silver Eagle is made from one ounce of 99.9% fine silver. It's no wonder why these hefty silver dollars have become THE global standard for silver bullion coins, with over 640,000,000 coins minted to date.

And now, the US Mint has released a special Silver Eagle that might just become THE greatest of all time…the *Star Privy Silver Eagle!*



Consider this….the 1996 Silver Eagle is the lowest mintage with 3,603,386 coins made. The Star Privy Silver Eagle has a mintage of only 500,000 coins. That's SEVEN TIMES LOWER. Just look at the graph for perspective.

The First 50,000 Coins Released

Each coin comes certified in Gem Brilliant Uncirculated condition, coming from the first 50,000 coins issued, the "top 10%" if you will, certified by the leading independent 3rd party grading company NGC. Those are bragging rights every collector would dream of having!

What's So Special?

There are two "key" reasons why the Star Privy Silver Eagle is poised to become the most sought-after coin in the Silver Eagle series;

One, collectors LOVE "Firsts" and the Star Privy is the First-Ever bullion Silver Eagle to have a Privy Mark, cementing its permanent place in Silver Eagle history.

Two, collectors also GO CRAZY for low mintage coins, the lower the better. And the Star Privy Silver Eagle not only has a low mintage. It's the lowest mintage bullion Silver Eagle EVER!

First-Ever Privy-Marked Bullion Silver Eagle

Privy marks are small symbols added to coin, oftentimes to commemorate special occasions and/or historic events. In this case, the US Mint has added a "star" to the Silver Eagle to celebrate the release of a new mobile gaming app, 8th Era, a groundbreaking new mobile gaming app that marries gaming with coin collecting to inspire the next generation of collectors. It's an instant "must-have" for Silver Eagle collectors.

Lowest Mintage Bullion Silver Eagle EVER

Not only is the Star Privy Silver Eagle the first ever privy-marked bullion Silver Eagle, it's also the lowest mintage bullion Silver Eagle ever! How low? It's not even close!

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EASY SQUEEGEE

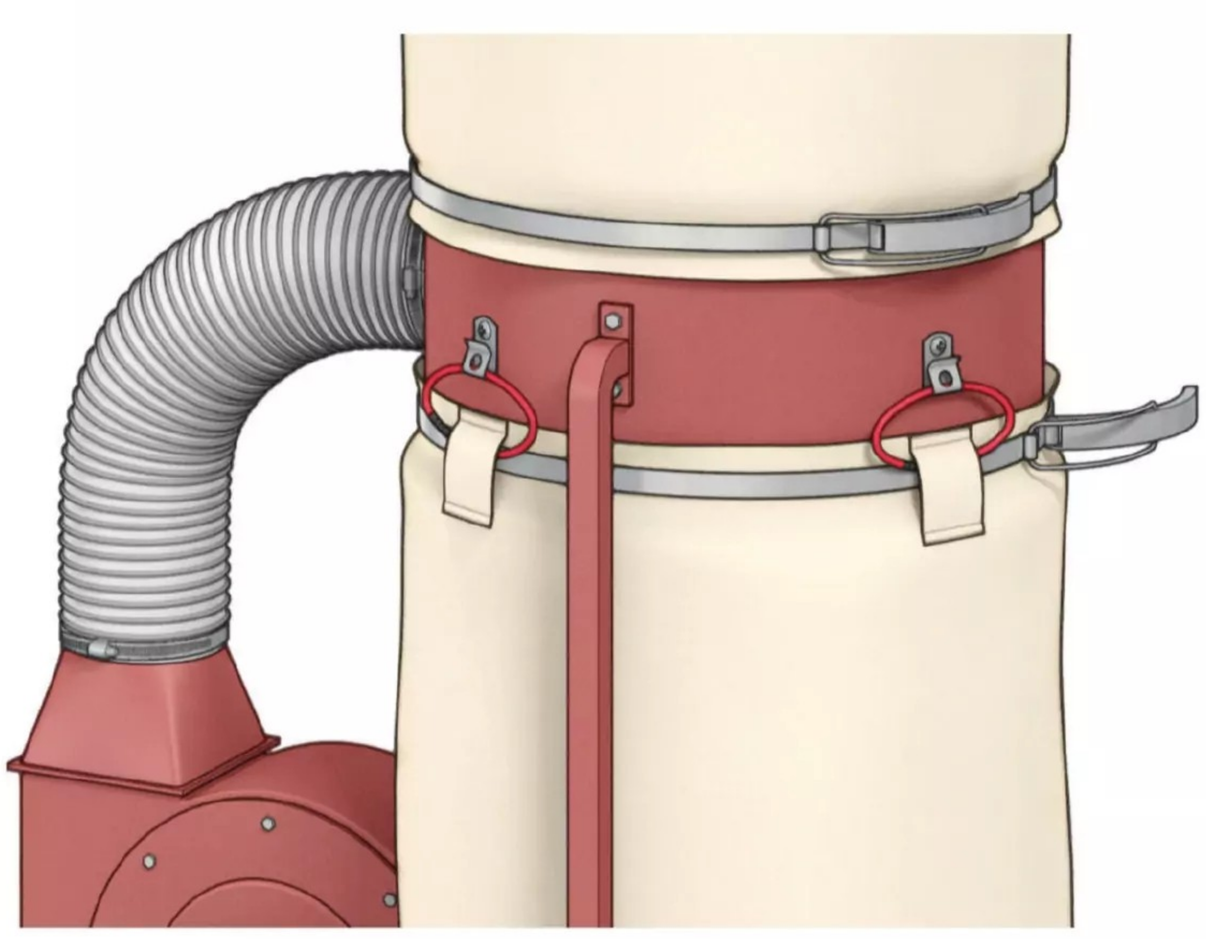
My shop broom struggles to sweep up fine sawdust and shavings from the shop floor, but I found a great solution in my car-cleaning supplies: a beat-up windshield squeegee. The rubber squeegee side does a great job of gathering dust, and the sponge side, dampened, is great for a giving the floor area a quick cleanup. The small size of the squeegee makes it great for reaching under tool bases and workbenches.

Chris Hubert
Lakewood, Washington

A SERVING OF GLUE

This glue station helps me keep glue-ups mess-free. The holder is made from thin scrap on feet. To this, I added a notched rest that holds the glue brush over a hole that fits a plastic condiment cup filled with glue. This setup keeps my glue at the ready and it catches any drips to make my glue-ups a bit less messy.

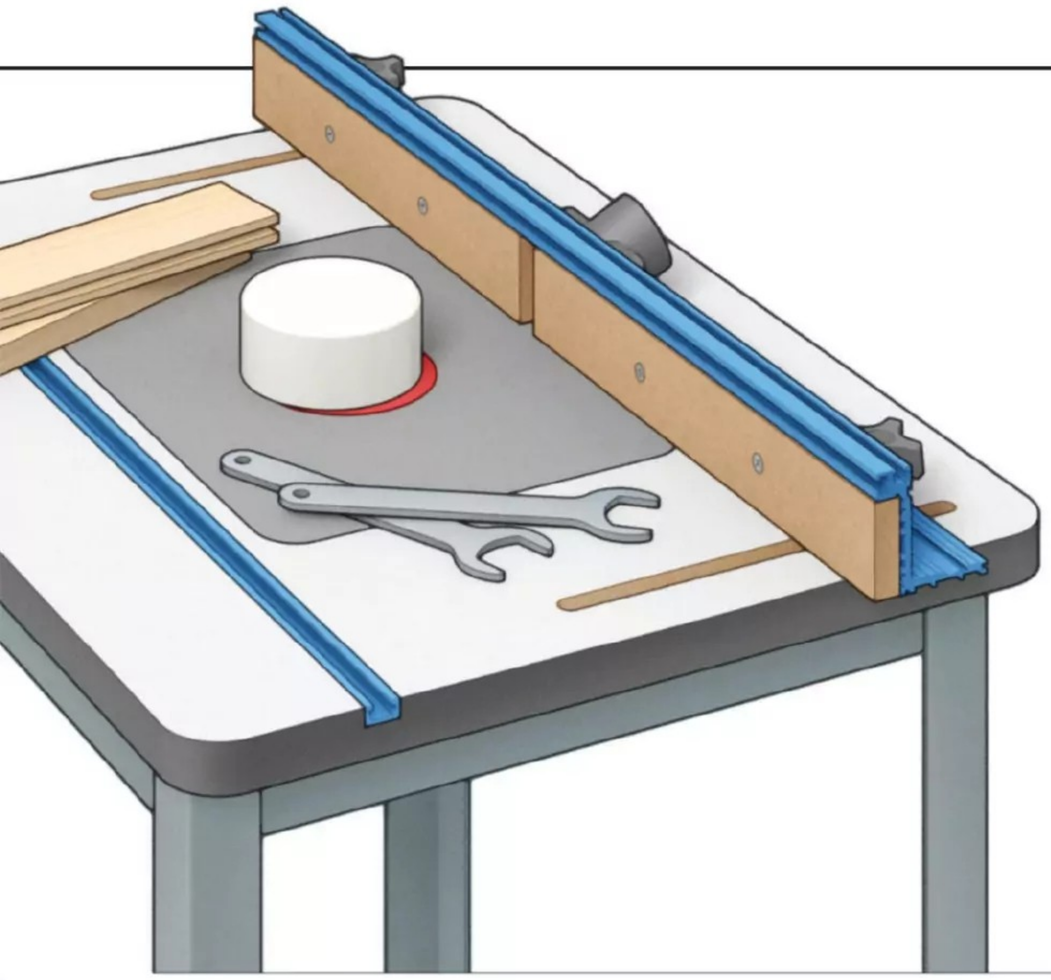
Carlos Brooker
Lancaster, Ohio



BELT & SUSPENDERS

These simple hangers finally ended my frustration with reinstalling the lower bag on my dust collector after I empty it. First, I slipped a length of heavy-gauge solid wire through each loop on the bag and bent the wire into a closed hoop. Then I screwed cable clips to the dust collector housing above each hoop. Hanging the hoops on the clips holds the bag in place and leaves my hands free to fine-tune the bag position and secure the retaining band.

Sam Howe
Cedar City, Utah



UNDER COVER

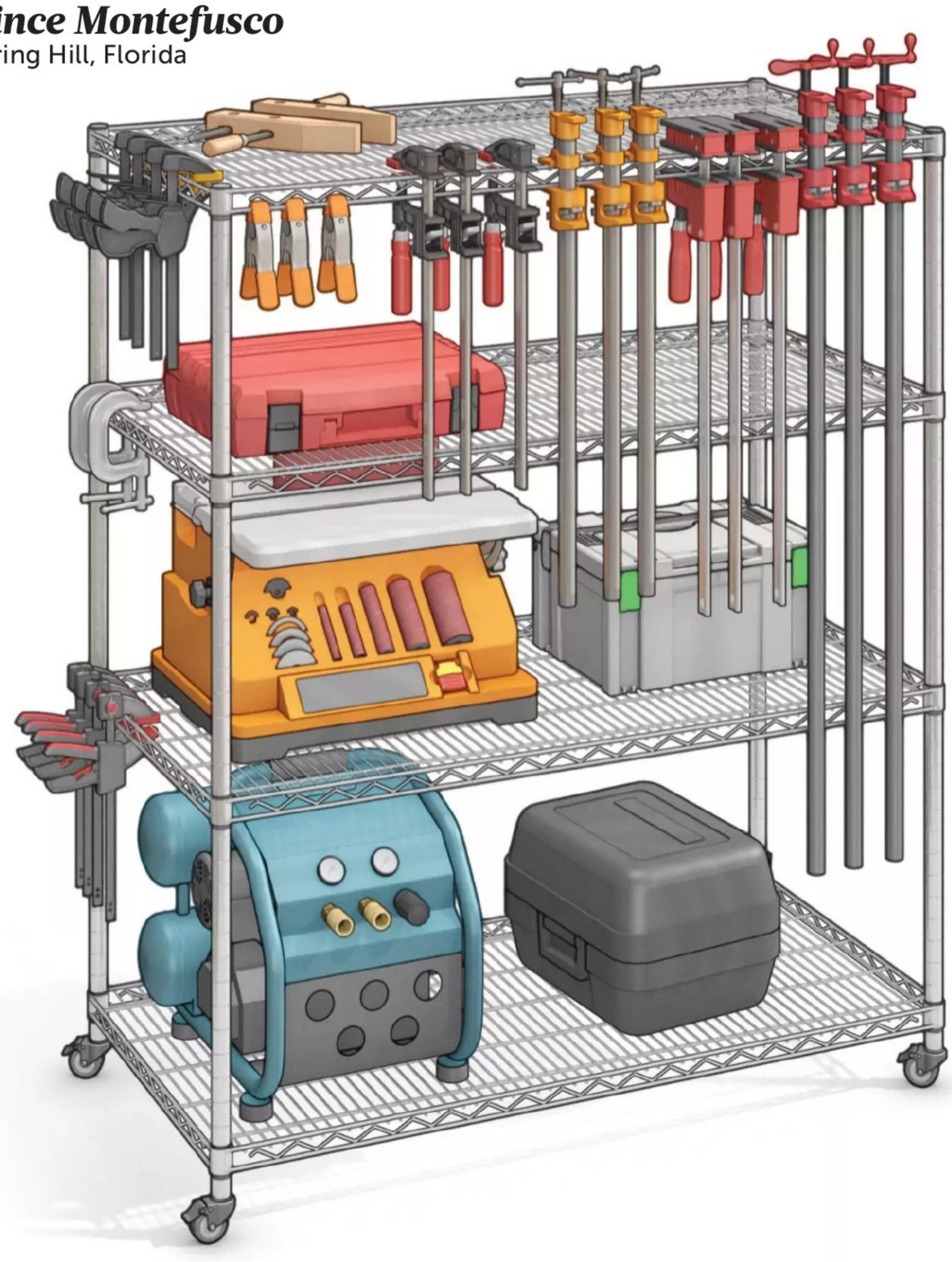
Once I dial in a bit setup on my router table, I like to leave it in place as long as needed. But I hate to leave an exposed bit sticking through the table. An inexpensive PVC pipe cap easily sits in place over the bit providing protection from the exposed bit and a reminder that I have a setup I don't want to change.

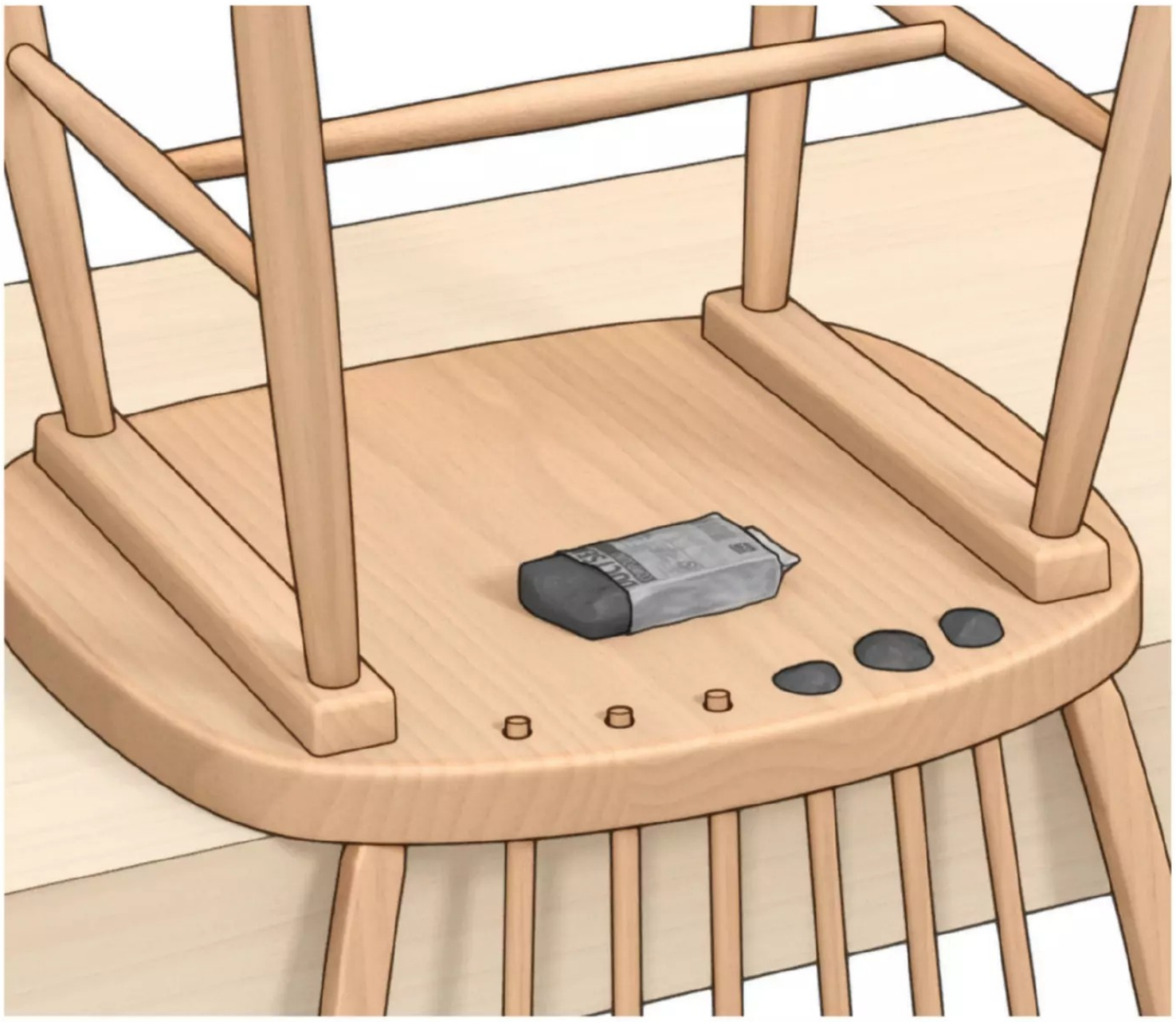
Tom Brock
Sacramento, California

READY-MADE RACK

To create simple, ready-made shop storage, I purchased a stainless-steel shelving unit with wheels from the local warehouse club. Its design proves ideal for storing clamps all around the shelves' perimeters, while the shelves themselves hold benchtop tools and tool cases. The unit rolls around easily, and I love that the wire shelves don't collect sawdust.

Vince Montefusco
Spring Hill, Florida





WORTH A DAM

While repairing a chair, I needed a way to keep epoxy from dripping out as I reattached the back spindles into holes drilled all the way through the seat. To dam up the holes, I turned to duct-sealing putty (found in the HVAC-supply aisle at any home center). I dry-assembled the spindles, flipped the chair upside down, and molded the putty easily around the spindle protrusions. Then I set the chair upright and removed the spindles, spread glue in the holes and on the spindle tenons, and reinserted them without any drips. After the glue dried, The putty peeled easily away resulting in a dam-fine chair repair.

Mark Lane
Omaha, Nebraska

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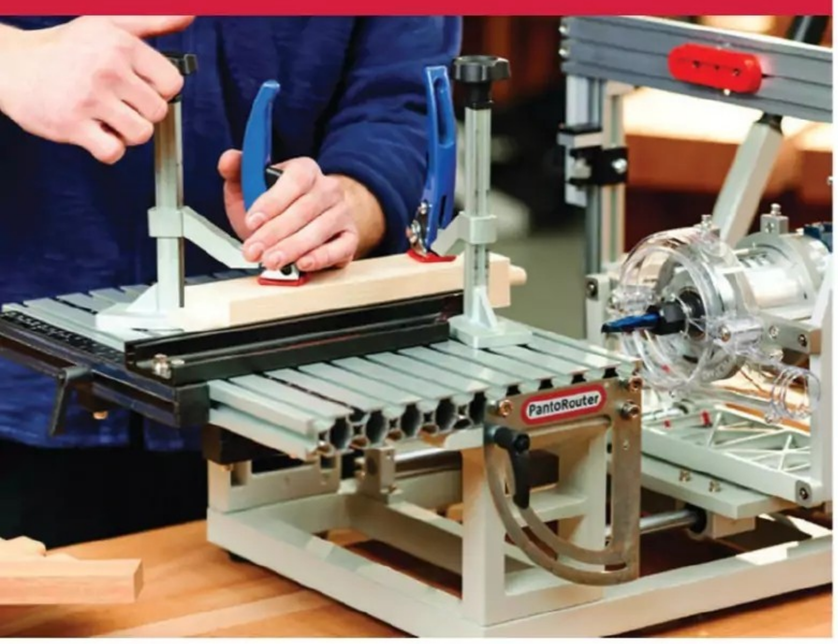

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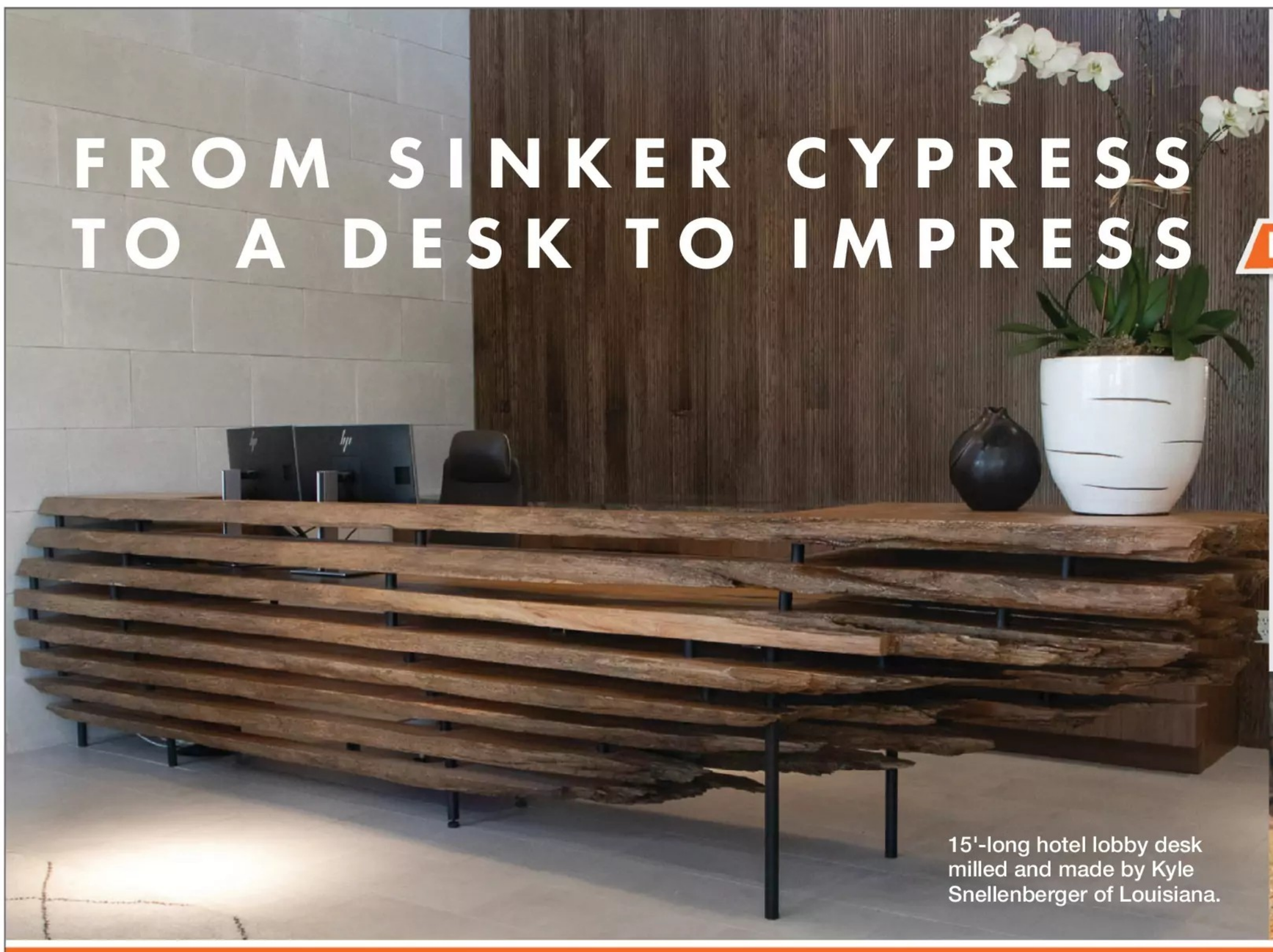

15'-long hotel lobby desk milled and made by Kyle Snellenberger of Louisiana.

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PADDED BENCH

This cushy project features straightforward techniques to create its midcentury look. Even the upholstery is easy.

WRITER: CRAIG RUEGSEGGER
DESIGNER/BUILDER: KEVIN BOYLE
UPHOLSTERY: SONJA CARMON

OVERALL DIMENSIONS
46"W x 17⅛"D x 20"H

PHOTOGRAPHERS: JASON DONNELLY, JACOB FOX; **ILLUSTRATOR:** CHRISTOPHER MILLS

You'll find this bench the perfect accessory to place at the foot of the bed or near an entry door. Sit to put on shoes or socks, or just to take a moment.

Rock-solid bridle joints lock the stretcher to the leg assemblies, creating a stable perch that won't twist or sway. Cut these joints on just the tablesaw. You can even upholster the padded seats yourself with our step-by-step instructions on *page 28*. The seats drop into the frame so you can easily remove them for cleaning, or to change the fabric to refresh the look.

While the leg (A) blanks are still square, cut the mortises. We used a mortising machine with a ½" chisel, but you can also drill overlapping ½" holes at the drill press, then chisel the walls and ends square.

SHAPE THE LEGS AND RAILS

Sturdy tapered legs support the seats. A rail ties each pair of legs together with mortise-and-tenon joints.

TIP!

Laminate ¾"-thick stock, if needed, to make thicker blanks for the legs.

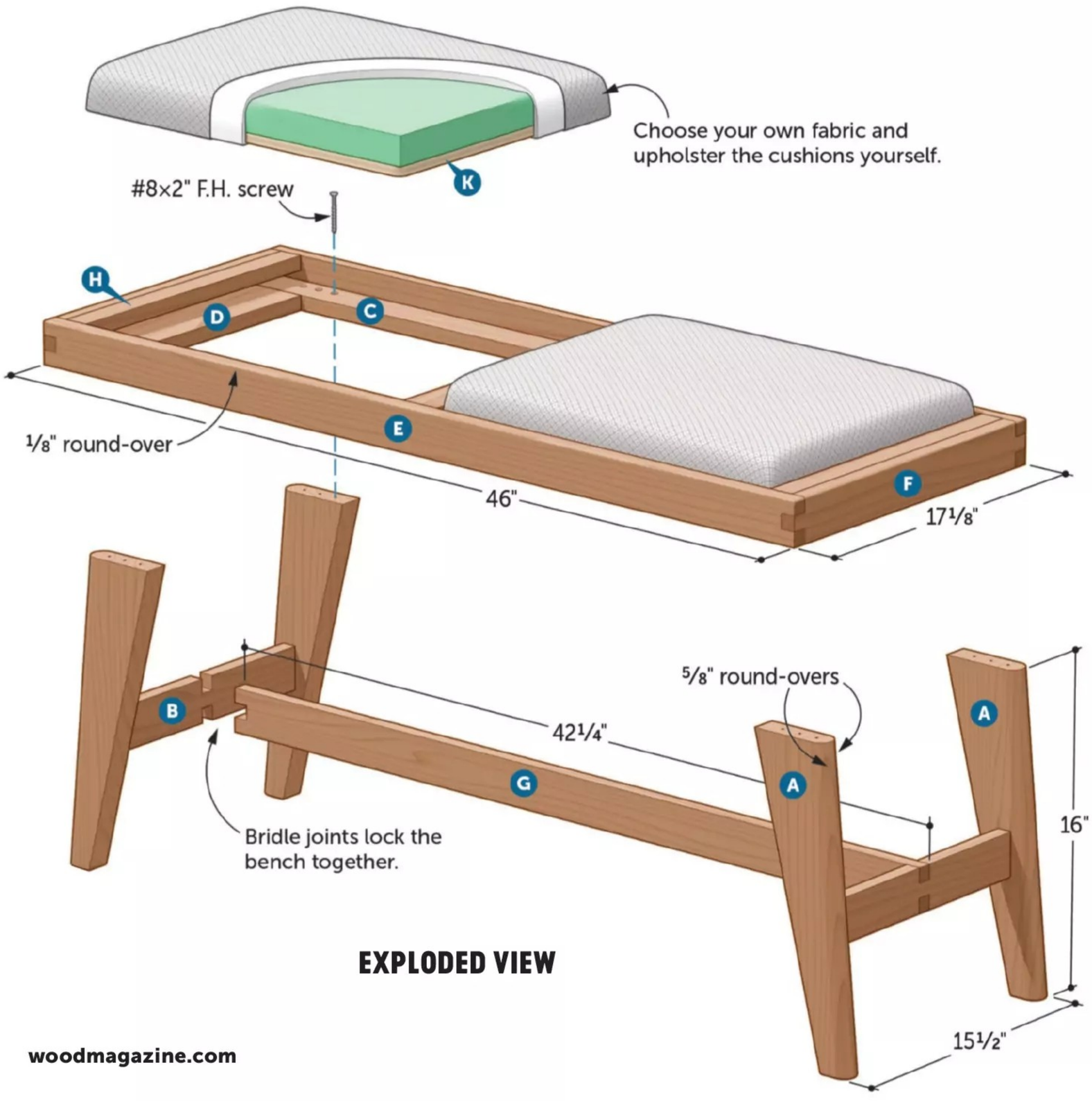
1 From 1¼" stock, cut four 5½×16" blanks for the legs (A). Lay out the taper and mortise locations on the blanks **[Drawing 1]**, making sure to create two mirrored pairs.

2 Form the mortises **[Photo A]**. Clean the bottom of the mortises with a chisel to ensure they are a full 1" deep.

3 Bandsaw just outside the leg layout lines. Clean up to the lines with a plane or on the jointer.

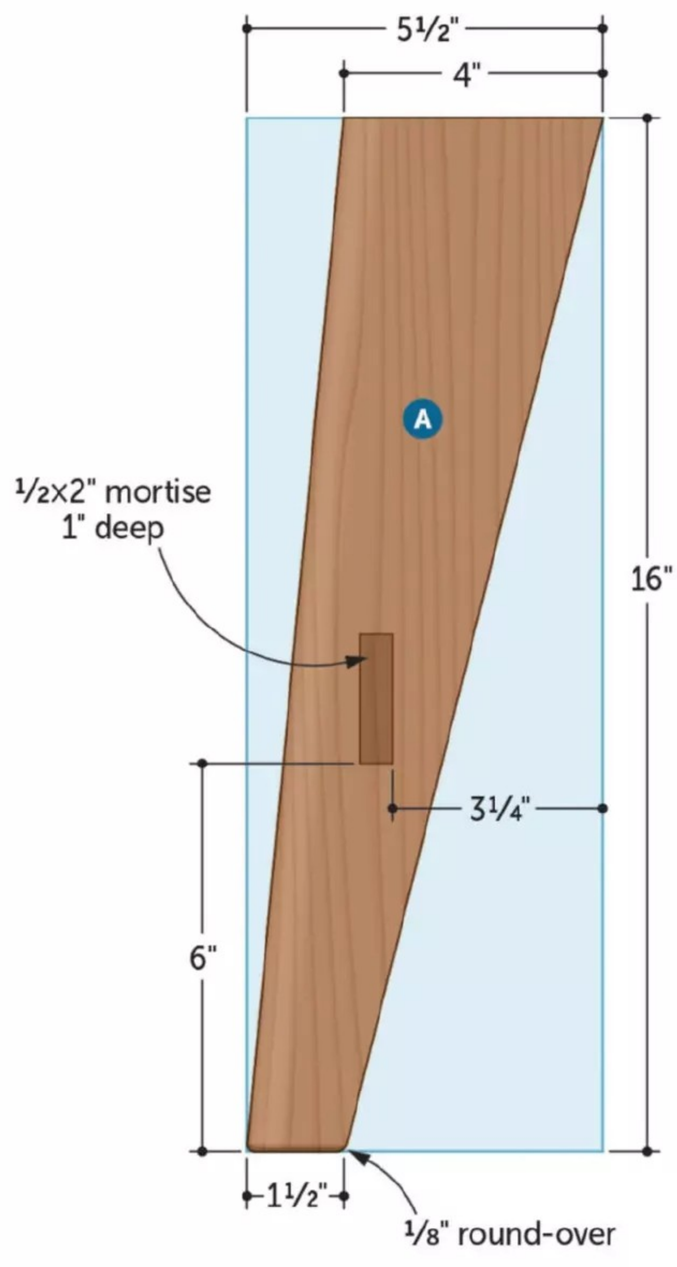
4 Rout ⅝" round-overs on the outside edge of each leg **[Exploded View]**, making multiple passes to avoid chip-out. Rout the ⅛" round-overs around the bottom of each leg **[Drawing 1]**.

Prefer to taper the legs at the tablesaw? Try this jig.
woodmagazine.com/simpletaper



EXPLODED VIEW

1 LEG



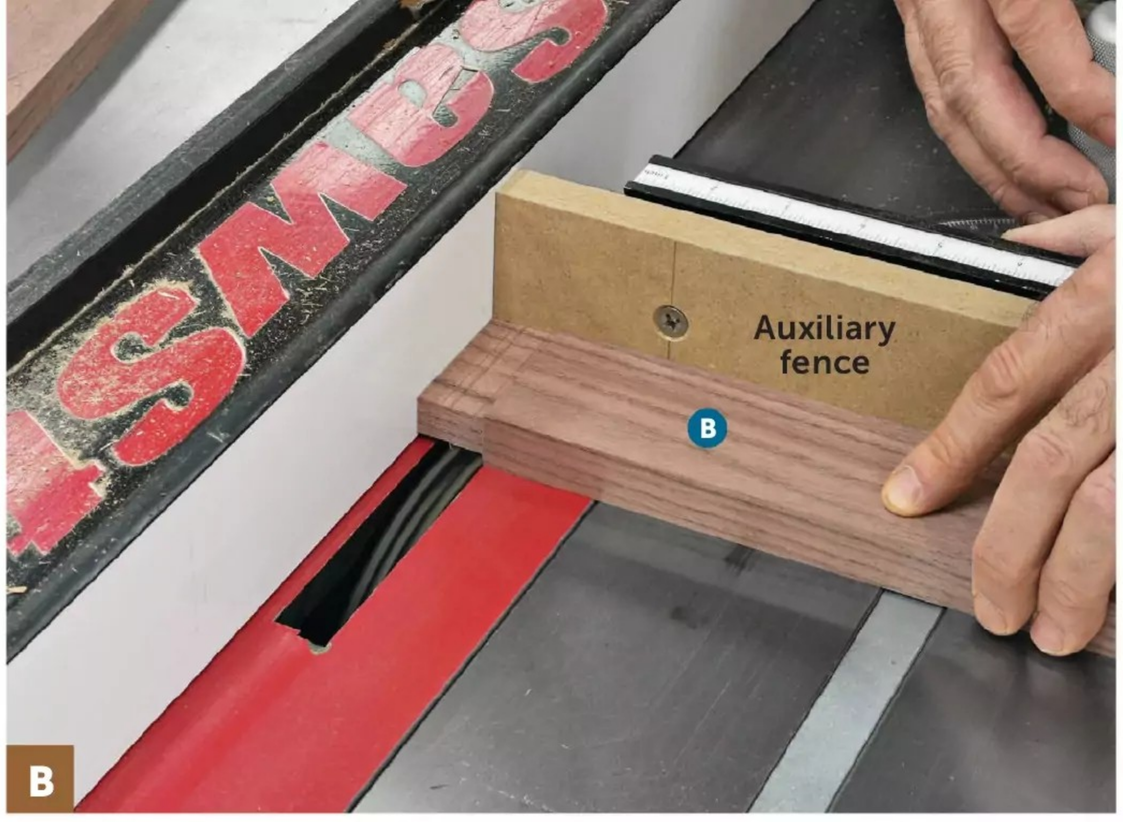
TIP!

Set up a dado stack in your tablesaw as close to ¾" as possible without using shims. Cut a dado in a scrap and use this as a gauge to plane stock for the ¾" parts for this project. Use the same dado stack to cut joinery later.

5 Mill stock for the leg rails (B) and cut them to size **[Parts List]**. Save some cutoffs for setting up the tablesaw in the next step.

6 Install a dado stack in your tablesaw and set the blade height to about ⅛". Make passes on the end of a leg-rail scrap on all four faces to form a stub tenon. Check the tenon's fit in a leg (A) mortise. Adjust the blade height as needed, then cut the tenons **[Photo B]**.

7 Test the fit of the tenons in the mortises, then set the legs and leg rails aside for now.



Once you have the dado blade height dialed in, set the fence 1" from the outside of the blade. Attach an auxiliary fence to your miter gauge to prevent chip-out and cut the leg rail (B) tenons to length.

SUPPORT THE SEATS

Next, use sturdy half-lap joinery to build a support for the seats. Mill a bit of extra material to use for dialing in the tablesaw setup.

1 Mill the seat support rails (C) and seat support stretchers (D) to size **[Drawing 2]** and save some cutoffs for setting up the tablesaw.

2 Install a dado stack in your tablesaw and raise it to just under one-half the thickness of a rail. Make a pass on one end of two scraps and test their fit **[Photo C]**, adjusting and retesting the fit as needed.

3 Set the rip fence using one of the seat support rails (C) as a gauge. To do that, position the edge of the rail flush with an outermost tooth of the dado blade, then bring the rip fence up to contact the opposite edge of the rail. Rabbet the ends of the seat support stretchers (D) **[Photo D]**.

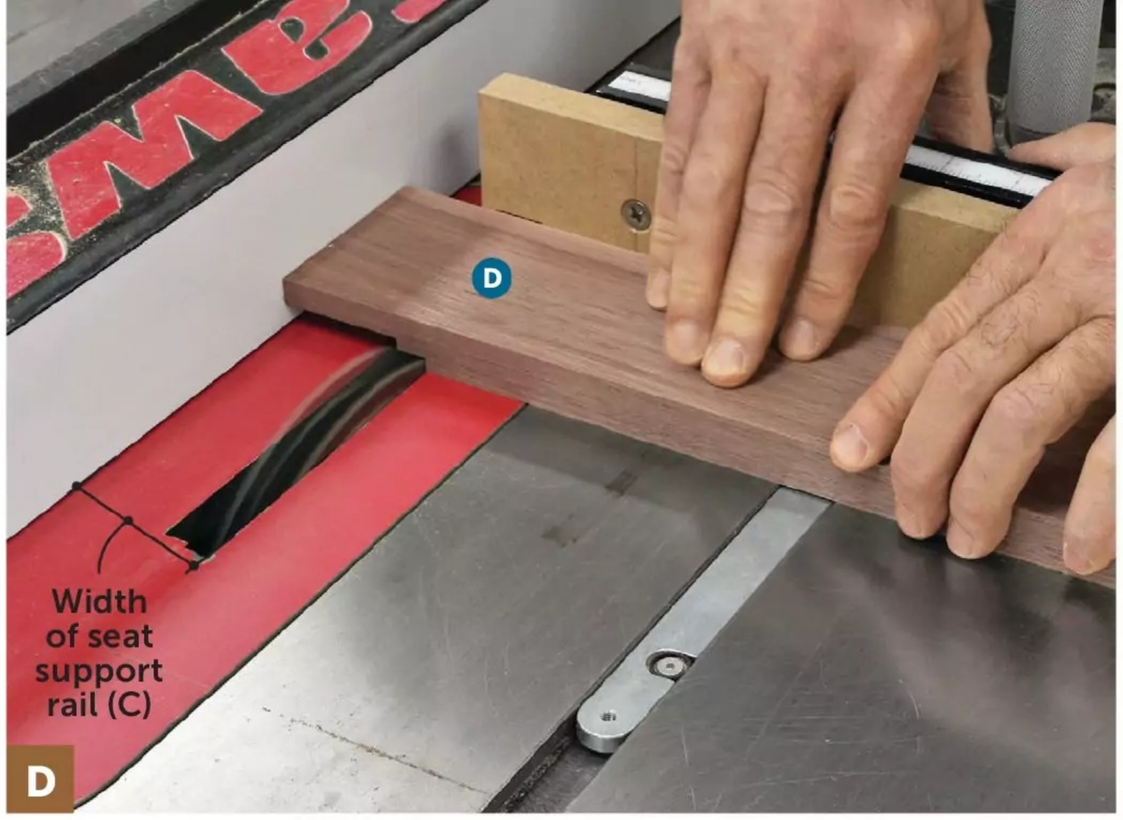
4 Reposition the rip fence using a seat support stretcher (D) to gauge to the outside edge of the dado blade. Rabbet each end of the seat support rails (C) **[Drawing 2]**.

5 Mark the location of the dado on each seat support rail **[Photo E]**. Cut the dado on each rail to the lines **[Drawing 2]**.

6 Glue up the seat support stretchers and rails **[Photo F]**. After the glue dries, finish-sand the seat support assembly.

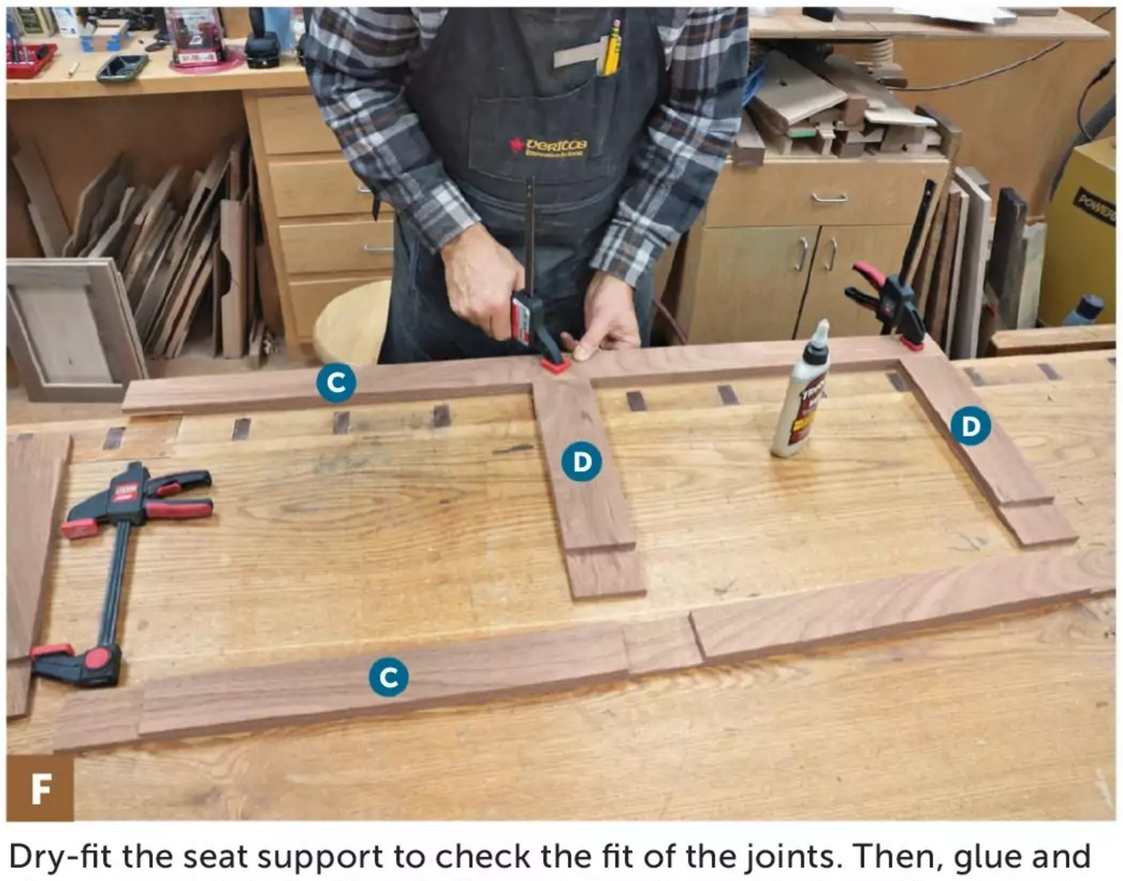
> **UPHOLSTERING CUSHIONS MAY SEEM BEYOND YOUR SKILL SET, BUT I THINK YOU'LL FIND IT QUITE EASY TO GET PROFESSIONAL-LOOKING RESULTS.**
>
> ***-KEVIN BOYLE, SENIOR DESIGN EDITOR***

The dado blade height is set correctly when the faces of the rabbets make contact while the test pieces rest flat on the tablesaw. Start with the blade a bit low and raise it between cuts to get a proper fit.



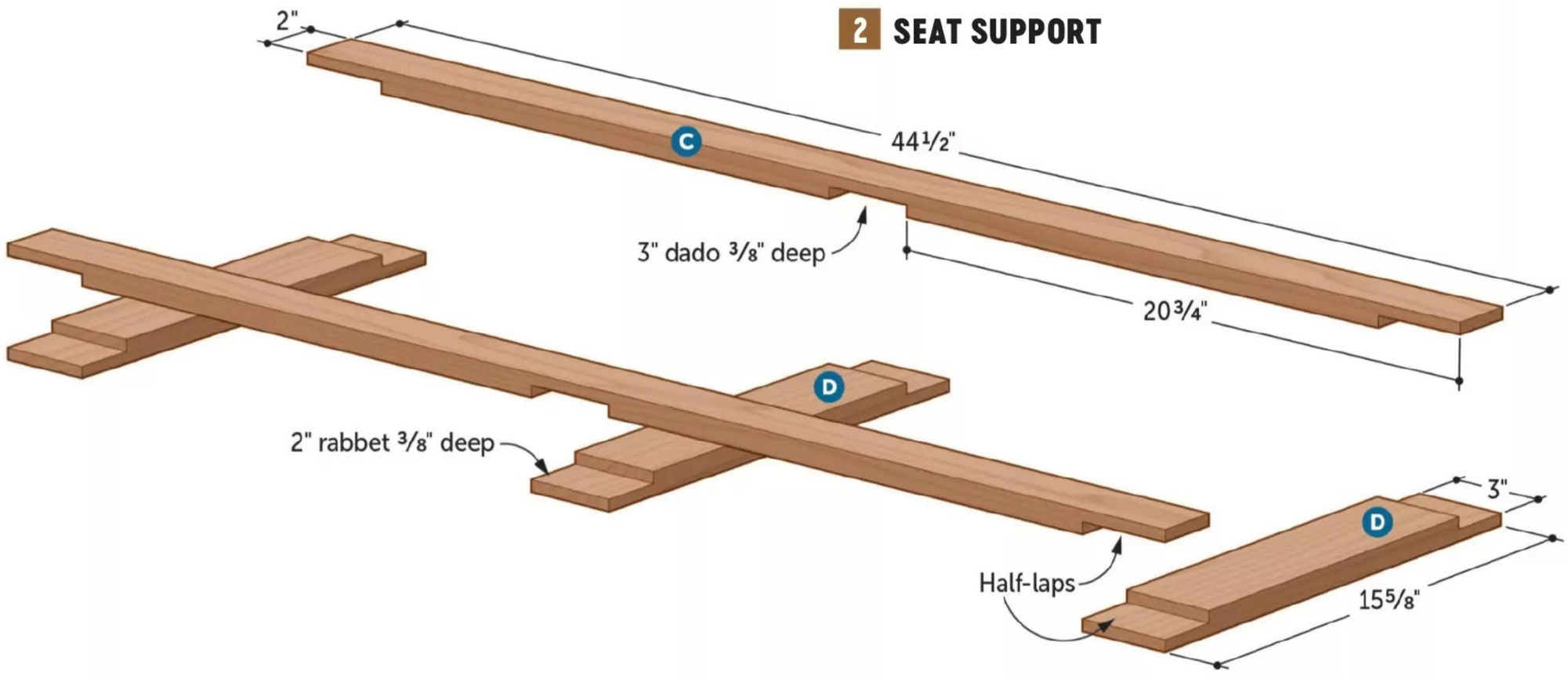
Attach an auxiliary fence to your miter gauge to back up the cut. Make several passes over the dado blade until the end of the seat support stretcher (D) touches the rip fence.

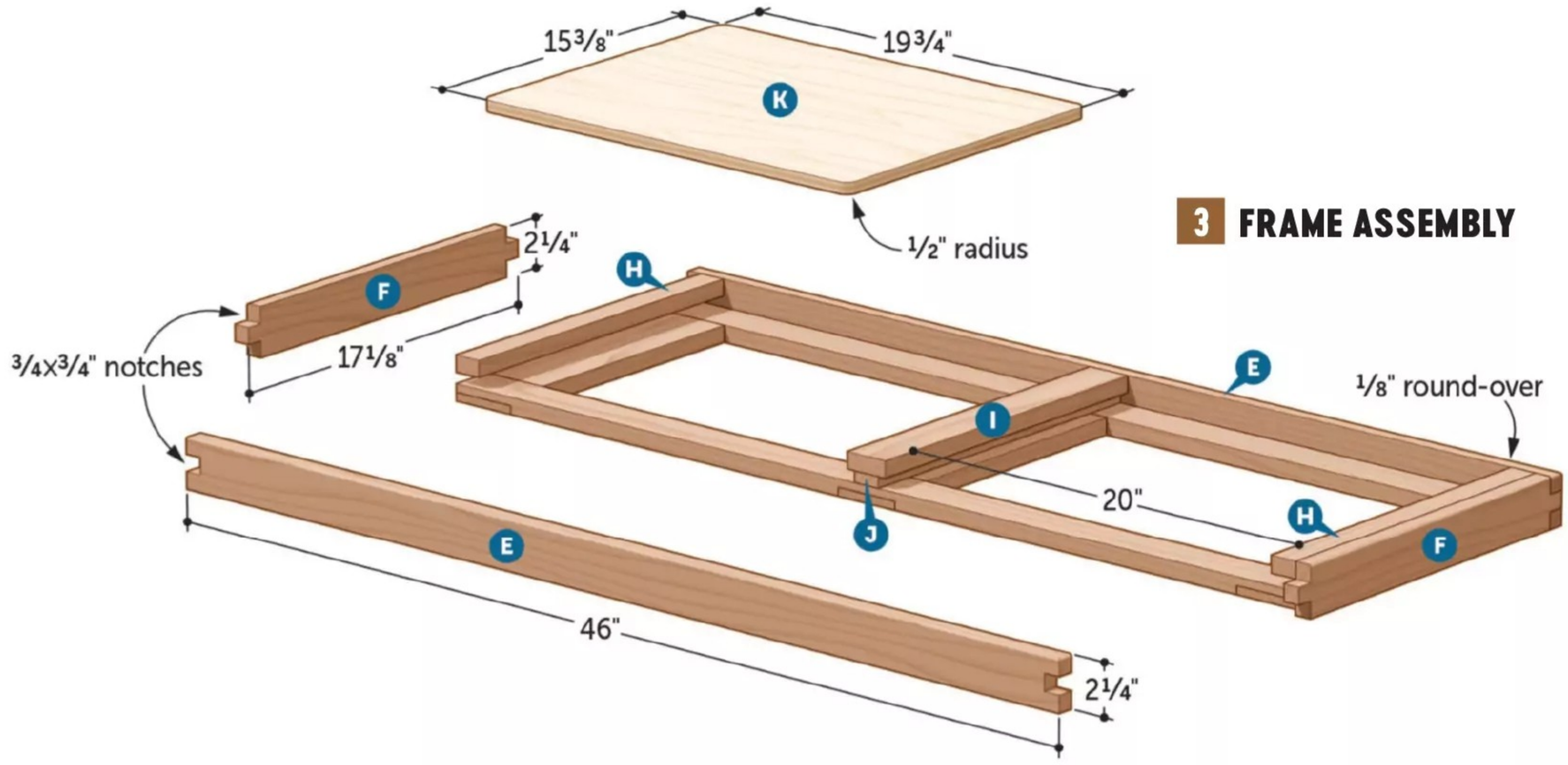
Place a seat support rail (C) on your bench with the rabbets up. Center the rabbet of a seat support stretcher (D) on the length of the rail. Mark along the edges of the stretcher with a marking knife.



Dry-fit the seat support to check the fit of the joints. Then, glue and clamp one joint at a time before adding the next piece. Check both faces to make sure the shoulders of each joint are tight.

2 SEAT SUPPORT





FRAME THE SUPPORT

The frame rails and stretchers (E, F) that wrap the seat support use bridle joints that mirror those joining the leg stretcher (G) to the leg rails (B). Save setup time by completing both now.

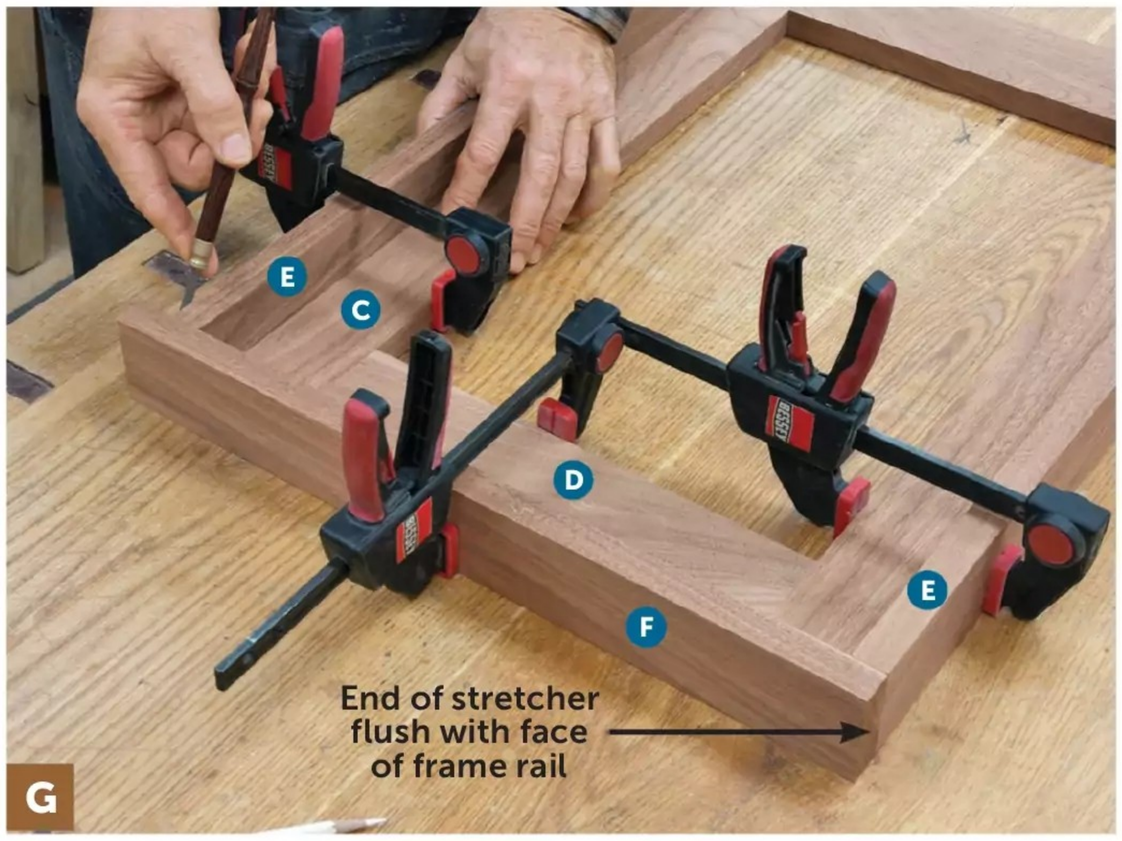
1 From 3/4" stock, cut the frame rails (E), frame stretchers (F), and the leg stretcher (G) to width. Crosscut the frame rails and stretchers 1" overlength and the leg stretcher (G) to finished length **[Materials List]**. Save some offcuts of the same material to dial in the tablesaw setup.

2 Clamp the frame rails (E) to the sides of the seat support (C/D) and mark the length of the frame stretchers (F) **[Photo G]**. Use the same process to mark the length of the frame rails **[Photo H]**. Cut the frame stretchers and rails to length.

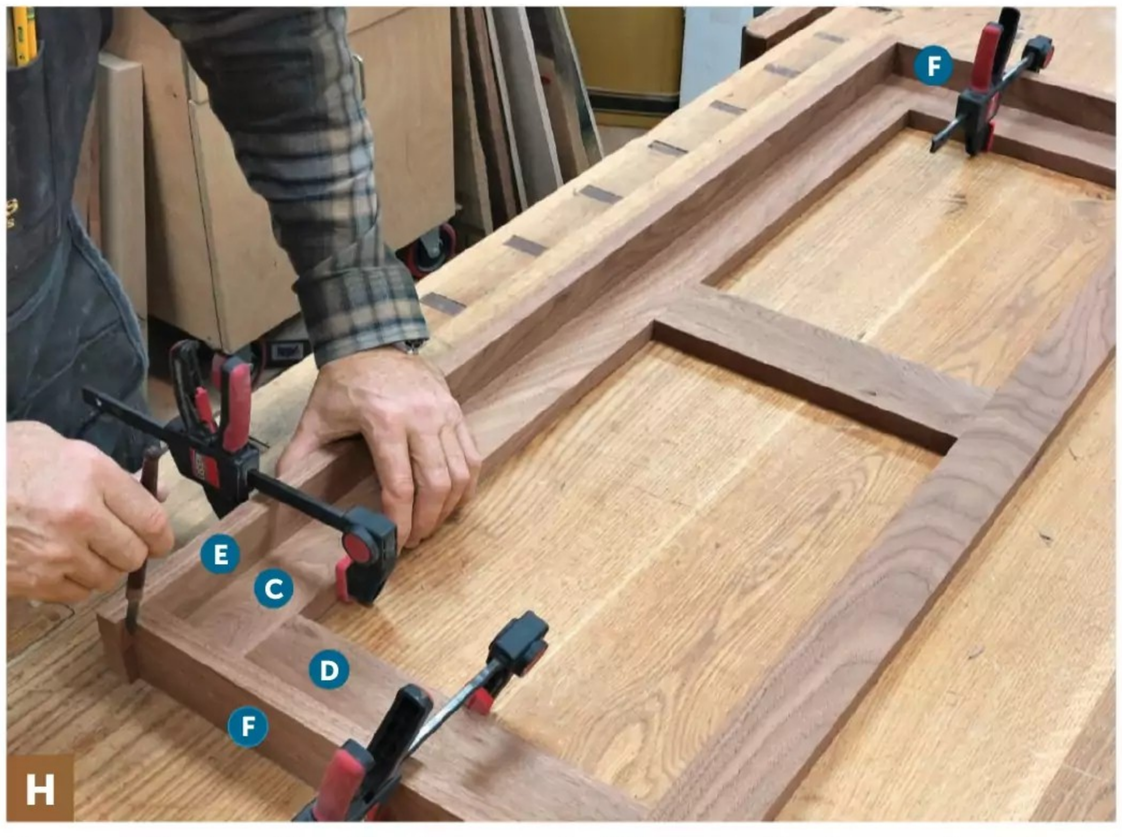
3 Install a dado stack to match the thickness of the frame rails (E). Making test cuts on a cutoff from the frame rails, adjust the rip fence to cut a centered notch in one end. Then notch each end of the frame rails **[Photo I, Drawing 3]**. While you're set up, notch the leg stretcher (G) **[Drawing 4]**.

4 Attach an auxiliary face to your rip fence and position it to just brush the dado blade. Cut the tenons on the frame stretchers (F) **[Photo J]**.

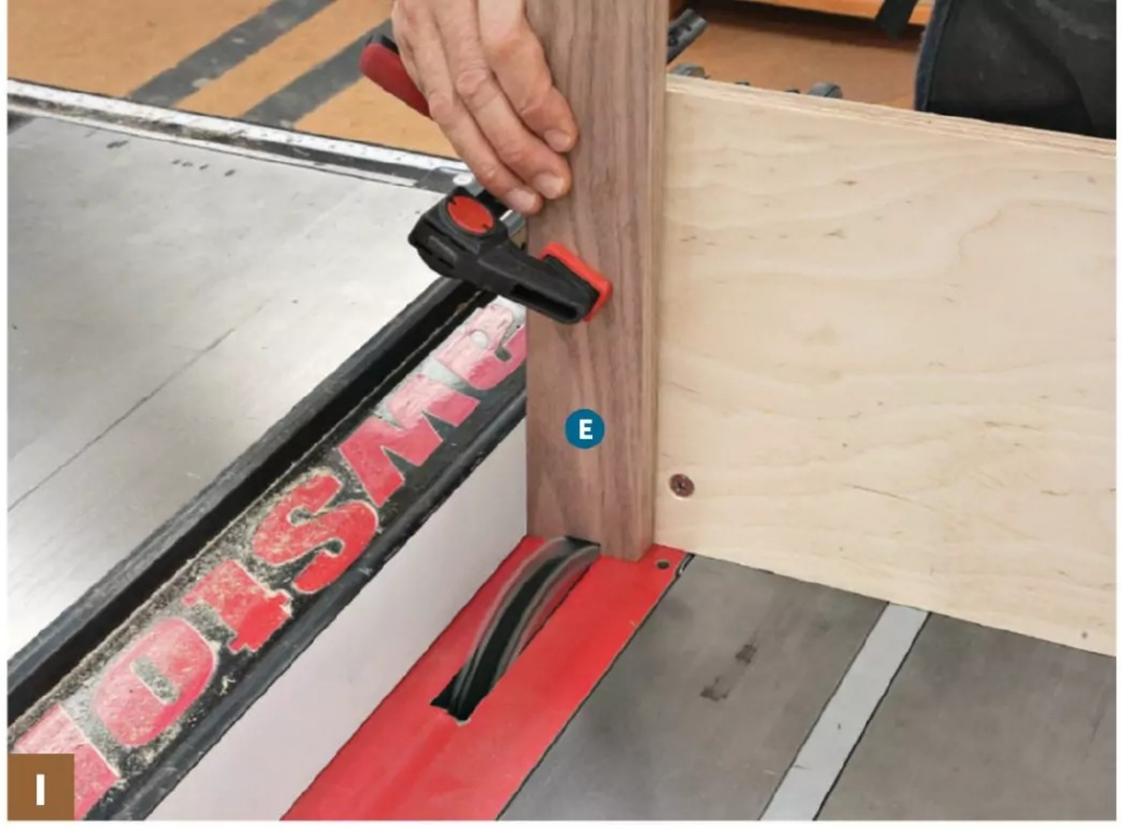
5 While you have the saw set up, retrieve the leg rails (B). Cut a centered notch on each edge of each rail **[Drawing 4, Photo K]**. Set the leg rails aside again. Finish-sand the frame rails and stretchers.



Clamp the frame rails (E) flush with one end of the seat support (C/D). Then clamp a frame stretcher (F) flush with the outside face of a frame rail and mark the opposite end of the stretcher for length.

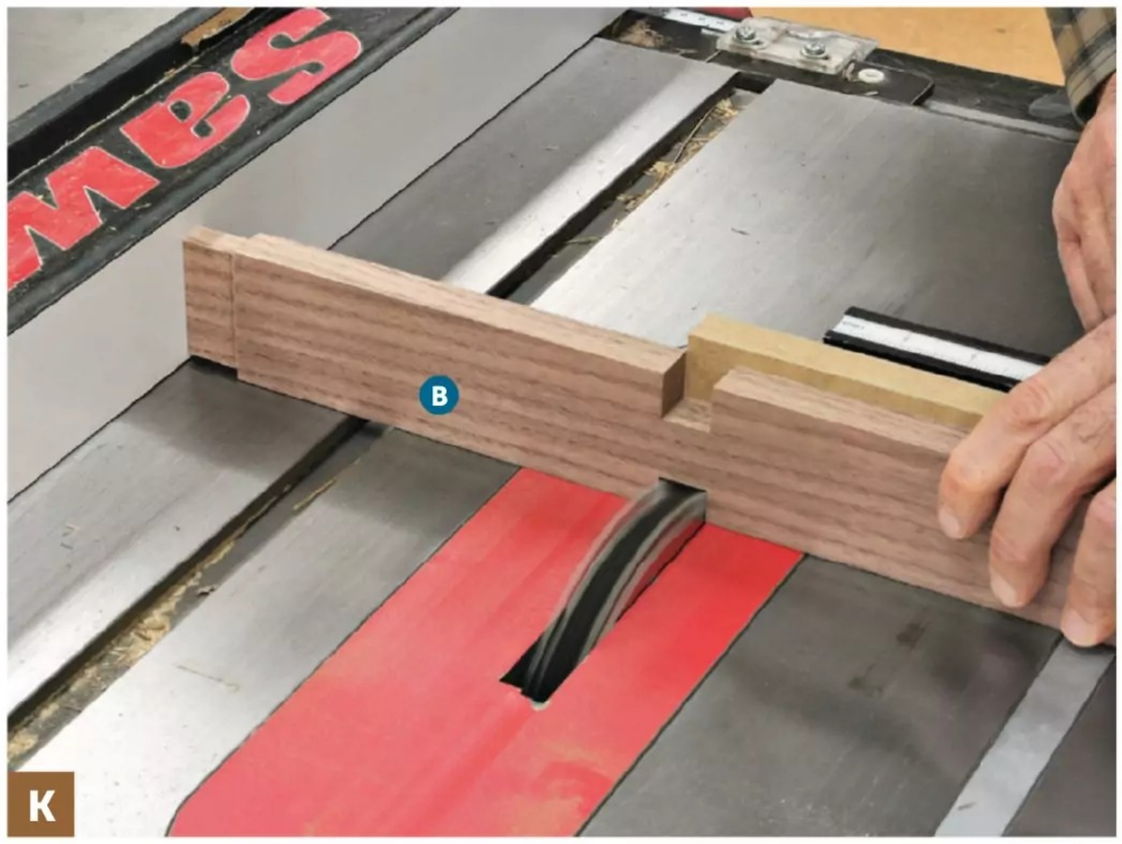


To mark the length of the frame rails (E), clamp the frame stretchers (F) flush with the edge of a seat support rail (C). Align an end of a frame rail with the outside face of a frame stretcher and mark the rail.

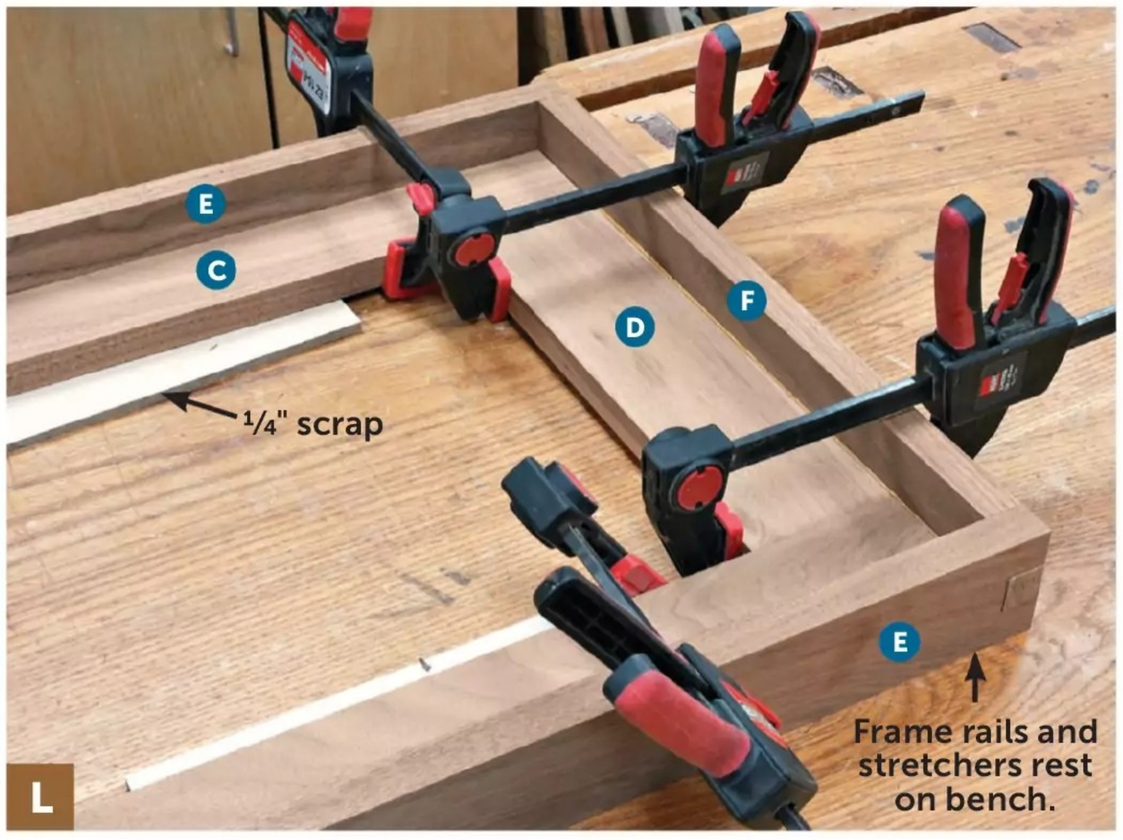


Attach a tall fence to your miter gauge to back up and support the frame rail (E). Set the dado blade height to match the thickness of the frame stretchers (F). Notch each end of the rails.

Make test cuts in cutoffs from the frame stretchers (F) to create a tenon that fits the notches in the frame rails (E). Then notch both edges of both ends of the frame stretchers.



Use the rip fence as a stop to position the leg rail (B). When cutting the second notch, butt the same end of the rail against the fence to ensure the notches align perfectly.



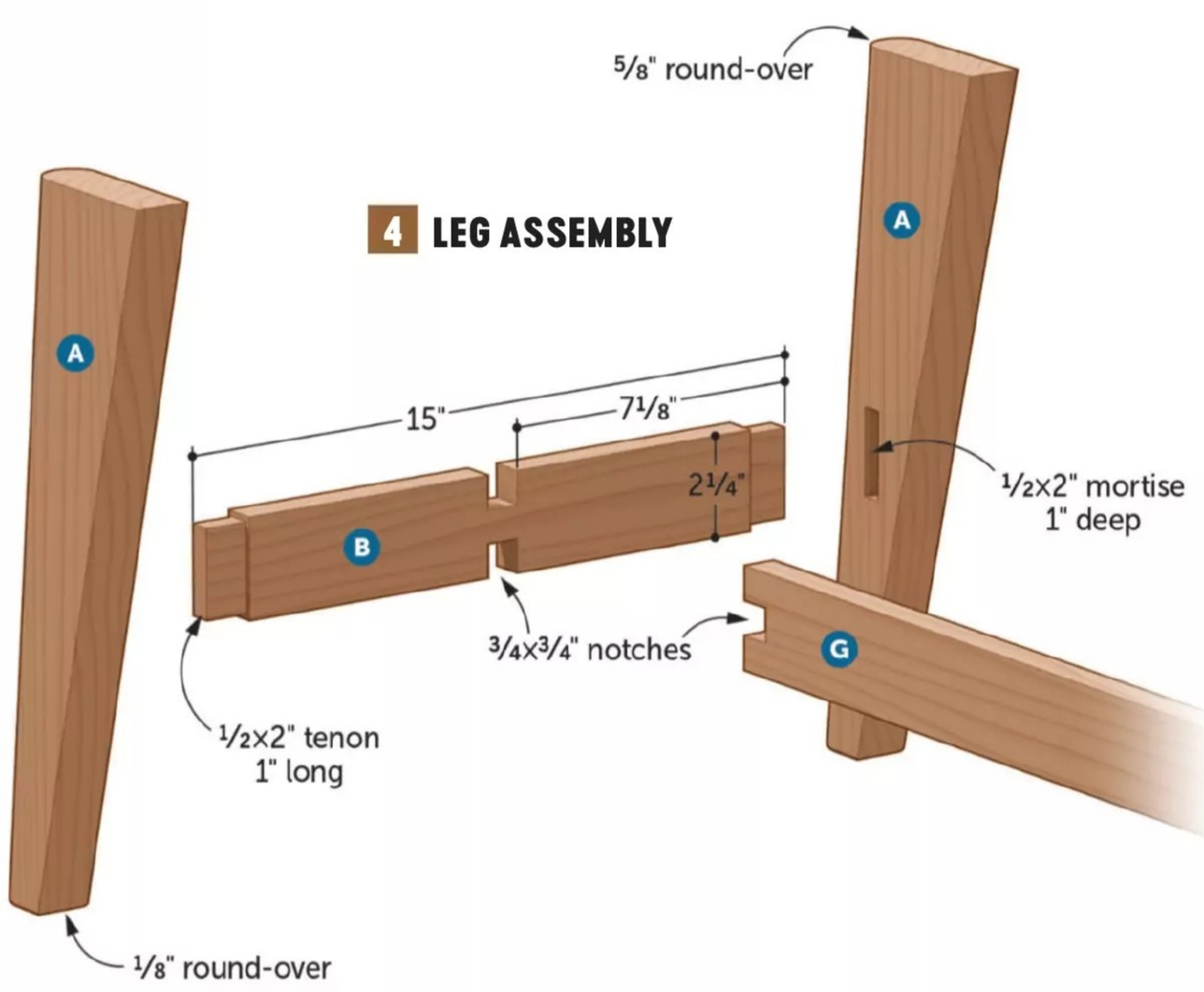
Scrap material lifts the seat support (C/D) to create a lower lip. Glue a frame rail (E) to a frame stretcher (F), then glue this assembly to the seat support. Add the remaining stretcher and rail.

6 Rest the seat support (C/D) on scraps of ¼" material on your bench. Glue and clamp the frame rails and stretchers (E, F) around the seat support **[Photo L, Drawing 3]**.

7 While the glue dries, cut the fillers (H, I) to size from ¾" stock and the riser (J) from ½" stock to fit between the frame rails (E) **[Drawing 3]**.

8 Glue the riser (J) to the middle seat support stretcher (D), creating two equal-size openings **[Drawing 3]**. Then, glue the end fillers (H) flush with the top of the frame stretchers (F). Glue the middle filler (I) to the riser, centered.

9 After the glue dries, round over the top outside edge of the frame rails and stretchers (E, F) **[Drawing 3]**. Touch up any areas that need sanding.



A CUSHY ASSIGNMENT

Upholstering the cushions takes no special skills beyond some simple sewing in a line. Choose a fabric for the cushions to complement your decor. And if you want to freshen the look later, it's easy to remove and replace the fabric. Find foam and batting at fabric retailers, hobby stores, or upholstery shops.

Using spray adhesive, attach an oversize piece of foam to each seat pan (K). Trim the foam flush with the seat pans **[Photo 1]**.

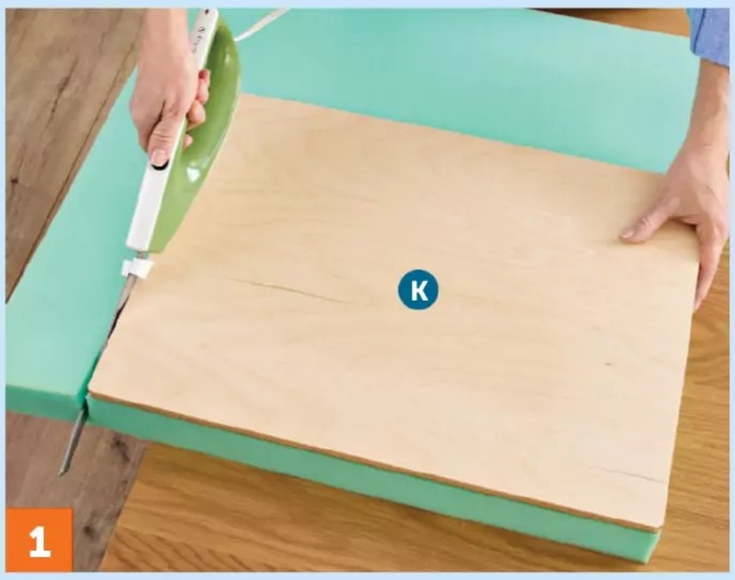
For each cushion, cut two layers of batting large enough to wrap around the foam and at least 1" onto the seat pan. Center a seat pan on the two layers of batting and trim the corners **[Photo 2]**.

Wrap the batting around the foam and seat pan, pull the batting taut, and staple it in place [**Photo 3]**.

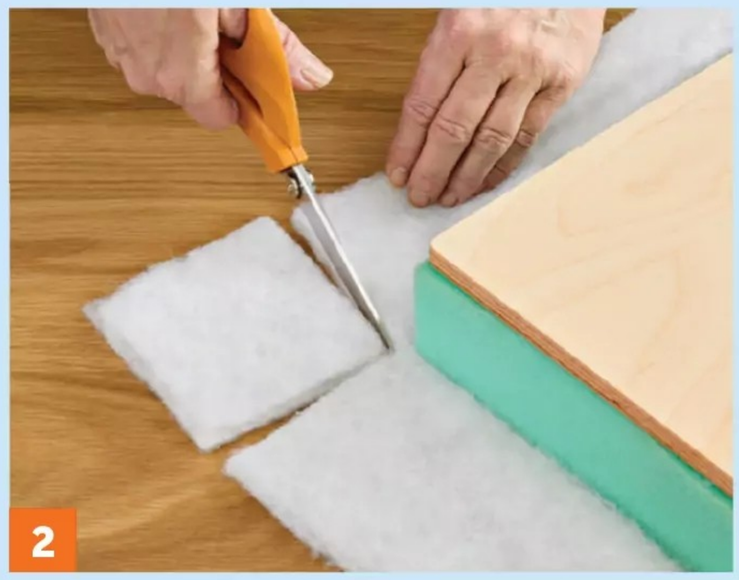
Cut the fabric 8½" longer and wider than the seat pans (K). Fold the fabric diagonally with the back side out, and follow the three steps in the **Drawing** to sew and trim the corners.

Turn the fabric right side out and pull it over the foam and batting. Align the seams at each corner and check for even amounts of fabric on each side.

Turn the cushion upside down and fold one long edge of the fabric over the seat pan (K). Begin securing the fabric with ¼" staples **[Photo 4]**. Complete both long edges, then do the short edges. Gather up and secure the corners with 5/16" staples after all four edges are done **[Photo 5]**.



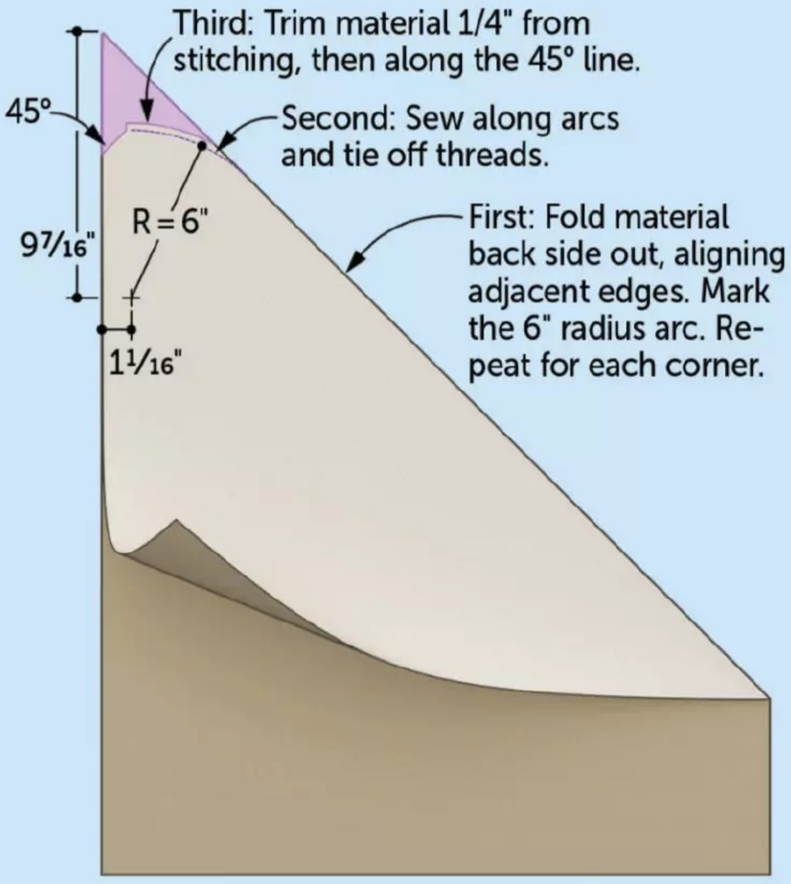
Use an electric knife or a serrated bread knife to trim the foam. Keep the blade against the plywood seat pan (K) and perpendicular to its face.



Align the scissors with the edge of the foam and cut away each corner of the batting layers. This reduces bulk at the corners, making it easier to fit the fabric covering.

Fold the batting up on a long edge, aligning its notched end with the edge of the foam and seat pan. Staple along the length, then repeat as you work your way around.

Roll enough of the unfinished edge of the fabric under to allow stapling through it. Work from the center to one corner, pulling the fabric taut as you go. Then repeat toward the other corner.



After stapling along all four edges, reload your stapler with 5/16" fasteners. Gather up the loose fabric at a corner into a triangle. Fold the triangle over, keeping it taut, and secure it with several staples.

BRING IT TOGETHER

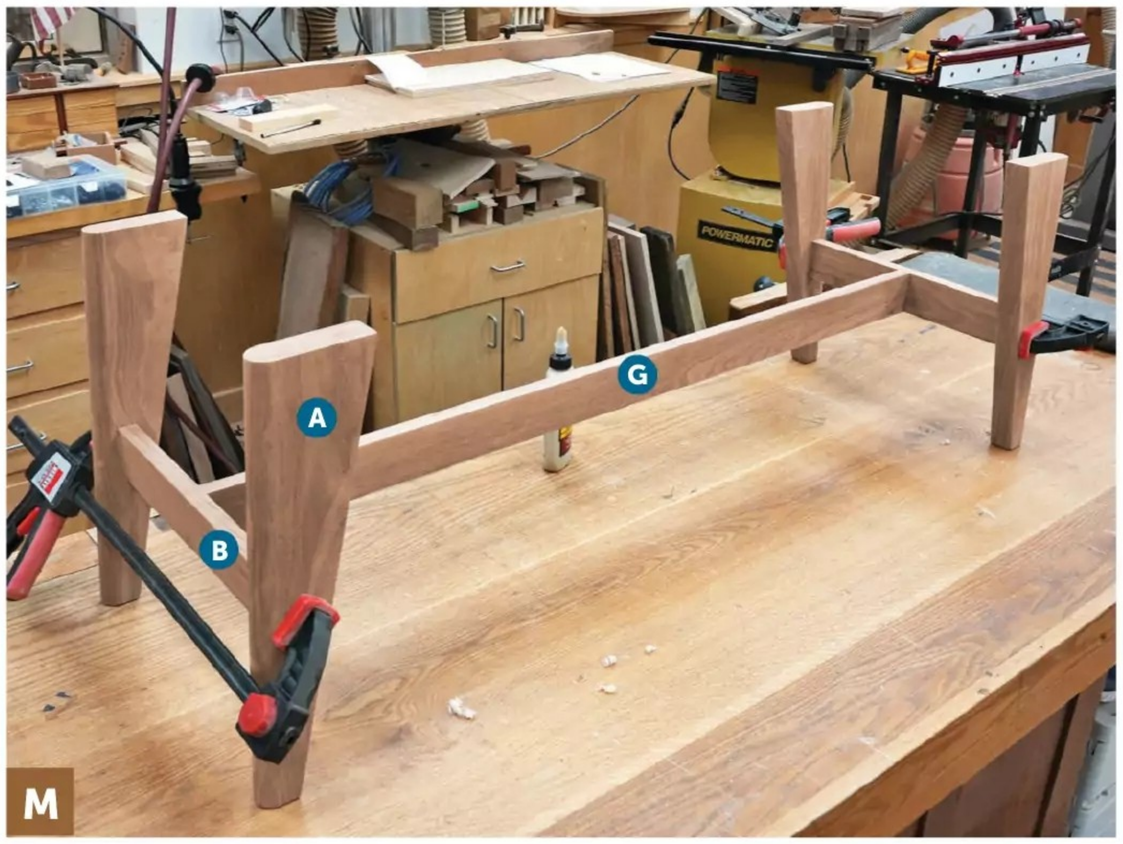
1 Begin assembling the base by gluing the leg stretcher (G) between the leg rails (B). Make sure the rails are square to the stretcher. Remove any glue squeeze-out with a damp rag.

2 After the glue dries, glue the legs (A) to the leg rails (B) **[Photo M]**. Finish-sand the leg assembly.

3 Center the frame assembly on the leg assembly. Drill pilot holes and screw the frame to the legs **[Exploded View]**.

4 Apply a finish. We sprayed on three coats of satin lacquer.

5 Cut the seat pans (K) 1/4" smaller than their openings in each dimension. Then, upholster them as shown in *A Cushy Assignment, previous page*. Place the cushions in the frame, and you can now rest on your laurels.



Assemble the base on a flat surface such as your workbench. Apply glue to the leg-rail tenons on one end and clamp the legs in place. Repeat for the opposite end.

> **THE SIMPLE, STRAIGHT LINES OF THIS BENCH LET THE BOLD JOINERY DETAILS SHINE.**
>
> ***-KEVIN BOYLE, SENIOR DESIGN EDITOR***

PARTS LIST

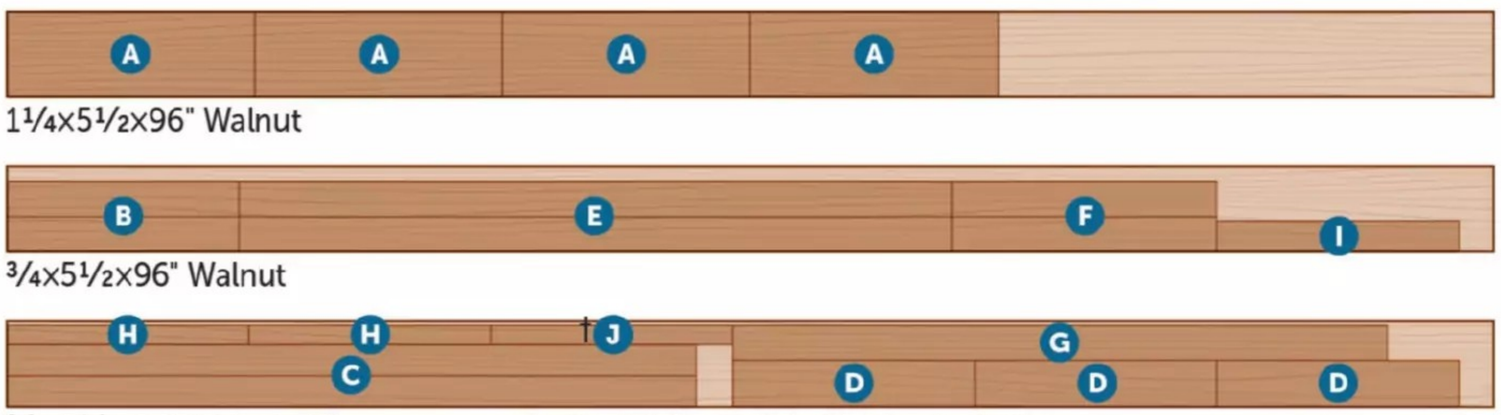
PART		FINISHED SIZE T	W	L	Matl.	Qty.
A	LEGS	1¼"	5½"	16"	W	4
B	LEG RAILS	¾"	2¼"	15"	W	2
C	SEAT SUPPORT RAILS	¾"	2"	44½"	W	2
D	SEAT SUPPORT STRETCHERS	¾"	3"	15⅝"	W	3
E*	FRAME RAILS	¾"	2¼"	46"	W	2
F*	FRAME STRETCHERS	¾"	2¼"	17⅛"	W	2
G	LEG STRETCHER	¾"	2¼"	42¼"	W	1
H	END FILLERS	¾"	1¼"	15⅝"	W	2
I	MIDDLE FILLER	¾"	2"	15⅝"	W	1
J	RISER	½"	1¼"	15⅝"	W	1
K	SEAT PANS	½"	15⅜"	19¾"	Ply	2

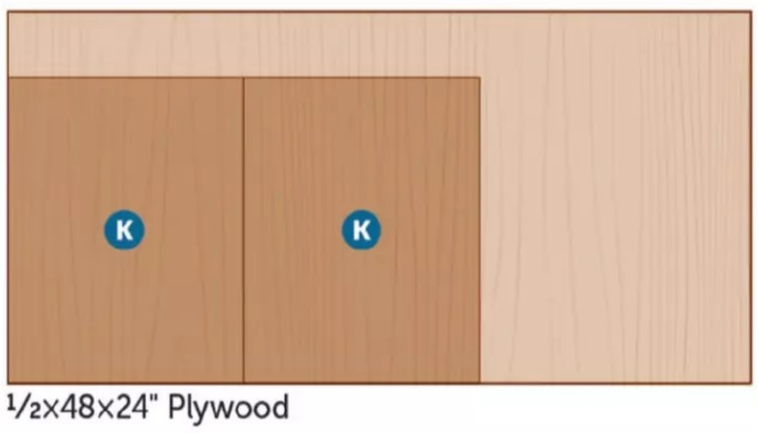
*Parts initially cut oversize. See the instructions.

MATERIALS KEY: W–walnut, Ply–plywood.
SUPPLIES: #8×2" flathead screws, 2×16×40" high-density foam, twin-size extra-loft poly batting, 1 yard fabric, ¼" and 5/16" staples, spray adhesive.
BLADES AND BITS: Dado set, ⅛" and ⅝" round-over bits, electric knife.
PROJECT COST: It cost us about $320 to build this project. Your cost will vary by region and source.

CUTTING DIAGRAM

We purchased 6 board feet of 6/4 walnut and 8 board feet of 4/4 walnut. Before cutting parts to size, we planed them to the thicknesses shown in these example boards.





HAPPY HOPPY HARES

Explore your whimsical side by building this batch of bouncing bunnies in a fun forest. It's a toy kids will love, so hop to it!

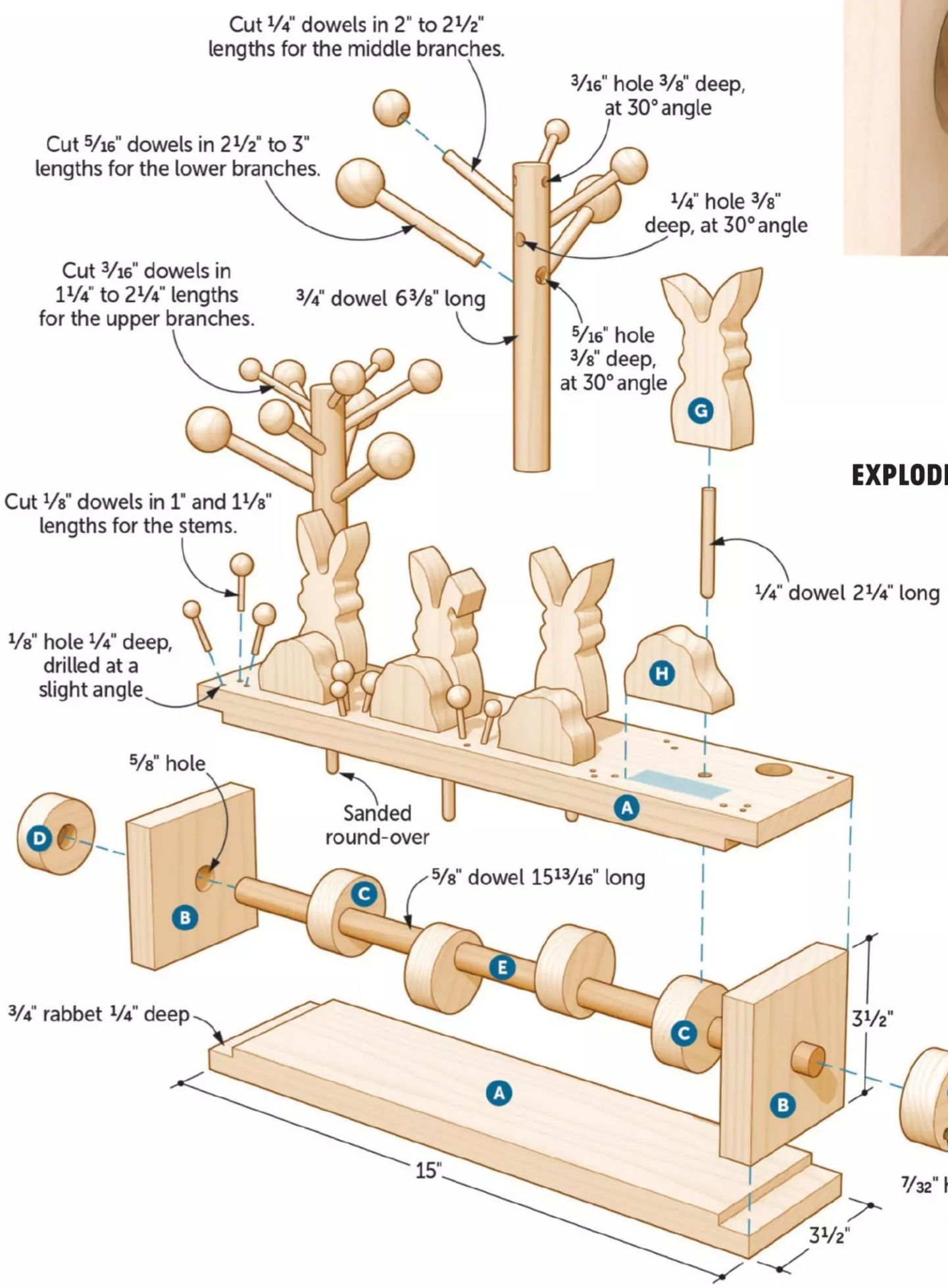
WRITER: DAVE STONE
DESIGNER: DUFF GOLDMAN
BUILDERS: KEVIN BOYLE, DUFF GOLDMAN

OVERALL DIMENSIONS
17⅝"W × 6"D × 12"H

Take a tour of Duff Goldman's shop.
woodmagazine.com/duffsworkshop

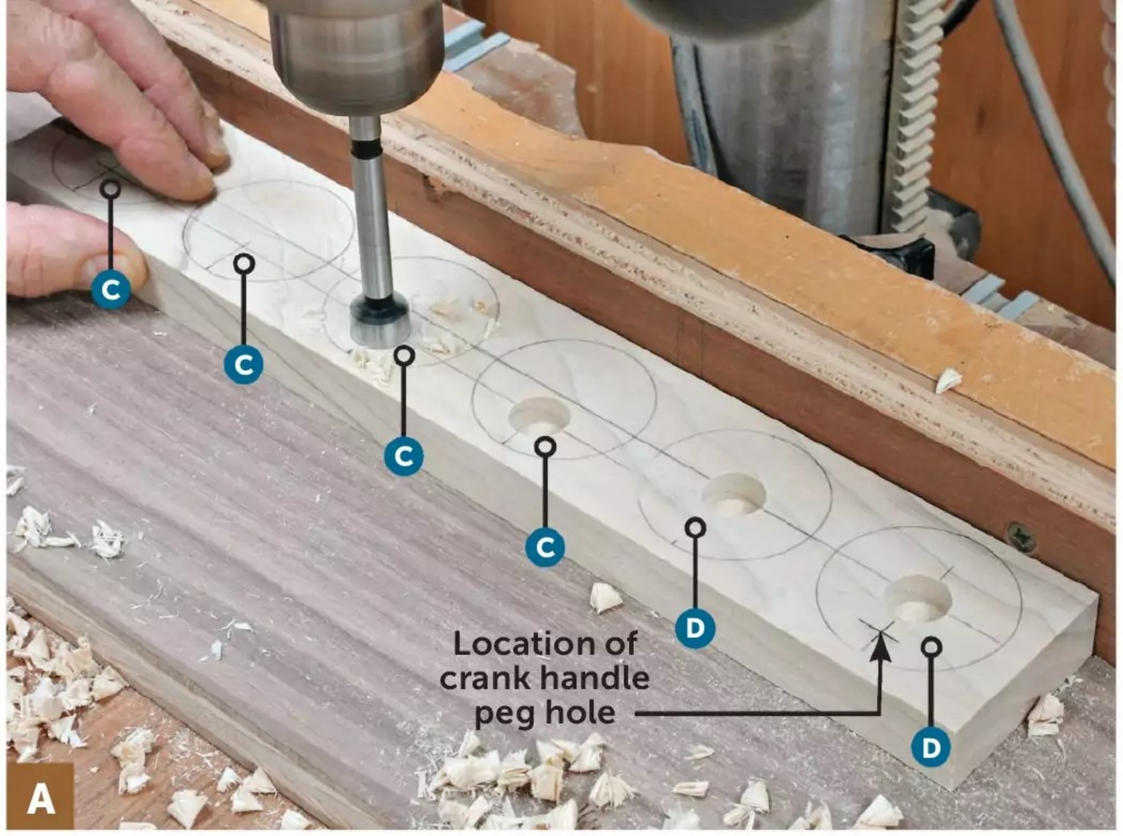
Today's interactive toys often have screens or run on batteries. But this one, designed by celebrity cake artist Duff Goldman (whose workshop we featured in issue 303, July 2025), runs on imagination. Put it into the hands of any kid (or kid at heart) and you'll quickly see a smile as they turn the crank that makes the four bunnies hop up and down in their woodland home.

You'll smile, too, as you build this project from a single board, a few dowels, and an assortment of wooden balls from the craft store. We also offer a project kit **[Source]** that includes all the parts you need, except the board, to get you cranking. By the way, if rabbits aren't your favorite, you can easily use this design as a hopping-off point for your own version.



EXPLODED VIEW

PHOTOGRAPHER: JACOB FOX; ILLUSTRATOR: CHRISTOPHER MILLS



Drill ⅝" holes ⅜" deep, centered on the two crankshaft caps (D). Drill ⅝" holes through the crankshaft cams (C) at the offset line.

CRANK OUT THE BASE

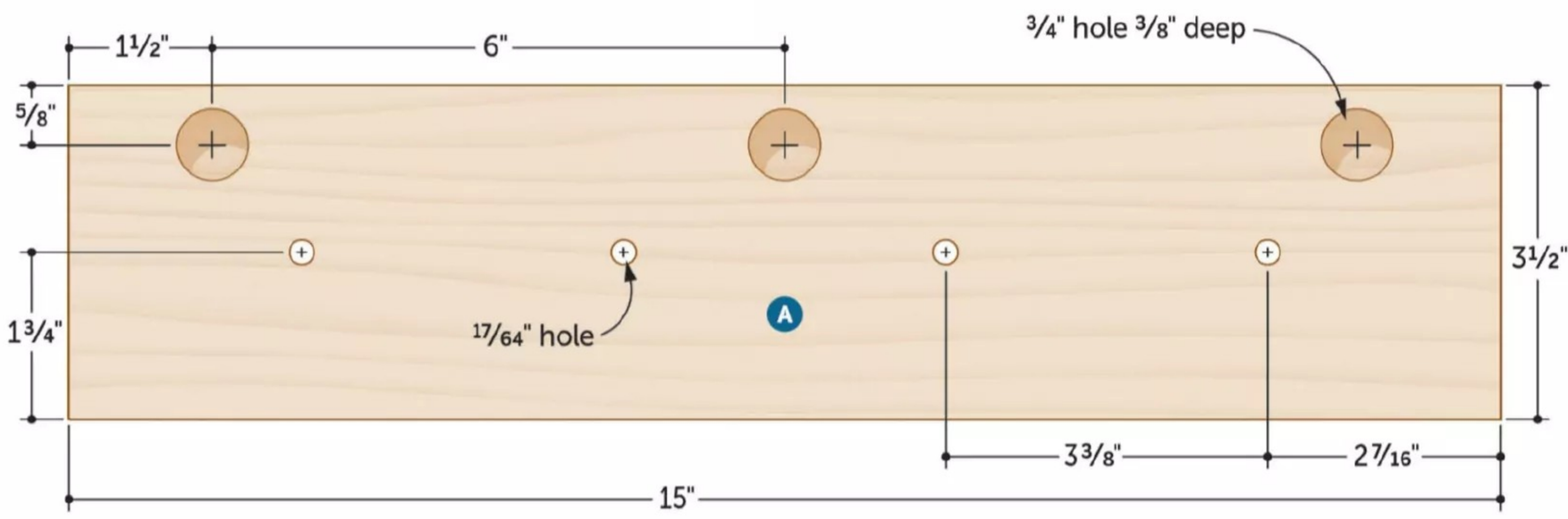
1 From ¾" stock, cut the base top and bottom (A) and ends (B) to size **[Exploded View]**. Lay out and drill a centered ⅝" hole in each base end (B) for the crankshaft to pass through.

2 Install a ¾" dado stack in your tablesaw and set it for a ¼"-deep cut. Attach an auxiliary fence to the rip fence and position it so the blade just brushes against it. Then rabbet each end of the top and bottom (A), using your miter gauge with an auxiliary fence to support the piece and prevent tear-out.

3 Lay out the hole locations in the base top (A) for the bunny follower dowels, as well as for the tree trunks, and drill these on the drill press **[Drawing 1]**. Note that the follower holes go all the way through, while the tree holes are stopped.

No drill press? Drill perpendicular holes with this handy jig. woodmagazine.com/straightholes

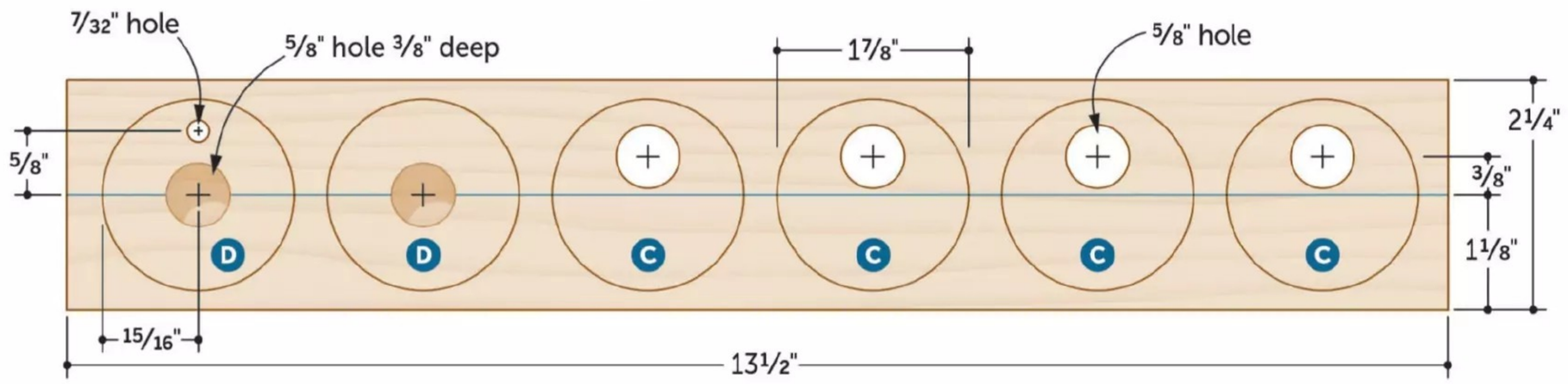
1 BASE TOP

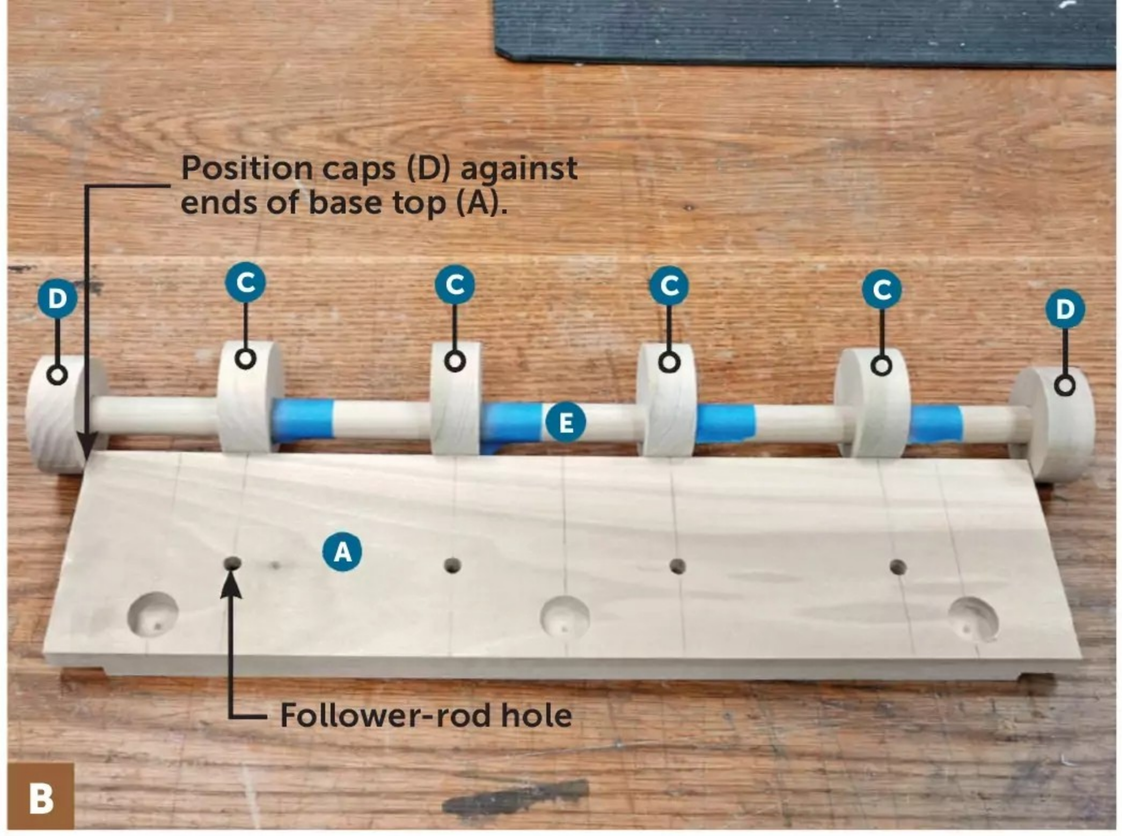


4 On a piece of ¾×2¼×13½" poplar, lay out circles for the cams (C) and caps (D) along with hole locations for the crankshaft and crank handle **[Drawing 2]**. At the drill press, use a ⅝" bit to drill stopped holes in the caps and through-holes in the cams **[Photo A]**. Then switch to a 7/32" bit to drill a hole through one of the caps for the hand crank handle. Cut each cam and cap to rough shape just outside the layout line, and then sand each to final shape.

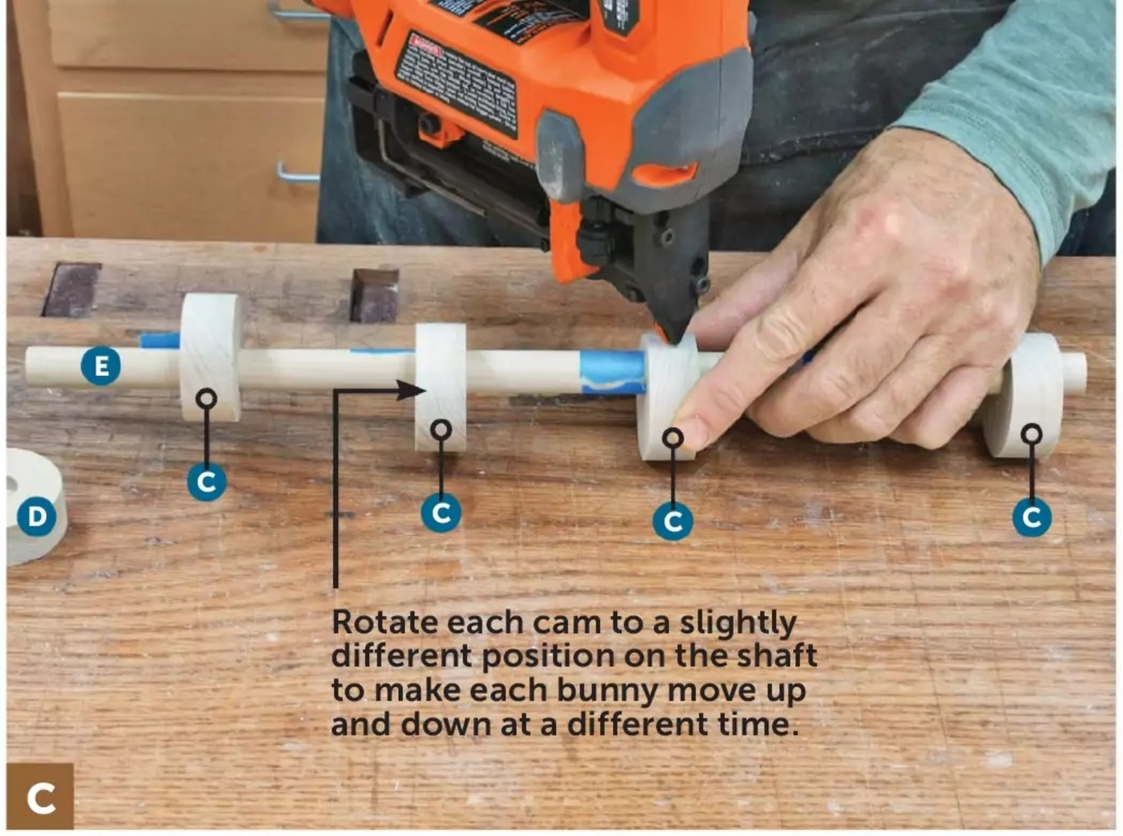
5 Cut the crankshaft (E) to length from a ⅝" dowel **[Exploded View]**. Slide the cams (C) onto the shaft followed by the caps (D). Place this assembly (C–E) alongside the base top (A) and align the cams with the holes **[Photo B]**. Then attach each cam to the crankshaft **[Photo C]**.

2 CAPS AND CAMS





Center the cams (C) on the follower-dowel holes, and then wrap painter's tape around the crankshaft (E) to mark each location.



Slide each cam (C) away from the tape and dab glue on the crankshaft (E). Reposition the cam and drive in a couple of ½" pin nails.

6 Slip the crankshaft assembly (C/E) into the holes in the base ends (B). If the fit is tight, sand the holes in the ends to enlarge them slightly. With the crankshaft assembly in place, glue and clamp the base top and bottom (A) to the ends.

7 Cut the crank handle (F) to length from ⅝" dowel. Mark a centerpoint on the end and drill a ¼" through hole. See *Dealing with Dowels* on *page 58*. Place an axle peg through the dowel, apply a small amount of glue into the hole in one cap (D), and insert the peg. Make sure the crank handle spins freely on the peg.

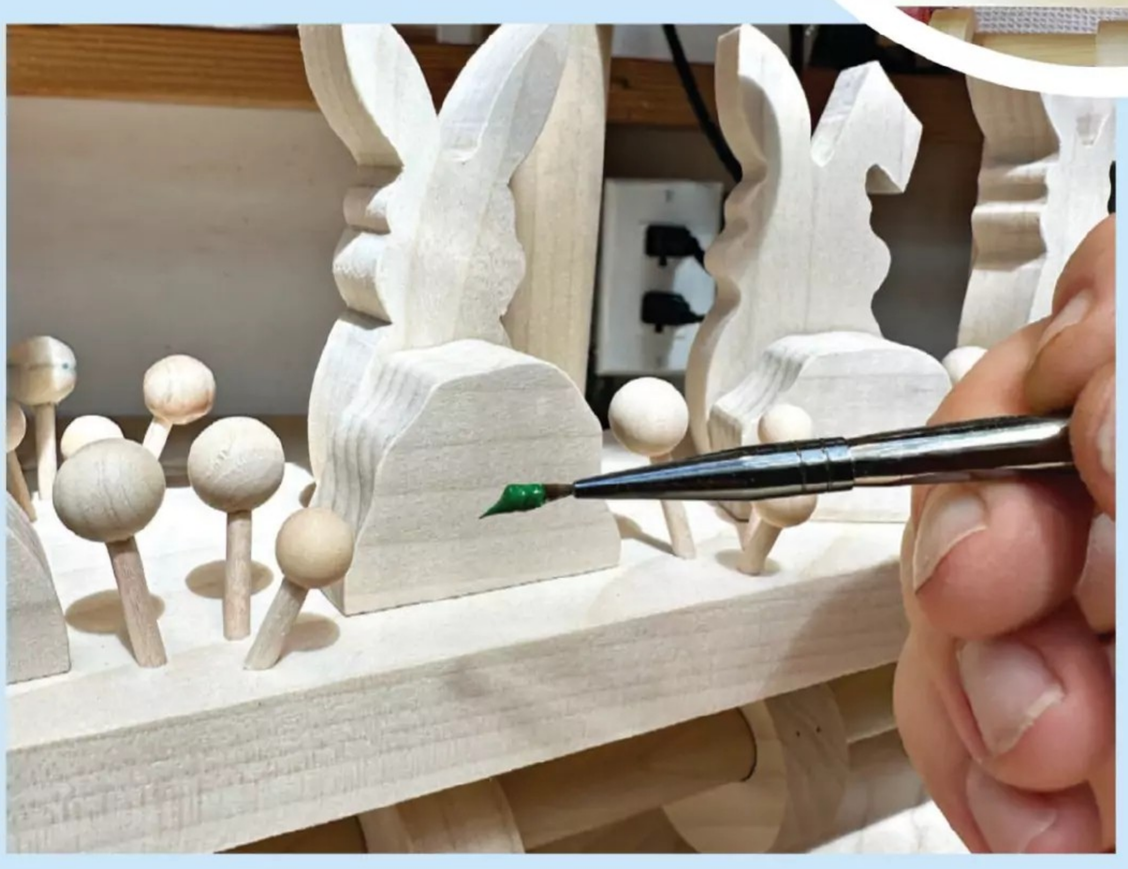
8 Glue the caps (D) onto the protruding ends of the crankshaft (E), making sure there's a small gap so the crankshaft turns freely.

DUFF'S TOP TIPS FOR PAINTING SUCCESS

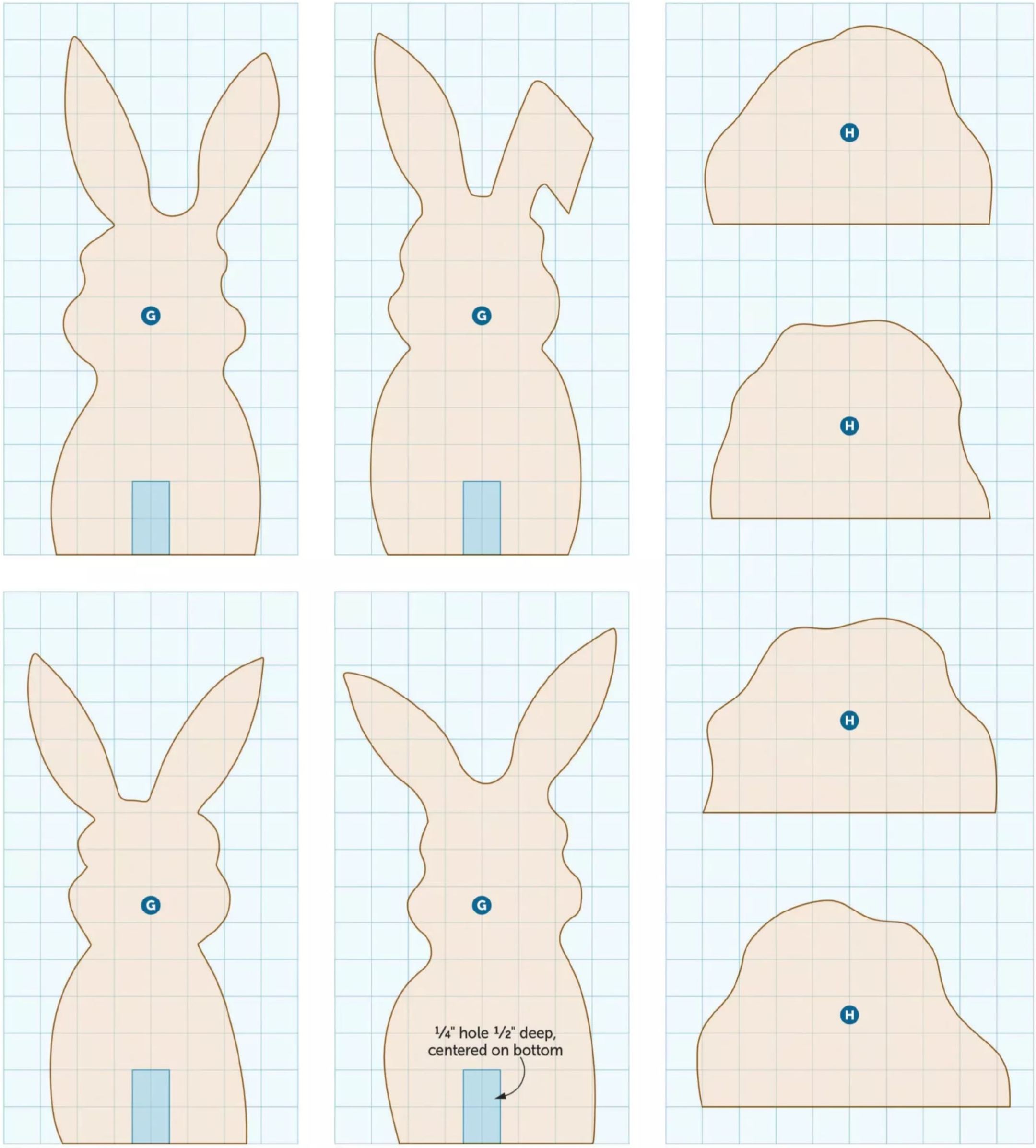
As a cake artist, Duff Goldman definitely has a leg up when it comes to creative painting. But he believes anyone can do it. Here's some of his best advice.

- Google images of what you want to create. For this project, try "cute animals" or "cute cartoon animals."
- Try to copy what you find. You won't get it exact, but that's what will make it your own.
- Sketch with pencil first. If you don't like it, erase and start again.
- Use artist's acrylic paints. They're easy to use and readily available.
- Get a magnifying task light to make small details larger.
- Don't get hung up on perfect. Unlike icing on a cake, if paint doesn't come out right, you can sand it off and start again.

Even if you can't match Duff Goldman's decorating prowess, you can give your toy an enchanting look with artist's paints and imagination.



3 FULL-SIZE PATTERNS



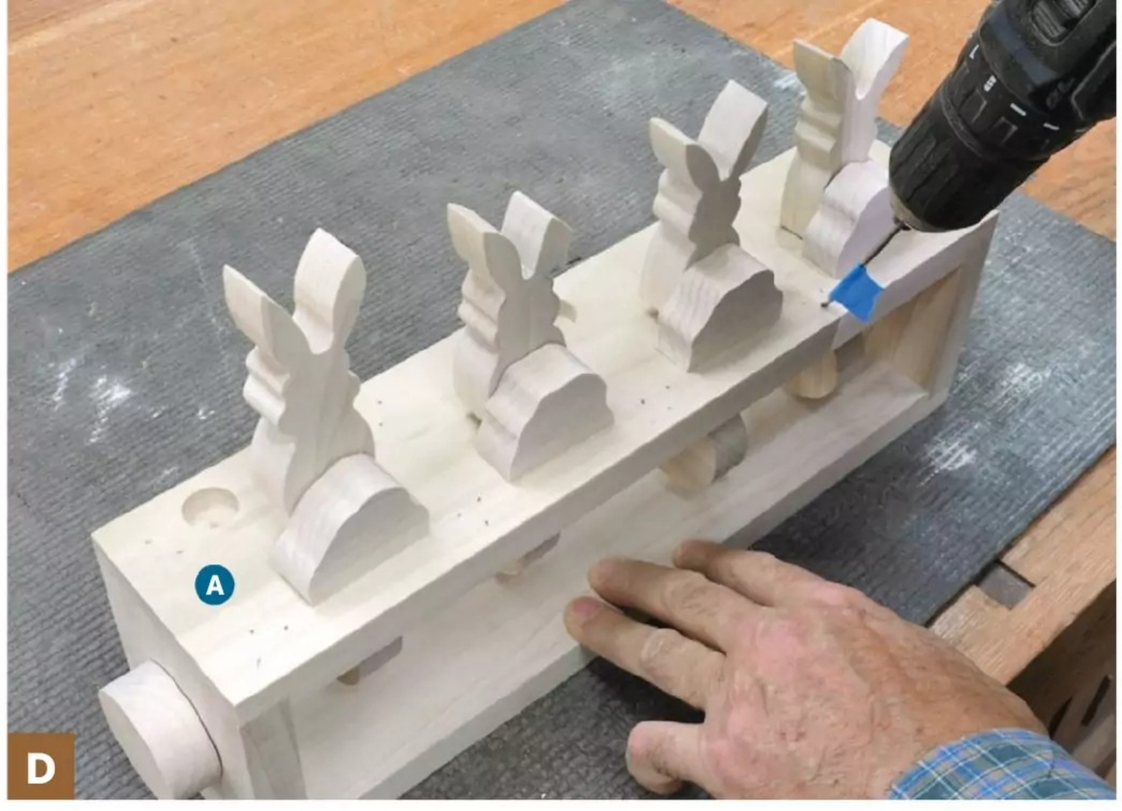
One square = ¼"

ADD BUNNIES AND BOULDERS

1 Cut four ¾×2×3¾" blanks for the bunnies (G) and a ¾×2½×7¾" blank for the boulders (H). Make copies of the full-size patterns **[Drawing 3]** and adhere them to the blanks. Drill a hole in the bottom of each bunny blank for the follower dowel.

2 Cut the bunnies and boulders to shape and sand the cut edges smooth. Then cut four follower dowels 2¼" long from ¼" dowel. Sand a round-over on one end. Glue the other end of each dowel into a bunny.

3 Place each bunny onto a hole in the base top (A) and temporarily position a boulder (H) in front of each bunny, leaving about a 1/16" gap. Mark and drill locations of the flower stems where you want them **[Photo D]**.



Wrap tape around a drill bit to act as a stop, and then bore ⅛" holes where you marked for flower stems. We added 27 total.

Position a trunk in the jig and drill holes where you want them for the branches. Brad-point bits prevent wandering as you start the holes.

ADD FLORA FOR YOUR FAUNA

TIP!

To hold the balls while drilling, wrap painter's tape around the jaws of locking pliers and set them to apply gentle pressure.

1 To make the flowers, drill ⅛" holes in the ⅜" and ½" balls for the flower blooms. For the stems, cut ⅛" dowels to 1" and 1⅛" lengths. Then glue them into the balls. Place the flowers temporarily into the holes in the base top (A), mixing and matching their locations to create groupings you like.

2 Create tree trunks by cutting ¾" dowel into three 6⅜" lengths. Build the cradle jig **[Drawing 4]** and use it to hold the trunks at a consistent 30° angle while you drill holes for the branches **[Photo E]**. We positioned the lowest branches about 4" from the trunk base in holes for 5/16" dowels, drilling them at random spacing around each trunk and at slightly offset heights **[Exploded View]**. Change to progressively smaller bits and repeat the process for the middle and upper branches. Don't worry if the holes intersect one another. Then glue the dowels into their holes.

3 Drill corresponding holes in the 1", ¾", and ½" balls so you can glue them to the branches to form clumps of leaves.

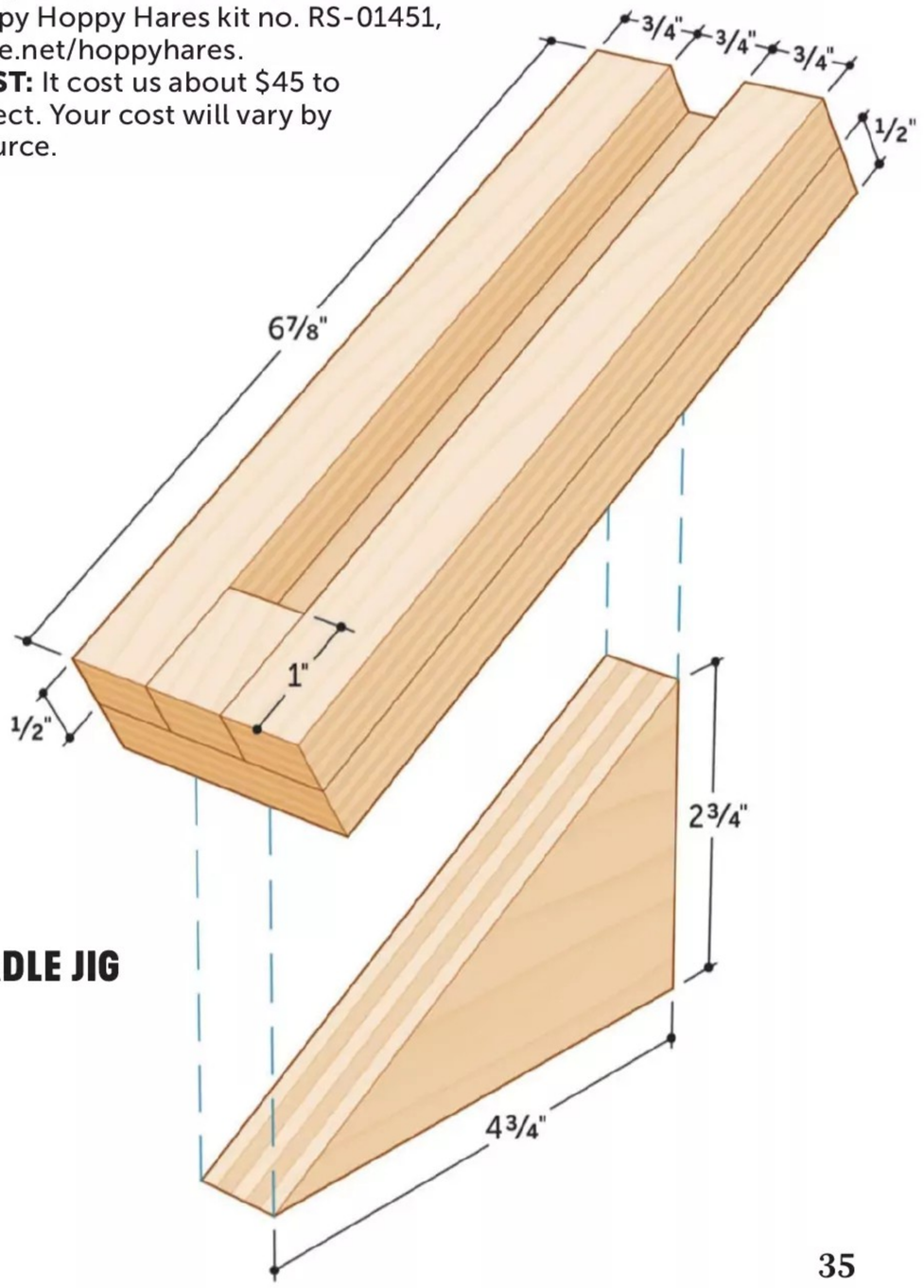
4 With your flora and fauna complete, remove the bunnies, boulders, trees, and flowers from the base, and finish-sand everything as needed. We masked off the base top (A) and coated the base parts with two coats of aerosol semigloss lacquer. After that, we put the parts in the talented hands of Duff Goldman, the project designer, to paint. See *Duff's Top Tips for Painting Success, page 33*. After the paint dries, epoxy the flowers, tree trunks and leaves, as well as the boulders into position. Drop the bunnies into place and put this handmade toy into the hands of a worthy recipient. We know they'll be as happy as the hopping hares.

PARTS LIST

PART		FINISHED SIZE T	W	L	Matl.	Qty.
A	BASE TOP/BOTTOM	¾"	3½"	15"	P	2
B	BASE ENDS	¾"	3½"	3½"	P	2
C*	CAMS	¾"	1⅞" dia.		P	4
D*	CAPS	¾"	1⅞" dia.		P	2
E	CRANKSHAFT	⅝" dia.		15 13/16"	PD	1
F	CRANK HANDLE	⅝" dia.		⅞"	PD	1
G*	BUNNIES	¾"	2"	3½"	P	4
H*	BOULDERS	¾"	2⅛"	1⅜"	P	4

*Parts initially cut oversize. See the instructions.

MATERIALS KEY: P–poplar, PD–poplar dowel.
BLADE AND BITS: Dado set; ⅛", 3/16", 7/32", ¼", 17/64" 5/16" brad-point bits; ⅝" and ¾" Forstner bits.
SOURCE: Happy Hoppy Hares kit no. RS-01451, $27, woodstore.net/hoppyhares.
PROJECT COST: It cost us about $45 to build this project. Your cost will vary by region and source.



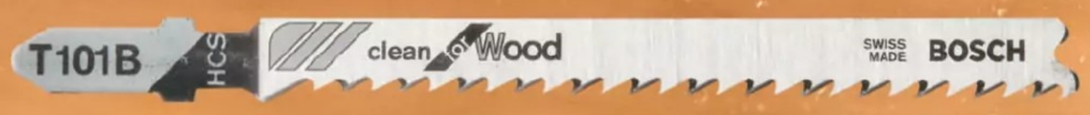
4 CRADLE JIG

4 MUST-HAVE JIGSAW BLADES

With a slender, highly visible blade, the versatile jigsaw allows straight or curved cuts with minimal waste. Variable speed gives you greater control over the cut quality. But true jigsaw mastery comes when you match the right blade to your specific cutting task. Here are four blades we always keep on hand in the *WOOD*® shop.

WRITER: KERRY GIBSON
PHOTOGRAPHER: JAKE STERNQUIST

CLEAN CUT



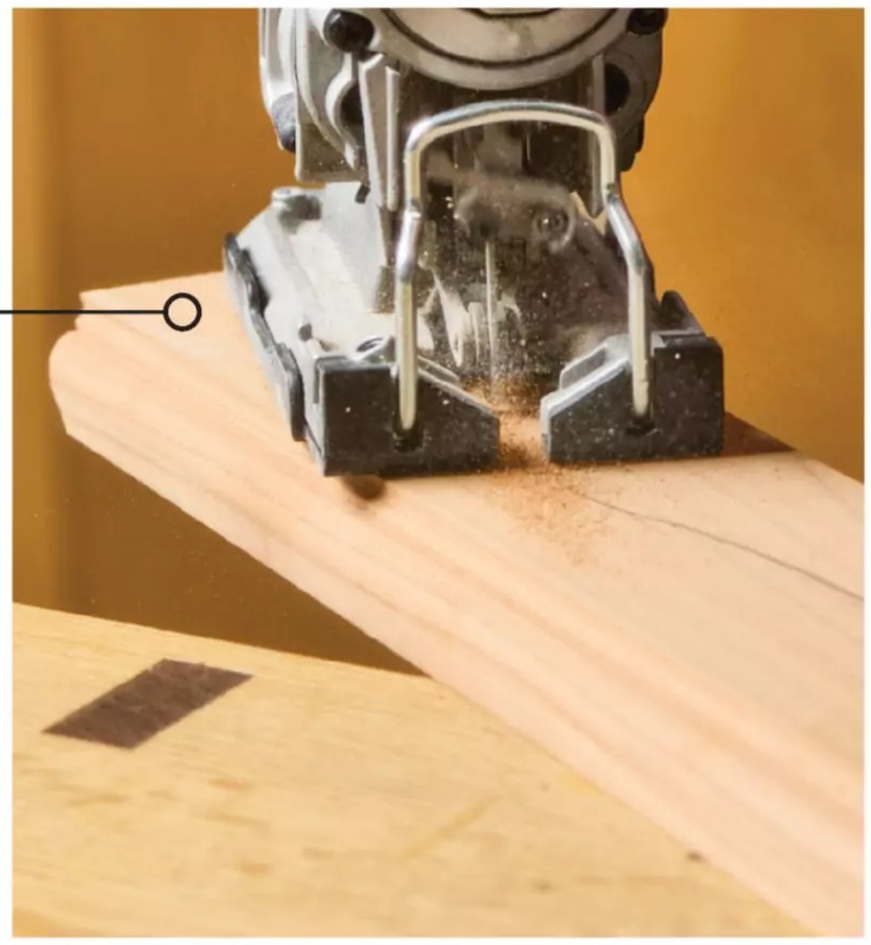
With 10–12 teeth per inch (tpi), this blade lets you make straight and gently curved cuts with relatively smooth results. Precision-ground teeth have no set and slightly overlap each other with the ground edge toward the inside, helping to create a smooth cut.

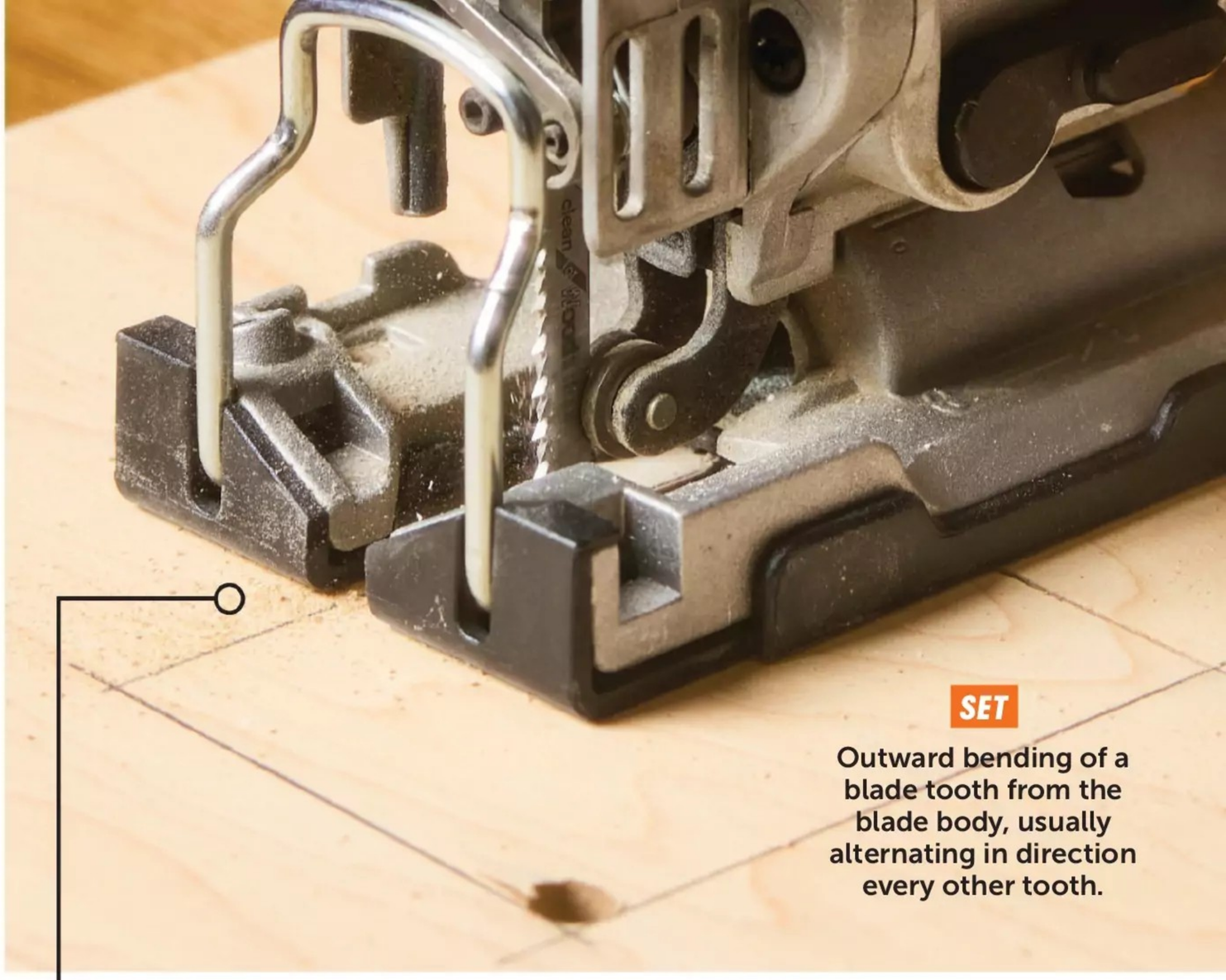
- Uses: Straight and gently curved finish cuts in solid wood
- Motor speed: Medium
- Orbital setting: Medium for straight cuts, none for curves
- Feed rate: Medium

SCROLLING

Choose this narrow blade for making fine scrolling or tightly curved cuts in solid wood or plywood. The 20 tpi and lack of tooth set produce a clean cut. The teeth are ground to cut on both the up- and downstroke.

- Uses: Curved cuts in solid wood and plywood
- Motor speed: Medium
- Orbital setting: None
- Feed rate: Slow to Medium





SET

Outward bending of a blade tooth from the blade body, usually alternating in direction every other tooth.

REVERSE TOOTH

By cutting on the downstroke, this blade minimizes chip-out on the veneer of plywood or laminates, making it great for applications needing a clean top surface, such as a sink cutout. At 10 tpi, the teeth are ground similar to the clean cut blade except they hook down.

- Uses: Straight and gently curved finish cuts in solid wood and plywood
- Motor speed: Medium
- Orbital setting: None
- Feed rate: Slow to Medium

ROUGH CUT

Choose this blade for straight or curved cuts when speed matters more than smoothness. With 8 tpi and an aggressive set, it takes large bites and creates a wide kerf that prevents binding.

- Uses: Rough cuts in thicker stock
- Motor speed: Medium to high
- Orbital setting: Maximum for straight cuts, medium for curves
- Feed rate: Medium to fast

ORBITAL CUTTING

Changing blade movement from straight up and down to an elliptical motion for fast, aggressive cutting.

WORKSHOP IN A BOX

Organize a shopful of tools in arm's reach alongside a sturdy, stowable workbench—all in one box.

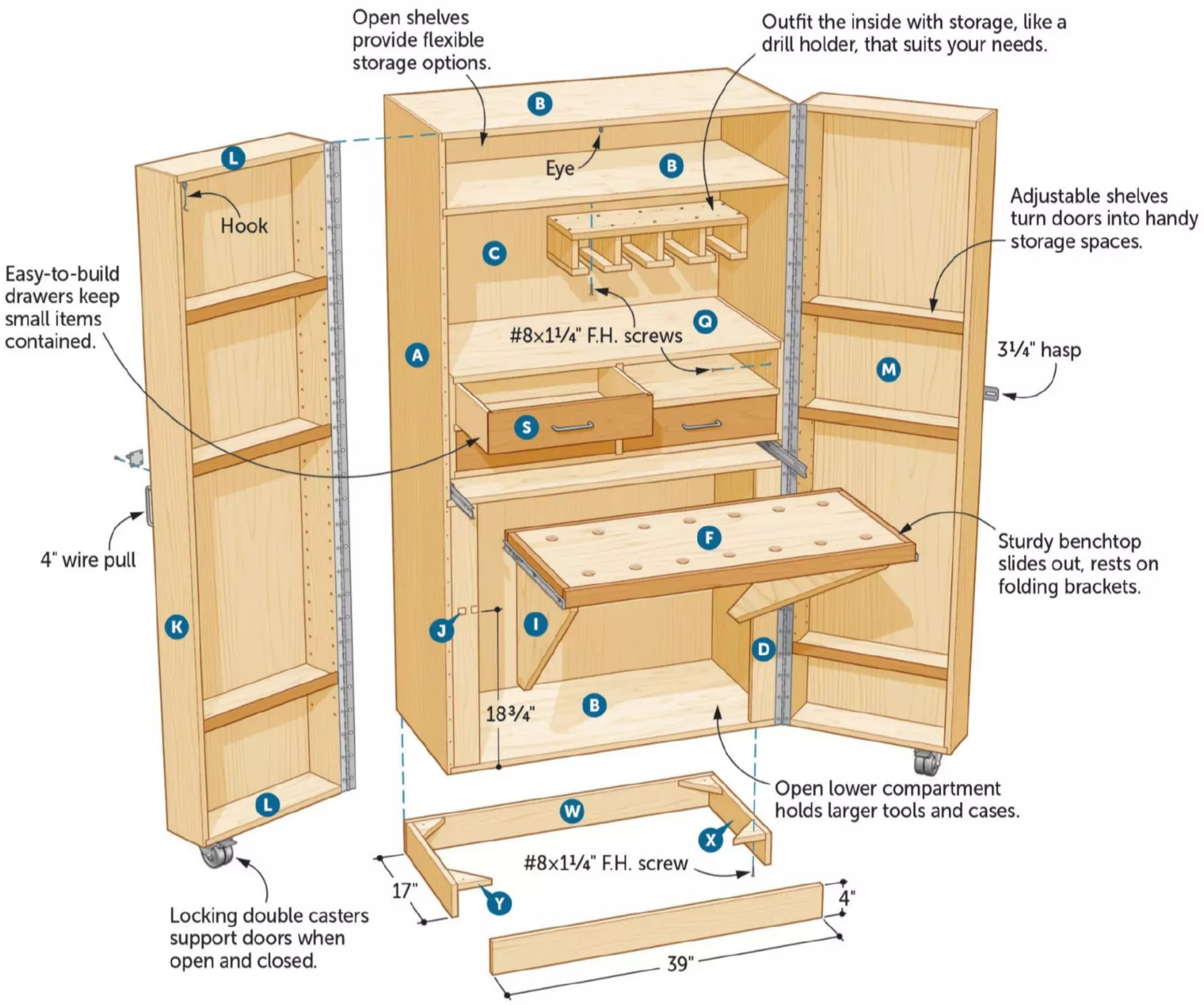
WRITER: ZACH BROWN
DESIGNER: KEVIN BOYLE
BUILDER: BRIAN BERGSTROM

With loads of storage and limitless options for customization, this tall cabinet-plus-workstation is a great solution to keep any workspace tidy. When closed, the full-height double doors keep the contents protected and dust-free. And when you're ready to work, open the doors to reveal neatly organized tools and a convenient slide-out worksurface.

The cabinet is made from Baltic birch plywood, but we added hardwood accents here and there, because even shop storage deserves a little flair.

Note: **If you can't get Baltic birch in full 4×8' sheets, substitute standard birch or maple plywood.**

EXPLODED VIEW



PHOTOGRAPHER: JACOB FOX
ILLUSTRATOR: CHRISTOPHER MILLS

OVERALL DIMENSIONS
40"W × 26½"D × 76"H

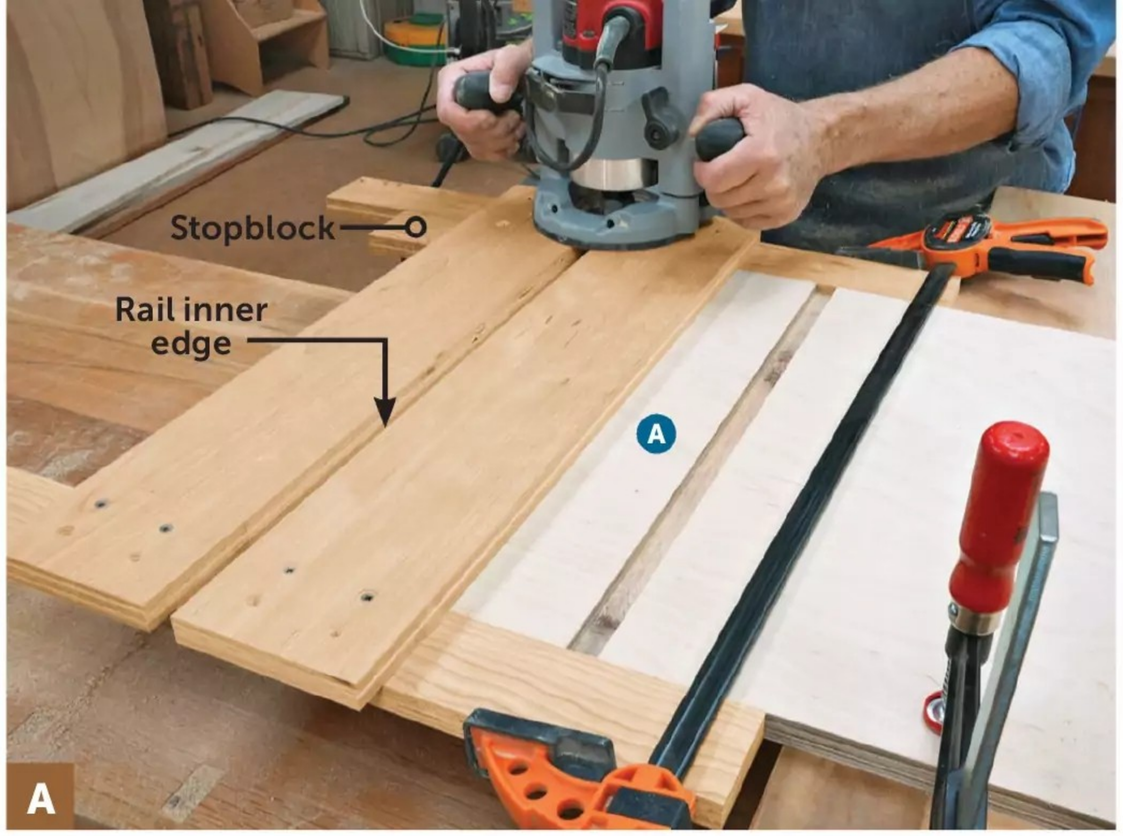
CONSTRUCT THE CASE

Large plywood panels make up the entire case. Shallow dadoes lock the parts together for easy alignment and increased strength.

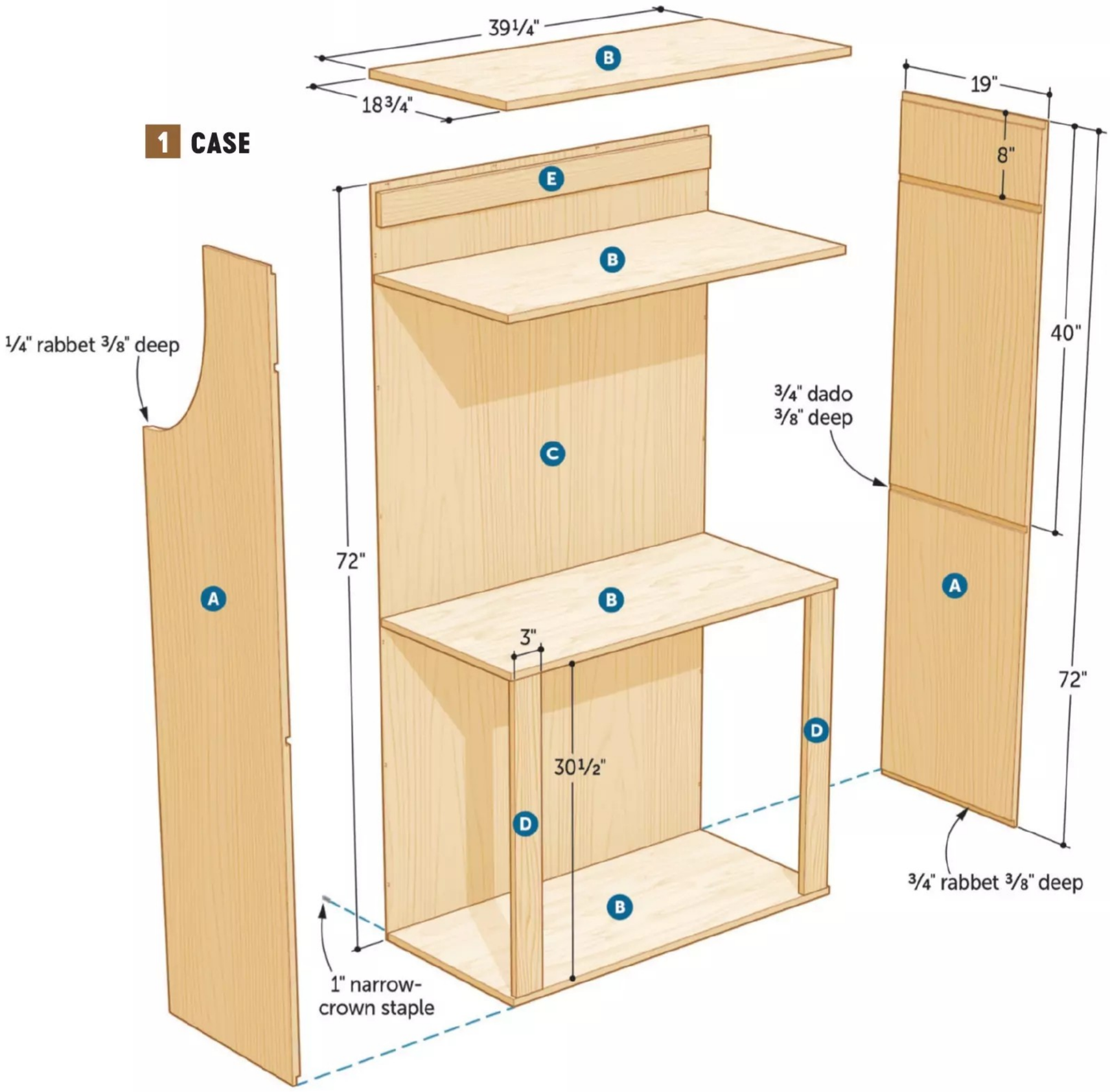
1 From ¾" plywood, cut the case sides (A) to size, along with the top, bottom, and shelves (B) **[Drawing 1, Parts List]**. Lay out the dadoes on the sides.

2 To cut the dadoes and rabbets in the long plywood panels, build the jig shown in *Shop-Made Jig Delivers Dead-On Dadoes*, on the *next page*.

3 Install a ⅝" dado clean-out bit in your router and set it to cut a ⅜"-deep dado, accounting for the jig thickness. Clamp the dado jig to the sides (A), aligned with your layout lines, and rout the dadoes. Start with the bearing riding along one rail, then continue back with the bearing riding against the other rail. Then use the jig to rabbet the top and bottom of each side **[Drawing 1, Photo A]**.



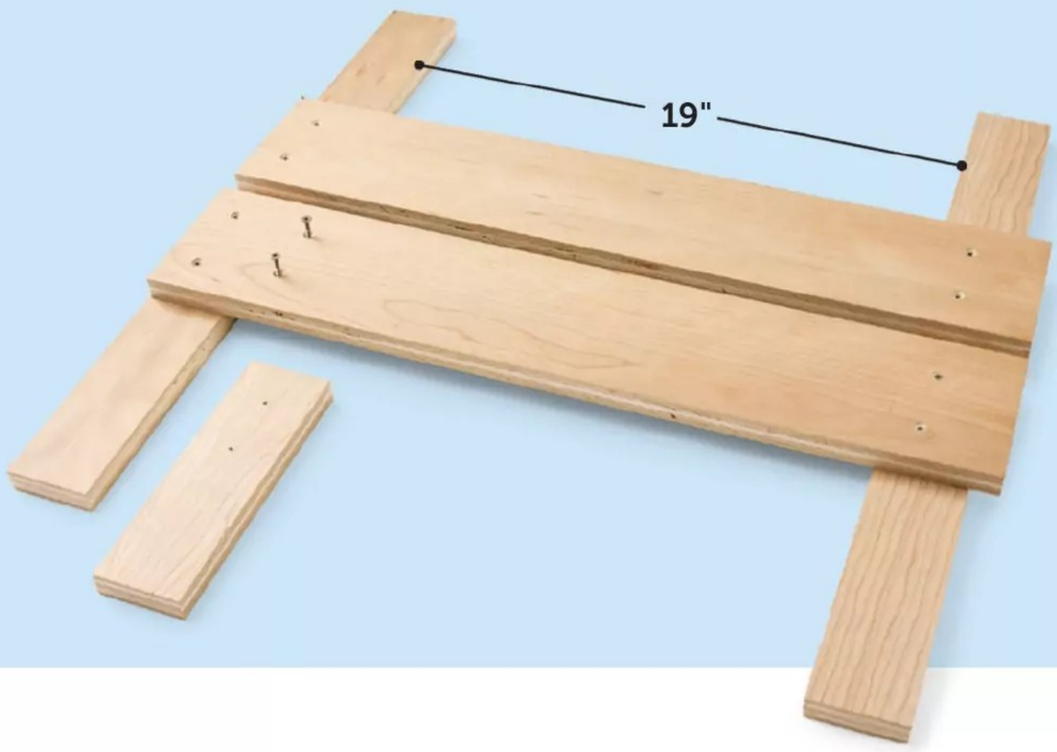
Screw a stopblock to the underside of the jig with one end flush to the inside edge of a rail. Position the jig with the stopblock touching the end of the side (A), clamp it in place, and rout the rabbet.

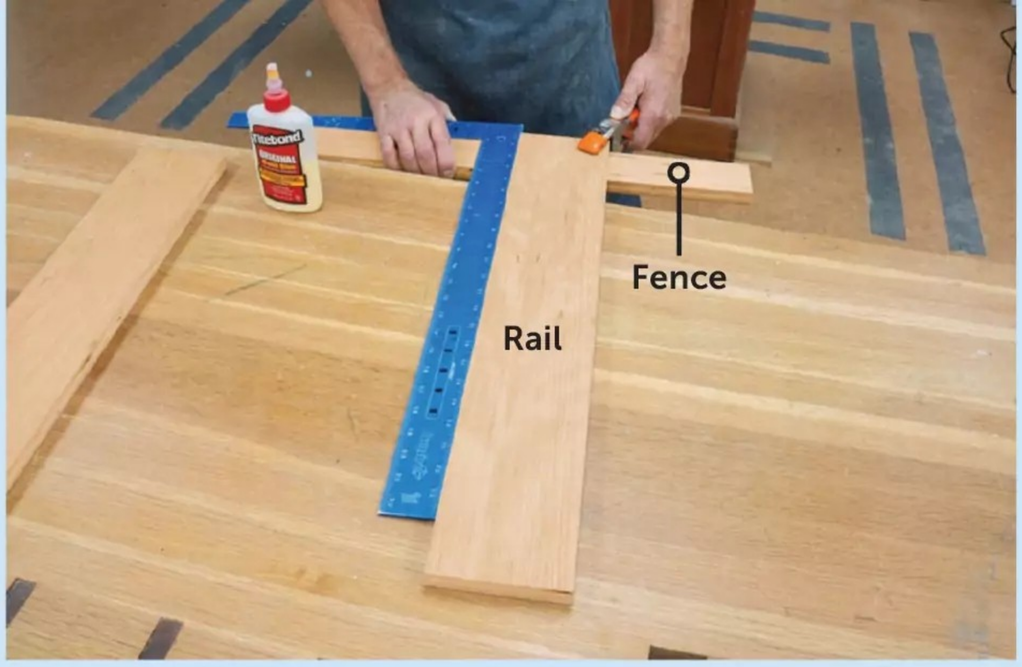


SHOP-MADE JIG DELIVERS DEAD-ON DADOES

This simple dado jig makes it easy to create dadoes that are perfectly positioned, perpendicular to the workpiece edge, and exactly the same width as the thickness of your building materials. You can make it from scrap ¾" plywood and a few screws.

Cut two rails that will guide your router equipped with a dado clean-out bit and two fences that register the jig along the workpiece edge. Attach a fence to the first rail (*right top*). Attach the other fence near the opposite end of the rail, leaving 19" between it and the first fence (matching the 19"-wide carcase sides) while ensuring that it's square. Attach the second rail to create a perfectly sized dado gap in the jig (*right bottom*).





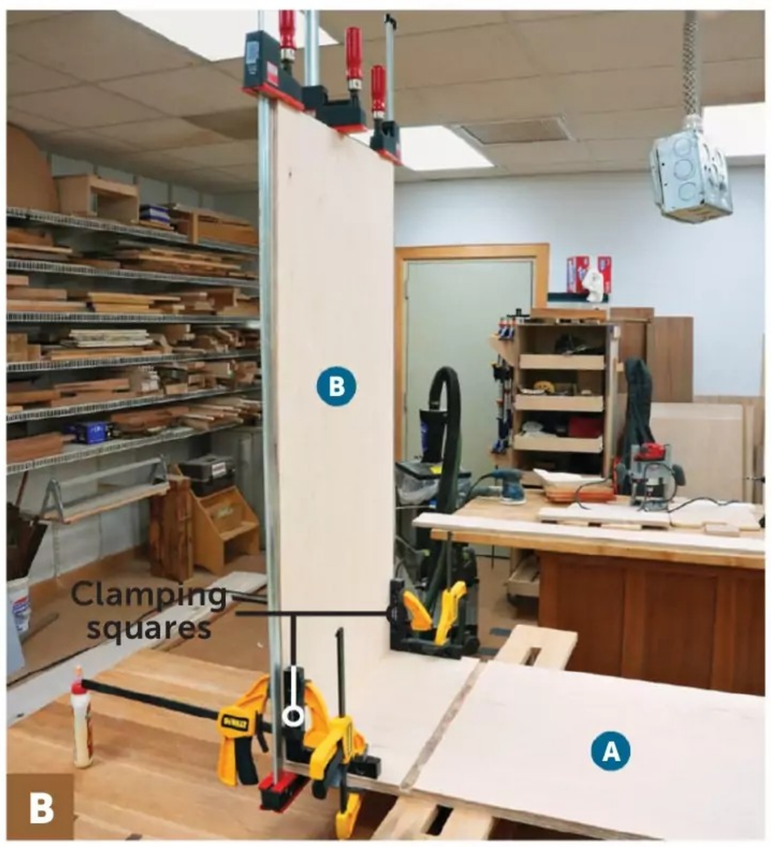
Glue and clamp a fence to the bottom of a rail, flush with the end. Use a large square to make sure the fence and rail meet at exactly 90°. Then screw the rail to the fences.

Use a scrap piece of the same ¾" plywood you're building your project from to create a gap between the two rails. Tighten the clamps so the second rail fits tight but the scrap can still slide with moderate pressure. Then attach the rail to the fences.

4 Swap to a ¼" rabbeting bit, set it to cut ⅜" deep, and rabbet the back edge of each side (A) to receive the back, making sure to create mirror-image sides.

5 Assemble the case by gluing the top, bottom, and shelves (B) to one side **[Photo B]**; then add the second side. Check for square by ensuring you have equal diagonal measurements across the front or back of the assembly.

6 Measure for the back (C) and cut it to fit **[Drawing 1]**, then set it aside. Cut the lower supports (D) and back cleat (E) to fit, and then glue them in place in the case assembly.

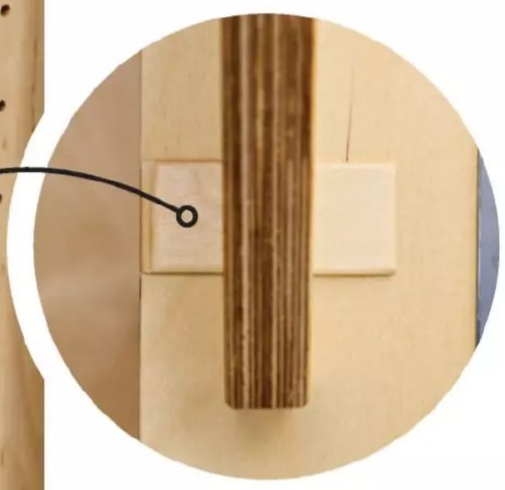


To make it easier to manage the large pieces during glue-up, glue and clamp each top/bottom/shelf (B) to a side (A) one at a time. Clamping squares help to keep the pieces at 90° until the glue dries.

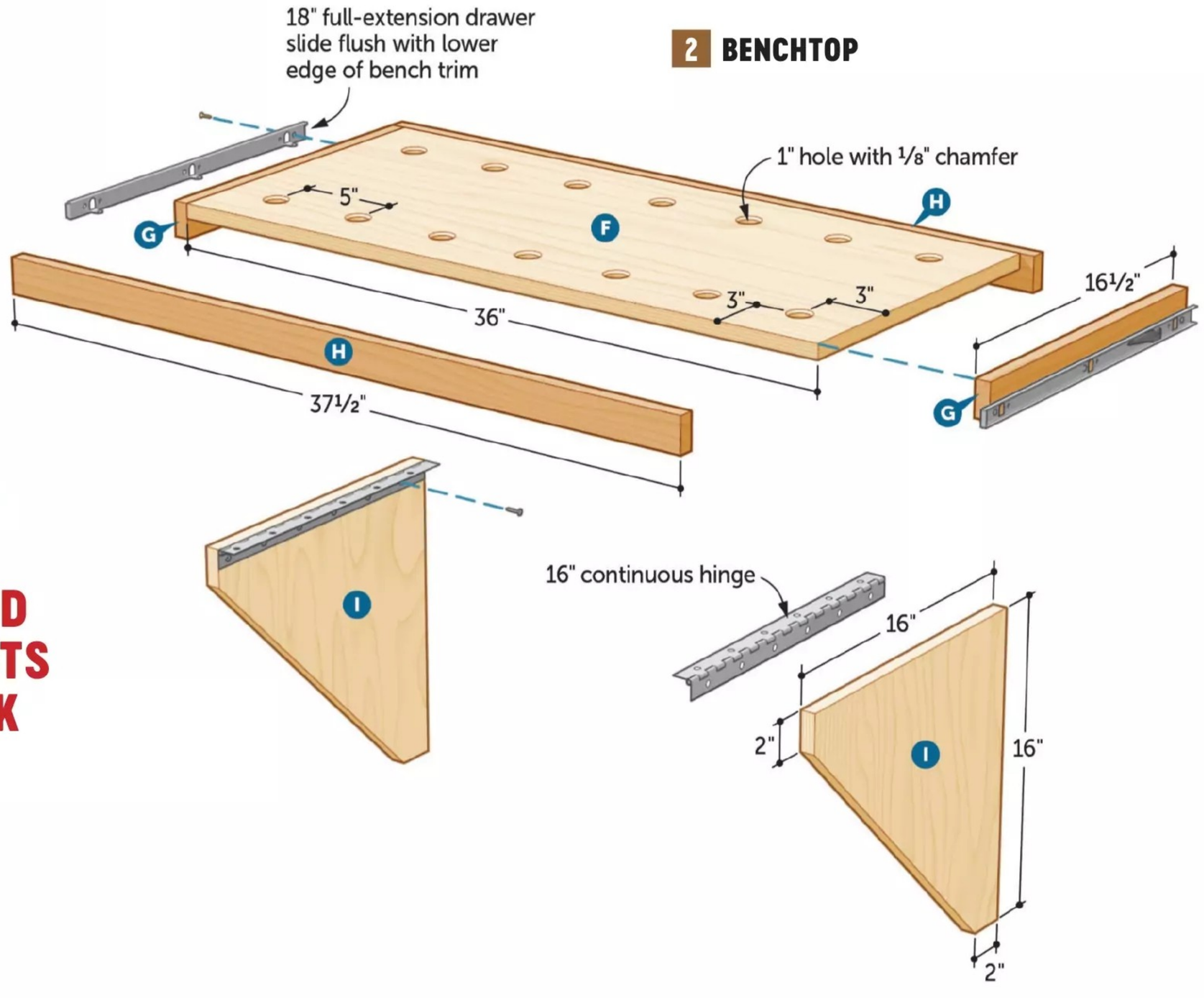
BRING IN A BENCHTOP

1 Cut the benchtop (F) to size and lay out the holes on the surface [Drawing 2]. We drilled 1" holes in the benchtop to accommodate MFT-style vertical clamps. See *The Hole Story, next page*. Drill the holes using a backer board below the benchtop to reduce tear-out. Install a chamfer bit in your router and rout a ⅛" chamfer on the top perimeter of each hole.

2 Cut the benchtop trim (G, H) to size from ¾" hardwood. We used cherry to contrast with the birch plywood. Glue and clamp the trim to the edges of the benchtop, flush with the top.

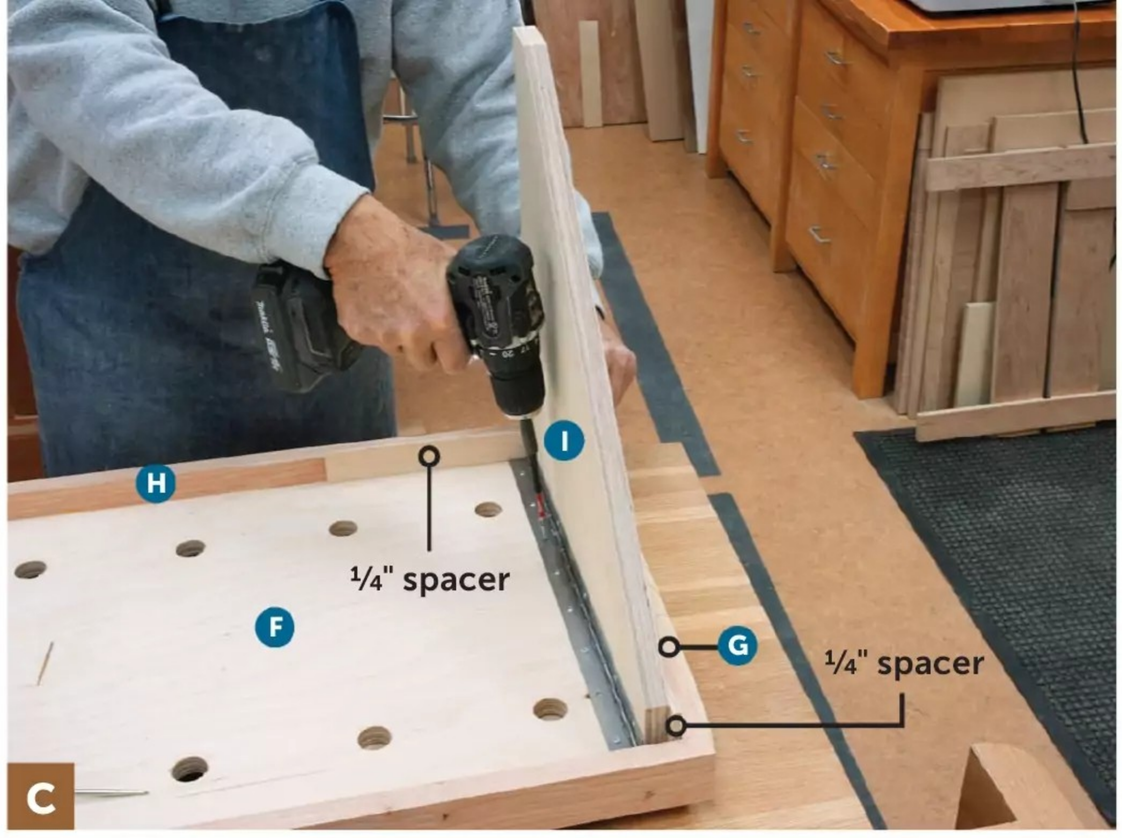


Two ⅛" stops hold the brackets in position to support the benchtop. We tapered the inside stops to help the brackets slip into place easily.

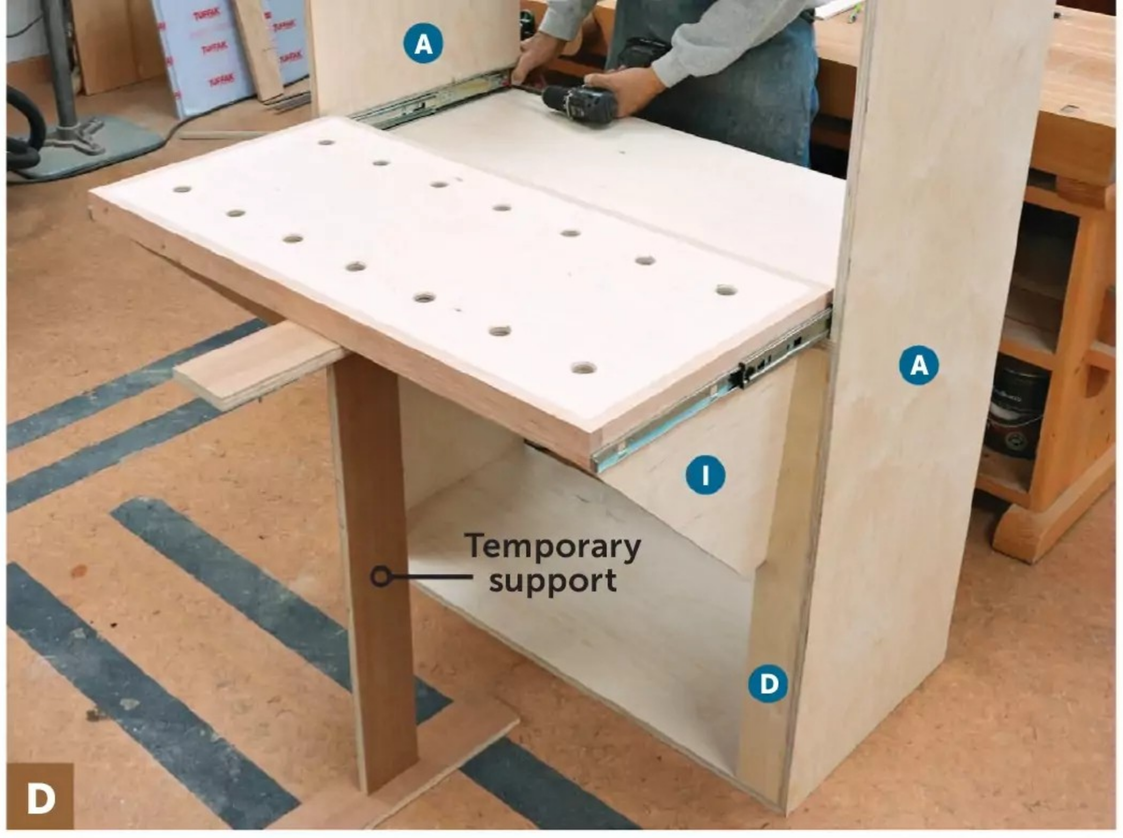


“HEAVY-DUTY DRAWER SLIDES MAKE THE BENCHTOP DEPLOY AND STOW EASILY. BRACKETS MAKE THE BENCH ROCK SOLID WHILE IN USE.”

-KEVIN BOYLE, SENIOR DESIGN EDITOR



Place 1/4" spacers along the benchtop back trim (H) and side trim (G). Position the bracket (I) against the spacers and screw the hinge to the underside of the benchtop (F).

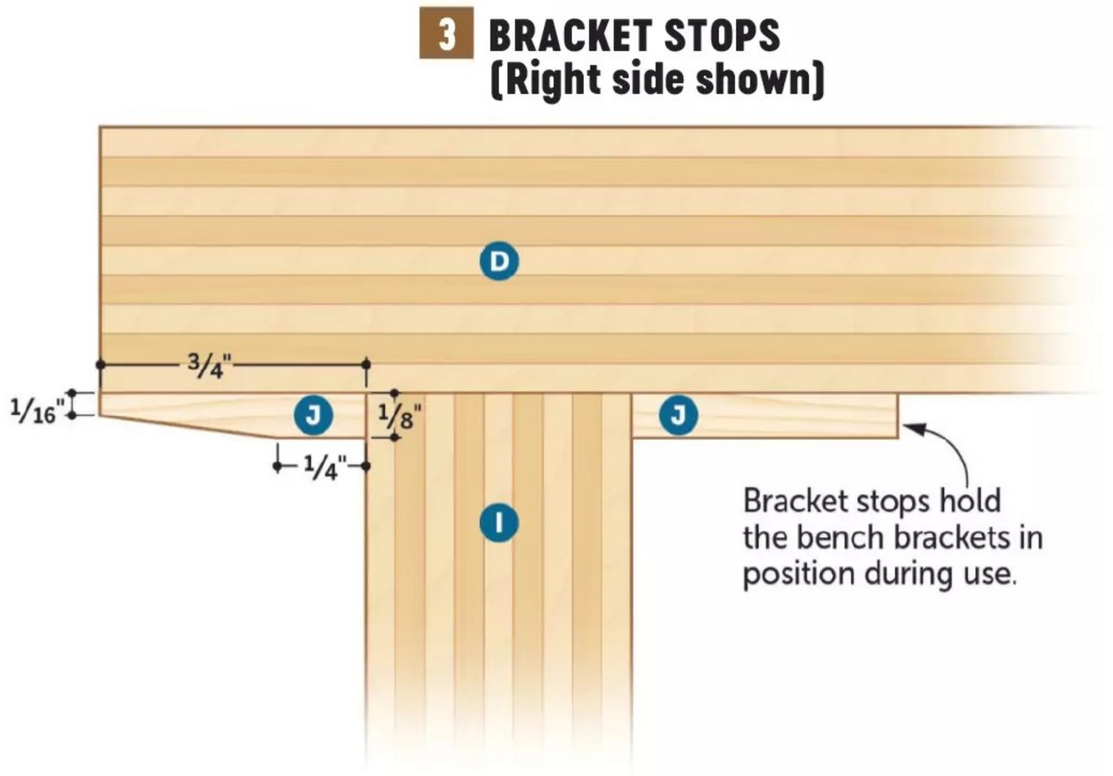


Use a support to position the benchtop assembly with the back edges of the brackets (I) tight against the lower supports (D). Fully extend the drawer slides and screw them to the cabinet sides (A).

3 Cut the brackets (I) to size and shape **[Drawing 2]**. Screw a continuous hinge to the inside face of each bracket, flush with the top edge, then attach them to the underside of the benchtop **[Photo C]**.

4 Install the drawer slides on the sides of the benchtop, flush with the bottom and front edge **[Drawing 2]**. Then attach the benchtop assembly to the cabinet **[Photo D]**.

5 From 1/8" maple, cut the bracket stops (J) to size. On two stops, sand a taper on one face **[Drawing 3]**. Glue the tapered stops to the lower supports (D), with the tapered edge flush with the inside edge of the support **[Exploded View]**. Then glue the flat stops 3/4" from the tapered stops.

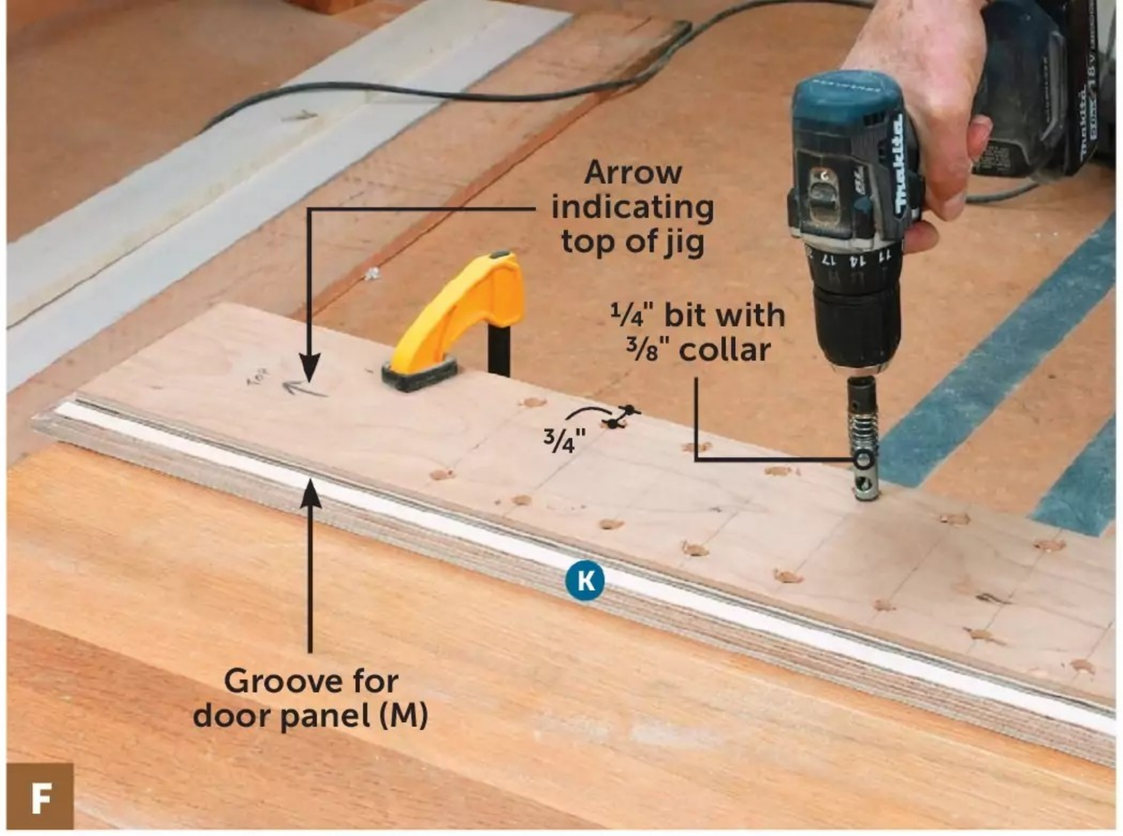


THE HOLE STORY

We opted for nonstandard 1" holes in our worksurface to more easily use MFT-style clamps [*Source*]. These quick-release clamps feature a body (and holding power) that resembles F-style clamps. But their straight, narrow head easily hooks through the enlarged dogholes to rest flat on the underside of the bench, making them a stable and versatile hold-down. As a bonus, these clamps were designed to work with tracksaw guide rails, T-track, or dovetail keyways, making them a multitalented tool. Plus they store nicely in your new cabinet.

If you prefer standard-size holes found in traditional workbenches or you already have a collection of doghole accessories, opt for 3/4" holes using the same spacing illustrated in **Drawing 2**, *previous page*.

In the same way you rabbeted the case sides, use the dado jig and rabbet-cutting stopblock to rout a rabbet on the top and bottom of each door side (K).



Clamp the hole jig to each door side (K), flush with the edge of the upper rabbet and the back edge. Drill the shelf-pin holes in the side using a ¼" shelf-pin drilling bit.

STORE MORE IN DOUBLE DOORS

1 Cut the door sides, tops, bottoms, and panels (K, L, M) to size **[Drawing 4]**. Use the dado jig to form the rabbets on the sides (K) **[Photo E]**. Cut the groove in the sides, as well as in the tops/bottoms (L).

2 Install a ⅜" rabbeting bit in your router, set it to cut ½" deep, and rabbet all four edges on the front face of each door panel (M) to fit the panel into the grooves **[Drawing 4]**.

Apply a thin bead of glue to the grooves in the sides (K) and top and bottom (L) to avoid squeeze-out. Clamp across the assembly in both directions and check for square.

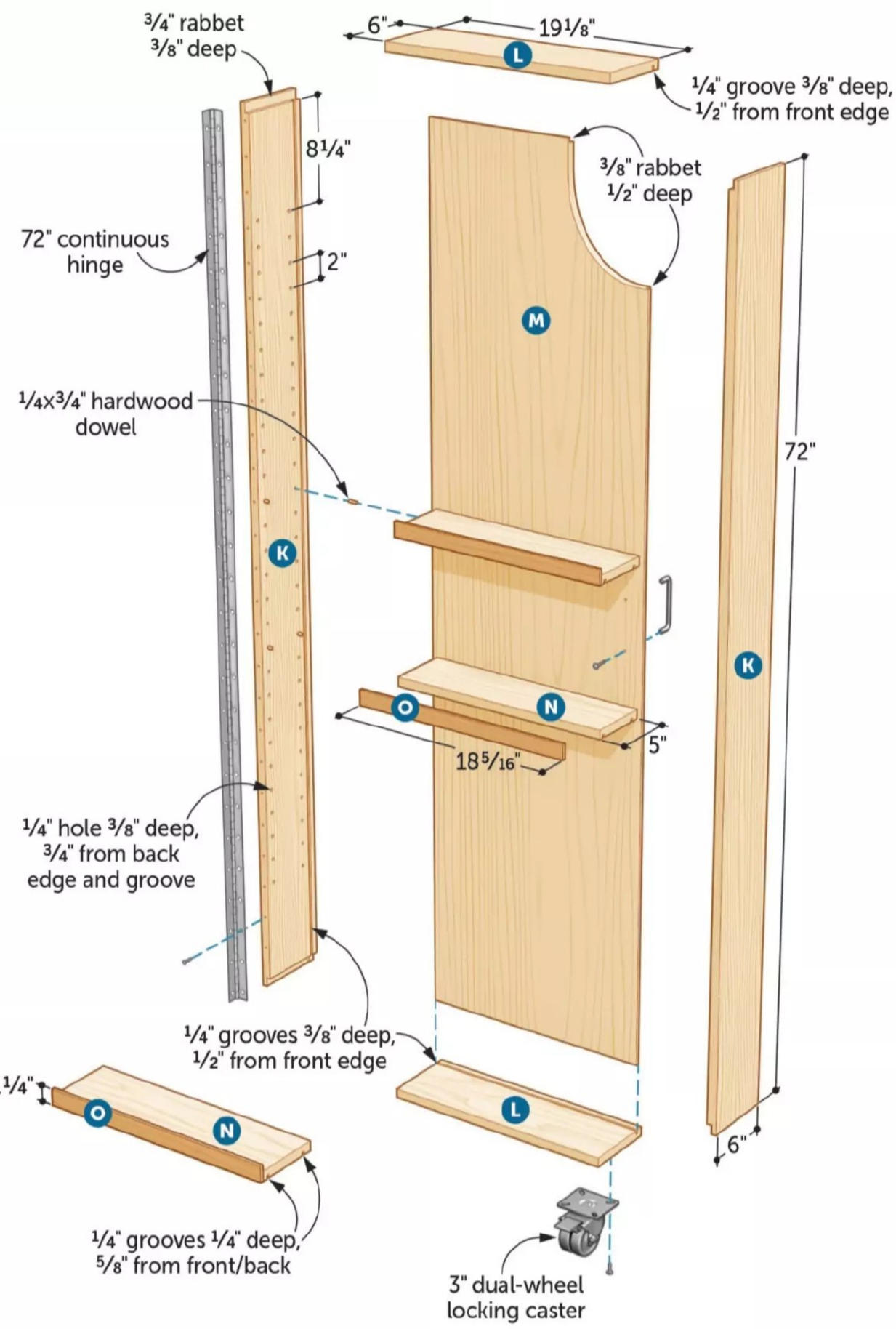
Don't have cabinet-length clamps? Here are seven ways to stretch short clamps.
woodmagazine.com/clampstretchers

3 From scrap ¼" plywood, cut a 5¼×66" shelf-pin hole drilling jig and lay out the holes **[Drawing 4]**. Drill ⅜" holes at each mark. Use the jig and a self-centering bit to drill the ¼" shelf-pin holes in the sides (K) **[Photo F]**.

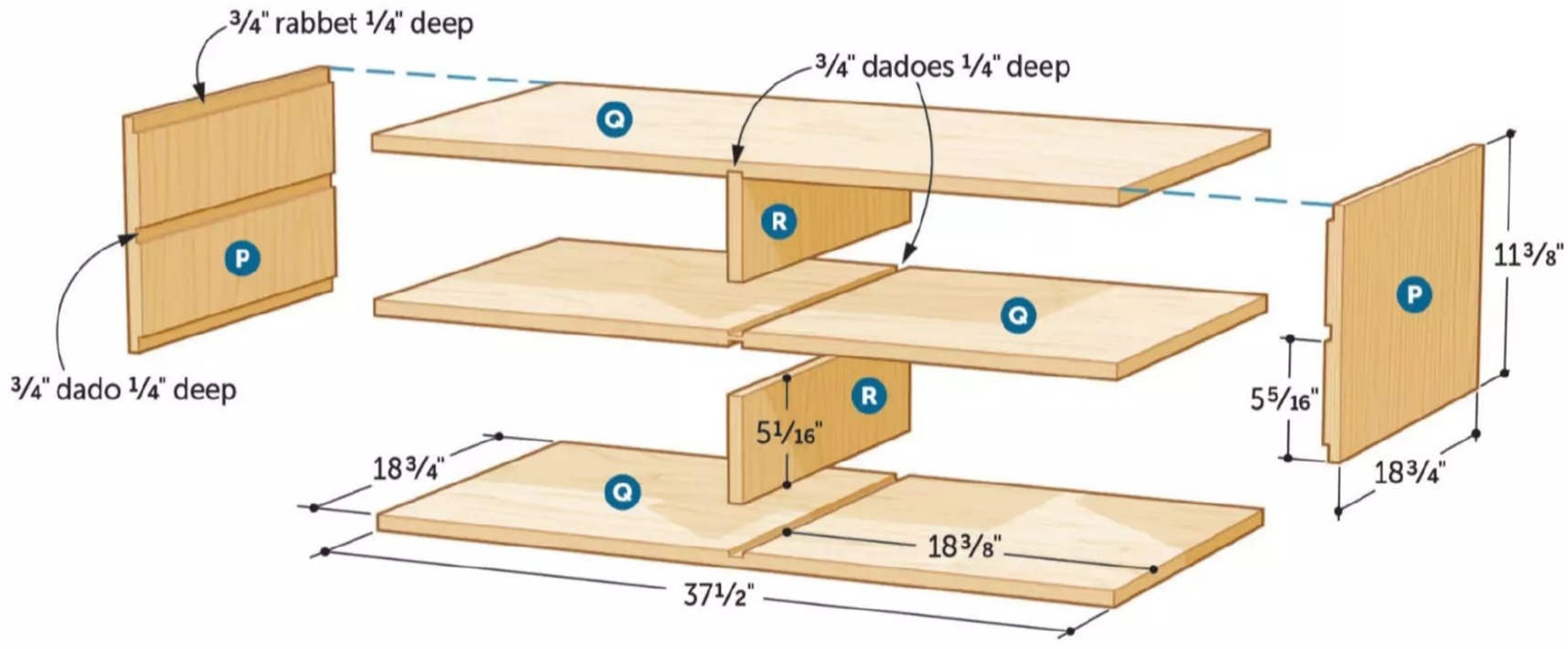
4 Apply glue to the rabbets and groove on the sides (K) and the groove in the top and bottom (L), and assemble the doors (K-M) **[Photo G]**.

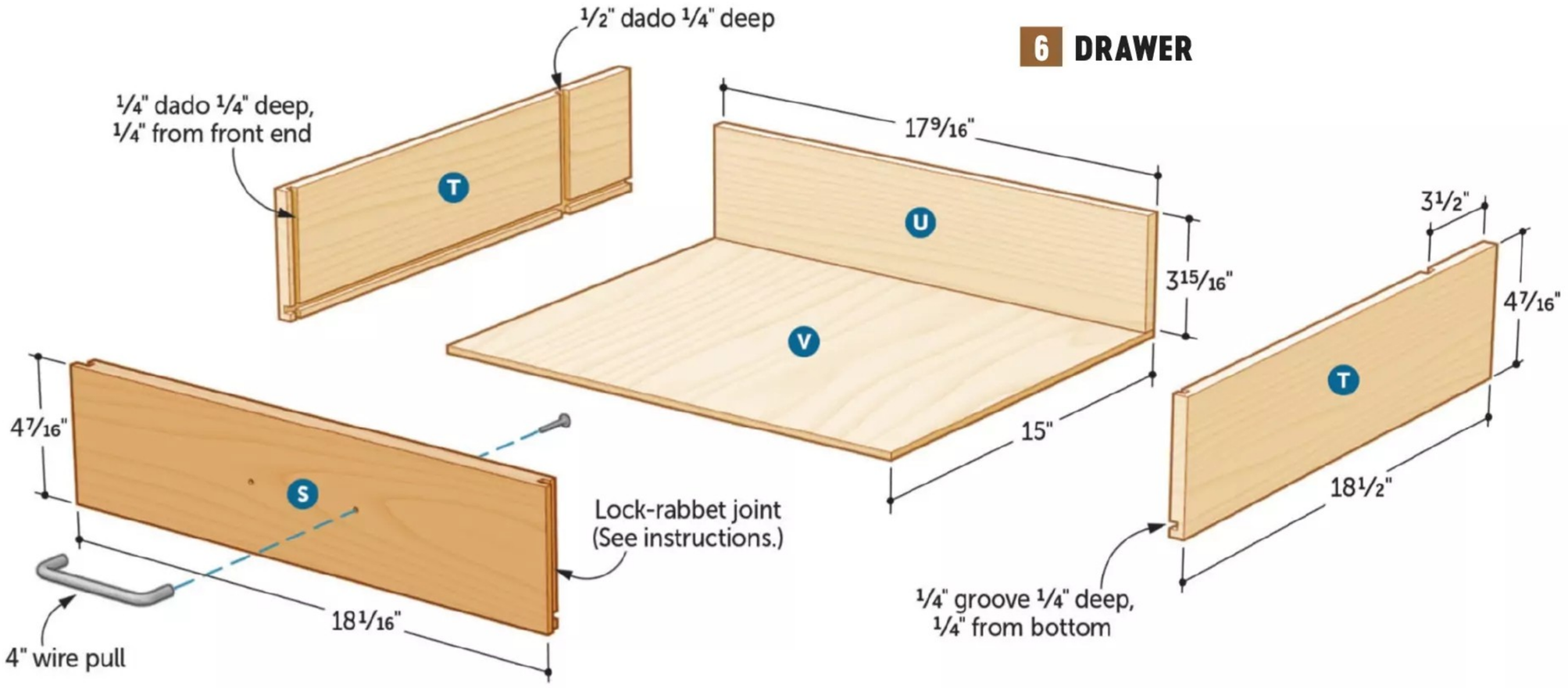
5 Cut the door shelves and trim (N, O) to size. Glue the hardwood trim to the front of each shelf, flush with the bottom **[Drawing 4]**. Once the glue dries, form the grooves on the bottom of the shelves.

4 DOOR



5 DRAWER CASE





A DRAWER TIMES FOUR

1 Cut the drawer case sides, top, bottom, divider, and uprights (P, Q, R) to size **[Drawing 5]**.

2 Use the dado jig to rout the dadoes and rabbets in the sides, as well as the dado in one face of the top and bottom, and in both faces of the divider.

TIP!

Use pin nails to hold the corners together as you assemble the drawer case.

3 Apply glue to the rabbets and dadoes and clamp the drawer case assembly together, checking for square.

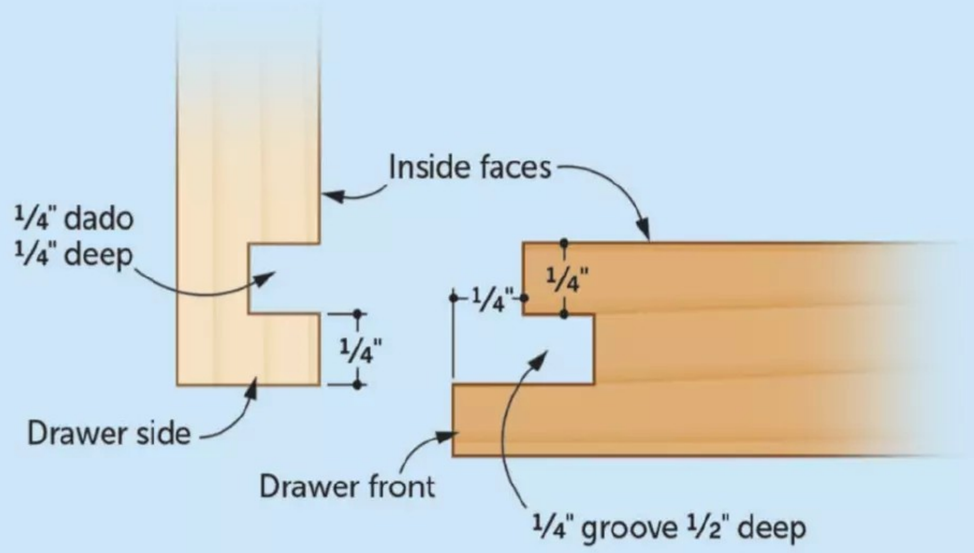
4 To make a continuous grain pattern across the drawer fronts (S), start with two 3/4" cherry blanks 4 7/16×37". Cut the blanks in half, then trim the opposite end to cut the drawer fronts to final length **[Drawing 6]**. From 1/2" maple, cut the drawer sides and backs (T, U) to size.

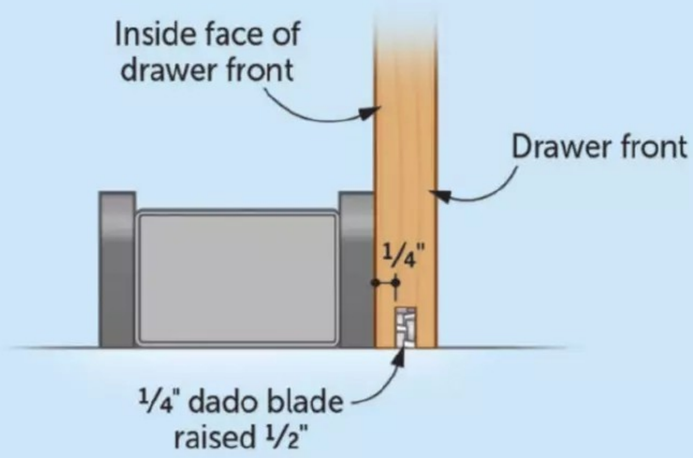
5 To connect the drawer fronts and sides, we used a lock-rabbet joint. See *Three Cuts for Strong Drawers, next page*. Cut the joinery, along with a groove in the drawer front (S) and sides (T) for the drawer bottom. Then switch to a 1/2" dado blade and cut the dado in each side for the drawer back (U).

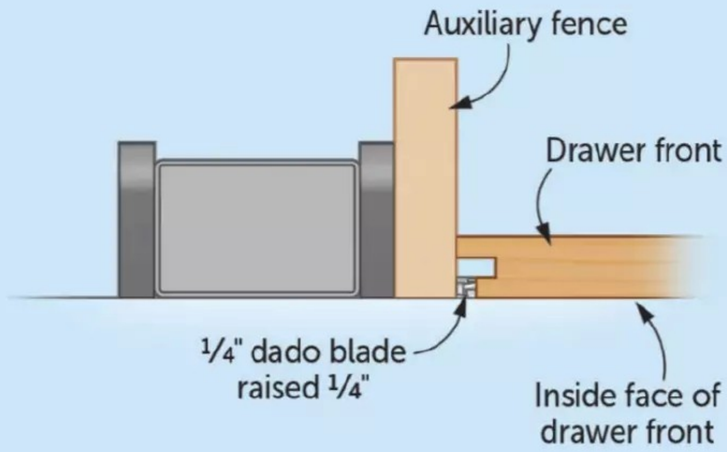
6 Dry-assemble a drawer, measure, and cut the drawer bottoms (V) to fit. Apply glue to the dadoes and grooves, and assemble the drawer front and sides around the bottom. Apply glue to the dadoes in the sides and to the bottom edge of the drawer back. Slide it into place and apply clamps while checking for square. Repeat for the other drawers.

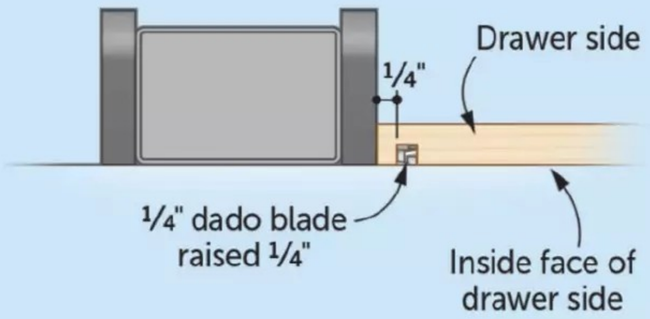
THREE CUTS FOR STRONG DRAWERS

Follow these three simple steps to create a strong, interlocking joint that doesn't interrupt the grain pattern across the drawer fronts.









1 Install a 1/4" dado stack in your tablesaw and raise it to 1/2", the exact thickness of your drawer sides. Use a pushblock to guide the workpiece as you cut a groove in the ends of each drawer front 1/4" from the inside face.

2 Attach an auxiliary fence to your tablesaw's rip fence and adjust it to just touch the blade. Lower the blade to 1/4" and use an auxiliary fence on your miter gauge to back the cut as you notch the back face of the drawer front end grooves.

3 Remove the auxiliary fence from your rip fence and position the rip fence 1/4" from the dado blade. Use an auxiliary fence on your miter gauge as you cut the 1/4" dado on the inside face of each drawer side.

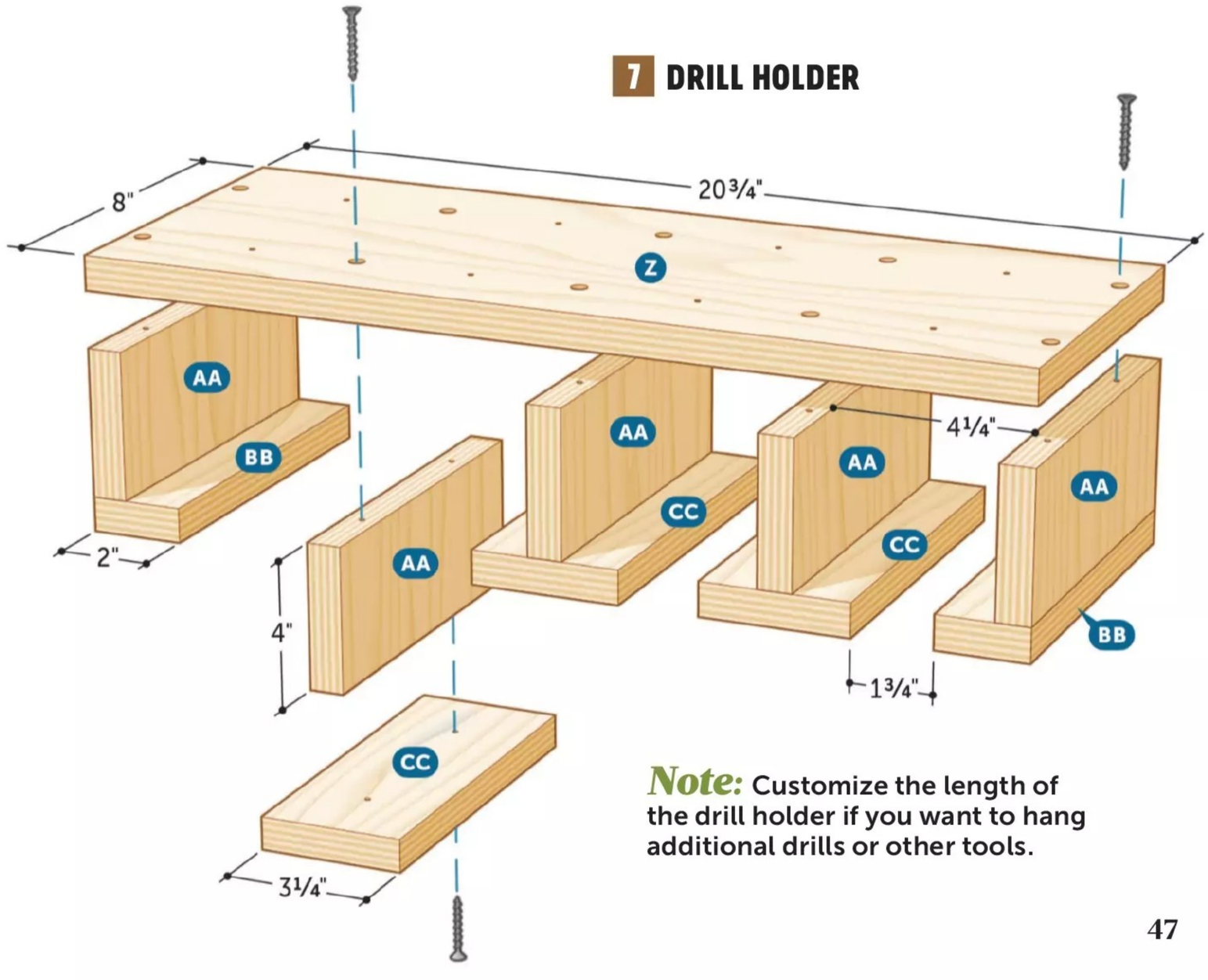
FIT IT OUT AND WRAP IT UP

1 Cut the base parts (W-Y) to size and shape, making right triangles for the corner blocks (Y) **[Exploded View]**. Glue and clamp together the base assembly. Once the glue dries, glue and screw it to the bottom of the cabinet, flush with the back and centered side-to-side.

2 Cut the drill holder parts (Z-CC) to size. Glue and screw the supports (BB, CC) to the verticals (AA). Then glue and screw the top (Z) to those assemblies **[Drawing 7]**.

3 Remove the benchtop from the cabinet and finish-sand each project assembly. Apply a finish. We brushed two coats of polyurethane to all of the exterior and interior parts.

7 DRILL HOLDER



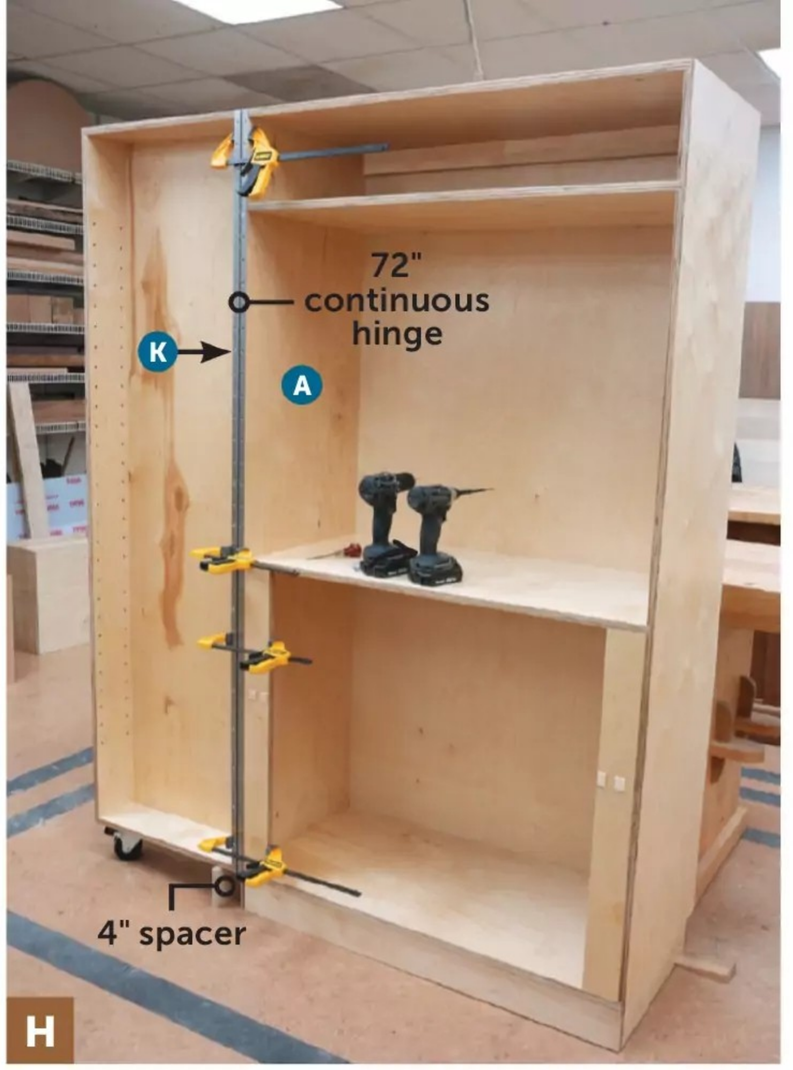
Note: **Customize the length of the drill holder if you want to hang additional drills or other tools.**

4 Attach the case back using narrow-crown staples **[Drawing 1]**. Screw a locking caster to the bottom of each door **[Drawing 4]**; then attach the doors using 72" continuous hinges **[Photo H]**.

5 Reinstall the benchtop assembly. Place ¼" spacers on the benchtop and set the drawer box assembly on the spacers, flush with the front of the cabinet **[Exploded View]**. Screw the drawer box to the cabinet sides and remove the spacers. Screw the drill holder to the upper shelf, flush with the back of the shelf.

6 From ¼" dowel, cut ¾"-long shelf pins and use them to install the shelves in the doors **[Drawing 4]**. Attach the wire pulls to the doors and drawer fronts, and insert the drawers **[Exploded View]**.

7 Attach the hook and eye and hasp hardware to the doors **[Exploded View]**. Move the cabinet into place and drive at least one 3" screw through the back cleat (E) and into a wall stud. Load up your shop in a box with all of your essential tools.



Support the hinge side of the door with a 4" spacer. Then clamp the door to the cabinet with a ⅛" spacer (thickness of the hinge barrel) in between. Screw the hinge to the cabinet side (A) and door side (K).

PARTS LIST

PART		FINISHED SIZE T	W	L	Matl.	Qty.
CASE						
A	SIDES	¾"	19"	72"	BB	2
B	TOP/BOTTOM/SHELVES	¾"	18¾"	39¼"	BB	4
C	BACK	¼"	39¼"	72"	BB	1
D	LOWER SUPPORTS	¾"	3"	30½"	BB	2
E	BACK CLEAT	¾"	3"	38½"	BB	1
BENCHTOP						
F	BENCHTOP	¾"	16½"	36"	BB	1
G	SIDE TRIM	¾"	1¾"	16½"	C	2
H	FRONT/BACK TRIM	¾"	1¾"	37½"	C	2
I	BRACKETS	¾"	16"	16"	BB	2
J	BRACKET STOPS	⅛"	¾"	¾"	M	4
DOORS						
K	DOOR SIDES	¾"	6"	72"	BB	4
L	DOOR TOPS/BOTTOMS	¾"	6"	19⅛"	BB	4
M	DOOR PANELS	¾"	19⅛"	71¼"	BB	2
N	SHELVES	¾"	5"	18⅝"	BB	6
O	SHELF TRIM	¼"	1¼"	18⅝"	C	6
DRAWER CASE AND DRAWERS						
P	DRAWER CASE SIDES	¾"	18¾"	11⅜"	BB	2
Q	DRAWER CASE DIVIDERS	¾"	18¾"	37½"	BB	3
R	DRAWER CASE UPRIGHTS	¾"	18¾"	5¹⁄₁₆"	BB	2
S*	DRAWER FRONTS	¾"	4⁷⁄₁₆"	18¹⁄₁₆"	C	4
T	DRAWER SIDES	½"	4⁷⁄₁₆"	18½"	M	8
U	DRAWER BACKS	½"	3¹⁵⁄₁₆"	17⁹⁄₁₆"	M	4
V	DRAWER BOTTOMS	¼"	17⁹⁄₁₆"	15"	BB	4

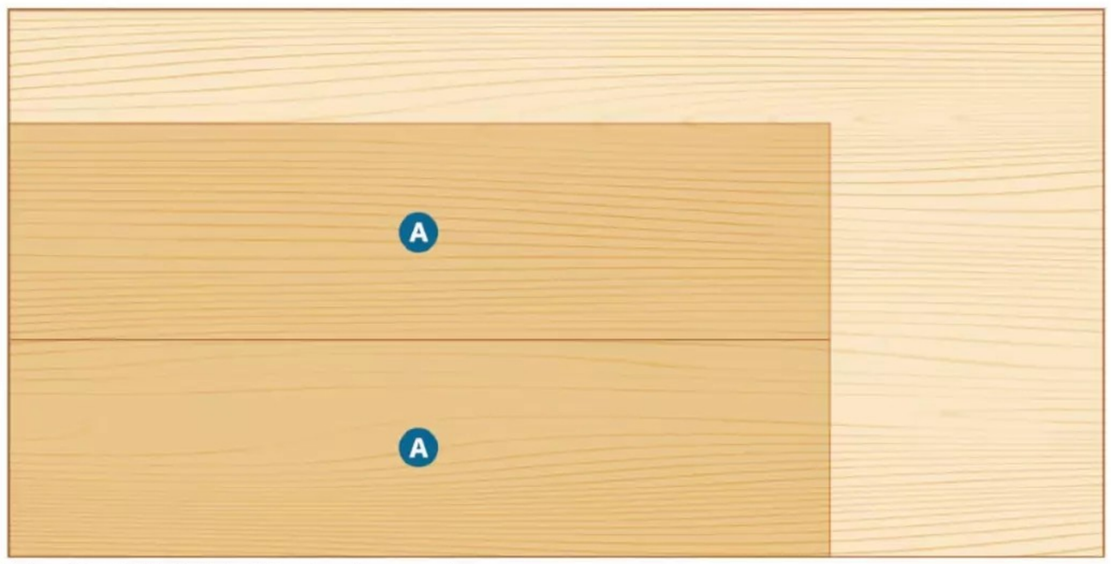
PART		FINISHED SIZE T	W	L	Matl.	Qty.
BASE						
W	BASE FRONT/BACK	¾"	4"	39"	BB	2
X	BASE SIDES	¾"	4"	17"	BB	2
Y	BASE CORNER BLOCKS	¾"	4"	4"	BB	4
DRILL HOLDER						
Z	TOP	¾"	8"	20¾"	BB	1
AA	VERTICALS	¾"	8"	4"	BB	5
BB	END SUPPORTS	¾"	2"	8"	BB	2
CC	MIDDLE SUPPORTS	¾"	3¼"	8"	BB	3

*Parts initially cut oversize. See the instructions.

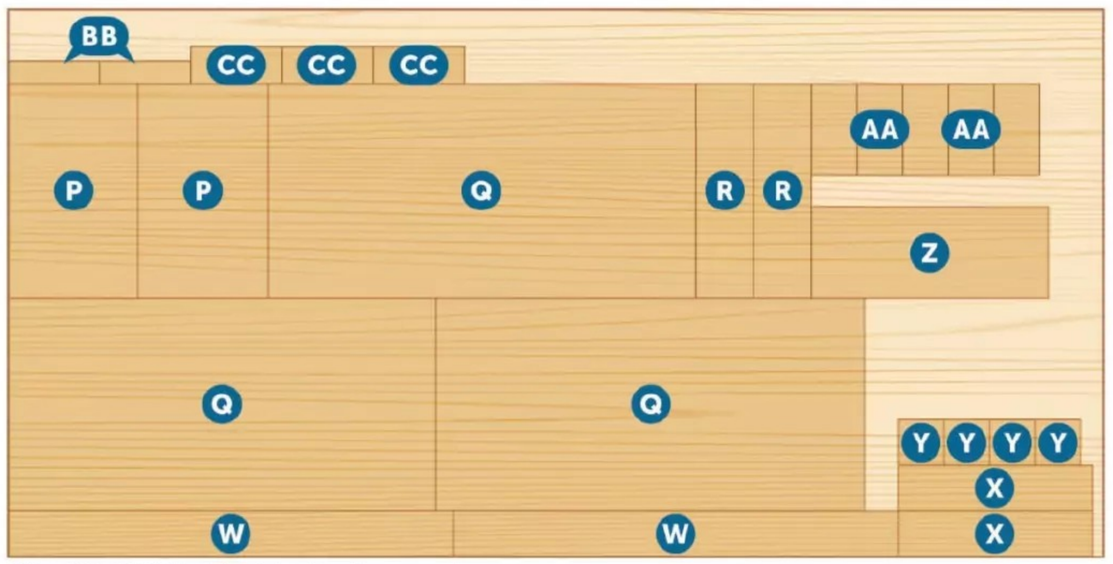
MATERIALS KEY: BB–Baltic birch plywood, C–cherry, M–maple.
SUPPLIES: #8x1¼" flathead screws, 1" narrow-crown staples, 18" full-extension drawer slides (2), 16" continuous hinges (2), 72" continuous hinges (2), 4" wire pulls (6), ¼" hardwood dowel, hook and eye latch, 3¼" hasp.
BLADE AND BITS: Dado-blade set, ⅝" dado clean-out router bit, ¼" and ⅜" rabbet-cutting router bits, chamfer router bit.
SOURCE: ¼" shelf drilling bit no. 40604, $25; 3" dual-wheel locking casters no. 84082 (2), $8 each; Makita guide rail clamps no. 69593 (2-pack), $54, rockler.com.
PROJECT COST: It cost us about $750 to build this project. Your cost will vary by region and source.

CUTTING DIAGRAM

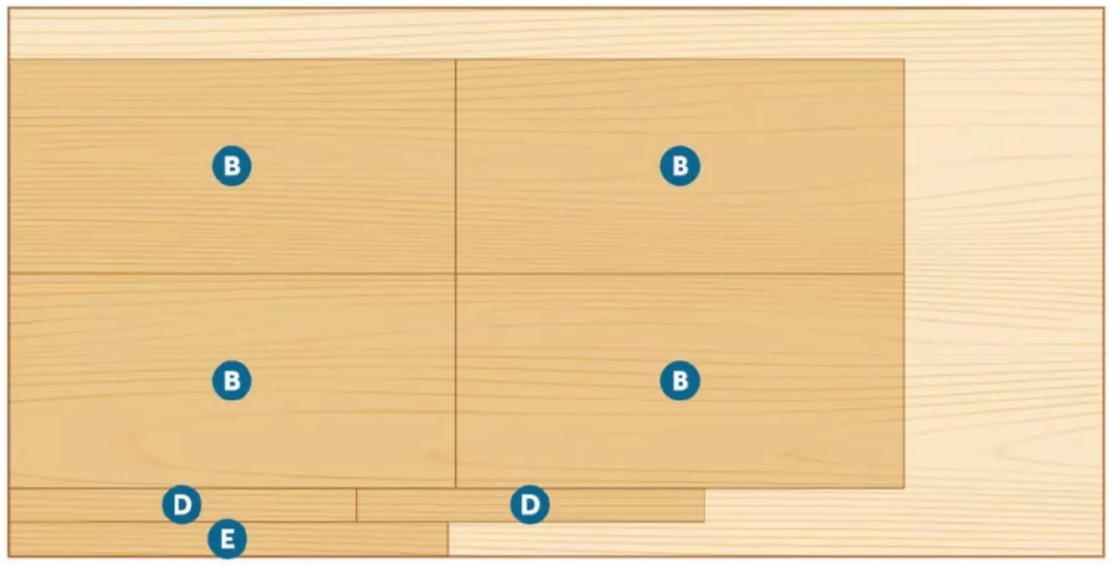
We purchased 5 sheets of ¾" Baltic birch plywood, 1½ sheets of ¼" Baltic birch plywood, 8 board feet of 4/4 cherry and 12 board feet of 4/4 maple. Before cutting parts to size, we planed them to the thicknesses shown in these example boards.



¾x48x96" Baltic birch plywood

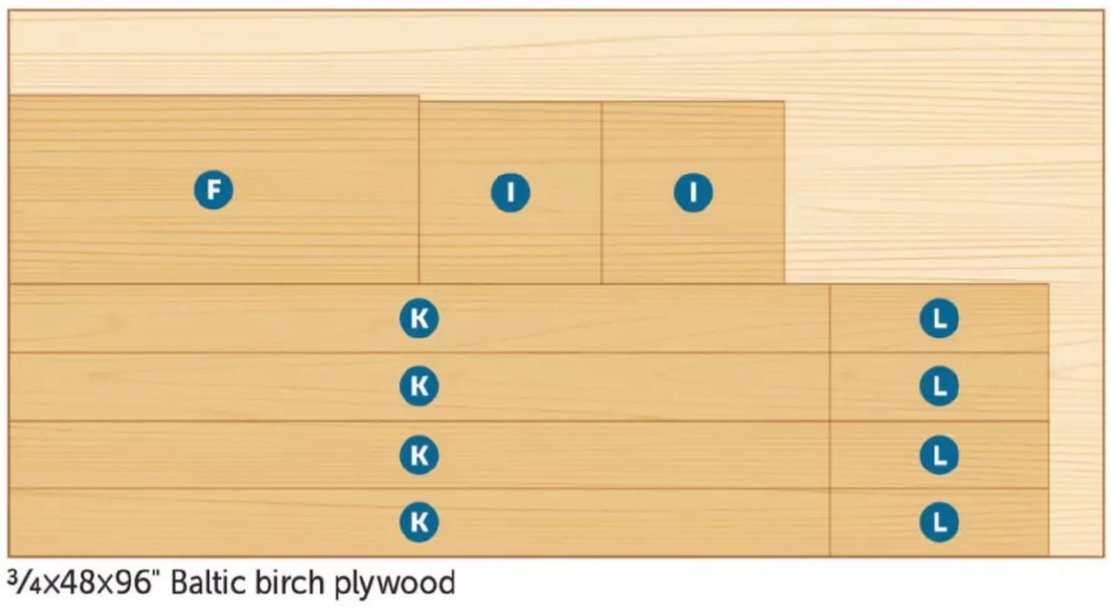


¾x48x96" Baltic birch plywood

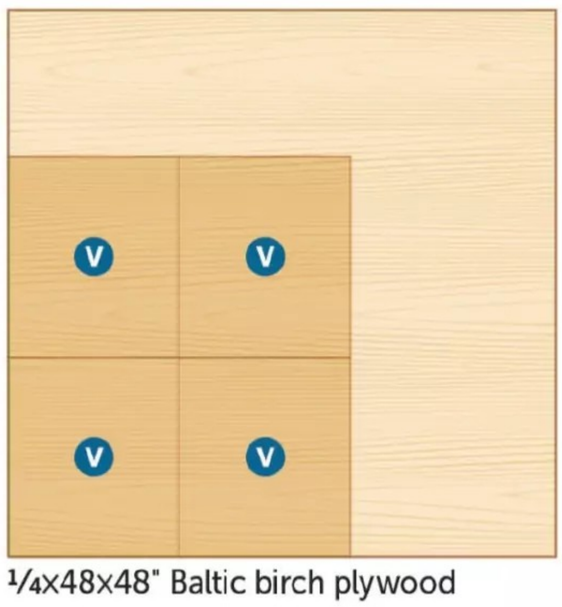


¾x48x96" Baltic birch plywood

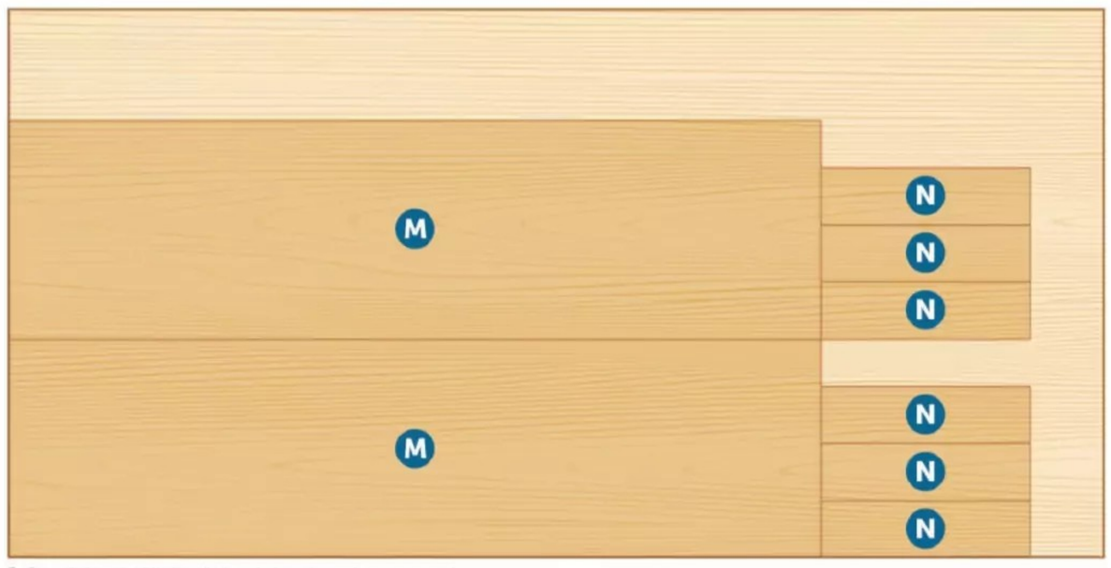
¼x96x48" Baltic birch plywood



¾x48x96" Baltic birch plywood



¼x48x48" Baltic birch plywood



¾x48x96" Baltic birch plywood

¾x5½x96" Cherry †Plane or resaw to the thickness listed in the Parts List.

¾x5½x96" Cherry

½x5½x96" Maple

½x5½x96" Maple †Plane or resaw to the thickness listed in the Parts List.

½x5½x96" Maple

NEXT-LEVEL TOOLS

Step up your woodworking skills using these tools our *WOOD*® magazine craftsmen rely on to achieve awesome results.

WRITER: VINCE ANCONA with KEVIN BOYLE and JOHN OLSON

PHOTOGRAPHER: CARSON DOWNING

Whenever readers visit the *WOOD*® magazine workshop, they frequently ask how we make our projects look so good. Most of the credit goes to our design editors, Kevin Boyle and John Olson. Their years of experience shine through in everything they create. But having the right tools makes a huge difference, too.

We asked Kevin and John to share their thoughts on some of the tools that they believe take their woodworking to the next level. This is not just another list of must-have tools. Instead, consider their recommendations if you're ready to elevate your woodworking from good to great or make practicing the craft more enjoyable.

HONING GUIDE

Sharpening is a skill many woodworkers struggle with, but a honing guide can shorten the learning curve significantly. While many good examples exist, John prefers the Veritas Mk. II guide from Lee Valley for its ease of use and versatility. A registration jig included with the guide makes setting the bevel angle nearly foolproof, resulting in a perfect edge every time. And accessory rollers and clamping heads allow the guide to handle narrow or short blades, or camber an edge.

Note: **Purchase plans for the sharpening station shown here at woodstore.net/sharpeningstation.**

A miter square can be used to lay out or check 45° angles as well as supplementary 135° angles.

MITER AND DOUBLE SQUARES

John carries a 4" double square in his shop apron for layout tasks. He prefers it over a combination square, even though it's not capable of checking 45° miters. For that task, John relies on a dedicated miter square. It provides more registration surface area than the short 45° face of a combination square. John takes confidence in knowing his miter square will be accurate every time he uses it to check inside and outside miters, resulting in gap-free joints.

For maximum versatility, when shopping for a cordless palm router look for a model that includes a plunge base as well as a fixed base.

CORDLESS PALM ROUTER

Both Kevin and John use multiple routers in the shop. But they confess that the cordless palm router quickly developed as a favorite. Also known as a compact or trim router, the palm router accepts only ¼"-shank bits, but still manages to handle most everyday routing tasks, such as chamfers, round-overs, and grooves. Without the tether of a power cord, the cordless palm router provides the freedom to move all around a project while routing.

LOW-ANGLE BENCH PLANES

As a dedicated hand-plane user, John counts low-angle bench planes among his favorites. Low-angle planes require less effort to push, and they handle end grain better than standard-angle planes. Lacking an adjustable frog, these planes set up more easily and require less fuss to achieve good results. The mouth opening on most low-angle planes is adjustable, allowing John to set the plane with a tight opening to reduce tear-out. While John owns low-angle planes in different lengths that specialize in smoothing, jointing, and thicknessing, he says that you can achieve similar functionality with just a low-angle jack and an extra blade. Hone one blade with a slight camber for smoothing, the other straight across for jointing and heavier stock removal.

Note: **Low-angle planes have a cutting angle of 37° versus the 45° found in standard-angle planes. This lower angle enables the blade to slice through end grain and cross grain with minimal effort.**

The adjustable mouth on a low-angle plane allows you to narrow the opening around the blade, greatly reducing tear-out when smoothing difficult woods.

Unlike a pencil, a marking knife leaves an incised line in the wood, perfect for registering a chisel or saw when starting a cut.

MARKING KNIFE

Although pencils have their place, Kevin prefers a marking knife for layout tasks because it scores the wood fibers to create a crisp, precise line that is less likely to experience tear-out during cutting. Kevin's marking knife of choice is a Japanese Kiradashi knife. In addition to everyday parts layout, the long, slender profile of this knife allows it to reach into tight quarters, such as when transferring a dovetail layout to a mating pin board. Kiradashi knives are beveled on one side only, leaving a flat reference face, and are available for right- or left-handed users.

CRANKED-NECK CHISEL

For flush-trimming plugs or dowels, smoothing the bottom of a dado or groove, or just removing a bit of dried glue from the interior corners of a project, Kevin likes his cranked-neck chisel. A dogleg bend in the chisel's shank creates an offset in the handle, allowing the chisel to register flat against the surface of a board. Although he could have purchased a commercially made cranked-neck chisel, Kevin actually made his own by heating the neck of a standard chisel with a torch until red-hot, then bending it to shape.

A bend in the neck of the chisel raises the handle high enough to get a good grip for paring.

In addition to extending across the full width of the sole, the low-angle blade cuts end grain and cross grain with ease.

RABBETING BLOCK PLANE

Although Kevin uses more of a power-tool approach than John, he relies on a block plane for fitting doors and drawers, chamfering edges, or trimming end grain. Rather than a standard block plane, however, Kevin prefers a rabbeting block plane. Openings in the sides of the plane allow the blade to extend the full width of the body, letting it reach into the corner of a shoulder. Kevin uses his to trim tenons, rabbets, or tongues. He typically starts by cutting joints slightly tight, then using the plane to bring them down to a perfect fit.

SLIDING TABLESAW

Here in the *WOOD*® shop, we're fortunate to have three tablesaws, one of which Kevin and John share that's equipped with a sliding crosscut table. For a home shop, this may feel like a luxury. But after using one, they both admit they'd have a hard time going back to a saw with only a miter gauge. In comparison, a sliding table greatly increases crosscut capacity. For crosscutting pieces to length or cutting panels to size, it offers unparalleled accuracy. Flip stops on the fence of the sliding table allow for cutting multiple parts to identical lengths. To say that it transforms a tablesaw into a precision cutoff machine is not an overstatement.

Switching the Rotex sander to rotary mode allows it to quickly sand away saw-blade marks on this rough-sawn board.

RANDOM-ORBIT SANDERS

Both Kevin and John list a random-orbit sander among their favorite tools, but for different reasons. John likes his 6" Festool Rotex sander because it switches from random-orbit to rotary mode quickly when he needs to hog off lots of material. The aggressive sanding action of this tool makes it great for coarse sanding, such as removing saw-blade or planer marks or rough shaping.

On the other hand, Kevin likes his 6" Festool ETS 150/3 EQ sander for its smooth operation. He uses it for finish sanding on almost every project. He says that he could steer this lightweight and well-balanced sander with one finger (although we recommend maintaining a good grip with at least one hand). It also has excellent dust-collection capability, allowing him to breathe easier during long sanding sessions.

Note: **A rotary sander simply spins. But a random-orbit sander rotates and oscillates in an orbital path at the same time. This dual motion helps prevent swirl marks.**

TIMBER LINE EXPRESS

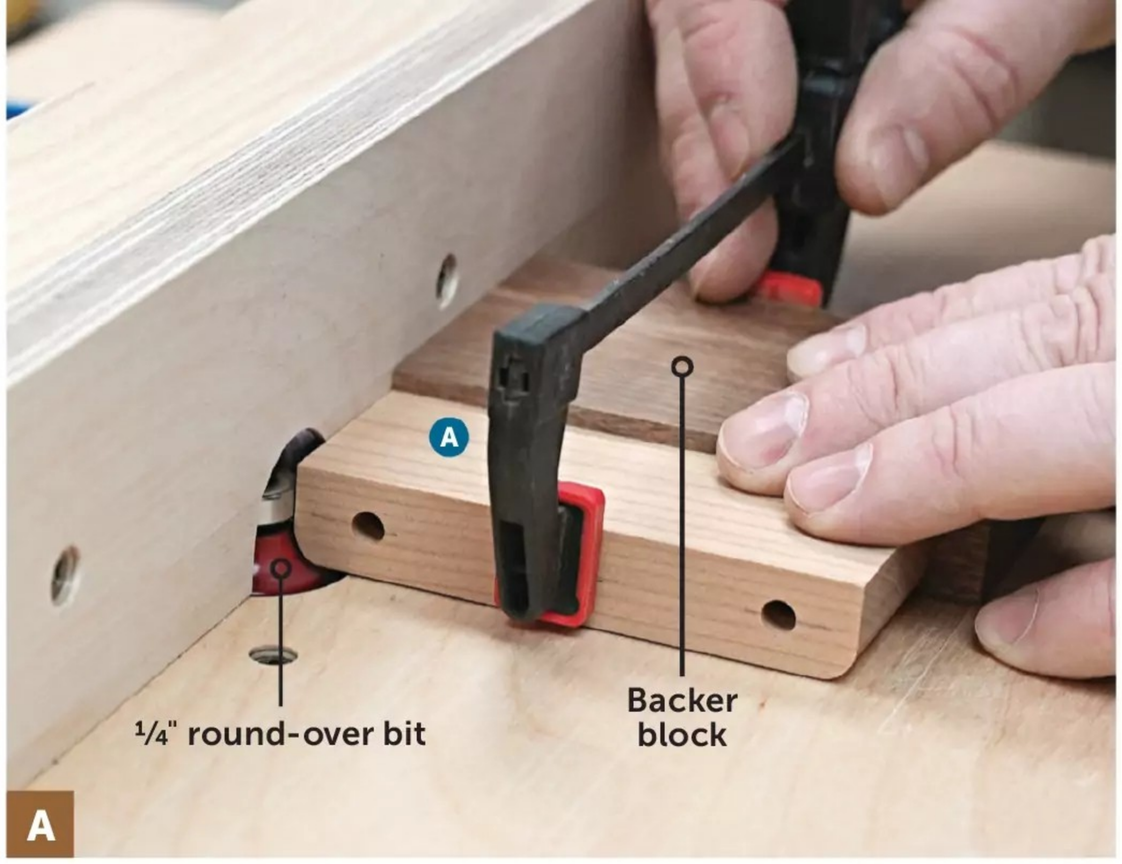
THE LITTLE ENGINE THAT COULD

Use this hardworking engine to push and pull your Timber Line cars into place in preparation for their cross-country journey.

WRITER: VINCE ANCONA
DESIGNER/BUILDER: JOHN OLSON

Small, self-contained locomotives such as this one played vital roles in the heyday of railroads. They hauled ore or logs over short runs, or shunted cars between tracks in switchyards. And just like the subject of the well-known children's tale, they were occasionally called upon to pull longer trains over short distances.

In keeping with the era of the other Timber Line Express cars, our little engine is steam powered. But unlike those longer cars that use a pivoting truck assembly at each end, this short locomotive travels on a single, six-wheel frame. Although the parts for this wheel frame differ from those of previous cars, you'll notice construction similarities. Our project kit **[Sources]** includes specialty items like the wheels, pegs, and smokestack.



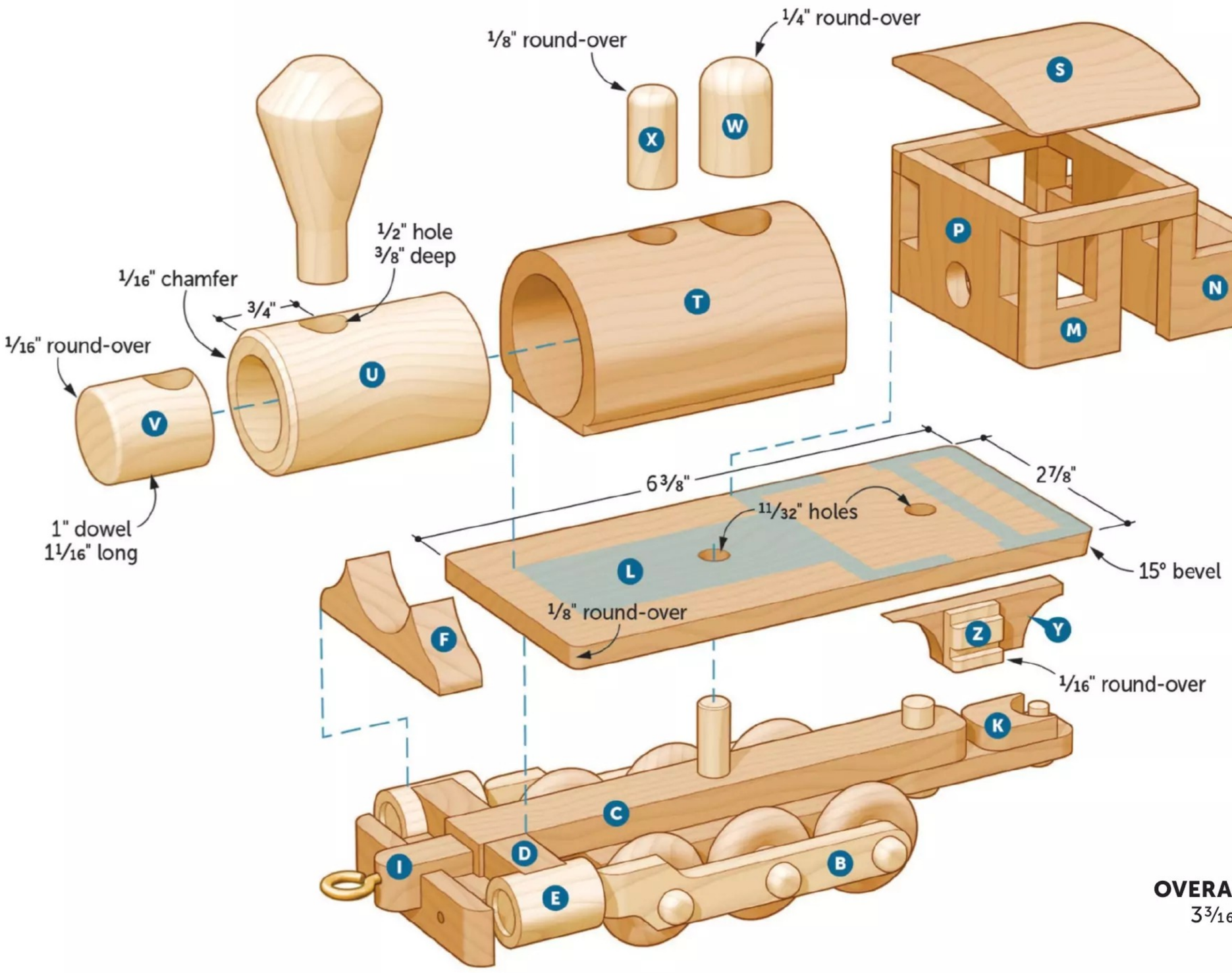
Clamp the wheel truck (A) to a backer block before routing the round-overs, both to prevent tear-out and to keep your fingers a safe distance from the router bit.

PUT THE ENGINE ON WHEELS

1 Cut the wheel truck (A) to size **[Drawing 1]**. Lay out and drill the holes on both edges for the axle pegs. Round over the lower front and back ends **[Photo A]**.

2 Cut the blanks for the drive links (B) to overall size **[Parts List, Drawing 1a]**. Lay out and drill the holes, then cut the links to shape. Sand a round-over on the end of each link, creating a left and right drive link.

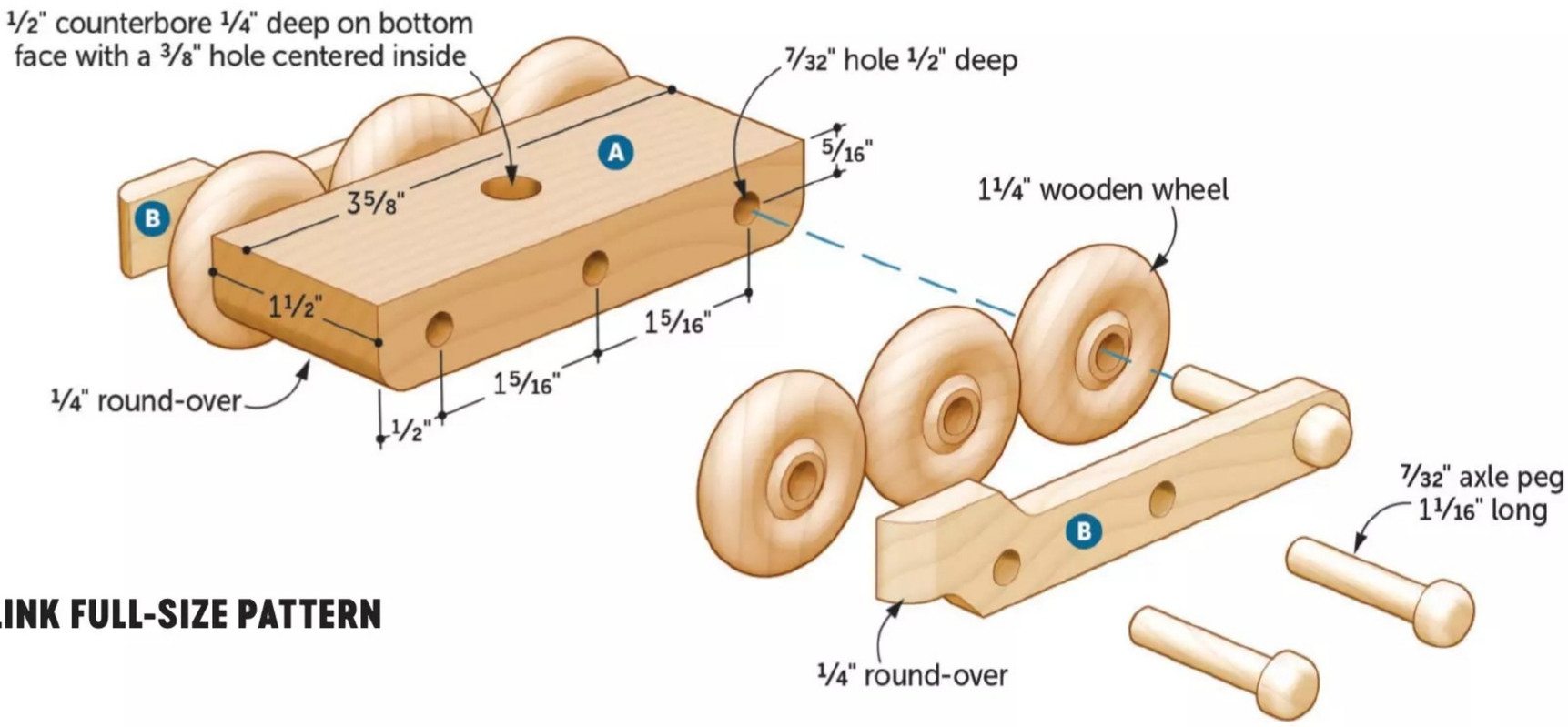
EXPLODED VIEW



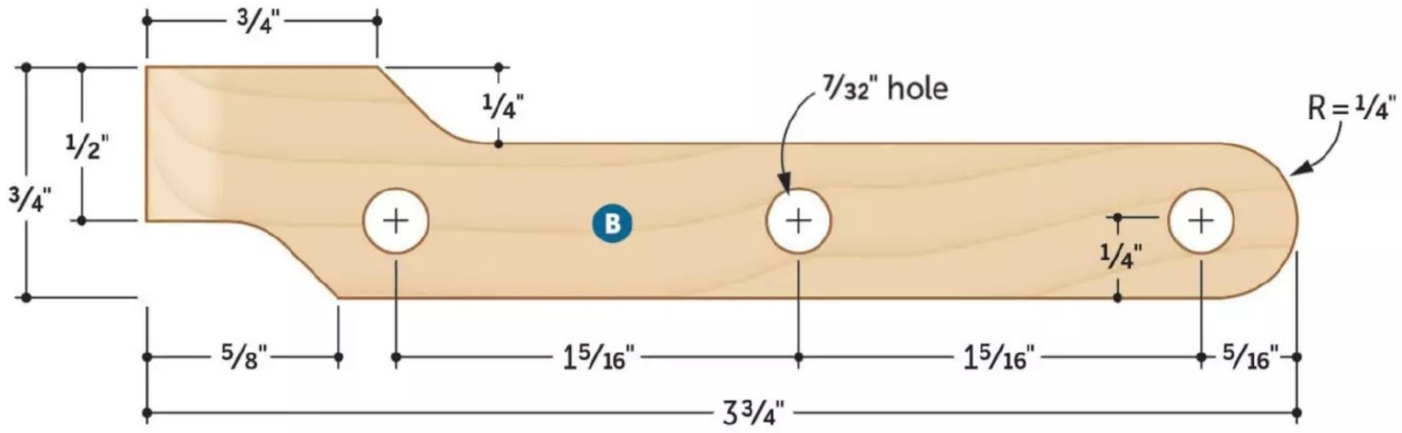
OVERALL DIMENSIONS
3 3/16"W × 9"L × 4¾"H

PHOTOGRAPHER: JASON DONNELLY; **ILLUSTRATOR:** CHRISTOPHER MILLS

1 WHEEL ASSEMBLY

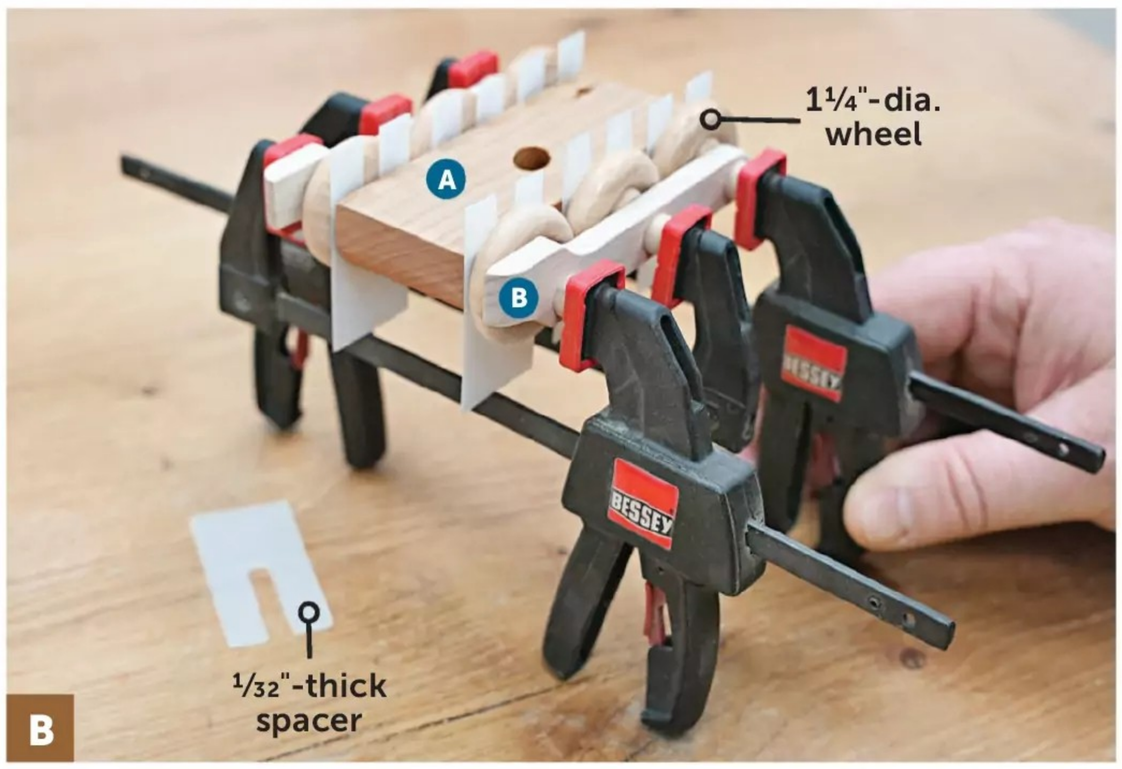


1a DRIVE LINK FULL-SIZE PATTERN



3 On the bottom face of the wheel truck (A), drill a centered 1/2" counterbore 1/4" deep **[Drawing 1]**. Then drill a 3/8" hole through the wheel truck, centered in the counterbore.

4 Glue the axle pegs into the holes in the drive links (B) using a few drops of cyanoacrylate glue on the underside of each peg head. After the glue cures, slip the wheels and spacers (included in the project kit) onto the axle pegs. Using wood glue, secure the pegs into the holes in the wheel truck (A) **[Photo B]**.



Cut slots in the 1/32" spacers from the project kit to fit around the axle pegs. Glue the drive link/axle assemblies to the wheel truck, sandwiching the wheels and spacers in between.

BUILD FROM THE FRAME UP

1 Cut the frame rail (C) to size **[Drawings 2 and 3]**. Drill the holes and round over the corners on one end.

2 Cut the steam cradle (D) to overall size. Notch the center of the cradle to fit around the frame rail (C) **[Photo C]** and shape the ends. Glue the frame rail to the steam cradle with the square end extending 1/16" past the front face of the steam cradle **[Drawing 3]**.

3 From 3/4" dowel stock, cut the two steam chests (E) to length **[Parts List, Drawing 3]**. Drill a 1/2" counterbore in one end of each chest (see *Dealing with Dowels, page 58*) and then glue the chests to the ends of the steam cradle **[Photo D]**.

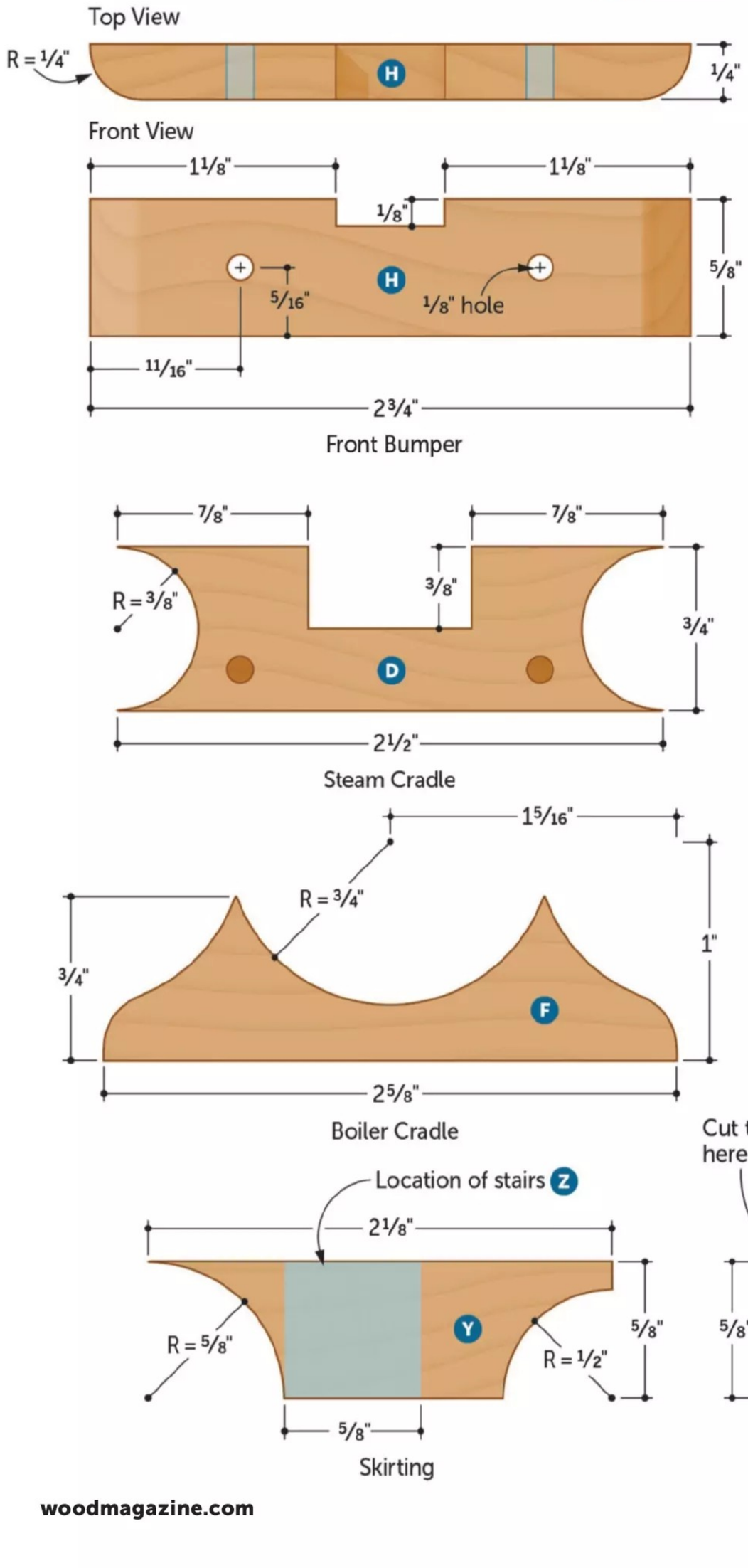
4 Cut the boiler cradle (F) to size and shape **[Drawing 2]**. Glue it to the top of the frame rail/steam cradle assembly (C/D/E), making sure it's centered side-to-side.

5 Cut the bumper frame (G) and front bumper (H) to size **[Drawings 2 and 3]**. Notch the front bumper and round over the ends. Glue the bumper frame to the bumper, ensuring that it's centered and flush with the bottom of the notch.

Use a stopblock to define the ends of the notch on the steam cradle (D), then nibble away the waste from the center with overlapping cuts. Shape the ends using a bandsaw and spindle sander.

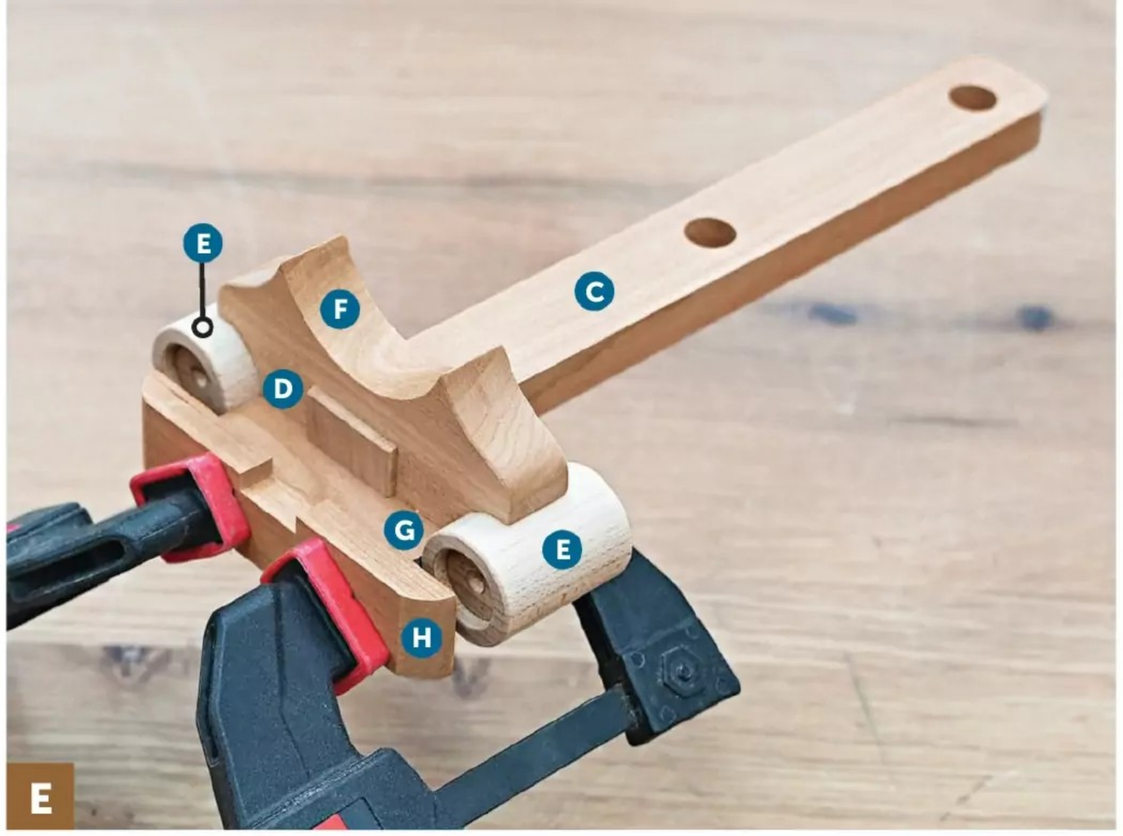
After gluing the frame rail (C) to the steam cradle (D), center the steam chests (E) on the ends of the steam cradle and glue them in place, making sure the counterbores face out.

2 FRAME PARTS FULL-SIZE PATTERNS



6 Glue and clamp the bumper assembly (G/H) to the frame assembly (C–F) **[Photo E]**. After the glue dries, lay out and drill ⅛" holes 1" deep through the bumper assembly into the steam cradle **[Drawing 3]**. Glue ⅛" dowels into the holes and trim them flush.

7 Cut a 3"-long blank to width for the front tongue (I). Cut a ⅝"-wide, ¼"-deep dado ⅜" from one end. Then drill a hole in that end for the brass eye screw **[Photo F]**. Round over the end and cut the front tongue to final length to leave a ⅝" rabbet on one end **[Drawing 2]**. Glue and clamp the front tongue into the notch in the front bumper **[Drawing 3]**.



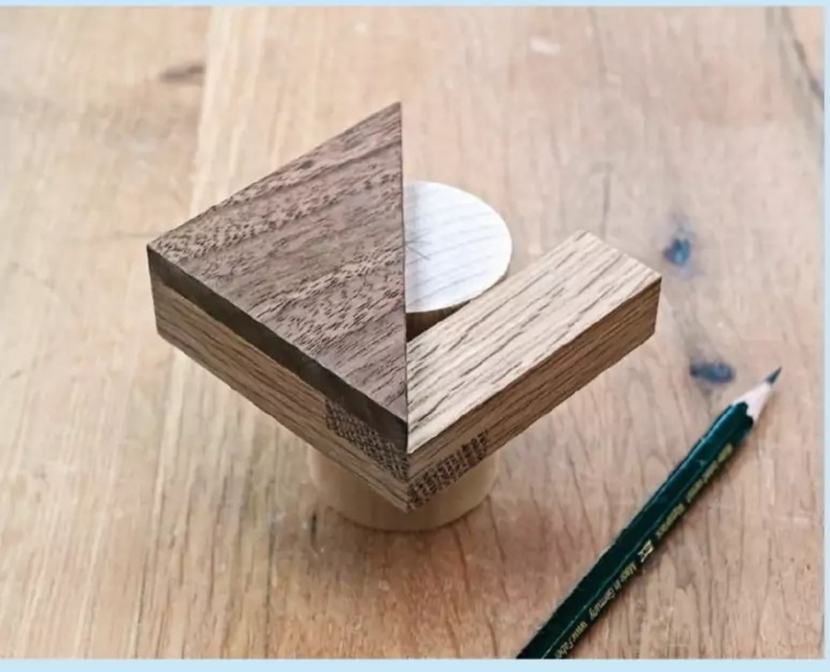
With the boiler cradle (F) glued to the steam cradle (D), glue the bumper assembly (G/H) in place, aligning it with the underside of the frame rail (C) and centering it between the steam chests (E).

DEALING WITH DOWELS

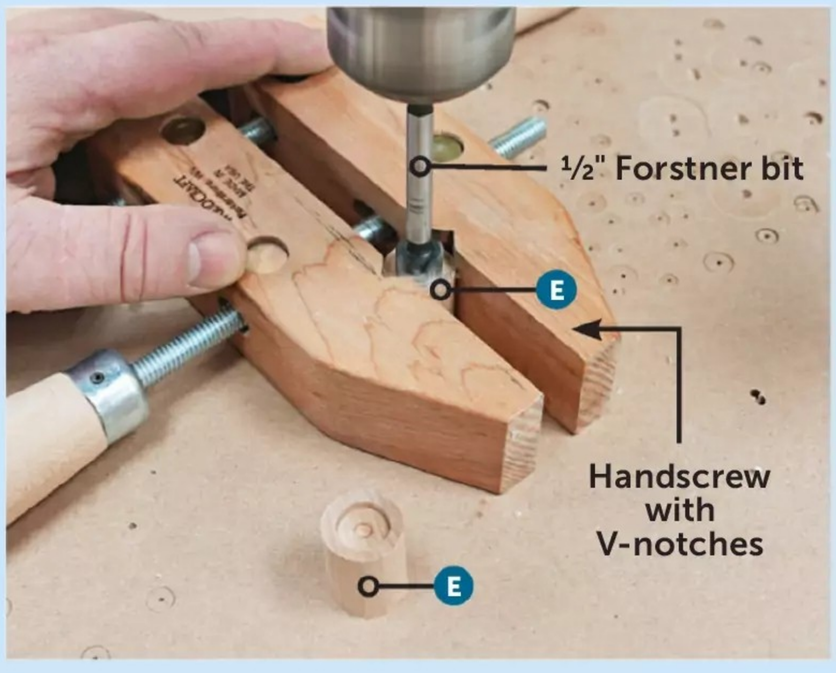
To simplify construction, we used dowels for several parts of this engine. But this created some new challenges. Without any flat surfaces, laying out the centerpoints and clamping the dowels for drilling counterbores required some outside-the-box thinking.

To lay out the centerpoint on the ends of the dowels, we made a small center-finding aid (*below left*). To use the centerfinder, place it over the end of the dowel so both legs contact the edges. Scribe a line along the long edge of the triangle, then rotate the dowel a few times and scribe additional lines. The lines will converge around the centerpoint of the dowel. Using an awl to mark the centerpoint makes it easy to line up the centerpoint of your Forstner or brad-point bit.

To grip short sections of dowel stock securely when drilling the ends, cut a pair of small V-notches in the jaws of a handscrew (*below center*). If you don't have a handscrew available, make your own holding device by drilling holes along the center of a piece of scrap to match the diameters of the dowels. Rip the board down the center at the bandsaw to keep the kerf as narrow as possible. Clamp the dowel between the two halves, then clamp everything to the drill press table before drilling (*below right*).

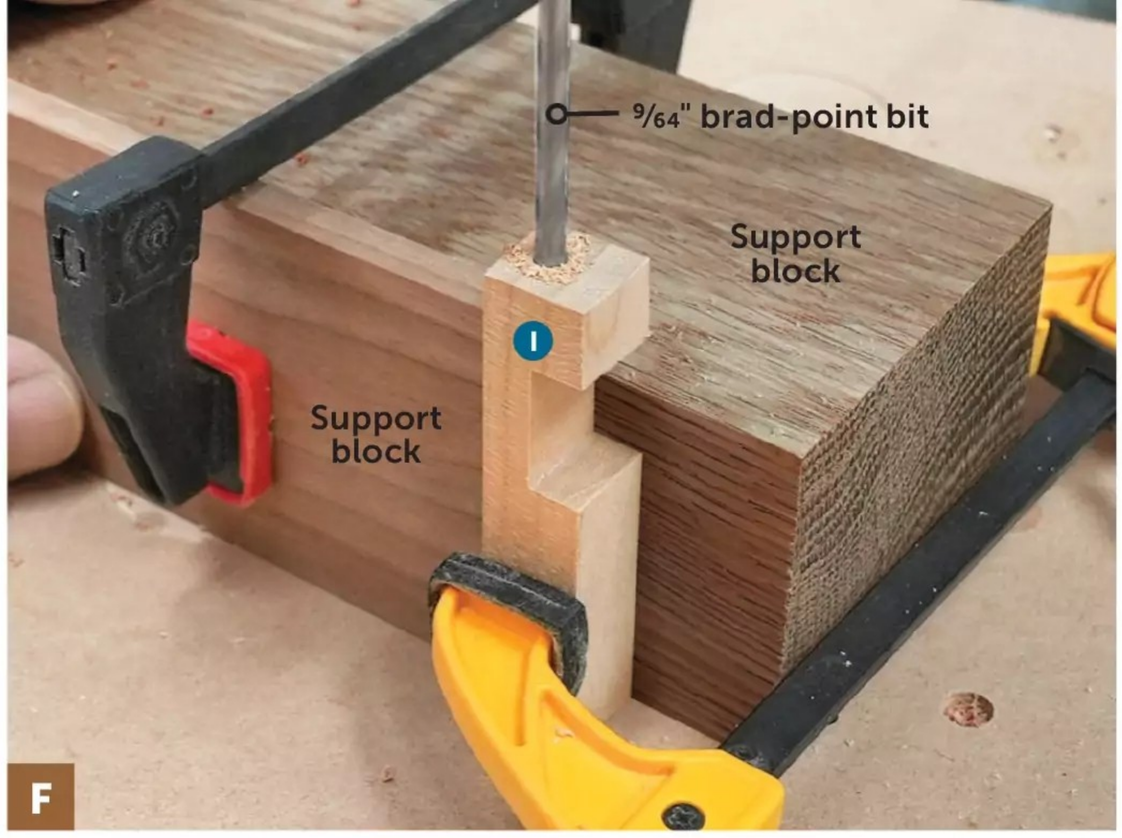


To make a centerfinder, cut two ½×¾×2½" legs, half-lap one end of each, and glue them together at a right angle. Then cut a ¼×2½×2½" right triangle and glue it to the top of the legs.



Disassemble a small handscrew and rout V-notches into the jaws before reassembling. Then clamp each steam chest (E) securely and use a Forstner bit to drill a centered, 1/16"-deep counterbore on one end.

To hold the boiler (U), drill a hole in the center of a board, then rip it down the middle at the bandsaw. Clamp the workpiece between the two halves, then clamp everything down to the drill press.



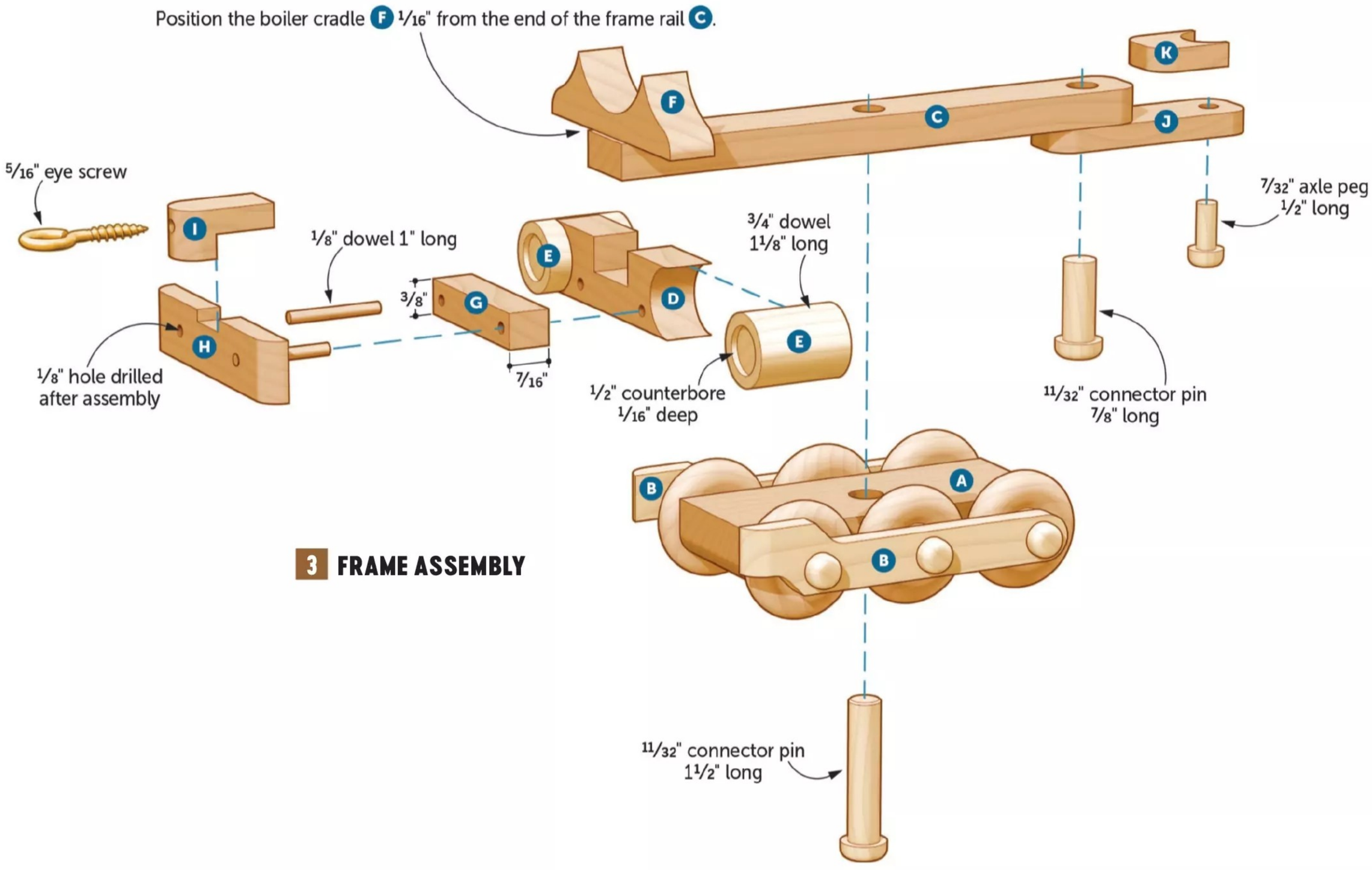
Use a pair of support blocks to hold the tongue blank plumb, square, and vertical while drilling a hole in the end. A 9/64" brad-point bit makes a clean hole in the end grain, without wandering.

To form the hitch shroud (K), round the corners on the end of a long blank, then drill a hole centered on the width. Crosscut the part to finished length at the midpoint of the hole.

8 Cut the rear tongue (J) to size **[Drawing 2]**. Drill the two holes in the tongue and round over the corners.

9 Cut an 8"-long blank to width for the hitch shroud (K). Round over the corners on one end and drill a centered hole **[Photo G]**. Cut the hitch shroud to length and glue it to the rear tongue **[Drawing 3]**. Glue an axle peg into the smaller hole in the rear tongue from underneath, then trim it flush with the top of the shroud.

3 FRAME ASSEMBLY



CREATE A PLATFORM AND CAB

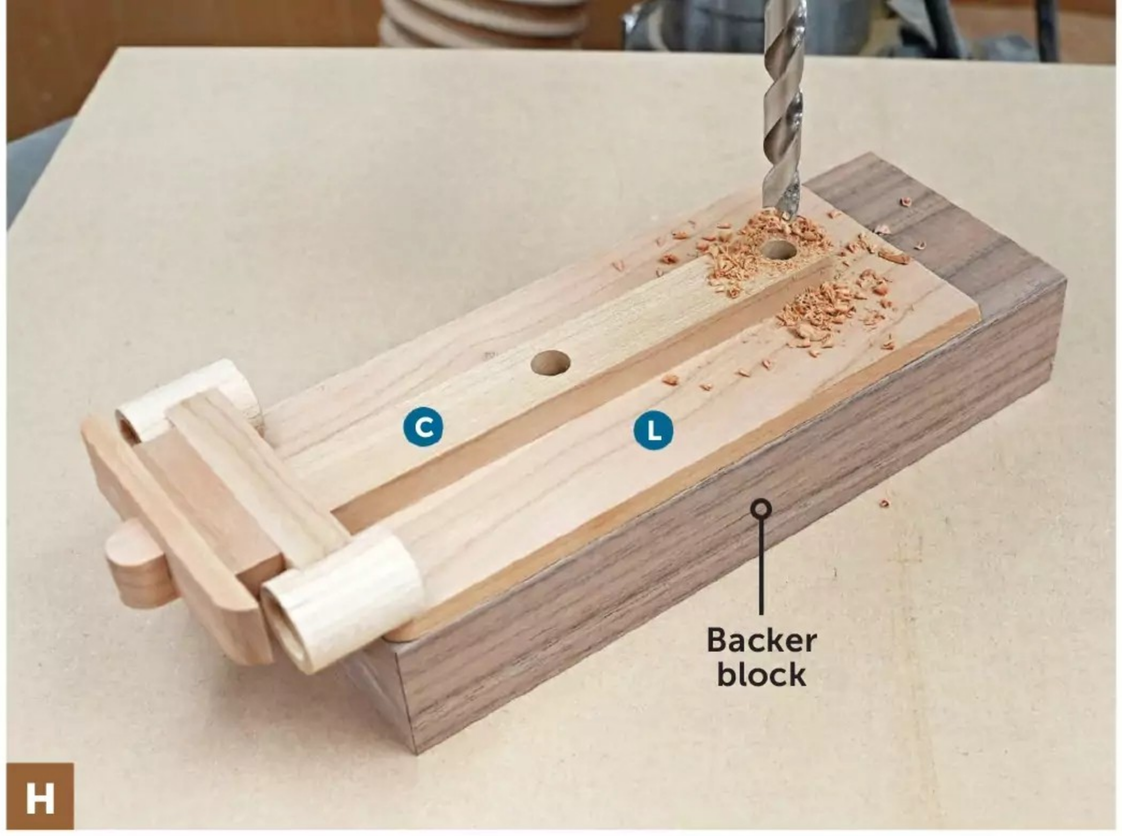
1 Cut the platform (L) to size, beveling one end at 15° **[Parts List, Exploded View]**. Sand 1/8" round-overs on only the front corners. Glue the platform to the frame rail (C), butting it against the boiler cradle (F) and centering it side-to-side. After the glue dries, extend the holes in the frame rail through the platform **[Photo H]**.

2 From 1/4" stock, cut the cab sides (M), hopper sides (N), and cab headers (O) to overall size **[Drawing 4]**. Lay out and cut the cab and hopper sides to shape. Glue and clamp the cab headers to the upper edges of the cab and hopper sides **[Drawing 5]**.

3 Cut the cab front (P), cab back (Q), and hopper back (R) to size **[Drawing 4]**. Lay out and cut the window openings in the front and back using a scrollsaw or coping saw. Sand the openings smooth. Drill the hole in the cab front for the firebox opening. Bevel-cut the ends of the hopper back to 15°. Glue these three parts between the side assemblies to create a roofless cab assembly **[Drawing 5]**.

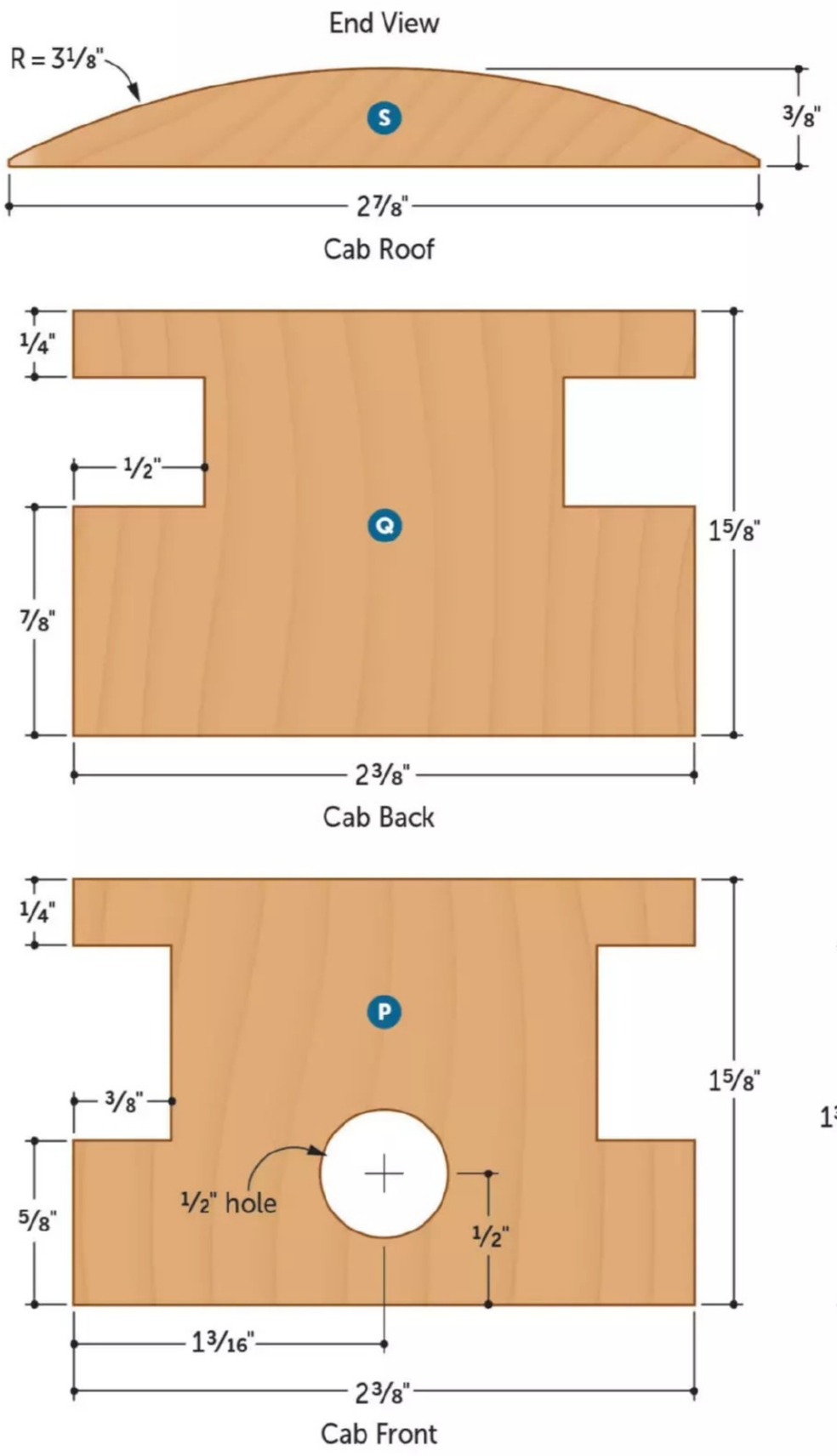
4 From stock planed to 3/8", cut the cab roof (S) to overall size **[Drawing 5]**. Glue and clamp the roof to the top of the cab assembly. After the glue dries, clean up any squeeze-out.

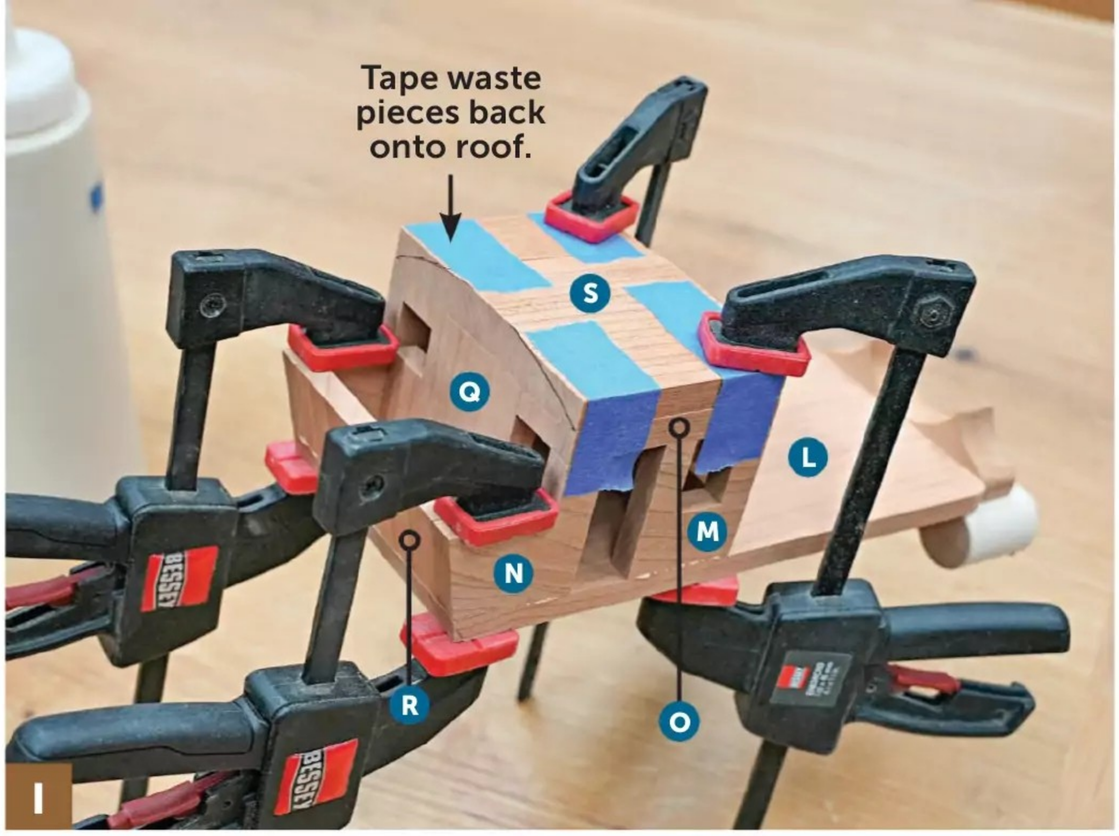
5 Lay out the curve on the rear end of the cab roof (S). Bandsaw the roof to shape, saving the cutoffs. Glue and clamp the cab assembly to the top of the platform, flush with the edges and back end **[Photo I]**. After the glue dries, sand the curve of the roof smooth. Round the corners of the cab and hopper with a fine file, followed by sanding.



Place the frame rail/platform assembly on a backer block and, using the holes in the frame rail (C) as a guide, drill through the platform (L).

4 CAB PARTS FULL SIZE PATTERNS





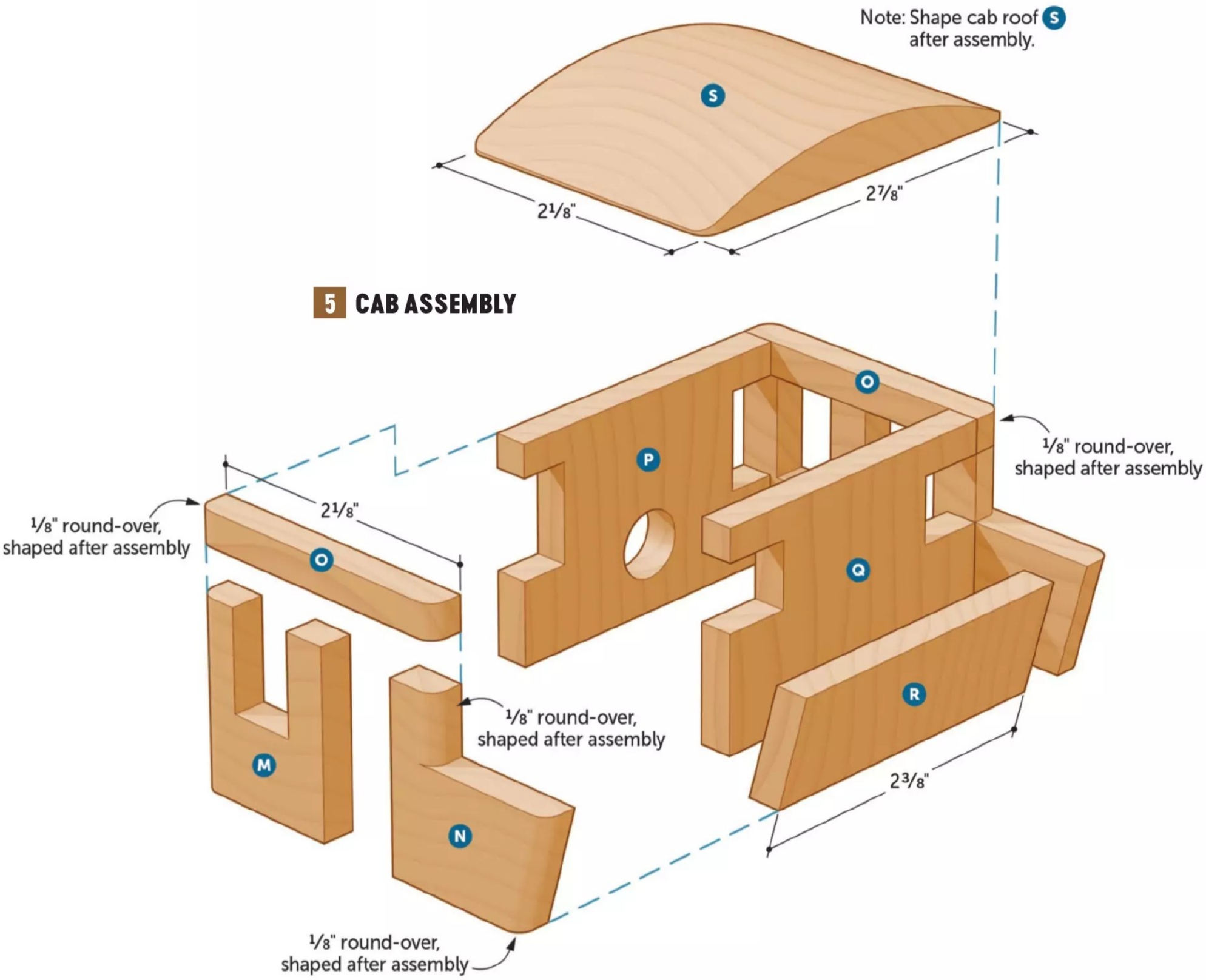
Tape the waste pieces from the roof to the cab assembly to provide a flat clamping surface. Glue and clamp the cab assembly to the back end of the platform, keeping the edges and end flush.

Clamp the boiler jacket (T) to a vertical support to bore the large hole in the end grain. Then drill holes in the top for the sand and steam domes (W, X).

FULL STEAM AHEAD

1 Cut the blank for the boiler jacket (T) to size **[Parts List, Drawing 6]**. Lay out and drill a large counterbore in one end of the jacket to hold the boiler (U) **[Photo J]**. Drill the two holes in the top of the boiler jacket **[Drawing 6]**.

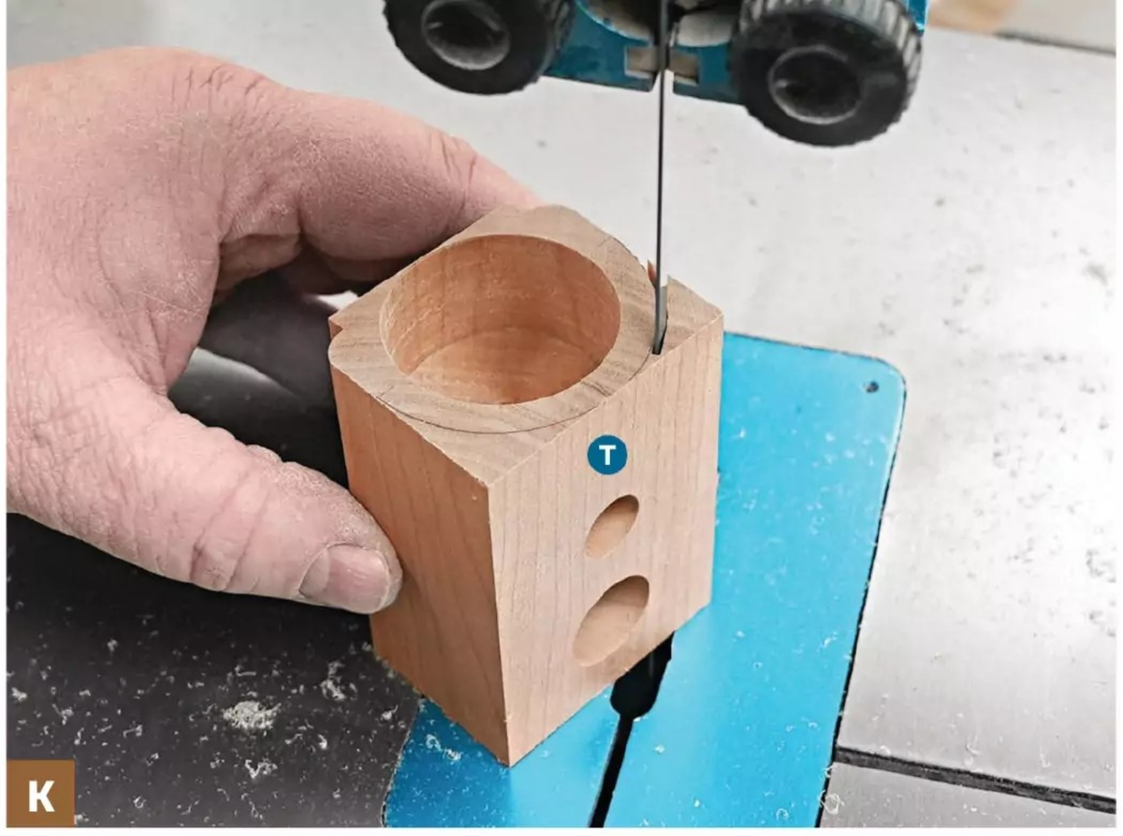
2 Round over the lower edges of the boiler jacket at the router table, raising the bit high enough to create a 1/8" shoulder below the round-over.



3 Lay out the curve for the top of the boiler jacket on the front end, then cut the curve at the bandsaw **[Photo K]**.

4 Cut the boiler (U) and boiler door (V) to length from maple dowel stock **[Parts List, Exploded View]**. Drill a 1"-deep counterbore in the end of the boiler, then file and sand the chamfer around the front end. Sand a round-over around one end of the boiler door (V), and glue the door into the boiler.

5 Glue the boiler assembly (U/V) into the counterbore you drilled in the end of the boiler jacket (T). After the glue dries, drill a hole in the boiler assembly for the smokestack. Sand the smokestack thoroughly and glue it into the hole.

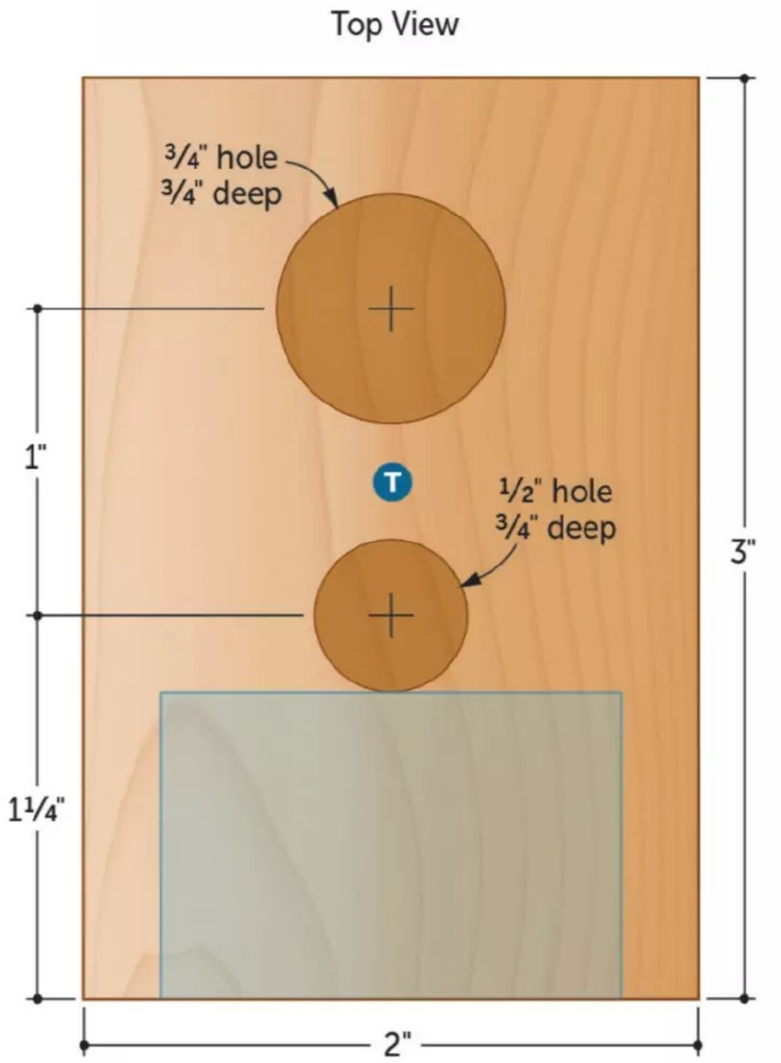


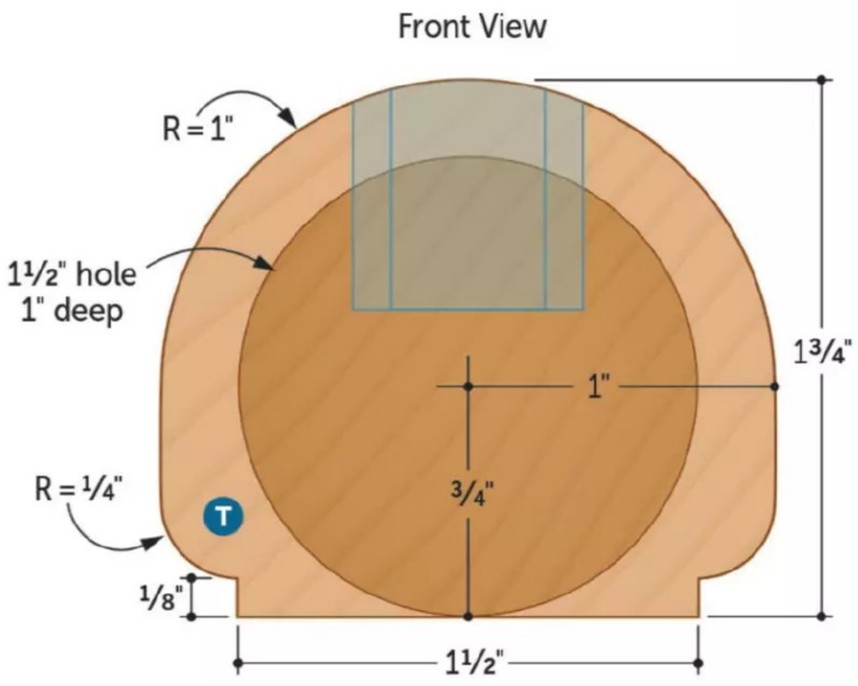
Cut the radius on top of the boiler jacket (T) by standing the piece on end at the bandsaw. Cut just outside the layout line, then sand the curve smooth.

6 Using a file and sandpaper, round over one end of ¾" and ½" dowel rods for the sand dome (W) and steam dome (X) **[Exploded View]**. Cut these pieces to length and glue them into the top of the boiler jacket (T).

7 Glue the boiler assembly to the top face of the boiler cradle and platform (F, L). After the glue has dried, extend the front 11/32" hole through the frame rail and platform into the bottom of the boiler jacket for the connector pin.

6 BOILER JACKET FULL-SIZE PATTERNS





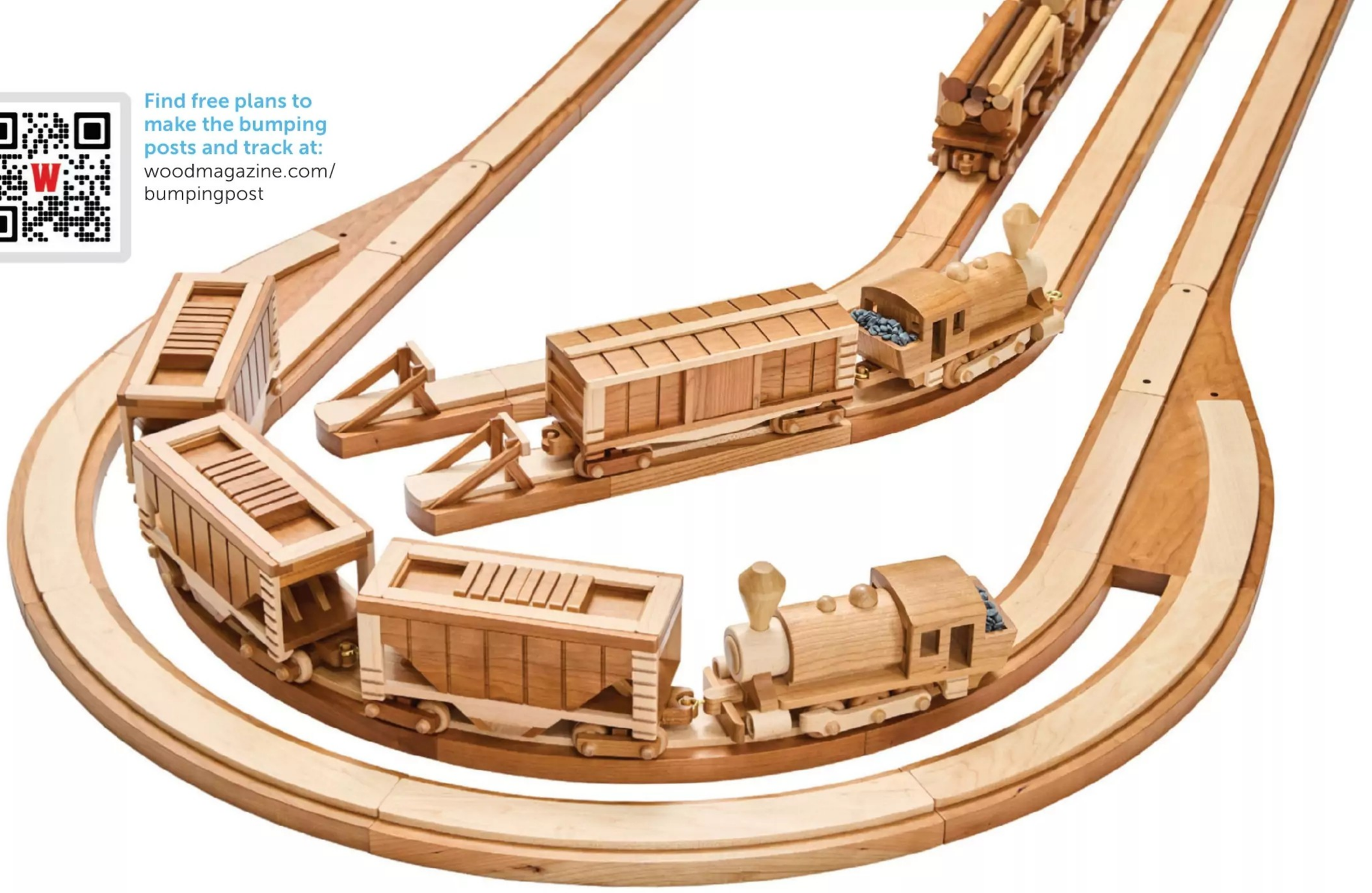
LEAVING THE STATION

1 Cut the cab skirting (Y) to size **[Parts List, Drawing 2]**. Lay out the curves on the ends of the skirting, cut them at the bandsaw, and sand them smooth.

2 To make the stairs (Z), cut a ¼"-thick blank to ⅝" wide and 4" long. Cut saw kerfs to form dadoes near each end **[Drawing 2]**. Round over the edges, then crosscut each stair to final length from the blank to leave a ⅛" rabbet at one end of each. Glue a stair to each cab skirt, aligned with the larger radius to make a left and right pair **[Exploded View]**. Glue the skirt/stair assemblies to the bottom of the platform, centering the stairs under the door openings of the cab and keeping the stair faces flush with the edge of the platform.

3 Dry-assemble the wheel assembly and platform/boiler assembly, making sure the hole is deep enough for the connector pin. Dry-assemble the rear hitch as well, then mark and cut to length the connector pin so that it sits flush with the platform inside the cab.

Find free plans to make the bumping posts and track at:
woodmagazine.com/bumpingpost



4 Take the assemblies apart and apply three coats of matte spray lacquer, rubbing out between coats with 0000 steel wool. Rotate the wheels as you apply the finish to ensure adequate coverage and to prevent the wheels from becoming stuck to the axles.

5 After the finish dries, attach the rear hitch and wheel assembly by gluing the connector pins in place, making sure the assemblies can pivot freely. Finally, thread the brass screw eye into the front hitch, while repeating "I thought I could, I thought I could."

PARTS LIST

PART		FINISHED SIZE T	W	L	Matl.	Qty.
A	WHEEL TRUCK	5/8"	1 1/2"	3 5/8"	C	1
B	DRIVE LINKS	1/4"	3/4"	3 3/4"	M	2
C	FRAME RAIL	3/8"	3/4"	6 1/8"	C	1
D	STEAM CRADLE	1/2"	3/4"	2 1/2"	C	1
E	STEAM CHESTS	3/4" diam.		1"	M	2
F	BOILER CRADLE	1/2"	3/4"	2 5/8"	C	1
G	BUMPER FRAME	3/8"	7/16"	1 3/4"	C	1
H	FRONT BUMPER	1/4"	5/8"	2 3/4"	C	1
I*	FRONT TONGUE	1/2"	1/2"	1"	C	1
J	REAR TONGUE	1/4"	3/4"	2 3/8"	C	1
K*	HITCH SHROUD	1/4"	3/4"	7/8"	C	1
L	PLATFORM	1/4"	2 7/8"	6 3/8"	C	1
M	CAB SIDES	1/4"	1 3/8"	1 1/8"	C	2
N	HOPPER SIDES	1/4"	1 3/8"	1 3/8"	C	2
O	CAB HEADERS	1/4"	1/4"	2 1/8"	C	2
P	CAB FRONT	1/4"	2 3/8"	1 5/8"	C	1

PART		FINISHED SIZE T	W	L	Matl.	Qty.
Q	CAB BACK	1/4"	2 3/8"	1 5/8"	C	1
R	HOPPER BACK	1/4"	2 3/8"	1"	C	1
S	CAB ROOF	3/8"	2 7/8"	2 1/8"	C	1
T	BOILER JACKET	1 3/4"	2"	3"	C	1
U	BOILER	1 1/2" diam.		2 1/4"	M	1
V	BOILER DOOR	1" diam.		1 1/16"	M	1
W*	BOILER SAND DOME	3/4"-diam.		1 1/8"	M	1
X*	BOILER STEAM DOME	1/2"-diam.		1"	M	1
Y	CAB SKIRTING	1/4"	5/8"	2 1/8"	C	2
Z*	STAIRS	1/4"	5/8"	5/8"	M	2

*Parts initially cut oversize. See the instructions.

MATERIALS KEY: C–cherry, M–maple.
BITS: 1/8", 9/64", 7/32", 11/32", and 3/8" brad-point bits, 1/2", 5/8", 3/4", 1", and 1 1/2" Forstner bits, 1/4" round-over router bit.
SOURCE: Little Engine Kit no. RS-01450 $19.75, woodstore.net/littleenginekit.
PROJECT COST: It cost us about $40 to build this project. Your cost will vary by region and source.

3 SIMPLE SOLUTIONS FOR LOOSE-TENON JOINTS

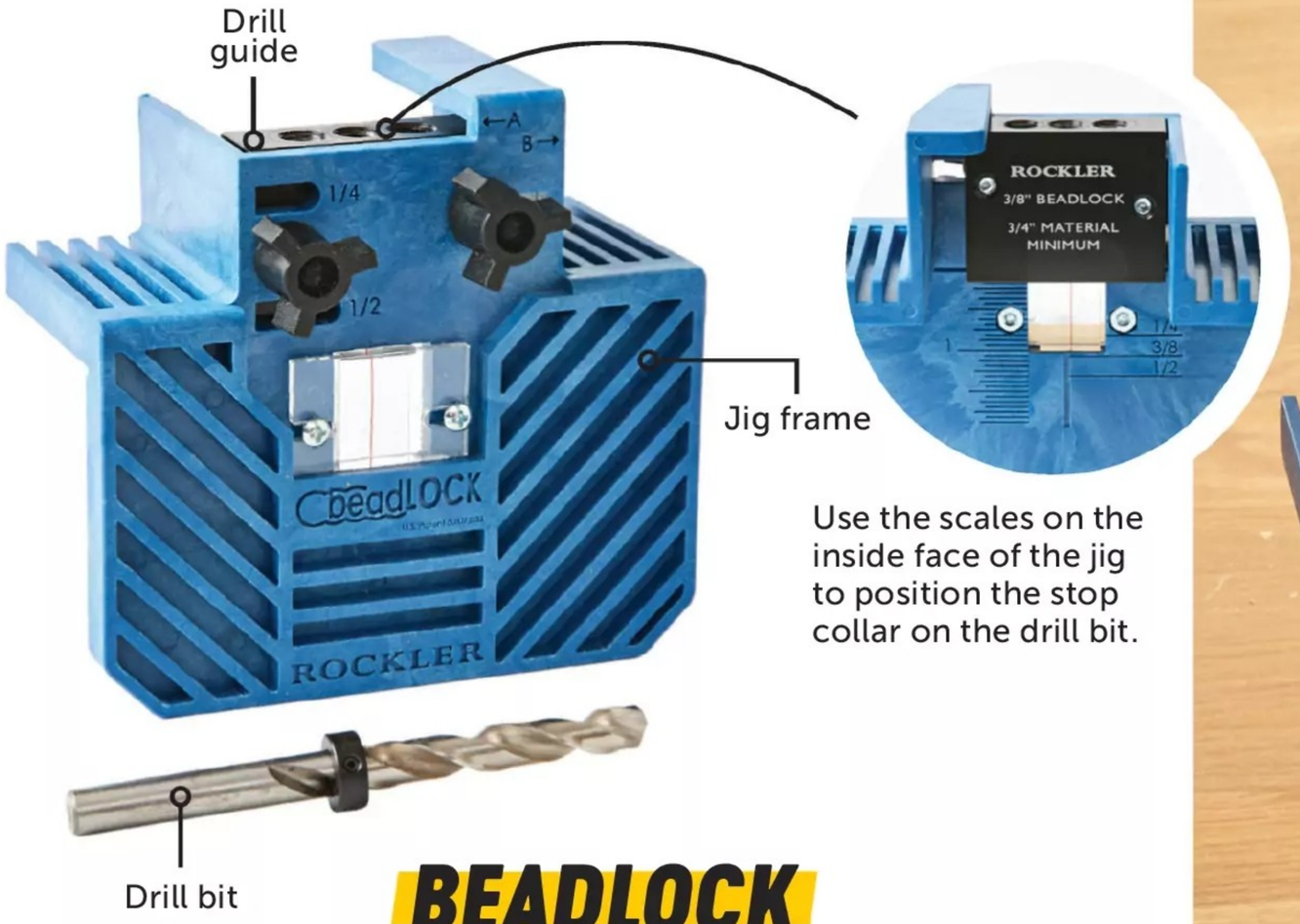
By using your drill or router, these jigs promise strong, accurate joints at an affordable price. Discover if one is right for your shop.

WRITER: VINCE ANCONA

Since Festool introduced their Domino joiner system to the U.S. in 2007, it has largely replaced biscuit joiners in a lot of professional cabinet shops. Rather than just cutting a thin slot, the Domino uses a spiral cutter that rotates and oscillates simultaneously to create mortises perfectly sized to fit the loose tenons, or dominoes. Because they're thicker than biscuits, dominoes offer structural strength as well as alignment. This fact makes the Domino joiner hands-down the most efficient tool for creating accurate mortises for loose-tenon joints. But that efficiency comes with a four-figure price tag.

Less expensive alternatives exist that allow you to use your router or drill to create mortises for loose-tenon joinery. While they can't match the Domino for speed and convenience, we evaluated three to see how they compare in accuracy and fit.

PHOTOGRAPHER: JACOB FOX



Use the scales on the inside face of the jig to position the stop collar on the drill bit.

Align the layout line on your workpiece with the index line in the window and clamp the jig in place. Use the guide block to drill the first set of holes, then loosen the knobs and slide the block to the right to drill overlapping holes.

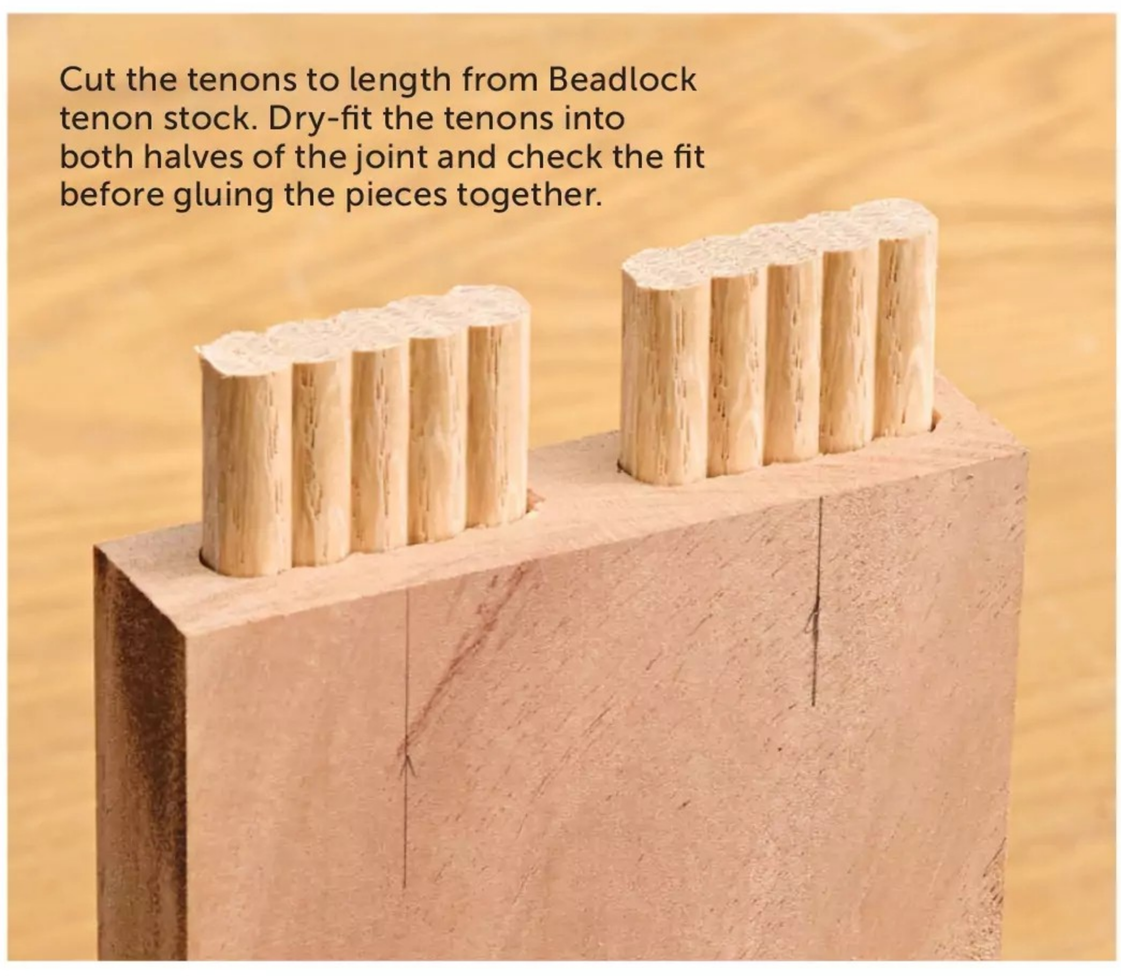
BEADLOCK

The System. Rockler's Beadlock jig allows you to create loose-tenon joints using an ordinary drill. It works similar to a doweling jig in that it guides a drill bit to create a hole perpendicular to the edge or end of a workpiece. But the Beadlock jig enables you to drill a series of overlapping holes without repositioning the jig. The result is a scalloped, or beaded, mortise. Instead of dowels, beaded tenon stock matching the profile of the mortise joins the two pieces together.

The heart of the Beadlock system is a hardened steel drill guide that mounts to a plastic jig frame. A row of evenly spaced holes in the drill guide keeps your bit perpendicular to the workpiece as you drill. A stop collar on the drill bit controls the depth of the holes.

The standard 3/8" Beadlock drilling guide and tenon stock are designed for use with stock at least 3/4" thick. Rockler also offers 1/4" and 1/2" drilling guides that fit in the same jig base. These allow you to scale the tenons down or up for stock as thin as 1/2" or 1" or greater.

The Setup. To use the jig, start by mounting the block in the jig and sliding it all the way to the left (Position A) before tightening the knobs. Using the scale molded into the face of the jig, position the stop collar on the drill bit for the desired hole depth. Mark the center of the mortise on both halves of your joint. A clear plastic window with a centerline on the jig frame makes it easy to position the jig on the workpiece before clamping it in place.



Cut the tenons to length from Beadlock tenon stock. Dry-fit the tenons into both halves of the joint and check the fit before gluing the pieces together.

The Experience. With the workpiece secured in a vise, drill the first series of holes, *above*. In order to clear the chips while drilling, you'll need to back the drill out a few times for each hole. After completing the row of holes, loosen the knobs and shift the block to the right (Position B) within the jig frame, then drill the overlapping holes to complete the mortise. Unclamp the jig from the workpiece and then repeat the entire process on the mating piece. Once you've mortised both halves of the joint, cut a tenon to length from a piece of Beadlock tenon stock and glue everything together, *left*.

The Results. Once you have the jig set up, drilling the holes to create the mortise is pretty automatic, albeit a bit repetitive. We did experience a little flex in the jig, making it important to hold the drill straight while drilling the holes. We found the system a little tedious and time-consuming to use, but as long as you carefully adjust everything beforehand, you can achieve strong, accurate loose-tenon joints.

The Beadlock jig does not automatically center the mortise on the thickness of the workpiece. And there's no way to adjust the position of the mortise in relation to the stock thickness, aside from inserting a shim between the jig and the drilling guide or your workpiece. This requires you to clamp all your workpieces in the jig with the same side facing the jig to ensure proper alignment. Rockler does offer a series of spacer blocks if you wish to create offset mortises.

Using the Beadlock system requires Beadlock tenon stock. All three sizes are reasonably priced, but if you make a lot of 3/8" mortises, Rockler offers a router bit to make your own tenons, *below*.

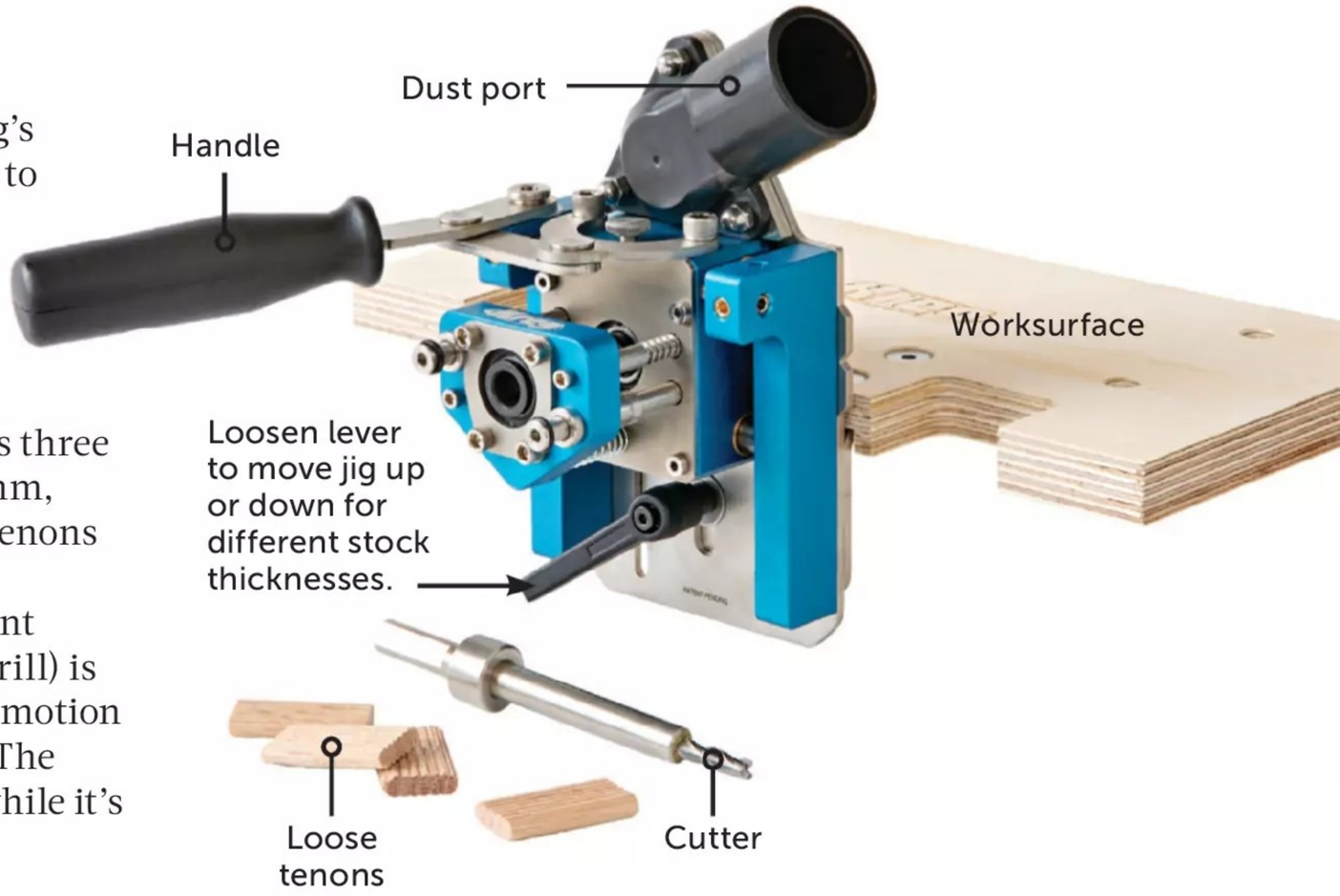
Rockler, *rockler.com*
Beadlock Pro Jig, no. BDL7892, $90

Using a special bit (sold separately) you can create your own Beadlock tenon stock. Rockler offers the bit only for 3/8" Beadlock tenons.

MORTISEMATE

The System. Like the Beadlock, Kreg's MortiseMate also uses a handheld drill to create mortises. But instead of overlapping holes, the MortiseMate uses a special carbide-tipped cutter combined with a side-to-side motion to mill out the mortise, similar to the way a Domino works. Kreg offers three sizes of cutters for the MortiseMate (6mm, 8mm, and 10mm). Domino-like loose tenons then join the pieces.

What makes the MortiseMate different from the Domino (aside from using a drill) is the fact that you supply the oscillating motion through the use of a handle on the jig. The handle moves the cutter side-to-side while it's spinning to create the mortise.



After aligning both mating workpieces, draw a witness mark across the jointline to indicate the approximate center of the joint. You don't have to center the mark.

The Setup. The MortiseMate features a plywood worksurface that you screw or clamp to your bench. To cut a mortise, start by marking your workpieces, *left*. Using a scale on the face of the jig, adjust the jig body up or down according to the approximate thickness of your workpieces. Index lines on the cutter make it easy to position a stop collar to control the depth of the mortise. A dust port on top of the MortiseMate accepts a 1¼" shop vacuum hose.

Align the witness mark on the first workpiece with the index line on the face of the MortiseMate and clamp the workpiece to the base of the jig.

The Experience. To use the jig, position and clamp the first workpiece to the worksurface, *upper right*. With the cutter mounted in your drill, insert the cutter through both bushings in the jig until the stop collar contacts the front bushing. Then start the drill and apply forward pressure as you move the handle side-to-side against a pair of stops, *lower right*. Each swing of the handle advances the bit until reaching the final mortise depth.

After milling the mortise, remove the cutter from the jig and repeat the process with your mating workpiece. Glue a MortiseMate loose tenon into both mortises to complete the joint, *below*.

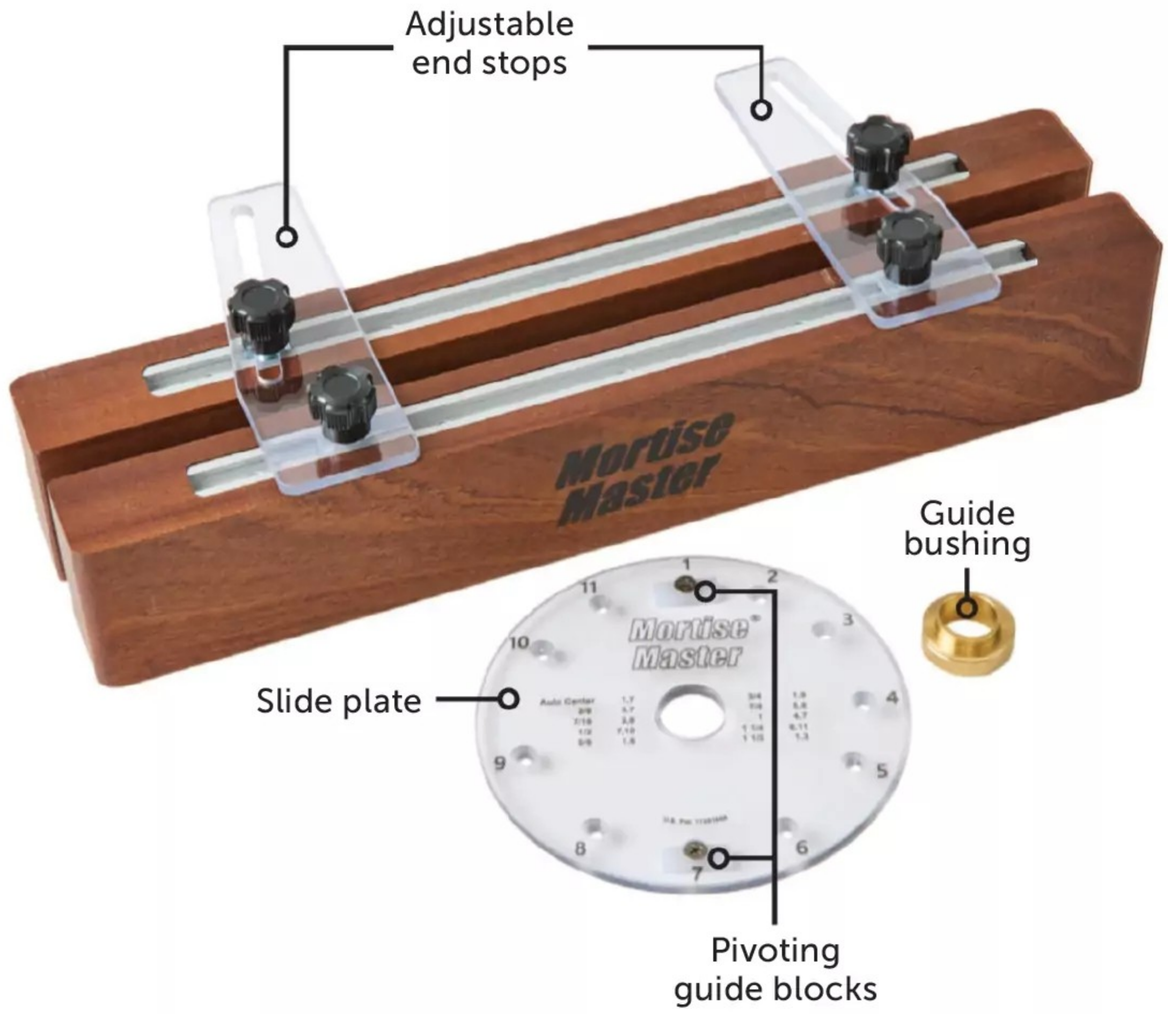
As you move the handle, the drill bit advances in 0.05" increments until reaching final depth, which is regulated by an adjustable stop collar mounted to the bit.

The MortiseMate uses Domino-style tenons. Grooves on the tenons provide relief for excess glue, making it easier to insert the tenons into the mortises.

The Results. Using the MortiseMate feels a little odd at first–sort of like patting your head and rubbing your stomach at the same time. Once you get past the initial awkwardness of the combined forward and side-to-side motion, however, it becomes easy to develop a rhythm for cranking out clean mortises. The system works faster than the Beadlock. And when hooked up to a shop vacuum, the dust collection was quite effective.

On our test joints, the tenons fit a little loose in the mortises. You can control the length of the mortises by adjusting a pair of setscrews on the jig. But because the width of the mortise is determined by the diameter of the cutter, there's no adjusting fit in this dimension. The amount of play in the joint was not enough to compromise its integrity, but you'll want to pay attention to alignment when gluing the pieces together.

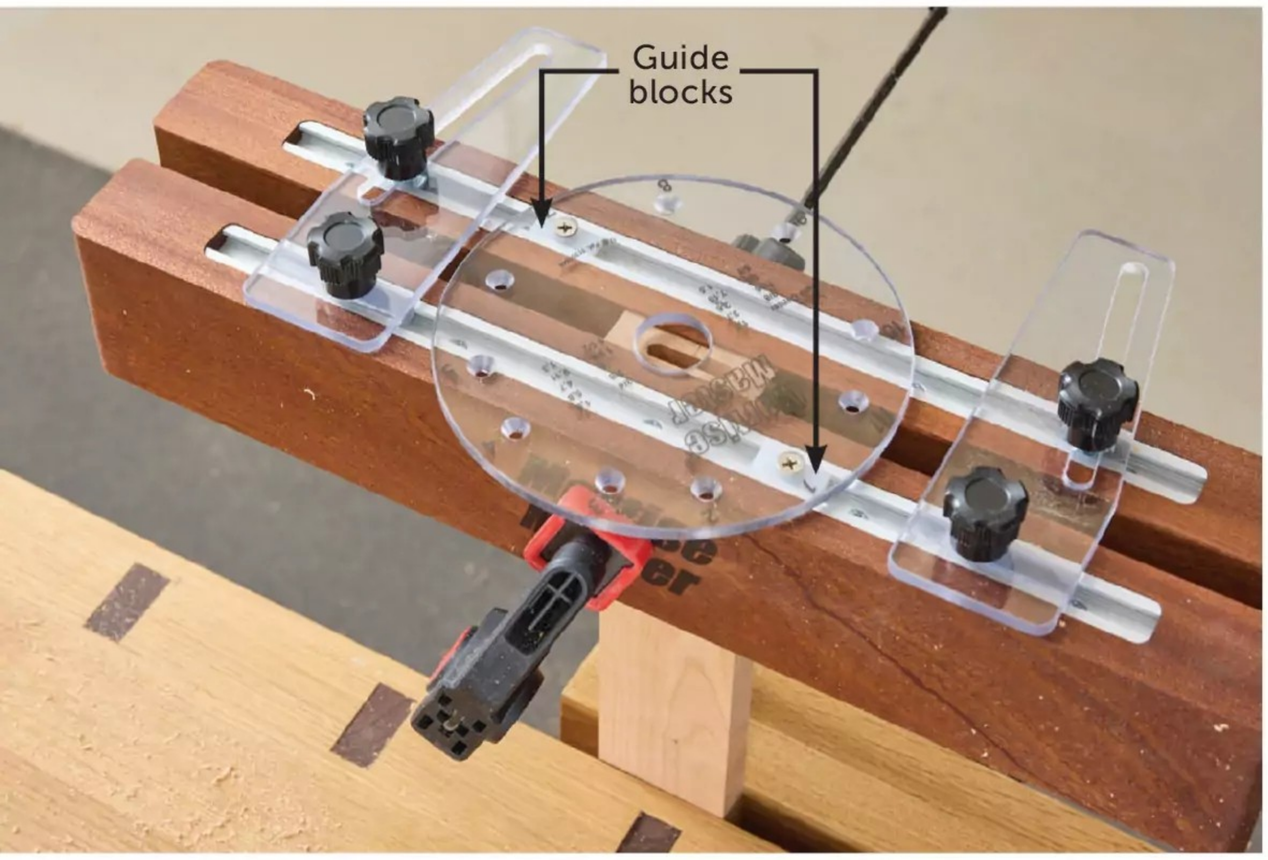
Kreg, *kregtool.com*
MortiseMate, no. KLTJ100, $300



MORTISE MASTER

The System. Rather than relying on a drill like the MortiseMate or Beadlock, the Mortise Master cuts mortises using a router. At first glance, the Mortise Master seems like little more than a self-centering jig for routing a slot in the edge or end of a workpiece. But a closer look reveals more.

The heart of the Mortise Master is a round acrylic slide plate that mates up with your plunge router by means of an included guide bushing. A pair of pivoting guide blocks attach to the underside of the slide plate and travel in aluminum T-tracks mounted in the tops of the two wood clamp plates, or jaws. With the guide blocks mounted to the correct holes in the slide plate, the jig automatically centers the mortise on the stock, no matter the thickness. Additional sets of holes allow for making offset mortises. Adjustable stops at each end of the jig control the router travel and length of the mortise.



The round slide plate sits on top of the jaws of the Mortise Master, with blocks that travel in a pair of T-tracks. Adjustable stops on each side of the guide plate limit the plate travel.

The Setup. To use the Mortise Master, start by installing the guide bushing in your plunge router, using a centering cone to ensure the bushing is centered in the baseplate. Install a spiral upcut bit in your router to match the desired mortise width.

Butt your workpieces together and mark witness lines across the center of the jointline. Using a square, extend the witness line across the mating edges or ends of each piece. Secure the first piece between the clamp plates, lining up the witness line with the index mark on the fixed clamp plate. A thin leveling lip along the top edge of each clamp plate provides a registration surface for the workpiece.

To set the end stops, place the slide plate on the jig, centered over the workpiece. Then use spacer blocks or a ruler to position the stops an equal distance from the edge of the slide plate according to the desired

With the guide bushing installed in your router baseplate, place the bushing in the center hole of the slide plate. Lower the bit into the workpiece and rout the mortise in multiple passes.

A thin lip milled into the top edge of each wood jaw registers the workpiece and aligns it with the jig while you tighten the clamps. With the mating piece clamped in place, rout a matching mortise.

length of the mortise. You'll have to take the diameter of the cutter into account when doing this. For example, using a 1/4"-diameter cutter with the stops set 1/2" from either side of the slide plate will produce a mortise 1 1/4" long.

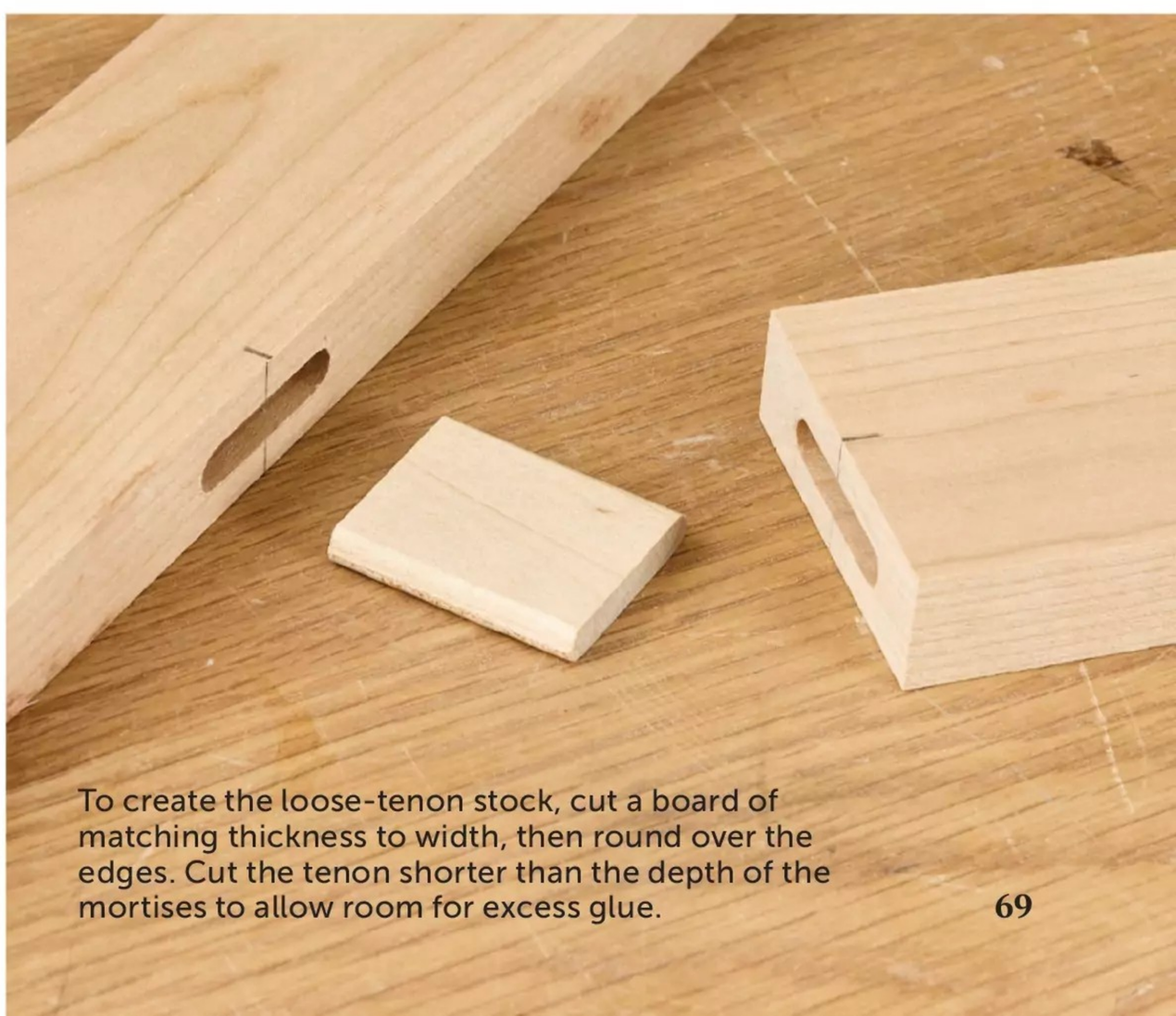
The Experience. Before routing the mortise, set the plunge stop on your router to control the depth, taking the thickness of the slide plate and leveling lips into account. Set your router on top of the slide plate so the guide bushing drops into the center hole of the plate. Turn the router on and plunge a hole full depth at each end of the mortise. Then rout away the waste in between the two holes in successively deeper passes, moving the router back and forth between the stops until reaching final depth, *above left*. Repeat the process with the mating workpiece, *above right*.

With the Mortise Master, you make your own tenon stock by rounding over the edges of a blank sized to match the width and length of the mortise, *right*.

The Results. The Mortise Master works well, but isn't quite as automatic in use as either the Beadlock or the MortiseMate. Because it doesn't use standard tenon stock, it involves a little more setup, primarily when positioning the end stops. We'd recommend cutting a test mortise once you think you have everything dialed in. Once you've confirmed your setup, the Mortise Master cranks out clean, accurate mortises in short order. And provided you size the tenons properly, the joints fit together extremely well. As an added bonus, the Mortise Master gives you the flexibility to create custom-size tenons to match the scale of your project.

Mortise Master, *mortisemaster.com*
$225

With a little practice, any one of these three jigs will create strong, accurate loose-tenon joinery at a fraction of the cost of a Festool Domino. What the Domino offers for the increase in price is speed and convenience. Because of this, frequent users of loose-tenon joints would do well to save up for the Domino. But for occasional use, one of these alternatives will yield similar results and leave you with money left over to spend on other tools or wood.



To create the loose-tenon stock, cut a board of matching thickness to width, then round over the edges. Cut the tenon shorter than the depth of the mortises to allow room for excess glue.

IN-YOUR-FACE SAFETY

Eye protection ranks as arguably the most important safety precaution you can take in the shop to shield yourself from dust, debris, chemicals, and sharp objects. But even the best safety glasses leave your face unprotected. Check out these shields that cover your entire face to protect not only your vision but your beauty as well.

Face protection with a filter

Tooltekt's mask protects your eyes and blocks dust by sealing tightly over your face and chin. An opening in the bottom allows breathing air in and prevents fogging, plus holds a disposable filter to keep out dust. Designed to work with or without glasses, this shield proved surprisingly comfortable after a short time getting acclimated, and it didn't inhibit breathing. The design allows wearing a cap. It comes with 20 dust filters and a small spray bottle of anti-fog coating.

Tooltekt, *tooltekt.com*
Anti-Dust & Fog-Free Face Shield, $40

PHOTOGRAPHERS: JACOB FOX, KERRY GIBSON, BRIE GOLDMAN

continued on page 72

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Traditional style with good straps

A soft metal lip around the perimeter of the Pyramex face shield's lens not only stiffens it but also bends to control its fit around your face. Fore and aft lens positions are adjustable, as well. The lens flips up but lacks a solid stop, meaning it can easily fall down. The straps are comfortable and wrap low around the back of your head to provide solid hold without requiring overtightening.

Pyramex, *pyramex.com*
Ridgeline Headgear Combo no. HGBRKITCS, $35

Solid perimeter protection

Unlike the others in the group, Jackson Safety's mask adds a perimeter of solid material surrounding the lens. That offers an extra measure of protection for your face and the lens without inhibiting peripheral or downward vision. The rigid straps prove easy to adjust and provide a comfortable fit.

Jackson Safety, *jacksonsafety.com*
Maxview Premium Face Shield no. 14200, $35

Goggles plus a removable face guard

NoCry's mask provides two levels of protection. Wear just the goggles that have a full gasket to keep dust out and help prevent fogging, plus a comfortable strap and good peripheral vision. Or clip on the closely contoured guard to protect your whole face. A center plate slides to regulate airflow to your nose.

NoCry, *nocry.com*
UltraShield Pro Goggles + Facemask no. 6X3, $37

Contoured lens hugs tight

The contoured lens on the Lincoln Electric mask is extra thick to maximize impact resistance, but remains lightweight and distortion free. It fits closely around your face with adjustable fore and aft position. You can also adjust the lens angle to tuck the lower edge tightly to your chin. The mask easily flips up and has stops in multiple positions, offering increased customizing of the fit on the fly.

Lincoln Electric, *lincolnelectric.com*
OmniShield Clear Face Shield no. K3750-1, $44

continued on page 74

★★★★★

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Time Travel at the Speed of a 1935 Speedster?

The 1930s brought unprecedented innovation in machine-age technology and materials. Industrial designers from the auto industry translated the principles of aerodynamics and streamlining into everyday objects like radios and toasters. It was also a decade when an unequaled variety of watch cases and movements came into being. In lieu of hands to tell time, one such complication, called a jumping mechanism, utilized numerals on a disc viewed through a window. With its striking resemblance to the dashboard gauges and radio dials of the decade, the jump hour watch was indeed "in tune" with the times!

True to Machine Art aesthetics, the sleek brushed stainless steel case is clear on the back, allowing a peek at the inner workings.

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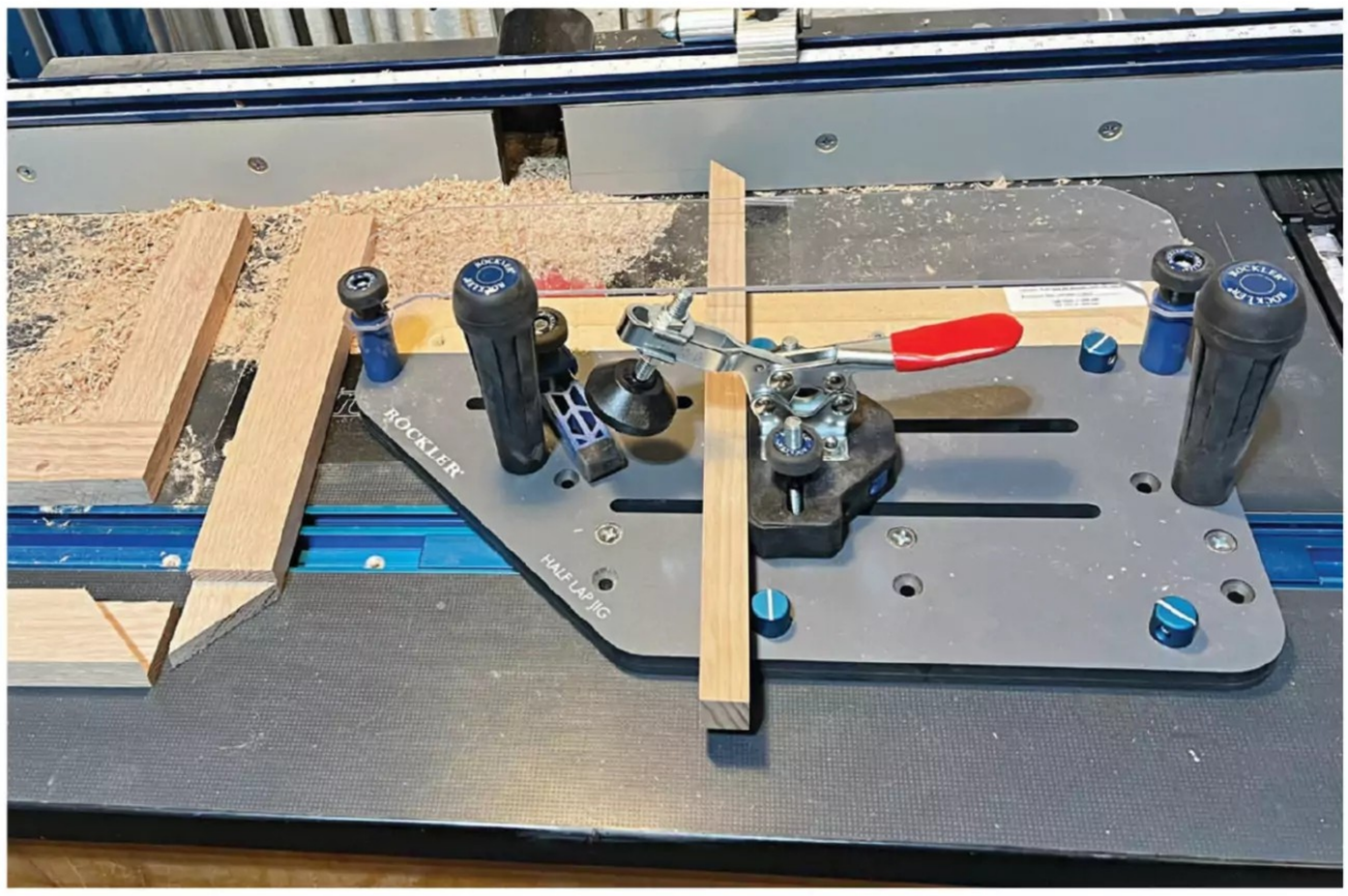

SHOP-TESTED

ROUTER TABLE SLED QUICKLY CUTS FINE-FITTING HALF-LAP JOINTS

Tester: Kerry Gibson

Rockler's Router Table Half Lap Jig quickly and easily cuts tight-fitting half-lap joints at 45° or 90°. First, use the jig's onboard centerfinder to mark the workpiece and set the height of a ½" spiral upcut bit (sold separately) to cut halfway through your workpiece thickness (up to 1" thick). Position the jig's replaceable auxiliary fence against the 45° or 90° stops and secure the workpiece with the integrated clamps. Then make multiple passes with the jig to form the half-lap. A miter-slot runner guides the jig. For the final shoulder cut, simply line up your layout line with the jig's edge.

Rockler, *rockler.com*
Router Table Half Lap Jig no. 57578, $120

SHOP-TESTED

HIGH-TORQUE CIRC SAW

Tester: Dave Stone

Metabo's 7¼" cordless circular saw incorporates clever features that make it a strong performer. The motor runs at 6,000 rpm for fast cuts. Under high loads, a "torque-boost" feature automatically reduces speed to 4,500 rpm for more cutting power. I appreciate the dust blower that keeps the cutline visible as you work, as well as the soft-start motor and blade brake. Sold as a bare tool, the saw works with Metabo dual-voltage 18/36V batteries.

Metabo HPT, *metabo-hpt.com*
36V 7¼" Circular Saw no. HPTC3607DBQ4, $199 (bare tool)

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Wood-Mizer, *woodmizer.com*
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A GLIMPSE INSIDE THE OCTOBER ISSUE (ON SALE AUGUST 15)

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TESTED: BENCHTOP MORTISERS
Boring squares is not just your rebellious teenager's nickname for you; it's also the specialty skill of nine dedicated machines we put to the test. See our top pick for making fast, clean mortises.

CANINE KENNEL CABINET
Designed to fit a standard dog crate, this cabinet creates a cozy resting space for your pup and stylish storage for you. No fur baby? No problem. We offer several hardworking non-doggo design options, as well.

RIP-FENCE RIDER
This convenient caddy keeps essential tablesaw accessories such as pushsticks, pencils, and rules close at hand but safely corralled.

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