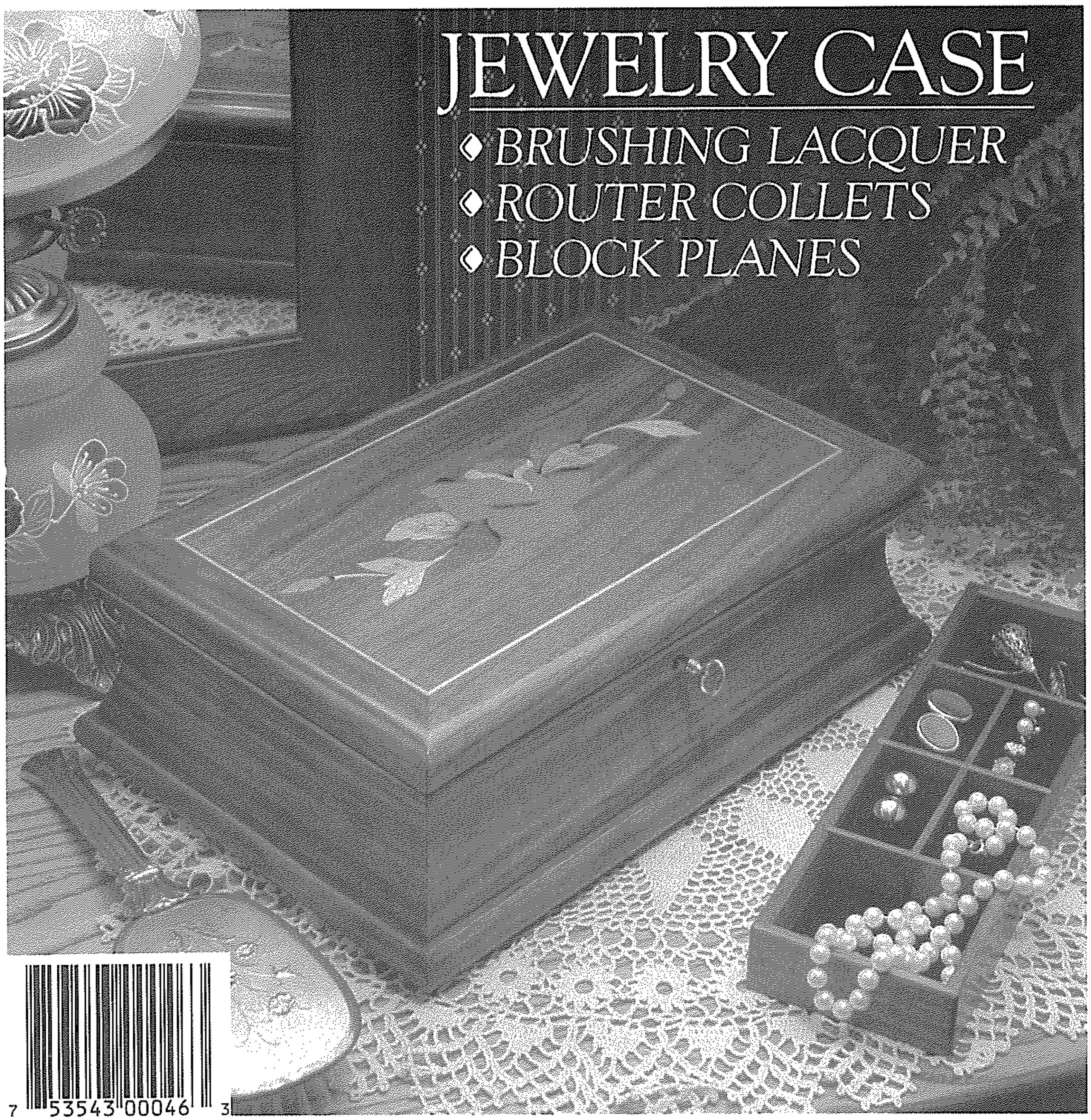
NO. 46 NOTES FROM THE SHOP

Woodsmith®



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Sawdust

ABOUT THIS ISSUE. Whenever we get a new tool for the shop, there seems to be a gathering of interest. Everyone wants to have a chance to examine it and work with it a little to get a feel for it.

But as soon as the "new toy" feeling wears off, there are the inevitable comments about quality. As you might imagine, the comments are sometimes negative, and seem to center on the two biggest deterrents to quality: time and money.

"It would be a much better tool if they had just taken the time to . . ." "Why didn't they spend a little more to . . ."

Of course, there's the other side to this coin. If the manufacturers did everything they could to ensure top quality, the comments would be, "Yeah, it's a nice tool, but it costs too much."

Somewhere in between there's a happy medium. For the most part, I'm happy if basic quality is built into the tool, and the only real problems concern the "fit and finish." That is, I'm happy if I can do something myself to make improvements.

That's the approach I take with most hand tools. And it's the basis for the article in this issue (on page 16) about tuning up a block plane.

A brand new plane right out of the box, should be considered a tool kit rather than a tool that's ready to use. Almost all planes need a little tuning up to make them work properly . . . and just as important, to make them feel good in your hand.

At first, it may seem frustrating that you have to go through this effort at all, especially with a new plane. But it's rewarding work. You get to know the plane from a new perspective. How all the parts work and how they fit together.

As you transform the tool kit into a tool, you add a little of yourself to it. Then I like the old practice of adding my initials to the tool. It kind of says I've worked on this tool and made it my own.

STORIES. There's one other benefit to all this work. As I was tuning up a new block plane, I started thinking about how it functions, and why it's built the way it is.

If you take away some of the myths and folklore associated with old tools, you begin to think of them as real tools that are built to do a job. Block planes are nice little planes that can be held in one hand (while you hold the workpiece in the other hand).

They're nice for all sorts of little trimming jobs.

It struck me that that was kind of an important thought. (Things tend to take on more importance when I'm working alone in the shop.)

But in this case it really was important to strip away the myths about block planes. They're often described as small planes designed to plane end grain. This has to do with the blade angle and the way the blade is mounted in the plane.

It makes a nice story. And it's a story that's been around almost long enough to be "true" — age alone creates credibility.

But the story is not very accurate. Which is what led to the article (on page 18) about block planes, mounting angles, and how block planes actually cut wood.

Okay, so what are you getting at? Are you saying block planes aren't good for planing end grain?

Well, that's part of it. The thing is that there's a general consensus that block planes can only be used for planing end grain. Period.

But that's so limiting. They're really nice for all sorts of trimming jobs. Even when planing with the grain (as on the edge of a board). And conversely, if you have a large surface of end grain to plane, a bench plane might be a better choice.

So as I was sitting down in the shop tuning up my new block plane "kit," I thought that all the folklore and stories I've heard are interesting, but I don't have to be hampered by them. My block plane is a nice little tool and I'm happy working with it — even with the grain.

JEWELRY CASE. Most woodworking projects tend to be a series of steps — each step with its own challenges. But the jewelry case we built for this issue was almost a series of individual projects.

For a long time, I've wanted to try a few techniques that all seemed to come together in this one project. Cutting the parabolic cove on the sides of the case with a table saw was one of the techniques I've been waiting to try.

I also wanted to work with a marquetry veneer. Mounting this particular inlay was no big problem. But I wanted to see how to apply the finish.

You have to seal the inlay, work in paste wood filler (around it but not on it), then seal again, and finish the whole surface. I wasn't sure at first if all that was going to work, but it came out just fine.

And the one step that seemed like the most fun was mounting the lock. A jewelry case like this deserves a brass lock with its own key. Mounting this lock turned out to be an afternoon's project in itself.

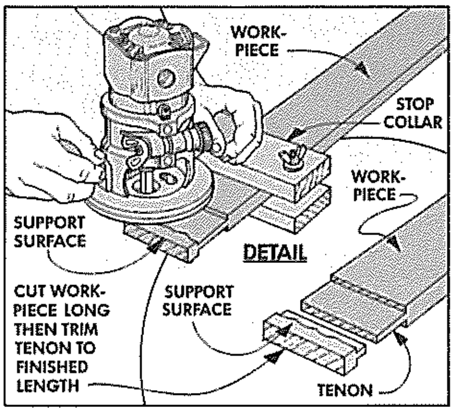
But once it was mortised in, and actually worked, I was glad I had the chance to add it to the case.

NEXT MAILING. The October issue of Woodsmith (No. 47) will be mailed the week following October 31, 1986.

Tips & Techniques

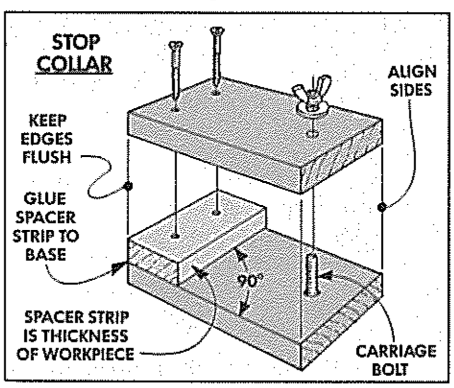
TENONS ON LONG BOARDS

I've always had a problem making accurate tenons on the ends of boards that are too long to slide over a table saw or router table. The obvious answer is to use a hand-held router. But sooner or later you have to cut away the outside support surface that holds up half the router. So how do you hold the router base flat?



My solution is to begin with a board 1" to 2" longer than the finished length. Rout out the cheeks of the tenon, but leave a band of wood at the very end of the board to support the router base, see drawing above. After routing both cheeks, cut off the band and leave the finished tenon.

But there's another problem — how do you rout straight shoulders and keep the shoulder on one face even with the shoulder on the other face? To solve this problem I built a stop collar that acts as a fence for the router base to ride against.



The collar is made from a couple of pieces of scrap that sandwich a spacer strip. The thickness of the spacer strip should equal the thickness of the workpiece. The whole assembly is held together with glue and screws and then the workpiece is pinched inside by tightening a wing nut on a carriage bolt.

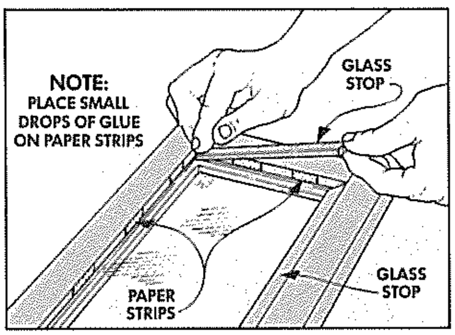
When using the stop collar to cut a tenon, check that the edge of the collar is perpendicular with the edge of the workpiece. Next ride the router against the collar on both sides of the workpiece to form the shoulders. Then continue routing to form the tenon, and finally cut off the support surface.

Brian Spiwak
Horsham, Pennsylvania

FASTENING GLASS STOPS

I recently completed a grandfather clock in solid cherry. Fastening the hardwood glass stops into the rabbets in the door has always presented a problem. If they're glued in permanently, the glass can't be easily replaced. And nailing them risks cracking the glass and leaves nail holes.

I solved the problem by gluing 1"-long brown paper strips between the glass stop and the rabbet in the door. (This is one method used to hold bowls to faceplates in turning.) The paper strips are spaced a couple inches apart and held in place with glue on both sides of the paper. (Be careful not to get glue where there isn't any paper.) The paper is thin so the gap isn't noticeable.



To replace broken glass, simply insert a thin knife blade between the stop and frame and gently twist. The paper will be split right down the middle and the wood stops can be pulled out. Then clean off the old paper, replace the glass, and start over.

James D. Johnson
Lake City, Florida

LOCATING DRAWER FRONTS

Sometimes when I finish installing a drawer I discover it's not straight. But if the false drawer front is realigned in relation to the rest of the cabinet, the drawer will look fine. One way to align the drawer front is with double-sided carpet tape.

Start by making the drawer without the false front attached. Then install the slides and drawer in the cabinet. Once the drawer is in place, apply strips of carpet tape to the front and peel off the protective facing.

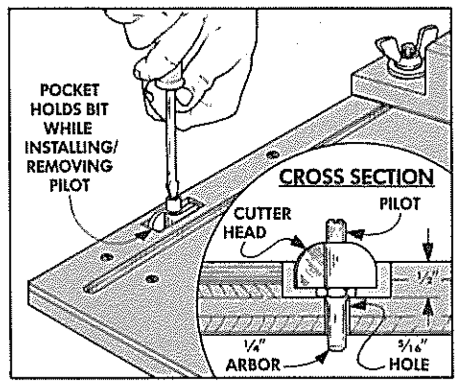
For a flush front drawer, the false front can then be aligned in relation to the drawer opening. If it's an overlay or lip front, it can be lined up with the other drawers and door fronts or the outside of the cabinet. Once aligned, apply pressure so the front and drawer are temporarily attached.

Finally, pull the drawer out, drill, and permanently screw the false front to the drawer in the correct location.

Stephen Shirley
Denver, Colorado

A BIT POCKET

My Sears router bit set includes a standard arbor that accepts different cutting heads and pilots. One problem I've had is holding a



cutting head while assembling the bit. It's awkward to hold, and I'm always afraid the cutting head will be dulled or chipped if I hold it with pliers or in a vise.

To solve the problem, I added a small pocket to my *Woodsmith* router table to hold the bit while it's being assembled. First, drill a $\frac{5}{16}$"-dia. hole near an edge of the table to accept the ¼" arbor. Then chisel a ¾" wide by 1½" long pocket ½" deep into the table top around the hole.

The pocket acts as a holder to prevent the cutter head from rotating while adding the arbor (by turning the cutter head upside down in the pocket), or installing the pilot with the arbor down in the hole as shown in the art. The pocket is useful again when disassembling the bit.

Robert Deatherage
Newton, Iowa

Collet Problems

SOLUTIONS FOR ROUTER HEADACHES

I guess it's not a secret that we like using routers here at *Woodsmith*. I often get asked what power tools to buy first when setting up a shop. A router would have to be one of my first choices.

But routers have their share of problems. It's not surprising. Any tool that works in excess of 20,000 RPM (by far the highest RPM tool in the shop) is likely to have problems. Most of the problems and questions I've encountered center around a very small part of the router: the collet.

THE COLLET. So, what's a collet? A collet is a split, cone-shaped sleeve that holds the bit in the router.

All collets work on the same basic principle: a taper on one part of the assembly works against a taper on another part. By tightening a nut around the collet (or in some routers tightening down the collet itself) the two tapers bear on one another and cause the collet to squeeze around the shank of the bit.

A router collet is different from a drill chuck in that a collet wraps around and bears on the entire shank of the router bit. A drill chuck bears on a limited number of points (usually three).

- *I'd like to know what causes a router bit to start to creep up out of the collet and penetrate into the wood. I've ruined several projects when this happened. Once it happened right after I checked to be sure the bit was tightened in place.*

This problem isn't unique. We regularly receive letters containing horror stories of bits coming loose in collets and going too deep into somebody's prize walnut project. We've had it happen in our own shop, and it's frustrating.

TOO DEEP A CUT. It usually happens when taking a deep cut — deeper than it should be. I can tell that I'm in trouble by a change in pitch (whine) of the motor. If you hear a change in the pitch (or even suspect it) turn off the router and check to see if the bit is slipping.

Part of the problem here is that a deep cut causes considerable vibration and bending of the bit which puts pressure against the side of the collet. It's likely to loosen. So one solution is to take lighter cuts and increase the depth slowly.

BIT INSERTION. Another reason a bit might come loose is that it's inserted *too far* into the collet. There's a temptation to push the bit all the way down into the collet, thinking that if it's out even a little, it will lose some gripping power.

But some bits can be inserted *too deep*. If a bit has a slight transition fillet (a radius at the point where the cutting head meets the shank), it shouldn't be inserted all the way down into the collet. If it's too deep, the collet will only grip the transition radius and not the entire shank of the bit, see Fig. 2.

FIGURE 1

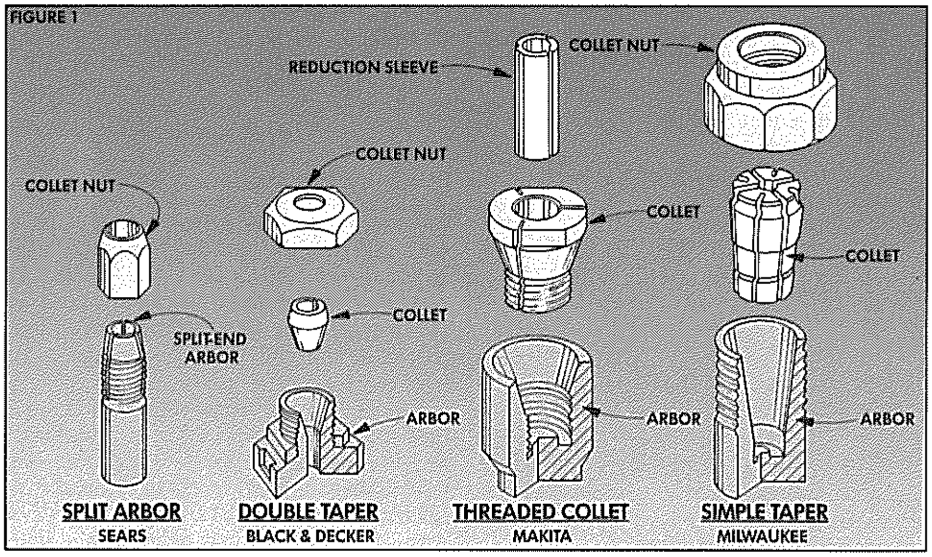
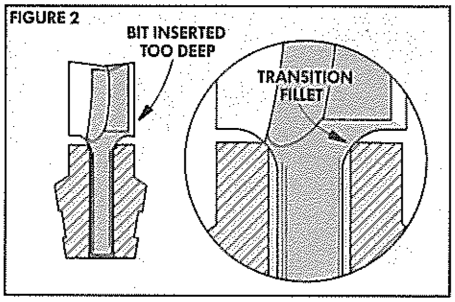


FIGURE 2



- *Is one router collet design better than any of the others?*

I think so (see the box at the end of this article), but part of the problem is that you have to live with the collet designed for the router you have — collets aren't interchangeable from one brand to another. However, when buying a new router, the design of the collet would be one thing I'd consider.

Most collets fit into one of four basic designs, see Fig. 1:

SPLIT ARBOR. The new Sears routers have a very simple collet system — in fact, it's not really a separate collet at all. Instead, a tapered nut fits over a taper on the split end of the threaded router arbor. As the nut is tightened it squeezes the arbor around the router bit shank. One of the problems with this system is that if something goes wrong, you can't simply replace a collet. You have to replace the entire arbor — and that can be almost as expensive as buying a whole new router.

DOUBLE TAPER. Black & Decker and Porter-Cable routers both have a double tapered collet. A taper on the collet nut fits over a taper on the collet. And then a second taper on the collet fits into a tapered hole in the end of the router arbor. As the nut is tightened the collet squeezes around the bit. The only problem with this system is the length of the collet — the Black & Decker collet is only 3/8" long. That's not much surface grabbing the shank of the router bit.

THREADED COLLET. The Japanese routers (Makita, Hitachi, and Ryobi) use a threaded collet without a collet nut. Threads on the *outside* of the collet fit into threads *inside* the arbor. To tighten it, a wrench is put on the collet itself. As it's screwed into the arbor a taper on the inside of the arbor bears against a taper on the outside of the collet. This squeezes the collet around the shank of the bit.

SIMPLE TAPER. The system used on the Milwaukee router is a very straightforward approach to a collet and it seems to be one of the best around (pun intended). A tapered collet fits down into a tapered hole in the router arbor. As a collet nut is tightened it presses the collet straight down into the arbor and squeezes around the shank of the bit.

- *Do router collets ever wear out and need replacing?*

One router bit distributor claims that approximately 80% of bit breakage comes from worn or dirty collets. If you're working with a sharp bit with a clean shank and the bit is inserted to the correct depth in the router, but the bit still slips, the problem may be in the collet itself.

The pressures on a collet sometimes turn it into an oblong shape. Then it's time to replace it. Don't put it off to the side — throw it away and get a new one. Replacing a collet can be an expense ($5 to $25), but it's small compared to destroying a project.

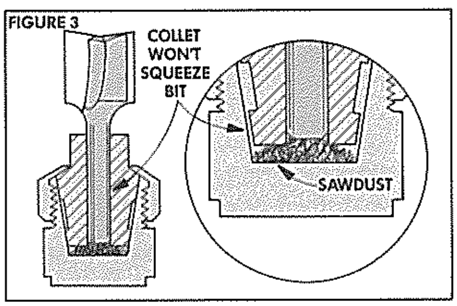
• *Can you use the wrenches to tighten the collet too much or too little?*

Yes. You shouldn't have to be Superman to tighten or loosen a collet around a router bit. In fact, you shouldn't even need to use two hands to tighten the collet.

The wrenches usually have enough offset so that they can be positioned slightly apart from each other. Then grip both wrenches in *one* hand and squeeze them together to tighten. Any more than that is too much. To loosen, reverse the position of the wrenches in relation to each other and once again squeeze them together.

• *Why does the bit come loose more often when I'm working with the router mounted under the router table?*

Part of the problem might be that sawdust and chips can fall into the collet opening when the router is upside down. If dust or chips are packed down in the bottom of the opening, the build-up will prevent the collet



from going down far enough to tighten the bit, see Fig. 3. It feels like it's tightened, but the collet may not be squeezed tight around the shank of the router bit.

To prevent this I always brush off the router table top *before* removing the bit. I also blow all the dust out of the collet opening once the bit is removed. Sometimes it takes loosening and removing the nut and taking the collet *all the way out* to clean it. And while it's out, clean out any little wood slivers or chips in the collet slits.

• *Are the bits ever the primary cause of slippage?*

Sure. The shank of a router bit should be clean of rust, dirt, oil, and burrs. I make a habit of checking and cleaning the shank before putting it in the router. If there's a burr on the bit, it's probably an indication that it's slipping in the collet. The burr will ruin the collet so I try to carefully file the burr off or throw away the bit.

DULL BITS. Probably the biggest problem of all is the most fundamental. If the bit gets dull, it's working too hard — causing vibration and eventually coming loose. Don't take chances with a dull bit. Get it sharpened or buy a new bit.

When buying bits, be sure to buy from a reputable manufacturer. "One major problem is that some router shanks aren't machined to tight tolerances," according to William Whiteside of Whiteside Machine Company.

Whiteside turns the shanks on his bits so they're no more than .001" undersize. But he's seen bits that are as much as .004" undersize. If a bit is undersize, the collet has to be squeezed more and it's likely to eventually turn the collet into an oval shape.

• *A few stores and catalogs offer ½" shank bits. Is there any advantage to having these bits with larger shanks?*

Bits with a ½"-dia. shank have twice the surface area in contact with the collet. Every time I've worked with a ½" shank bit I've immediately felt a difference. There's less vibration. And where there's less vibration the bit isn't as likely to come loose.

When I first started using ½" shank bits, I was surprised to find that they aren't much more expensive than ¼" shank bits (about $2 to $5 more per bit). In the manufacturing process straight bits that cut larger than ¼" grooves actually start out with a ½" shank. Then some are machined down to be sold with a ¼" shank. The ½" shank bits are sold to industry while the ¼" shank bits are sold to home woodworkers.

Many commercial-duty routers and large plunge routers are actually designed for ½" shank bits. To use ¼" shank bits in some routers (such as the Makita 3601B), you have to insert a ¼" reduction sleeve inside the collet, see Fig. 1. On the others you use a smaller collet.

REDUCTION SLEEVE. While we're on the subject of reduction sleeves, I think this sleeve may be the source of problems with the Makita router. The collet itself squeezes on the sleeve and then the sleeve squeezes on the ¼" shank bit. Transferring the pressure through a sleeve is more likely to cause problems than squeezing on the bit itself. For this reason, I've started slowly replacing all my ¼" shank bits with ½" shank bits so I don't have to use the reduction sleeve when working with the Makita router.

(Note: Some people say — and it makes some sense to me — that if you're using a router with a reduction sleeve, you should always check to see that the *through* expansion slit in the sleeve is lined up with the *through* expansion slit in the collet. This should help prevent slippage.)

• *What procedure should you follow when a router bit is stuck in a collet and won't come out?*

This seems to happen a lot on our Porter-Cable router. If the collet nut is completely loose and the bit still sticks, I give the *collet nut* (not the bit) a sharp rap with the wrench (which is most convenient since it's in my hand). The sharp rap right on the nut is usually enough to break it free. Or I tap the end of the bit with a block of wood. (Don't tap the bit with a metal wrench; carbide chips easily.)

On the few rare occasions where I have had to use a pair of pliers to carefully pull the bit out, I've discovered that the bit or collet wasn't clean.

A FINAL THOUGHT

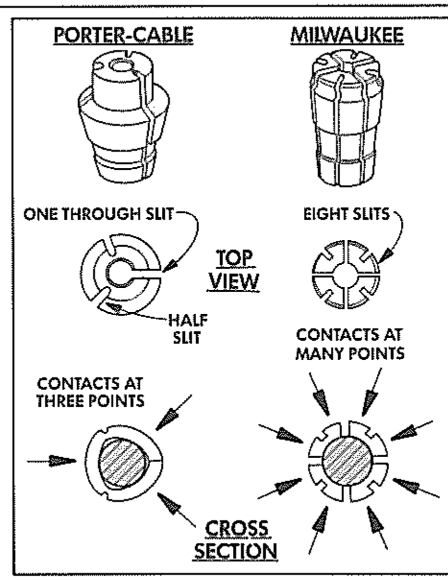
Almost any router (like any tool) will cause some kind of a problem at one time or another. But if you take the extra time to be sure you're working with a good collet and bit, and they're kept clean and fit together as they should, many of the problems can be kept under control (or at least on the right rout.)

COLLET DESIGN

One important difference in collet design is the number of slits cut in the collet. Most collets have one expansion slit *all the way* through the side. Some collets (such as the Porter-Cable) also have two more slits *half-way* through the collet to "give" when tightening the collet around the bit.

Probably the best designed collet, in my opinion, is found on Milwaukee routers. The Milwaukee collet has eight slits in it. None of the eight slits is cut all the way through the thickness from the outside to the shank hole. But all the slits run almost the entire length of the collet. You can squeeze the Milwaukee collet in your fingers and feel the give.

With other collets, if the shank hole in the collet or shank on the router bit isn't perfectly round, the bit may be held at only three points. But with the Milwaukee collet, pressure is going to be applied uniformly around the bit.

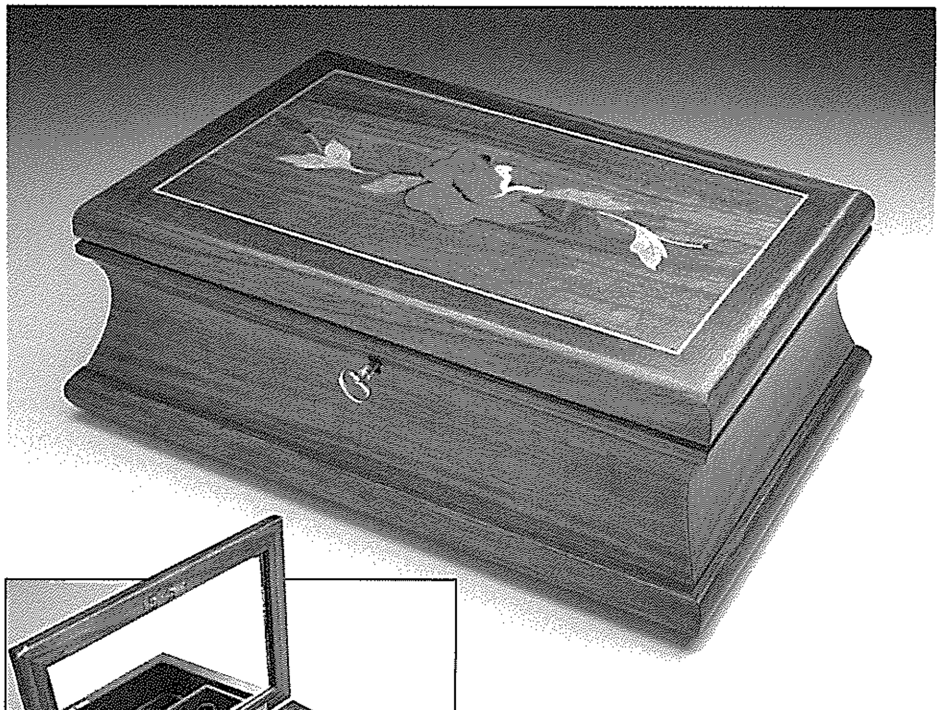


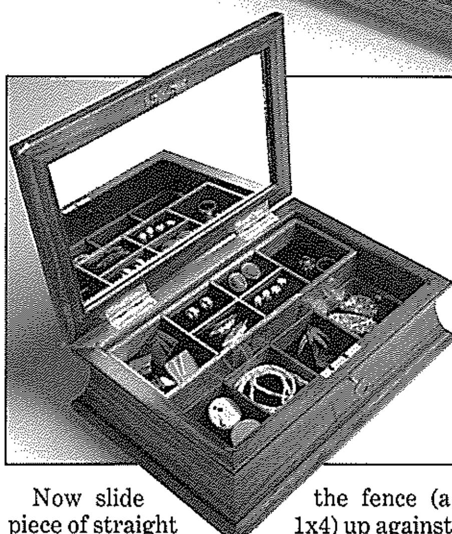
Jewelry Case

A JEWEL OF A PROJECT

Fine jewelry deserves a fine home. The challenge is to build a case that has a delicate, yet rich appearance — in keeping with its contents. That's what we tried to do with this case. And we also wanted to add a fancy touch with the inlaid top.

In one respect this case is only a four-sided box that's joined with miter and spline joints. But what makes it a little unique is that the sides are cut to the shape of a gentle parabolic cove (sort of an offset swoop).





CUT SIDES

I started work by cutting the stock (I used walnut) for the sides to rough size. This means cutting two pieces of 4/4 stock (13⁄16" actual thickness) to a rough width of 3½" by 28" long. (This yields one long and one short side out of each piece with a little left over.)

THE TEMPLATE. Next, set up the saw to cut the parabolic cove in these two pieces. To do this, you need a template to set the position of the guide fence that's used to guide the stock. (Note: In place of the template, you can also use the cove jig shown in *Woodsmith* No. 36.)

The template is made by cutting a rectangular hole in a piece of posterboard, see Fig. 1. The critical measurements of this hole are the width of the center opening (2¼"), and the distance between the opening and the outside edge of the template (⅝").

SET SAW BLADE. After making the template, tilt the saw blade to a 45° angle and raise it to a height of ⅜", see Fig. 2. (Tilting the blade at 45° is the trick to making a parabolic cove.)

POSITION FENCE. Now use the template to position the fence. It helps here to place masking tape over the table insert and mark where the blade enters and exits, see Fig. 3. Then twist the template until the edges touch the marks on the masking tape and tape it down, see Fig. 4.

Now slide the fence (a piece of straight 1x4) up against the edge of the template. This will position the fence ⅝" from the blade and at the proper angle to make the cove cut.

CUT COVE. After clamping the fence in position, lower the blade so it's only 1⁄16" high and make a pass with the stock for the sides. (I tried this on a piece of scrap first to get the feel of this operation). Slide the workpiece slowly over the blade and it will cut a cove.

Gradually raise the blade (in 1⁄16" increments) and make repeated passes until the blade is at full height (⅜"). (At this height, the cove should have the parabolic shape and be 2¼" wide, refer to Fig. 8.)

SMOOTH THE COVE. To get the smoothest cut, make the last pass very slowly. Even with this, the cove will have tiny ridges. I found that a gooseneck scraper does a good job of cleaning the cove right up. (See *Woodsmith* No. 39 for more about sharpening and using scrapers.)

FIGURE 1

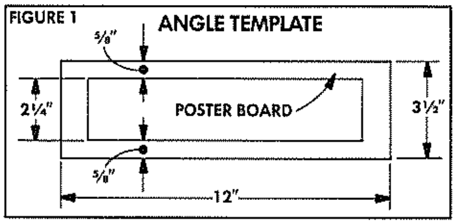


FIGURE 2

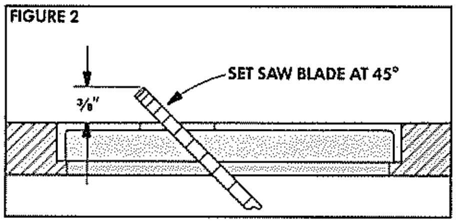


FIGURE 3

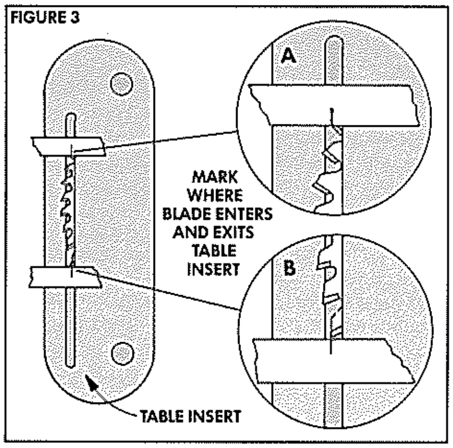
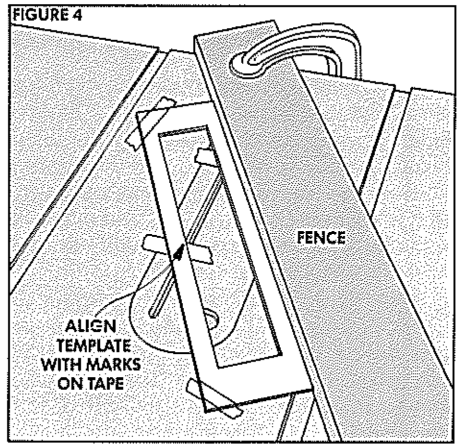


FIGURE 4



MITER AND SPLINE JOINTS

After the cove is scraped and sanded smooth, cut the workpieces to get a 13" and 9" length out of each piece. These four pieces are then mitered to get two front/back pieces (A) 12¼" long and two end pieces (B) 8¼" long, see Fig. 5.

CUT TO LENGTH. To miter these pieces to length, I added an auxiliary fence to the miter gauge and used a stop block (as shown in Fig. 6) to make sure I cut matching pieces to exactly the same length.

Start by cutting a 45° miter on one end of each workpiece. Then clamp a mitered stop block to the auxiliary fence to cut one of the front/back pieces (A) to final length. (I set the stop so the piece was a little long and made a cut. Then I nudged the stop over and cut to the final length of 12¼".)

As soon as this piece is cut, cut the other front/back piece with the stop block in the same position. Then repeat this procedure to miter the two end pieces (B) to a final length of 8¼".

GROOVE FOR SPLINE. The sides are joined with the aid of splines. (Splines add strength to the miters and keep the pieces aligned as they're clamped together.)

To make this joint, you have to cut a 3/16"-deep groove in each mitered end, see Corner Detail in Fig. 5. Keep the saw blade at a 45° angle and slide the rip fence over to use as a stop. Position the fence to cut the groove 1/16" from the *inside* corner of each piece, see Fig. 7.

Note: It helps here to use a test piece to make sure the groove is not cut too deep so you don't cut through into the cove.

TRIM TO WIDTH. After the grooves are cut, the four sides can be trimmed to a final width of 2¾". Trim a little off both edges so there's a ⅜"-wide border above the cove and a ⅛"-wide border below the cove, see Fig. 8.

SPLINES. The last step is to cut the splines. Since the splines will show on the top edge of the case, I decided to make them out of walnut (using scrap left over from making the sides).

The splines are cut so the grain runs across the joint line (for greatest strength). Set the blade a little over ⅜" high (the combined depth of the grooves in the mitered ends), and set the fence ⅛" from the blade (the thickness of the saw blade kerf), see Step 1 in Fig. 9.

Now stand the workpiece on end and make cuts on both ends. Then re-adjust the fence to cut off the splines (see Step 2) so they're a tad *less* than ⅜" wide (to leave room for glue in the grooves).

After the splines are cut, carefully test fit them in the grooves. Then band-clamp the sides together to make sure the case is square. But don't glue the sides together yet — the lock has to be mortised in the front piece first.

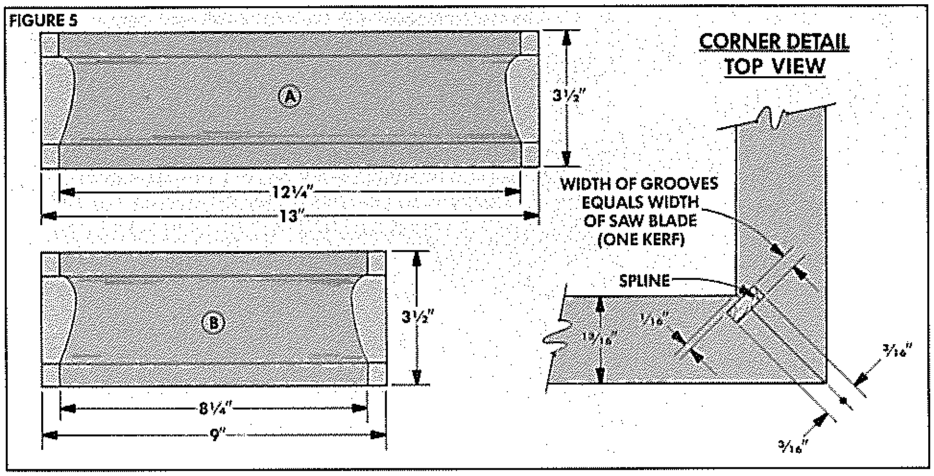
FIGURE 5


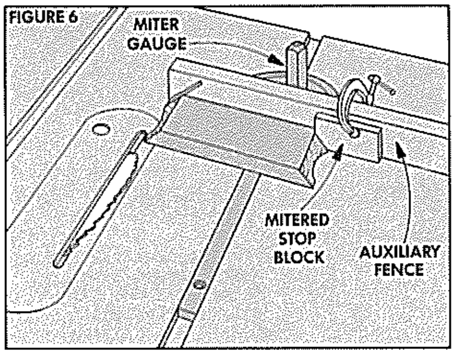
FIGURE 6


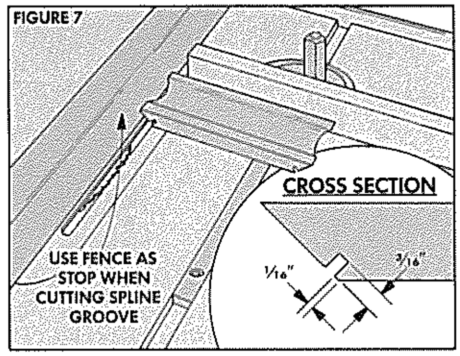
FIGURE 7


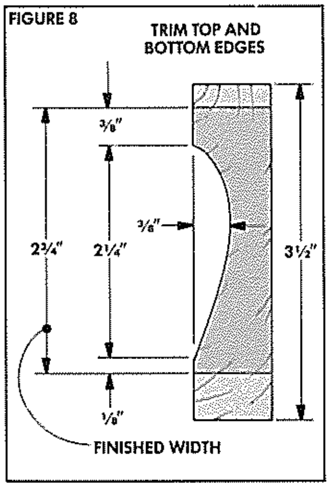
FIGURE 8


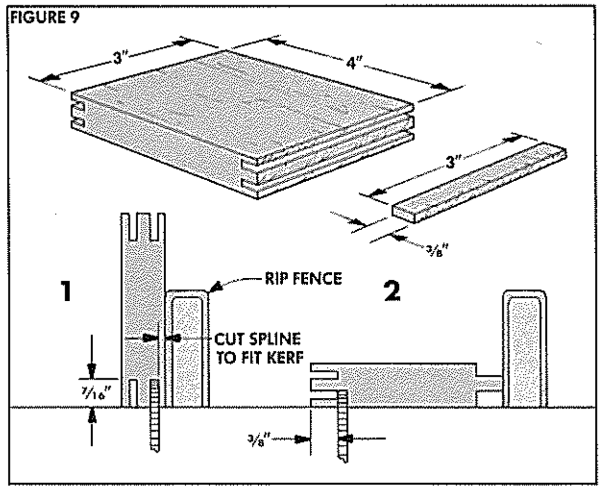
FIGURE 9


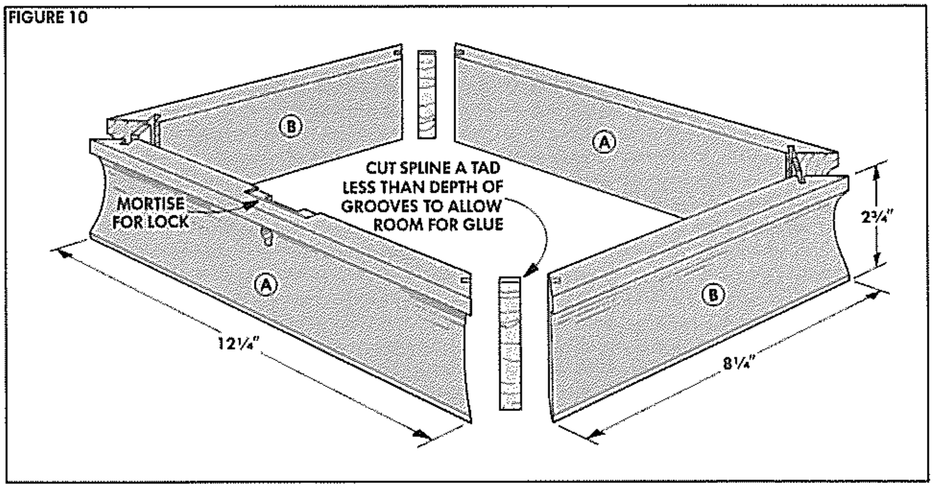
FIGURE 10


FIGURE 11

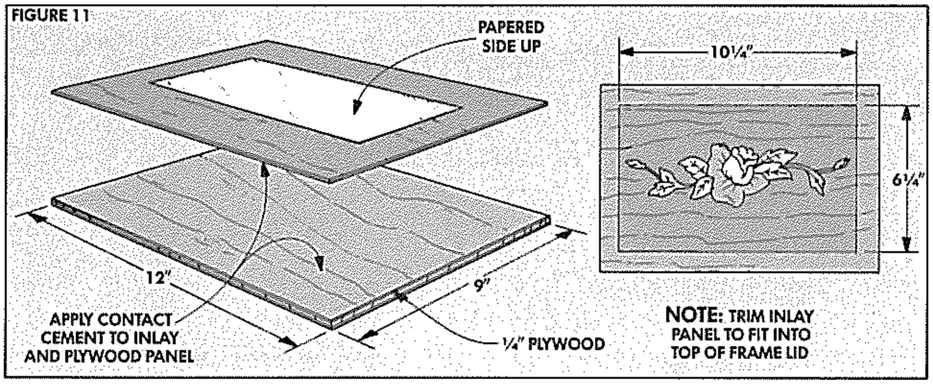


FIGURE 12

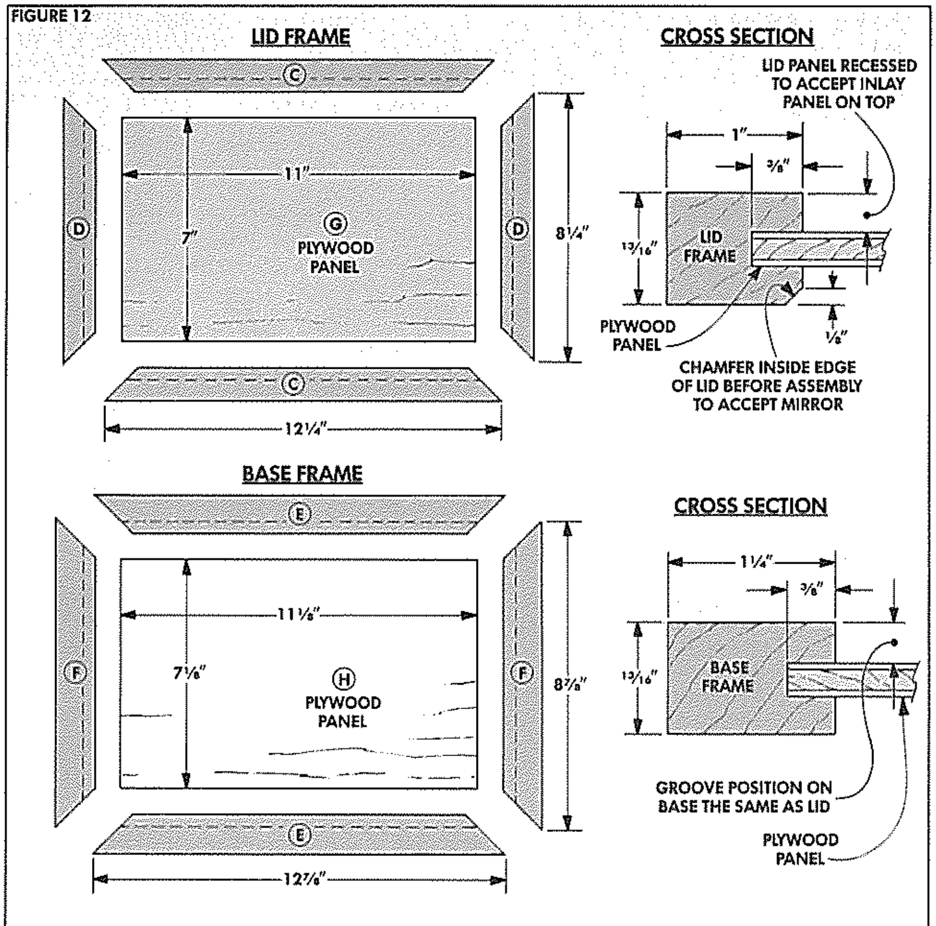


FIGURE 13

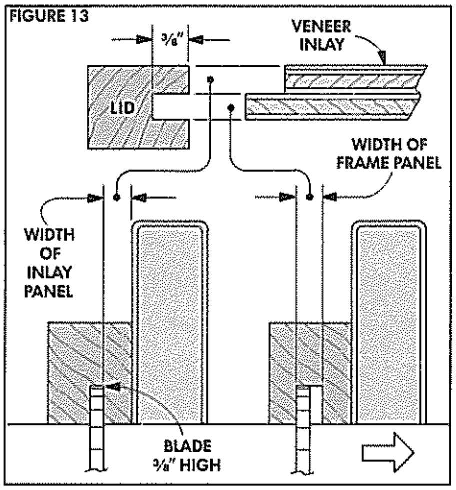
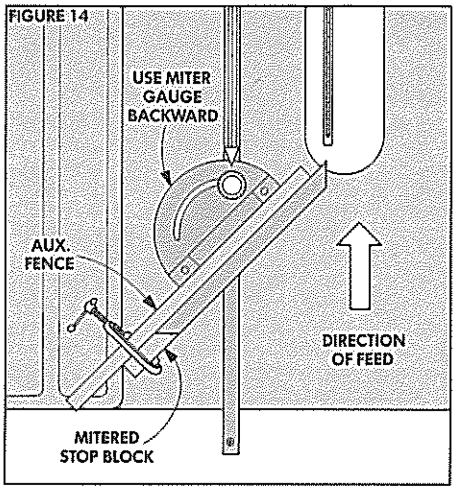


FIGURE 14



ASSEMBLE THE CASE

There's one more step on the case before it can be assembled. I cut the mortise for the lock and mounted it. (See the article on page 12 for a step-by-step procedure.)

After the lock is mounted, assemble the case by gluing and band-clamping the mitered sides together.

MARQUETRY INLAY FOR LID

The next step is to build walnut frames for the lid and base. Then to make it a little fancy, I also added a panel with a marquetry inlay, see the photo on page 6.

ADDING AN INLAY. Adding the rose inlay is easy. It comes as a pre-made piece — the rose is already inlaid into a surrounding piece of walnut veneer. (See *Woodsmith* No. 28 for more on working with other types of inlays.)

To mount the inlay, apply contact cement to a piece of ¼″ plywood and to the inlay itself. (Note: The inlay comes with a paper backing. Apply the contact cement to the *other* side — so the papered side is up when it's mounted, see Fig. 11.)

Use a roller to press the inlay onto the plywood. Then moisten the paper backing to loosen the glue and scrape the paper off.

THE LID AND BASE FRAMES

Next, I made the lid and base frames. Start by cutting two strips of 4/4 stock for the lid 1″ wide by 24″ long (which is enough for one long and one short side), and two other strips for the base 1¼″ wide by 24″ long.

GROOVE. Before mitering these pieces, I cut a groove on one edge for the ¼″ plywood lid and base panels (G and H). The position of this groove is critical on the lid frame. It has to be positioned so the rose inlay panel can be mounted flush with the surface of the frame.

Set up the saw so the distance between the fence and the blade is equal to the thickness of the inlay panel, see Fig. 13. Make one pass on all four strips.

Note: Although the bottom frame doesn't have an inlay panel, I cut the groove in the same position as on the top frame. This will recess the base panel (H) to create a "secret compartment" when the tray is added later.

Next, widen the groove to accept the plywood panel by moving the fence away from the blade and making another pass on each piece, see Fig. 13.

CUT FRAME PIECES. After the grooves are cut, cut each strip into two rough-length pieces (9″ long and 14″ long) to get the eight pieces needed for the frames.

Next, miter these pieces to final length. The pieces for the lid frame are mitered to length to equal the outside dimensions of the case. But the pieces for the base frame are ⅝″ longer than the outside dimensions of the case, see Fig. 12.

MITER ENDS. As when mitering the sides, I added an auxiliary fence and stop to the miter gauge. It also helps if you reverse the miter gauge in the table slot so as the miter is cut, the blade pushes the workpiece against the stop, see Fig. 14.

PLYWOOD PANELS. Now the plywood panels can be cut to fit the frames. Dry-assemble the frames to get the inside measurements, and add the depth of the grooves. Then cut the panels to this size.

CHAMFER FRAME EDGES. One last step before assembling the frames. Rout a 1/8" chamfer on the inside edges of the top frame — leaving a shoulder for the mirror that's mounted later on the inside face of the lid panel, see Cross Section in Fig. 17.

ASSEMBLY. Now dry-assemble the frame and panels to check the fit. Then glue and clamp them together.

RABBET FOR BANDING STRIP. When the top frame is dry, the inlay panel can be added. Trim it to fit in the frame. Then I added a banding strip between the frame and the inlay panel (I), see Fig. 16.

To do this, rout a rabbet (on the router table) around the perimeter of the inlay panel equal to the width and thickness of the banding strip, see Fig. 15. Then glue the panel in the frame and glue the banding strip in the rabbet, see Fig. 16.

ROUND EDGES. To complete the frames, round over the outside edges. On the top frame I used a 1/2" round-over bit to rout the top edge, see Fig. 17. Then I routed a 45° chamfer on the outside bottom edge.

Note: This chamfer is more than just decoration — it's needed for clearance on the back edge where the hinges are mounted. Also, while the chamfer bit is in place, go ahead and chamfer the top outside edges of the case, see Fig. 19.

The bottom frame is routed with a 1/2" round-over bit set 3/8" high to create a softened bullnose profile, see Fig. 18.

MOUNT LID AND BASE TO CASE

At this point the lid and base frames are ready to be mounted to the case.

MOUNT HINGES. To mount the lid, I used brass hinges set so the outside of the knuckle lines up with the outside edge of the case and the lid frame, see Cross Section view in Fig. 20.

Note: By mounting the hinges in this position, the lid will not fall all the way back when it's opened. It will open about 120° and stay there without the need of a chain to hold it up.

After the lid is hinged, add the catch plate for the lock, see page 13.

MOUNT BOTTOM FRAME. To mount the bottom frame, glue and screw it to the sides. Then put buttons in the screw holes to act as "feet," see Fig. 20.

MIRROR. Finally, I cut a mirror to fit inside the lid frame. (It's mounted with epoxy after the case is finished.)

FIGURE 15

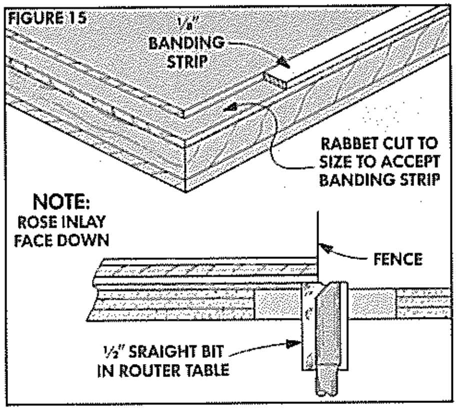


FIGURE 16

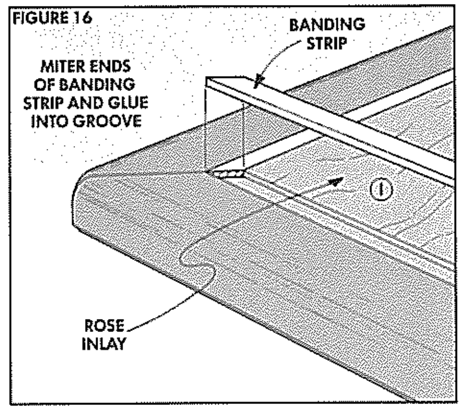


FIGURE 17

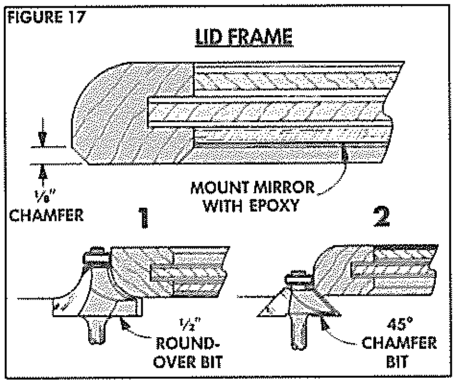


FIGURE 18

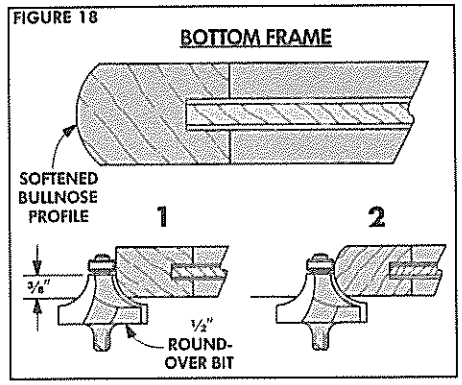


FIGURE 19

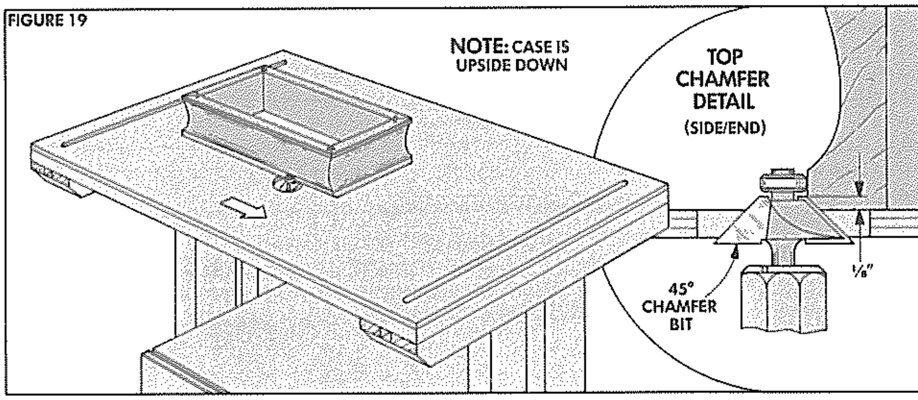
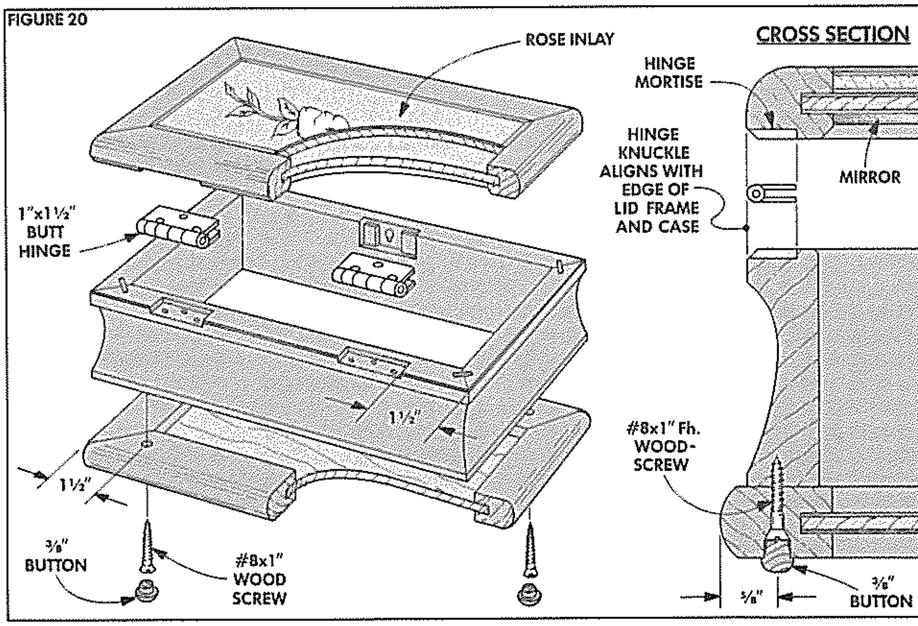
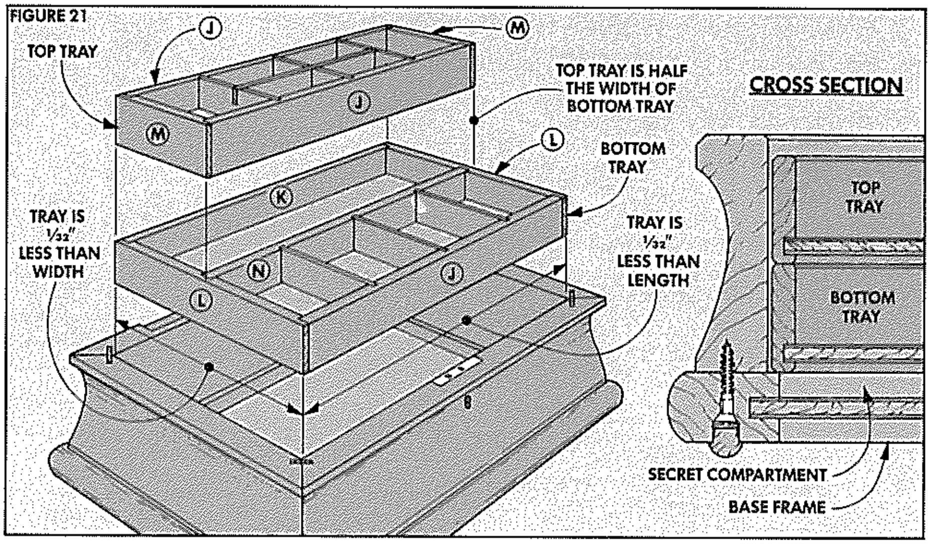
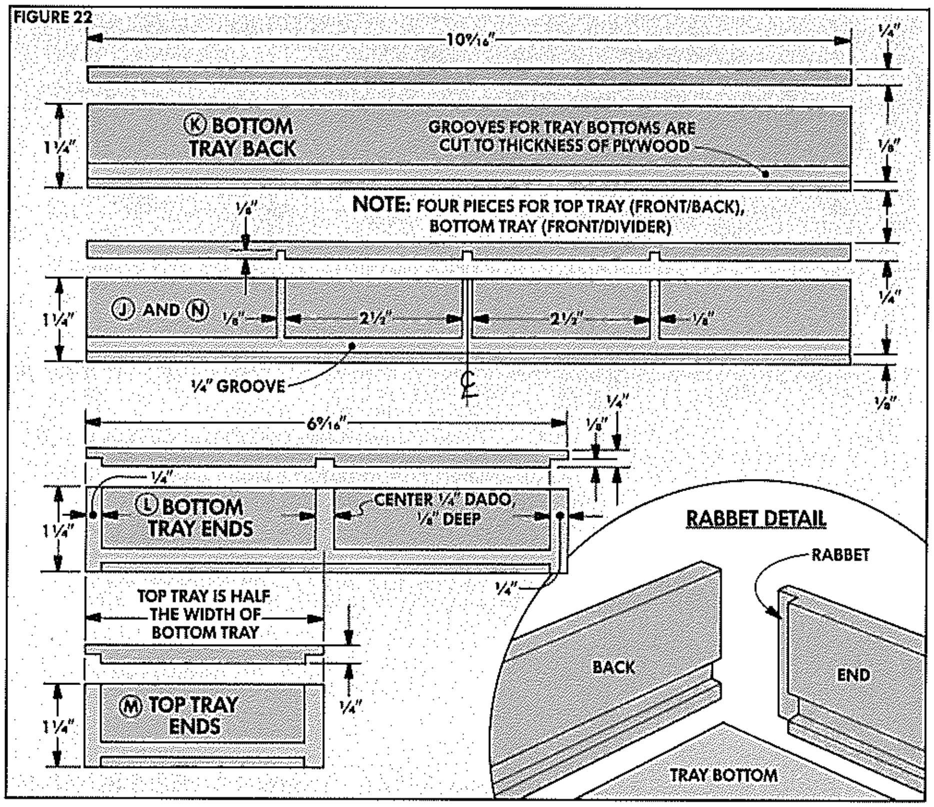
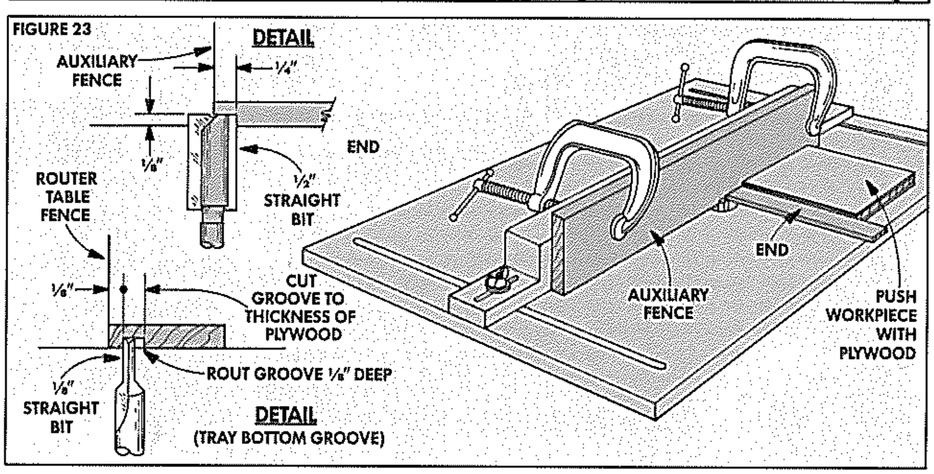


FIGURE 20









THE TRAYS

The jewelry case is complete at this point — except for the trays. I decided to build two trays, each with several small compartments for individual pieces of jewelry. The large tray is sized to fit the entire bottom of the case. A smaller tray rests right on top of the bottom tray (and slides back and forth over it), see Fig. 21.

RESAW STOCK. Both trays consist of an outside frame made from walnut that's resawn to a thickness of ¼". Inside these frames are the "egg-crate" dividers that are resawn to ⅛" thick. (Resawing is like ripping, but with the stock turned on edge to get thinner pieces.)

THE OUTSIDE FRAMES. Start by cutting four pieces of 4/4 stock for the outside frames (for both trays) to a rough length of 14". (This is plenty for the nine ¼"-thick pieces needed for the trays.)

RIP TO WIDTH. Rip these four pieces to a rough width of 1⅜". (These pieces are ripped down to final width *after* the rabbets and dadoes are cut. Since these cuts tend to split out the edges, it's best to cut the pieces to final width later to trim off the split edges.)

RESAW. Now resaw these four pieces to get eight workpieces ¼" thick.

CUT TO LENGTH. Then from these workpieces, cut the nine pieces for the two trays, see Fig. 22. I started with the four end pieces (L and M) for both trays. The end pieces (L) for the bottom tray are cut to length 1/32" less than the inside front-to-back measurment of the assembled case. The end pieces (M) for the top tray are half this length.

RABBETS. Next, cut rabbets at both ends of all four end pieces ⅛" deep by ¼" wide to accept the front/back pieces, see Detail in Fig. 22. I cut these on the router table with a ½" straight bit, see Fig. 23.

Shop Note: To support the narrow workpieces as the rabbets are cut, clamp an auxiliary fence to the front of the router table fence. Then turn on the router and pivot the fence into the bit to cut an opening just as wide as the bit.

When cutting the rabbets, I used a piece of scrap plywood to support and push the pieces through the bit, see Fig. 23.

DADO. After the rabbets are cut, there's also a ¼"-wide dado for the middle divider (N) cut in the center of the two end pieces (L) of the bottom tray. I used a ⅛" straight bit to cut this dado in two passes, refer to Detail in Fig. 23.

CUT FRONT/BACKS. After the rabbets and dadoes are cut, the front/back pieces (J and K) and the middle divider (N) are cut to final length so when the tray is assembled it's 1/32" less than the inside width of the case.

TRIM TO WIDTH. Next, rip all nine pieces to a final width of 1¼". (This width leaves a

¼" space at the top of the case when the trays are stacked, see Cross Section view in Fig. 21.)

GROOVE FOR BOTTOM. Finally, cut a groove ⅛" up from the bottom edge of all pieces (except the divider) to accept a ¼" plywood bottom. (I did this on the router table by making two passes with a ⅛" straight bit, see Detail in Fig. 23.)

THE DIVIDERS

To make the compartments in each tray, I cut ⅛"-thick "egg-crate" dividers. The same basic procedure is used to cut these dividers as was used on the tray pieces.

First, cut a piece of 4/4 stock to width of ¾" and to rough length of 12". Then resaw this piece into three strips ⅛" thick. Note: It helps if the final thickness is equal to the width of a ⅛" router bit, since this bit is used to cut the dadoes that hold the dividers.

CUT DADOES. To mount the dividers to the tray frame, cut ⅛" x ⅛" dadoes on the tray frames as shown in Fig. 22.

CUT CROSS-LAPS. The dividers on the top tray are interlocked by cutting cross-lap joints on the table saw, see Fig. 25.

TRIM TO SIZE. After the dadoes and cross-laps are cut, trim the dividers down to final width and length. Note: The egg-crate dividers as well as the middle divider (N) are trimmed to a final width to allow for the thickness of the velvet lining. So, make the lining first (see below) before trimming them down.

ASSEMBLY. When all pieces are cut to final size, assemble the two trays by gluing the four sides to the plywood bottom. (I didn't glue the middle divider or the egg-crate dividers in place so they can be removed to make bigger compartments.)

LINING THE TRAYS

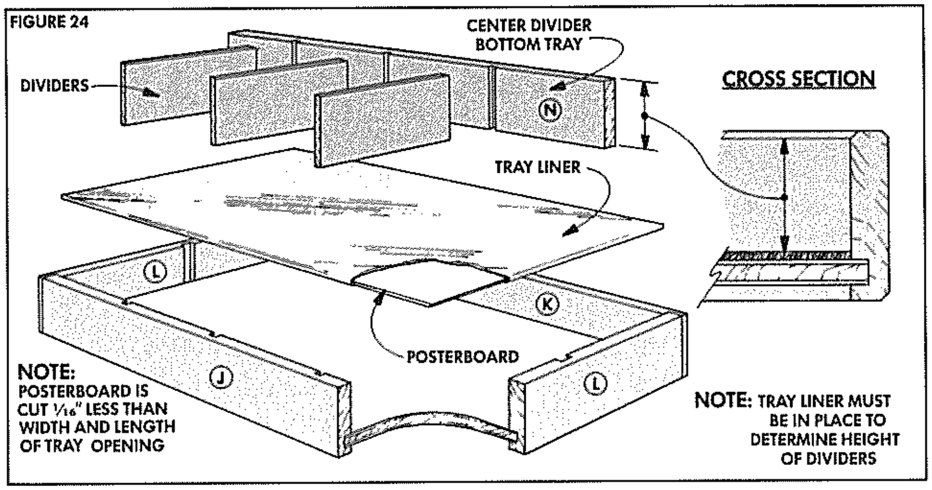
The bottoms of both trays are lined with black velvet. The best way I've found to do this is to mount the fabric to a piece of posterboard. (Also see a method for "flocking" on page 23.)

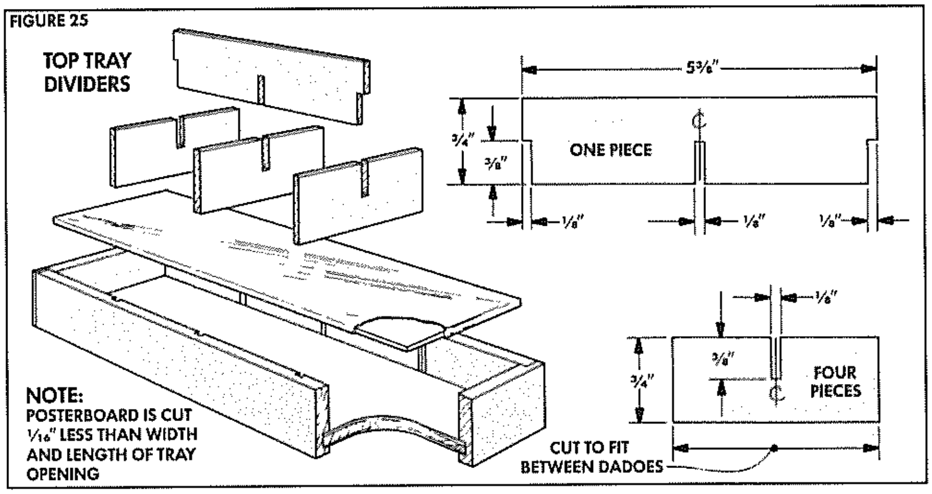
Cut the posterboard to size so it's ¹⁄₁₆" less (in both directions) than the inside dimensions of the tray, see Fig. 26. Then cut the fabric so it's 1" larger than the posterboard in both dimensions.

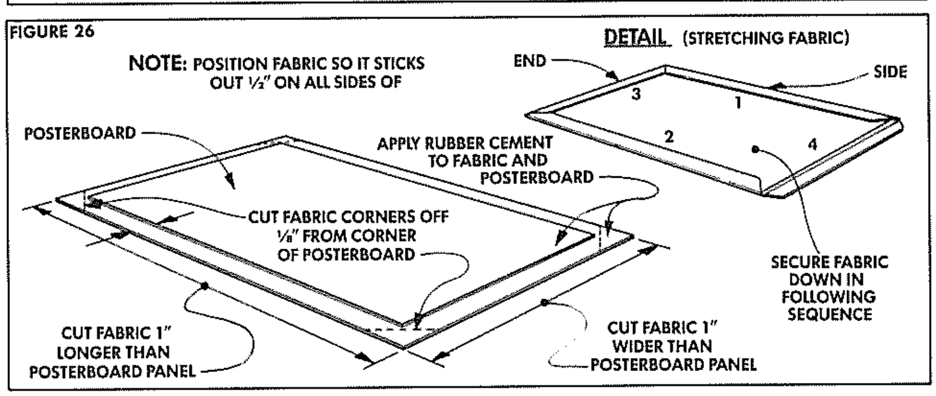
To mount the fabric, cut the corners off to within ⅛" of the posterboard. Then apply rubber cement to the outside border of the posterboard and the fabric overlap and fold the tabs over, stretching the fabric tight.

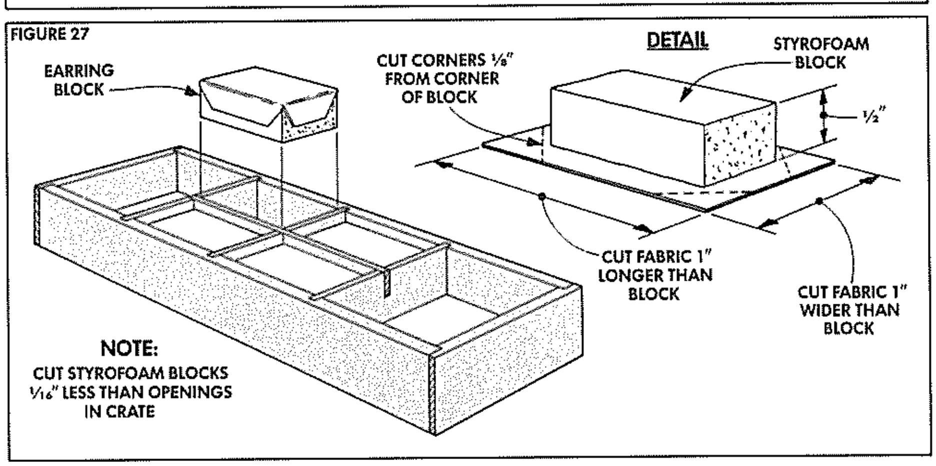
EARRING BLOCKS. I also made two earring blocks (for pierced earrings) out of chunks of Styrofoam covered with velvet, see Fig. 27.

FINISHING. I finished the jewelry case with brushing lacquer, as described on page 22. But it's not the easiest finish to work with. If I were doing it again, I would use a rubbing varnish on the case and tung oil on the trays, see *Woodsmith* No. 43.









Mounting the Lock

A CLOSE FIT IS THE KEY

A jewelry case wouldn't be complete without a lock. Not that a thief couldn't carry off the loot — case and all — in one hand. It's just a matter of principle.

Since a neat lock installation adds a touch of craftsmanship to the case, I treat it as a project in itself.

POSITION THE LOCK

The first step is positioning the lock mechanism on the front of the case. Begin by marking the exact center of the lock on top of the lock plate. Next, mark the center of the case front on the top surface of the case front. Then, with the lock upside down against the inside of the case front, hold it with the center marks aligned, see Fig. 1.

MARK LOCK POSITION. With the lock held in place, press the flat side of a chisel against the plate and nick the edges of the case front on either side of the lock, see Fig. 1. Then, with a sharp pencil, trace the outline of the lock plate on the inside of the case front.

SCORE LOCK OUTLINE. After the lock outline is marked, it must be scored to provide clean edges on the finished mortise. This is a two-part operation that requires a chisel (or a marking knife) and a combination square.

SCORE SIDE OUTLINES. First, I score the outlines of the sides of the lock plate. Set the combination square so the rule projects the height of the lock plate, see Fig. 2. Next, press the cutting edge of the chisel into one of the nicks and slide the square over tight against the chisel, see Fig. 3. (Note: Be sure the back of the chisel — not the bevel — contacts the square.)

When the square is butted against the chisel, hold it tight. Then move the chisel so the point is on the penciled line marking the bottom of the lock, see Fig. 3. Next score the outline of the side by drawing the cutting edge away from the penciled bottom line to the edge of the case front. Repeat the process on the opposite side.

SCORE BOTTOM OUTLINE. To score the bottom outline, the combination square and chisel are used together like a cutting gauge, see Fig. 4.

Begin by pressing the square tight against the top of the case front. Next, hold the chisel edge against the bottom of the square's rule. Then draw the square and the chisel across the top edge of the case front to score the lock plate bottom outline between the two side outlines.

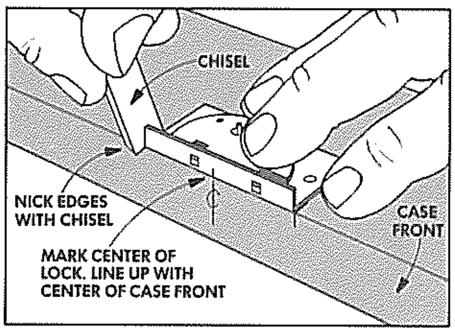
SCORE LOCK PLATE LIP. The lock plate has a lip that "folds" over the top edge of the case front. To score the outline of the lip on the top edge, just reset the combination square and repeat steps 2 through 4.

MORTISE LOCK IN PLACE

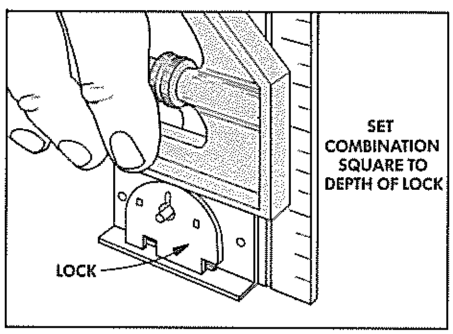
After the lock plate outline is scored, the excess wood is removed to mortise the lock in place. This is a two-part process that forms a shoulder to support the lock plate and a recess for the locking mechanism. I used a chisel and a router with a ¼" straight bit to do this.

MORTISE FOR LOCK PLATE. The first step is to mortise the case front so the surface of the lock plate is flush with the inside of the case front. Begin by setting the router so the bit projects to cut as deep as the thickness of the *plate* (not the mechanism). Then, rout out the waste almost to the scored outline, see Fig. 5.

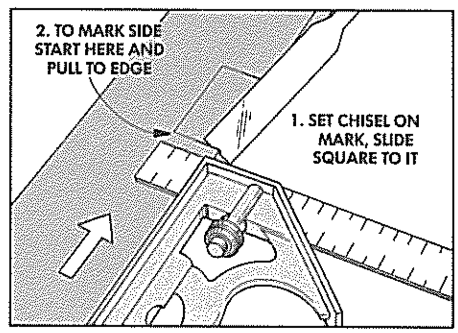
After the bulk of the waste is routed out,



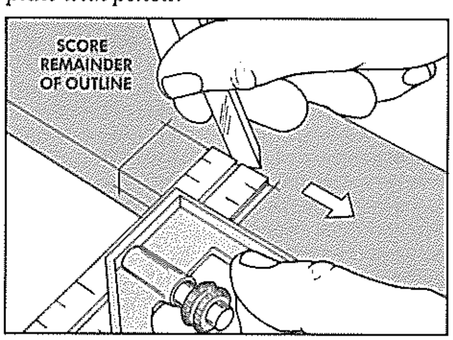
1 *Align center of lock plate with center of case front. Use chisel to nick edges of front to width of plate. Then, trace outline of plate with pencil.*



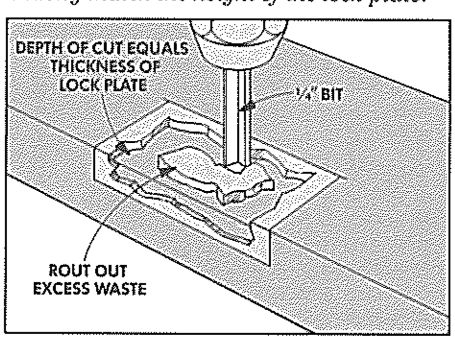
2 *Set combination square for use as marking gauge. Place lock upright on flat surface and lock the square's rule to exactly match the height of the lock plate.*



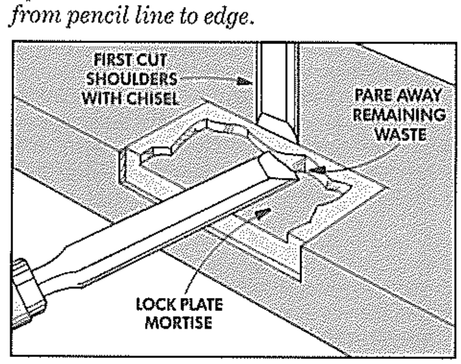
3 *Score outline of lock plate by placing chisel in "nick" on edge. Next, slide square until it contacts chisel. Then score from pencil line to edge.*



4 *Use square and chisel together as marking gauge. Press square against top of case front. Then slide square and chisel to score bottom line of lock plate.*



5 *Use router with ¼" bit to rough out waste to thickness of lock plate. Be careful to keep the bit from gouging the scored perimeter lines.*



6 *Remove waste to outline. First, chisel straight down on outline to depth of routed surface. Then pare to outline with chisel back pressed flat on surface.*

the rest is removed to the scored outline with a chisel, see Fig. 6. First, chisel down around the scored perimeter to the depth of the routed surface. Then, pare away the remaining waste with the back of the chisel pressed flat against the routed surface.

MORTISE FOR LOCK MECHANISM. After the lock plate mortise is finished, another mortise is cut to allow room for the lock mechanism. Begin by setting the router bit so it projects slightly higher than the thickness of the lock mechanism, see Fig. 7.

Next, draw an outline centered inside the lock plate mortise that allows room for the mechanism, see Fig. 8. Then, rout almost to the line and finish by paring right up to the outline with a chisel.

LOCATE KEYHOLE

The last step of installing the lock mechanism is locating and drilling the keyhole. Begin by pressing the lock into the mortise so the "key pin" leaves a dimple in the bottom of the mortise, see Fig. 9.

Using the dimple as a centerpoint, drill a ¼" hole with a brad point bit from the inside of the case front, see Fig. 10. To prevent chip out, stop drilling as soon as the point of the bit breaks through the coved outside surface. Then finish the hole from the outside of the case front.

To complete the keyhole, use a ⅛" bit to drill a second hole centered 3/16" down from the first hole, see Fig. 11. The shoulder left between the two holes can be cleaned up with a needle file or X-Acto knife to form the keyhole shape.

ASSEMBLE BOX. Before the lock installation can be completed, the box has to be assembled and the hinges installed. This is because the hinging action of the lid controls the alignment of the lock mechanism and the catch plate.

INSTALL CATCH PLATE

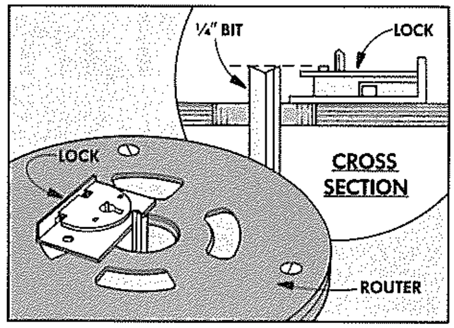
After the box is assembled, the catch plate is installed. Locating the position of the catch plate is easy because it has two points on either end to mark its position.

MARK CATCH PLATE POSITION. Begin by placing the catch plate in the lock, see Detail in Fig. 12. Then close the lid and press it tight so the points on the catch plate mark the inside of the lid.

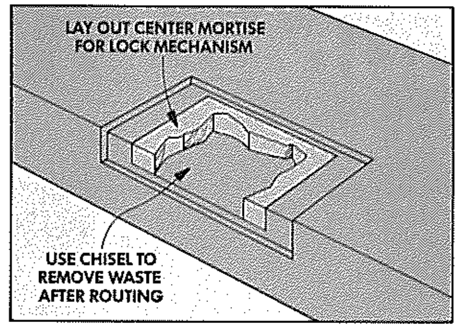
SCORE CATCH PLATE OUTLINE. Now remove the catch plate from the lock and position it on the marks made by the points. Tap the catch plate flush against the lid, and score the outline of the catch plate with a chisel, see Fig. 13.

MORTISE CATCH PLATE. To cut the mortise within the scored outline, begin by setting a ⅛" straight bit to rout to the thickness of the catch plate. Next rout the waste almost to the outline (see Fig. 14), and finish by paring to the outline.

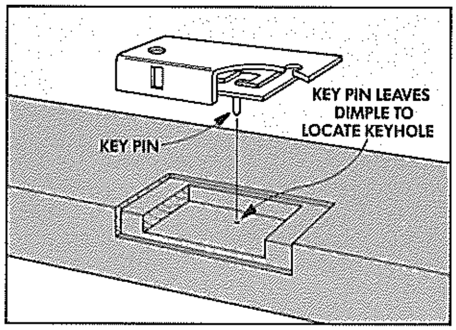
Finally, press the catch plate into the mortise and install the screws.



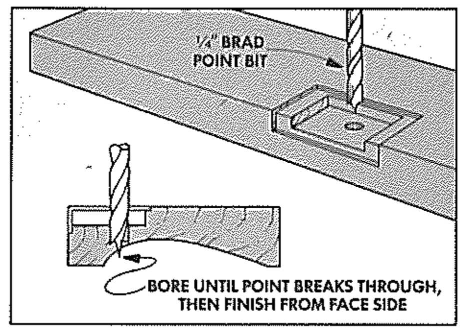
7 *Set depth of cut to rough out waste for lock mechanism. Bit projects slightly higher than total thickness of lock mechanism, but not as high as key pin.*



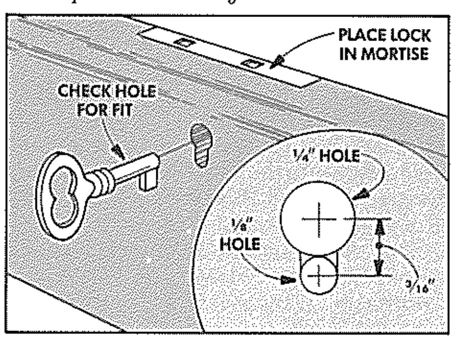
8 *Lay out location of lock mechanism mortise within lock plate mortise. Rout out waste almost to outline with router. Then clean up to outline with chisel.*



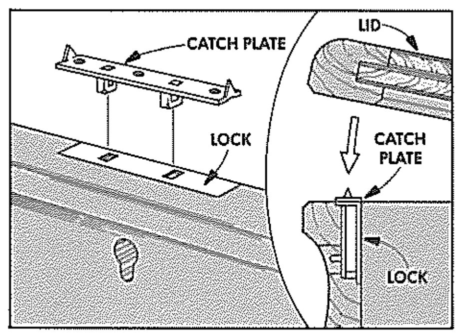
9 *To mark position of keyhole, press the lock tightly into the finished mortise. The key pin in the lock mechanism will leave a "dimple" to mark keyhole.*



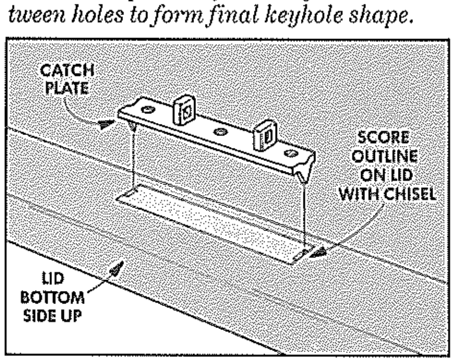
10 *Bore main hole for keyhole with ¼" brad point bit. Use "dimple" left by key pin for center point. Stop when point breaks through, finish from face side.*



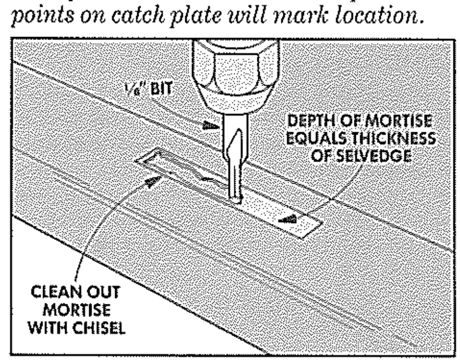
11 *Finish keyhole by first boring ⅛"-dia. hole centered 3/16" below first hole. Then pare or file away shoulder between holes to form final keyhole shape.*



12 *To position catch plate in lid, place catch plate in lock mechanism. Then press the lid down on catch plate. Two points on catch plate will mark location.*



13 *To mark mortise for catch plate, tap catch plate into lid using point impressions for reference. Then score outline with corner of chisel.*



14 *To cut the mortise, rout waste almost to outline with ⅛" bit set to thickness of plate. Remove remaining waste to outline with chisel.*

Block Planes

A NEW LOOK AT AN OLD FRIEND

Some myths die hard. One that I've always found hard to believe is how the block plane got its name. According to hearsay, block planes were used to smooth the tops of butcher blocks. Butcher block tops are all end grain. So, as the story goes, the plane was designed with a low blade angle to cut end grain cleanly.

This doesn't make much sense. First of all, the manufacture of butcher blocks never was a major industry. In fact, of the more than 75 models of block planes Stanley offered during the past century, just one was specifically designed for butcher blocks. It was the No. 64, a 12"-long plane with a 2"-wide blade — definitely not a block plane as we know them now.

The second reason I can't go along with this "butcher block theory" has to do with the blade angle. While all standard block planes have their blades *mounted* at a lower angle, the cutting angle is actually the same as on bench planes. (For an explanation on cutting geometry, see page 18.)

Just one model of block planes — the low-angle block plane — actually has a cutting angle that's suitable for severing end grain.

Although I haven't been able to find any references telling how the name "block plane" actually did evolve, I'm comfortable thinking the name came from one of two old-time terms.

The first was the expression, "blocking in." Blocking in meant shaving just a touch from the end or edge of one workpiece to make it fit between two others, as when fitting trim molding in house construction. The perfect blocking-in plane was one small enough to fit in a tool pouch or pocket (final fitting was done on the job, not at the bench) and used with one hand while the other hand held the workpiece.

The second term associated with block planes is really a definition. An iron casting that contains the working parts of a mechanical device is called a "block." (For example: an engine block.) The fundamental difference between a bench plane and a block plane is that the working parts of a block plane are in the body casting itself — the block. (On a bench plane the working parts are part of another piece added to the body — the frog.)

Although I'm not positive either of these is the origin of the block plane's name, both seem to make more sense than the butcher block myth.

ONE-HANDED PLANE

Whatever the origin of its name, I grab a block plane whenever planing is easier with one hand than it is with two. Of course, I'm not the first to appreciate the convenience of a one-hand plane. In fact, I have a hunch that the block plane is responsible for the demise of two of the original bench planes.

The cast iron bench planes currently manufactured by Stanley, Record, Footprint, and several others are all copies or descendants of the Bailey series Stanley introduced in 1870. The original line consisted of models numbered 1 through 8.

Models No. 1 and No. 2 were small smooth planes, 5½" and 7" long. The No. 1 was discontinued in 1943; the No. 2 in 1958.

Although collectors prize these planes today, why weren't they popular with woodworkers? My theory is that their small size made them almost impossible to work with. They were designed with a handle mounted behind the frog (as all bench planes are). But they were so small that they were awkward to use with two hands and the high-mounted blade made them uncomfortable to hold with one hand. So, whenever a woodworker needed a small plane he bought a block plane instead.

MORE DIFFERENCES

In order to make block planes compact enough for one-hand use, the blade angle has to be lowered. Although this eliminates the need for a handle, it means the blade must be mounted directly to the body (block) instead of to the frog (as it is on a bench plane). This one change leads to a series of differences between block and bench planes.

BEVEL-UP BLADE. Besides the fact that the blade is mounted directly to the body, there is one other major difference between block planes and bench planes. Since the blade is held at a low angle (12° or 20°), the blade must be mounted *bevel up* to provide clearance behind the cutting edge. If it were mounted bevel down, as on a bench plane, the "heel" of the bevel would prevent the cutting edge from contacting the wood.

ADJUSTABLE THROAT. Because the blade is mounted directly to the body (instead of to a frog as it is on a bench plane), there's one other problem. This is with the throat opening (the space between the cutting edge of the blade and the sole) that plays a critical role in a plane's cutting efficiency.

Adjusting the throat opening on a bench plane involves moving the frog (and thus the whole blade assembly) forward or back. But, the block plane has no frog. So, to provide a throat opening adjustment, the better block planes have a sliding plate fitted into the front of the sole. Moving this plate forward or back increases or decreases the size of the throat opening.

NO CAP IRON. Another difference between block planes and bench planes is that a block plane doesn't have the cap iron (chipper) that's an essential part of the cutting assembly on a bench plane. It's easy to understand why when you stop to think about what a cap iron does.

A cap iron on a bench plane applies downward pressure near the cutting edge of the blade to lessen vibration ("chatter"). This is necessary because the end of the blade projecting through the sole is unsupported.

A block plane lacks the cap iron for two reasons. First, since the blade is mounted with the bevel up, it's not possible to apply downward pressure near the cutting edge. Second, the blade is supported by the plane body itself almost to the edge. So, additional stiffening that a cap iron furnishes on a bench plane isn't necessary to stop chatter.

TODAY'S BLOCK PLANES

Two basic types of block planes are available today. The first type is an inexpensive, small plane available in almost every hardware store. These lack a throat adjustment plate and other adjustment niceties. I think these cheap block planes are difficult to work with and a waste of money.

For just a few dollars more you can get the second type. These are high-quality hand tools (see Sources, page 24). Two models are available — standard and low-angle block planes. Their size and construction are similar. The basic differences between the two are the blade mounting angle and the blade adjustment mechanisms. These differences are so subtle that it's worth taking a close look at the parts of a block plane.

BLOCK PLANE PARTS

The best way to understand how a block plane works is to take it completely apart and examine each piece.

FIGURE 1

STANDARD BLOCK PLANE
(BLADE MOUNTED AT 20°)

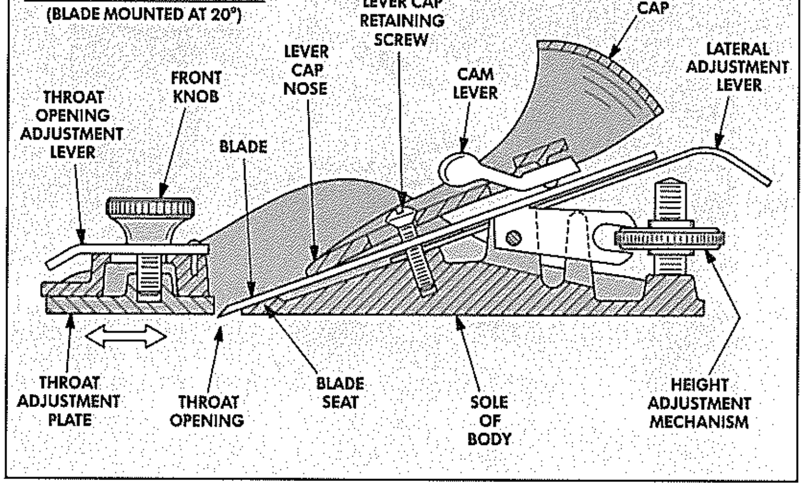
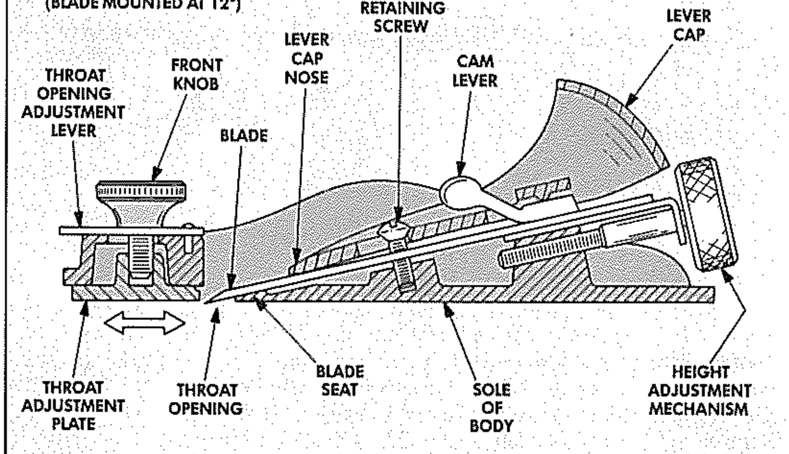


FIGURE 2

LOW-ANGLE BLOCK PLANE
(BLADE MOUNTED AT 12°)



When a block plane is disassembled, it breaks down into six basic components: the body, the blade, the lever cap, the lateral adjustment lever, the throat opening assembly, and the blade height adjusting assembly.

THE BODY. The body is the most basic part. It's an iron casting (a block) that serves two purposes. First, it supports the blade and all adjustment mechanisms. Second, it has a flat bottom (sole) so the blade stays a uniform distance from the workpiece.

THE BLADE. Resting directly on the body is the blade. The blade in a block plane is similar to the blade in a bench plane — only smaller. It's supported at two points. At the front, the blade is supported almost to the cutting edge by the blade seat cast into the body behind the throat. The rear of the blade rests on top of the "boss" that holds the height adjustment mechanism.

THE LEVER CAP. The blade is held in position by the lever cap. The lever cap has two jobs. Since block planes don't have handles, the lever cap is cast to fit comfortably in the palm of the hand.

The functional role of the lever cap is to secure the blade into the plane body. The lever has a cam on its lower surface that works in conjunction with the cap screw to press the blade against the body.

HEIGHT ADJUSTING ASSEMBLY. At the back of both the standard and low-angle block plane there's a blade height adjustment assembly, but the way they work differs on these two types of block planes. On the standard block plane, spinning a wheel mounted horizontally under the blade raises or lowers it, see Fig. 1.

On a low-angle block plane, there's not enough space between the blade and the body for the wheel mechanism. So, blade adjustment is accomplished by turning a knob that sticks out behind the blade, see Fig. 2.

LATERAL ADJUSTMENT ASSEMBLY. One of the better features to look for when buying a block plane is the lateral adjustment lever. This mechanism is necessary to pivot the blade a few degrees one way or another to skew it so the cutting edge is parallel with the sole.

The standard block plane has a thin, hook-shaped lever that sticks out behind the height adjustment wheel. Moving this lever from one side to the other makes minute adjustments in the skew of the blade angle in relation to the front of the throat opening.

Older models of low-angle block planes and the current Record 060½ low-angle block plane lack this feature. Lateral adjustments on these planes are made by tapping the side of the blade near the top.

The reason many low-angle block planes lack this mechanism is simple. There just wasn't room for it. Last year, Stanley modified its 84-year-old No. 60½ low-angle block plane with a stamped metal lateral adjustment plate. Now its blade can be moved precisely.

THROAT OPENING ASSEMBLY. Finally, there's one other adjustment that's important on any block plane. At the front end there should be an adjustable sliding plate. This is one of the most innovative features found on a plane.

Adjusting the throat on a bench plane requires disassembling the plane and repositioning the frog — no minor task. The throat opening on quality block planes can be adjusted from a hair-line crack to a wide gap in seconds just by moving the sliding plate at the front of the sole.

To adjust the throat opening, the front knob is loosened. Then a lever projecting from the front of the plane is moved from one side to the other. This moves the sliding plate that's fitted into the sole forward or back to open or close the throat.

THE FINAL CHOICE

All of these features bring us to two high-quality block planes — the No. 9½ standard block plane and the No. 60½ low-angle block plane made by both Stanley and Record (see Sources, page 24). And, in a sense we're right back where we started — the only real difference between these two is the blade angle.

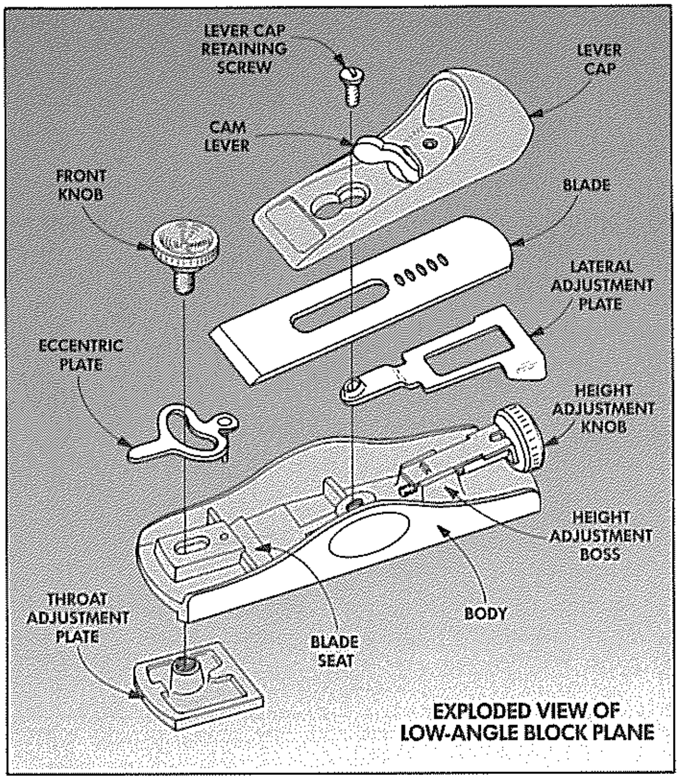
In choosing a block plane, my vote goes to the low-angle block plane. It seems to be the better all-around performer — even though this defies the accepted theories regarding plane geometry (see page 18).

Deciding between the Stanley 60½ and the Record 060½ is tough. The Record has high-quality castings that make it seem like an old-time tool. But, it's more than ¼" wider than the Stanley and feels a little bulky for a one-hand plane.

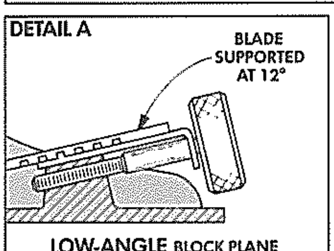
The castings on the Stanley aren't as nice as those on the Record and overall the Stanley seems "cheaper." But I like the lateral adjustment mechanism. And the size of the Stanley makes it feel right at home in my hand.

Tuning Up Block Planes

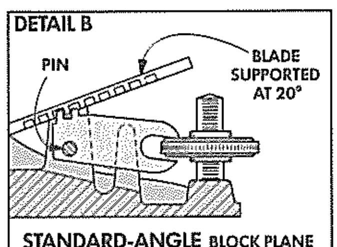
HOW TO TURN A "KIT" INTO A TOOL



EXPLODED VIEW OF LOW-ANGLE BLOCK PLANE



LOW-ANGLE BLOCK PLANE HEIGHT ADJUSTMENT MECHANISM



STANDARD-ANGLE BLOCK PLANE HEIGHT ADJUSTMENT MECHANISM

When I take a brand new block plane out of the box, I think of it more as a plane "kit" than a precision tool. It's a kit that's temporarily assembled to give me an idea what it will look like when it's finished. But before it's ready for use, it has to be taken apart and tuned up. I have two reasons for fine-tuning a plane. The first is obvious — it makes the plane capable of performing to its full potential. But, the second reason is almost as important to me. It makes the plane feel better in my hand.

A brand new block plane feels like any iron casting. It's cold, rough, and gritty. Handling a new plane is like running my fingernails down a blackboard. But, after tuning it up, the plane feels warm and smooth.

THE TUNE UP

Tuning a block plane doesn't call for any special equipment. I use an 8" mill file (smooth-cut is best, but second-cut or bastard work fine) and a supply of 220, 320, and 400-grit silicon carbide paper. The tune-up begins by completely disassembling the plane.

SQUARE THROAT OPENING. The first area to tackle is the rear edge of the throat opening, see Fig. 1. This edge must be square with the sides of the body.

To square this edge, begin by scribing a line across the sole just behind the throat, using an accurate square as a guide. Then secure the plane body in a vise and use a mill file to trim the metal to the line, see Fig. 1.

SMOOTH THE BLADE SEAT. After the throat opening is square, the blade seat is smoothed. The blade seat is the angled platform inside the body just behind the throat, see Exploded View. On an out-of-the-box block plane it's usually rough and covered with paint. It must be smoothed and flattened to support the blade and eliminate chatter.

LOW-ANGLE BLOCK PLANE. To smooth the seat on a low-angle block plane, insert the file through the throat, see Fig. 2. Then, with the file resting on the blade height adjustment boss, apply pressure over the seat and file in long, smooth strokes, see Figs. 2 and 3.

Note: On the newer Stanley 60½, you have to use the cap screw boss as a filing support. This is because the height adjustment boss on this plane is lower to accommodate the adjustment mechanism and doesn't line up with the blade seat.

While filing, be careful to remove an even amount of metal all across the seat so you don't end up bedding the blade at an angle. I check frequently to make certain the surface of the seat remains parallel with the plane bottom (sole) at the rear of the throat opening, see Fig. 4.

STANDARD BLOCK PLANE. Smoothing the blade seat on a standard block plane is a little different. This is because its blade height adjustment mechanism is pinned into the boss, see Detail B, above. If you use the boss as a file support with the mechanism in place, you risk filing off the two points that grip the notches in the bottom side of the blade.

There's a trick to using the boss as a filing support without endangering the points on the height adjustment mechanism. Drive out the pin with a punch or nail set and use the boss as a filing support as with the low-angle block plane. After the seat is smooth, reassemble the mechanism and tap the pin back in place.

COUNTERSINK CAP SCREW. After the blade seat is smooth and level, I work on the lever cap. The first step here involves the hole for the lever cap retaining screw.

Whenever the cam is loosened for major blade adjustment, the entire lever cap has a way of falling completely off. When this happens, I end up with a handful of plane parts rather than the block plane I was trying to adjust. To prevent this from happening, I countersink the screw hole in the lever cap.

To do this, chamfer the edges of the screw hole with a ½" countersink bit, see Fig. 5. This allows the screw to be set deeper than normal. With the screw set deeper, the cap won't come off when I loosen the lever.

FLATTEN LEVER CAP NOSE. After countersinking the screw hole, I work on the lever cap's nose. The lower surface of the nose must be flat and free of paint so it applies even pressure on the top of the blade. Again, I flatten the lower surface of the nose with a mill file.

Begin by laying the file flat on the workbench surface. Next, place the lever cap on the work surface with the nose on the file and the back edge on the surface of the table, see Fig. 6. Then, stroke the nose of the lever cap along the file (toward the tang) until the entire lower edge is flat from side to side.

FLATTEN THE SOLE. Now it's time for the most visible part of the block plane tune-up — flattening the sole. The sole of a block plane must be flat to keep the blade in firm contact with the wood. The most critical parts are the toe, the heel, and the surfaces around the throat opening. To ensure uniform contact, I flatten the entire sole.

Note: Before I begin flattening the sole, I reassemble the plane. This is so the body will be "stressed" the same during flattening as it is in use. (Just make sure the blade doesn't project through the throat.)

To flatten the sole, use silicon carbide paper as an abrasive and WD-40 as a lubricant. (The WD-40 carries away the metal "dust" so the silicon carbide paper cuts faster and lasts longer.)

The only way to get the bottom of the plane flat is to place the silicon carbide paper on a flat surface to begin with, see Fig. 7. The table on my saw is the flattest surface in my shop, so I use this surface when flattening the plane bottom.

Now, saturate a full sheet of 220-grit paper with WD-40. Then, stroke the plane back and forth. The area being flattened will appear shiny. Dull spots indicate hollows, see Fig. 8. Keep sanding until all the dull spots disappear.

When there are no more hollows, switch to 320-grit, and finally finish with 400-grit to completely smooth the sole.

CHAMFER SOLE EDGES. After the sole is smooth, the edges tend to be sharp. I chamfer these edges to prevent them from scratching the wood (or my fingers).

I suppose I could chamfer the edge by just running the mill file over it. But, I take a little extra time and make this chamfer a uniform bevel around the entire perimeter of the sole. To keep the chamfer uniform, I use a simple jig, see Fig. 9.

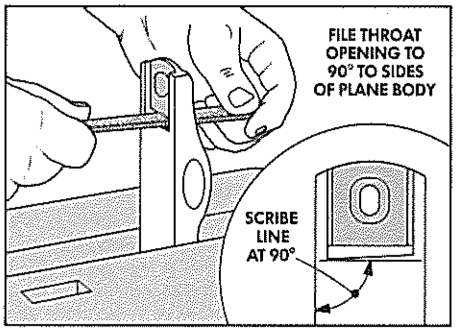
This jig is nothing more than a scrap of wood with a 45° kerf just wide enough to grip the mill file. With the file pressed into the kerf, push the plane against the wood and stroke it toward the tang of the file. A few passes along each edge is sufficient.

Then continue the chamfer around the ends of the plane. Note: When chamfering the front end, check to be sure the throat adjustment plate is flush with the front end of the plane body.

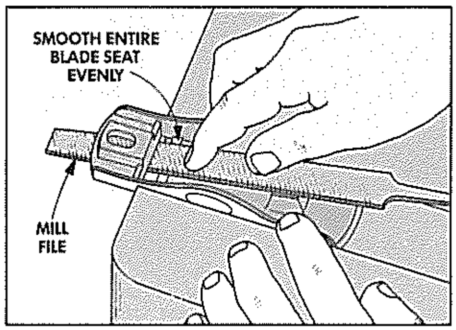
FINISHING TOUCHES

When the bottom is smooth and shiny and the edges neatly chamfered, I "sand" the sides, too. This isn't necessary, but it makes the plane look and feel better.

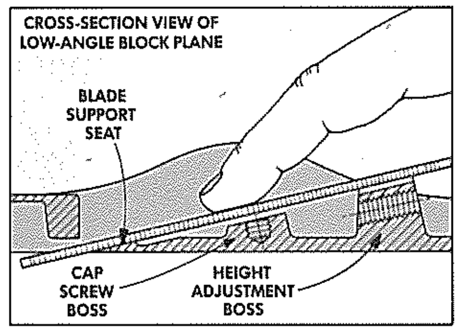
When the whole body gleams, I wipe it clean and give it a protective coat of paste wax. Now the plane feels great in my hand — even when I'm not planing.



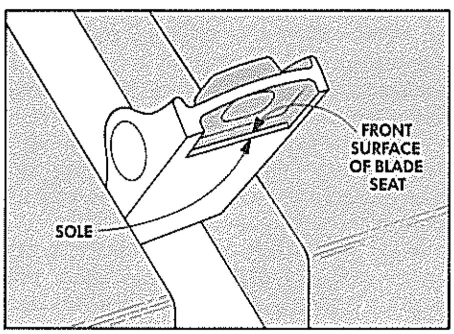
1 *To make throat opening square with sides, scribe a line just behind the throat, using an awl and accurate square. Then file excess metal to the scribed line.*



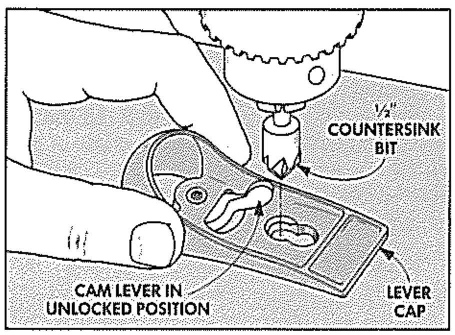
2 *To smooth blade seat, secure plane body in bench vise and insert a mill file through the throat. While filing, apply pressure on forward stroke only.*



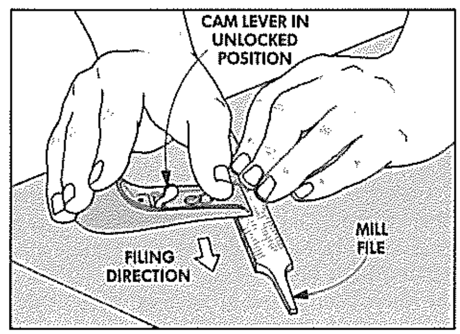
3 *On low-angle block plane, file rests on top surface of blade seat and height adjustment boss. Concentrate pressure over blade seat and keep seat thickness uniform.*



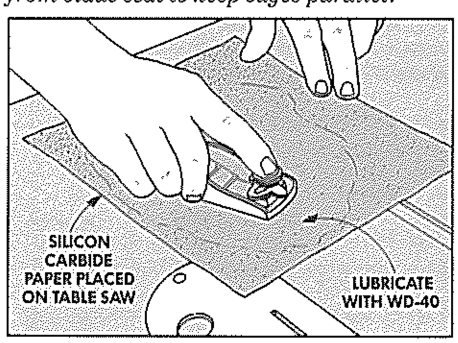
4 *Blade seat surface must be parallel to plane sole. When filing, watch edge of opening. Remove even amount of metal from blade seat to keep edges parallel.*



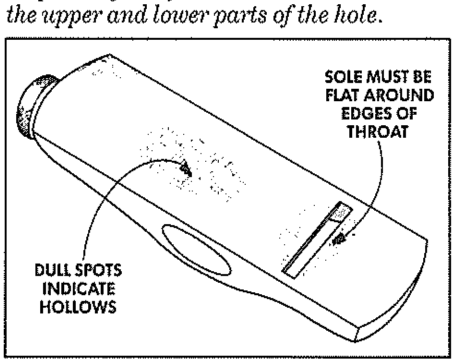
5 *Chamfer the lip of the lever cap screw hole with a ½" countersink. Go just deep enough to form a "shoulder" between the upper and lower parts of the hole.*



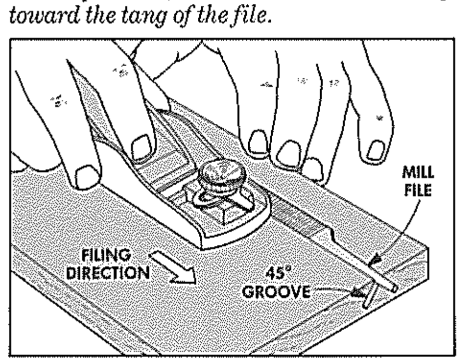
6 *Flatten the bottom of lever cap's nose on a mill file. Position the cam lever in the lowest position, then stroke the lever cap toward the tang of the file.*



7 *Assemble plane with blade and flatten the sole on a sheet of silicon carbide paper laid on a flat surface. WD-40 as lubricant makes cutting go faster.*



8 *Continue sanding until no dull spots (that indicate hollow areas) remain. Pay particular attention to making certain sole is flat all the way to edges of the throat.*



9 *Chamfer edges of plane body on a mill file held by a 45° kerf in a scrap of wood. Lock throat adjustment plate flush with front of plane to chamfer around front.*

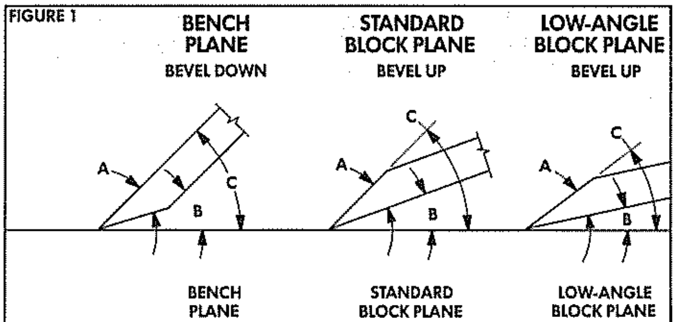
Plane Geometry

WHEN DOES 20° EQUAL 45°?

The myth concerning the origin of the block plane's name (see page 14) isn't the only thing that doesn't make sense to me. My other concern is that almost all the books and even the instructions that come with block planes say that they're good for cutting end grain because the blade is mounted at a lower angle than in a bench plane.

Although this appears to be the case, there's actually no functional difference between the *cutting* angle of a standard block plane and the *cutting* angle of a bench plane.

FIGURE 1



		BENCH PLANE	STANDARD BLOCK PLANE	LOW-ANGLE BLOCK PLANE
SHARPNESS ANGLE	(A)	25°	25°	25°
MOUNTING ANGLE	(B)	45°	20°	12°
CUTTING ANGLE	(C)	45°	45°	37°

ANGLES

The geometry that makes planes work involves many angles. But just three angles are important for understanding why a bench plane and standard block plane really cut the wood at the same angle. The first of these angles is the *sharpness* angle (A), which is the angle formed by the bevel and the back of the blade. The next angle is the *blade mounting angle* (B), which is the angle the blade is mounted in the plane. The last angle is the *cutting angle* (C), which is the angle the cutting edge meets the wood.

The reason there's confusion is that sometimes the mounting angle is the same as the cutting angle and sometimes it's not. It depends on whether the blade is mounted with the bevel *down* or the bevel *up*.

BEVEL-DOWN MOUNTING. When the blade is mounted with the bevel *down* (as it is on a bench plane), the mounting angle and cutting angle are the same, see Fig. 1. Since the blade is mounted in the frog at 45°, then the cutting angle also is 45°.

BEVEL-UP MOUNTING. However, mounting the blade with the bevel *up* (as it is in a block plane) changes everything. Now the cutting angle is formed by the beveled surface behind the edge. So the actual *cutting* angle is the sum of the *mounting* angle plus the *sharpness* angle.

In a standard block plane the *mounting angle* is only 20°. But to get the real *cutting angle* you have to add the *sharpness* angle (which is usually 25°). The result is 45°, which is exactly the same as the cutting angle in the bench plane, see Fig. 1.

LOW-ANGLE BLOCK ANGLE. There is one block plane that is different. The cutting angle on a *low-angle* block plane is different from the cutting angle on a standard block plane or a bench plane. This is because its blade is mounted at 12°.

Adding the 12° mounting angle to the 25° sharpness angle gives a cutting angle of 37°. So the low-angle block plane is the only block plane with a cutting angle that differs from a bench plane.

THE OPTIMUM CUTTING ANGLE

Okay, so what difference does the cutting angle make? The answer depends on the planing direction in relation to the grain.

The lowest angle would seem best for all planes because most of the force would be transmitted in the direction of the cut. But the wood also reacts to the force of the cut *ahead* of the point being cut. How it reacts depends on the direction of the grain.

PLANING WITH THE GRAIN. Wood is easiest to plane *with* the grain (as opposed to planing across the grain or against end grain). But, there's a basic problem even when planing with the grain. As the shaving slides up the blade, the cutting edge slices the fibers. But the blade also works like a lever — transmitting a prying force into the wood ahead of the cutting edge, see Fig. 2.

This prying force can tear the wood *ahead* of the cut, leaving a rough surface behind. There are two ways to reduce this tearing effect. One is to close the throat opening and the other is to raise the angle of the blade.

Closing the throat (by moving the frog in a bench plane or sliding the throat plate back in a block plane) keeps the plane's sole pressing on the wood just before it's cut, see Fig. 3. With the wood pressed in place, the tearing is minimized.

Raising the cutting angle causes the shaving to bend upward and break right after it's cut. This effectively shortens the "lever" that causes the tearing, so less energy is transmitted back to the wood. The result is a smoother cut.

Adding a cap iron over the blade on a bench plane increases the bending and breaking action even more. This is why it's often called a "chip breaker."

Note: While this "chip breaker" theory makes sense, I believe a cap iron's real function is adding stiffness to a blade mounted bevel down.

So, for *planing with the grain*, theory holds that the optimum blade angle would be high and the throat opening closed tight. This would indicate that bench planes and standard block planes will leave a smooth surface when planing with the grain and low-

FIGURE 2

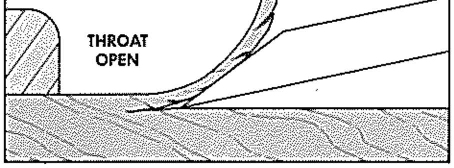


FIGURE 3

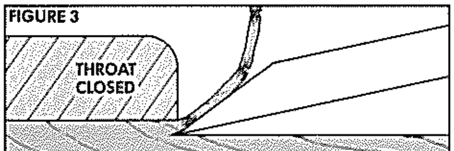


FIGURE 4

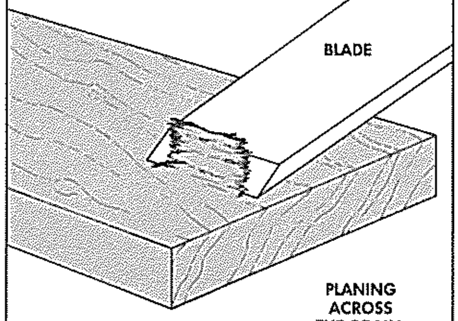
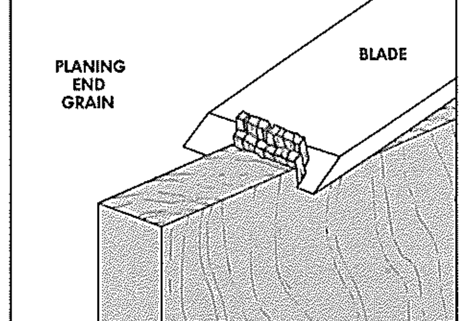


FIGURE 5



angle block planes won't.

But, when you actually go down to the shop, experience doesn't seem to go completely along with the high-angle theory. When working with different planes with cutting angles varying from 37° to 50°, I find a low-angle block plane (37°) leaves almost as smooth a surface as a European smooth plane with a 50° cutting angle. Since I use the block plane just for one-handed trimming, the surface left when planing with the grain is perfectly acceptable.

Changing the throat opening does make a difference, though. When it's left wide open planing with the grain, the surface being planed tends to be fuzzy. Closing it down to a hairline leaves the surface smooth.

PLANING ACROSS THE GRAIN. Planing across the grain is an entirely different story. The wood fibers resist the blade more than when planing with the grain. This is because the cutting edge is parallel to the wood fibers, see Fig. 4.

A low cutting angle is the most efficient when planing across the grain. This is because the edge has to go through the wood fibers sideways. If the blade angle is high, it tends to lift the fibers and pull them apart, leaving a very rough surface behind.

The throat opening doesn't affect the *smoothness* of the cut when planing across the grain. But opening the throat makes planing across the grain *easier*. The reason for the wide opening is that a cross-grain shaving doesn't come out as a continuous ribbon. Rather it's a bundle of fibers that can quickly clog a narrow throat.

So, for cross-grain planing, the low-angle block plane works better than the standard block plane. Its cutting angle is closer to optimum, and its throat can be opened quickly. The standard block plane's throat can be opened quickly, too. But its high cutting angle tends to pull the fibers.

(Years ago Stanley made a No. 62 low-angle plane specifically for cutting across the grain. It was the approximate size of a jack plane , but had a sliding plate throat adjustment and its 2"-wide blade was mounted at 12° — bevel up as on low-angle block planes today. See photo on page 14.)

END-GRAIN PLANING. End grain presents the most resistance of all planing operations. This is where all the myths began. The optimum angle is the lowest possible so the cutting force can be transmitted almost perpendicular to the wood fibers, see Fig. 5.

The throat opening isn't critical when planing end grain. The short ends of the wood fibers separate so easily that they can't transmit a prying force ahead of the cut. Also, the severed fibers turn into dust rather than shavings or bundles of fibers, so there's no problem with clogging the throat when planing end grain.

The real problem with end grain is that it resists being planed at all. Planing end grain requires more force than I can apply with a small, one-hand plane. That's why I pocket my block plane and grab a big bench plane when I'm faced with a major end grain planing project (see box below).

THE FINAL CHOICE

So, what does all this mean in terms of choosing a block plane? To begin with, both types of block planes are general purpose tools — essentially carpenters' planes. They are most commonly used on-site for final fitting of small parts. Since the "blocking in" cuts made by the plane usually aren't visible, a really fine cut doesn't matter.

But a block plane is capable of doing really fine work (on a small scale) when it's fine-tuned and well sharpened. Then it's a precision tool that deserves a place in the shop.

The standard angle block plane does a pretty good job of planing with the grain, but it really isn't suited for cross-grain or end-grain planing. Its cutting angle is too high. Besides, it's too small and light to apply the extra force needed to cut end grain.

My choice for the all-around one hand trimming plane is the low-angle block plane. It does a good job planing with and across the grain, (but it's too small and light for serious end-grain planing). And it's the only plane that offers a real difference in the cutting angle.

REDUCING THE ANGLE

With the exception of the block plane (and a few rabbet and shoulder planes), all the planes available today have their blades mounted at an angle between 40° and 50°. But, I doubt that the tool designers were thinking about the physics of planing when settling on that angle.

I think the real reason for mounting the blade at about 45° is so the handle and the various adjustment mechanisms can be grouped together. This makes the plane comfortable to hold and easy to adjust, but it results in a cutting angle that's considerably less than perfect.

IMPROVING THE CUTTING ANGLE

The 45° cutting angle is too high for cutting across the grain, through irregular grain, or trimming end grain. So, when planing in any direction other than along the straightest grain, the cutting angle should be lowered.

That's a great suggestion, but how do you alter the cutting angle on a plane? You can't — but you can achieve the same effect by skewing the plane, see Fig. A.

As the plane is skewed to the direction of movement, the *effective* cutting angle decreases, see Fig. B. (With the plane skewed at 45° to the direction of thrust, the effective cutting angle is lowered to about 35°.)

The reason the effective cutting angle decreases is because the cutting angle is now a diagonal line across the blade, rather than a line perpendicular to the blade edge, see Fig. B.

At first this seems confusing. But, there's an easy way to visualize how the cutting angle changes. It's just like standing at the bottom of a steep mountain you're about to climb. Climbing straight to the top requires hiking up at 45°. A lot of work.

The climb is a lot easier by zig-zagging back and forth up the face of the hill. You're still going up, but at a much lower angle.

ACROSS THE GRAIN. When planing across the grain, skewing the plane at about 45° lets the blade come in at a lower cutting angle and slice the wood fibers cleanly. This technique is even more helpful when smoothing end grain (or wild grain like bird's eye, burl, or any figured wood). Then I skew the plane even more so the blade edge approaches the wood fibers from an extremely low angle.

END GRAIN. When faced with a really demanding end-grain project — like a butcher block top — my choice would be the big No. 7 jointer plane. Its size and weight let me apply a lot of muscle. I hone the blade to a razor edge, skew the plane almost sideways, and power the plane through the ends of the wood fibers.

And all this time my block plane (which everyone thought was originally designed for smoothing butcher blocks) would probably be in my pocket.

FIGURE A

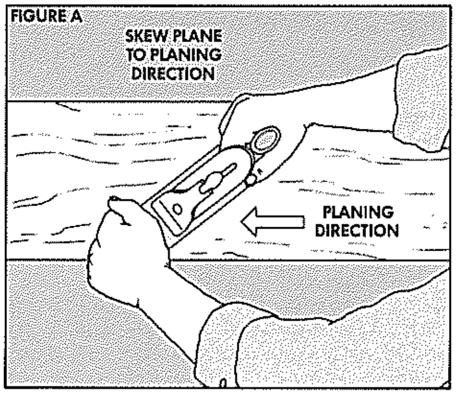
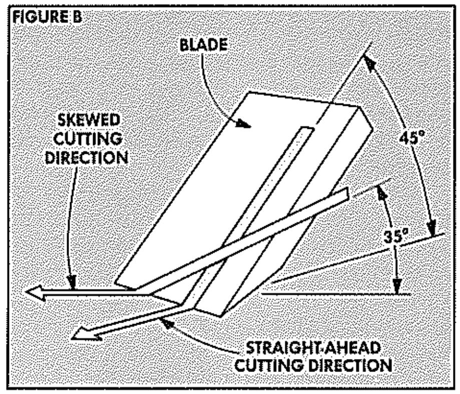
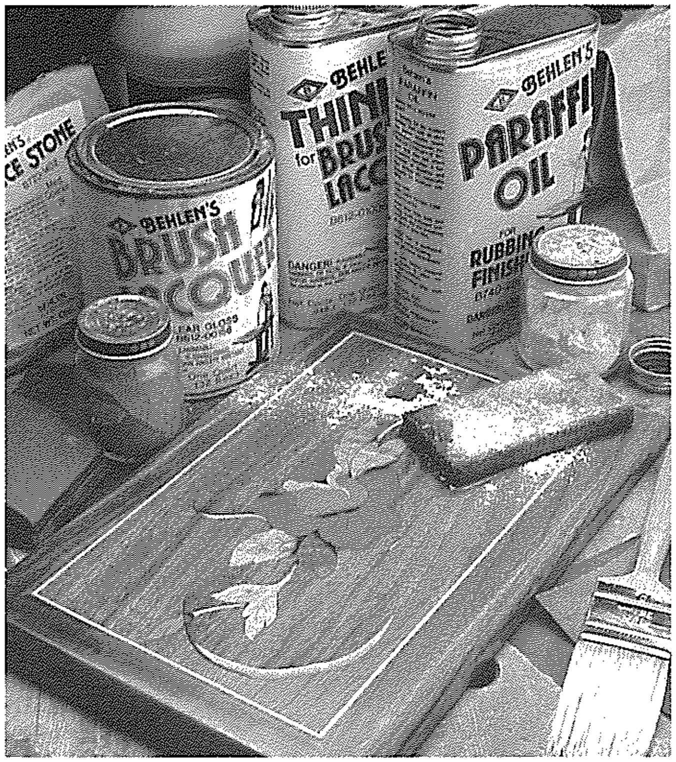


FIGURE B



Finishing: Brushing Lacquer

REFLECTIONS ON A TOUGH FINISH



"Lacquer" may be the most misunderstood word in wood finishing. (Or at least it ranks right up there with "stain.") Part of the confusion comes from the history of the word lacquer.

A LITTLE HISTORY

Originally the word lacquer was used to describe a finish made from the sap of a Japanese Lacquer Tree (Rhus verniciflua). It's a deep black finish that's best known for its use in the Orient on small boxes. The finish dries by oxidation (not evaporation, as modern lacquers) and eventually turns deep black on exposure to air and light. Traditionally it took dozens of applications over as long as twenty years of hardening and drying in dark, damp closets to obtain a true Japanese "lacquered" finish.

SPIRIT VARNISHES. In the 18th and 19th centuries the term lacquer was used in Europe to describe a mixture of shellacs and gums in alcohol — sometimes called spirit varnishes.

VARNISH ON METAL. Recently the term has been used to describe the baked-on varnishes found on the inside of tin food and beverage cans or coatings on metals such as brass or copper.

NITROCELLULOSE LACQUER. Today, lacquer generally refers to a nitrocellulose liquid that dries by evaporation. That's nitrocellulose, as in gun powder. As a matter of fact, it was gun powder that helped make lacquer popular.

After World War I there was an excess of nitrocellulose powder left from the war effort. Nitrocellulose lacquer was first used in 1855. But it took the development of better synthetic solvents (to lower the viscosity) and the abundance of cheap nitrocellulose powder (left from the war) to make anyone see the value of lacquer. And that person was Henry Ford. As the story goes, Henry was looking for a way to increase auto production by speeding up the painting/drying process. Lacquer was his answer.

Nitrocellulose lacquer can also be an answer for woodworkers. (But like any finish, lacquer does have problems. More on this later.) Lacquer is much clearer than varnish and won't yellow over the years. It doesn't darken the wood tones as much as varnishes or oils. And it dries quickly — speeding up the whole finishing process.

HOW IT'S MADE

Nitrocellulose lacquer starts out as cotton (cellulose). After the initial picking of the long fiber cotton, the short fibers or "linters" are left stuck to the pod. The linters are collected and converted into nitrocellulose.

First, the linters are washed, bleached, and then cooked in a mixture of sulfuric and nitric acid — that's where the "nitro" comes from. If it's nitrated to 10 - 11% it becomes plastic, 12% lacquer, and 13% explosives (sometimes called gun cotton).

Then the mixture is purified and washed with boiling water. Finally the water is replaced with alcohol since dry nitrocellulose is extremely explosive but alcohol has a damping effect.

At this point it still looks like ordinary cotton (sometimes it's called pyroxlin). It's more brittle than cotton and it needs to be dissolved in a solvent so it can be applied to the surface of the wood. Even after it's dissolved, a nitrocellulose mixture wouldn't be very flexible or adhere well. So it's modified and liquified.

ADDED INGREDIENTS. To help the nitrocellulose adhere to the surface, look glossy, build up, and rub easier, resins such as alkyd and gums such as ester gum are added. (This also lowers the cost since resins and gums are cheaper than nitrocellulose.) Then to make the lacquers less brittle, plasticizers (oils and chemicals) are added. And sometimes silica (fine sand) is added to produce a dull, flat finish.

SOLVENTS. The only purpose of adding solvents is to make it possible to apply the solids to a surface. Once the solids are on the surface, the solvents evaporate.

Often it's the amount of solvents added that makes one lacquer different from another. Early lacquers had 85% solvents and only 15% solids (nitrocellulose, resins, and plasticizer), but today's lacquers may contain as much as 35% solids.

And it's not one solvent that's added, but several. A couple solvents are added to dissolve the nitrocellulose and then more solvents (called diluents) are added to dissolve each of the resins and blend the nitrocellulose and resins together.

What this all means is that you should only thin down lacquer with the thinner recommended by the manufacturer. Many manufacturers make their own thinner since they know what it takes to dissolve the nitrocellulose, resins, and plasticizers in their lacquer. (I'm usually skeptical when manufacturers recommend using only their own brand of sealer, thinner, or whatever. I think they're just trying to make another sale. But in the case of lacquer and thinners, it's always best to follow their recommendation.)

HOT SOLVENT

In using lacquers, you may have to take into consideration the solvent more than the solids. That's because the solvents in lacquers are considered "hot solvents." They're not really hot (as opposed to cold), but they're called hot since they dissolve just about any standard finish.

COMPATIBILITY. Since hot solvents dissolve other finishes, don't use lacquer on top of varnish, paint, or oil finishes. The lacquer will "boil up," blister, or wrinkle another finish just like paint remover does. (Note: It's usually okay to use a "cold solvent" finish such as varnish on top of lacquer, but I'd sand the lacquer finish lightly first.)

Lacquers (with solvents) even dissolve themselves. That's how they work. With varnish, each coat lays on top of the preceding coat — there is almost no dissolving of the previous coat so it's best to sand slightly between coats to help the next coat adhere. With lacquer, each coat dissolves and softens the coat under it to create one cohesive layer.

VARNISH VS. LACQUER. Though each coat melts into the previous one, each coat of lacquer is usually thinner than a coat of varnish. Therefore more coats of lacquer are required for the same surface build-up. But lacquer dries faster, so it's kind of a trade-off. It will take more coats of lacquer to get the same thickness, but more coats can be put on in a day.

And there's another advantage to lacquer. Since lacquer dries by evaporation rather than oxidation (reacting with air), it's not as likely to "skin over" in a can.

SPRAYING VS. BRUSHING LACQUERS

Typically lacquer is sprayed on. As a matter of fact, most of the furniture sold in stores today has a sprayed lacquer finish. But there are problems spraying in home shops (see box below).

BRUSHING LACQUERS. However, lacquer can be used in a home shop. A number of brands of *brushing* lacquers (see Sources, page 24) have been developed to overcome the problems associated with spraying.

DEFT. Deft Clear Wood Finish is one of the most popular and widely available brushing lacquers. It seems thinner and easier to apply than most of the others. (Note: I recently interviewed the Technical Director at Deft about their Clear Wood Finish. Since it's different from other brushing lacquers and Deft has recently introduced a new gloss Clear Wood Finish, we plan to include the interview and some tips on applying and using Deft in an upcoming issue of *Woodsmith.*)

HIGHER SOLIDS CONTENT. Deft and the other brushing lacquers include more resins and gums in relation to nitrocellulose (it allows a quicker build) and a higher percentage of solids to solvents than spraying lacquers. And since brushing lacquers aren't made to be sprayed from a gun, they don't have to be further thinned down before they're applied. (Note: Don't try to brush spraying lacquers. They dry too fast.) But brushing lacquers can be very difficult to apply (see page 22), and once you start working with them some unique problems develop.

THE STAIN PROBLEM

I've had a number of problems with brushing lacquers, but the biggest one is trying to brush it over stain or paste wood filler. Since it's a "hot" finish, it tends to lift the stain or filler. Then the color of the stain or filler mixes with the lacquer being brushed on and you have a mess on your hands.

As you brush, the stain gets pulled right out of the wood, into the brush, and then back into the can of lacquer. From that point on, all the lacquer turns cloudy and there are spots where the stained surface is lighter.

What's the solution? The easy solution is not to use stain if you're going to brush on lacquer.

If you want to stain, don't use stains that are heavily pigmented (see *Woodsmith* No. 40). Use water-based aniline dyes, non-grain raising stains (such as Behlen's Solar Lux), one of the Minwax stains that only contain dyes (no pigments), or a stain that is especially made to be used under a specific lacquer (such as Deft's Wood Stain).

Then after the stain is *completely* dry, spray on a light coat of aerosol lacquer sanding sealer (such as Behlen's Jet-Spray) over the stain. Or use thinned shellac as a seal coat. Shellac *softens* slightly under most lacquer solvents, but won't completely *dissolve* under a thin coat of lacquer.

Sometimes I simply thin down a coat (50/50) of the brushing lacquer as a sealer. If it's flowed on quickly and not brushed back and forth, it will dry almost immediately — before it has a chance to lift the stain.

OPEN-GRAINED WOODS

Another problem I've noticed with lacquers is that after the solvent evaporates, the remaining lacquer solids collapse down into the pores of open-grained woods creating "sinkholes." To prevent this I use a paste wood filler and then a sealer (see *Woodsmith* No. 39), or I add extra coats of lacquer, sanding the surface completely level between coats.

CONCLUSION

Are the problems associated with brushing lacquer worth the finish obtained? Maybe. I wouldn't use it on a large surface like a table top. It's too hard to flow on a flat finish across the entire top.

But I might use brushing lacquer on a small object such as the jewelry case shown in this issue. You can build it up fast since it dries so quickly, and the finished coat can be rubbed to a clear, hard finish.

THE PROBLEMS OF SPRAYING

How do you get the kind of clear, glossy lacquer finish that's found on store-bought furniture on projects in a home shop? The answer is that you can't — without spending quite a bit of money and taking a number of precautions.

Furniture factories have sophisticated spraying systems (some even spray heated lacquer for quick drying). The systems include dust-free finishing rooms with filters, spray booths, exhaust fans, and explosion-proof lights and switches. It's not the kind of set-up most people are able to put in their basement or garage shop. And without this equipment, spraying can be dangerous, especially indoors.

FLAMMABLE AND EXPLOSIVE. Lacquer thinner can be extremely flammable and explosive. In a basement the fumes can easily gather near the floor, travel to a gas furnace or water heater pilot light, and explode before you can tell the fumes are building up. Even the small spark from a light switch can set off an explosion. That's why electrical switches in finishing rooms are usually "explosion-proof" or located outside the room.

How about using a window fan to exhaust lacquer fumes? Forget it. Any ordinary fan creates sparks as it operates. And that spark could cause an explosion. Only sealed, explosion-proof fans should be used to exhaust lacquer fumes.

BREATHING THE FUMES. Lacquer and lacquer thinner are dangerous to inhale. And when they're sprayed they fill the air and can easily get into your lungs. A respirator is a must. I'm not talking about a dust mask, but a respirator with replaceable filters approved by the National Institute for Occupational Safety (NIOSH).

Not only does the finisher have to breath and smell the fumes while he sprays, but the whole family suffers as well. Once it's in the air it drifts all over the house. And you thought sawdust was a problem.

THE EXPENSE. It's easy to spend up to $800 by the time you get a good air compressor, spray gun, cup, air hose, and air transformer. While this equipment would be fine for spraying *outdoors*, it doesn't include the cost of a spray booth or exhaust fan. (Note: An airless spray gun, such as a Wagner, is less expensive, but it's built to spray paint. Spraying lacquer usually results in runs, drips, and overspray.)

There are some newer high volume, low pressure systems — the Apollo and Croix systems are a couple I'm familiar with — that can be purchased for $500 to $600, but that's still beyond the budget of most home woodworkers.

WHAT ABOUT AEROSOLS? You have all the same problems (explosion, fumes) with aerosols that you have with a spray gun except the expense. And aerosol lacquers usually put out such a thin coat that it takes many coats (and cans) to build up the finish you want. It might be okay to spray a small box, but you could go through dozens of cans to finish a dining table. And I still don't feel comfortable doing it indoors.

All in all, spraying on a lacquer finish is not a practical (or safe) option in a typical home-shop environment.

Applying Brushing Lacquer

HOW TO FLOW IT ON

I always thought varnish was difficult to apply. Then I tried brushing lacquer. It makes varnish look like a Sunday stroll in the park. Brushing lacquers' major advantage over varnish — they dry quicker — is also their major disadvantage.

They dry so quickly that you can't really brush them on. Or at least you can't do much brushing after the liquid is on the surface. It's more like flowing it on. But that's getting ahead of the story.

FILL AND SEAL

The process starts with filling and sealing so the lacquer won't collapse into the pores of the wood. This step is especially important for open-grained woods.

On the walnut jewelry case (see page 6) I started by brushing a coat of shellac on the flower inlay and maple border with a small artist's brush. The shellac sealed these parts and prevented the color of the filler from staining them.

PASTE WOOD FILLER. Next, I applied a coat of Behlen's Medium Brown Mahogany Paste Wood Filler, brushing in with the grain and wiping off across the grain. (Note: I only applied the filler to the box itself, not the trays, since I wasn't concerned that every surface of the trays be perfectly smooth.) After the first coat of filler dried, I applied a second thin coat since the first coat hadn't completely filled the pores.

SEALER. When the second coat was dry, I sanded lightly to flatten the surface. Then I thinned down some 5 lb. cut shellac (3 parts denatured alcohol to 1 part shellac) and brushed it over the entire box and trays to seal the filler and the wood.

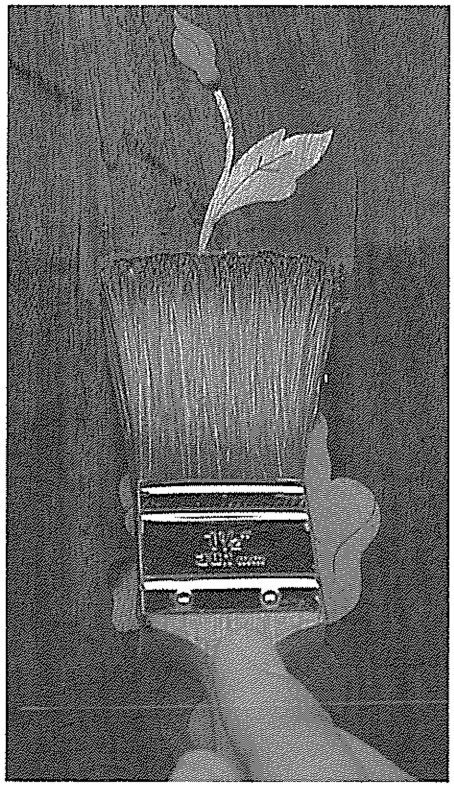
APPLYING THE LACQUER

After the shellac has a chance to dry, lightly sand the box and trays with 320 to 400-grit sandpaper. This should leave a flat, smooth surface for the lacquer.

BRISTLE BRUSH. With varnish I use a cheap foam brush. But the hot solvents in lacquer would quickly dissolve a foam brush, so use a soft, natural hair, high-quality bristle brush.

To apply brushing lacquer, pour the lacquer into a separate jar and then dunk the brush in deeply, almost halfway up the bristles. The object is to fill up the bristles with lots of lacquer — sometimes called "fully charging" the brush.

FLOWING ON. Then hold the brush at a low angle to the workpiece (if possible keep the workpiece horizontal) and allow the lacquer to *flow* out of the brush. Don't brush



it back and forth like varnish or paint. Just flow on a thin coat.

As you work, it starts drying and if you try to brush it out even thinner, there will be brush marks. Instead of brushing it out, keep refilling the brush. One fill of the brush might not last more than 12 inches. Anytime you feel the brush start to drag, fill it up again.

Unlike varnish, resist the temptation of going back over and filling in missed spots since the surrounding area may already be setting up. If you miss a spot, go on, and then cover the spot with the next coat.

SECOND COAT. Though it may feel dry to the touch in minutes, it's best to wait a couple hours before applying a second coat.

Since lacquer coats dissolve into each other, it isn't necessary to sand between coats. But leveling with 280-grit non-clogging sandpaper will flatten out brush marks. And then rub with 0000 steel wool to leave a uniform, dead-flat surface.

If you thought the first coat was difficult to flow on, the second is usually worse. It's flowed on like the first, but it starts to dissolve the first coat as it's being applied. If the brush isn't kept completely full of lacquer, it "catches" like a dull razor on two day's growth. And this can create brush marks and a washboard appearance.

SOME SOLUTIONS

This may all sound like brushing lacquer isn't worth the trouble, but there are some things you can do to make it easier.

If the lacquer seems to be too thick and won't flow, I've found that occasionally dipping the brush in lacquer thinner before dipping it in the lacquer helps it flow better.

THIN IT DOWN. Sometimes I even thin down the lacquer itself. (Note: I usually thin the first coat about 50/50). To determine exactly how much to thin, it takes some trial and error. If it's hard to brush, there's not enough thinner. If there are runs or brush marks or it takes too many coats to build up the finish, there's too much thinner.

RUNS, DRIPS. After each coat of lacquer dries, I carefully rub any runs and drips level with a little thinner on a fingertip. Then I allow the surface to dry and lightly sand before applying another coat.

RUBBING SMOOTH

I flow on at least three coats of brushing lacquer and then wait 48 hours before rubbing the finish smooth. (Note: Wait this long since there's some final slow solvent evaporation that can cause the lacquer film to shrink down into the pores of the wood.)

After the problems of applying lacquer, there's at last some relief — I find it's easier to rub smooth than most varnishes. (See *Woodsmith* No. 42 for a summary of rubbing materials and techniques.)

GLOSSY FINISH. For a glossy finish, I start by leveling the surface with 600-grit wet-or-dry sandpaper and rubbing oil. (Use 400-grit first if the surface has brush marks or rough spots).

Spread a thin coat of rubbing oil on the surface and sprinkle some FFFF pumice on top like you're salting a T-bone. Now lightly mix the oil and pumice to a creamy paste with a rag or felt pad and start rubbing with the grain.

Next clean the surface and then follow the same rubbing procedure with rottenstone and oil. The rottenstone burnishes the surface and brings it to a fine high-gloss, polished appearance.

SATIN FINISH. For a satin finish you need a surface with a little deeper scratch pattern. To obtain this, I just rub 0000 steel wool in the direction of the grain and then buff with a soft cloth. For a little bit more gloss, something between satin and glossy, work some paste wax into the steel wool and rub with the grain. Then buff it to a fine luster.

Talking Shop

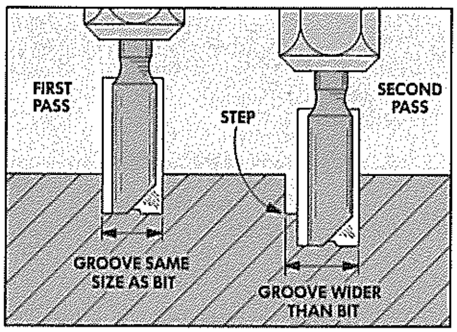
AN OPEN FORUM FOR COMMENTS AND QUESTIONS

A STEPPED GROOVE

I mentioned in the article about router collets on page 4 that one way to prevent bits from coming loose is to take light passes and increase the depth of cut slowly. But sometimes increasing the depth can result in a "stepped" or oversized groove.

A ½" straight bit, for example, will cut a ½" groove on its first pass. But if the bit is set a little deeper for a second pass, it might cut slightly off to one side of the original groove. The final groove is slightly stepped and oversized, see drawing below. (Note: This isn't a problem when routing an edge using a bit with a guide bearing.)

There are a couple reasons for this oversized groove. First, the bit may not be perfectly centered in the router base. If



you're using a hand-held router (not in a router table) and routing so the router base runs against a straightedge (fence), you might inadvertently rotate the router between passes so the point where the base meets the fence may be different for the second (deeper) pass. The solution is to make sure the same point on the router base rides against the fence for each pass.

There's another cause of an oversized groove with either a hand-held router or on a router table. Some routers are designed with so much play that as you increase the depth of cut and then retighten the motor, the bit cuts at a slightly different point.

This leaves you with three options. First, you can make your initial cut the full depth. Second, learn to live with a stepped and oversized groove. Or third, use a bit with a diameter that's *smaller* than the desired groove width, and make two overlapping passes to reach the desired width. I usually use this last option.

ROUTER WRENCHES

While working on the article about router collets I began looking at the wide variety of wrenches that come with routers. Why do router manufacturers put so much time and money into the router and then include such cheap wrenches?

Most of the wrenches are real knucklebusters. They're too small and the handle edges are too sharp. The only ones I'm happy with are those that come with the Makita and Milwaukee routers.

For the other routers in our shop I bought open-end wrenches that fit the nut and arbor for each router. (A 9⁄16" wrench fits the Sears 1½ HP router perfectly.) These wrenches are much easier on the hands, and I can actually get all my fingers comfortably around them to tighten and loosen the bit.

SUEDE-TEX FLOCK

We lined the bottom of the trays in the jewelry case with fabric (see page 11). But there's another way to line a case or box — using a material called Suede-Tex. Actually it's not really lining, it's flocking. And it produces a soft surface that's often easier to apply than lining.

Suede-Tex consists of a colored undercoat adhesive that's painted on the surface and millions of tiny rayon fibers that are dropped (or shot through a hand-operated spray gun) onto the wet adhesive. Once the adhesive dries, the fibers are left standing on end to provide a uniform nap on the surface — any surface. It can be used on the bottom of turned bowls and lamps, inside instrument cases and boxes, and as a decorative effect on picture frames. It can even be sprayed on walls. (See Sources, page 24, for information on ordering Suede-Tex.)

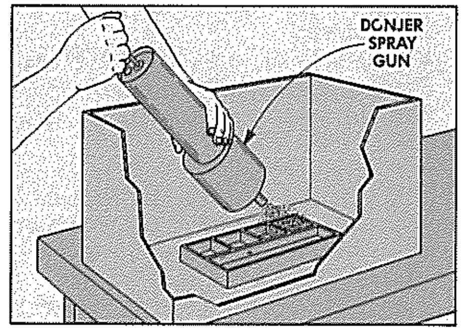
Shop Note: Apply Suede-Tex only *after* completing all the other finishing steps on the project. Otherwise the oil, varnish, or lacquer will get into the Suede-Tex.

ADHESIVE. The undercoat adhesive that's sold with Suede-Tex is more like a thick paint than an adhesive. It's available in 26 colors to match the shade of fibers (though using one color adhesive and another color fiber can be interesting). The adhesive is simply brushed on the surface with an ordinary paint brush.

I've tried using a thick coat of oil-base enamel rather than the Suede-Tex adhesive and it seemed to work. "You may have happened onto something that does work," commented Jerry Goldman of DonJer Products, the manufacturer of Suede-Tex, "but some paints won't. Our adhesive is guaranteed to work. It has more solids than many paints and is formulated to dry quickly (but not crack later) and hold the fibers erect."

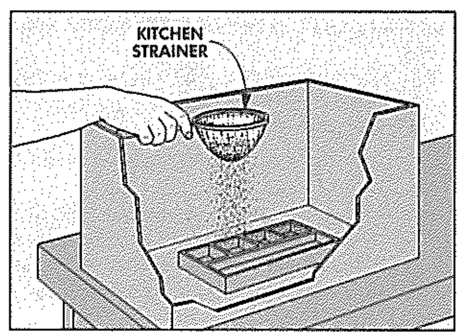
FIBERS. The fibers are cut to a uniform 1⁄32" length from rayon filaments. The trick is how to get the fibers *uniformly* stuck into the paint as soon as possible after painting.

SPRAY GUN. DonJer manufactures a pump-type spray gun that reminds me of



something that's used to spray for bugs or to dust roses. The gun separates all the tiny Suede-Tex fibers like a dust storm and then ejects them straight and hard into the adhesive. It's the easiest way to get a uniform, even nap with all the fibers standing on end.

ANOTHER METHOD. The cost of the gun (over $20) led me to see if it could be done another way. Just sprinkling the fibers doesn't work — they bunch up. But by sifting them through something (such as a piece of window screen or a kitchen strainer) the fibers get broken up enough to spread out evenly over the surface. With the help of gravity this method seems to work fine for most flat surfaces, but sometimes it's difficult to cover the vertical sides inside a box.



When I sift (or shoot) the fibers, I place the object to be covered inside a cardboard box. And always use more fibers than needed. After the paint has dried overnight, shake off and reclaim the excess fibers and brush the flocked surface with a soft brush. (Note: With careful reclaiming, 3 oz. of fibers will cover 15 sq. ft.)

The first time I saw Suede-Tex I was skeptical. I thought the fibers wouldn't hold up. But they do. The surface is a durable, rich, and soft finish.

Sources

JEWELRY CASE

You can order the inlay, hinges, and buttons for the Jewelry Case from:

Constantine's
2050 Eastchester Road
Bronx, NY 10461-2297
(800) 223-8087

- Hinges, 1 pair, brass plated, 1½" joint length, 1" open width (73A15)
- Wood Screw Hole Buttons, ⅜" dia., walnut (38WB)
- Flower Inlay (IW8)

Note: The inlay we received actually measured 9" x 12". But the panel with inlay glued on is cut to fit 6¼" x 10¼"- after the box is constructed (see Fig. 11, page 8).

You can order the lock for the Jewelry Case from:

Van Dyke's Restorer's Catalog
PO Box 278
Woonsocket, SD 57385
(800) 843-3320

- Jewelry Box Lock and Key, brass plated, 5⁄16" x 11⁄16" x 2"

The ⅛"-wide maple inlay strip in the lid of the Jewelry Case can be cut from a piece of scrap. (See Woodsmith Issue 44, page 23 for an explanation of how to do this.) Or it can be ordered from:

Constantine's
2050 Eastchester Road
Bronx, NY 10461-2297
(800) 223-8087

- (36) Natural Wood Strips-Holly (DOV9)

Note: A 36" strip is more than enough for the Jewelry Case project, but Constantine's has a minimum order of a dozen 36"-long strips.

The fabric (velour or velveteen) used to line the trays in the Jewelry Case can be purchased at most fabric stores. To cover the bottom of both trays you will need a piece about 12" x 12".

We purchased the ⅛"-thick mirror for the bottom side of the lid from a local glass store. It measured approximately 6" wide by 10" long. (Have it cut to fit the inside dimensions of the lid frame.)

BLOCK PLANES

The block planes discussed in the articles beginning on page 14 are generally available in hardware stores and from almost all mail order tool catalogs. We purchased our block planes from:

Woodcraft
210 Wood County Industrial Park
P.O. Box 1686
Parkersburg, WV 26102-1686
(800) 225-1153

- Stanley Standard Block Plane No. 9½ (17S62)
- Stanley Low-Angle Block Plane No. 60½ (17W42)
- Record Standard Block Plane No. 9½ (02B20)
- Record Low-Angle Block Plane No. 060½ (01B11)

Another good source for block planes is to shop local flea markets and garage sales. Just be sure you have the "new" prices well in mind to get the best deal.

BRUSHING LACQUERS

We tried a number of brushing lacquers while preparing the article on page 20. We used Behlen's Brush Lacquer on the Jewelry Case. You can order it and the other finishing supplies mentioned from:

Wood Finishing Supply Co., Inc.
100 Throop St.
Palmyra, NY 14522
(315) 597-3743

- Behlen's Brushing Lacquer, 1 Qt. (B612-00156)
- Behlen's Brushing Lacquer, 1 Gal. (B612-00157)
- Behlen's Brushing Lacquer Thinner, 1 Qt. (B612-01006)
- Behlen's Pore-O-Pac Paste Wood Filler, Medium Brown Mahogany, 1 Qt. (B774-06F86)
- Behlen's Solar Lux (NGR) Stain in Pts. and Qts. (see catalog for colors)
- Behlen's Jet Spray Sanding Sealer, 15 fluid oz. can (B101-0803)

We also tried other brands of brushing lacquer. Here are the names, sources, and some of our comments after testing each:

Behlen's Qualatone Velvet Lacquer: Can be brushed or sprayed. Easier to brush than Behlen's Brush Lacquer since it's a little thinner. Dries slightly cloudy. Commonly used by muscal instrument makers. This product is available from:

Wood Finishing Supply Co., Inc.
100 Throop St.
Palmyra, NY 14522
(315) 597-3743

- Behlen's Qualatone Velvet Lacquer, 1 Qt. (B611-03176)
- Behlen's Qualatone Velvet Lacquer, 1 Gal. (B611-03177)

WoodFinishing Enterprises Brushing Lacquer: Very clear in the can. About the smoothest and easiest to apply. This lacquer is a little heavier than Qualatone but thinner than Behlen's Brush Lacquer. It can be ordered from:

WoodFinishing Enterprises
1729 N. 68th St.
Wauwatosa, WI 53213
(414) 774-1724

- WoodFinishing Brushing Lacquer, 1 Qt. (22-22605)

Note: WoodFinishing Enterprises is a very small, specialized finishing company. Because they are so small, they can sometimes be a little slow in processing your order. They will send a free catalog on request, but be patient.

Deft Clear Wood Finish and Deft Wood Stains and Minwax stains mentioned in the article should be available at many local paint, hardware stores, and lumberyards. Both Deft and Minwax products can also be purchased from the following suppliers:

Craftsman Wood Service Company
1735 W. Cortland Ct.
Addison, IL 60101
(800) 543-9367

The Woodworkers' Store
21801 Industrial Boulevard
Rogers, MN 55374-9514
(800) 279-4441

SPRAY SYSTEMS

We mentioned two high volume, low pressure air spray systems in the article on page 20 on brushing lacquers. If you would like more information and the name of a local dealer contact:

Apollo Sprayers Int., Inc.
1030 Joshua Way
Vista, CA 92083
(619) 727-8300

Croix Air Products, Inc.
520 Airport Road-Fleming Field
So. St. Paul, MN 55075
(800) 328-4827, Ext. 1240

SUEDE-TEX

You can order the Suede-Tex supplies mentioned on page 23 from these mail order suppliers or straight from the manufacturer, DonJer Products Company:

Constantine's
2050 Eastchester Road
Bronx, NY 10461-2297
(800) 223-8087

Woodcraft
PO Box 1686
Parkersburg, WV 26102-1686
(800) 225-1153

DonJer Products Company
Ilene Court, Building 8
Belle Mead, NJ 08502
(800) 336-6537

DonJer Products has a free brochure, and a product sample is available on request.