

Harry Bryan's Workshop Series

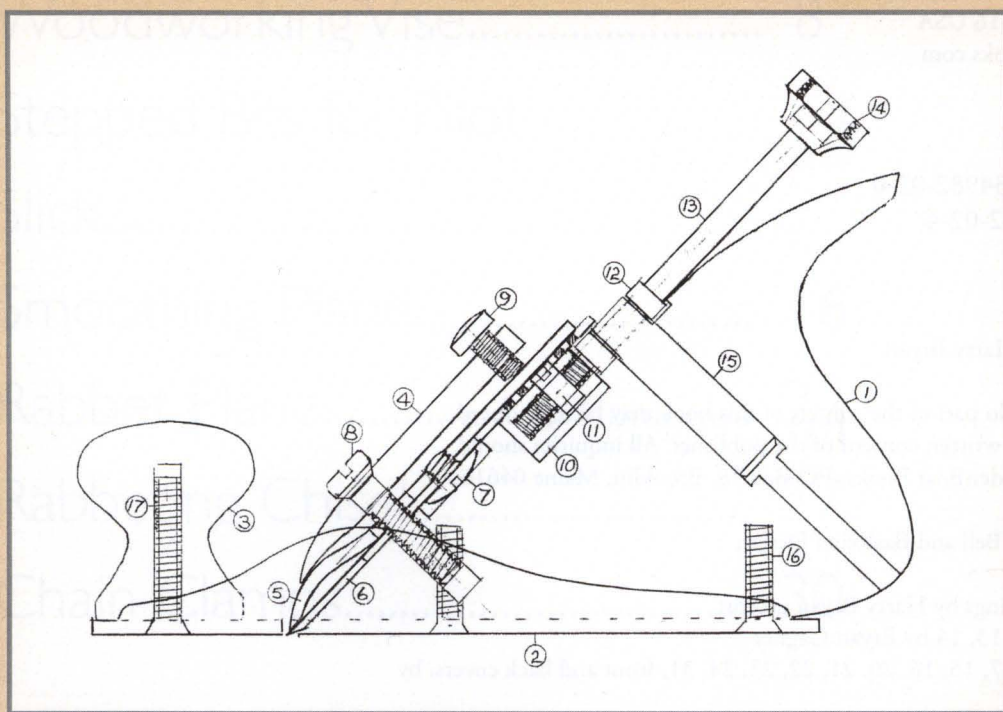
MAKING HAND TOOLS



Rabbet Plane • Bevels • Pencil Divider • Step Bits • Chain Clamps
Slick • Smoothing Plane • Rabbeting Chisel • Woodworking Vise

Harry Bryan's Workshop Series

MAKING HAND TOOLS



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Boatbuilder's Bevels

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Boatbuilder's Bevels

In cabinet work and in house building, most cuts are made at 90 or 45 degrees. A framing square or combination square is used to lay out the lines for these cuts. A house carpenter employs a bevel square (more commonly just called a bevel) for the few fits that must be made at other angles. In contrast, a boatbuilder finds that most cuts are other than 90 or 45 degrees, and the bevel becomes an important and often-used tool. Because a boat has so many confined places in which we need to take measurements, the thick-bodied carpenter's bevel with its large wing nut for locking the blade can be a frustrating and inaccurate tool to use. Some bevels have a clamping lever that is flush with the side of the stock, or have the wing nut on the opposite end from the blade pivot, but the thickness of the tool's stock still can be awkward—especially when you lift bevels from a flat surface such as a drawing or lofting. The standard carpenter's bevel has its good points, such

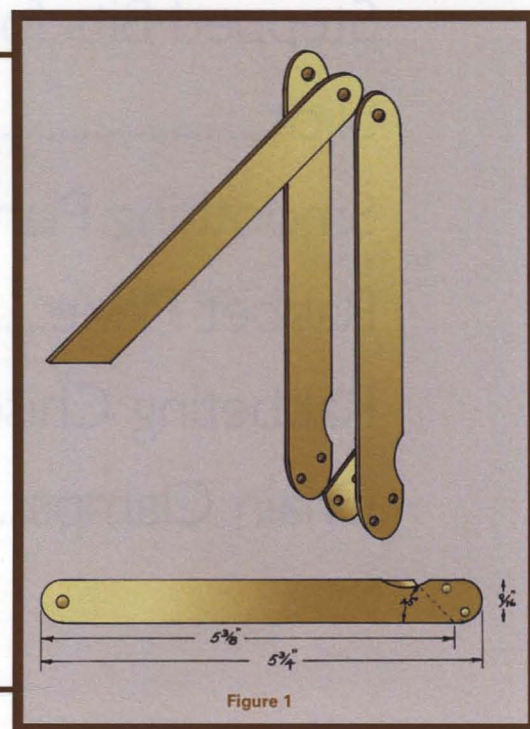
as a strong clamping mechanism and a sliding blade that gives complementary angles, but I find that more and more I reach for one of the two boatbuilder's bevels presented here. I made the single-bladed bevel shown in Figure 1 some years ago. It has proved just right for reading plans, as the thin pieces of the stock allow the blade to lie close to the paper. It works equally well for taking bevels off the boat's structure—only occasionally being restricted by the length of the blade. Figure 2 shows my version of a tool called a boatbuilder's bevel in R.A. Salaman's *Dictionary of Woodworking Tools*. His example has a 12"-long hardwood stock "used by shipwrights." The tool also appears in the Edward Preston & Sons 1901 catalog from Birmingham, England. The second blade, being much shorter, will be found useful in restricted spaces. I believe that the 7" version shown here will be better suited for most boat work.

Tools Needed to Make These Bevels

- High-tension hacksaw frame with a medium, 24-teeth-per-inch blade
- Mill file and half-round file: 8" or 10" long
- Set of twist drills
- Centerpunch
- Countersink for metal
- Extra-fine Sharpie marking pen, or equivalent, for layout
- Light ball-peen hammer

Materials

- Sheet brass or stainless steel, 1/16" thick
- 10-gauge copper nails for the pins that hold the stock together
- 8-gauge copper nails for the blade pivot pins



Construction

The following directions are for the two-bladed bevel, but they also should serve for the single-bladed tool. Draw the parts carefully. The more accurately you draw and saw, the less filing will need to be done. Saw out the pieces, and file them to the marked lines. Make sure all edges are straight so the tool will lie solidly when taking bevels, and so its edges can be used as miniature straightedges for future layout work. Hold the file lengthwise along each edge for the finishing strokes. In this way, because the file is straight, the edge it creates should also be straight. Try to shape the rounded ends as accurate half-circles. Do not file the rounded hollows on the edges yet. Clamp the longer blade in place between the two pieces that

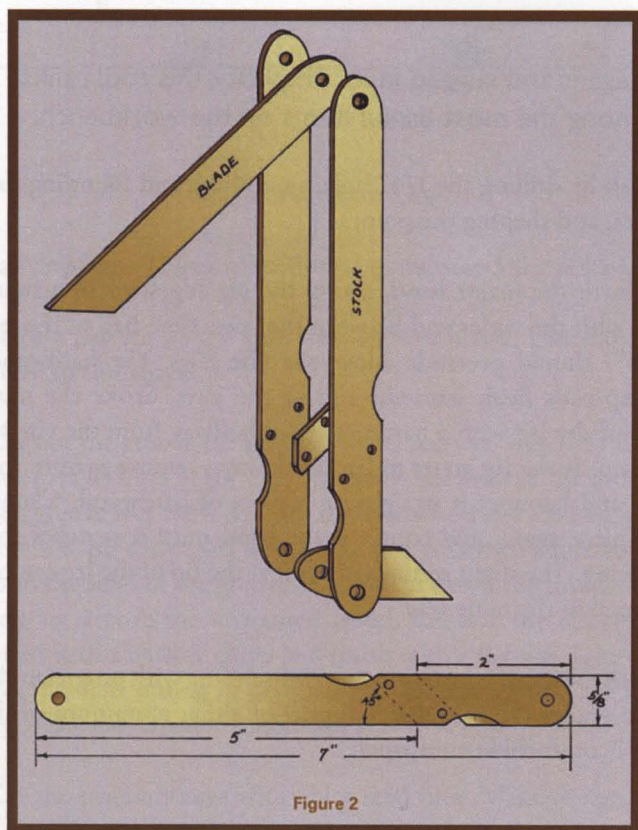
form the stock. Centerpunch for the long blade's pivot hole. Drill for the 8-gauge pivot pin. Size the drill using a caliper or a test hole in a scrap of metal. The fit should be close if the finished tool is to be solid and accurate. A loose fit has the risk of bending the pin when peening—a definite problem. Occasionally one drill in your kit will be too small and the next size up will be too big. One solution for this difficulty is to drill the hole slightly undersize, and then file the copper nail to fit. To do this filing accurately, first cut off the head of the nail, then chuck it in a drill. Close the jaws in your vise so the gap between them is slightly smaller than the diameter of the nail.

Lay the nail along this groove and, with one hand holding the drill, turn it on and run it at a moderate speed in a direction which has the top surface of the nail moving toward you. With your other hand, file the moving nail with long, slow strokes until it fits the hole. If you have confidence in your ability to sharpen drills (see *WoodenBoat* magazine No. 121), you can get the slightly smaller drill to make a larger hole by grinding it so that one of the drill tip's two cutting edges is longer than the other. The point of the drill will then be slightly off-center, and it will drill an oversize hole. This trick will also work in hardwood to ease the driving of bolts if there is danger of their seizing or bending because the hole is too small. After drilling the hole, countersink it slightly on both outer surfaces of the stock. Insert the 8-gauge nail (don't cut it to length or peen it yet). With the blade in the closed position, fit the filler piece that separates the two stock sides and lies in contact with the blade ends when the blades are closed. Drill for 10-gauge pins, and countersink the outer surfaces. Rivet the two halves together as follows: Cut each pin so that it protrudes about 1/16" from the stock on each side. Lay the assembly over the anvil on your machinist's vise (or some other heavy piece of steel) and slightly peen one end of the pin. Turn the assembly over and peen the other end of the pin, trying to flare out the pin equally on both ends. Continue tapping the pin until it is firmly seated in the countersink. If you judged the pin length correctly, there should have been only slightly more than enough material to fill the countersink. File the excess flush with the surface. Now fit the short blade, and drill and countersink for its pivot pin. Cut the pivot pins for both blades to length,



and rivet them in place. Peen them slowly and keep testing the friction in the blade movement as it gradually increases. When the blades feel right, file the pins flush with the surface. Note the position of the indentations for pushing the blades out from the stock. File these to shape with the half-round file. Filing may create a burr on the inside of the stock that can be removed with the tip of a jackknife.

The basic construction is now complete, but you will probably find that the edges need filing to bring all three layers into alignment. Soften the sharp edges ever so slightly and buff the metal to a nice shine. As you use these bevels, especially when new, the blade will gradually become loose. To correct this, place the tool on a heavy metal surface and tap the pivot pin slightly with the flat (not ball-peen) head of a hammer. Be careful not to get it too tight.



Boatbuilder's Pencil Dividers

While pencil dividers (or compass) are a handy tool for a carpenter, they are practically indispensable to boatbuilders. Most of the fits between pieces in a boat involve curves and compound angles. Scribing with dividers is usually the easiest and most accurate way of achieving a tight joint.

Using dividers to spile the shape of a plank is the preferred method of many builders, but scribing and spiling often require that the dividers be used in restricted spaces. The tool must also be rigid in its setting in order to do accurate work.

There are plenty of flimsy or delicate dividers on the market. There are some excellent rugged workshop methods; but the pencil is usually held at an angle to the leg, which restricts its usefulness in tight places.

The dividers presented here have proved to be most satisfactory in use. They are decent to look at and have a good feel in your hand.

Materials

1. Steel leg: 3/16 x 3/4 x 6 1/2" mild steel
 2. Wooden leg: 5/8 x 3/4 x 4 7/8" hardwood
 3. Spring-type automotive hose clamp: 1/2" inside diameter
 4. 1/4-20 x 1" bolt
 5. 1/4" flat washer
 6. 1/4" wing nut (A brass or stainless bolt, washer, and nut will add a touch of class.)
- Total cost of materials: less than \$3.
Time to complete: Irrelevant.

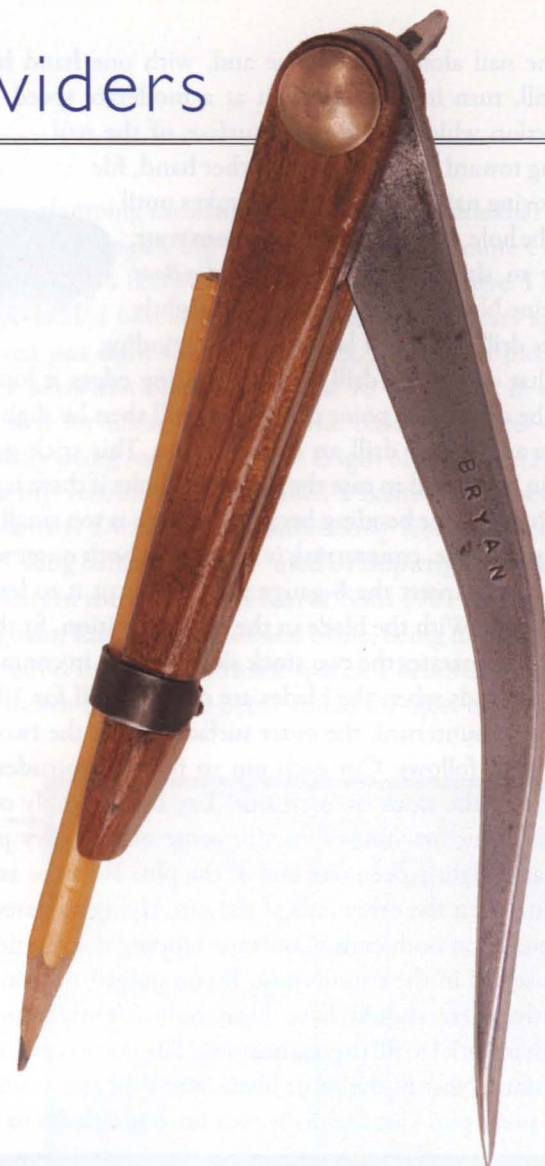
Making the Dividers The Steel Leg

Procure a 3/16"-thick piece of mild steel from a welding shop or steel fabrication shop.

Make a pattern of the shape (straight, not bent) from the illustrations shown here. Manila file folders make good pattern material.

Trace the pattern onto the steel, and make the long tapered cut with a hacksaw.

Form the round end by cutting off the corners of the steel leg with a hacksaw and finishing with a grinder and file.

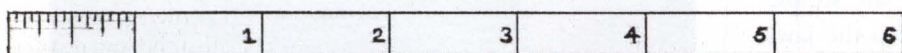
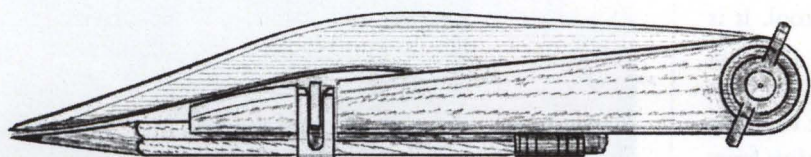
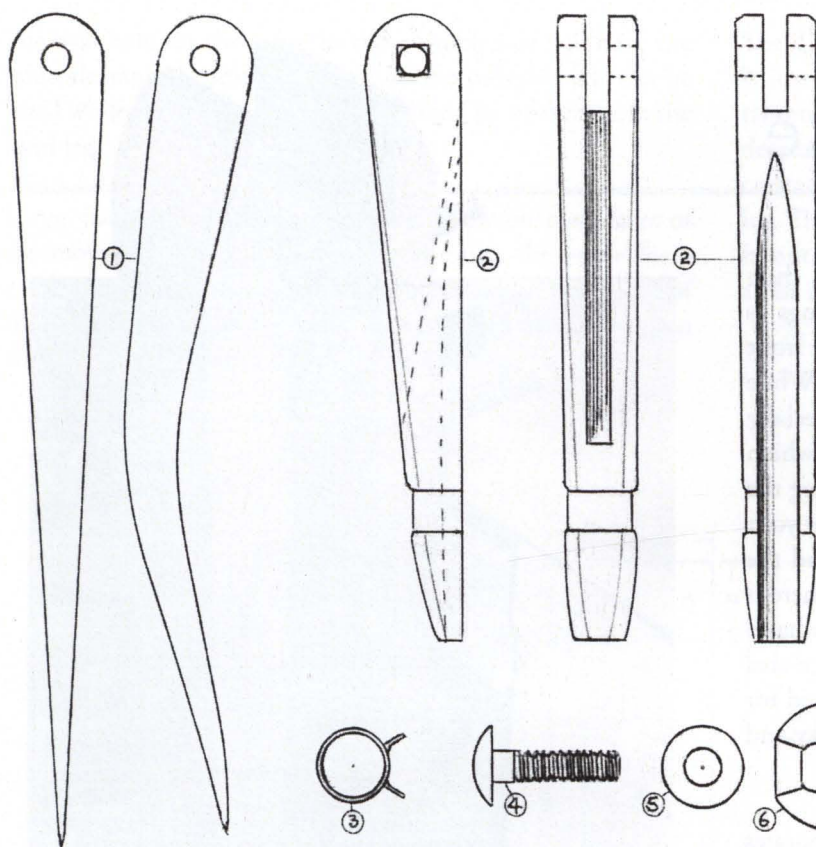


Elegant and rugged in its simplicity, this tool ranks among the most useful items on the workbench.

Finish by drilling the 1/4" hole, smoothing and rounding the edges, and shaping the point.

To form the major bend, clamp the leg edgewise in a stout vise with the wider end between the jaws. One-half of the leg (3/4") should protrude above the vise jaws. Use hardwood clamp-pads flush with the top of the jaws. Strike the near side of the leg with a hammer about halfway from the vise to the tip. If the leg starts to bend sideways, remove it from the vise and hammer it straight on a piece of hardwood. Clamp the piece again, and continue the bend until it matches the drawing. The slight secondary bend at the tip of the leg can be formed in the same way.

Polish the leg, if you desire, by hand-sanding with progressively finer grades (150-, 220-, 320-grit) of either aluminum-oxide or silicon-carbide sandpaper.



The Wooden Leg

Saw and plane a block of hardwood to measure $5/8 \times 3/4 \times 4 7/8$ ".

Trace a pattern of the side view on this blank. Cut out and finish to this shape.

Cut out the groove for the steel leg as follows: Carefully draw two parallel lines $3/16$ " apart to define the sides of the groove. The groove will show $3/4$ " on the side where the steel leg goes and $3/4$ " on the pencil side. Make two cuts with a fine saw to form the sides of the groove. A third cut down the middle will help to remove the unwanted wood. Remove the remaining wood with a narrow chisel and finish with a flat file. Take care to get a nice, sliding fit between the wooden leg and the steel leg at the end where the bolt will go.

Cut the pencil groove with chisel and files. Make the groove

somewhat V-shaped and about $1/4$ " wide at the surface. You don't want the pencil to roll at all when it is held in place with the spring clamp. If the groove is slightly concave lengthwise, this will help to hold the pencil solidly.

Drill a $1/4$ " hole for the bolt. A piece of wood placed in the steel-leg slot while drilling will help ensure a nice, clean hole. Use a sharp, narrow knife to square up one side of the hole to accept the carriage-bolt head.

Taper the sides of the leg slightly. It should measure $5/8$ " thick at the bolt hole and a little less than $9/16$ " thick at the small end before it tapers to the tip. Mark the location of the seat for the spring clamp, and taper from the lower edge of the seat to the tip. Leave a strong $1/16$ " of wood around the end of the pencil groove.

File the seat for the spring clamp. Use pliers to open the clamp, and trial-fit it often as you proceed.

Finishing

Assemble the dividers and see if the shape of the steel leg needs any fine-tuning in order to make a close fit with the pencil tip as shown in the drawing. Varnish the wooden leg.



Woodworking Vise

One of the essential tools in the boatbuilder's shop is good vise. What is referred to in tool catalogs as "woodworking vise" usually mounts under the front of the workbench; its jaws are level with the bench top. While this configuration is ideal for many operations, especially planing the edges of planking, there are many jobs for which a vise mounted above the bench is far superior. Clamping the work above the bench brings it closer to eye level without your having to stoop. You can saw off stock held in jaws, and the height is far better for filing and rasping. In addition, there is much less restriction when using a drawknife or spokeshave. The jaws of machinist's vises don't have sufficient surface area to prevent crushing the wood. Because they are designed for maximum strength, the jaws of machinists' vises are bulky and get in the way of some woodworking operations.

The vise shown here is not difficult to build, and it incorporates most of the features that I feel are essential for this tool. It is heavy and rigid to help prevent chattering as we're planing, and it transfers stresses to the bench and shop floor. Its jaws are cut away as much as possible so they don't restrict working on complex shapes. Heavy steel inserts in the clamping faces ensure that metal objects can be held without damage to the vise. Also, the meeting edges can be kept sharp in order to hold small projects. While leg vises of this sort are simple and strong, some provision must be made to keep the jaws parallel throughout their operating range. The usual way is to include a sliding tenon at the bottom of the movable jaw with a series of holes to lock it in place. This system works, but the adjusting increments are necessarily coarse. The worker must bend down to remove and replace the pin for each adjustment. Our vise requires only that you lift the movable jaw slightly while it is moved to a new clamping width.

The drawings include all the dimensions needed to build this vise. The following tips should help to ensure the success of your project.

The wood for this tool should be hard and heavy. Its mass will help to dampen vibrations, while its hardness will help to hold fastenings and keep the sliding bars firmly fixed in the movable jaw. The teeth in the lower sliding bar are cut with a hacksaw and cleaned up with a three-cornered file. A high tension hacksaw frame fitted with good-quality blades is worth the investment. A coat of pigmented shellac, white paint, or machinists' layout dye will help in drawing accurate markings on the steel. The easier way to fit the steel bars accurately and securely in the movable jaw is to make their mortises oversized.



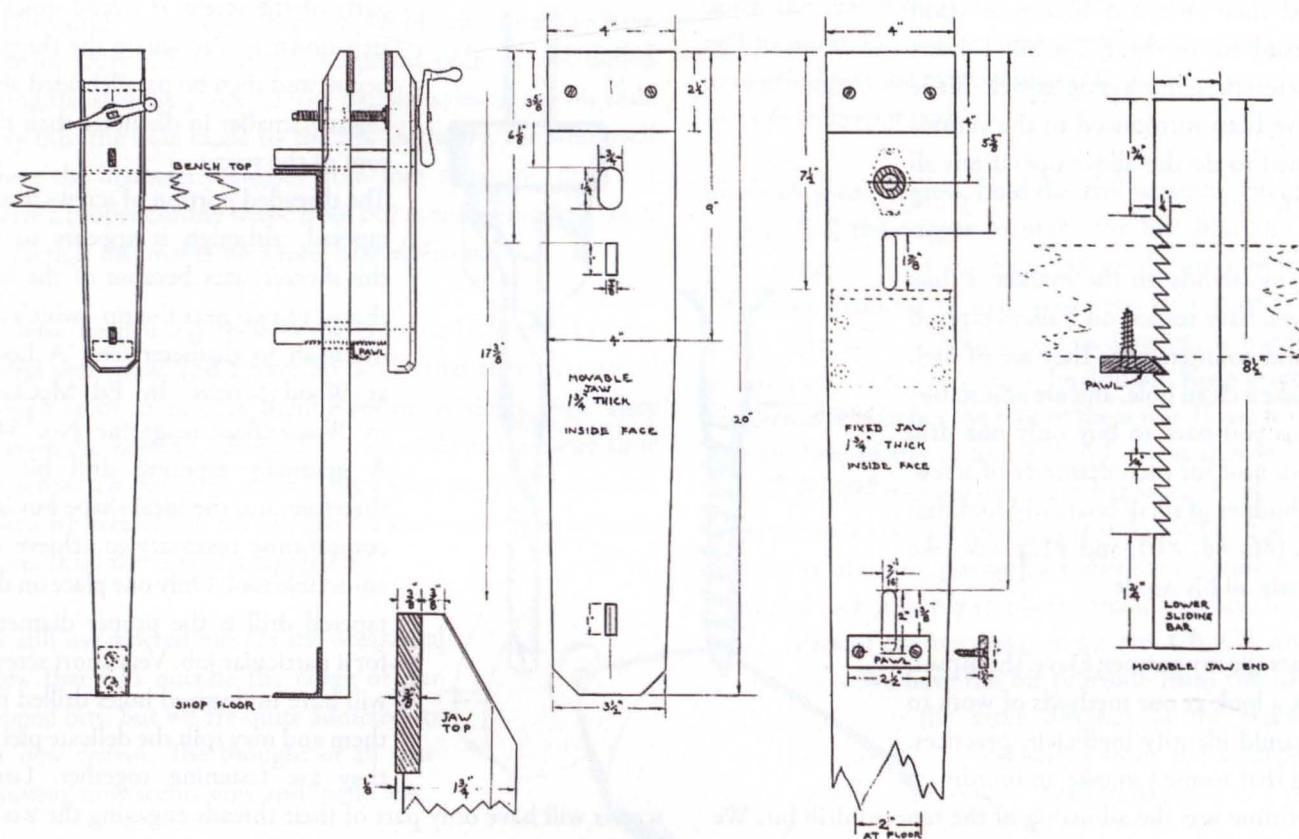
The tapered leg of this heavy and sturdy vise transfers stresses to the bench and shop floor. Planing can be accomplished without chattering. Work is held at a comfortable height, and the jaws provide a secure grip without crushing the wood.

Then coat the mortises and ends of the bars with thickened epoxy to ensure a proper fit. The mortises for the bars in the fixed jaw should be wide enough for a sliding fit. When laid out correctly, the vertical heights of these mortises will allow the teeth in the lower bar to lift clear of the pawl.

The oval hole for the screw in the movable jaw will have the same clearance beneath the screw so the movable jaw can be lifted while the screw remains constrained by its threads in the fixed leg.

Large, flat washers are fitted over the screw on both faces of the movable leg. Drill a 1/8" hole through the screw for a cotter pin to hold these washers against the leg. The thrust of this cotter pin against the inner washer causes the jaw to open when the screw is backed off.

The distance from the top edge of the jaws down to the screw is just under 4" and is typical of most vises. You might be tempted to increase this depth, but the clamping pressure will decrease significantly as the screw is moved toward the fulcrum created by the pawl engaged in a notch of the lower sliding leg. The success of this project will depend largely on accurate layout, so sharpen your pencil often and you will make a good a vise as you can buy on the market—maybe even better.



The drawings detail the simple construction of this vise, but success depends on accuracy. Work with sharp pencils and tools.

Materials

- Fixed jaw, 1 3/4" x 4" length 7 1/2" above bench, plus distance from bench to floor.
- Movable jaw, 1 3/4" x 4" x 20". Both jaws oak, maple, beech, or other dense hardwood.
- Jaw pads, 3/8" x 2 1/2" x 4" mild steel.
- Sliding bars, 2 (3/8" x 1" x 8 1/2") mild steel.
- Pawl, 1/4" x 1" x 2 1/2" mild steel.
- Bench top angle, 1/4" x 3" x 3 7/8" long.
- Floor angle, 1/4" x 3" x 1 7/8" long.
- Two 5/8" flat washers.
- One 1/8" x 1" cotter pin.
- Twelve No. 12 x 1" flathead wood screws.
- Press screw, 11/16" diameter x 9" long.

Stepped Bits for Pilot Holes

Forty years ago, I built a 13' sailboat fastened with galvanized wood screws. The screws were closely spaced around each plank and deck panel. There were many hundreds of fastenings. I didn't know anything about special bits for drilling pilot holes for screws, and I didn't know about Yankee screwdrivers and had never tried driving screws with a bit brace. For each screw I drilled a pilot for the threads, a larger hole for the shank, and then switched bits once again to countersink for the head. Luckily I didn't need to counterbore for a plug as well. Since then, I have been introduced to the various bits designed to do the above operations all in one shot.

Of the many brands on the market, I, like many others, have settled on Fuller's tapered drill bits and countersinks. They are of high quality, make a clean hole, and are adjustable. That means you have to buy only one drill countersink unit for each diameter of screw. Thus, the builder of small boats will find that four units (#6, #8, #10, and #12) will take care of nearly all his needs.

Several years ago my partner, Dave Thompson and I took a look at our methods of work to see if we could identify inefficient practices. One thing that seemed to take an inordinate amount of time was the adjusting of the tapered drill bit. We were always changing the length of the drill bit, sometimes to match different screw lengths and sometimes to allow for different densities of wood. The set-screws that lock the position of the countersink on the drill bit eventually wear and begin to slip. Sometimes, this is discovered only after several too-deep holes have been drilled.

It occurred to us that if we had a set of drill bits and countersinks that was fixed for the most-often-used sizes, the time we would save would justify their costs. A further saving in time would be realized if these bits were stored on the wall in a well-labeled rack.

Tapered drills are considerably more expensive than straight ones. The nine sizes we felt were needed for the screw sizes we most often used represented a formidable outlay of cash.

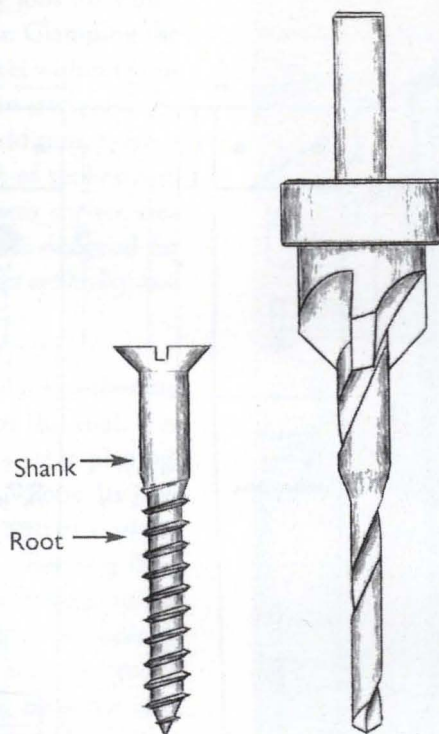
One way of saving money was to shape our own tapered bits from straight bits. (We would still buy Fuller's countersinks to fit these bits.) This had further appeal as a replacement bit, suitable for tapering, and would be available from the local hardware store. We began to look closely at tapered bits in order to understand what it was that we were trying to reproduce.

The ideal drill bit would start out as a large as the shank (unthreaded part) of the screw. It would quickly step down in size where the threads begin, and then be parallel sided and slightly smaller in diameter than the root of the screw.

The threaded portion of screws is not tapered, although it appears so in the shorter sizes because of the last thread of two near the tip—which do diminish in diameter (see "A Look at Wood Screws" by Ed McClave in *WoodenBoat* magazine No. 54). A gradually tapering drill bit is, therefore, not the ideal shape but is a compromise necessary to achieve an adjustable tool. Only one place on the tapered drill is the proper diameter for a particular job. Very short screws will have undersized holes drilled for them and may split the delicate pieces they are fastening together. Long

screws will have only part of their threads engaging the wood and will suffer a measurable loss of holding power. The tapered bit for #10 screws reaches the full diameter of the shank at a distance of 7/8" from the tip. Any threads beyond that length are not fully contributing to holding power.

We had decided to give up adjustability and so were free to grind a drill bit to produce steps that matched each length of screw. We tested the holding power of the stepped shape against the tapered shape by driving two screws to equal depths in spruce. One pilot hole was made with a tapered bit, one with a stepped bit. We then engaged the head of the screw with a goosenecked wrecking bar. This bar had a stout stick of wood clamped to its shank to increase the length of the bar to 4'. We attached a spring scale to the end of the bar and pulled on the scale until the screw was torn from the wood. The force required to remove the screw was recorded.



All tests indicated an increase in holding power for the stepped bit. Using #8 x 1¼" screws, the increase was 10%. For #10 x 1¼" screws it was 5%, and for the #10 x 1½" it was 15%.

Another disadvantage of the tapered bit is the amount of power required to bore a hole with it. When the bit is new and the edges of the flutes are sharp the power needed is not excessive, but it will still absorb more power than a straight bit because the entire length of the taper is cutting the wood. When the flutes become worn the bit becomes a dull wedge which burns its way into the wood. This is not a significant problem if you are using a 110- or 220- volt drill with plenty of power. It is a big problem with cordless drills, especially those in the lower voltage range. In contrast, the stepped bit needs only to have its point sharp. (The original sharpened point is not dulled during the shaping process.) The parallel sides of the bit slide easily into the hole made by the tip. In theory, the step itself (where the diameter increases from root to shank) does not receive a proper cutting shape from our grinding method. But, in practice, this makes no appreciable difference.

We have been using these home-grounded stepped bits for several years now, and I have no doubt that they have saved enough labor to pay for themselves many times over. They increase the holding power of screws while at the same time the screws are easier to drive. Often they need no lubricant. When we break a bit, we can grind a new one in five minutes at one-third the cost of a tapered bit.

We still use tapered bits for the occasional screw that falls outside the range of our stepped bits, but we are quite addicted to the new system. The thought of all that adjusting now seems slow and inefficient.

The nine bit sizes Harry uses are:

#10 — 1½", 1¼", 1"

#8 — 1¼", 1", 7/8", (The 7/8" can be used for 3/4" as well.)

#6 — 1¼", 1", 3/4" (The 3/4" can be used for 5/8" as well.)

How to Grind a Stepped Bit

Select a standard high-speed steel twist drill that matches the shank diameter of the screw you have chosen. A #6 screw will need a 9/64" drill bit, #8 needs 11/64", and #10 needs 13/64".

Hold the drill bit and screw side by side with their points aligned. Using a felt-tipped marker, make a line around the

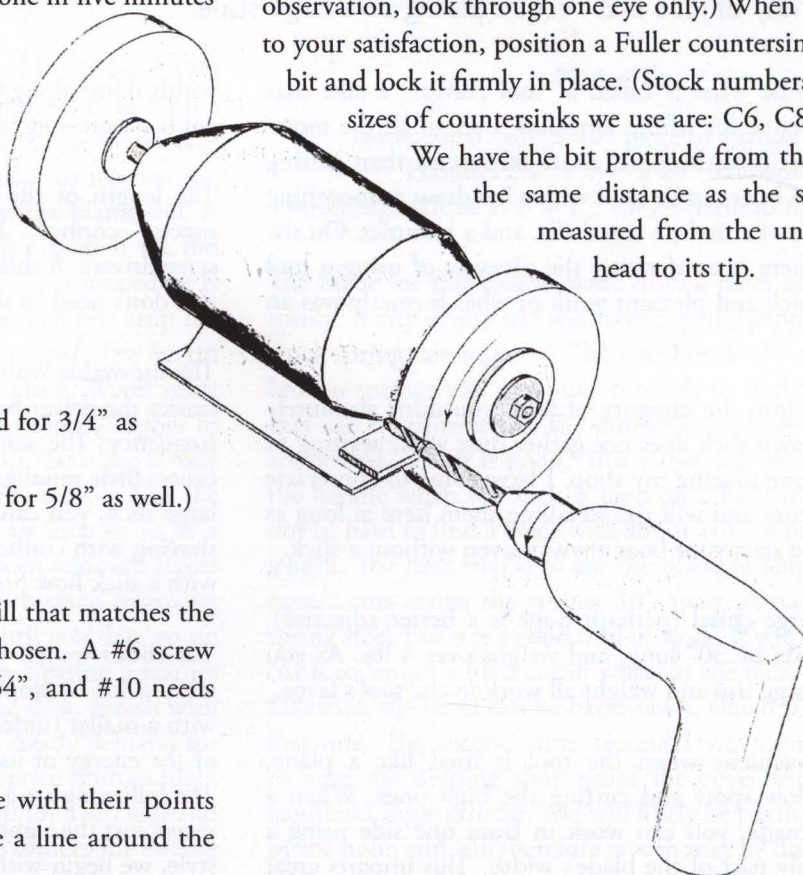
drill corresponding to the point where the threads of the screw end and the unthreaded shank begin.

Dress the stone on your bench grinder, if necessary, until it has a flat face and sharp corners. A good wheel dresser is indispensable if you hope to do more than the crudest class of work with the grinder. Now position the tool rest as close to the stone as you can without touching it. Chuck the drill bit in a power drill and hold it across the rest parallel with the grinder's motor shaft. Have a can of water close by.

With the drill turning in the same direction as the stone (meeting faces going in opposite directions), begin grinding down the diameter of the drill bit between the marked line and its point. Go slowly, being careful not to produce a taper or to grind past the marked line. Dip the bit in water every few seconds to keep it cool.

To check your progress, hold the drill between you and a light source. Pull the trigger to make the bit spin, and you will get a good sense of its shape. Make the step, or transition, from root diameter to shank diameter as abrupt as you can. Some taper here, as shown in the drawing, is inevitable and contributes to the strength of the drill bit. Keep grinding until the diameter matches the root of the screw. If you hold a screw directly behind the spinning drill bit you should be able to see the threads sticking out on either side. (As you make this observation, look through one eye only.) When the shaping is to your satisfaction, position a Fuller countersink on the drill bit and lock it firmly in place. (Stock numbers for the three sizes of countersinks we use are: C6, C8, and C102.)

We have the bit protrude from the countersink the same distance as the screw's length measured from the underside of its head to its tip.



Boatbuilder's Slick

A massive chisel you can build



A slick is basically an oversized and weighty chisel, usually 3" wide. It has myriad uses in the boatshop. Boatbuilders commonly employ it for cutting plank scarfs (as shown above) and for a variety of jobs that require paring on a large scale.

I try not to be what is called a "tool cultist." I take that to be someone for whom amassing a set of all the most-sought-after tools becomes more important than getting the job done. A boat can be built with a handsaw, a smoothing plane, a couple of chisels, a few drills, and a hammer. On the other hand, there is no denying the pleasure of using a tool that makes quick and pleasant work of what formerly was an onerous task.

The slick falls into the category of tools you don't absolutely need, yet my own slick does not gather dust while waiting to impress someone touring my shop. I have come to appreciate its unique virtues and will risk detailing them here as long as you promise to start your boat anyway, even without a slick.

A slick is a large chisel (perhaps huge is a better adjective). Mine is 3" wide by 30" long, and weighs over 4 lbs. As you will see, this large size and weight all work in the tool's favor.

Width is convenient when the tool is used like a plane, bridging the low spots and cutting the high ones. When a heavy cut is made, you can work in from one side using a corner and only part of the blade's width. This imparts great pressure to the shortened cutting edge while the extra blade

width skims along the newly created surface assuring that the cut is progressing in the desired plane.

The length of the tool (blade and handle combined) gives precise control. I first realized this while comparing screwdrivers. A short, stubby screwdriver is a miserable tool if you don't need its short length.

The inevitable wobbling of your hand when force is required causes the driver head to jump out of the slot with annoying frequency. The same wobbling with an 8"-long screwdriver causes little misalignment at the tip. With the 30" length of a large slick, you can choose to take a heavy cut or a gossamer shaving with confidence. It often surprises those not familiar with a slick how precise and delicate such a large tool can be.

The slick's weight is its real secret. Once you get it going, it takes a lot to stop it. It is a push-by-hand tool, so striking with a mallet (unless it was absurdly huge) would have much of the energy of its blow absorbed by the mass of the blade. The following are a few of the jobs in our shop where the slick seems just the right tool. When we start planking a boat dory style, we begin with the boat upside down and its framing in place. The fore-and-aft-planked bottom comes next, followed



If you're lucky, you might come across a used slick like the top one (the author's "Fulton") at a flea market or an antique tool shop. Alternatively, you can make one yourself from a piece of broken truck spring and wood scrap.

by the garboards, which are hung overlapping the bottom, and left proud. Trimming off this extra wood would be ideal for a drawknife except that its grips prevent its cutting flush with the bottom. The slick doesn't have this problem, and its wide blade assures that the cut progresses parallel with the bottom until nearly flush. A few passes with a smoothing plane will help you finish the job.

Although we cut most of a rabbeted stem with a 1" mortising chisel and mallet, much of the final smoothing is done with a slick. Here, the weight of the tool helps in paring the surface of the tough oak, while the long length helps us see that the slick's blade is coming at the rabbet just as the plank will. A favorite job, and one that justifies having a slick if we did nothing else with it, is cutting plank scarfs. Our procedure is a common one. Set the two pieces to be joined one atop the other, their ends offset by the length of the scarf. The length of the scarf is also marked on the upper piece. Wood must now be removed to change the step-down from the upper to the lower plank into a straight, sloped cut. Starting at one side, use the corner and about 1" of blade to remove half the depth of wood. Move the slick sideways an inch or so at a time until that same amount of wood has been removed across the board's width. Repeat the process as necessary, removing one half the remaining depth each time until you dare go no farther. You should be less than 1/8" from creating a feather edge on each piece before you abandon the slick. Finish with a good, sharp smoothing plane. There is a steady demand for secondhand slicks, they are scarce and the price is often high. I would expect to pay the best part of \$100 for a secondhand slick in good condition. I have listed some sources for buying good-quality new slicks at the end of this article. I own two

slicks. One, I bartered for. It is a "Fulton," a brand name once used by Sears, Roebuck and Company. My 1908 Sears reprint catalog lists it for \$1.04, so you see, you shouldn't have waited so long to get one. My second slick is handmade. If you don't count the oak handle that I made from an offcut, the total cost was about \$10 for labor at the local welding shop. It works as well as the commercial equivalent in every way.

Materials

Blade: 7/16" x 3" x 10" piece of a truck spring

Handle: 2 1/4" x 2 1/4" x 24" hardwood

Fastenings: Three 1/4" x 1", 10-24 flathead machine bolts

The blade for this tool is made from a piece of broken truck spring. A city of any size will have a spring shop where broken truck springs are repaired. There will undoubtedly be a pile of broken springs you can hunt through to find a piece or two that can be trimmed to the dimensions above. Most springs are bowed, which is good. This curve will give clearance for the handle when the slick is used on a flat surface. It should not be hard to find a piece with about 1/8" of bow over 10" of length. The next step is to cut the blade to length by making square cuts across the spring, 10" apart. A hacksaw will cut spring steel, but it is a good deal of work. It will be far easier to cut it to length with a cutoff wheel at the local welding shop. Likewise, the bevel can be hand-sawn, which is how I did the first one. The second time around I was more than happy to have the welding shop grind the bevel with a powerful, handheld angle grinder. You will likely be paying for any work by the hour, and will therefore save money by drawing cut lines and the limit of the bevel ahead of time. If you are able to find

a piece of spring that is 7/16" thick, a bevel ground 1" back will give the proper angle of 25 degrees. Grind the corners of the spring at the opposite end from the cutting edge so there will be a nice transition from the blade into the handle. Back at your own shop, refine the bevel with a file, and then sand the whole blade to a nice finish. It is much easier to bring the blade to its final shape now, while it is still soft enough to file; any overheating due to grinding is not an issue. Any shaping with a grinder after hardening and tempering will have to be slow, cautious work. Next, you'll want to make a handle. If you have a wood-turning lathe, chuck a piece of hardwood 2¼" x 2¼" x 26" and turn it to the dimensions shown on the drawing (facing page), then trim it to length. If you don't have a lathe, lay out the dimensions on one face, then saw and



A slick's size doesn't mean that it isn't adaptable. Even the largest ones, when properly sharpened, can render a very thin shaving and give the builder a great deal of control in his work.

finish opposite faces to the line. Turn the stock 90 degrees, lay out the shape again, then saw and finish it so the handle is accurate but square in cross section. Use a spokeshave to take the corners away until the piece is accurately eight-sided. Proceed to 16 sides, and then sand it until it is round and smooth. With the handle made, saw out the half-lap where it overlaps the blade, mark the bolt pattern on the handle, clamp the two parts together, and drill down through all with a 13/64" drill bit. This is a pilot hole. The holes in the wood will be enlarged to 1/4" and they will be countersunk to accept the bolt heads. The 13/64" holes in the steel blade are actually a little oversize for a 1/4-20 tap because the spring steel is quite tough. The large pilot hole reduces the chance that the tap will break. If tapping is still difficult (even using plenty of cutting

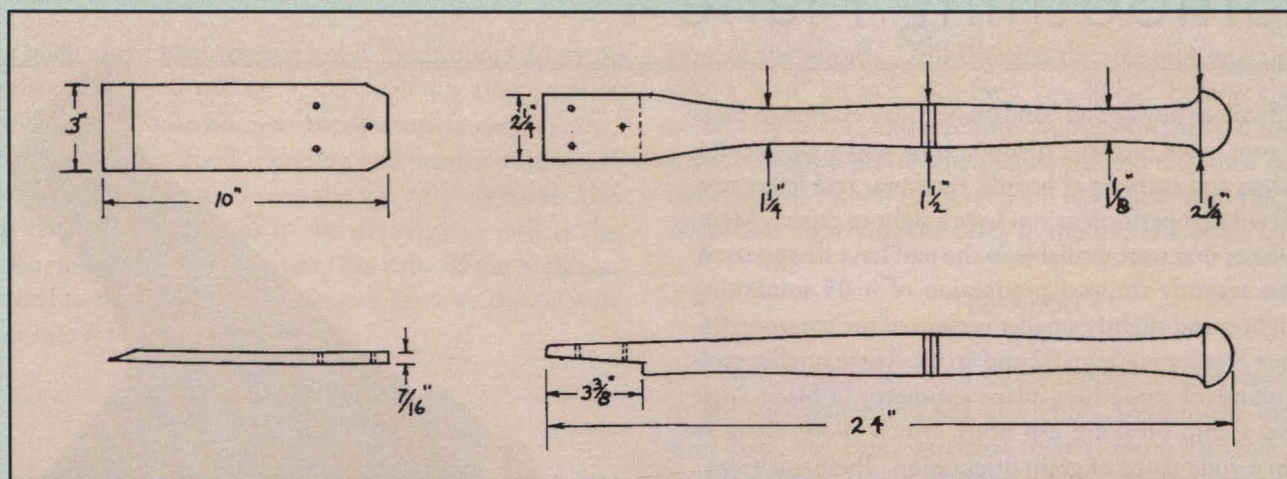


A slick can remove a great deal of material in short order. No doubt, this is one of its most satisfying uses. It can be used to peel-off huge and bulky shavings without chipping or tearout.

oil and properly backing the tap as you go), the pilot hole can be enlarged to 7/32". This leaves a very shallow thread in the blade. Nonetheless, there is little strain on these fastenings and they will have sufficient strength. Although the blade can be sharpened and used as is, it is likely you will find the edge too soft, so it requires frequent resharpening. The hardening and tempering required for this tool are, in theory, dead simple.

Step one is to heat the blade (or at least 2" of the beveled end) to a red heat, then drop it into a bucket of water deep enough to cover it. Next, transfer the blade to a 500-degree oven until the blade reaches that temperature. Then, turn the oven off and remove the blade when it is cool. That's the theory, but let's break the process down and look closer at each step. We are trying to achieve an intermediate hardness, hard enough to stay sharp for a reasonable length of time, but not so hard as to be brittle and chip when hitting a tough knot.

Steel cannot be gradually increased in hardness to something between soft and fully hard. It can only be fully hardened and then gradually softened to the desired hardness. Therefore, the first step is to fully harden the slick's blade. There is no need to harden more than 2" of the blade, as a lifetime of boatbuilding would be unlikely to wear away more than 1/2". Heat the beveled end until it is bright red. Orange is too hot. When the desired temperature is reached, a magnet will no longer stick to the metal. I use my shop wood stove for most of this work. Rake a deep bed of hardwood coals near the draft. Place the end of the blade in the coals and put more dry wood on top. Have a full bucket of room-temperature water next to the stove. After about 10 minutes, when the end of the blade has reached a bright red heat, pull the blade to the door with a poker, then pick it up using a gauntleted



Making a slick requires only rudimentary metalwork and some simple woodworking. If you have access to a lathe, you can make quick work of turning the handle. Trim all pieces to the dimensions shown and assemble as directed for a slick that is balanced-feeling and fun to use.

glove and large locking pliers. Fully immerse the blade in the water and swirl it around until it stops hissing. It is crucial to make the transfer to the water quickly while the blade is still in the bright red, non-magnetic heat range. The blade should now be glass-hard. With the hardened point of an awl or steel scriber, pick a spot at the far end from the bevel where you did not achieve red heat. Pushing at the slick's blade with this point, you should be able to feel it stick slightly into the metal surface. Try the same thing at the bevel. If you successfully hardened the blade, your hardened point will only skid on the surface. If the point sticks in, try a file. If you can file the end that was heated, your hardening job was unsuccessful. Either you did not get the blade hot enough or you did not cool it fast enough. Lacking a suitable stove, you can take the blade to a welding shop and have them heat the end of the blade with an acetylene torch. Bring a magnet with you to help define the critical temperature. An automotive magnet is a good choice here. The important points here are: first, get the blade hot enough (it will not harden if you don't); and second, fully immerse the blade. I broke my first attempt by only partly immersing it. You may be advised to use oil for hardening, and that has advantages. The oil cools the steel a bit more slowly so there is less chance of cracking the blade. Peanut oil is a good choice, as it has a high flash point. However, a bucket of peanut oil is fairly expensive (although I suppose you could sneak most of it back onto the pantry shelf if your careful—just don't get caught. With oil there can be a lot of smoke and the risk of fire, so I'd stick with water. The blade is now too hard to be a practical tool. Its edge would crumble or chip in tough going. We need to temper the hardness. This tempering or softening is done by raising the temperature of the blade to a predetermined level, then allowing it

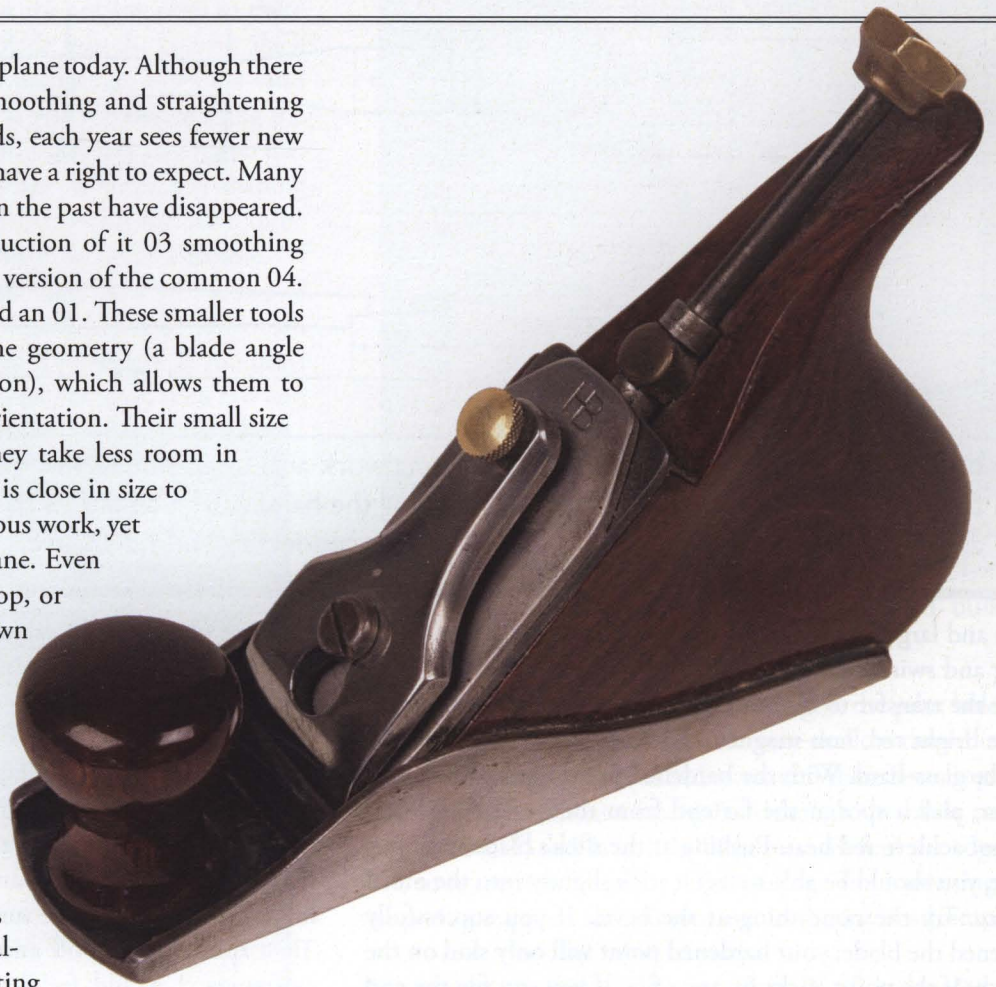
to return to room temperature. As the temperature of the steel rises above 300°F, its hardness begins to decrease. With this comes a consequent increase in toughness. Between 475 and 500 degrees, most hardened steels reach a balance of hardness and toughness that is suitable for woodworking chisels. The easiest way for an amateur to bring the slick to this temperature is in the kitchen oven. Put the blade in the oven, then set the temperature between 475 and 500 degrees. Leave the blade in for at least an hour to be sure it has reached that temperature. Then turn the oven off and let it cool. In this age of energy awareness, I would feel happier if you were to have some friends over for pizza while you do this, as the temperature is suitable for both operations.

The blade, which you once had nice and shiny, will be dirty gray/blue from the oxides formed during the heat treating process. But it will be easy to restore its sheen with fine sandpaper, a Scotchbrite pad, or buffing wheel. Attach the blade to the handle; hone the edge, and the slick will be ready for use.



7" Smoothing Plane

It is difficult to buy a good hand plane today. Although there is no tool more essential to smoothing and straightening the edges and surfaces of boards, each year sees fewer new planes offered that perform as you have a right to expect. Many types of planes that were available in the past have disappeared. Record has recently stopped production of its 03 smoothing plane, a lighter and slightly smaller version of the common 04. At one time Stanley made an 02 and an 01. These smaller tools have the standard smoothing plane geometry (a blade angle of 45° and a chip breaking cap iron), which allows them to cut well in a wide range of grain orientation. Their small size allows for one-handed use and they take less room in your kit. The plane presented here is close in size to the 02. It is large enough to do serious work, yet it has the advantages of a small plane. Even though it is made in your own shop, or rather because it is made in your own shop, it can cut better and will feel better in your hand than any plane available from the major manufacturers. Anyone can build this plane, using only the tools found in the average home shop. Thus, no castings are required, and there is no welding, brazing, or silver soldering. A metal lathe is not required and thread cutting is held to a few small operations.



Hints for Working with Metal

Marking: For drawing on metal, use a Sanford ultra-fine permanent marker or layout die, available from a machinist's supply store.

Sawing: A good hacksaw that holds the blade rigid makes a big difference in the control of the cut. Buy good blades. Most stores have several price ranges. Buy the best blades available. You will find that a new blade will make quick work of the most of the curves. Finish to the line with files.

Filing: Two files will do most of the work this project requires. A 10" half-round, double-cut machinist's file will work quickly to bring your saw cuts to the line, and a 10" single-cut mill file will produce a fine finish ready to polish. A 6" flat file and small round file also will be useful. The mill file will pick up metal chips which get stuck between the file teeth. These should be removed occasionally with a file card of sharp metal point.

Finishing: To finish the surface of the steel, do all shaping with the files, including rounding of edges where appropriate. Next, use 150-grit silicon-carbide paper to sand all file marks away. This is slow, but not unpleasant, work. Turn on the radio and sit in a rocker. Switch to 220-grit paper, then finally to 320.

Drilling: A drill press will be a great convenience for this project but is not absolutely necessary. Use a centerpunch to start holes accurately.

The Body

Cut the body of the plane from a heavy hardwood. Cherry or some other fruit-wood will serve, although a heavier tropical wood will give the tool a bit more momentum in rough going. Give the back edge a good rounding and work a nice shape into the extension that goes over the top of your hand. Use the top view (looking down) in the drawings as well as the accompanying photos to guide you. The sides of the body can be sculpted to fit the thumb and fingers, but this should wait until the sole is fitted.

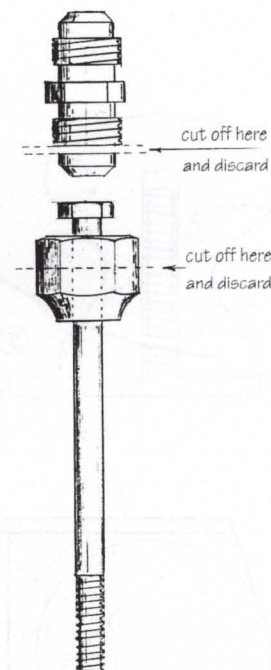
The Sole

The sole is made from 1 x 2" channel. A welding shop or steel fabrication shop is the place to get this (as well as the steel for the cap iron and lever cap). Use the profile view (from the side) in the drawings to make a pattern, and cut out the shape with hack-saw and files. Note the curve in the ends in the top view. You will find that with a new hack-saw blade you can saw most of the length close to the line. Where the curve is too great, do your best with a series of straight cuts. Finish to the line with the half-round file. Now flatten the bottom. This is tedious but important to the satisfactory operation. Careful filing alone will accomplish the job. Hold the sole upside down in a vise having smooth or padded jaws. File carefully until all is bright metal. A bench sander will accomplish the job more quickly, as will a belt sander—but the sander is likely to ruin the job if you do not use it with great finesse. When the bottom is as flat as these tools can make it, lay a piece of 150-grit silicon-carbide paper on a flat surface such as the top of a table saw or jointer and scrub away until all is truly flat. Now work on the sides. Fit the body to the sole. Colored chalk rubbed inside the sole will transfer to the body as you repeatedly try the fit, showing where more needs to be taken off. The body will be set in a thickened epoxy, so the fit needs to be good, not perfect. Use 1/4-20 x 1" flathead machine screws (two forward and one aft) to back up the epoxy. At this stage, do just the fitting—do not drill holes or apply the epoxy yet. Mark the mouth. This is the slot in the bottom of the sole for the blade, and should finish 3/16" wide. Too wide a mouth will limit the ability of the plane to do fine work in contrary grain; err on the narrow side, and widen the cut later if necessary. To make the mouth, draw parallel lines 3/16" apart across the body on the inside. A sharp scribe is the tool to use for this accurate marking. Draw a centerline on which to centerpunch and drill a series of 5/32" diameter holes that almost intersect one another. With either a jeweler's file, or some careful twisting of the work under the drill, you should be able to connect these holes. Finish with a thin flat file. Note that the back edge of the mouth is at 45° to agree with the slope of the body. File this angle after the mouth is accurately shaped at the bottom. Place the body into the sole. Carefully align the forward face of the body with the back

edge of the mouth. Drill through the sole and into the body with a 3/16" bit as a pilot for a 1/4-20 tap. Enlarge the holes in the sole to 1/4" and carefully countersink them so the screw heads will stand proud when tightened and the screw slots will just disappear when the screws are filed flush with the surface of the sole. Marrying the body to the sole will come later.

The Knob

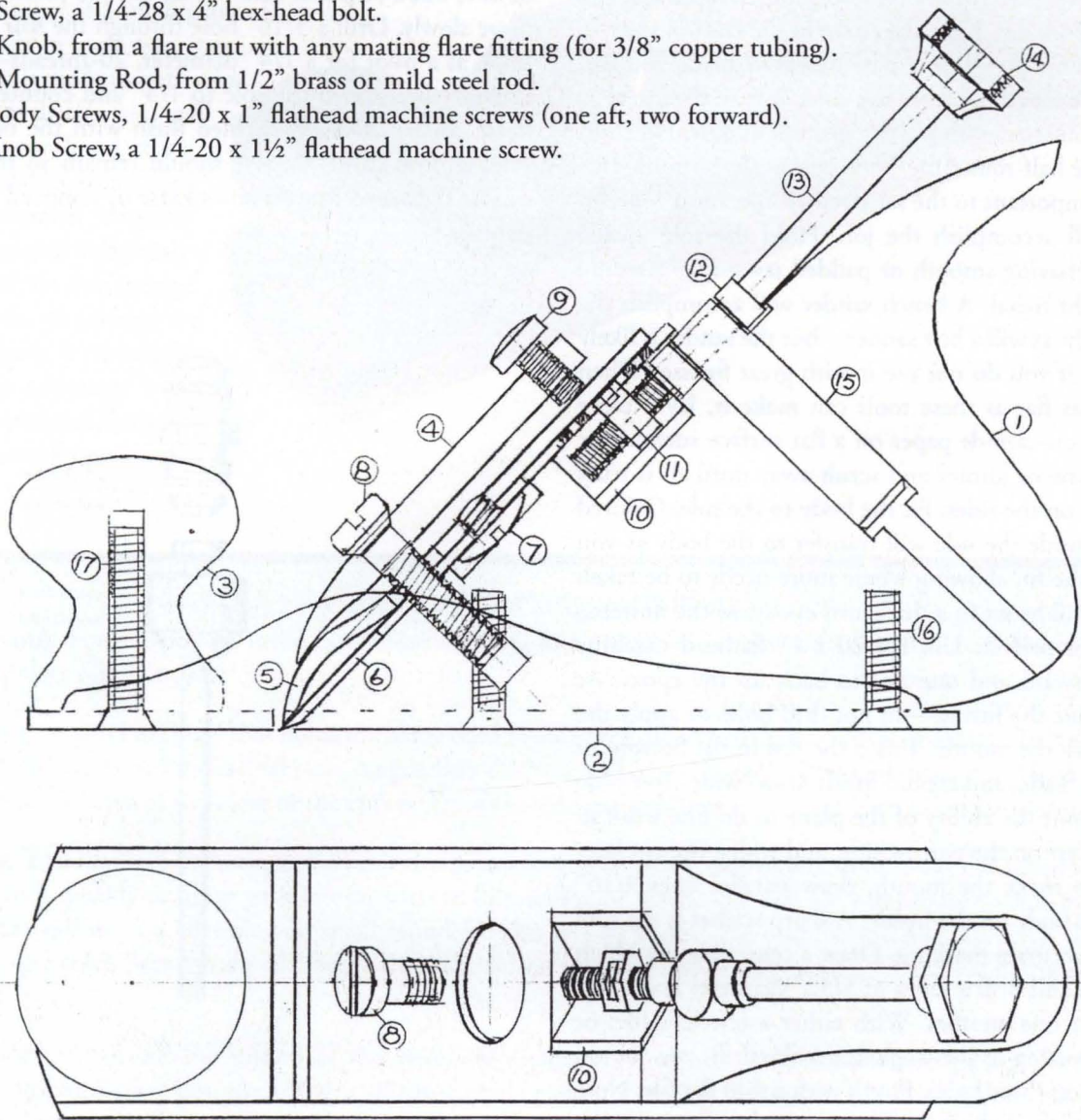
It is fascinating to see what subtle differences in shape can do to the appearance and feel of a knob. Design one that suits your taste, but make sure that there is room for your thumb between the knob and the lever cap. You are quite restricted in a small plane, as there must be room for the shavings to escape as well. Use a wool lathe to shape the knob if you have access to one, but a rasp and files will do the job just as well—albeit more slowly. Drill a 3/16" hole through the sole and into the knob as a pilot for a 1/4" diameter, 20-threads-per-inch tap. Enlarge the hole in the sole to 1/4" and countersink for the head. When the screw is filed flush with the bottom of the sole, almost all of the slot should remain so that the knob can be tightened if it becomes loose or removed if it becomes damaged.



The 7" Smoothing Plane — Key to Parts

(Numbers refer to circled numbers in the drawings.)

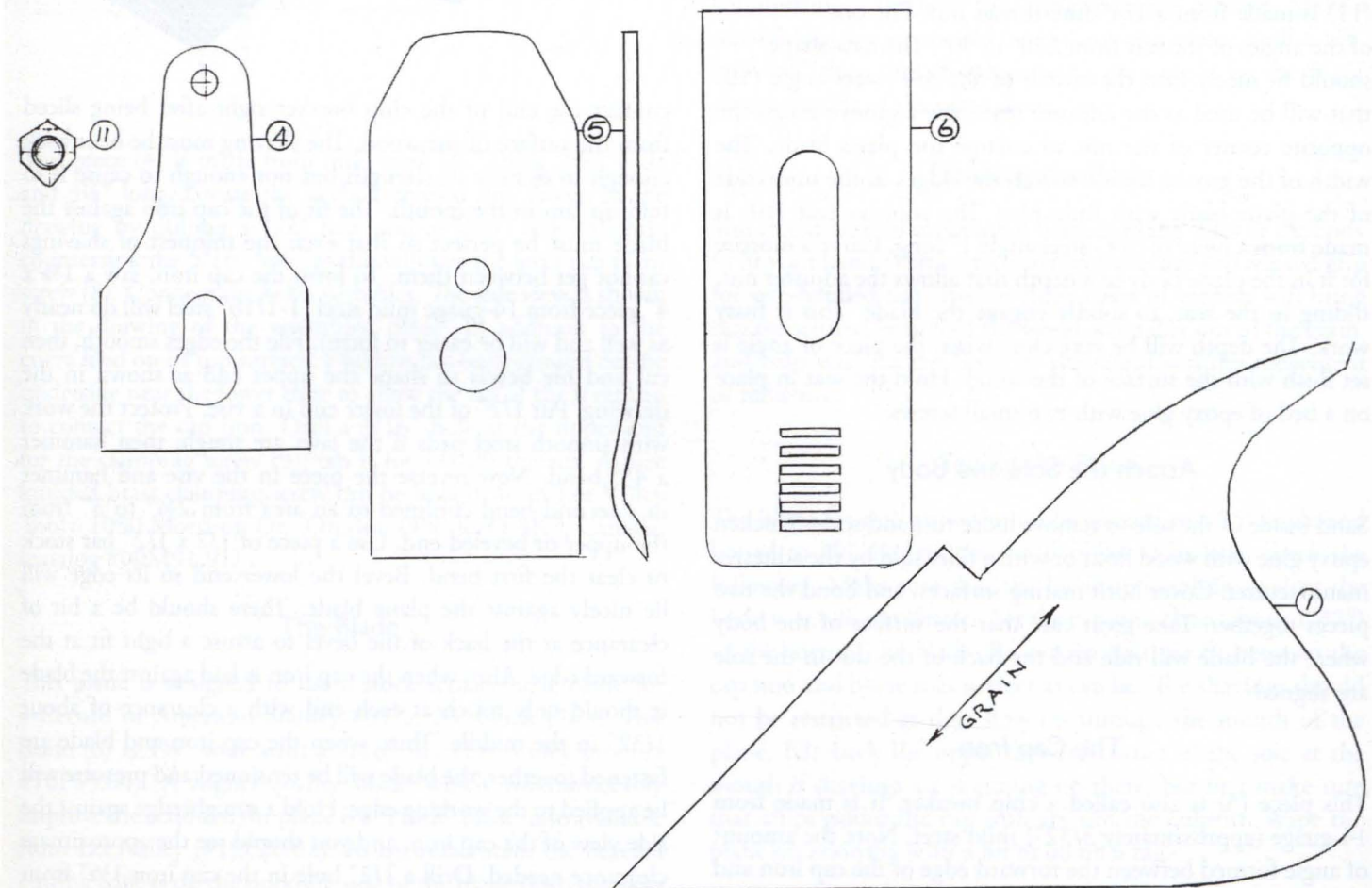
1. Body, $1\frac{3}{4} \times 3\frac{3}{4} \times 7\frac{1}{2}$ " hardwood.
2. Sole, 2×1 channel 7" long. Mild steel.
3. Knob, $1\frac{1}{2}$ " diameter x $1\frac{3}{4}$ " high. Same wood as body.
4. Lever cap, $\frac{1}{4} \times 2$ " mild steel flat-bar.
5. Cap Iron, from 14-gauge mild steel ($\frac{1}{16}$ " would do as well).
6. Cutting Iron (blade), $1\frac{5}{8}$ " wide (replacement blade for American-made Stanley #09 $\frac{1}{2}$ block plane).
7. Cap-Iron Screw, from a $\frac{5}{16}$ " carriage bolt.
8. Lever-Cap Pivot Screw, from a $\frac{5}{16}$ " x $1\frac{1}{2}$ " hex-head bolt.
9. Lever-Cap Clamping Screw, from a $\frac{1}{4}$ -20 knurled brass screw.
10. Adjuster Seat, from $\frac{1}{16}$ "-thick, $\frac{3}{4}$ " mild steel angle.
11. Adjuster Nut, from a $\frac{1}{4}$ -28 nut.
12. Collars, from $\frac{3}{8}$ " mild steel rod.
13. Adjuster Screw, a $\frac{1}{4}$ -28 x 4" hex-head bolt.
14. Adjuster Knob, from a flare nut with any mating flare fitting (for $\frac{3}{8}$ " copper tubing).
15. Adjuster Mounting Rod, from $\frac{1}{2}$ " brass or mild steel rod.
16. Sole-to-Body Screws, $\frac{1}{4}$ -20 x 1" flathead machine screws (one aft, two forward).
17. Sole-to-Knob Screw, a $\frac{1}{4}$ -20 x $1\frac{1}{2}$ " flathead machine screw.



The Adjuster Assembly

The action of the adjuster is as follows: When the adjusting screw (13) is turned, it rotates in the adjuster mounting rod (15). There are no threads between the two collars (12), which are pinned to the adjusting screw. The adjusting nut (11) has its bottom filed to a right angle to fit against the adjuster seat (10). The nut is thus kept from turning and slides along the seat. The top of the nut is shaped to fit into the slots of the plane blade, which is forced to move with the nut. Play, or backlash, in the adjuster comes from excessive clearance in the fits between nut and blade, collars and mounting rod, and the mounting rod and its socket in the body. Do your best to keep this play to a minimum. When the adjusting screw is turned to the right, the blade is withdrawn. This is backwards from most commercial planes (not all, however, as Stanley turned out many planes with this action). In order to advance the blade by turning to the right, you would need a left-hand threaded bolt and nut, which are usually difficult or expensive to obtain. The adjusting screw (13) is made from a 1/4 x 4" fine (28 threads per inch) hex-head bolt. The knob (14) is made from a brass flare fitting for 3/8" copper tubing, available from an installer of gas appliances. Either a tee, elbow, or coupling will do. Unscrew one of the nuts from the gas fitting. Saw off the part of the fitting that is beyond the threads. (You will

be removing the tapered end which seats against the bottom of the nut. There should be a slight turned shoulder at the end of the threads, allowing you to cut square.) Carefully file off any letters or marks on the bolt head, as these may keep the bolt from seating square to the knob. Insert the 1/4" bolt through the nut, then screw the nut with protruding bolt back onto the fitting. Because of the tapered seat inside of the square cut just made, the bolt will center itself when the nut is carefully tightened. To permanently attach and finish the knob, clean the bolt head and the inside of the flare nut with fine sandpaper and cover them with thickened epoxy. Screw the bolt, nut, and fitting tightly together, see that all looks symmetrical, then let the epoxy harden. Cut off the unneeded portion of the completed assembly that protrudes, then clean the sawn surface with either file or lathe. The mounting rod (15) is made from a piece of 1/2" brass or mild steel rod. It is inserted into a hole in the body and serves as a base for the adjuster and a bearing for the adjusting screw (13). Brass is the best material to make the rod from, as it will not rust and lock itself permanently into the body. Locate the center of the hole and prick it with an awl to be sure the drill will start exactly where intended. Experiment with a scrap piece of hardwood to see that you have a press fit of the rod in the hole. (Forstner bits, augers, twist drills, brad points, and spade bits all seem to make holes of slightly different sizes.)



The hole should be at right angles to the surface on which the blade will lie. Make the depth about 1/8" greater than needed to position the rod. Now switch to a 1/4" bit and continue the hole until it emerges from the heel of the body. A punch made from a 4" common nail with the point ground flat can be inserted up through this hole to drive out the adjuster.

Drill a 1/4" hole for the adjusting screw through one end of the mounting rod. Leave only 1/16" of metal between the hole and the top of the rod. You may want to leave a bit more and file away the excess after drilling. This hole must be at right angles to the rod, so get help sighting if you don't have a drill press. File flats across the holes to make seats for the collars (12). Don't file away too much as you will decrease support for the adjusting screw. Some flat is necessary, as otherwise the rod will wear quickly and the adjuster will be sloppy. Make the two collars on the lathe or by drilling a 1/4" hole in the end of a 3/8" rod, then sawing off the collars so they will finish 3/16" thick. Pin the collars to the adjusting screw (with mounting rod between) by drilling through and inserting wire brads. Very slight depressions made with a countersink will allow you to peen the ends of the brad into the collars. File them flush after peening. The adjuster nut (11) is made from a 1/4" fine-thread nut. File one of the angles of the nut from 120° to 90°. The new shape should fit nicely into the crotch of the 3/4" steel angle (10) that will be used as the adjuster seat. Saw a groove across the opposite corner of the nut to enlarge the plane blade. The width of the groove should match the ridges in the underside of the plane blade with little play. The adjuster seat (10) is made from a piece of 3/4" steel angle 1" long. Carve a mortise for it in the plane body to a depth that allows the adjuster nut, sliding in the seat, to solidly engage the blade. This is fussy work. The depth will be very close when the piece of angle is set flush with the surface of the wood. Hold the seat in place on a bed of epoxy glue with two small screws.

Attach the Sole and Body

Sand inside of the sole to remove loose rust and scale. Thicken epoxy glue with wood flour or with a filler sold by the adhesive manufacturer. Cover both mating surfaces, and bond the two pieces together. Take great care that the surface of the body where the blade will ride and the back of the slot in the sole are aligned.

The Cap Iron

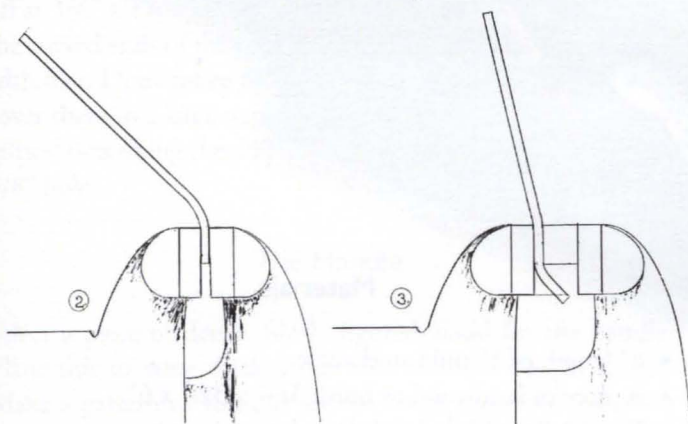
This piece (5) is also called a chip breaker. It is made from 14-gauge (approximately 3/32") mild steel. Note the amount of angle formed between the forward edge of the cap iron and the blade surface in profile view. The chip or shaving must



contact the end of the chip breaker right after being sliced from the surface of the wood. The shaving must be bent back enough to destroy its strength but not enough to cause it to fold up jam in the mouth. The fit of the cap iron against the blade must be perfect so that even the thinnest of shavings cannot get between them. To form the cap iron, saw a 1 5/8 x 4" piece from 14-gauge mild steel (1-1/16" steel will do nearly as well and will be easier to form). File the edges smooth, then cut and file bevels to shape the upper end as shown in the drawing. Put 1/2" of the lower end in a vise. Protect the work with smooth steel pads if the jaws are rough, then hammer a 45° bend. Now reverse the piece in the vise and hammer in a second bend confined to an area from 2 3/4" to 3" from the upper or beveled end. Use a piece of 1/2 x 1/2" bar stock to clear the first bend. Bevel the lower end so its edge will lie nicely against the plane blade. There should be a bit of clearance at the back of the bevel to assure a tight fit at the forward edge. Also, when the cap iron is laid against the blade it should only touch at each end with a clearance of about 1/32" in the middle. Thus, when the cap iron and blade are fastened together, the blade will be tensioned and pressure will be applied to the working edge. Hold a straightedge against the side view of the cap iron, and you should see the approximate clearance needed. Drill a 1/2" hole in the cap iron 1 1/2" from

the lower end. Drill a second hole 1/4" in diameter and 2 1/8" from the lower end, then thread this hole with a 5/16" coarse tap. Now polish the cap iron. To make the cap iron screw (7), get a 5/16" carriage bolt with threads that run its full length. File away the square shoulder under the head. File the diameter of the head to 1 1/16". This last operation goes easily if you chuck the bolt in a drill and hold it against a spinning grinding wheel. Now flatten the top of the bolt head slightly (to about 1/8" or slightly more). Saw a screwdriver slot in the bolt head. Use two blades together in the hacksaw frame to make a suitable wide slot. Now run a 5/16" die up the bolt to continue the threads onto the area where the square shoulder was filed away. You may need to put the die on backwards to run the threads snugly against the bolt head. Cut off the surplus length of bolt so that when the blade is clamped to the cap iron, the bolt is just proud of the surface of the cap iron.

The Lever Cap



This piece (4) is made from mild steel 1/2" thick, 1 5/8" wide and 3 1/8" long. Create the keyhole-shaped slot shown in the drawing by drilling a 1/2" hole and a 5/16" hole. Slightly countersink the 5/16" hole, as this will key the lever cap pivot screw (8). Connect the holes with files. The side view is shown in the drawing of the assembled plane. In addition to the curve filed on its top surface, a hollow has been ground on the underside near the lower edge to allow the tip of the lever cap to contact the cap iron. Drill a 3/16" hole at the upper end for the clamping screw (9); tap it for 1/4-20 threads. A nice knurled brass clamping screw can be bought from Lee Valley Tools, 1080 Morrison Dr., Ottawa, ON, K2H 8K7, Canada, (catalog #00M91.01).

The Blade

This plane is designed to use a stock replacement blade for a Record or American Stanley #09 1/2, 20° block plane. This blade (6) is 1 5/8" wide with a 7/16" slot (Lee Valley product #10P65.04). A higher-quality blade which will noticeably improve the action of the plane is a "Hock" blade, also available from Lee Valley (#19P20.02). As manufactured, the beveled cutting edge is on the opposite side of the blade from the slots

that engage the adjuster; but you want the bevel and slot to be on the same side. There are two options: The first is to regrind the bevel, which is not difficult except for the patience needed to avoid burning the steel while grinding. The second option is to cut the slots through to the other side of the blade. A diamond cutting wheel on a Dremel Tool will do the job. The advantage of the second option is saving about 1/4" of your valuable blade. Bend the cap iron in a vise.

Fitting the Blade Assembly and Lever Cap to the Body

Without using the cap iron screw, set the blade and cap iron in place against the body with the cutting edge of the blade barely protruding below the cap iron (less than 1/16") and just proud of the sole, as it would be when taking a light cut. After making sure this assembly is centered and square, mark the position of the cap iron screw hole on the plane body. With a 7/8" Forstner bit, drill a mortise in the body deep enough so the cap iron screw just clears the bottom when the blade is in place. Now assemble the blade and cap iron. Taking great care that everything is centered, mark the center of the 1/2" hole where the lever cap pivot screw will go. This screw is made from a 5/16 x 1 1/2" hex-head bolt. The shape shown on the plan will be easy to make if you have a metal lathe. If you don't have a lathe, file the head nearly round, then true it up by spinning the bolt against a moving grinding wheel while holding it in a drill. Bevel the head's lower corner to fit the countersink in the lever cap using the same method. Make a screwdriver slot as you did for the cap iron screw. Drill a 1/4" hole 7/8" deep into the plane body, then tap it for the 5/16" coarse threads of the pivot screw.

Finishing the Body

You might wish to carve some shape into the sides of the body to fit your hand. This helps to achieve a secure and relaxed grip for one-handed use. Two or three coats of varnish will bring out the natural beauty of the wood, keep dirt out of the grain, and help stabilize the body by slowing down the movement of moisture.

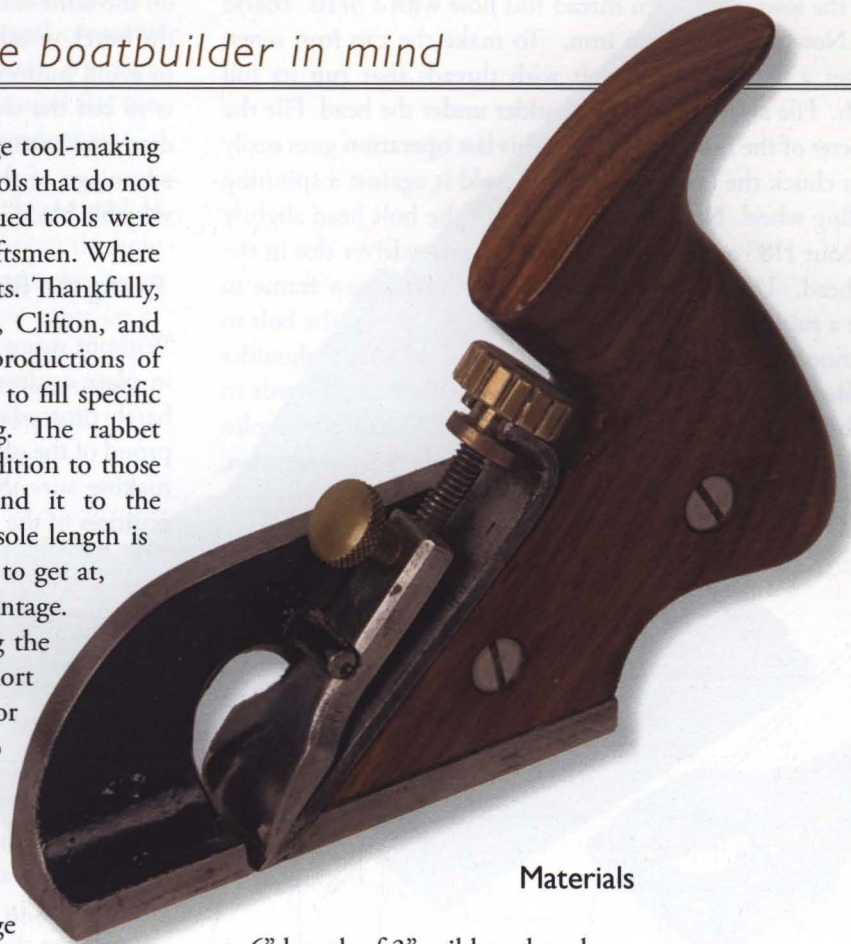
Tuning the Plane

The blade for this plane should be ground to a 25° angle and honed to 30°. For the tool to perform at its best, check the following: Make sure that the blade rests solidly against the body so it will not chatter. Set the cap iron close (about 1/32") to the edge of the blade. Be certain that the fit between the cap iron and blade is as perfect as can be. The shavings should not be restricted as they flow up through the mouth of the plane. File back the upper forward corner of the sole at the mouth if shavings are jamming up there, but first make sure that chips under the cap iron are not the culprits. Wipe the plane occasionally with a bit of oil on a rag.

Rabbit Plane

A specialized tool with the boatbuilder in mind

For some time now, the trend among large tool-making companies has been to stop producing tools that do not sell in volume. Most of these discontinued tools were originally designed to meet specific needs of craftsmen. Where their craft is still practiced, the need still exists. Thankfully, relatively new companies such as Lie-Nielsen, Clifton, and Veritas have brought back some excellent reproductions of discontinued tools or have designed new tools to fill specific needs, many of which arise in boatbuilding. The rabbit plane presented here should prove a useful addition to those presently available. Three features recommend it to the boatbuilder or general woodworker. First, its sole length is short. Boats present all sorts of difficult places to get at, and in those instances a short plane has an advantage. The short sole is particularly useful in working the gently curved areas of keel and stem rabbets. Short bullnose planes are available and are excellent for very specific jobs, but these tools never seem to work as well as a rabbit plane with a longer foredeck. The second feature of this plane is the power the user can deliver to the cutting edge of the blade. As in a larger bench plane, thrust is transmitted through its relatively large handle by the palm of the hand rather than by the grip of the fingers, which is necessary in smaller rabbit planes. Because this efficient force is directed to a relatively narrow $3/4"$ blade, it is very effectively transferred into cutting action. The third attraction of this tool is that you can make it yourself. If you have the patience to mark out the work accurately, cut and file to the line, and start all over again when you blow it—as we all do occasionally—then read on, and let's get this thing started.



Materials

- 6" length of 3" mild steel angle.
- A piece of hardwood to finish $3/4" \times 3\frac{1}{2}" \times 6"$.
- Two 10-24 x 1" flathead slotted machine screws.
- $1/4$ -20 x $1\frac{1}{2}"$ hex head cap screw (bolt). Must have at least $5/8"$ not threaded.
- Knurled brass screw (Lee Valley No. 00M91.01, for example).
- Adjuster knob, $3/4"$ diameter brass or steel.
- Bed frame steel.

Tools Needed

- Hacksaw—A good sturdy frame that can hold the blade in high tension makes a world of difference.
- Hacksaw blades—One coarse (18 teeth per inch) and one fine (24 teeth per inch). Buy only the highest quality.
- Files:
 - 1) One 10" mill file, single-cut for smooth finish filing.
 - 2) One 10" half-round file, double-cut for fast work and for inside curves.
 - 3) One 6" flat machinist's or mill file, thinner than the 10" file, for work around the mouth.
 - 4) One $1/4"$ -diameter chainsaw or round file for chamfering the hole in the side plate. These four files represent a considerable expense if you buy them for this project, yet they are a basic minimum for anyone wishing to improve their metalworking skills.
- Taps—One $1/4$ -20, and one 10-24, with a suitable tap handle.
- Twist drills— $5/32"$, $3/16"$, $1/4"$, and $5/8"$. If you do not already have the capability of boring a $5/8"$ hole in metal, it will probably be best to have this work done at your local garage or machine shop.
- Assorted aluminum oxide or silicon carbide sandpaper.

The Body

Obtain a 6"-long piece of 3" mild steel angle from your local welding or machine shop. The thickness of the metal should be $\frac{1}{4}$ ". Before having this piece cut, inspect it to be certain that there are no defects such as large pits or dents, which will end up in the completed tool. Give the metal a quick sanding or wirebrushing to remove loose rust. At this point, I paint the metal with a coat of B-I-N Primer Sealer, a white-pigmented shellac used by painters as an undercoating. This product dries in minutes and provides an excellent surface for drawing. An alternative method of drawing on steel is an extra-fine felt-tipped marker—the "Sharpie" made by Sanford is a good one, for example. Make a pattern using the $\frac{1}{4}$ "-square grid shown in the accompanying drawings. Manila file folders make good pattern stock. When the pattern is complete, trace it onto the steel. The first cuts to make with the hacksaw are two long ones that will reduce the angle iron to a piece that will finish off at $\frac{3}{4}$ " x $1\frac{3}{4}$ ", after filing off the saw marks. Approximate the curved ends of the plane sole with straight saw cuts. Finish with files. Don't make the mouth and side cutouts now; we'll cover them in a later step. Accuracy in patternmaking is most critical in scribing the 45° line and in placing the center of the $\frac{5}{8}$ " hole.

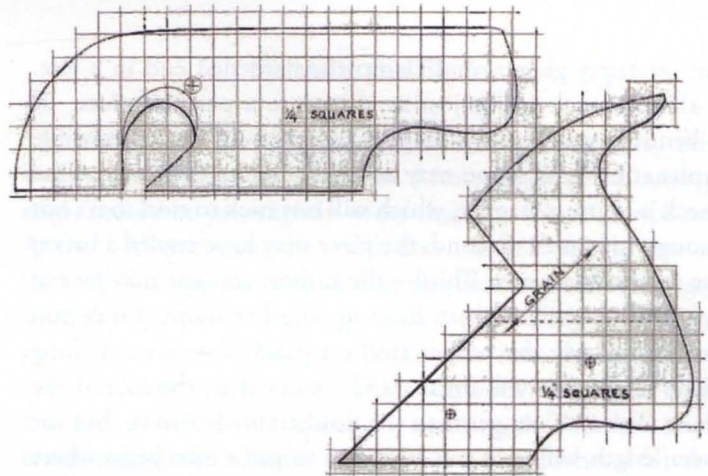
The Handle

Select a piece of dense, nicely figured wood for the handle. Plane this to same thickness as the width of the plane sole. Make a pattern as you did for the body, and trace this onto the wood, taking care to align the grain as indicated. Cut out the handle and finish the edges square to the traced lines. Take particular care with the surface on which the blade will lie. Don't round any corners yet. Lay out and cut the rabbet or half-mortise shown on one side of the handle, which will allow the handle to lie flush with the outside of the plane body. First, make a series of saw cuts just shy of the required depth, and then finish off the half-mortise with a chisel. The bottom corner of the handle will need to be shaped to fit against the rounded inside corner of the angle-iron body. When the fit is close, it may be further improved by applying chalk to the steel of the body and then putting the handle in place and gently rubbing it against the chalked surface. The transferred chalk will indicate high spots on the wood, which can then be trimmed. Repeat the process until you are pleased with the fit.

Fastening the Handle to the Body

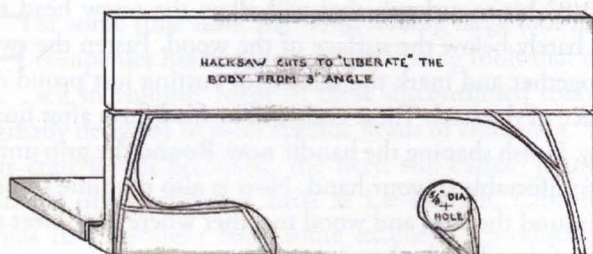
A drill press, although not absolutely necessary, will be a big help in assuring accuracy. Clamp the handle and body together, making sure the clamp is clear of the positions shown in the drawings for the two 10-24 flathead machine screws. Slight differences in shape between the handle and the plane body at the curved back end of the plane will be filed to a

uniform shape after the two are fastened together. After boring through the handle and body with a $\frac{5}{32}$ " bit in the positions indicated in the drawings, separate the body and handle once more. Thread the holes in the body with a 10-24 tap. Enlarge the holes in the handle to $\frac{3}{16}$ ", and countersink these holes with a $\frac{3}{8}$ " bit to a depth that will allow the screw head to lie at or barely below the surface of the wood. Fasten the two pieces together and mark the screws for cutting just proud of the surface of the steel. These ends will be filed flush after final assembly. Finish shaping the handle now. Round the grip until it feels comfortable in your hand. Now is also the time to use a file to round the steel and wood together where they meet at the back of the plane body.



Beginning the Blade

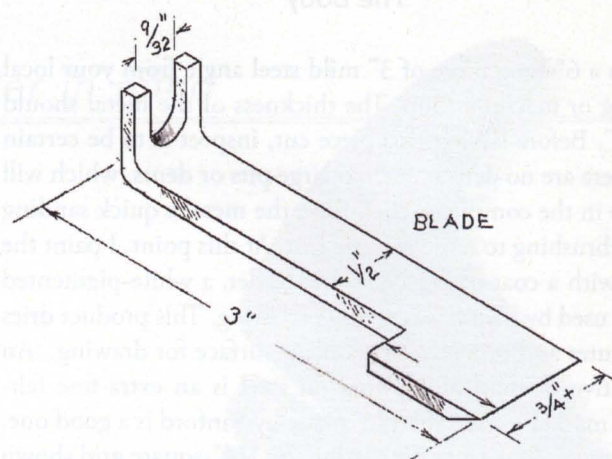
In order to be precise in cutting the mouth in the sole of the plane, it will be necessary to at least rough out the blade. If you have not experimented with hardening and tempering steel, making the blade can be a valuable experience, opening a whole range of toolmaking possibilities for you. First, locate an old bed frame. We are interested in the type that has all those springs around its Perimeter, supporting a grid of wire under the mattress. Probably a frame for supporting a box spring would work as well. The angle iron is what we are after. This is not the same as mild steel angle as found at the welding shop. Bed-spring angle is about $\frac{1}{8}$ " thick. This is thinner for a given width than mild steel angle, but it is strong because it has a higher carbon content, which is what allows it to be hardened. Try the local junkyard. Once you have located a frame, you are set for a long time with good steel for planes, chisels, and knives. Here is how to test the metal in the bed frame to see whether it is suitable. Cut off a piece with a fine-toothed hacksaw. Coarse teeth will sometimes catch on thin steel and break. Saw off a $\frac{1}{8}$ " strip about 2" long, forming a sliver $\frac{1}{8}$ " x $\frac{1}{8}$ " x 2". Grip one end of the piece of steel with pliers and heat the other end bright red with a propane torch. Immediately plunge it into room-temperature water and swirl it about. After you finish doing this, the steel should be brittle hard.



Put on safety glasses, and clamp the hardened end in a vise. It should break easily, just as if it were a piece of glass. If it bends instead of breaking, then there are several possible explanations. First, you may not have heated it enough. One check is to use a magnet, which will not stick to steel that's hot enough to harden. Second, the piece may have cooled a bit on the way to the water. Third—the carbon content may be too low, and you will have to hunt up another frame. Once you know you have the proper steel on hand, saw out a 4"-long blade blank that will finish $1/32$ " wider than the sole of the plane. This is 1" longer than the finished blade will be, but the extra length will give you two tries to get a nice bend where the blade engages the adjusting screw. Don't saw out the offset in the blade until you finish making the bend. Heat the area of the bend with a propane torch until it has a bright red glow to it. Then transfer the hot iron as quickly as you can to your vise with the short end to be bent sticking up. Hammer the end over into a right angle. If your vise jaws have hard, sharp surfaces, which tend to mar the surface of the steel you are clamping, you can make the jaw liners by cutting a couple of jaw-length pieces off your bedspring angle. When the end has been bent, make sure that the rest of the blade is flat. File the edges smooth and square.

Cutting the Mouth

Lay the rough blade on its bed on the handle so that it overlaps (continues past) the bottom of the plane. Mark two lines along the edge of the bottom to precisely indicate the minimum amount of steel that would have to be cut away to allow the blade to pass through the bottom.



Square the aft line across the bottom of the plane. From the point where the forward edge of the blade reaches the bottom, measure $1/32$ " forward, and square a line across at that point. The area between the two lines will be the mouth. Lay out the side opening on the right side (outside) of the body. The forward edge of this opening should be angled forward slightly, as drawn, to help clear chips. It will also be easier to file the mouth to its correct width if the metal above it has been cut away a bit. The $5/8$ "-diameter hole is centered $5/8$ " up from the bottom of the sole and $5/16$ " + out (measured at a right angle) from the slope of the handle. Saw and file the opening to shape. A small flat file will be found useful for working on the mouth. Work a $3/16$ "-wide rounded chamfer around the top half of the inside surface of the opening using a round file. This chamfer should extend to the outside surface of the body in order to convince the shavings to curl to the left.

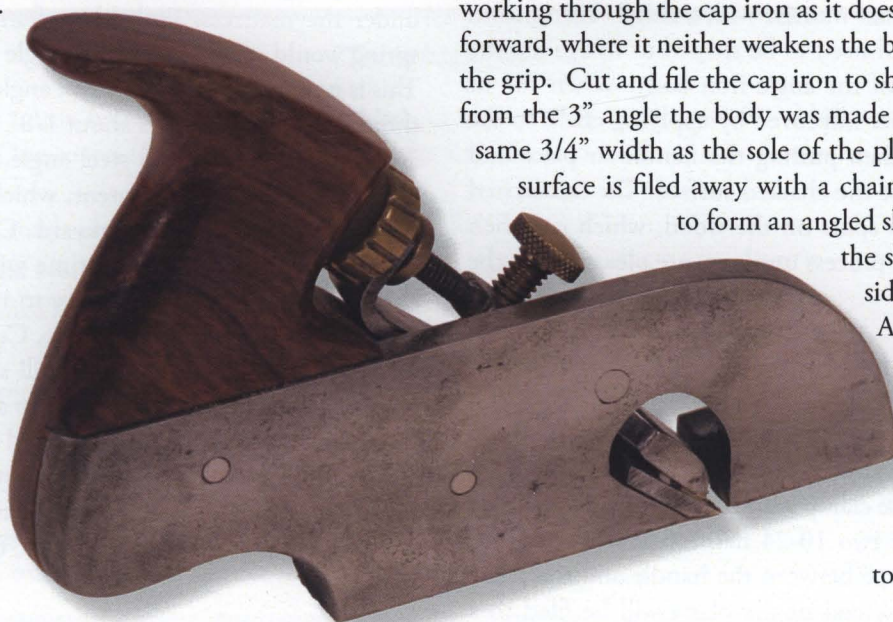
The Adjusting Cap Iron

The essence of good design is simplicity. Adjusters add complexity to a plane, yet some way of making frequent minute changes in blade exposure is worth the effort. This adjuster, working through the cap iron as it does, keeps the mechanism forward, where it neither weakens the body nor interferes with the grip. Cut and file the cap iron to shape from steel left over from the 3" angle the body was made from. It should be the same $3/4$ " width as the sole of the plane. Note that the top

surface is filed away with a chainsaw file and a flat file

to form an angled shoulder that helps turn the shavings away from the side of the plane body.

Also, to allow clearance away from the body of the plane, the cap iron is narrowed from its shoulder toward its back end. The side that will be adjacent to the metal side of the

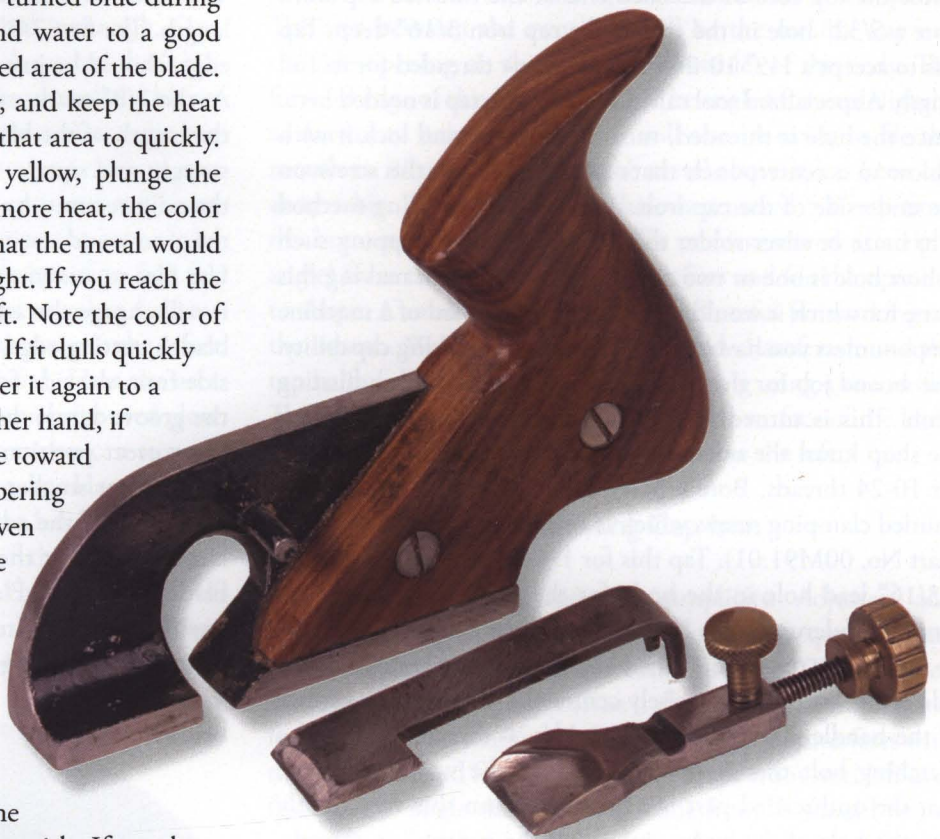


Hardening and Tempering the Blade

Have at hand a tin can nearly filled with room temperature water. Heat the cutting end of the blade until it is bright red. The usual propane torch should be capable of delivering enough heat if you keep cool drafts away and keep your holding pliers back near the forked end. Other ways to increase heat are to make a crude oven with firebrick, fiberglass insulation, or charcoal briquettes. If you have a gas stove, you can heat the iron over the stove while you also apply heat with the torch. When the blade is bright red, plunge it quickly into the water and swirl it around. If the blade is not agitated, the water near the surface of the blade will boil, preventing the rapid cooling necessary for proper hardening. To test the blade's hardness, try to file the bevel on the blade. If the blade is properly hard, you will get nowhere with the file. You must now soften—or temper—the blade a bit. First, polish the non-beveled face of the blade with fine sandpaper. It will have turned blue during the hardening process. Take the torch and water to a good source of light, and slowly heat the hardened area of the blade. Be patient, hold the torch about 4" away, and keep the heat back from the thin edge to avoid heating that area too quickly. When the color changes from silver to yellow, plunge the blade into water as before. If you applied more heat, the color would turn bronze, which would mean that the metal would be softer but would probably still be all right. If you reach the blue stage, the metal is going to be too soft. Note the color of the blade before you give it its final polish. If it dulls quickly in use, re-harden the blade and then temper it again to a lighter yellowish or straw color. On the other hand, if the blade tends to chip easily, temper more toward a bronze color. An alternate way of tempering is to put the hardened iron in a kitchen oven at 400° for a half an hour or so. Save some energy by sliding it in along side your dinner. No quenching is necessary with this method.

Finishing and Tuning the Plane

Remove the handle from the body. Sand the handle and give it two or three coats of varnish. If you have a power bench sander, use it to remove the rust, mill scale, and pitting from the side and bottom of the body. To do this work by hand, lay a piece of 10-grit aluminum oxide or silicon carbide sandpaper face up on a table saw or bandsaw table and scrub away. Refine the surface finish of the body and cap iron by holding them in your hand while you sand them with 180-grit, then 220. You can polish beyond this if you wish. Sand and paint the inside surface of the body. Reassemble the plane, grind and hone the blade to a keen edge, and try it out.



Rabbeting Chisel

Accuracy is improved with a tool shaped to prevent tearout



It's hard to believe a lug wrench can look this good.

Boatbuilding is separated from house building or cabinetmaking by certain processes that, while not unique to boatbuilding, are much more common in that discipline. Along with lofting, determining plank shapes, steam-bending, riveting and clenching fastenings, cutting a rabbet by hand falls into this category.

Cutting a plank rabbet can be daunting for a beginner. It is, in fact, a task approached with caution by most professionals because few spend enough time at this specific task to maintain complete confidence in the outcome. There is much to contend with to get the job right. The depth of the rabbet is critical, as well as the angle, which is constantly changing. The structure of the typical stem-forefoot-keel presents joints and grain changes that increase the chance that wood fibers will tear or split beyond the rabbet or bearding line.

Rabbets are usually cut with a straight chisel. The blade edge is held parallel with the rabbet line (see photos, next page), and the tool is driven down into the wood and through the grain. Another cut is made from near the bearding line toward and reaching the first cut at its lowest point. The wood between these cuts is still held in place because the ends of the fibers have not been severed. Additional cuts will have to be made to sever these fibers so they will not develop splits and so you can see and check what you've done. In North America, oak is apt to be the wood of choice for the backbone. It is notoriously stringy stuff, and you often work at an area a bit more than

you would like before things are cleaned up enough to assess your accuracy.

The chisel presented here is designed to cut the fibers as you go. This practically eliminates the danger of unwanted cracks or splits and lifts the waste out cleanly, letting you check on your progress as you go. Look at the tool end-on, and you will see that it is nothing more than a miniature lipped adze outfitted with a striking handle. The lipped adze is designed to cut cleanly across the grain, severing the fibers as it goes. The carpenter's adze, which does not have lips, will, if used across the grain, act like the straight chisel and produce a fibrous cut with an unpredictable amount of tearout.

This rabbeting chisel will do almost all of the work needed to produce the finished rabbet. The final fairing will benefit from the use of a wide, straight chisel or a rabbet plane.

To make this tool, find a lug wrench, the type used for removing wheels from a large car. The type shown in Figure 1 (on page 29) has either a 3/4" or 13/16" socket and a handle with an offset of nearly 90°. You could use a cross-shaped wrench, a type that has four sockets. This would give you four potential chisels, and you wouldn't have to straighten out the bend. The trouble with this approach is that the cross wrench is good for removing wheel nuts. The offset lug wrench is only good for removing the skin on your knuckles, so you might as well make it into a chisel.

To begin, heat the bend in the handle until it begins to glow red into the handle until it is about 1/2" from being seated. Remove the tang from the handle and let it cool. Do a final polishing of the chisel, slip a leather washer over the tang up against the steel washer, and drive the handle home. Varnish the handle, hone the cutting edge, and you are done. A small propane torch will probably not have enough heat for this. If you have a woodstove in the shop, bury the bend in a good bed of coals for about five minutes, and it should be hot enough; otherwise, you may need the help of an acetylene torch at your local welding shop. Clamp the hot wrench in a vise with the jaws grasping the tool between the socket and the bend. Straighten out the handle. Once it is close to straight, small bends can be taken out by striking the bend with a heavy hammer while the wrench is laid across the end-grain of a piece of hardwood from the firewood pile.

The next step is to change the shape of the socket from six sides to a rectangle. To do this, heat the socket to a red heat, lay it on an anvil with one of the six corners pointing up, and hammer the corner down until it becomes one straight edge. You will not be able to make the angle on the inside of the edge disappear until you file it during the next step. While the tool is still hot, turn it over and try to make the opposite edge straight as well. This will allow you to choose the better of the two edges as you continue to shape the tool. Refer to Figures 2, 3, 4, and 5 (next page). A section of railroad track about 1' long makes a good anvil for this sort of work.

Next, make the curved saw cut shown in Figure 4. While you have the hacksaw out, cut off the excess length of the wrench handle, leaving 7" for the chisel. Using files (with a little help from a grinder if you wish), create the finished outside shape of the tool. File a nice, clean front edge where the cutting edge will be. When the shaping is done, create the inside bevel with a round file. Work carefully until the edge is nearly sharp and the cutting angle of both bottom and lips is 25°.

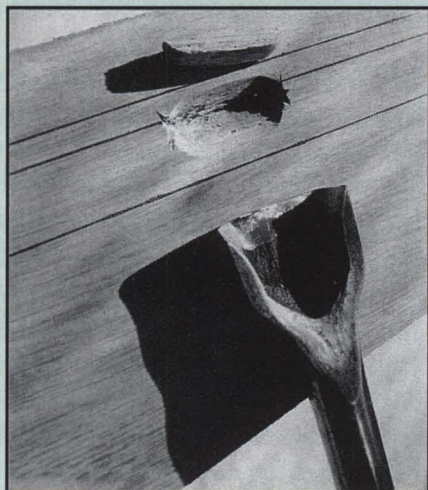
Now create the tang. It will be 3" long. At its larger end, its cross-section will be the largest square that can be created with the stock you have (probably 7/16" square). Taper this down to about 3/16" square at the tip. If you have a powerful grinder, you can probably shape the tang with this tool alone. I used a hacksaw and files. With either method, take care to end all faces evenly at the 3" mark (see Figure 8).

With a three-cornered or square file, create a square hole in a stout washer and drive it up against the shoulder at the start of the tang. If you have not already done so, this is the time to polish up the surface of the tool using files, sandpaper, and buffing compound.

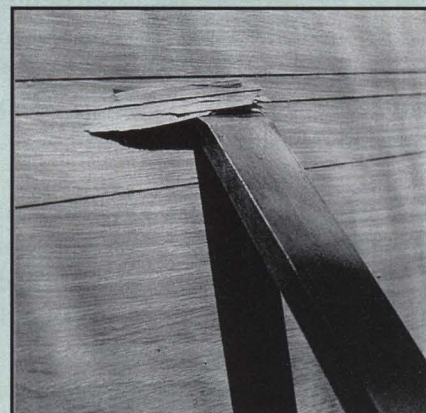
The next step is hardening and tempering the cutting edge. Heat the end of the chisel to a bright red (a magnet will not stick to the metal when it is hot enough). Immediately plunge the heated edge into a container of cold water. Test the tool end with a file to see if it is harder than areas farther back on the shank, which were not subjected to heat treatment. If it does not resist the cutting action of the file, try hardening again. This time heat the tool hotter and cool it more quickly.

The edge is now brittle-hard and must be softened (tempered) a bit. Polish the back of the tool with fine sandpaper, then use a propane torch to heat the shank of the tool about 2" back from the cutting edge. Hold the torch far enough away that the metal will heat slowly. Soon the shiny silver metal between the torch-heated area and the cutting edge will turn to a straw-yellow color. Conduction will carry this color toward the cutting edge. The straw color will be followed by bronze then blue. When the bronze just begins to reach the cutting edge, immediately plunge the tool into cold water.

An alternative method of tempering is to place the hardened tool in your kitchen oven at 375°F until you are sure that the tool has reached the temperature. If it is hot enough, it



Left: A straight chisel can cause tearout along the rabbet, and care must be taken to avoid having these splits extend outside the lines. In this photo and at the right, the upper line is the bearding line, representing the intersection of the plank's inner face with the side of the keel. The lower line is the rabbet line, representing the intersection of the outer plank face with the keel. The middle line represents the apex of the rabbet's triangular cross-section. (See *WoodenBoat* magazine No. 111 for further explanation.)



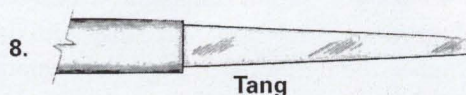
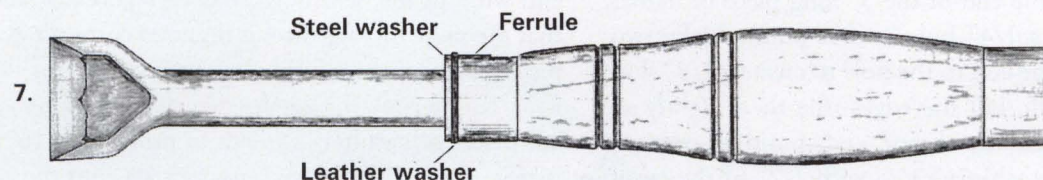
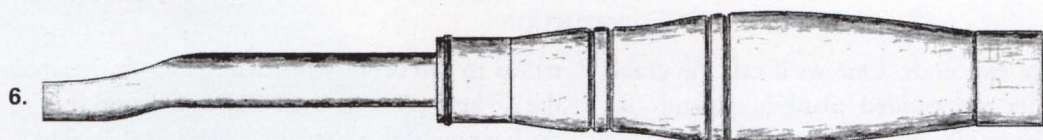
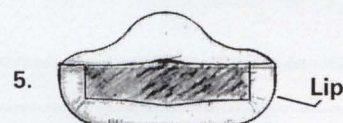
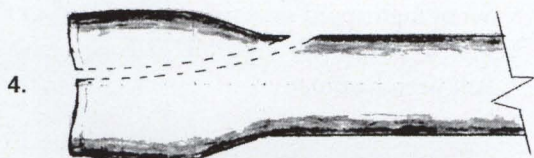
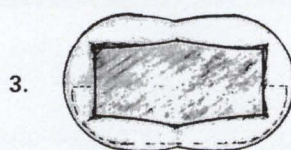
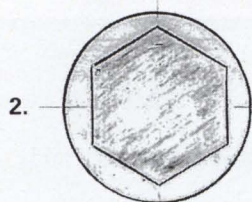
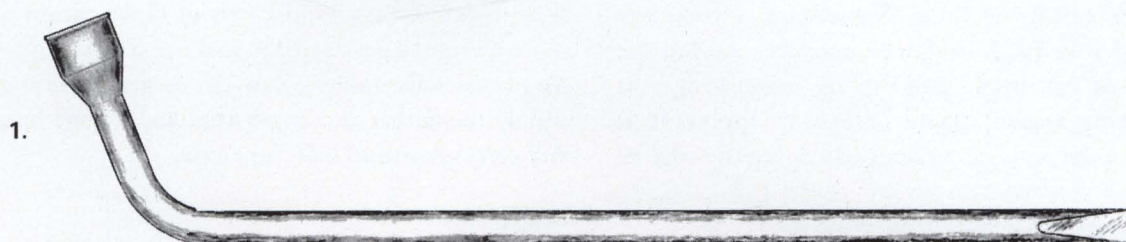
Above: The lipped chisel cuts across the grain at the same time as it cuts with the grain, giving more control over tearout.

should take on a yellow-bronze color. The tool can cool at any speed after reaching oven temperature. It does not have to be quenched.

The handle can be made on a lathe or be worked from a square section with rasps and files. Ferrules can be made from copper or brass tube, or cut from a bicycle frame. (Incidentally, bicycle frame stock makes dandy punches for leatherwork and gasket making.) The tapered hole for the tang is approximated with three different-sized drills. A small drill the size of the small end of the tang is driven into the handle the full length of the tang. A mid-sized drill goes halfway down, then a larger bit makes about a 1/2"-deep hole. Heat the tang with a propane

torch to just below a red heat and burn it into the handle until it is about 1/2" from being seated. Remove the tang from the handle and let it cool.

Do a final polishing of the chisel, slip a leather washer over the tang up against the steel washer, and drive the handle home. Varnish the handle, hone the cutting edge, and you are done.



1. Lug wrench 3/4" or 13/16".
2. End view of socket before forging.
3. End side view of socket after forging.
4. Side view of socket after forging.
Hacksaw cut indicated to remove unwanted metal.
5. End view of completed chisel.
6. Side view of completed tool.
7. Top view of completed tool.
8. Tang.

Chain Clamps

Shop-built aids for hanging planks

A good fit in carvel planking requires that one plank touches another. Ideally, light will not pass through the seam. This almost always requires some sideways pressure on the plank being hung. Sometimes, a good jolt from the base of your palm might be enough to bring the planks together, or you might need to rig some wedges or clamps. A clamping system should be easy to apply and it should exert adequate pressure without damaging the edge of

the plank. It should not be restricted by molds, ribbands, or adjacent frames; and it shouldn't obstruct the placing of the plank fastenings. The chain clamp presented here meets all of these requirements—and a pair of these clamps will be even more useful. To get started in making your clamps, consult the list of materials. Your local welder or steel fabricating shop can supply the flatbar and angle iron, and a good hardware store will carry chain and nails for rivets.

Materials

- Two pieces of 3/16" x 1" mild steel flatbar, one 5" long, the other 6" long
- Two pieces of 1/8" x 1" mild steel angle iron, one 2" long, the other 3" long
- One 20-penny (4) common nail; two 16-penny (3 1/2") common nails; two 6-penny (2") common nails
- A piece of hardwood 5/16" x 3/4" x 4"
- A piece of 3/16" chain 28" long

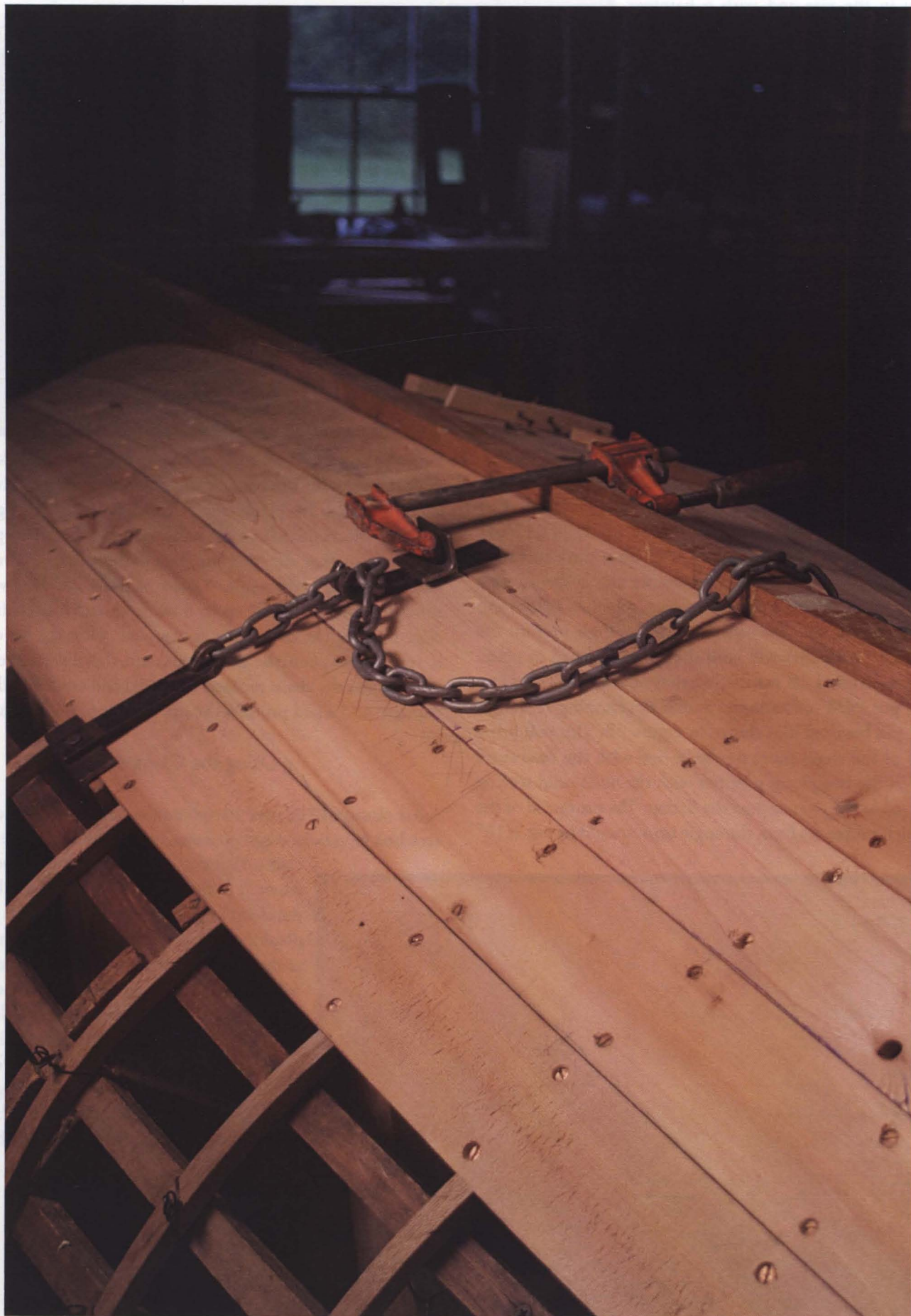
Tools Needed

- A good-quality high-tension hacksaw frame and blade
- Half-round file
- Set of high-speed steel twist drills 1/16" to 1/4"
- A 5/16" twist drill, auger bit, or Forstner bit
- Ball-peen hammer
- Centerpunch

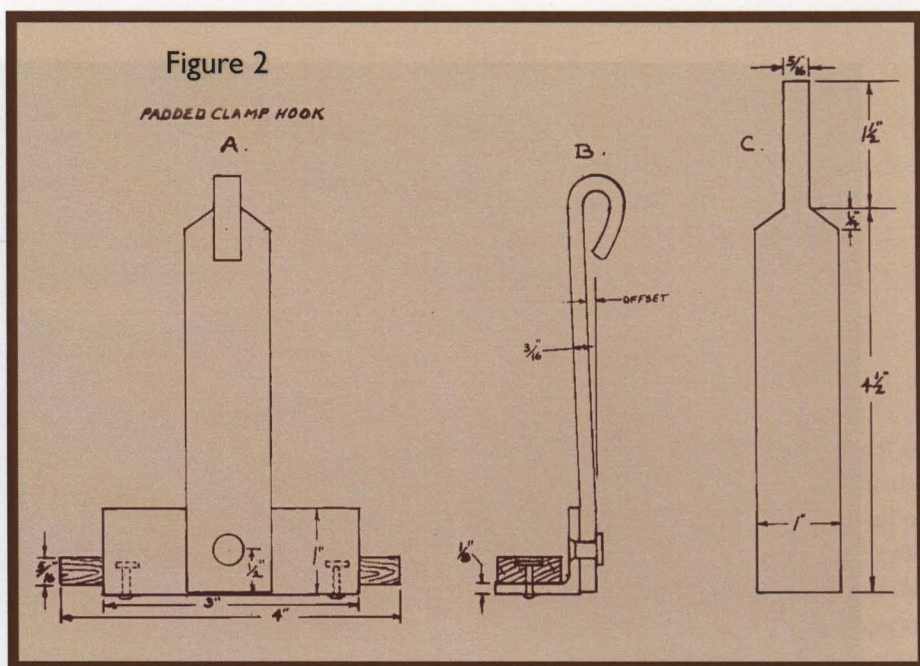
Construction

These chain clamps have two ends. One we'll call the grab-hook end, and the other the padded plank-hook end. To make the grab hook, refer to Figure 1, and proceed as follows: Centerpunch 1" from the end of the 5"-long piece of flatbar (see Figure 1C). Drill a 1/4" hole at that point. Make two parallel saw cuts from the end to the hole to create a 1/4" slot. File all saw cuts smooth, kill the edges (file them lightly so that they are not dangerously sharp), and round all corners. Clamp the piece in a machinist's vise with 1/2" of the tangs protruding above the jaws. Bend the tangs to a 45-degree angle with a hammer. Lift up the work 1/4", and continue the bend to 90 degrees. Lift another 1/4", and complete the bend to 135 degrees. This incremental bending should give a

radius to the bend which will better fit the chain. Now take the 2"-long piece of angle iron and clamp it to the piece with the bent tangs that you just created. It should be 1 1/2" from the end without the bent tangs. Check Figures 1A and 1B to see that the piece of angle iron is oriented correctly. Rivet the two pieces together thus: Drill close-fitting holes for the 16-penny nails, countersink these holes slightly at the outer surfaces, and cut pieces of nail long enough to protrude 1/16" above each surface. Pound the excess length down into the countersinks until the assembled pieces are tight together. File any excess rivet material flush with the surface (see *WoodenBoat* magazine No. 189, page 48 for more about riveting metal).



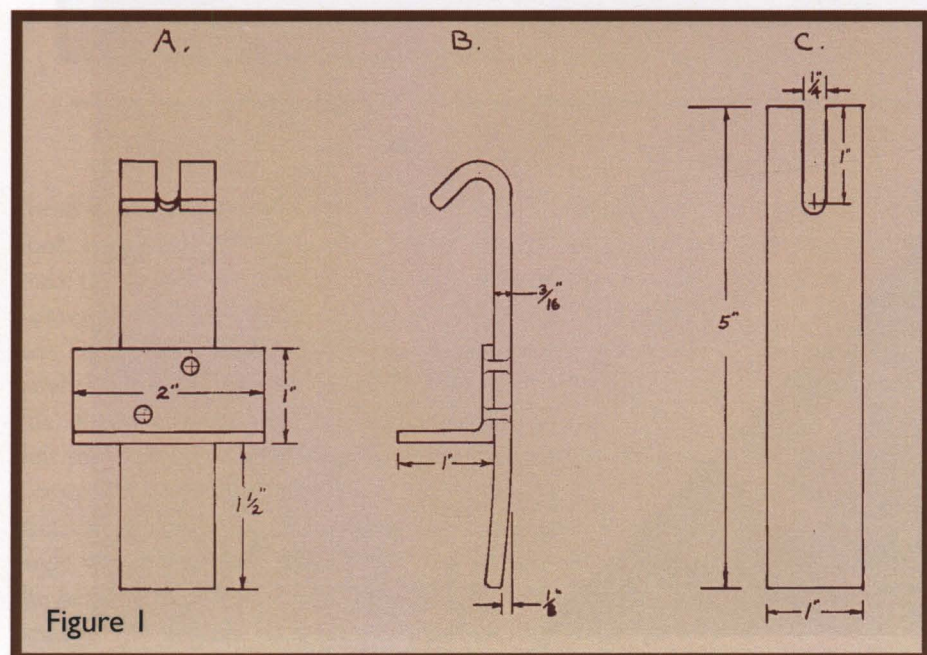
To complete the grab hook, clamp the assembly in the vise and with a hammer put a slight bend (about $1/8''$) in the $1\frac{1}{2}''$ section which extends beyond the angle iron. This will keep the corners from denting the planking (see Figure 1B). To make the padded plank hook, refer to Figure 2 and do the following: Using a hacksaw and file, work the end of the 6"-long piece of flatbar to the shape shown in Figure 2C. The tang created at the top of the bar will be formed into the eye that holds the chain. To bend the tang, hold the piece in the vise so that $1/2''$ of the tang protrudes. Bend the tang slightly with a hammer, then raise the piece up $1/4''$ and bend some more. Finally, raise the piece so that all of the tang protrudes and complete the bend, leaving enough of an opening to insert the chain. It might help to make the last of the bend around a $5/16''$ or $3/8''$ rod to get the shape you want. Take the 3"-long piece of angle iron and clamp it to the 1" flatbar so that it is positioned as shown in Figures 2A and 2B. Drill a $13/64''$ hole through both pieces centered $1/2''$ from the end of the 1" flatbar. This should be the right size for the 20-penny (4") nail/rivet which will hold these two pieces together. Before you rivet these pieces, drill the other face of the angle iron for the 6-penny (2") nails that will hold the hardwood pad in place. See Figures 2A and 2B for the location of these holes. Before riveting, put a $1/8''$ offset in the flatbar by clamping 1" of it in the vise and bending it as shown in Figure 2B. This will bring the pull of the chain more nearly in line with the hardwood pad. Rivet the two pieces together with the nail's head serving as the head of the rivet against the flatbar. The other end of the nail, which protrudes from the angle iron, should be cut $1/16''$



long and pounded into a slight countersink. Do not make this joint too tight, as the padded angle iron will need to pivot to align itself with the plank edge. Using a $5/16''$ twist, auger, or Forstner bit, counterbore the hardwood pad for the 6-penny nailheads so that they are just below the surface. Rivet the hardwood pad to the angle. A piece of chain 28" long will be sufficient for most hulls up to 8' wide. Attach the chain and close the eye. The clamp now is complete. Here the bar clamp is secured between the grab hook and the sheerstrake. The block under the chain protects the faired and sanded hull from damage, and a pad protects the upper edge of the sheerstrake.

Using the Clamps

A bar clamp will be used to tighten the chain clamp. It can be attached in various ways, as shown in the photos. As the chain clamp tightens around the hull (especially where it pulls around the turn of the bilge), the chain might slightly dent the edges of the planks. This is usually of no consequence, as the plank edges are high at this point and will be planed down as the hull is smoothed. If marring of the surface is a problem, a block of wood slipped under the chain will prevent any damage. Any tendency for the padded hook to slip off the plank edge can be eliminated by sticking a piece of adhesive-backed sandpaper to the wood of the hook.



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