Wooden Clamps

They're strong, handsome and cheap to make

by Richard Showalter

Author's tub of clamps.

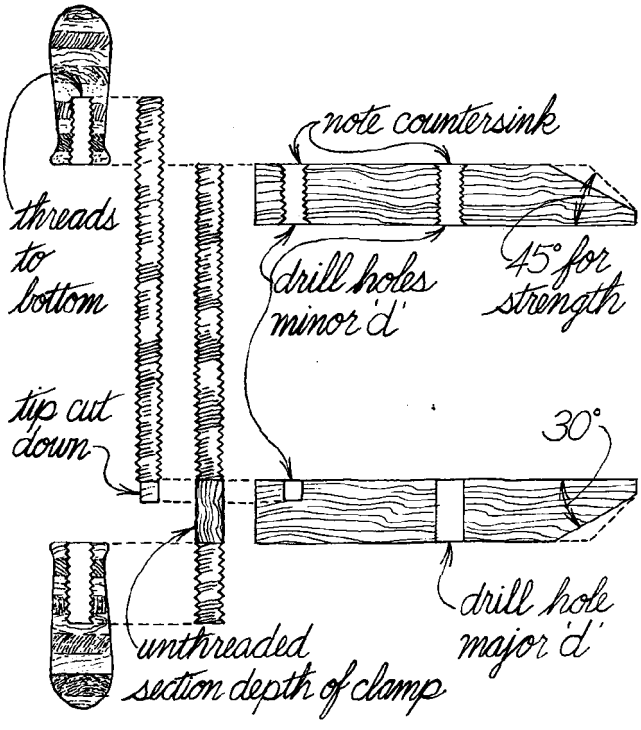
During the six years I've been making my living as a woodworker, I've lived in a small town in Oregon, fifty miles from the closest city. The markets for the expensive children's toys I make are still farther away and it became obvious very early that shipping and packing were going to be an important part of making my livelihood. I became interested in using wooden screws *(Fine Woodworking,* Spring '77) as a way to make my work collapsible and more easily shipped. I bought a wooden threading tool and began making my own screws. They did everything I had hoped in making my work more portable and added to the value of the toy as well.

The most important spin-off has been the manufacture of wooden clamps. My shop is now equipped with a wonderful variety of them. They are fitted to my own hand, suited to my particular needs and esthetically pleasing to me by virtue of their materials and because they were fashioned in my own shop. The financial benefits are not to be despised either—it would cost hundreds of dollars to duplicate the number and range of clamps now at my disposal.

The scale you work on will determine the size clamps you need. If you want to make clamps corresponding to Jorgenson hand screws in the 8-in. to 12-in. range and want to buy only one threading set, the best size is 7/8 in. This makes a screw heavy enough to handle the strains of most applications, but still slender enough to be in proportion to a comfortable handle. One-inch screws make the clamp a little clumsy and the extra strength seems unnecessary. Wooden screws rarely strip. Most hand-screw clamps fail—when they do—by breaking at the center hole in the unthreaded jaw. If you work on a smaller scale, making instruments or doing similar, delicate work, the 1/2-in. and 3/8-in. sizes will make little hand-screw clamps as well as luthier's clamps.

Clamp jaws may be made from nearly any hardwood. (I've even made acceptable clamps using yew, technically a softwood but a very dense and springy one.) Clamp jaws flex considerably in use and should be free of knots, bark inclusions and wind shakes. The slightest fault will be magnified by the stress of use.

The finished width of the jaw should be at least double the diameter of the screw. A clamp using 1/2-in. screws should have jaws at least 1 in. wide. Jaws should be as thick as or slightly thicker than they are wide. These tolerances are critical for large clamps. Obviously, adding more width and thickness increases the strength of the clamp, but in the larger sizes also increases the weight and clumsiness of the tool and ruins its feel. In the smaller sizes bulking up the measure-



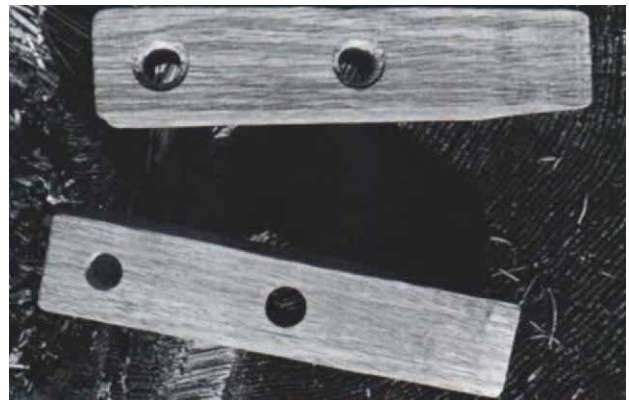
Wooden hand screws may be made in almost any size, with jaws and handles shaped to fit particular types of work.

ments can provide a valuable safety margin and does not make them too clumsy.

Surfaces of jaw stock should be square and parallel. Clamp the jaws together during drilling so the surfaces will mate when the clamp is finished. Holes should be drilled with a drill press or doweling jig. Any skew to these holes will cause the finished clamp to bind in a way that cannot be corrected. The middle hole should be centered from end to end of the clamp. A 12-in. jaw will have its middle screw 6 in. from either end. The rear hole should center 1 in. from the back edge of the jaw in large clamps, 3/4 in. in smaller ones.

Because the tap raises a small curl of wood as it enters and leaves the stock, I use a Forstner bit 1/8 in. larger than the hole I'm drilling and drill a countersink 1/8 in. deep in the top surface of the clamp jaw that will be threaded. (The other jaw is not threaded.) I then use the proper-size bit to drill the two holes to be tapped, stopping the bit when the point breaks through. Using the breakout hole as a guide, I switch back to the larger bit and drill the same 1/8-in. deep hole on the opposite surface. The same result may be achieved by leaving the stock 1/8 in. oversize and planing or jointing to dimension after it has been tapped.

Holes in the piece of jaw stock that is not tapped should be located by allowing the point of the bit—remember, the jaws are clamped together—to break through. The middle hole in the untapped jaw should be drilled the same diameter as the screw, e.g., a 1-in. hole for a 1-in. screw. The rear hole in the unthreaded jaw should extend one-third of the way through the piece of stock, and should be the same diameter as the hole in the threaded jaw before it's tapped, e.g., for a 1-in. screw the hole is 7/8 in. If this hole is too shallow the clamp falls apart in use; if it's too deep the clamp will be weak.



Holes in upper jaw are countersunk with Forstner bit before drilling through and tapping. Rear hole in lower jaw is blind.

I put a 30° slope on the front of the jaws. If you are going to use your clamps to apply very heavy pressure most of the time, the angle should be increased to 45°. This extra material in the nose makes the clamp stronger. It is amazing how such a small change in dimensions will affect the clamp's feel.

I plane or joint a bevel on the two upper edges of each jaw, but this is cosmetic. In use clamps are often laid in piles and banged around, and the bevel keeps them from looking chewed up quite so soon.

No sandpaper, by the way, should be used on any piece until after it is completely threaded. Small pieces of abrasive will cling to the work and dull thread cutters. Although they

Threading Tools

A user's evaluation

I presently have taps and screwboxes *(Bine Woodworking,* Spring '77) in 1/2-in., 3/4-in. and 1-in. sizes. The best commercially available threading tools I've found are made in West Germany (there is no brand name on them) and were formerly sold by Woodcraft Supply. Woodcraft has since begun manufacturing its own version of this tool in this country. My 3/4-in. tool is a Woodcraft product but I like the West German one better because its screwbox handle is fixed to the box with a full-length metal tang, headed over at the end. The Woodcraft handle is attached to the screwbox by a coarse screw threaded into end grain—a poor woodworking practice. The handle constantly unscrews itself in use if you are left-handed, as I am.

The most serious fault of the Woodcraft tool is that the screwbox cuts only a fair thread. The West German tools I have leave a small portion of the original dowel surface intact at the crown of the thread; the Woodcraft tool brings the thread to a sharp crown that makes the threads very delicate.

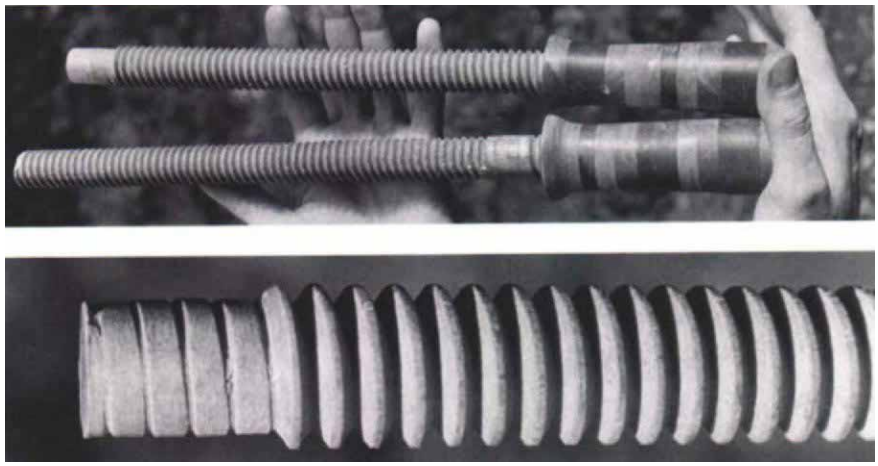
Frog Tool in Chicago still carries the West German imports and I would advise buying from them.

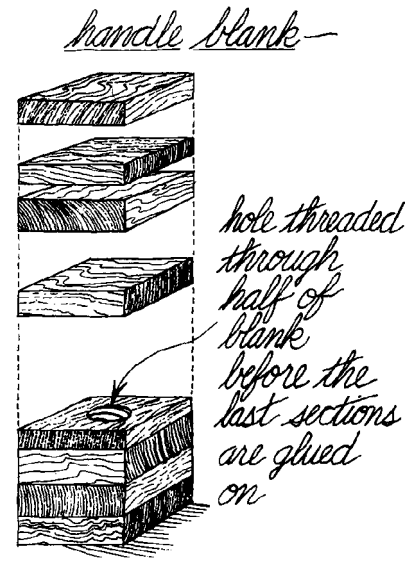
Marples, which ordinarily makes excellent tools, markets a threading set whose 1/2-in. model I found unsatisfactory. The die consists of a wooden box with a metal cutter, the traditional way in which this tool has been made. The tap is cast metal, not machined tool steel. The thread it cuts is sharply crowned and overfine, with too many threads to the inch. The only way I found to make it produce any sort of screw was to cut the wood off to length as it emerged from the box. This inefficient procedure limits the number of things that may be done with the tool. The Marples tap is also very fragile. (My difficulty with this tool is not unique. I spoke with a high-school shop teacher who had purchased the Marples sets in all sizes and was unable to make them perform as they should.)

Brookstone Co. markets a threading set in three sizes, made by Conover Woodcraft of Parkman, Ohio. This is almost an excellent tool. Both tap and screwbox produce a clean thread and the tools are attractively priced. But at three inches the shank of the tap is simply too short.

Finding adequate doweling can be almost as difficult as finding a satisfactory screw set. Stanley used to market a hand-cranked dowel maker, and expensive lathe-powered tools are still available. Commercially available doweling is usually birch or hard maple and very seldom truly round. Variations in moisture content during manufacture and storage often produce doweling that is oval in cross section. For the same reason, much doweling is not straight either. Always check doweling for straightness, piece by piece, before buying it.

Woodcraft Supply sells sizing blocks for doweling that consist of a piece of tempered tool steel with accurately sized circular holes. Doweling is driven through them with a mallet to remove excess stock and bring it back to round. These blocks do not include sizes over 1/2 in., however. I have made sizing blocks for larger sizes by detempering a piece of automobile leaf spring and having a machine shop drill appropriate holes, countersunk on the underside. If you do this, have two holes drilled for each size, one the exact size and one 1/32 in. smaller. The reason for this is that the West German tap and screwbox are made on metric lathes that only approximate U. S. sizes. The "1-in." tool, for example, is made for 2.5-cm doweling. A true inch is 2.54 cm. The undersized holes allow you to make appropriate adjustments. Also drill two small holes in the plate so you can fasten it to a bench top. And don't forget to retemper the metal. —*R. S.*





Handle blank is laminated as in drawing at right. Rear screw, top and enlargement, has shaped tip to fit blind hole in jaw. Middle screw is longer of the two, is unthreaded near handle where it passes through lower jaw, and its handle has substantial flange where it bears against jaw.

can be sharpened again, extreme care must be used to make the tools perform properly and you will wish to do it as seldom as possible.

The two holes in the threaded jaw should be tapped next. The tap needs to be backed off one-quarter of a turn every two turns to break the chip and help keep the nose clear of impacted shavings. The tap should turn freely, without much resistance. If the tap becomes difficult to turn, removed stock is probably packing up in its nose. It should be backed out and the chips and shavings removed. For this purpose I use a heavy piece of Bakelite plastic that I have sharpened to a point. A copper or brass rod about 4 in. long and sharpened to a long point will work well too. Steel should not be used; sometimes considerable force is necessary to clear chips from the nose hole and it is easy to slip and damage the cutters. Packing is worst in threading blind holes where there is no place for removed stock to go but the bottom of the hole.

If you find yourself using all your strength to turn the tap, something is wrong. The tap should be backed out and the trouble located. I keep a small lump of beeswax on my bench and after tapping the first hole in a piece of work I run the beeswax over the tap. Friction makes the tap warm, and the beeswax flows on nicely and eases the work. I then stick a small piece of rag or cotton in each tapped hole and drip Danish oil into it until it is saturated. Remove the rag in an hour or so, after the thread is thoroughly soaked. It is not uncommon in use for some glue to drip on the wooden screws. If a drip gets inadvertently turned into the tapped hole in the jaw while the clamp is being adjusted, the oil will keep it from adhering and freezing the clamp. Danish oil also strengthens the threads. If you try your clamp while the oil is wet it will make an ear-splitting squeal with every turn. The squeal disappears as soon as the oil is dry.

After the initial tapping, even with a well-sharpened tap, stresses in the wood and compression caused by the tapping process cause the sides of the hole to expand slightly over a period of two or three days. This can make the screws bind. It is not critical in hand-screw clamps, which can always be taken apart and retapped, but in other applications—C-clamps and bar clamps where the tool cannot be taken apart after assembly—stock should be set aside and retapped after a few days. Take care to start the tap in the same track as for the first threading. Only a very small amount of material will be removed in the second tapping but it will make a great difference in how smoothly the finished tool will turn. If the clamp still binds, rethreading the screw will help.

The jaws of the clamp can be scraped or sanded to final surface finish. I oil and wax my clamps. Besides making them more attractive, wax keeps glue drips from sticking.

Screws should be made from dense, close-grained wood that is free from knots. I've successfully used beech, cherry, pear, apple, dogwood, black walnut, yew and myrtle. I own an antique clamp that has ash screws, but I've had poor results with both ash and oak, though these woods tap well and make good clamp jaws. I have successfully used oak stock taken from root balls rather than the trunks of trees.

There are two methods of making screws and their handles. The standard way is to turn both handle and screw from one piece. I don't have a lathe so I make handles and screws separately. The only difference is that in the lathe-turned method the rear screw cannot be threaded all the way to the shoulder of the handle—it has to be slightly longer to compensate.

Because taps cannot be used in end grain, I laminate handle blocks by alternating blocks of wood according to grain, sometimes as many as seven or eight for each handle. This is a good use for scraps. I laminate half the length of the handle at a time, drill it through and tap it, then glue on three or four blocks to finish the blank. This allows the screw to bottom out in the hole made for it. If the handle is glued together completely and then tapped, the screw will not fit in the portion of the hole left unthreaded by the nose of the tap. This void in the handle will be weak.

When I first started making clamps I drilled a hole the diameter of my screw stock in my handle, inserted the unthreaded end of the middle dowel with a liberal dose of glue and put another, smaller dowel across the handle to secure it. This didn't work because the middle handle undergoes great stress. All of these original handles eventually broke their pins and glue joints and had to be redone in the way I am describing.

I turn handles by removing the appropriate tap from its handle, chucking it in the drill press and screwing the blank onto the tap. With the drill press running, I shape and finish them free-hand with a Surform and sandpaper. The handle of

the middle screw should have a good flange of very hard wood at the bottom, where it will bear against the clamp jaw. This flange should be at least 1/8 in. wide all around and well-supported. The handle above it shouldn't be thinned too drastically. The rear handle is under much less stress and need have no flange. Of course very nice handles can be made without turning—simply cut them into hexagonal shapes.

The two screws that fit into the handles aren't identical. The middle screw should have an unthreaded section the depth of the unthreaded jaw. If this section is threaded the clamp jaw tries to ride down the spiral when the clamp is turned two-handed, and it gives a galloping effect to what should be a smooth rotation. If your doweling is accurately sized you will have to scrape or sand this unthreaded portion to get it to fit the hole and turn smoothly.

The tip of the rear screw should also be sanded or shaped to fit its socket in the unthreaded jaw. Shallow grooves showing the bottom of the threads should still be there when the fit is proper. The accuracy of the fit in these holes makes the difference between a sloppy and a tight clamp.

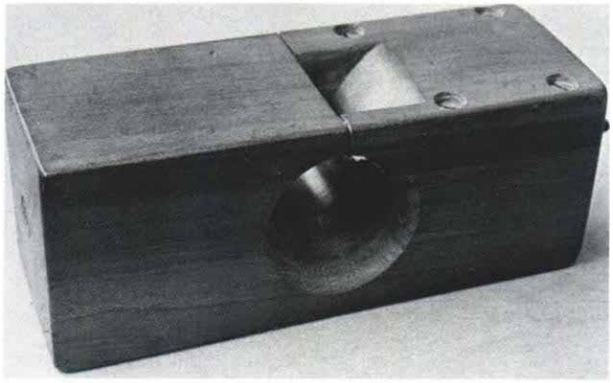
On large clamps I make the screws long enough to open the jaws 9 in. I rarely use the clamp opened this far because flex in the center screw cuts down on the pressure that may be applied. Occasionally, however, it has been nice to have this

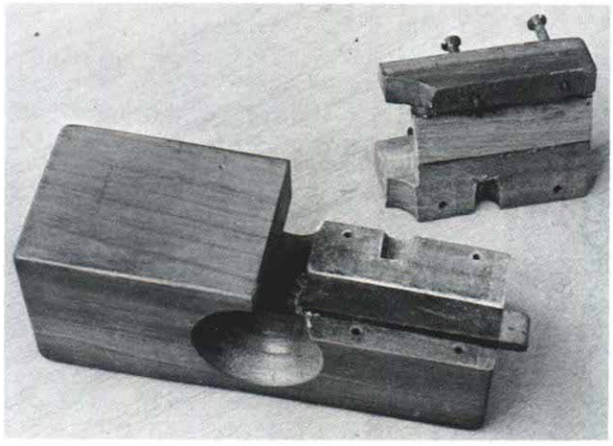
A Dowel Maker

by Trevor Robinson

Because commercial dowels are made only in birch, beech or maple, and large diameters are expensive or hard to get, it is useful to be able to make your own with the simple tool shown here. Properly sharpened and set, the tool turns easily around a square length of hardwood, cutting it smooth and round in a single pass.

The body of the tool is made from a block of hardwood about 2-3/4 in. square and 7-1/2 in. long. First locate and bore a hole the diameter of the desired dowel. Then on the lathe a conical depression is turned to meet the hole so that about an inch of cylindrical bore remains. For a 1-in. dowel, the mouth of the cone is 2-1/8 in. wide; for other dimensions the cone should allow the square of wood to enter about 1/2 in. before it encounters the cutter. This means that the large diameter of the cone is about twice the small diameter. The next step is to drill the holes for the four screws that will fasten the two sections together. By drilling them before sawing the block; alignment is automatic. Two saw cuts separate the clamping section from the main block. Mating channels are then chiseled along the inner faces of the two pieces to hold the cutting blade, which is just a saw kerf thicker than the resulting channel. Thus the cone remains smooth, and the screws hold the blade tightly.

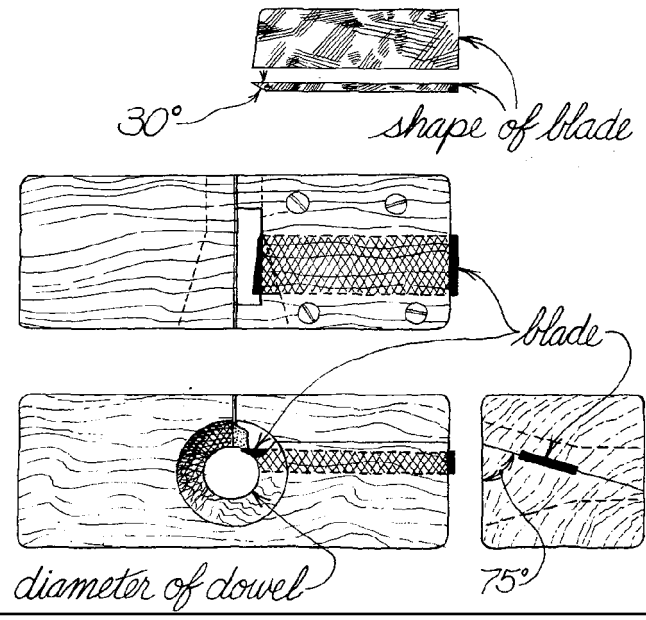




Dowel maker, top, is made of one block of wood out into two parts, bottom. Note rounded heel of cutter—it just grazes finished dowel.

Blades can be made from old files. The file should first be annealed by heating red-hot and cooling slowly. Then a suitable length can be cut off and shaped. Before the final sharpening the cutter should be retempered by heating red-hot, quenching, and reheating to 475° F (light-orange oxidation color) before the last quench *(Fine Woodworking,* Fall '76).

The position of the cutter is very important for getting a smooth dowel. The heel end of the cutting edge should just graze the surface of the Finished diameter so that the dowel is a snug fit as it comes through. Waxing the bore will make it go more easily. The square of wood to be cut should be just slightly larger than the diameter of the dowel—about 1-1/16 in. square for a 1-in. dowel. It helps to chamfer off the four corners at the leading end of the piece to get it started without splintering. Then the wood can be held vertically in a vise and the tool turned without forcing it down. With a sharp, properly positioned blade the weight of the tool is enough to keep it moving along the wood.



Modified tubing cutter propels dowel through German screwbox.

capacity. If you make both screws 14 in. long from handle flange to tip, you can shorten them until they feel right.

When threading doweling, you can insert it in a bench vise and turn the die round and round the dowel. If the wood you are using is brittle or of small diameter, however, the dowel may twist, cracking the threads. If this happens, hand-hold the dowel and turn the die around it. The flex then takes place in your wrist. Large doweling, 3/4-in. diameter and up, can be hand-held successfully without undue fatigue. Smaller sizes are difficult to grip and your hands are liable to cramp. I have modified a small tubing cutter by removing the cutting wheel and reshaping the bottom jaw into a doweling holder to help thread small screws.

To glue screws to the handles, drip glue into the hole; don't coat the screws with it. If possible, try not to get any glue on the threads in the upper half of the hole. Most of the holding is done by the threads on the screws; the glue is only to keep them from turning off the handles. Too much glue can cause the screw to freeze before it seats because frictional heat rapidly sets the glue. Turn the handles on slowly and evenly without stopping until you feel them seat. It is best to turn the screws in dry first and mark them when they are fully seated. This allows you to stop when you should. The screw provides a lot of mechanical advantage and it is easy to pop the end off the handle. Too much glue and this mechanical advantage can produce a hydraulic effect, causing the end to come off or the sides to rupture.

The design of the C-clamp I am about to describe is from an article in *USSR* magazine describing a contemporary Soviet woodworker's shop. I've seen a similar clamp in a 17th-century print of a French cabinetmaker's shop.

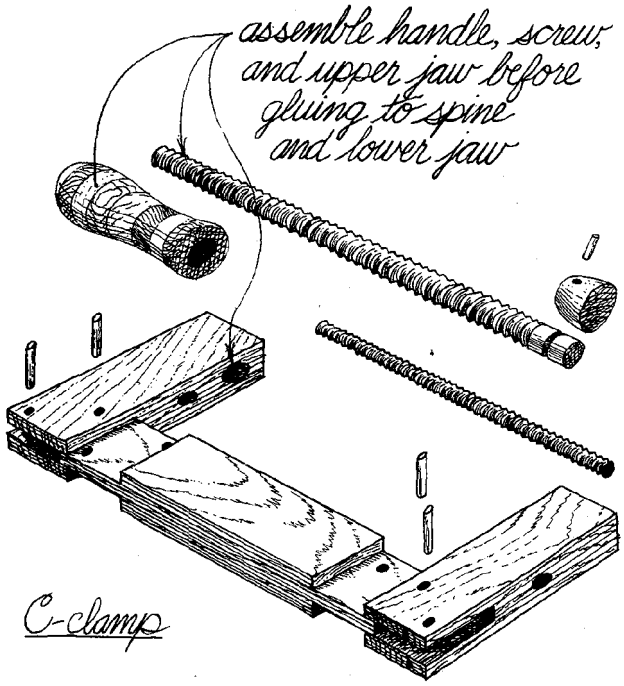
Wooden C-clamps are bulkier than their metal counterparts and because of the center brace look deeper than they should to someone used to metal clamps. The center brace in the Russian clamp was made from a piece of brass rod threaded for a nut at either end. I use a wooden brace because I have a suitable small threading set.

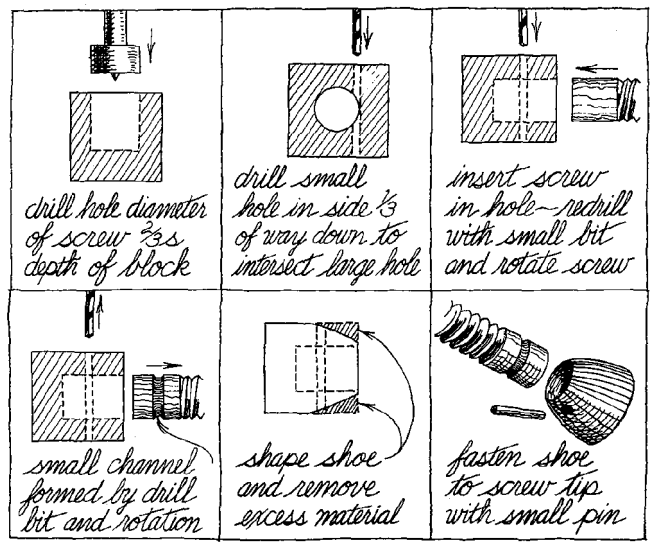
The three parts of the clamp body are held together by mortise and tenon joints. If you are using a wooden screw for the center brace, make up the upper and lower jaws of the clamp body first and thread the holes. Screw the small-diameter dowel through the holes and then measure for the long piece that will form the spine of the clamp. If you are using a metal rod, all three pieces may be made at the same time, to arbitrary measurements. With a metal rod it is possible to draw the rod down to the dimensions of the clamp; with a wooden rod, clearance in the mating threads can result in play of 1/16 in. in the length of the spine piece.

The threaded hole in the clamp jaw that will receive the main screw should be made slightly less than 90° to the axis of the jaw. Two or three degrees is enough. There is a certain amount of spring in the clamp that, because wood is flexible, cannot be eliminated. If the hole is drilled at the logical 90° angle, the clamp will spring under pressure and tend to slide off the work. This is true not only for the C-clamp but for wooden bar clamps as well.

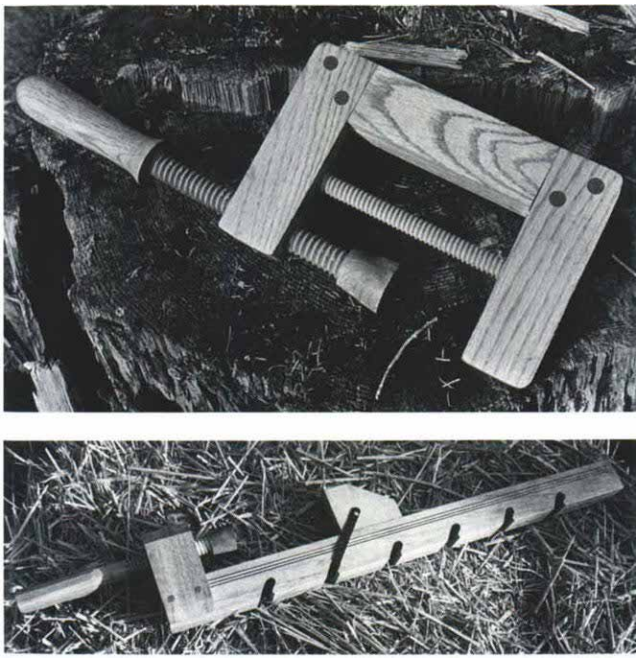
Handles for these clamps can be made in either of the ways described earlier.

Since the hole in the upper jaw will not be accessible when the clamp is assembled, all C-clamp parts should be set aside for two or three days and the upper jaw hole rethreaded. The screw assembly should be attached to the upper jaw before gluing the spine and lower jaw to this piece.





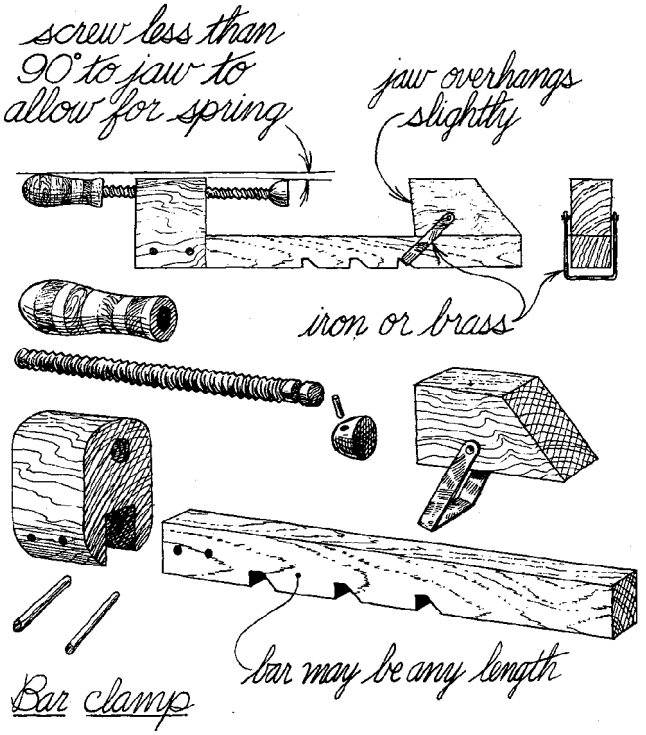
Basic C-clamp, left, can be fitted with freely turning wooden shoe, above. Shoe is made of toughest available wood—author starts with square chunk of hardwood root and drills across the grain, not into end grain. Shoe will break if tip of screw isn't cut truly square, for delicate work, surface shoe with scrap of leather.

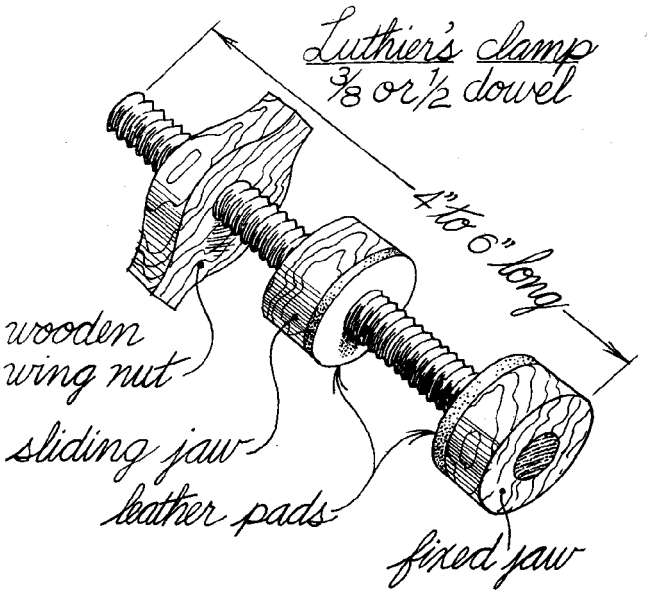


Screws of C-clamp, top, and bar clamp are slanted to allow for flex.

Bar clamps, because they must adjust to material of greatly varying widths, cannot have a center brace. Consequently, they must be more massive. The jaw of the clamp that takes the screw is fixed and heavily made. Again, depress the angle of the screw hole a few degrees from square to allow for spring. The adjustable jaw of the bar clamp should also be slanted a few degrees for the same reason. The bar that secures the adjustable jaw of the clamp can be made from iron or 1/8-in. sheet brass cut to shape and bent with heat.

Luthier's clamps can be made using 1/2-in. or 3/8-in. threaded dowel. The wooden wing nut shown in the drawing





above has numerous applications in clamps and other kinds of woodworking using wooden screws.

Gang clamps for marquetry should be easy to make using the protective tip described for the C-clamp, although this application is outside my personal experience.

By making threaded holes in the tips of the jaws of a standard hand-screw clamp you can increase its possible applications. Different mandrels can be made to screw into the tips, to produce deep engagement clamps or clamps specially tailored to shaped work.

The action of wooden clamps, like all wooden machinery, improves with time. Small mechanical irregularities wear to accommodate one another and the combination of wax, oil, heat and pressure forms bearing surfaces like glass.

I have described the assembly of a single clamp. Obviously it will always be a more efficient use of drill and saw setups to make a number at once. I have a box under my bench where I save likely pieces of material. When it begins to overflow I take a day off and make a batch of clamps. I try to make clamps using all the woods that pass through my shop. This allows me to show wood samples to visitors and it keeps a variety of wood in front of me. The choice of wood for a piece I am making is often suggested by the clamps I am using.

Once you have been through the process you will find you can make five or ten clamps a day without much difficulty.