

A cheap saw kit the author encountered at a 1950s industrial-arts show inspired the design for this shopmade parallel-arm scroll saw. Powered by an old dryer motor, the saw's 2-in. stroke makes for an aggressive cut.

Shopmade Scroll Saw

Eccentric drive simplifies construction

by Mark White

I was a high-school student in the mid-1950s when I attended my first industrial-arts conference in Oswego, N.Y. One of the displays there featured a cheap kit for a motorized version of the wooden scroll saw my great uncles had used to cut fretwork for fancy houses they built at the turn of the century. The saw was made almost entirely of unfinished, $\frac{3}{4}$ -in. ash. It was simple and homely, but boy could it cut. For years, I've tried to lay my hands on one, but the manufacturer has disappeared without a trace.

Since I had already built a large walking-beam saw (see *FWW #24* or *FWW on Making and Modifying Machines*), I finally decided to design my own scroll saw. I ended up with a saw that performs as well as any of the factory-made machines I've tried and will saw very tight curves in wood up to 2 in. thick, leaving a smooth surface that requires no sanding. For inside cuts on fretwork, the blade can be removed, threaded through a hole in the wood and reinstalled in less than 30 seconds.

Inspired by the homely kit I'd seen years earlier, I made my saw as simple as possible. Basically, it consists of two parallel wooden arms mounted on a rigid wooden frame and kept in tension by the blade at one end and a stout nylon cord at the other end. The blade is driven by the reciprocating motion generated by a pair of eccentric, rotating weights attached to the lower arm with a shaft and pillow block. An old clothes-dryer motor drives a section of rubber hose that acts as a flexible shaft to spin the weights. Because the weights are eccentrically mounted, they actually unbalance the pillow-block shaft, causing it to oscillate one cycle for every revolution of the motor. Although the stroke can be varied by changing the length of the weights, I've found that weights made from 2-in. bar stock, $3\frac{1}{2}$ in. long, work best with the 6-in. coping sawblades I use in the saw. These longer blades produce a more aggressive cut than the 4-in. blades most scroll

saws use. As shown here, the saw has a 24-in. throat, but if you need a smaller or larger throat, you can scale the dimensions up or down without affecting performance.

Building the frame and arms—When choosing wood for the frame, pick a stable and warp-resistant material. For this saw, I used two Sitka-spruce 2x12s about 32 in. long, because that's what I had. White pine or fir would work as well, or if you want a nicer-looking saw, use walnut, beech or maple. To ensure precise alignment of the arm pivot holes, screw the boards for the frame together and machine both parts at once. The pivot holes— $\frac{1}{2}$ in. dia. for the top arm and $\frac{3}{4}$ in. dia. for the bottom arm—should be bored on a drill press. Bore the large access holes for the rotating weights with a Forstner bit or a hole saw, or saw them out with a jigsaw and much patience. After bandsawing the frames to shape, I separate the two sections and rout a radius on all the edges except those that mate to the base and the saw table.

I also used spruce for the arms, but ash, cherry and pine are good choices, too. Whatever wood you pick, keep the weight of the arms as low as possible near the blade end. If the arms are too heavy, excess vibration and poor reciprocating action will result. One advantage of spruce is that it has sound knots hard enough to serve as bearings for the bolts or rods on which each arm pivots. On one of the saws I've built, a $1\frac{1}{4}$ -in. knot drilled for the pivot shaft and regularly lubricated with gear oil has lasted four years as a bearing. The lower pivot on the saw shown here is a $\frac{3}{4}$ -in.-dia. steel rod in an Oilite bearing of the equivalent inside diameter. Oilite bearings—self-lubricating, sintered bronze sleeves—are available in a range of sizes. Refer to the supplies box for a source.

As the drawing shows, the distance from the pivot point to the blade mount is $\frac{1}{4}$ in. longer on the top arm than it is on the

bottom arm. This causes the blade to back out of the cut on the upstroke and advance into the material on the downstroke, increasing blade life and improving performance. Reducing the blade rake (angle) to $\frac{1}{8}$ in. will make the blade less aggressive and the cut more precise.

The eccentric drive—For the drive, you'll need some $\frac{1}{4}$ -in. by 2-in. mild steel bar stock, a $3\frac{1}{2}$ -in. to $3\frac{3}{4}$ -in. bolt to serve as a shaft and a $\frac{3}{4}$ -in. ID pillow block. As shown in detail C, the weights are fashioned from the bar stock, then mounted on either side of the pillow-block bearing by the shaft. The threads on the bolt's excess length are filed or ground off to give the rubber-hose coupler good purchase. To make the weights, I first bored the bar stock, then cut them to final size. It's tough boring large holes in heavy steel, so I started by boring a $\frac{1}{4}$ -in. hole, which I then enlarged to $\frac{3}{4}$ in. Do this boring on a drill press and be sure to clamp the steel firmly and keep your hands well clear of the work.

I assembled the drive mechanism by holding the bolt head tightly in a vise while the nut was drawn up very lightly. Washers, or a $\frac{7}{8}$ -in. nut, can be used as spacers to keep the weights from striking the arm as they rotate. As you tighten the nut, make sure the weights are aligned so they'll rotate in unison, otherwise the reciprocating action will be uneven. Once it's assembled, position the pillow block on the lower arm, as shown in the drawing. Before bolting the pillow block down, make sure the weights rotate through their full arc without striking the arm. If they strike the arm, add a thicker spacer. By the way, the drive can be positioned so the motor is on either side of the saw.

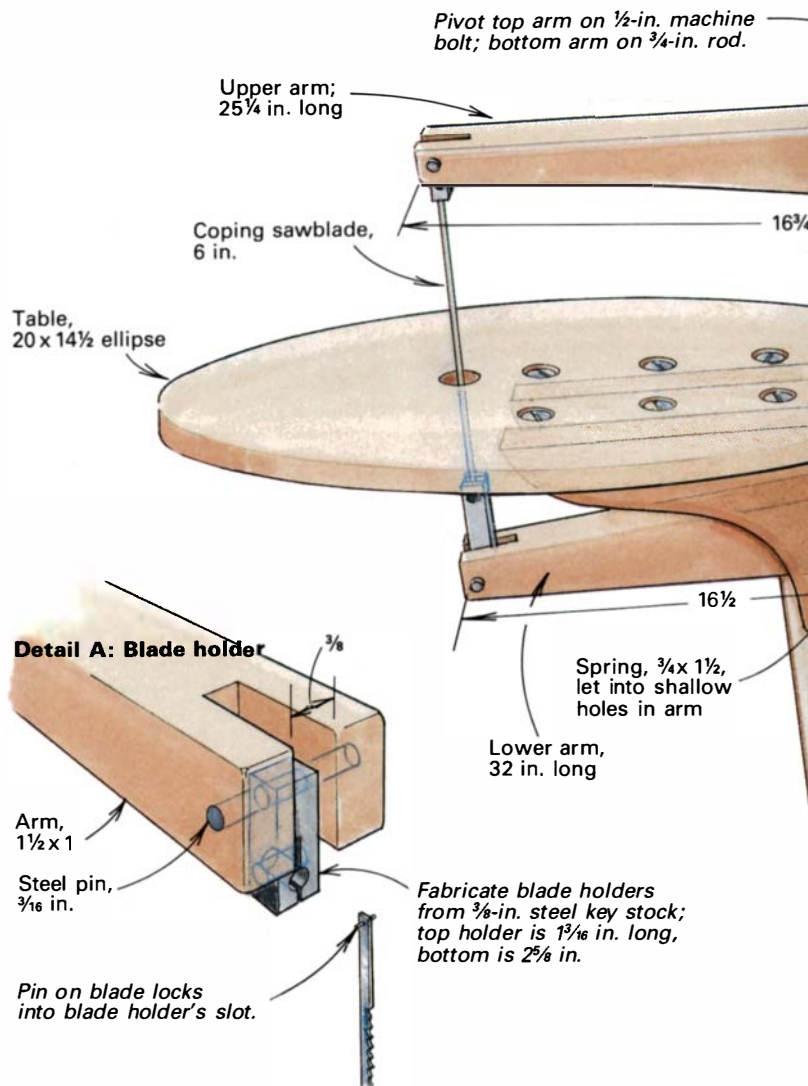
Assembling the saw—Begin assembly by inserting the arm pivot bolts in their holes and positioning the upper and lower arms on the frame. Rotate the eccentric weights by hand, and on the inside of the frame, mark the path they describe. With a large Forstner bit and/or a chisel, chop clearance cavities in both frame pieces to accommodate the rotating weights. Remember, the arm's travel is at least 1 in. in both directions, so be sure you've provided enough clearance. Although the spinning weights are well protected by the saw's frames, it's probably not a bad idea to fashion some sort of a removable guard for the back of the saw as an added safety feature. Before proceeding with final assembly, the blade holders and tensioner must be made.

I made the blade holders from $\frac{3}{8}$ -in. key stock, as shown in the drawing. Each blade holder fits into a slot cut into the end of the arm and is held in place by a $\frac{3}{16}$ -in. steel pin. If you can find them, pins that are hardened and ground will work best with the softer key stock, but in a pinch, a small bolt could also suffice. The blade itself is inserted through the holder's slot and held in place by pins on the ends of the blade.

To cut well, the blade must be under considerable tension; and on commercial saws, this is usually done with a threaded rod. But in keeping with my saw's low-tech design, my tensioner is simply a loop of nylon cord that passes around a $\frac{1}{4}$ -in. pin in the lower arm and through a hole in the upper arm, where it wraps around a dowel. Twisting the loop tensions the blade, as with a bowsaw. This setup may sound crude, but it's effective, and because it's flexible, the saw won't shake itself apart when a blade breaks. Sometimes, vibration will tend to unwind the tensioner, a problem that can be remedied by carving a detent notch for the dowel where it seats against its mounting knob.

To minimize warping, I finish both sides of the frames with varnish or shellac before assembling the saw. Once the finish is dry, I test assemble the parts, tightening the fasteners fingertight.

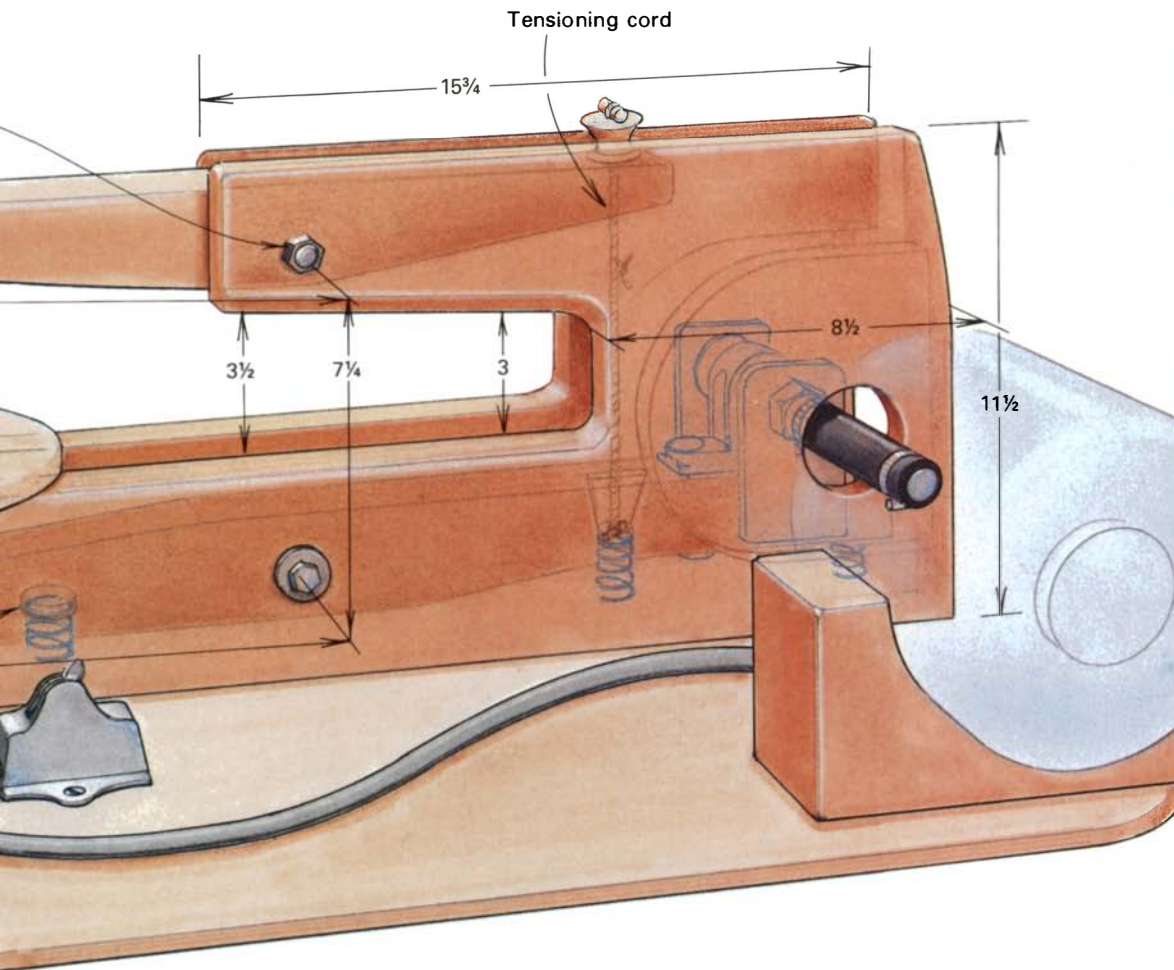
Fig. 1: Scroll saw plan



With a blade installed and lightly tensioned, I move the arms by hand. They should slide lightly against the sides of the frame. If there's binding, trim as needed with a handplane. To keep the lower arm roughly centered in its swing and to give the rotating weights some resistance to work against, I mounted three coil springs between the lower arm and the saw's base. The springs—straight from the hardware store—are $1\frac{1}{2}$ in. long, $\frac{3}{4}$ in. in diameter. To hold each spring fast against vibration, I bent one end of the coil down and threaded it into a small hole bored in the base. Long finishing nails will temporarily hold the coil springs in place while the saw is attached to its plywood base.

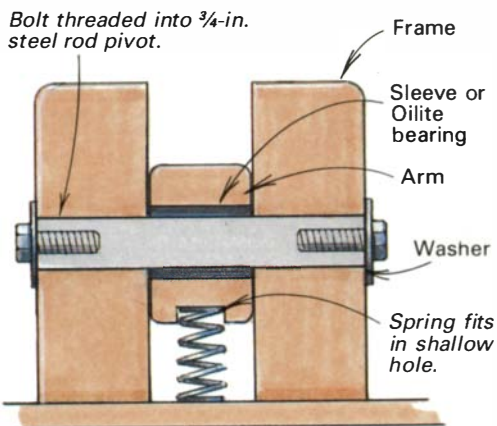
Trial run—To test the saw, I chuck a bolt into a variable-speed drill and connect this through a section of rubber hose to the eccentric drive shaft. I run the machine for a few minutes at slow speed to check everything out. Both arms should reciprocate freely with minimal vibration. If the front or back of the bottom arm strikes the base, adjust the position of the springs or install stiffer ones. Once this test is done, I connect a permanent motor and switch. The saw doesn't require much power— $\frac{1}{3}$ HP to $\frac{1}{4}$ HP should be plenty at 1,720 RPM. Do not, under any circumstances, use a 3,450-RPM motor. Unless you reduce its speed through pulleys, a motor this fast will cause dangerous vibration.

To finish up the saw, I make a 20-in.-dia. elliptical saw table out of $\frac{3}{4}$ -in. plywood and screw it to the frames with drywall

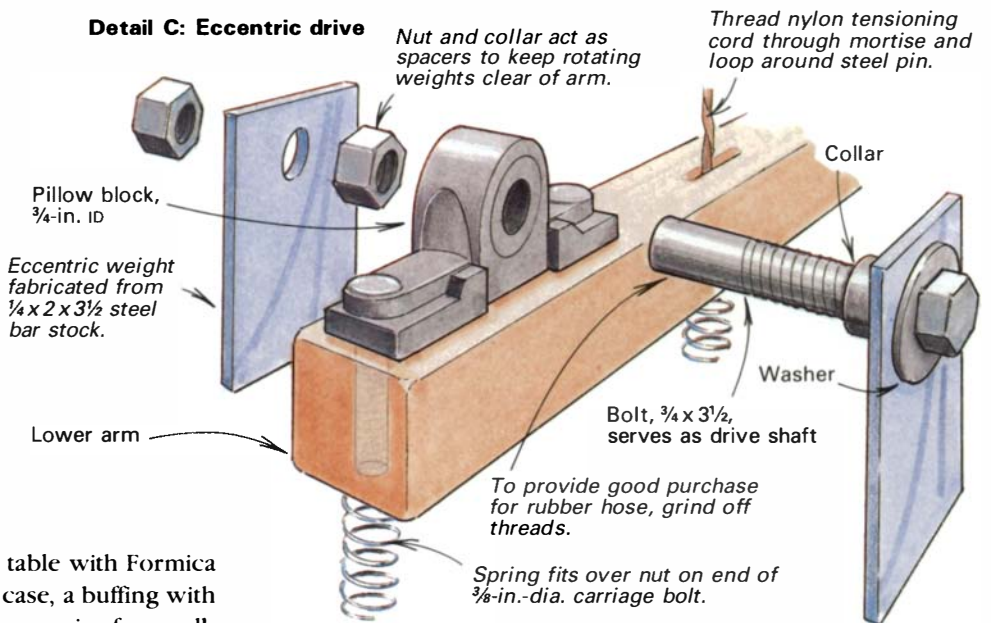


A pair of eccentrically mounted steel weights bolted to a pillow-block bearing generate the saw's reciprocating action. The motor is connected to the reciprocal drive through a rubber hose, which acts as a flexible shaft.

Detail B: Bottom pivot



Detail C: Eccentric drive



screws. For a really smooth surface, cover the table with Formica or make it out of an old sink cutout. In either case, a buffing with paste wax will make maneuvering the workpiece easier for small-radius scroll work. I've come up with solutions for the two aspects of using a scroll saw that I find most unpleasant: vibration and dust. A 3-in.-thick foam-rubber pad placed under the saw's base dampens noise and vibration considerably and keeps the saw from walking across the table. On a few of the machines I've built, I tapped into the airstream coming off the motor's cooling fan and diverted it through a 1/2-in. copper tube to a point just in front of the blade. If you do this, make sure to orient the tube so it blows dust toward the back of the saw and not toward the operator. □

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Sources of supply

Pillow blocks and motors are available locally from Grainger's. For a catalog and list of distributors, write W.W. Grainger, Inc., 5959 W. Howard St., Niles, IL 60648; (312) 647-8900.

Bar stock, Oilite bearings and hardware are available from Small Parts, 6901 N.E. Third Ave., Miami, FL 33238; (305) 751-0856.

Key and bar stock is available from Metal by Mail, 18170 W. Davidson Road, Brookfield, WI 53005; (414) 786-4276.