Treadle Lathe

Build your own

by Jim Richey

When Chester Knight of Conroe, Tex., built his wooden treadle lathe, he had several goals in mind. He wanted it to be lightweight and portable, easily knocked down to its components. He wanted something pleasing to look at, clean and balanced with subtle curves. But most of all, he wanted a functional, mechanically sound tool capable of producing, on a smaller scale, the same high-quality turned goods as a modern power lathe.

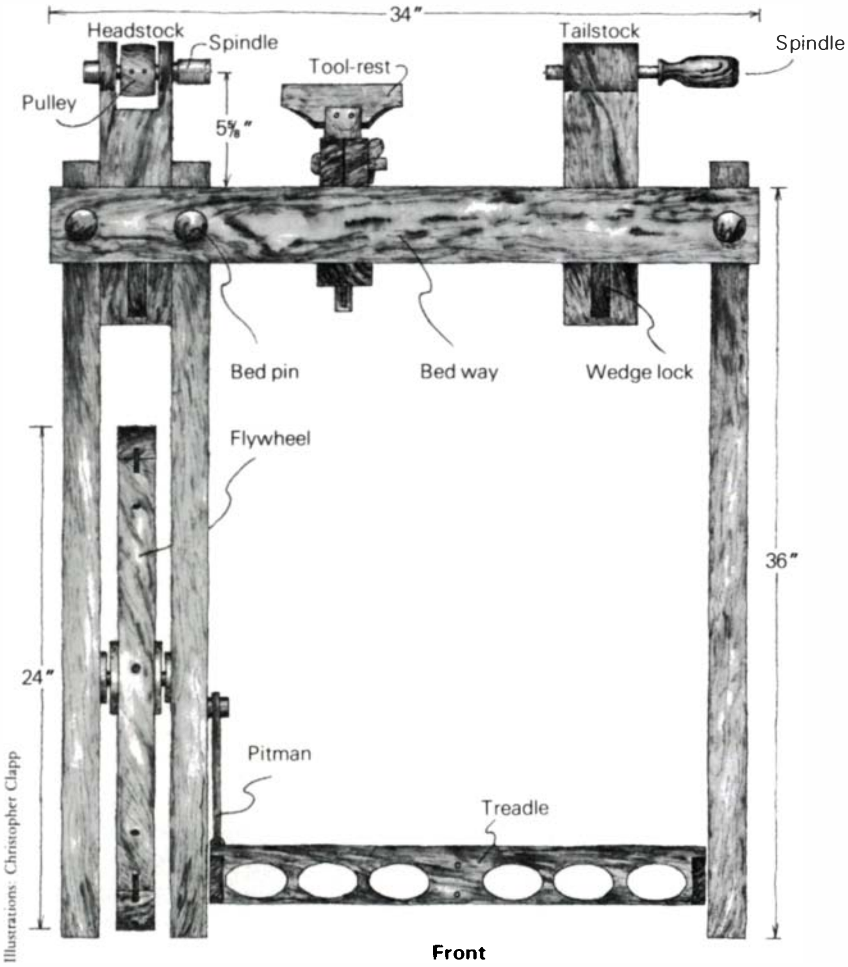
The design is Knight's own, but he readily admits borrowing a few ideas from early treadle lathes. Heinrich Scholl's Texas-German treadle lathe, built in the 1870s, was especially influential. That 9-ft. monster has a heavy, solid wood flywheel that can be worked from the treadle or belted to a motor. The lathe is pictured in *Texas Furniture*, by Lonn Taylor and David B. Warren (University of Texas Press, Box 7819, University Sta., Austin, Tex. 78712), and is occasionally displayed in Scholl's hometown, New Braunfels, Tex. Knight also borrowed from the treadle lathe in the cabinet shop at Old Sturbridge (Mass.) Village. The large spoked flywheel on this reproduction is fastened above and behind the lathe bed. Like Knight's, both of these lathes have mortise and tenon construction (with tusk tenon locks), double beam bed and solid wood, wedge-locked headstock and tailstock, but both are more massive and awkward-looking.

Except for a few templates and overall rough measurements, Knight didn't make or use plans. He explains, "I feel better about the end result—there's more a feeling of creativity and accomplishment." Knight roughs out the main dimensions of a project, and the remaining parts are "cut to fit." He urges other woodworkers to use this approach if they decide to make a treadle lathe—many non-critical measurements have been left off these drawings, in hopes that the woodworker will rely on his own sense of scale.

Knight used ash throughout the lathe. It's tough and springy, and has a flashy grain. It's also available in the 3½- in. squares necessary for the tailstock and headstock. Curiously, the bed ways are yellow pine. Knight wanted to experiment with the bed length, so he designed the leg notches to take a garden-variety 2x4 bed way. After he found the right length he just never substituted ash for the pine. For consistency and bed "spring" (a reputedly important attribute of wood-bed lathes) ash would be marginally better than yellow pine. But consider the flexibility of a 2x4 bed. A few bucks buys a new bed of virtually any length.

The only metal parts are the headstock and tailstock spindles and the flywheel shaft and crank. Knight owns a small metal lathe and he has 40 years of metalworking experience—all the metal parts (with the exception of the spur center he bought from Sears) were custom-machined. Each woodworker should choose metal parts on the basis of his preferences, projected uses of the lathe and access to metalworking machines. The choices range from simple solid shafts running in wood bearings to more advanced hollow shafts with Morse taper sockets running in bushings or ball bearings. You'll also need access to a wood lathe to turn the hub and spokes of the flywheel, and the spindle pulley.

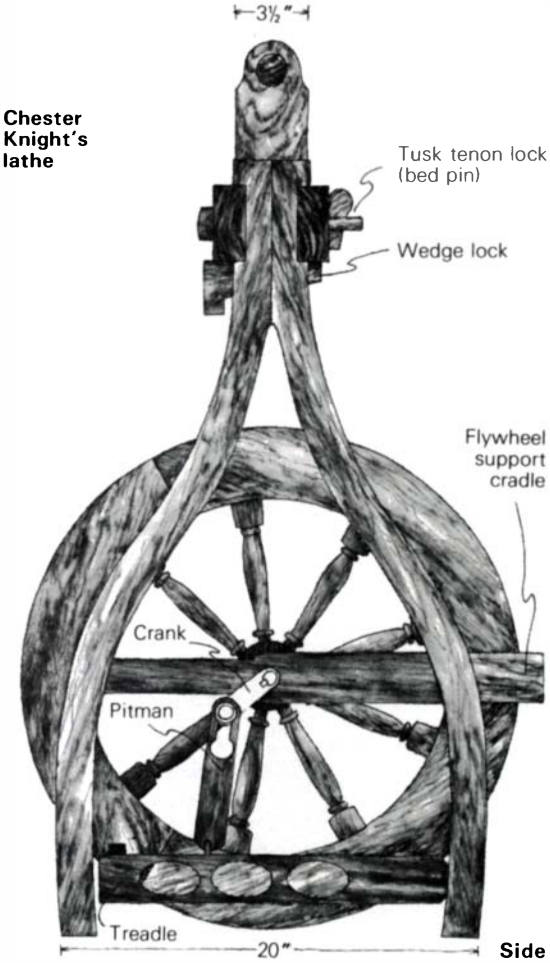
Frame — The first step in making a treadle lathe is building the frame—legs and bed. Start by bandsawing the legs



Front

Illustrations: Christopher Clapp

Chester Knight's lathe



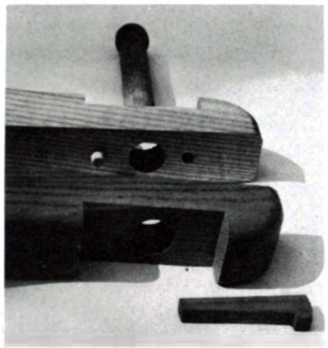
Side

from 1¾-in. thick by 8-in. wide ash planks. The wishbone profile causes a lot of waste, but most of it will be used later for flywheel spokes and smaller parts. Cut the notch in each leg a little small so that it can be trimmed to a snug fit with the ways. Leg pairs are not permanently joined to each other, but dowel pins are glued in one leg and mated to corresponding holes in the other leg to keep the leg halves from shifting.

After the leg pairs are ready, trim the notches to accept the bed ways. This operation is more important than it seems. The depth of the notches will determine the spread of the bed ways (2½ in.), which should be exact and consistent from head to tail. Also, any slop in the fit of the bed in the notches will translate to side-to-side racking later on.

With the bed ways installed in the notches, drill the 1-in. bed pin holes through both ways and the leg pairs. Position the outside legs about ½ in. from each bed end. Position the middle leg so that the gap between the two left legs will fit the headstock (3½ in.).

Turn the bed pins for a slip fit in the 1-in. pin holes. Leave a shoulder (or cap) on the front of each pin and about 1½ in. of extra length on the back. Mark and cut the ¼-in. tusk mortises on the back end of the three pins and fit a tapered tusk tenon (wedge) to each. With the pins home and the tusk tenons tapped tight, the frame should be solid and wobble-free.

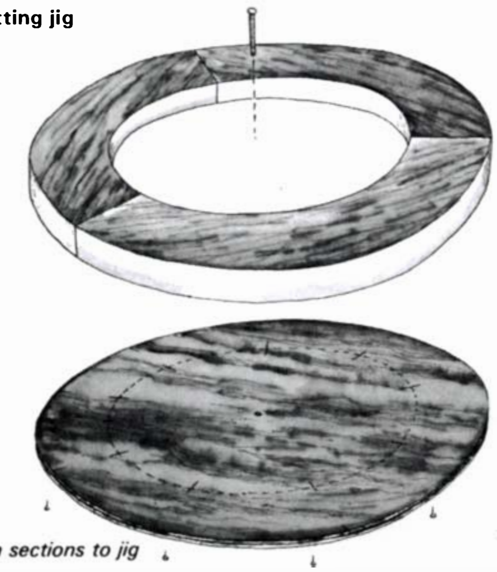


Lathe legs are joined with dowel pins glued in one leg and mated to the other. Bed pins, which hold the ways to the frame, are mortised on back ends. Tapered tusk tenons are wedged in for a tight fit.

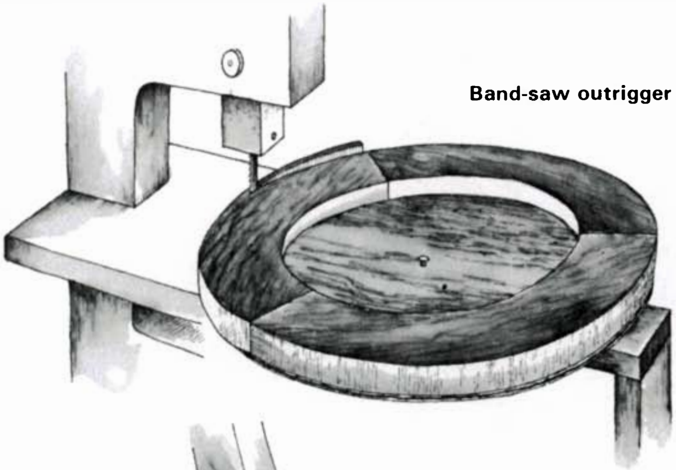
Flywheel — The flywheel is the most challenging aspect of the lathe. The goal is to end up with a perfectly round, true-running wheel of sufficient size and weight to operate the lathe easily. Knight departed from tradition here in both design and construction. He used three rim sections (not the traditional four) and nine spokes (rather than an even number). He says "an odd number of spokes is more interesting, balanced and pleasing to the eye." He also used dowel joints, driven through the rim into the outboard end of each spoke, to fasten the spokes to the rim, replacing the usual dowel-tenoned spoke end. This allows the rim and the spoke-hub units to be glued up separately and fitted at final assembly.

The first step of flywheel construction is jointing and rough-cutting the three rim sections. For a 24-in. wheel you'll need three ash planks 1¾ in. by 8 in. by 24 in. Make and use a template of a rim section to get the angles right. Joint the three sections to a perfect fit where they meet, but leave the outside and inside curves about ½ in. wide. Knight recommends a simple jig (next page), basically a circle of plywood with a pivot hole at its center, for cutting both the outside and inside of the rim. Tack the three sections in place on the jig. The jig is center-pivoted on an extension to the band-saw table (band-saw outrigger). Then the jig with attached rim sections is rotated against the blade, cutting a perfect circle on the outside of the wheel.

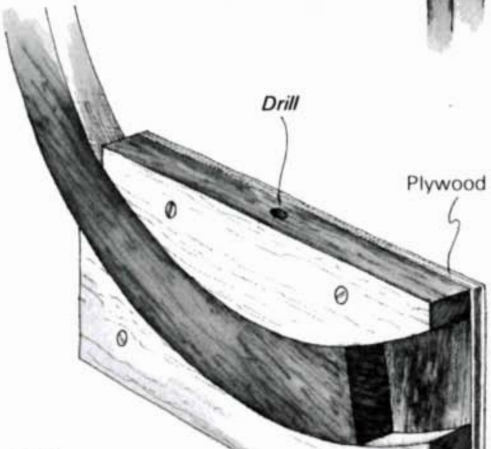
Before cutting the inside curve (which destroys the jig), Rim-cutting jig



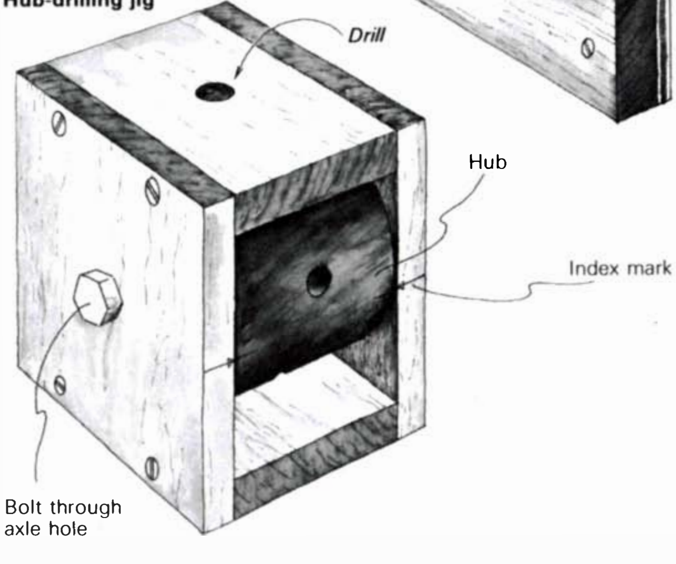
Band-saw outrigger



Rim-drilling jig



Hub-drilling jig



mark the nine spoke locations on the rim using a protractor for the 40° spacing. Cut the inside circumference by moving the pivot point toward the blade. Temporarily remove one rim section to enter the blade and rotate the jig against the blade as before. After that's done, remove the rim sections and drill 3/8-in. dowel holes where marked. It's a good idea to construct and use a drilling jig, as shown in the diagram, so that the holes are at the correct angle. Drill these holes all the way through the rim. To complete the rim, cut and fit splines at the joints of the three rim sections. Glue up the rim on a flat surface using a strap clamp to tighten the sections.

Hub and spokes — For the hub, select a good chunk of 3½-in. square ash about 4 in. long. Predrill the shaft hole before the hub is turned. Drive a dowel through the shaft hole, trim the dowel flush with the block, and pin the hub to the dowel at one end to prevent the hub from slipping. Mount the block on the lathe with the spindles dead center on the dowel, so the shaft hole is true with the hub. Turn the hub to a 3¼-in. diameter. Score the centerline of the hub for easier spoke-hole drilling later. Hub length depends on the spread of the legs and the thickness of wood to be used in the yet-to-be-constructed flywheel cradle: Knight's hub is 2¼ in. long. Turn the hub a little short in length so it won't rub the cradle. You can later add fiber or leather spacers to center the wheel in the cradle. Remember not to part the hub through to the shaft until all turning and sanding is completed.

Next, remove the hub, mark and drill the nine ½-in. spoke holes on the centerline. Again, make and use a drilling jig so the holes will be at the correct angle and the same depth. Turn the nine spokes using 1¼-in. ash. Allow a little extra length on the outboard end to be trimmed later. Knight left the last couple of inches of the outboard end of the spokes square. This puts more weight on the rim of the wheel and leaves more wood for the dowel joint. Drill the outboard end of each spoke to accept a 3/8-in. dowel.

Finish-sand the hub and spokes, then glue the spokes in the hub carefully, maintaining a flat plane perpendicular to the hub. After the glue is dry, trim the spoke ends with the same band-saw table outrigger setup used to cut the rim. Pivot the hub at its shaft and rotate the spokes into the blade, trimming each one to length. Be careful not to cut the spokes short. If everything goes right, the spokes should be trimmed to length with their ends rounded to match the inside curvature of the rim.

Before final assembly, finish-sand the rim, especially the inside circumference where the installed spokes will frustrate further sanding. The last step is to drive home a 3/8-in. dowel through the rim into each spoke end. Taper the dowel ends, cut a *V*-groove and apply glue to the dowel (not the hole). Trim the dowels flush with the rim. The result of all this careful cutting and drilling should be a round, true flywheel.

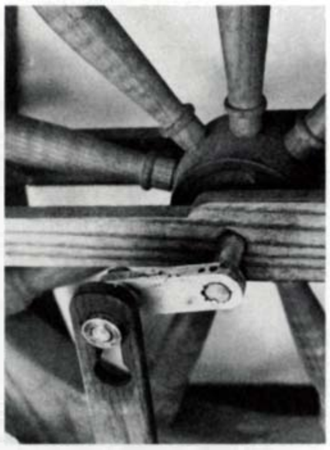
Knight successfully used a flat rim, but he suggests that a slightly crowned rim would help keep the drive belt centered. Crowning could be done on the outboard end of a power lathe or with a router setup.

Shaft, crank and flywheel — The next step is fitting a shaft to the flywheel. The flywheel exerts a lot of torque on the shaft, and it is important to lock the shaft and hub into a solid unit. Knight used a 9/16 drill-rod shaft keyed to the hub. This approach is difficult to duplicate without metal-working equipment, but there are alternatives. The most direct is the approach used by early builders—a square shaft (with rounded ends) fitted to a snug, square hole in the hub. A wedge driven into the hub contacting a flat spot on the shaft is another alternative. Yet another approach, based on a flanged shaft, is described in the article on spinning wheels in *Fine Woodworking*, Summer '78. This article also describes an alternate approach to wheel construction that would work well with a treadle lathe.

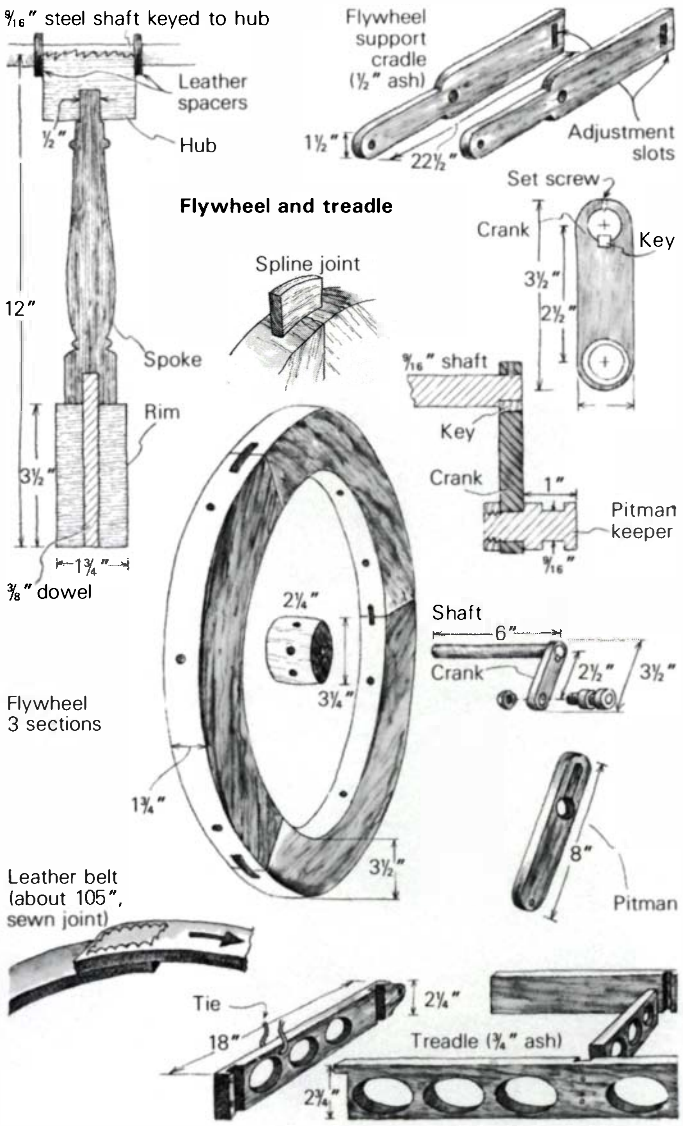
On the outboard side, the shaft should extend slightly more than the thickness of the support cradle. On the inboard side the shaft should extend beyond the cradle so the crank arm can be attached. If the crank is to be bent right from the shaft (as suggested by Knight) an extra 4 in. or 5 in. of shaft extension is needed.

Knight made a separate crank arm from aluminum, keyed it to the inboard shaft end and locked it in place with a set screw. As an alternate, he suggests bending the crank directly from the shaft material. This is direct, requires no metal-working tools and is as effective, if not as elegant. Knight's crank arm is about 2½ in. from the center of the shaft to the center of the pitman keeper.

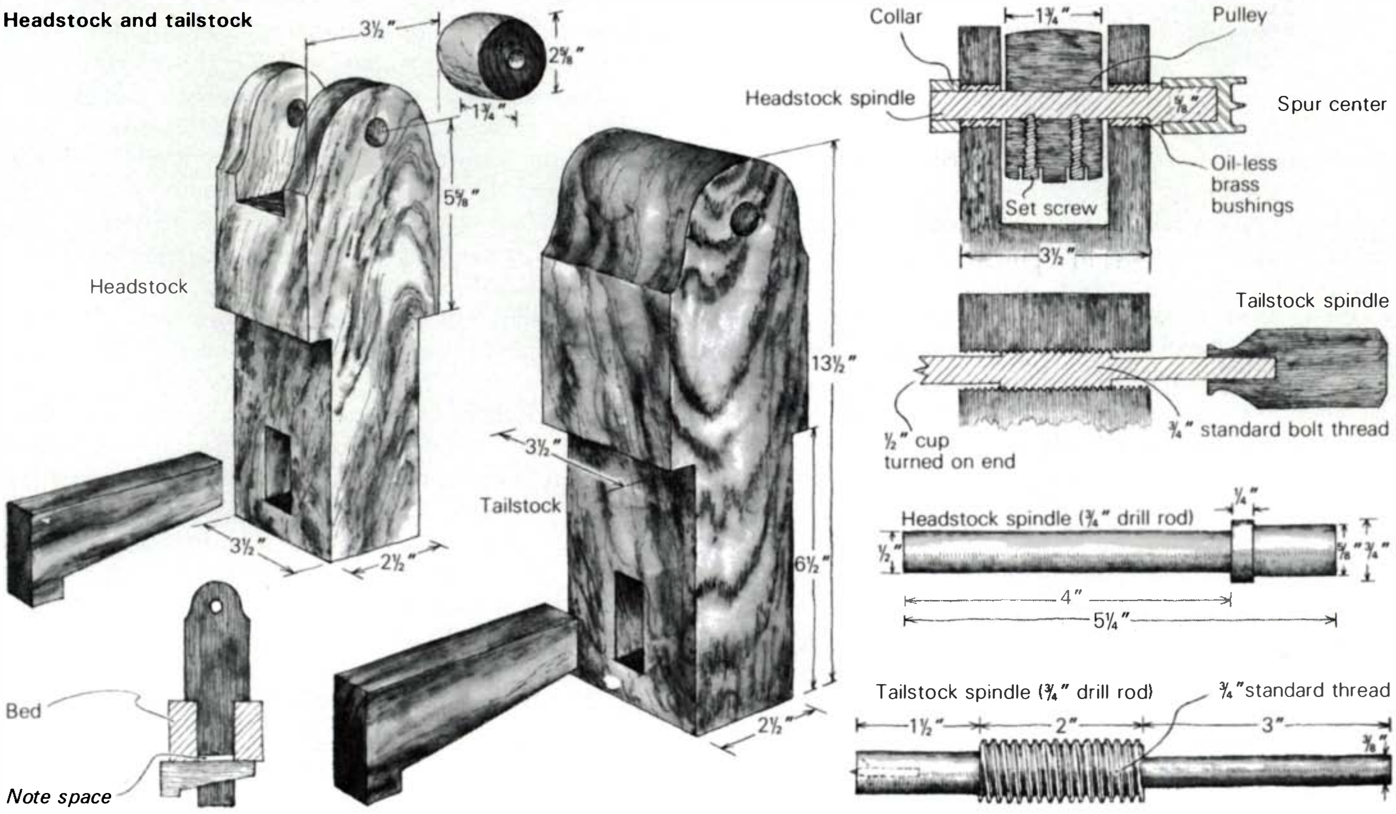
The wooden pitman transfers power from the treadle to the crank. The pitman is fitted to the crank by a keyhole slot and is tied to the treadle with a leather thong. You'll have to experiment a bit to find the right pitman length and tie point on the



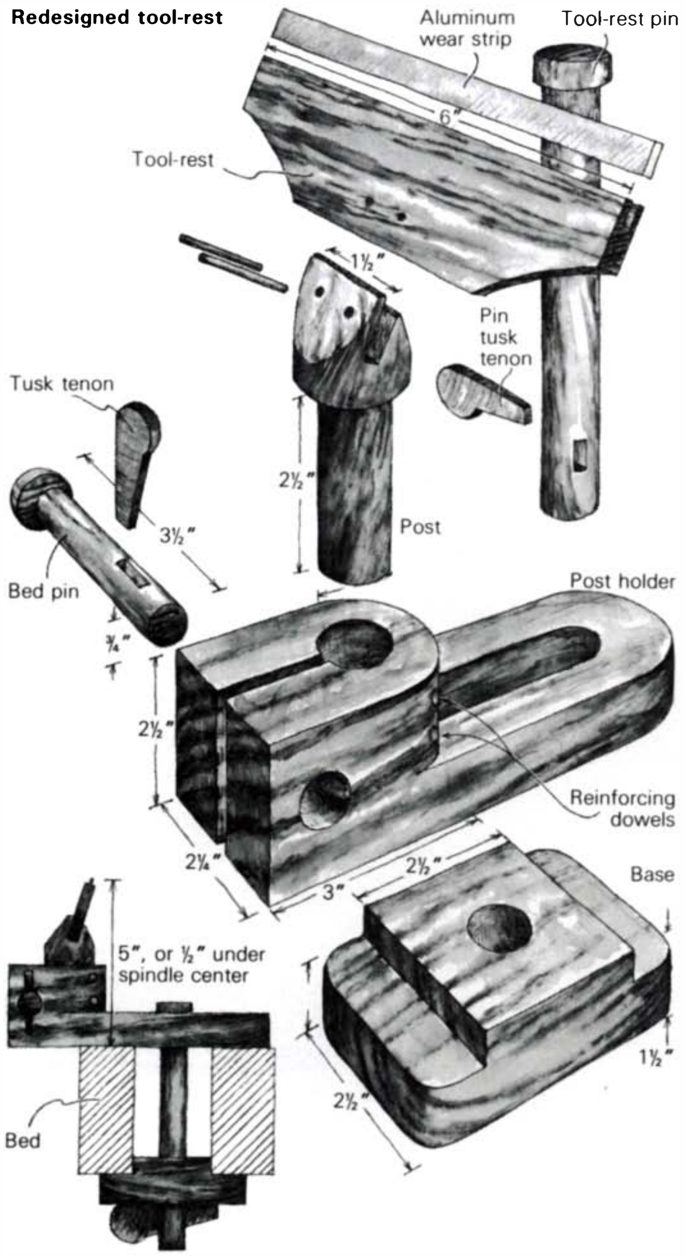
Shaft, crank and pitman assembly connect to hub through flywheel support cradle.



Headstock and tailstock



Redesigned tool-rest



treadle side—both of these can be varied to give the treadle different actions. As the tie point is moved to the back, the treadle throw increases. Knight used an 8-in. pitman tied about a third of the way back from the treadle's front edge. Combined with a 2½-in. crank, this gives about a 6-in. throw to the front of the treadle. To position the pitman, Knight turned and threaded an aluminum keeper that screws to the crank. The middle ⅜ in. of the button was turned to a smaller diameter. If a bent crank is used, machine or grind the pitman keeper groove near the shaft end before the crank is bent. Grinding could be done by rotating the shaft against a cut-off wheel mounted in a table saw. A simple jig should be constructed so the grind will be consistent.

Knight first tried a "floating" flywheel cradle pivoted on wooden pins at the front and left free at the rear. He found it difficult to get the necessary stiffness in the *U*-shaped cradle: His solution was to cut slots in the cradle arms where they cross the back legs. He installed screws through the slots into the legs to allow adjustment of the cradle sides for proper belt tension and flywheel axis alignment.

The treadle is simply a box frame pivoted on wooden pins set into the legs at the rear. The treadle should fit comfortably between the legs, with the front edge just inside the legs at the front. Knight used a template-guided router to cut elliptical holes in the treadle frame. Although the holes aren't necessary, they reduce weight and add a nice design touch.

Headstock and tailstock — The headstock and tailstock (diagram on previous page), or puppets (as they were called on early lathes), are bandsawn from solid 3½-in.square stock. The bottom of each is cut thinner (to 2½ in.) so that the lower parts fit snugly between the ways. Cut a tapered mortise in the bottom of each puppet so that a wedge can be driven in, locking the unit in position. The wedge should exert equal pressure on both front and back bed ways and should extend slightly at the back so it can be loosened easily.

Knight machined the headstock spindle from drill rod. Dimensions are given in the drawings. The inboard end was turned to ⅝ in. to accept an inexpensive spur center available through the Sears tool catalog. The original lathe used oil-less brass bushings for the spindle bearings. These were later replaced by small ball bearings let into the headstock and capped by wood. Knight feels the slight reduction in friction (because of the ball bearings) makes a difference.

Drill the headstock for the bushings or bearings and cut the notch on the headstock top for the spindle pulley. Select a turning block for the pulley and predrill the pulley shaft hole (as before in the wheel hub). Turn the pulley with a crowned rim profile. Install the shaft in the headstock through the pulley. Lock the pulley to the shaft with long hex-head set screws threaded through the pulley and mated with drill-point dimples in the shaft. To save set-up time at craft shows, Knight uses a threaded headstock spindle and predrilled turning blanks that screw right on the spindle, eliminating use of the tailstock.

Knight machined the tailstock spindle from drill rod. To adjust the spindle, he threaded the middle portion of the rod and tapped the wooden spindle hole with a standard metal tap. Metal taps don't cut particularly clean threads in wood but this seems to have worked well. Knight turned the cup center right on the inboard end of the spindle, but an inexpensive cup center is available from Sears. He fitted a wood handle to the other end. For those lacking access to a metal lathe, a large bolt or lag bolt could be effectively adapted for use as a tailstock spindle. The power drive is provided by a 1¾-in. wide leather (latigo) belt stitched together at its ends. The belt on Knight's lathe is about 105 in. long.

The tool-rest requires some nifty engineering. It must move from side to side on the bed, in and out, and ideally, up and down for different cutting angles. Knight's original tool-rest is excellent in most respects, but he is not satisfied because of two small design flaws: The rest is set vertically (it should have been canted slightly toward the work) and the height is not adjustable. The drawings show a slightly redesigned tool-rest that eliminates these drawbacks.

Knight used a router with a ⅜-in. rounding-over bit to shape the legs and outside bed way edges. Since the lathe is a throw-it-in-the-trunk tool, he kept the finish-sanding to a minimum. He used a synthetic oil finish (Minwax) with a light stain base to seal the wood and bring out the grain. □

Jim Richey, of Houston, Tex., is a correspondent for Fine Woodworking *magazine.*