Photo: Norman Zentil

***Routing spiral grooves in a turned column*** *lends a decorative touch that's hard to create any other way. The author's setup employs a plunge router held in a carriage that is pulled along the lathe bed as a cable and system of pulleys synchronously rotates the turning blank.*

***The walnut lamp base,*** *above, was stave-constructed and then turned to a smooth taper. The four decorative spiral grooves that wrap around the base were routed using Zentil's lathe system.*

***The mahogany plant stand,*** *left, made by the author, has a column made from a stave-constructed, hollow turning blank that was spirally routed using a combination of regular and custom-made bits.*

# Spiral-Routing on the Lathe

## *A shopmade setup for putting a twist on turnings*

by Norman Zentil

Spiral shapes have always appealed to me. So when I turned a wooden plant stand a couple of years ago, I decided to decorate it by routing an accelerating spiral pattern into its tapered column. I built my own spiral-routing system, shown in the large photo on the facing page and figure 2 on p. 89. The system employs a router mounted in a sliding carriage, which the operator pulls along the lathe bed. A system of pulleys and weights, connected to the carriage by a cable, rotates the turning blank synchronously with the travel of the router, hence creating grooves, flutes or reeds on the turning.

Although my setup may look complicated, it's actually not all that difficult to build, once you understand how it operates. And although nine years of experience making tools and jigs gave me the skill to fabricate many of the parts from metal, you can just as easily substitute plywood and plastic for some of the parts.

Because spiral-routing is done with the lathe *off,* most of the system's components don't have to withstand the force of a spinning lathe. My system is adaptable to just about any lathe with dual ways—wood- or metal-turning—and is flexible enough to allow dozens of different spiral patterns to be routed. The setup isn't limited to just routing cylindrical turnings. By offsetting the axis of the turning, I can rout spirals on the surface of a tapered turning, such as the column on my lamp base shown in the small, top photo on the facing page. And my system is capable of creating even more complex forms, like the column on my plant stand shown in the bottom photo on the facing page.

It would take pages of drawings to show you every dimension of every part of my lathe system, and then it probably wouldn't fit your lathe. Therefore, I'll concentrate on explaining the construction, features and critical elements of each part so that you can build your own spiral-routing system. But first, here's a rundown of all the components and how they function together.

## How the system works

The spiral-routing system consists of a number of different parts, most of which are mounted on the lathe itself. The components include: the universal drive center and tailstock offsetting device; the indexer; the router carriage; and the weighted drive cable and guide assemblies. My shopmade drive center and offsetting device make it possible to align a tapered turning off of the lathe's normal central axis.

The indexer is the real heart of my setup: It provides the means of rotating the turning in a way that's synchronized to the linear movement of the router. The body of the indexer is made up of two parts: an inner disc, which gets screwed to a 1¼-in.-dia. shoulder turned on the end of the turning blank, and an outer ring, around which the drive cable is wrapped. A repositionable cursor is screwed to the disc. Stops are screwed to the ring and allow the position of the inner disc and outer ring to be partially shifted for routing multiple, evenly spaced grooves around a turning,

I adapted my router-carriage design from one 1 saw in a magazine, adding cleats and bearings so the carriage can slide along the ways of the lathe bed. The carriage holds a plunge router above and parallel to the top edge of the turning during spiral-routing. The carriage also provides a means for raising and lowering the router. An "outrigger arm," which is screwed to the base of the carriage, is grooved for a sliding anchor block that the drive cable attaches to. This arrangement allows the location of the anchor point relative to the carriage to be changed for creating spirals of varying character, from a "uniform" spiral—one that twists evenly all the way around, like the stripes on a barber pole—to an "accelerated" spiral—one with a twist that changes from tightly wound at the bottom, to no twist at all at the top.

From the outrigger, the drive cable passes through a pair of guide pulleys, mounted to the lathe bed, that keep the cable running smoothly as it changes direction from horizontal to vertical. The cable then wraps completely around the indexer ring's pulley once and continues up to a guide assembly screwed to the wall behind the lathe. Finally, the cable end is tied to a lead weight that keeps the cable taut during spiral-routing.

Here's how all the components work together. After the surface of the blank has been turned to a smooth cylinder or taper, the router carriage is fitted to the bed ways with the cleats and bearings, and then the universal drive center and the indexer are screwed to the ends of the blank. If the work is tapered, the offsetting device is adjusted to make the top edge parallel with the lathe bed. The anchor block is positioned and clamped to the outrigger, and the drive cable is threaded in place, as described above. Next, I set the indexer cursor to the 0° hole, lock the cursor between the stops on the pulley, and tighten friction clips on the back of the indexer. To prepare the carriage, 1 chuck a bit into the plunge router and then set the plunge depth to take a shallow cut on the first pass. I slowly plunge the bit into the blank and slide the carriage toward the tailstock, creating the spiral flute. Each flute is routed in three passes, with plunge depth increased between passes. The position of the blank and indexer are shifted for subsequent spirals: The cursor is removed and repositioned in the proper hole to yield evenly spaced spirals, as desired (for example, choose holes 90° apart for four spirals). Subsequent flutes are routed just like the first.

## Jig construction

Most of the components in my setup were made from either Baltic-birch plywood or aluminum. I chose aluminum for some parts because it machines easily, but I'm sure that high-quality plywood or plastic parts would be adequate for most applications. For the sake of brevity, I've simplified some of the parts described below from the way I originally made them.

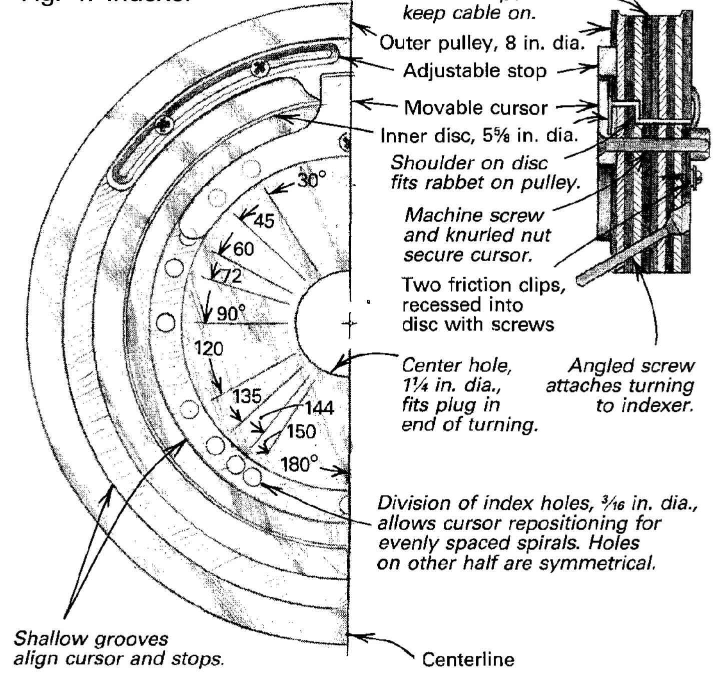
**The tailstock offsetting device and universal drive center**—The tailstock offsetting device (see figure 2 on p. 89) has two basic parts: the main block and the sliding block The main block is bored out to fit the ladle's tailstock spindle. A female dovetail is machined in the block, and two holes for locking bolts are drilled and tapped in one edge. Part of that edge is men slit on the bandsaw, and another slit is cut at the bottom of the block into the spindle-mounting hole. The sliding block is machined with a matching male dovetail. A hole bored into the sliding block receives a pressed-in ball bearing, which in turn gets a lathe-turned and case-hardened ¼-in.-dia. ball-end center pressed into it. When the sliding block is slipped into the main block and set to the desired offset, the Allen head locking bolts close the slits to lock the sliding block in place and simultaneously lock the assembly on the tailstock spindle.

I made my custom drive center by welding a small universal joint, purchased from a bearing-supply store, to a small faceplate on one end and to a #2 Morse tapered shank (to fit my lathe's headstock) on the other end. Incidentally, I use the center to actually turn tapers on my metal lathe using the lathe's screw-cutting feed to make the cut. If you plan to only use the setup for spiral-routing, you can simply substitute a regular multispur drive center.

**The indexer**—The indexer is made up of an inner disc and an outer ring, each made from two layers of ½-in. Baltic-birch plywood glued together and then lathe-turned. My inner disc has a diameter of 5½ in. with a ¼-in. by ⅜-in. rabbeted shoulder on the outer edge. I divided the face of the inner disc to create 2, 3, 4, 5, 6, 8 and 12 evenly spaced divisions (shown in figure 1 at right). Next, I drew a circle on the disc, drilled 3/16-in.-dia. holes at each index line, and routed a 3/8-in.-wide, shallow circular groove around the disc. The holes and groove are for mounting the cursor, which I made from 1/4-in.-thick aluminum. Two stops, also made from 1/4-in.-thick aluminum, provide a means of locking the cursor, and hence the position of the disc to the ring. The stops are slotted so they can be repositioned for changing groove width during spiral-routing (described later). I bored a 1 1/4-in.-dia. hole in the center of the indexer, and then I drilled two 1/8-in.-dia. holes at an angle for screws that attach the disc to the end of the turning.

The outside edge of the outer ring was turned with a small rim, which forms a sort of pulley to contain the drive cable. The center of the outer ring was turned to match the diameter of and fit the rabbet on the inner disc. The fit should be snug, but not tight. The outside diameter of my pulley is 8 in.; however, this diameter determines the number of times the turning rotates as the carriage travels along its length. Hence, a smaller-diameter pulley will produce more turns over a given length, yielding a more loosely coiled spiral; a larger diameter yields fewer turns, producing a more tightly coiled spiral. You may need to experiment to determine the best pulley diameter for the spirals you desire (I wouldn't go under 8 in.). After the pulley was turned, another shallow groove was routed near the rim, and the two cursor stops were screwed on. Finally, the friction clips that keep the disc and pulley together were bent from some cold-rolled steel. Holes in the clips allow them to be screwed to the tailstock-facing side of the inner disc. O-rings under the screws and washers (see figure 1 at right) permit the degree of friction that locks the inner disc and the outer ring together to be adjusted.

Fig. 1: Indexer




**The guide assemblies and drive cable**—Both upper and lower guide assemblies (shown in figure 2) use aircraft-cable pulleys I bought at a surplus store. The lower assembly has two pulleys: One (1 1/8 in. dia.) is aligned vertically to accept the cable as it comes off the indexer, and the other (3/4 in. dia.) is set at an angle to guide the cable as it travels to and from the carriage outrigger. Both pulleys are attached to an aluminum block clamped between the lathe's ways with a plate screwed on from underneath. The larger pulley bolts to the guide block through a slotted hole, with a washer under the nut, to allow up-and-down adjustment. The smaller pulley is screwed to the notched end of a short rod, which mounts through a hole in the guide block and locks with a setscrew. The rod and setscrew allow this pulley's angle and position to be adjusted. The upper guide, made from wood scraps, uses a 2-in.-dia. pulley mounted vertically between wood blocks with a machine screw for an axle. A 3/4-in.-thick plywood backing strip allows the assembly to be screwed to the wall behind the lathe.

For the drive cable, I used 90-lb.-test, stainless-steel, seven-strand fishing line (available at a sporting-goods store that carries salt-water-fishing tackle). For the weight, I used two 5-lb. lead weights (available from a tackle shop); that much weight was required to keep the indexer rotating properly against the pressure of the cutting router bit as the carriage moved. In lieu of lead, you could use sand in a cloth sack tied to the end of the cable.

**The router carriage**—I made the carriage as two separate units: an outer housing, which rides on the lathe bed, and an inner cradle, which holds the plunge router. Rows of 3/8-in.-dia. holes (spaced 3/4 in. apart on the outer housing and 5/8 in. apart on the inner carriage) on both sides of each unit allow router height to be adjusted in 1/8-in. increments to accommodate larger- or smaller-diameter turnings. To strengthen the housing, which is glued and screwed together from 1/2-in. Baltic-birch plywood, I allowed the base and top to overhang the sides and then glued on reinforcing strips at these junctures. Two wood strips, one on each side of the lathe bed, act as lateral guides. Two ball bearings (I used regular skateboard-wheel bearings) bolted to cleats through the guides on each side ensure that the carriage is held down flat and slides smoothly (but with some resistance) on the lathe bed. The outrigger arm, which is screwed to one edge of the carriage, has a 3/8-in.-wide slot dadoed into it. The cable anchor block, an aluminum bar fitted with an eyebolt for tying on the drive cable, fits into the outrigger's slot and is secured in place with a small C-clamp.

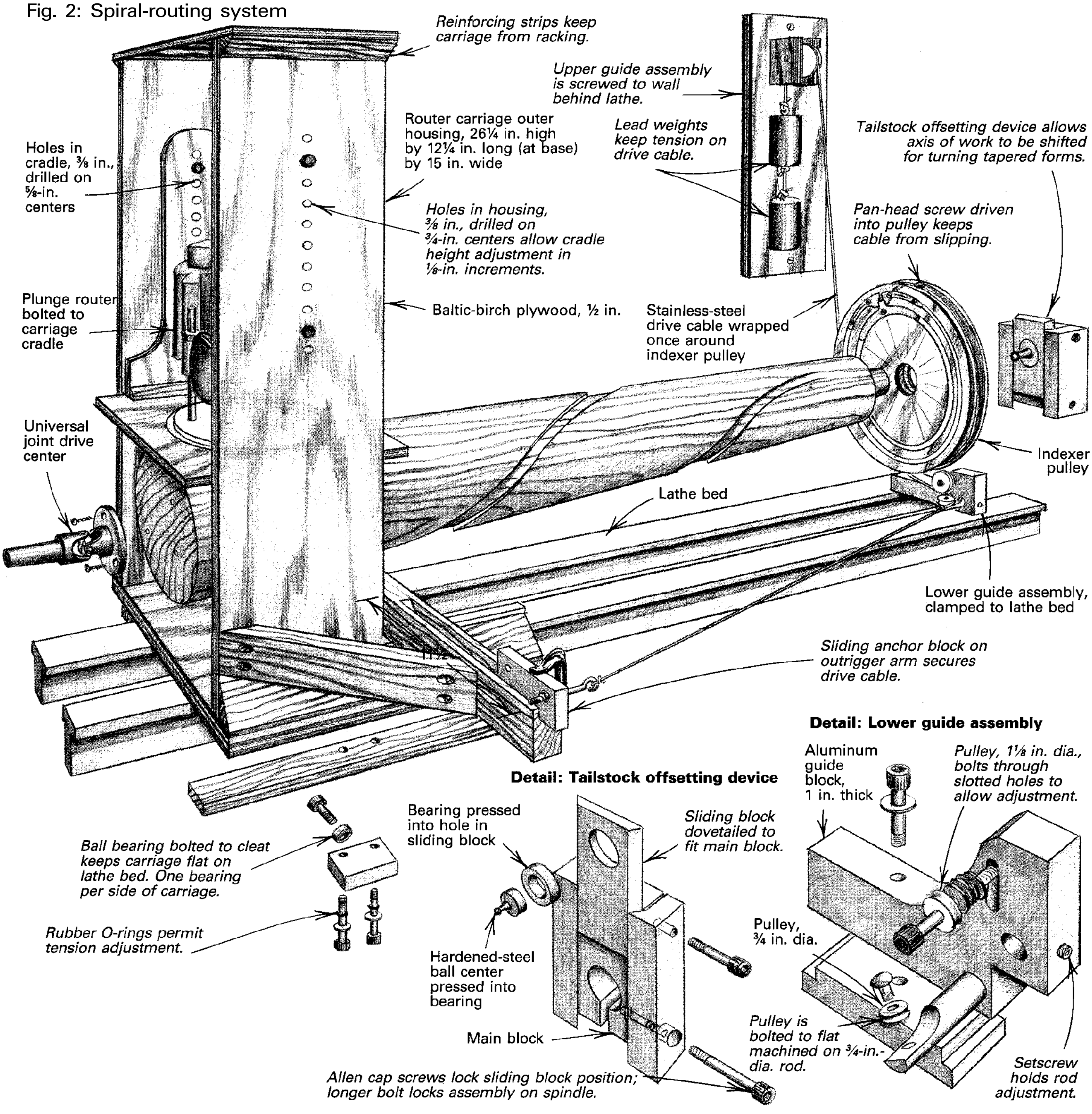
For a router, I use a Hitachi TR12 plunge model that accepts 1/2-in. shank bits. I've had some success routing spirals with regular, straight carbide bits. However, a bit with two spiral flutes (cutting edges) eliminates the tendency for wood chips to back up behind the cut. Even better is a two-flute milling cutter, which I've found completely removes the chips during routing.

## Spiral-routing variations

With a few alterations to the setup, you can produce a wide variety of spiral shapes and patterns on your turned work. The indexer allows you to rout just about as many spirals as you want around the turning. Also, by changing the location of the cable anchor block on the outrigger arm, you can adjust the curve of the spirals. For example, by setting the block very close to the carriage, you'll produce very uniform spirals down the length of the turning; for accelerated spirals, move the block farther out on the outrigger. Once you've found an arrangement you like, try core-box, veining or V-bits for different decorative effects. To change the width of cut using any given bit, set the cursor stops on the indexer pulley farther apart, and then take two passes—one with the cursor against one of the stops and another with the cursor against the other stop. The friction clips provide enough friction to keep the inner disc and outer ring from slipping out of position.

Changing the direction in which the cable wraps around the indexer pulley will allow you to rout spirals that twist in the opposite direction—a handy option for a pair of columns or matching

Fig. 2: Spiral-routing system




candlesticks. You could even rout two sets of spirals on the same turning-one set twisting clockwise and the other counterclockwise—to create a really intricate pattern. Another simple, yet attractive effect is to get spiral flutes or reeds to "light out" at one end. This is done entirely with the tailstock offsetting device. Instead of leveling the top edge of the cone or cylinder-shaped blank, raise or drop the tailstock end so that the router bit takes a full-depth cut at one end and a progressively lighter cut along the blank until the bit stops cutting at the other end. If you wish to rout stopped spirals or a short section of the turning, fit a pair of stop blocks to the lathe bed to limit carriage travel; I made my stop blocks from ¾-in.-thick aluminum and clamped them to the ways.

If you feel really ambitious, you can try making a hollow spiral column, like the one on my plant stand shown in the bottom photo on p. 86. To make the column, I glued up a hollow turning blank from tapered staves. I routed accelerated spiral grooves through the wall of the turning, and then I employed a custom-made router bit (with a cutting edge on the top) that was "plunged up" and run the length of each groove to clean and shape the inside of the column. This process creates the effect of four ribbons of wood swirling up from the base. □

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Drawings: Aaron Azevedo