Spiral Layouts—Three Ways

Introduction

The traditional way to lay out spirals leaves me cold—for a simple spiral on small work with 5 full turns you would need 4 longitudinal lines, dealing with parallax error scribing from the tool rest, and 21 or so circumferential lines and then you need to figure where you are in that visual mess. This article is about three different ways to lay out spirals for wire inlay on small work, although they can be adapted for other spiral uses. The first uses a simple to make layout tool to plot a series of dots with virtually no parallax error. The second uses masking tape wrapped around the work that the lines are drawn on when the tape is off the turning. And the third uses the resizing ease of CAD programs to layout the cutting lines on paper which is temporarily glued to the work. Why three ways? Well the first way is about the only way to handle spirals on a non-cylindrical turning and not everyone has discovered the usefulness of a CAD program.

Connect the Dots

Layout Tool

Begin by making the layout tool. To do that you need to know how big an area you want the spiral to be in, so make a couple of V-cuts in the turning at the ends of the area where the intended spiral, as in Fig01. Cut a rectangle of sheet metal (aluminum flashing, for instance) about an inch wider than the spiral area and 4 or so inches long. Put a piece of masking tape (it’s easier to draw on) across the rectangle about ¾” from one end. Arrange your tool rest an inch or so away from the center line. Now lay the rectangle across the turning and your tool rest so that the end of the rectangle lines along the center line on top of the turning. Make a mark with a pencil where the rectangle intersects the back edge of the tool rest as in Fig02.

Remove the rectangle from the lathe. Use a square to draw a line across the rectangle that are ¼” and 1-1/2” below the first line respectively as in Fig03. A metal vise makes a good break to bend sheet metal, but you can use any straight edge with care. Insert the rectangle in the vise so that middle line is at the top edge of the vise jaws. Bend the rectangle as far as it will go away from the tape as in Fig04. Remove the rectangle from the vise and continue the bend so that the metal is almost folded over. Reinsert the metal in the vise and close the jaws to complete the bend. Readjust the metal so that the first and third lines are even with the top edges of the front and back jaws respectively as in Fig05. Bend the metal to 90 degrees to front and back respectively as in Fig06. The completed layout tool, now in a squashed “T” shape, is seen from the bottom in Fig07.

Connect the Dots

Place the layout tool across the tool rest so the bottom tab is against the back edge of the tool rest. Move the tool rest so that the back edge of the layout tool is on the top center line of the turning as in Fig08. Put masking tape even with the back edge of the layout tool, then mark the extents of
the spiral area on the tape as in Fig09. Now you need something with a straight edge you can temporarily attach the tape to without losing adhesive that you can also draw on. I used a square of melamine.

Fig08: Adjusting the tool rest so that the back edge of the layout tool is centered on the top of the spindle when the bottom tab is against the back edge of the tool rest.

Fig09: Marking the spiral extents on tape attached to the layout tool.

Transfer the tape so that the marked edge lines up with the straight edge. Use a square to draw a line perpendicular to the spiral edge at the right hand mark as in Fig10. Decide how many turns you want your spiral to make. Arrange a ruler so that an inch mark is on the left hand mark, and as many inches away as you want turns is on the perpendicular line as in Fig11. In the example I wanted five turns. The 11” ruler mark is on the left hand tape mark, and the 6” ruler mark is on the vertical line. This is how flat woodworkers layout hand dovetails. Draw a line along the ruler. Make a tick mark at each inch. These marks will indicate the spiral intervals—call them interval marks. Now make a tick mark at each ¼” for the first inch. These marks will indicate where to register the spiral intervals at spindle rotations 90 degrees apart—call them registration marks. Use a square to draw lines from each tick mark down to the bottom of the tape as in Fig12. Fig13 shows the completely marked tape.

Fig10: After transferring the tape to a work surface and drawing a line perpendicular to the right extent mark.

Fig11: Drawing a diagonal line to divide the spiral area into equal segments.

Fig12: Extending the marks on the diagonal line down to the tape to mark the segments.

Fig13: The completed tape.

Transfer the tape back to the layout tool. What had been on the bottom when laying out the tape should be on the back edge of the layout tool, with the one quarter rotation marks at the left. (if you did it backwards, it’s not a big deal—just rotate the spindle the other way when changing intervals). Engage your lathe index at the zero position and place the layout tool in position. The back edge of the layout tool should be centered on the top of the spindle, and the tab should be against the back of the tool rest. Center the layout tool on the spiral extents (the first and last marks should be on the left and right V-grooves, respectively. Make a dot at each interval mark, including the ends as in the top image of Fig14.

Fig14: Using the layout tool to layout dots on the spindle in four steps.

Readjust your lathe index so that the top of the spindle has rotated one quarter of a turn away from you. Slide the layout tool to the right so that the rightmost registration mark is even with the right hand V-groove. Make a dot at each interval mark that is in between the V-Grooves as in the 2nd from the top image of Fig14.

Readjust your lathe index so that the spindle has rotated another quarter turn (now 180 degrees from the original orientation) away from you. Slide the layout tool to the right so that the middle registration mark is even with the right hand V-Groove. Make a dot at each interval mark in between the V-Grooves as in the 3rd from the top image of Fig14.

Readjust your lathe index so that the spindle has rotated another quarter turn (now 270 degrees total). Slide the layout tool to the right so that the left most registration mark is even with the V-Groove. Make a dot at each interval mark in between the V-Grooves as in Fig14. Now draw lines to connect the dots as in Fig15. You’ll have a nice visually clean line to follow when sawing the spiral.
Saw and Wind

Unlock the lathe indexing mechanism. Now use a saw to cut a groove following the line. You can use a mini-hacksaw, a mini-hacksaw blade mounted to aluminum bar to give an automatic depth stop, or a metal jigsaw blade mounted in a fret saw blade as in Fig16. Other than using a fine tooth blade you can use whatever saw suits the width cut you want and what you have on hand. Turn the lathe by hand as you saw, concentrating on following the line (you’ll need to keep the saw at a constant angle to do this) and keeping the saw from jumping out of the kerf due to sloppy or too vigorous strokes. When the sawing is complete use a drill to drill a hole where the spiral intersects the V-Groove at both ends of the spiral as in Fig17. Suit the drill bit size to the wire you’re using. Take care to keep the drill vertical so the exit hole is in the V-groove as well. A power drill is fine, I just keep a size drill bit in that cute little yankee-drill that’s works for most wire I use—it’s kept handy with my wire supply.

Start the wire-wrapping by making a right angle bend in the wire with needle nose pliers as in Fig18. Insert the wire into the left hand hole so that the bend is flush with the hole opening, then start winding on the wire by turning the spindle by hand. Make one turn into the V-Groove, then start into the spiral. Maintain tension the whole time. When you get to the end of the spiral you have to maintain tension with a finger slightly before the end of the spiral, wrap the wire around the spindle loosely and then through the hole as in Fig19, so that you have a turn in the V-groove. Then snug up the wire and cut the excess flush with diagonal cutters. The finished wire inlay is shown in Fig20.

To layout a crossed spiral, plot dots at both the 1st and 3rd register marks when the spindle is rotated at both 90 and 270 degrees. For curved surfaces, simply press the layout tool down to fit the curve. Fig21 shows an example of a crossed spiral on a curved surface.

Tape

Spirals can be complicated curves to draw in three dimensions, but conveniently if the 3D cylindrical surface is unrolled into a flat two dimensional surface, they become straight lines. You can do this trick with some extended release masking tape. It’s easier to see pencil lines on green tape than on blue. You’ll need tape that is somewhat wider than the circumference of your spindle.

Begin by cutting a piece of tape slightly longer than the extents of your spiral. Make a fold about ¼” from one side. Stick the tape on the spindle with the ¼” fold folded back as in Fig22. Wind the tape around the spindle and end by overlapping the folded back portion to create a tab as in Fig23. Mark the extents of the spiral on the tape. Now cut off the tab with a knife while maintaining moderate tension with your other hand as in Fig24. If you’re careful you’ll end up with tape that wraps almost exactly around the spindle as in Fig25.
Fig22: Starting to apply masking tape. The edge was folded back before attaching to the spindle.

Fig23: After wrapping the tape around the spindle forming a tab, and marking the spiral extents on the tape.

Fig24: Cutting off the tape tab to leave tape almost exactly wrapped around the spindle.

Fig25: After cutting off the tape tab.

Remove the tape from the spindle and transfer it to a smooth surface with a straight edge, such as a square of melamine. Use a square to draw a line perpendicular to the tape at the right hand extent mark as in Fig26. As before, use a ruler to divide the spiral area into the number of equal segments you want, as in Fig27. If you want a single spiral, simply draw lines from the top of one segment division to the bottom of the next, as in Fig29. You will only need to drill one hole in the spindle for a crossed spiral.

Fig26: The tape after transferring to a work surface and drawing on a perpendicular line at the right extent mark.

Fig27: After dividing the tape between the extent marks into equal segments.

Fig28: After drawing diagonal lines through the segments. This will yield a single spiral.

Fig29: After drawing diagonal lines the other way through the segments. This will yield a crossed spiral.

Transfer the tape back to the spindle, being careful to line up properly with the extents as in Fig30. Saw and wind on wire as before. The finished cross spiral example is shown in Fig31.

Fig30: After moving the tape back on to the spindle.

Fig31: The completed crossed spiral.

CAD

If you have a CAD program (or with a little more trouble, any program capable of image resizing) you can use it to lay out a spiral pattern. The great advantage is you only have to do the work of drafting the layout once, and then can easily resize it to fit a new spindle with minimal further work. It’s also fairly easy to do more complicated layouts such as graduated spirals, or spiraling groups of lines, or any other thing you can think up. To use CAD drawings, you simply prepare a stock layout that has the number of turns and pattern that you want. Then measure the dimensions (diameter and length) of the spindle area to be spiraled, and change the dimensions of the pattern to suit, print it out, and glue it on.

Begin by measuring and writing down the length of the spiral area as in Fig32, to get the required length of your pattern. Then wrap a sample of your printer paper around the spindle and measure the diameter of the spindle plus two paper thicknesses as in Fig33. It’s easier to do the math if you use a caliper that measure in hundredths of an inch, or in millimeters if you’re feeling European. Multiply the diameter by pi (3.12) to get the required height of your pattern.
Fig 32: Measuring the length of the spiral area with a dial caliper.

Fig 33: Measuring the diameter of the spindle plus paper with a dial caliper.

Fig 34: Changing the dimensions of the spiral pattern to suit the spindle in a CAD program.

After changing the dimensions of the pattern to your spindle, print out the pattern. Cut out the pattern and try it on the spindle for size as in Fig 35. If it’s off too much, simply adjust the dimensions and try again. Once you’re satisfied with the fit, apply some adhesive to the pattern. Post-it note glue will work, but spray adhesive such as 3M #77 gives a more secure hold but can still be easily removed with some mineral spirits. Fig 36 shows applying some spray adhesive to the back of the pattern. Newspaper absorbs the over spray, and a bamboo skewer keeps the spray from making the light pattern blow away.

Fig 35: Testing the fit of the pattern. This one is a little small so I printed out another with a slightly larger height.

Fig 36: Applying spray adhesive. Newspaper takes the over spray and a bamboo skewer keeps the pattern from blowing away.

Attach the pattern to the spindle as in Fig 37. As you now have nice thin black lines on a white background to follow, it should be easy to stay on the pattern when sawing (it’s easier to follow a line you can actually see). After sawing the pattern, saturate the paper with a paper towel dipped in mineral spirits as in Fig 38 and give it a minute or so to soak in. The pattern should come off easily. Use the paper towel and mineral spirits on the wood to remove any residual glue and then sand and wind on your wire. A completed spiral, this one a graduated crossed spiral, is shown in Fig 39.

Fig 37: After attaching the pattern to the spindle.

Fig 38: Removing the pattern after sawing by applying mineral spirits.

Fig 39: A crossed spiral with graduated segments. This would be difficult to lay out using traditional techniques, but is easy with a CAD program.

If you want to be able to see more clearly what your saw is doing to the wood and don’t want paper/adhesive/sawdust clogging the kerf, you could try heat transferring the pattern to the wood. This will only work for light colored woods such as maple. Tape the pattern in place with the pattern facing in. Mostly put the tape on the ends, but you’ll have to use some on the seam to keep it closed. Then iron over the pattern with a hot iron long enough to transfer the pattern to the wood. I had moderate success with this—I had to pencil in a few missed areas.

Pen Applications

At first a pen seems to be an obvious application for a wire spiral inlay—but what about drilling through the bushings and dodging the pen works with the wire? One way to avoid this problem is to use
something other than wire. A single tube design, such as Penn State Industries CEO design makes sense for a spiral design. Whatever kit you pick, make sure the wood can be left thick enough that you won’t cut down to the tube when you saw the spiral as that would be expecting miracles from your glue.

Before you begin turning the pen harvest some contrasting sawdust. One way to do this is to chuck up a small spindle in your lathe, place a sheet of paper under the wood, and turn on the lathe at a SLOW speed and your dust collector off. Sand with 100 grit or so, with the sandpaper stretched over the top of the spindle until you’ve got enough and then some.

Mount the pen blank and turn it a trifle oversize. Apply a coat of sanding sealer so that the sawdust won’t get into the pores where you don’t want it. Cut the spiral with whatever pattern method you favor. Mix the sawdust with a binder (I used lacquer sanding sealer) and work it into the saw kerf with your fingers. Don’t worry overly about the excess on top. Then give the binder a chance to cure.

After the binder is well cured, skim the pen surface with your skew. This will remove most of the excess sawdust on top as well as stray wood fibers left at the top of the kerf. You can sand longer if you don’t have skew confidence, but it’ll clog up quickly at first. Then sand, finish, and polish the pen as you usually do. The result is shown in the front of Figs. 42.

It is possible to use wire inlay with a single tube design. Use a crossed spiral design which only requires one hole and plan for the hole to be at the pen tip end of the tube. Use an adjustable length mandrel (I used a size D drill blank in a collet chuck) with the tailstock holding the second bushing in place. Turn the pen blank normally, being sure to design it so that the wood is thick enough that you won’t saw down to the tube. Use whatever layout method you like and saw the spiral.

Remove the bushing at the tailstock end, shorten the mandrel, and hold the pen tube in place with just the tailstock. Drill through one side of the wood and pen tube where the spirals intersect the end V-cut as in Fig. 40. Don’t try to drill through both sides, as with a hollow tube you’re not likely to hit the V-cut on the opposite side. Instead, turn the pen blank 180° and drill through wood and tube at the V-cut opposite the other hole. Sand the pen but don’t apply finish yet.

You won’t be able to maintain tension on the wire and thread the wire through the second hole, so before you start winding the wire on make a loop out of scrap wire. With the tailstock backed out so you can see, thread the free ends of the loop through both holes. Make a right angle bend about an inch from the end of the inlay wire and thread the bent end of the inlay wire through both holes as in Fig. 41. Bend the free ends of the loop and inlay wire out of the way towards the tailstock end and replace the tailstock.

Wind on the inlay wire maintaining tension. When you get to the end of the pattern, slip the end of the inlay wire through the loop, then grab the free ends of the loop with pliers and pull the loop through the hole thus pulling the inlay wire through. Trim the free ends of the inlay wire flush with the pen tube, and then apply finish as normal. Before assembly, push on the wires crossing the tube at the free end hole side to pull them out of the hole. The ferrule should easily push over the wire now. The finished pen is shown in the back of Fig. 42.

Tools and Materials

- Common
  - Fret Saw or Mini-Hacksaw
  - Diagonal Cutters
  - Needle Nose Pliers
  - Wire

- Connect the Dots
  - Aluminum flashing or other sheet metal
  - Masking tape

- Tape
  - Masking tape
  - Knife

- CAD
  - CAD program
  - Spray adhesive

Author

David Reed Smith is a basement woodturner living in Hampstead, Maryland. He welcomes questions, comments, and suggestions by email at David@DavidReedSmith.com. This article, along with about 50 others, is available on his web site at www.DavidReedSmith.com.