Diamond Ornament

Introduction
The Diamond Ornament is turned using an inside/outside technique and is what last years 6 Window Ornament should have been. This ornament uses eight diamond cross-sectioned staves with 45 degree points. You could use six diamond staves with 60 degree points in much the same manner, except the look would be a little different. In the eight stave version the look is more about a pierced globe and less about the window shape.

Briefly, this article starts with making a jig to hold the staves for the first turning. The staves are mounted for the first turning and a cove (or other shape) is turned for the inside. The staves are then reversed 180 degrees, glued up and mounted to turn the outside of the ornament. The number of steps in the second turning to go thin and still preserve support as long as possible uses a lot of space, so a rip fence for the staves and some ancillary jigs will only be available on my web site.

Ripping Diamond Staves
To rip the diamond staves I used an auxiliary fence for my table saw that almost completely captures the off-cut. It's not in this article because there's not room, and because I'm still tinkering with it. It will be available at Diamond Rip Fence.

You could also just rip the staves using your table saw, particularly if your saw is left tilt. You could also make a dedicated rip sled as in Triangle Diamond Rip Sled article on my web site and change the angle to 45 degrees.

The thickness of the stock determines the size of the diamonds which determines the greatest diameter of the ornament. I used stock 1/2" thick, which gave a globe diameter of about 2-1/4". When you are adjusting your sled or fence to rip diamonds, start by comparing the measurement of adjacent sides. When that's close you can rip a stave in half. Lay them on their sides, then flip one half over so that one stave is ripped side up and the other is board face side up. Compare the thickness visually or by feeling with your finger. If the ripped side is higher, then move the fence towards the blade. If the ripped sided is lower then move the fence away from the blade. After ripping the board into diamond staves I cut the staves 8" long.

Turning Jig
If you don't plan to make a batch of ornaments, or don't have a One-Way pattern tailstock, you can do the first turning without the jig as in Fig01. Gather the staves into a bundle and hold them together with rubber bands at the ends. Then wrap packing tape over the rubber bands. Finally compress the bundle securely by using cable ties and a cable tie gun. Mount the bundle between cup centers at drive and tailstock so that the drives physically hold each stave. It would be prudent, as with any staved project, to keep your speed sensible and wear a face shield. When the cove, or other inside shape is turned, remove the bundle from the lathe and cut through the band/tape/cable tie.

Fig01: The stave bundle mounted for turning without jigs.

If you plan to make several ornaments then making the turning jig would be a good investment in time (if nothing else, it helps align the staves properly for the bundle). Print out 4 copies (for two bases and two pierced) of Drawing A, or download DrawingA.pdf, which has all four on one sheet. The jig works by compressing the bundle via slightly beveled sides, and doesn't tolerate off size staves well. If the angle of the bevel were greater, it would tolerate more sizes, but not work as well. So if the stock you make your diamonds from isn't 1/2" thick you'll need to resize the jig. Chances are if you look deep enough into the properties button of your print dialog box you'll find something that will let you scale the image.
Apply some spray adhesive to the backs of the patterns and then attach them to 3/4" plywood. Then carefully cut out the discs on your band or scroll saw as in Fig02. Some marginal increase in accuracy could be gained by truing the rims of the discs on the lathe as long as the centering of the pattern is still accurate.

The interior of the discs can be cut on a bandsaw, as shown in the pictures, or on a scroll saw. If you do the work on a scroll saw, I recommend you follow the procedure with the bandsaw (except you can start the central hole with a pierced cut) rather than sawing around the pattern with a constant bevel. That would produce rounded points and perhaps not work as well. If your bandsaw table will not tilt 4 degrees both ways despite removing the 90 degree stop, you could consider making an auxiliary table by resawing a 2x6 at a 4 degree angle and taping it to your bandsaw table temporarily.

If you get lost in the directions for tilting the saw and which side to cut on, just remember that you're making a beveled recess and that the pattern, or up, side is smaller. Set your band saw table to 4 degrees, with the outside (on your right) down. Cut in from the outside along a line of a diamond side extended and cut out a circle of wood on the inside. The line you go in on should be on your left side of a point when it is facing you. Remove the center cut-out. Now cut along all of the diamond sides on your right when the point is facing you as in Fig03. Cut along the other side of the kerf should be on the line, and you should carry the cut a little past the point, maybe 1/16". Now tilt the bandsaw 4 degrees the other way (to your left down). Cut along the other side of the diamonds as in Fig04, again with the inside edge of the kerf on the line. Be careful with the off-cuts. It is best to stop the saw and remove them after each cut. I know it's a pain, but so is a trip to the ER and you only have to make two of these.

Put #2 jaws on your 4-jawed chuck and mount a base disc. Mount a drill chuck in your tailstock and mount a combined drill and countersink, or some other short rigid bit in the drill chuck. Turn on the lathe at a moderate speed and advance the combined drill and countersink into the disc to the end of the beveled portion of the bit. The combined drill and countersink is short and rigid, and unlike a standard drill bit, will not ordinarily be deflected upon entry by variations in the wood. Turn off the lathe and remove the combined drill and countersink. Mount a 21/32 drill in the drill chuck. Turn on the lathe at a slow speed and drill through the disc. Turn off the lathe and remove the drill bit. Engage the lathe spindle lock. Mount a mini-tap guide in the drill chuck. Place the nose of a 3/4x10 tap in the hole and bring up the tailstock so that the point of the mini-tap guide engages the dimple in the handle end of the tap. Advance the tailstock to compress the point of the mini-tap guide. The tap guide will keep the tap aligned while you turn the tap by hand with a tap wrench, or even an adjustable wrench as in Fig05. Repeat for the other jig base.

Buy a lottery ticket and then come back and follow the directions.

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Remove the paper patterns from the jig pieces. To avoid confusion when spreading glue, mark the pierced jig piece with a "G" (for Glue) on the side the paper was on. Spread wood glue on the G side of the pierced piece and clamp it to a base piece as in Fig06. Repeat for the other pair of pieces and allow the glue to cure. The completed jig is shown mounted on the tailstock in Fig07.
Fig06: Gluing the pierced piece of the jig to a base piece.

Fig07: The completed turning jig.

First Turning
Mount a chuck capable of holding 3/4" all-thread on your headstock, such as a collet chuck or a 4-jawed chuck with #1 jaws. Mount a short (about 2") piece of 3/4x10 all-thread, or the undistinguishable cut off portion of a 3/4x10 bolt in the chuck and screw one of the turning jigs. Screw the other turning jig on to your tailstock. Place a rubber band around the tailstock mounted turning jig so it will be handy. Put eight staves on the lathe bed where you can reach them. Start loading staves into the headstock jig starting at the bottom. Support the loaded staves with your left hand as you add them with your right hand as in Fig08. Load from the bottom up, alternating front and back. As you get past four staves or so it helps to insert the stave at an angle. Once all eight staves are in, put a rubber band around the bundle at the tailstock end, as in Fig09. The bundle will be a little more stable now so try adjust the diamond points so that they meet in the middle at the tailstock end. Bring up the tailstock and line up the jig with the bundle and then advance the tailstock so that the staves are held securely and compressed together. You can also try gathering the staves into a bundle and securing with rubber bands before loading into the jigs. However getting the staves aligned right without support tends to require too many hands. If you try this, then experiment with different sized rubber bands to find a size that will hold the staves aligned but not prevent you from easily moving and flipping them.

Fig08: Loading staves at an angle into the headstock mounted jig.

Fig09: After using a rubber band to stabilize the bundle.

Turn on the lathe at a sensible speed for staved work. A face-shield would also be a good idea. Use a spindle gouge to cut the cove that will be the inside shape of your globe. It should start about 1/2" or 3/4" from either turning jig (that plus the amount buried in the jig will give you enough for a finial). Rather than turn to a diameter, judge how deep to go by stopping the lathe and looking to see how wide a stave is at the lowest point as in Fig10. At first it would be prudent to leave the webs on the thick side.

Fig08: Judging the diameter by eyeing the thickness of each stave, as indicated by the arrows.

When sanding you don't want the skin abraded off your hands by the spinning diamond points. To keep your hands out of danger you can make a round sanding sponge. Select or turn 6" of 1" diameter dowel. Cut a piece of 2mm craft foam long enough for three wraps around the dowel and spray one side with adhesive. Wrap the foam around the dowel. Pipe insulation foam and a short dowel or even copper pipe would also work.

To sand with the round sanding sponge, hold your abrasive around the sponge at top and bottom and sand the cove as in Fig11. Fig12 shows the bundle after sanding.

Fig10: Judging the diameter by eyeing the thickness of each stave, as indicated by the arrows.

Fig11: Sanding the cove with a round sanding sponge to keep fingers away from the diamonds.

Fig12: After sanding the cove.
You could apply a friction polish to the cove at this time. Again you can wrap your applicator cloth/paper towel around the sponge to keep your fingers away. Optionally you can paint the inside with acrylic paint. Put newspaper over your lathe bed. Turn the lathe on at a very slow speed and hold a paint laden brush against the cove. Turn the lathe off and touch up any spots you missed. Fig13 shows the results. It looks a little overdone, perhaps, at this stage, but won't be so garish once it's mostly hidden on the inside. Allow the paint to dry then remove the stave bundle from the lathe.

**Glue-up**

The probability of cutting of consistently cutting eight staves accurately enough to glue them up all at once and have the survive turning down into a slender finial is pretty low. It's better to glue up in stages until you have two halves, then flatten the halves and then glue them together.

Begin by gluing up four pairs of staves. At first I tried using a compression block and a recessed V-block to glue up the pairs, but the staves were so buried I couldn't see if they were well aligned and joined. But without some sort of caul to spread out clamping pressure I figured three clamps per pair would be needed—for a total of twelve clamps. I didn't have that many medium sized Quick Clamps, and they didn't work well for the first clamping anyway, so I decided to make some out of PVC pipe. I'm certain it isn't original except for some of the details, but I don't remember where I saw it to cite it. I sliced 1-1/2" sections of 2" Schedule 40 pipe. Then I drilled two holes for handles with a 3/8" Forstner bit. I cut 5" long beveled sections of slightly over-size 3/8" dowel and inserted them through the holes. Then cut through one side of the pipe. More detailed directions and pictures are at [PVC Clamp](#).

Having a really flat surface to register the staves on for glue up helps with alignment—I used my table saw protected with a piece of plastic. It's also a good idea to clean up the ends of the bevels and any swarf hanging off sides of the webs where they were unsupported before beginning. Spread a thin coat of glue over the mating surfaces of one stave and line it up with another stave. Add three clamps, one at the top and two at the bottom, whilst holding the pieces down against a flat surface. Fig14 shows the result on the left image, as well as where you should try to place the clamps, as high on the opposing parallel faces as possible, on the right image. Alas, the right image also shows very clearly that I didn't follow my own directions about removing the swarf before glue-up. If you don't have enough clamps and don't care to make some you can also switch to the more quickly setting original Titebond and simply hold the pieces in place by hand until the glue grabs.

After the glue cures flatten the mating surfaces of the halves. I used a hand plane this time. Touch up the red paint if needed. Spread a thin coat of glue over the mating surfaces of one half. Again using a flat protected surface to help register the pieces, clamp the halves together as in Fig16. I found that larger generic quick clamps bridged the pairs of opposing points well. Start with the sides of the halves registered on the flat surface and apply a clamp at the top end. Now adjust the bottom end by eye so that all the diamond points meet and apply a clamp at the bottom. Check the alignment of the points at the top of the ornament to be sure they all meet and adjust if necessary. Then apply a clamp in the middle.

**Second Turning**

If you find discussions of design and creativity to be annoying BS you may safely skip to the next paragraph. This section of the article has many steps for two reasons. One is to maintain as much support as possible for each turning step. The other is too allow the entire ornament to be completed on lathe. I used to think my desire to do the latter was a conceit, adding unnecessary degrees of difficulty, but I've found at least a tentative justification. I'm reading *Imagine* by Jonah Lehrer. In it, while discussing Dylan’s breakthrough “Like a Rolling Stone” he states that "You break out of the box by stepping into shackles". Jonah claims that a period frustration is required prior to a creative insight and that seemingly artificial constraints forces you away from already learned clichés. Whether required or not, if you add to your tool kit when you only want to you'll have it available when you need it.

The ornament blank needs to be accurately mounted to ensure balanced web thicknesses. Trimming the top and bottom on the table saw may help with this, as will making a dimple with an awl or other
pointed tool at the center where the diamond point meet. Mount the ornament blank between cup centers and turn a stub tenon at the bottom of the ornament blank as in Fig17. Cup centers will physically hold each diamond segment and not tend to split your glue joint apart. I'm using a home made cup center held in the 4-jawed chuck with #1 jaws because that's what's needed for the next step. Only a short stub tenon is needed because most of the time the ornament will be supported by the tail stock.

Remount the ornament blank using #1 jaws in a 4-jawed chuck (or a collet chuck) as in Fig18. Begin turning the ornament by thinning the webs to final thickness as in Fig19. I've found that when cutting mostly air I have difficulty cutting a fair curve with a spindle gouge. So if you're comfortable with a skew, try using it for this cut. The wider bevel seems to make it easier to avoid little dips and bumps in the curve. Which ever tool you pick, you should be able to follow the ghost image, as in Fig20. Before you cut them really thin, however, you should stop the lathe and make sure that one or two webs aren't radically thinner than the rest so you don't cut through.

Now switch to a spindle gouge and thin the web area down to the part where adjacent webs meet as in Fig21. Use a spindle roughing gouge or your spindle gouge to turn away most of the exterior points on both sides of the globe. Now, before you've turned the caps of the globe thin and reduced support, sand the sides of the webs by hand with progressively finer abrasives and a right angled sanding block as in Fig22. It's pretty easy to tell if you've sanded a particular web with the first grit, but after that you may wish to count.

Now go back to your spindle gouge and turn most of the rest of the globe. Try to keep constant thickness walls above and below the openings. You should be able to judge this by looking obliquely as in Fig23. Once you've turned most of the globe, sand the globe. This will be safer and more comfortable if you use a sanding sponge as in Fig24. Fig25 shows the ornament after sanding the globe.
Fig25: After sanding the globe.

Now turn your attention to the top final while the bottom finial area is still thick enough to support it. First turn the finial to the shape you desire while the tailstock is still supporting it, as in Fig26. Then sand most of the final, and any parts of the top of the globe you didn't sand earlier as in Fig27. Lastly part off and sand the top of the final as in Fig28. This is why the bottom finial area should be left large until this point.

Fig26: After turning the top finial except for the tailstock nub.

Fig27: After sanding the finial.

Fig28: After parting off and sanding the top of the finial.

Now replace tailstock support with a foam padded cup center adaptor mounted on the tailstock as shown in Fig29. Details on making the adaptor are at Foam Cone Center. If you don't wish to bother with this, genuine One-Way tailstocks have a flared enough cup that you can try removing the center point and using a piece of 2mm craft foam between the finial and tailstock center. You could also, of course, just not part off the tailstock support nub until all turning is done and cut it off and sand it off lathe.

Fig29: Regaining tailstock support with a foam padded cup center adaptor.

Fig30: After turning and sanding the very bottom of the globe and finial transition.

Fig31: After reducing the finial area to its maximum diameter.

Now shape the very bottom of the globe and the transition to the bottom finial. Before thinning the rest of the finial, sand the transition and any parts of the bottom of the globe that weren't sanded before while you still have good support, as in Fig30. Reduce most of the finial area to it's maximum diameter with a spindle roughing gouge as in Fig31.

Fig32: After turning the top of the finial and marking the area for the bottom teardrop.

Now reduce the finial to its final diameter. Again, if you are comfortable with a skew you may find it to be the best tool for this. Sand the finial shaft as in Fig33. Then turn and sand most of the terminal teardrop as in Fig34. Remove the ornament from the chuck.

Fig33: After turning and sanding the finial shaft.
To reverse the ornament so you can turn off and sand the finial end on lathe, make a foam padded sleeve. Measure (or guess and trim later) the diameter and height of your top finial. Cut a piece of any thin sheet metal, such as aluminum flashing, as wide as the height of your finial and slightly shorter than the circumference of the widest part of the finial. Cut a piece of 2mm craft foam to match. Coat the foam with spray adhesive and glue it to the sheet metal piece. Now roll the padded metal, foam inward, around a dowel or drill bit shank that's about the same diameter as your finial. Place the padded sleeve around the finial. If there's not a gap, trim one of the edges so that there is. Further details and pictures of making a padded sleeve are available in the All-turned Crochet Hook article on my web site.

Place the padded sleeve over the finial and tighten the #1 jaws of the 4-jawed chuck around the sleeve, making sure that the gap is between jaws as in Fig35. Bring up the tailstock to support the nub at the bottom of the finial as in Fig36.

As the finial shaft is quite thin, and the ornament is mounted in the chuck with what amounts to a ball in a cylinder, only light cuts are possible with added support from your fingers required. If you decide at this point that the teardrop should be longer and try to reduce the diameter of the nub you will likely end up with a much shorter ornament. Using light cuts at the minimum diameter cut off the nub. Then sand the end of the teardrop while supporting the shaft with your fingers as in Fig37. The completed ornament is shown in Fig38. Remove the ornament from the lathe and add the hanger and finish of your choice.

You can change the look of the ornament quite a bit by changing the shape of the first turning. In the web version of this article I'll include photo pairs showing different designs.