Modern Ornamental Turning

Lecture Notes By

David Swanson

What is Ornamental Turning?

Technically, the term *Ornamental Turning* (OT) could be defined as any form of embellishment applied to an item that was first turned on a lathe. This basic definition would include not only carving the turning, but also drilling, cuts or the application and/or inlay of items strictly for the purpose of ornamentation. Purists will argue, however, that it is not “Ornamental Turning” unless the ornamentation is accomplished by means of machinery that are semi pre-set and then left to operate more or less on their own. I tend to lean more toward the middle ground on the term’s definition. I am of the camp that consider Ornamental Turning to be the use of machinery on a work piece, weather the machinery be operated by hand or by a motor driven device. Early examples show us a Rose Engine turned portrait frame surrounding a miniature portrait of *King Henry VIII,* sent by His Majesty, as a gift to *Katherine of Aragon*. Another rose engine turned frame, surrounding a miniature portrait of Katherine, was sent in return (the period means of sending a photo to your intended). These items were created on lathes that were not operated via any power source, save the traditional. Any of the period means of drive, bow, pole, great wheel or treadle not only provided power for turning the work piece, but when the lathe was stopped, the treadle could then supply power to the cutting frames to make the decorative cuts (less likely with the reciprocal drives). With the use of an index and a cross slide, or positional drill press, incredible works can be made, with precision that will amaze all who view the results. Thus the question I am often asked, even by other turners; “You made this on a *lathe*?”

My Turning History

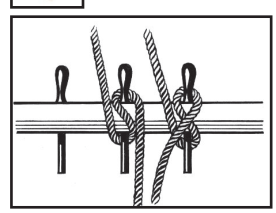
Turning wood on a lathe is a means of working in wood that I first became acquainted with in 1995. My earliest effort in turning was basically an impulse.

I had been creating bolts (short arrows) to be used in the Medieval crossbow that I had just finished. After cutting the cedar shafts, a 3” long piece of 3/8” shaft was left over. On a lark, I placed it into the Jacob’s chuck on my bench-top drill press and used wood files to shape it as it spun. Once I got used to the momentum of the file against the shaft, I “turned” a 1” tall goblet, complete with a knuckle in the stem. Of course this goblet was a mere toy, for I had not the means of holding it to hollow or finish it. Regardless of these details, I had become hooked! Once the day’s efforts in the shop were complete, I went inside and informed my wife of the good news;

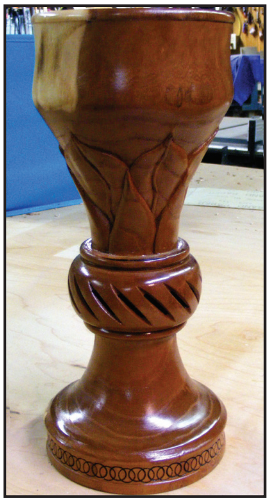
“I think I’d like to buy a lathe.”

When I had first started turning wood I had my hands full. The only person I knew, who was a turner, was the gentleman who taught me to carve. He was usually busy restoring antiques, so I only got advise from him, and encouragement when he saw my early work. I had no teacher, so what I learned was from videos, books, trade magazines. Through trial and error, I learned to both cut and scrape the wood, and with time and practice, my cuts were becoming smoother. The products of this practice saw the forms that I had created become more and more refined, giving the viewer fewer clues as to what shape the blank had been when I began. What started out as belaying pins (long spikes of wood or brass, to which rope was secured on board a ship — and used as off-hand weapons during the pirating age), began to shrink in diameter, transforming into back scratchers and pens, then into magic wands. Whereas the belaying pins had always been an excellent seller with the historical re-enactors, the Harry Potter craze was creating a real market for wands, especially those of a more sophisticated nature. Eventually my wands became more refined, until they were something that Olivander, himself, would have been happy

Belaying Pin *of Lignum Vitae, or Tree of Life.*



Above: *Belaying pins are set into pin rails so that the multitude of rope on board ship could be quickly tied off and secured. Pins were often used as weaponry in a when being boarded.*



Blooming Chalice
An example of my early OT work with carving. Rope cuts were made with the Dremel in the drill press.

*****Principles & Practice of Ornamental or Complex Turning*** *(Dover Woodworking) Nov 1, 2012. by John Jacob Holtzapffel.*

**** ***Peter the Great*** *used the lathe, himself, whereas other monarchs hired turners to work the machinery for them.*

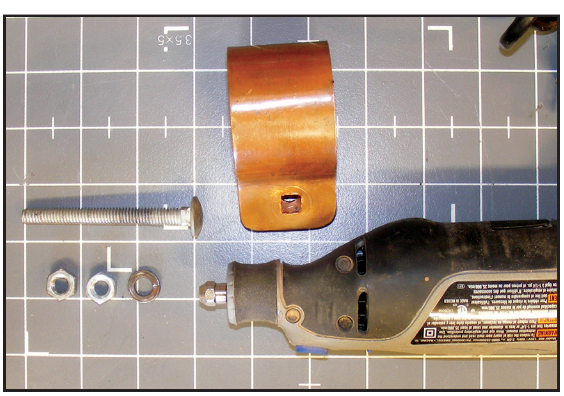
***** ***Wedgewood China*** *The function of the Rose Engine lathe becomes obvious when you begin looking through their catalog. All of the dishes with profiled edges had their originals cut with the rose engine. The fanciest urns and vases had the fluting and rope work done on the rose engine.*

to have made. This proved to be excellent exercise for refining my techniques for the reproduction of spindles on furniture I had begun restoring.

After turning for about ten years, I had been using my skills to not only rescue antique furniture, but to make new items as well. As I went on, I found myself getting a bit bored, so I began carving my turnings while they were still on the lathe, starting with my walking staff (right). Visiting various art shows, I saw inlays made from nested metal tubing and rods. I decided to investigate how these were done, so I went to the state library to see what books they had to offer. I sought both ideas and inspiration.

I did not find anything on the composite inlays, but I did find inspiration in a book, written about 1850, called ***Principles & Practice of Ornamental or Complex Turning****. Within these pages, I found chapter after chapter of things I not only could not do, but had no idea could even *be made* on a lathe. Rather than being discouraged, I was inspired and intrigued. If, after a decade of turning, I had never seen this type of work from others, I would bet that there were few other turners who were practicing these techniques.

Holtz's ***Principles & Practice of Ornamental or Complex Turning*** (the forth volume in particular is referred to by the OT community as "Holtz") is a book that was written by a gentleman whose family had built specialty lathes for at least four generations. This set of five books were intended to be an owner's manual for the machines that they made. Beautiful machinery, to be sure, these lathes were each hand-made works of art, being constructed of mahogany, steel and brass, and were capable of creating items, the likes of which had never prior been seen. Never cheap to purchase, even at that time, they were originally built for royalty and the incredibly wealthy — thus is why examples of the works from these lathes were executed by such notable individuals as *Peter the Great***, for his ilk were the only people who could afford the machinery, not to mention had the spare time to create works of art upon them. Some of these owners, who found themselves too busy to use the lathe themselves, would hire in a turner to create works for them. While researching, I found out that Wedgewood China*** had acquired a rose engine lathe from the Holtzapphels that they still use in the 21st century.



Right: *Mounting collar of copper. The square hole seats a carriage bolt. Positioned to not cover the air holes, the lock washer and two nuts hold the machine firmly, without crushing it. The extra length of the bolt allows it to be mounted into a jacob's chuck.*

Above: *My walking staff, featuring a double open helix with carved dragons, a Cabalist's model of the universe and a Celestial Sphere, detailed below, with quadrant, equatorial and sun lines inlaid in various woods and the constellations inlaid in copper and brass. All constellations are set with four gauges of wire for the four classifications of stars. Zodiac is in brass.*

Taking the price that Wedgewood paid at the time, I did a few quick calculations of price increase over the time, and converted from English pounds to US dollars to find that this particular lathe's current day price would be close to $10 million! It was said that the price would be equal to that of an entire block of houses in Victorian London.

Needless to say, I could not afford such a purchase price. The fact that the vast majority of the machines that survived the scrap metal collection of two World Wars are housed either in museums or in the collections of very wealthy individuals, only made an acquisition even more remote. Very few of these machines are still in the hands of those who can operate them, making them even more rare and pricey. A quick internet search shows an 1838 Holtz rose engine, #1636 on e-bay for an amazingly low $228,000!

Thus was my motivation to reverse engineer how the marvelous examples pictured in Holtz were created, or *could be created*, even though it sometimes meant re-inventing the wheel. Many of the techniques were originally accomplished by using, essentially a continuous cord-driven dentist's drill, that would hold various drills and profiled cutting bits intended to operate at high speeds. A sharp bit, a shallow bite and 24,000 RPM will create beautiful cuts into dense hardwoods and ivory that do not need any sanding. As a result, the facets created in the media being cut will sparkle in the light, creating a most wonderful effect on the finished piece — glinting as though it were made of opaque, cut glass. To see a beautiful example, go to You Tube and search for Geometric Chuck. Tool Time 35: Leinhard Rose Engine Lathe, Geometric Chuck (a 34:34 minute video). You will not be disappointed. Since there seem to be no blueprints or plans of the gearboxes used, reverse engineering was my only option.

Quest for Modern Machinery

The question then became;

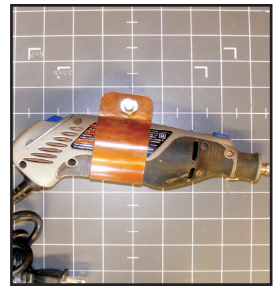
"How do I recreate these beautiful effects using modern machinery?"

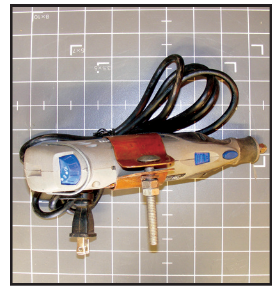
Since indexing is the heart and sole of OT (and the only part I could then afford), I began by purchasing and making use of a faceplate with built in indexing wheel (about $25 at Steve's Wholesale). This is a 6" aluminum faceplate with 96 notches in the back of the plate. I own a Delta 12-36 variable speed lathe that was not intended to operate with an index. The first order of business was to make the lathe compatible. With the oddly shaped plastic housing on the lathe's headstock, it took a bit of Southern ingenuity to resolve this problem, which I will explain later in the text. See the notes column on page 5 for an illustration of the pin system.

Next was to devise a means of drilling into a turned piece so the bit would not only approach the turning at 90º, but have tight control on placement and consistency as well. My first attempts were made using a hand-held drill, while inlaying the copper and brass stars in the purpleheart celestial sphere. This worked, mainly because I was trying to drill into markings drawn onto the sphere, but would not be as precise as I would need for creating geometric patterns. I next purchased a portable work station from Dremel, which was basically a drill press, into which the Dremel tool could be mounted. This was a great idea,

Above: *Dremel mounted in copper collar and set into the drill press, it's position locked down by the pin in the index. With the depth gauge set, the quill can be used to quickly and consistently cut rope molding.*

Notes





Above: *Three views of the copper collar I created to mount the Dremel tool to the drill press for plunge cuts.*

Below: *A view of the Dremel mounted in the drill press, making use of the index to make repeated angled cuts for rope molding.*

for I was able to fit the vertical post of the drill press directly into the banjo of the lathe, allowing me to position the drill press at virtually any angle in relation to the work, and be able to angle the Dremel up to 90º from vertical, while still retaining the capability of using the quill to decorate the work. The problem with this method is the fact that Dremel makes so many of the drill press parts from plastic. As a result, the tool has an inherent amount of slop to it, allowing the placement of the hole drilled a +/- $^{1}/_{8}$” slop in *any* direction. Steadying the quill with my left hand as I plunged it into the work with the right helped, but still I had a slop of +/-$^{1}/_{16}$”. The funny thing about the human eye and brain are that they spot patterns as a matter of course — it is part of our survival skills. If there is something amiss, it is seen right away. The slop of this machine was not nearly close enough to keep variations from showing up when inlaying a series of brass or copper wire into a helical strand down the length of a project, making it look like a drunken path.

Needless to say, trying to convince Dremel to make a more robust version of their workstation fell upon deaf ears. The thought of using the various parts to make molds to cast these parts in aluminum or brass is not yet feasible for lack of foundry equipment (I am working on that though...). Another solution to this problem would have to be found.

It was about this time that I invested in a floor model drill press. This freed up my B&D bench top drill press for other, more ornamental functions.

I had some 4” angle iron left over from a building project. Having two, 3’ sections of this angle iron, I asked a friend to spot weld them together for me, to form a U-shaped beam. I had plates of $^{1}/_{4}$” steel welded onto the open ends of the beam, into both I drilled a 1” hole. Mounting this behind my lathe, parallel to the lathe’s ways, I essentially had a new, set of ways behind my lathe. I then drilled a 10” x 10” plate of $^{1}/_{4}$” steel to mount 2” angle irons which acted as guides on the upper edges of the 4” angle, so that the plate could slide along the top edge of the U-shaped ways with barely any slop, keeping the platform 90º to the ways. To this I mounted my bench top drill press, via a Plumber’s flange that would allow the vertical post to screw into the steel plate, doing away with the oversized cast iron base of the drill press. Adding a 4’ long piece of 1” all thread through the holes in the end plates, I added an extended nut to the center of the all thread. I drilled a $^{1}/_{8}$” hole into the carrier plate, directly over the all thread and into the extended nut to place a brass pin through so that the plate would be drawn by the all thread via the coupler. Attaching a crank handle allowed me to crank the drill press’ platform down the entire length of the lathe, permitting me to quickly and accurately drill a hole anywhere along the length of the lathe’s bed. To more save even more time & effort, a hand drill can also be used with a socket to quickly move the platform.

Drilling Helices

The drilling rig, coupled with the index, made possible many examples of the easiest ornamentation seen in Holtz’s books. It enabled me to inlay various sized spots of copper, brass or aluminum into a work piece, in an array of patterns! The method of *Do, Step & Repeat,* became the mantra of the shop. To create a double helix of metal studs, I set the placement of the drill press and the proper notch in the lathe index to drill the first hole, closest to the head stock. Use a piece of the metal stock that has been sharpened to drill the hole. You will never find a closer fitting drill bit than this. The sharpened metal rod (preferably brass) will cut/burn it’s way through the turning, creating a perfect fitting hole for that sized stock. Be sure to sharpen the rod after every hole by holding a file to the spinning rod. After drilling the first hole, I rotate the piece 180º (the opposite notch in the index) set the index pin and drill the hole for the opposing spot. Do not try to drill all the way

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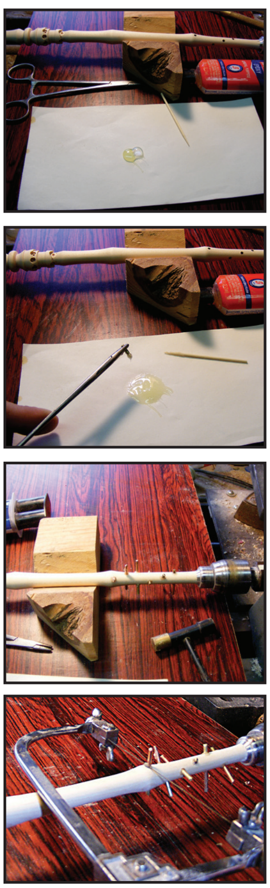
*** Counterclockwise Spirals** can be made, but one needs to pay attention to make sure that a screw on chuck does not try to unscrew from the headstock as the piece is being advanced to the next stop. This unscrewing action can quickly ruin the look of the spiral (voice of experience here).*

*** **Double Stick Tape** Do not buy the double stick tape from turner’s supply shops. It is far cheaper to get double stick carpet tape from Lowes or Builder’s Square, for it does not have the “specialty item” price increase of the specialty stores. Just be sure that it has a cloth base — the plastic base is not strong enough to keep from stretching.*



Process for inlaying metal studs.

through to create both holes at once. The holes on the exit side rarely end up where they are supposed to be, probably due to the bit flexing. Also, to drill through would be to take a chance of the turning splitting out upon exit. By moving the index two spaces and cranking the drill press two rounds with the hand crank, I can then drill the next pair of holes, perfectly spaced, both horizontally and diametrically. Do, Step & Repeat. Once all of the holes had been drilled, metal rods were glued into place with 5 minute Epoxy. When the glue has set, cut and file down and the area until flush, then sand. The result is a double helix of copper, opposing brass or aluminum, all evenly spaced and flush with the surface. Helices could be made to twist in either direction, depending upon which direction the advance step was made*. They can also be inlaid at any pitch — just vary the number of cranks versus the number of holes skipped in the index. On small diameter spindles, a matching number between the crank and the index will give you about a 45° angle.

Stone Inlay

By drilling larger holes and inlaying tubing, I can then inlay crushed stone, bone or acrylic into the interior of the tubing, giving a beautiful inlay framed with the metal. As with the rod, use a piece of brass tubing in the drill press to drill a perfect sized hole for the tubing. Be sure to re-sharpen the tubing with a round file for the interior and a flat file for the exterior, as seen in the scholar's column to the right.

Of course, you can also do a stone inlay without the metal tubing, but it is a bit trickier to level without altering the wood. Many new designs were created using these techniques. Even though what I was doing was far more accurate than using Dremel's drill press, I did not have the flexibility to approach the work from as many angles as the Dremel work station would. I later found that replacing the Dremel drill press with the headstock of a Unimat lathe (a small, hobby lathe used for making model aircraft parts and jewelry) would eventually resolve this issue, once I find a Jacob's chuck that will fit. The Unimat is what I refer to as a miniature ShopSmith. With the right accessories, this small lathe can be reconfigured to work as a mill, a table saw, plainer, drill press etc.. Mounted behind the lathe, I will take advantage of it's function as a miniature drill press. It is basically a scaled down version of the Dremel drill press, but with all metal parts rather than plastic.

Index Creation
Basis of Most Ornamentation

It soon became obvious that I needed more indices to use, since not all of the items to which I wanted to add ornamentation could be held on the faceplate. My solution? Make more indices! By attaching a piece of Plexiglas® to the faceplate with double stick carpet tape, I turned the plexi to size, exceeding the rim of the aluminum faceplate (allowing for larger holes to be drilled), then used the Dremel Drill Press (and adequate guidance by hand) in conjunction with the index on the metal faceplate to register the plexi so that I could drill holes around the edge of the plastic disc. Using this method I created a 48 hole index for every chuck and drive that I owned! This number of stops does not give me the versatility of the 96 stop index, but since I primarily turn spindles, this is rarely a problem. If the need for more stops arises, the spur drive can always be installed through the hole in the faceplate. Once the Morse taper is locked into the headstock, the spur drive and the faceplate act as one.

A friend of mine recently cut a steel index for me which has four rings of indices. The outermost ring has 180 holes, the innermost, ten. This will make virtually any pattern of stops I may need. Unfortunately, before I can use it, I will need to make a set of riser blocks for my lathe that will raise the head and tail stocks 1/2". The advantage of this is the fact that it will increase the capacity of my lathe by 1" (1/2" riser = 1/2" radius = 1" diameter). Thus

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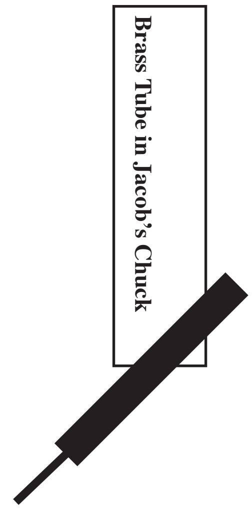
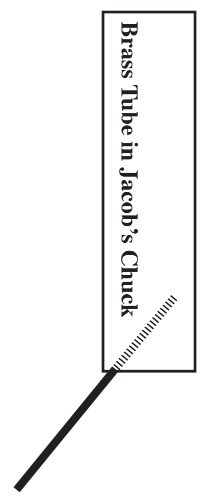
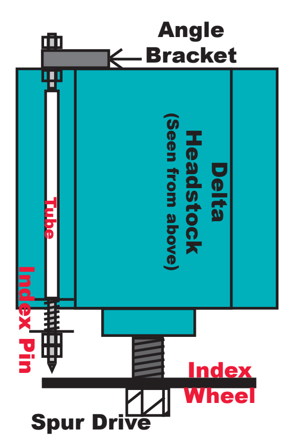


Sharpening the outside of the brass tube with a flat rifler file.



Sharpening the inside of the brass tube with a round rifler file.



***Index Pin** Assembly as described in the accompanying text.*

Above: Holly Wand *with barleycorn*

X = Quarter
- = Eighths
/ = Sixteenths

Oaken Wand *featuring overlap[ping coins in both directions and the four phases of Luna (full, 2 quarters and new). This wand came in First Place for spindle work at the Oklahoma State Fair.*

my lathe will graduate from a 12”x 36” to a 13”x 36”. The new index plate is made so that it screws directly onto the headstock.

Imitating Holtz

Effects such as a Barley Corn pattern (a series of overlapping or linked rings — see sidebar, page 7) were originally accomplished with the dentist’s drill and a hollow bit, or one of the cutting frames and an offset cutter. After studying the pattern, I decided to try something a bit different: Since I had such success drilling holes for inlay using brass rod, I cut a piece of brass tubing to the length needed and chucked it into the Jacob’s chuck of my traveling drill press. While in motion, I can hold a finely cut flat file against the outside bottom edge of the tube, then a round rifler file to the inside, effectively sharpening the tube as it spins. By pressing the tube into the desired area of the indexed turning via the drill press’ quill, the tube cuts into the wood, burning the line as it does, due to friction. When cutting harder woods such as rock maple, this sharpening process needs to be repeated after every cut to keep the tube from flaring out like the horn on a trumpet, creating larger holes with wider lines. Very consistent results can be had with regular sharpening. Purist OT’ers to whom I have suggested this were horrified that I was burning the wood, rather than just cutting it. I have found, though, that especially in lighter colored woods, this actually improves the appearance of the ornamentation by adding contrast. Besides, it isn’t like I am performing an actual act of wood burning, I am coloring the cuts in a way that could not be accomplished otherwise! I have never had one of these cuts require the removal of any burned wood, for it is all concentrated within the line of the cut. By offsetting the center line of the tube in relation to the turned piece, you can create the effect of overlapping coins in either direction around the work, or with some finagling, I have created the four phases of the moon around a wand, and won a blue ribbon at the state fair for my efforts! Both moons and overlapping coins can be seen on the wand on the left.

Setting up your lathe for indexing may be as easy as simply figuring out where your indexing pin is on your lathe. On the other hand, if your lathe was never meant to work with an index (like mine), you may have to start from scratch - but don’t worry, converting it is easier than you may think. You may even have what you need, already in your shop!

For best results, I recommend buying an index wheel to start. It will give you professionally spaced indices which will be much better for reproduction than anything that you or I could possibly accomplish by hand. Regardless, use the index that you have to position and affix a spring loaded pin to your lathe.

My Delta has a plastic case on it that is of a rather odd shape. As a result, I decided to use the shape to my advantage. I mounted the faceplate to the lathe and set about finding the optimum placement for the pin. Cutting off a piece of $^1/_2$” all thread about 3” longer than the width of the lathe’s housing, I chucked it into my hand drill and ran the drill while holding the end of the all thread to the belt sander. The result was a perfectly pointed piece of all thread that fit the index hole tightly, without any slop. Next was to slide the all thread into a piece of steel tubing that I had on hand, which was just barely larger than the all thread itself. This would serve as the sleeve in which the pin would slide. The sleeve I cut to the same length as the width of the lathe housing against which it would be attached. I positioned the tubing against the lathe so that the pin automatically went into the index, then taped the sleeve in place. I filled the crevice between the tubing and the lathe housing with silicone glue, which I knew would adhere to both the steel and the plastic housing. Once the glue had set, I removed the tape and set new tape to create a dam to hold the next application of silicone glue in place. A bead of glue filled this crevice. Once the glue set up I found that it holds the tube in place so well that I have not had any problem with it working it's way loose — even on the rare occasion of turning on the lathe with the index still locked in place.

Once the tube is glued to the lathe's housing, the all thread can be inserted (I covered mine with Teflon tape to get it to slide easier). Screw two nuts onto the pointed end of the all thread. Two washers on either side of a spring were placed between the nuts and the tube to add spring action to the pin to hold it in place in the wheel's stops. A piece of a metal, 90^o bracket was placed onto the opposing end of the all thread, held in place by two wing nuts that are locked together to hold the bracket in place and keep the spring compressed. The metal bracket was positioned so that when the index was not being used, it is held out of the way by putting the bracket onto the far left end of the headstock's housing. Of course, if you have more than one size of index wheel, you can position more than one spring-loaded pin to work with each. After seeing some other index systems, I came to realize that a pin system can also be made to attach to the ways of the lathe. There are many ways of solving a problem.

Duplicating Indices
Make One for Each Drive!

Your purchase of an index that was made in production is the perfect index for the purpose of reproduction. This will assure more evenly spaced stops than can otherwise be achieved. Indices can be made from a variety of media, spanning from wood to metal and plastics. Years ago I had acquired several sheets of black Plexiglas® from a store that was being remodeled. This material proved to be very suitable for this purpose.

Marking the Original Index

Mark one hole in the purchased index as the number 1 hole. If your original index is a faceplate, it probably has reenforcing spokes on it's back side. For the sake of convenience, pick one of these stops and place the tip of a red sharpie into this spot to make an obvious mark that will not get rubbed off. On the edge of the disc, make a groove with the corner of a triangular metal file. To differentiate the various positions, each of the quarters are marked with an X on the edge of the index, then colored in with the red Sharpie. Mark the eighths with a single line across the edge, and the sixteenths with an angled single line. Fill in these lines with whatever color you want to differentiate these divisions from the others. The trick here is to make it obvious at a glance to assure yourself of putting the pin into the right notch. With so many indices, it is all too easy to place the pin into the wrong stop. On the number one hole I have placed a large black "1" on the back of the plate.

Duplicating an Index

Once you have one index plate, you can easily duplicate it so that you have one for every chuck you own. As stated earlier, I made mine of Plexiglas®, but plywood or even MDF could be used as well — mind you, the plexi will outlast either of these other options.

Cut a piece of Plexiglas so that once turned round, it's edge will overhang the faceplate by enough so that the holes can be drilled without the bit coming into contact with the faceplate. Cutting it round on the band saw will make turning the edge true a lot less hazardous. You don't want corners flying off in the shop.

Attach the Plexiglas to the faceplate with double stick carpet tape as close to centered as you can manage. Use the center mark from the compass with the tail stock to get it centered. To make sure that the plexi is well adhered to the faceplate, run the tail stock up (minus the pointed center) with a piece of plywood between to act as a press. After about 5 minutes, the plexi should be secure enough to remove the tail stock and plywood. Make note of the size you need

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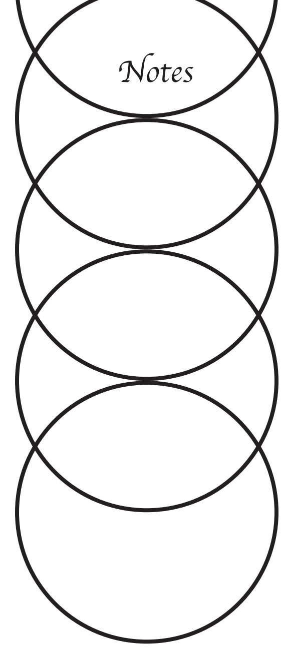
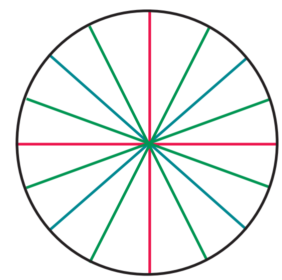
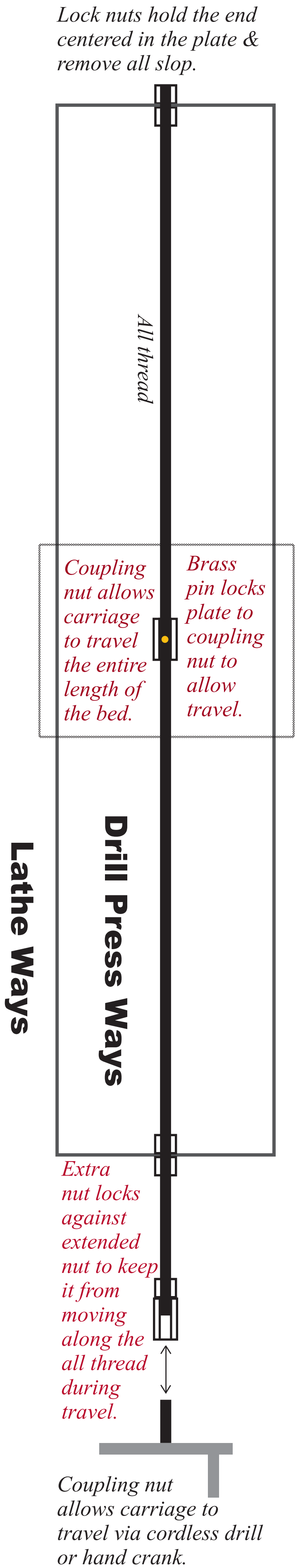


Barleycorn pattern



Red Lines show 1/4 stops, Blue with red shows 1/8 stops. Green, combined with the two other colors are the 1/16 positions.



to remove from the center so that it will either screw onto the headstock or slide behind the spur drive or the four jawed chuck. If your four jawed chuck requires a converter to screw it onto your lathe, cut the center hole to fit this converter so that the index is trapped between the chuck and the converter. On a four jawed chuck, mark the #1 hole at the number 1 jaw as a convenient reference.

Once the center is cut out to fit the appliance to which it will be fastened, true up the outer edge so that it runs smooth and gives you at least $^1/_4$” area into which you can drill the indices. Make sure that the line for the indices is aligned with the pin that you installed onto the lathe. When you have everything lined up, it is time to drill the indices. A quick reference line can be made by releasing the index pin and turning the lathe by hand, allowing the pin to scratch the surface. This will give you the line along which all of the holes will be drilled. Unlock the plate and turn on the lathe. Make a shallow cut on the bed side of the plate to act as your placement guide for the indices.

Drilling Indices

Drilling the indices can be done in three different ways.

1) A simple index can be made by hand. If making the index of steel, establish a center point, dimpling it with a punch and hammer. This gives you a fixed center point from which you can set the point of a compass with reliably repeatable results. The punched dimple also serves as a center punch to keep drill bits from wondering across the face of the steel. The use of a protractor, square and straight edge is essential. Using the center punch as a point of reference, use a compass to mark your outer circle. Establish your #1 point and scribe a line from there, through the center and on to the other side. After you have established your first line, use the square to find 90°, set the straight edge and scribe the second line. You now have four points set on the index. Continue to divide the areas remaining by half and marking the subsequent lines. Once you have this done, go around the scribed circle with a hammer and punch, punching points anywhere the circular line intersects with a radial one. Be as exacting as possible. Once all of the indices have been punched, go to the drill press. Drill the center hole with the bit that you intend to use for the indices. When this center hole has been drilled, turn off the drill press and reset the plate. What you want to do is to position the index so that the drill bit is centered in the punched spot of one of the indices, then as it is being held in position by the bit, pivot the disc until the center hole is over an area where you can drive a screw. Once you have a screw driven through the center, it becomes automatic to drill out the indices — once one hole is drilled, back off the quill, rotate the index to the next hole and drill it. If you have a wooden auxiliary table on your drill press, position the disc so that the stop is under the bit, then drill and place a pin in the first hole. Now you can accurately drill the other indices as you would drill the holes for adjustable shelves. Step and Repeat. Reset the pin for the eighths, then the sixteenths. To increase how long the bit remains sharp, when drilling metal use a slow speed and a cutting oil to lubricate and cool the bit. Plastic can be drilled the same as wood, but go slower and use a backer board to keep from chipping out the plexi upon exit. Brad Pointed bits are recommended for these softer materials.

2) The way that I did, on the lathe, is not the most accurate method (thanks to Dremel’s slop), but can be reasonably accurate if you take certain precautions. I used the Dremel tool with the drill press attachment set into the banjo of the lathe. Set up the drill press so that it will drill at 90° to the index. Tighten ***ALL*** thumbscrews! To avoid most of the inaccuracies inherent to this jig, make a drill guide by drilling a hole in a block of wood, with the bit you will use to drill the indices. Mount this block between the index plate and the drill press, with the bit already inside the hole. This will act as a steady and guide for the drill, insuring consistent results. This will eliminate any error you might make due to the drill press' slop. Any error on the index will be duplicated every time you make use of this index, so go slow and be careful.

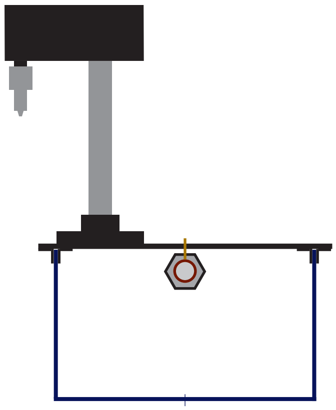
Place the pin into the number one hole of the original index. Drill the hole, aiming and guiding the quill as you do. Advance the original index to the next quarter hole position, set the pin, then drill the next hole. Drill all four quarter position holes, then advance to the eighth holes, or the ones which divide the quarter placement holes in half. If your new index will allow it, divide these holes again by drilling the 16th position holes. Repeat this process until you have all of the stops that your new index can support, making sure that the webbing between the holes is robust enough to not break out during usage. After you have drilled all of the stop holes, go through and mark the hole positions on the edge of the disc in the same way that you did for the original, metal index. This will make even division of the work quick and easy when you are making use of the index later.

Sand as needed to make the new index finger friendly. Don't forget to cut the hole in the middle, if you have not already cut it. It is best to start with a hole that is too small, then enlarge it. If you cut the hole too big, you will have to start again — thus is why I always started with the center hole. If it turned out right, then I would go ahead and drill all of the index stops.

To remove the new index from the faceplate, make sure that the lathe is off, then carefully pry the plastic loose from the faceplate with a thin putty knife, trying to apply the knife under the tape to keep from scratching or gouging the plastic. Clean off the tape from both surfaces (using the sticky side of the tape works very well). Screw the new index tightly onto the chuck and then it is ready to go. There should be no movement between the chuck and the index. If you find play, remove the disc, apply glue, then center and replace the disc.

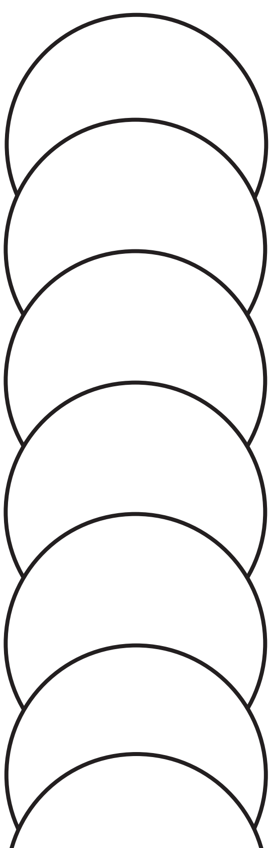
If you intend to put the index onto a spur drive that has a Morse taper, be sure that the hole in the center of the index is cut to match the smaller portion of the Morse taper where the index is to sit. When ready to seat the index onto the taper, clamp the spur drive into a vice with the Morse taper pointing upward. Be sure to use smooth jaws on the vice so that you do not mar the spur drive. Apply heat to the wide end of the taper with a propane torch — just enough heat should be built up so that when you bring the center hole of the index down onto it, you can press it down, setting it flush against the back of the spur drive, without burning the plastic or causing any run-away melting. Allow to cool in place. If it is a snug fit, the plastic sheeting will cool around the Morse taper, setting it in place. If your fit is not tight enough to stick, wait for the taper do cool, then add silicone or Epoxy glue to the joint and place it tightly into place to set, cleaning up any glue that may have squeezed out. The main goal, once the indices are drilled, is to mount them so that they will not slip as they are advanced to the next hole, which would cause errors in spacing. In fact, I have found it easiest to advance to the next hole by grasping the index and moving the work that way.

Lathe Table
Seen from beneath, the lathe table is simply a 1" steel rod welded to a 1/4" plate. The plate is drilled and attached to a sheet of MDF that has been laminated on the top to create a smooth surface.
The post is the diameter needed to mount it in the lathe's banjo. This table is a must have item for doing inlay, for it keeps the bits & pieces out of the sawdust. For carving and filing, it can offer support for a turning by cradling the turning in a V block as seen below.



Above: *Arrangement of angle irons, metal carage plate and all thread as seen from the tail stock end. The graphic shows the brass pin that goes through the metal plate and into the extended nut for the drill press' mobility.* ***Note:*** *Drill press is not rendered to scale & shown for relative positioning detail only. In reality, the quill overhangs more than half way over the center of the lathe bed.*

Below: *Overlapping Coin pattern is cut with a sharpened brass tube with the drill press set off center, toward lathe.*



The index will take up a little room on the Morse taper. In most cases, it will loosen it just enough so that it acts as a safety clutch — should you get a catch, the reduced friction in the Morse taper due to the index will allow the spur drive to slip, rather than causing the wood to chip out. If, however, it causes the index to not have enough grip in the Morse taper, turn away some of the index so that the plastic between the spur and the head stock is thin enough for the taper to get a decent grip.

3) If, on the other hand, you have access to a CNC machine, go for it! This is how a friend made a steel index for me. Simply set the diameter of the wheel in the designing program and the size hole that you want (1/8" diameter is great), then tell the computer to create an array of that hole "X" distance from the center. Don't forget to represent the center hole for mounting it on the lathe as well. Then tell the CNC machine to cut it out for you.

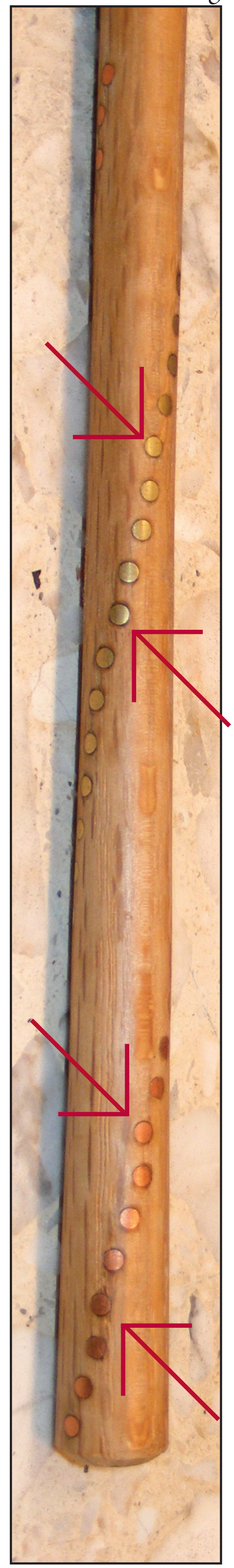
If you make the index larger than your lathe's capacity, you will need to create riser blocks for the head and tail stock, to bring the center up to the same height that is required by the new index. Be sure to increase the height by enough that it will easily clear the bed of the lathe. Also be sure that the steel risers are cut to lock into the ways of the lathe without play. Using the base of the tail stock will give you the pattern that needs to be milled. This will increase the lathe's capacity so that you will be capable of working on items larger in diameter than before installing the riser blocks, depending, of course, upon how thick you make the riser blocks.

Index in Action

Simply put, an index is used to hold a spindle (or other work) stationary on the lathe. This is a convenient item to use, especially if you intend to carve, or otherwise ornament your turning. To be capable of locking the spindle so that you can use not only carving chisels, but a mallet *with* the chisels, is a safer and easier way of carving that does not require fastening the turning to a bench. Several times in the past I have nearly cut myself while trying to hold a turning as it was being carved. The roundness of the item makes it particularly difficult to hold and carve at the same time. To have your carving suspended by its ends as you carve can spoil you. A table that is designed to fit on the lathe, via the banjo, will quickly spoil the turner/carver.

Lathe Table

One of the handiest accessories I have made for my lathe is a table (see page 9). Because my lathe's bed has a 2.5 inch gap between the ways, I found myself continuously digging under the ways to retrieve my palm chisels when dropped, preferably without cutting myself. The idea I had to combat this situation started with a piece of particleboard that was covered with a slick veneer. I cut a



3” section of 1” round steel and welded it to a 1/4”x 6”x 8” piece of plate steel. After drilling mounting holes through the plate, I screwed the plate and post to the bottom of the board. This 1” rod fits perfectly into the banjo of my lathe, giving me a movable table that can be set stationary, directly under the turning. This does an excellent job of holding my carving tools, as well as other items. I have also found that by placing a V block on the table, I can raise the table so that the V block supports the turning right where I most need it. If I need padding, I can always add cloth or some stiff foam padding to the V block. This gives me a more solid surface for hammering the metal stock into place.

Accurate Drilling

The key to doing any of the ornamental work that we are pursuing is accuracy. Believe me when I say that if you are doing a double helix of metal inlay, if even one of these spots is off by 1/16”, it will be noticed - if not by your customers, then at the very least, by you. This is the reason why I stopped using the Dremel drill press. The amount of slop built into the device due to plastic parts will quickly ruin the look of a piece that has otherwise been perfectly rendered (see spiral on facing page). The Dremel workstation simply does not have the needed substance to do the job accurately.

A jig that I saw in a publication would be far better. The inventor of this jig mounted a pipe or solid round stock into the banjo and drilled through the pre-drilled holes in a pipe or other round stock. Because the proper sized hole in the jig acts like a bushing, you can get perfectly aligned holes drilled into your work piece. Used in conjunction with the index, very precise work is possible - at least until you need to move the banjo to a location further down the length of the lathe, or change out the bit for a different size, which requires resetting the jig. This is a good idea that could help to take the slop out of Dremel’s drill press — the concept just needs to be refined. An picture of this type of jig being used can be seen on page 51.

My more refined technique came when I purchased a new, floor model drill press. This freed up the bench top model drill press I had been using for ornamental purposes.

I knew that using a drill press would greatly improve accuracy, give me a depth stop and pressure through the use of the quill.

As I had mentioned earlier, I had recently built a 2 car carport of wood. A 16’ width, spanned with a box beam built of 2” x 6” will still sag at that length, so I purchased a pair of 4” x 4” x 20’ steel angle iron, cut off the excess and mounted them along the bottom of the two main beams to shore them up - worked like a charm! Of course, this left me with a pair of 4”x 4’ beams without a purpose. Not being one who can throw away anything useful, I stashed them until they were needed. This project found the use for these leftover pieces.

A friend of mine spot welded the two angle irons together, forming a U beam. I added a plate of steel at either end, then drilled a 1” hole directly opposite of one another. I bought a 1” x 6’ piece of all thread to go through both holes. To act as bushings, I added a lock nut onto either side of each plate, using the narrow bead on the lock nut to nest within the hole as a self-centering device with adjustable tension. With a coupler nut threaded onto the middle of the all thread and an aluminum crank handle on the tail stock end, all I needed to do was find a way to connect the drill press to the extended nut to make the drill press’ travel fully functional.

I mounted the drill press to a 1/4” x 8” x 8” square of steel plate, after mounting two pairs of 2” angle irons to the underside of the plate. These pairs of angle irons are bolted on so that any slop can be taken out by adjusting the angle irons by sliding their faces against the inner and

Aluminum, brass and copper *are the best metals to be inlaid into your turnings. Silver and gold are also excellent choices, but who can afford them? Ferris metals, such as iron and steel are not good choices, for they are exceedingly hard and difficult to work. AB&C are all softer metals that work about the same as most woods, making it easy to get it flush with the wood.*

Sherbert Cup
I made *for my wife features 1/2” copper tubing with crushed malachite inlay. Cup is rock maple and paduk.*

Top: *Finial with rope molded bead. Note the composite metal inlay on the column.*
Bottom: *Carved, Caged Balls, one in each of the three columns of the hour glass. Inlay of copper tubing was filled with crushed malachite.*

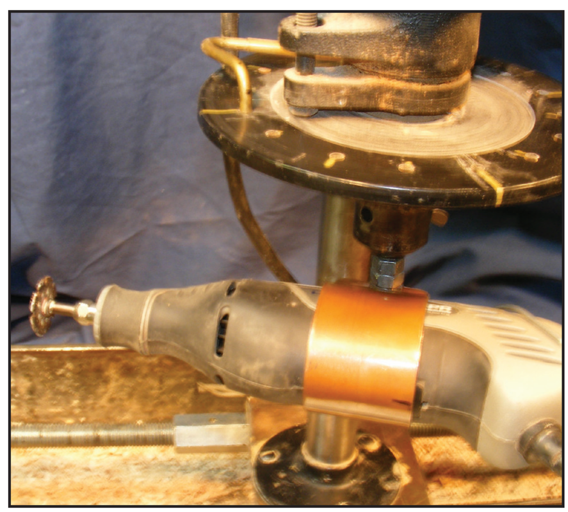
outer faces of the larger angle irons.

To fasten the sliding plate to the extended nut, I simply drilled a 1/8” hole through the carrier plate so that a 1/8” brass pin could be passed through the plate and into a hole drilled in one side of the extended nut. The result is a bench top drill press that can be moved the entire length of the lathe with great precision, either via the hand crank, or a 1” socket on my drill for moving it long distances.

This set up is quite versatile. The head stock index enables the user to aim the drill bit at virtually any spot on a turning around it’s circumference, while the all thread carriage allows movement of the drill press along the 3’ length of the lathe. Because the throat of the drill press is deeper than just aiming the bit over the center of the turning, the head of the drill press must be angled to hit the center of the turning. To easier register angle(s), I bought a circular protractor and drilled out the center to fit the post of the drill press. Finding the center, I glued a sharpened brass pin to the rear of the drill press housing. I then glued the round protractor to the post of the drill press with the 0º mark lined up with the point of the brass pin. Now, finding center is merely a matter of loosening the drill press head, lining the needle up with 0º and locking it back down. You may ask why I did not physically position the drill press at the 0º mark? This was intentional so that the drill bit could be moved beyond center for the effect of overlapping coins, going in either direction. This effect is possible because of the fact that one side of the cutting tube does not come into contact with the work. When repeated around the piece, the side that cuts seems to be covering the side of the next that did not cut (see the illustration on page 10 to see an example of “overlapping coins”). It should be noted that the depth gage of the quill should be used for consistent results when cutting overlapping coins.

The only thing about this rig that could stand improvement is the lack of ability

Above: *Hour Glass with open spirals and caged balls. Copper & malachite inlay seen on columns. Below: Dremel tool mounted in copper collar is chucked into the drill press. Note the index on the quill. This allows me to lock the quill so that the Dremel’s bit is at the correct angle for rope molding or cutting slots.*



to change the angle of the drill bit. Unlike the Dremel Workstation, the head on the Black & Decker drill press will not pivot the bit up 90º. I did some experiments with building a heavy duty double ball joint to enable such a capability, but since the head of this drill press weighs in at over 25 lbs., it was not a workable solution. Only after I had gone through this fruitless exercise did

I read an article about using the headstock from a Unimat lathe. I just happened to have such a lathe, and I did rig it up to mount to a vertical post, which enables it to be rotated 180º. The only problem I have encountered is the fact that the only part of this lathe that was missing was the Jacob's chuck — the one chuck I really needed! It is now a race to see if I encounter the proper chuck, or the tap and die set I need to alter a Jacob's chuck I already own.

Whereas the Unimat doesn't have the same plunge capabilities as the B&D drill press (2" vs. 4"), it still has a quill that allows the operator very precise control over the bit's placement and depth of cut. I look forward to getting an operational Jacob's chuck for it to increase my range of abilities.

Mixing Machinery

One feature of the bench top drill press that I have taken to task is the ability to use the Dremel in conjunction with the drill press. There are certain times when you might wish to assign the control of the drill press' quill with the bits available for the Dremel. An example of this is in making rope molding (see facing page). Several years ago I undertook building a frame for an hour long sand glass. The theme that I chose was a tribute to the travels of Marco Polo. The frame had rope molding as an encompassing theme, with the upper and lower frame ends being wrapped completely in half round rope molding and the three pillars were to be open spirals with rope molding on each end (rope was used throughout the journey, from controlling the Bactrian camel caravans to the ride home on board a Chinese junk). The moldings on the end caps were all done by hand, due to the rounded shape of the ends being both convex and concave — no machinery would have done a proper job of spacing the diagonal cuts. The rope beads on the finials, on the other hand, were perfectly suited to this operation.

Joining the Two

I had a strip of copper about 2" wide and 10" long on hand in my metal stash. This I carefully bent into a curve that would wrap around my Dremel tool, without covering the vent holes in the Dremel. Due to the soft nature of copper, it was relatively easy to get the fit pretty close. On the two ends I drilled a 1/4" hole and then used files to shape one of them into a square hole. This made it so that a carriage bolt would sit in the hole without turning. The addition of washers and nuts made it possible to tighten the bolt quite snugly to the Dremel without doing the least bit of damage to it. If duplicating this, please be sure that the copper band does not cover any of the air holes in the tool. This will cause the Dremel to overheat and burn out. Vent holes can be cut if needed. Measure the circumference of the tool where the band will sit and then add the thickness of the metal to the length. Leaving 3" of the bolt beyond the locked nuts gave me a stem by which I could place the Dremel into the Jacob's chuck.

Making use of one of the extra index wheels that I had made, I turned the center of it to the diameter of the largest section of the Jacob's chuck on the bench top drill press. A reasonable amount of Epoxy joined the index to the chuck permanently. I then rigged up a stop to work in conjunction with this index, using brass rod and tubing, making it so that I could lock the Jacob's chuck into any one of 16 positions. With the index locked in place, I could chuck the Dremel into the Jacob's chuck at the exact angle I wanted in relation to the bead. Setting the depth stop, I could then Step & Repeat all of the cuts for the rope on every bead that required this treatment. After cutting these I simply rounded them over with a file and I had matching rope molded beads throughout the project in a fraction of the time it would have taken to lay them out and carve them by hand. This same technique can be applied to a wide variety of bits, including those with a routered profile. The real advantage here is the ability to plunge a bit, sideways, into the work.

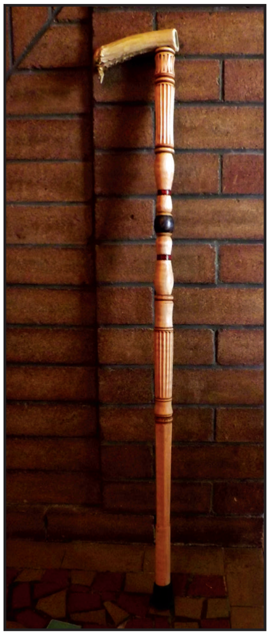
Notes

**** Crushing Stone***
The act of crushing stone is a violent one, sending shards all over the shop if you are not careful. The object is to contain as many of the shards as possible to cut down on the amount of stone needed for the job. I get out the lid of a holiday popcorn container and place a small stud setting anvil in it's center. I place the stone to be crushed on the anvil and align the male end of an old socket extension onto the stone, with my left hand forming a shield around it and the top of the anvil. When I strike the female end of the extension with a hammer, the stone is crushed into a variety of sized pieces that can be pushed off of the anvil, into the lid/tray. Any large pieces can then be retrieved for further crushing, or a new piece can be processed.

**** Note:*** *Darker or brightly colored stones can stain the wood when sanded. If this is the case, then come back and either sand or scrape the affected areas until the stain vanishes. Do not apply finish to the piece until all of the staining has ben removed or it will become a permanent feature.*

Warning!
Protective gear in the guise of safety glasses and face mask should be worn when crushing stone to protect your eyes and lungs. No mineral dust is good for continued breathing, but certain ones, such as malachite (formed from a copper solution), are downright poisonous.

Purpleheart Celestial Sphere



***My Dad's Cane that** I made of rock maple and deer antler. Ornamental work includes reeding and fluting. My dad is a big bowling fan, so rather than the classic vase and ball, I turned it with two bowling pins and a ball that has been marbleized using faux stone painting techniques. In the handle is a nickle from his birth year.*

A word of warning: Copper, even though it is an excellent ward against infection, is a metal from which it is nasty to get cut. Handle copper with care. Round over all corners that could catch skin, and smooth out any areas that have been cut or drilled. The fingers you save may be your own.

Inlaying Metal Studs

To make metal stud inlays requires planning that one might not otherwise consider. Will the studs all be the same size as they move toward the tip of the wand? If not, will it be moving from solid stock to tube stock (done with whimsy, this can be made to look like bubbles)? What metal(s) will be used? What is the ultimate pattern?

Go Shopping

Gaining a stock of aluminum, brass and copper rods and tubes is easy enough — just make a trip to any arts & crafts or model shop that sell metal stock in the forms of tubes rods and other shapes, usually found next to the sheet brass and copper, often in the model making or the doll house section of the store. In a pinch, I have even bought brazing rod from the hardware store, or stripped old electrical wire for copper or aluminum. These nonferrous metals are readily found — what is not is a set of drill bits to accompany them. If you try to use standard or even micro bits in your drill, you will quickly find that either the bit is too large or too small. When inlaying metals, the hole needs to be as close to the exact size as possible to the stock so that no glue line is seen, which would allow the rod or tube to fall out of line. Any round item that is inlaid at an angle other than 90^{o} will, when filed flat, create an ellipse rather than a circle. The solution to this dilemma is quite simple - use the brass stock as drill bits.

Brass is a pretty tough metal. The amalgamation of copper and zinc or tin is what differentiates bronze or brass from its components. As long as care is taken to insure that it is kept sharp, and is not abused by heat or pressure, a brass rod will act as an excellent drill bit, just as the brass tube works well to cut/burn circles for barleycorn.

To sharpen a brass rod for use as a drill bit, simply put it into your drill or screw gun. Turn on your belt sander and sharpen the brass rod as it spins against the moving sanding belt. This only takes a few moments to get the smooth cone and sharp point on the newly fashioned bit. It is best if you shoot for an angle that is sharper than 45^{o}, but the angle should be less than 1/4” long to ensure that the entire diameter is shown in the final inlay. This can be done with virtually any size of brass stock, but keep in mind that the longer the rod and the thinner the bit, the more likely it is to become bent from the pressure — and remember that it takes far less pressure on a 1/16” rod to both drill and to bend the brass bit over than it does with heavier stock. Caution must always be used. In action, it is the pressure and heat that will rend a hole into the wood, rather than an edge or flute on the part of the bit. Just take it slow and easy and re-use the flat rifler file often to sharpen and remove pitch. Whether made of the solid rod or tubing, I store these cutting implements in separate plastic drawers in a parts case to keep them clean, sharp, handy and undamaged. Be sure that the rods and tubes are cut long enough to be fully inserted into the Jacob's chuck, and still easily reach the wood. By putting the metal stock fully into the chuck, you are creating a more stable drill bit. If a bit acts like it wants to bend, shorten the unsupported space between the chuck and the work surface a tad to lessen the leverage causing it to bend.

Once the brass bit has become too short to use, replace it and use the original as brass for inlay. Not much ever goes to waste in my shop. For inlaying tubing, I have found that nearly every size of tubing has a matched size in the rods of brass. Simply drill with the brass rod as explained, then inlay the tubing. For larger tubing, you will be required to use actual drill bits — just be sure to first use the tubing to establish a parameter, then use standard bits to remove the waste, similar to the way a mortising bit works.

Composite Components

If you plan to nest tubing and rod, it is best to build the composites prior to starting the inlay process. Once the composite stud is nested together, mix up some Epoxy and place one end of the constructed piece into the oversized puddle of glue. Using the outermost tube as though it were a straw, draw the glue up into the tubing as far as you can, wipe off the end from the puddle and allow the glue to set. Applying a vacuum is the ideal means of drawing the glue into the tube, if you have the vacuum to use. The glue will keep the various components that you've constructed in one piece, without the worry of the pieces shifting or falling out.

To inlay the rods, tubes or constructed components into a pre-drilled hole, bevel the edge of the item that is to be inlaid either with a file, or by turning it as it rides against a belt sander. With solid rods, I will first bevel the end, then snip it off to about 1/4” length. I then repeat the process with the remaining rod until the stock is too short to safely apply to the sander. This

Queen's Imperial Crown of Brass *with inlays of malachite, jet and black obsidian stones. Each crown sports more than 500 faux pearls. The pair of crowns took three years to complete, and are housed in custom made mahogany boxes for transport.*

beveling will help ease the stock into the hole. Mix your Epoxy and dip the end of the first rod or tube into the glue. Using a pair of hemostats will keep your fingers clean and give you a means of holding it as you position it into the hole and drive it in with the jeweler's hammer. After you have all of your studs set into the work, and the glue has dried, cut off the metal about 1/16” from the surface using a jeweler's saw, then file the metal flush with the surface of the work, using a fine, double cut file (see page 4). Sand the entire area where the inlays are, from 220 through the highest grit you usually use. This will remove all of the errant glue and metal filings. Apply your usual finish.

For composite inlays, the procedure is the same, once you have the composite built and set. To set the composite, bevel the end, then mix up your Epoxy with the beveled end of the unit you have constructed. Line the bottom and sides of the hole with glue, using a toothpick. Line the tube up with the hole and push it in as far as you can by hand, then lightly drive it to the bottom of the hole with a brass headed jeweler's hammer. If you cannot get the piece fully in the hole, you are encountering pneumatic pressure. Anyone who has built something using dowels as the joint medium has encountered this, and experience will tell you not to simply hit it harder. To do so will break or split the wood. Instead, remove the glue from both surfaces and cut a very small groove into the side of the rod to allow air to escape. As long as there is an exit for the air, the inlay will slide right into place, with the glue acting as a lubricant. Give the seated inlay a couple of taps with the jeweler's hammer to make sure it bottoms out. Once the glue has set, carefully cut off the inlaid unit just above the surface with a fine-toothed jeweler's saw. If you attempt to do this prior to the glue being set, it will break both blade and the bond and you will need to set it again. Do not try to cut off the metal studs with a powered cutter. Using a metal or fiber cutting wheel or

Notes

Above: *Elder Wand with composite inlays in the form of flowers.*

* ***MDF***
Medium Density Fiberboard

** ***Switchable Magnets***
These are an ingenious device. A very strong rare earth magnet is contained in a housing that works as a cam. By turning the switch, the cam operates the magnet, lowering it to or lifting it from the surface, keeping the operator from having to struggle with breaking the magnetic field. It is literally a magnet that you can switch on or off.

Hand Spiraled Wand
Holly wand with moon phases. Spiraled handle is gridded off, then sketched in. Spiral is cut using files, then smoothed with sandpaper. Overlapping coins are cut with brass tubing in the drill press.

Above:
Making ornamental cuts with a 1/2” diameter brass tube.

bit inevitably heats up the metal and fries the glue - again requiring the piece to be removed and reset. Once the glue is set and the stud is cut off, use a fine, double cut file to bring the stud down flush to the surface of the work. The entirety of the finished inlay can be power sanded smooth with the lathe running and then finished.

When doing large numbers of inlays, I have found that it is best to do sections at a time — say all of the same sized studs at the same time. If you intend to inlay stone into tubing, use the brass tube to drill the outer parameter, then use smaller actual drill bits to clear out the center of the precut parameter. Use carving tools if need be to remove any excess wood. Inlay the tubing into the void, taping it down if needed, being careful of the angle at which it is set. Once the Epoxy is set, use an Ex Acto knife to clear out the excess glue from the inside of the tube and clean up any metal filings or rough edges of the tubing with a fine rifler file. Stone inlay doesn’t require a lot of depth — 1/8” is quite sufficient.

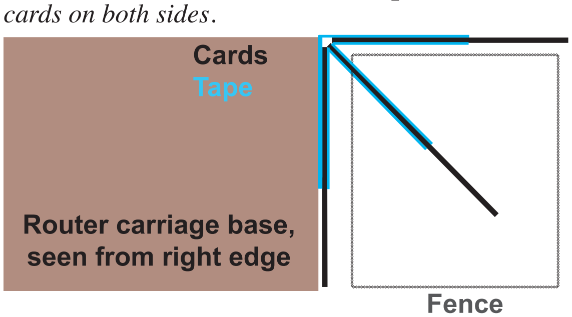
Stone Inlay

Inlaying the stone is quite simple, but it is messy. Break up some of the stone you plan to use for the inlay (see notes column, page 13). The goal is to make the pieces small enough to easily fit into the tubing, but large enough so that the type of stone will be easily recognizable. Prior to crushing stone, put on a particle mask to protect your lungs. All stone powders are bad for you to breathe, but stones such as malachite are downright poisonous — protect yourself!

Mix up a batch of clear Epoxy and line the inside of the tubing with it using a toothpick. Drop in the largest pieces of the stone and position them using the toothpick, then coat the entire contents of the tubing with Epoxy. While the glue is still wet, sprinkle in the finer pieces and stone dust to fill in the voids. Allow the glue to set to full strength in accordance with the instructions on the bottle or syringe. When set, carefully file the stone down to the surface of the work piece, the final strokes of the file should be with the grain to prevent scratches. Use a file card often to clear the file of glue and stone dust that quickly builds up. It is not uncommon to have small chunks of stone become dislodged during the filing process. If this happens, use a pointed burr bit in the Dremel tool to remove the glue from the troublesome area, clear the dust, then inlay more glue and stone into the newly opened void. Once set, file it down again, excavating and re-inlaying as needed until it comes out smooth. Sand and finish.

If you are inlaying a harder stone, such as any of those that are quartz based, you will need to use a harder stone to grind it down. When I inlaid garnet into a piece of jewelry, I had to use a grinding stone to flatten the inlay. Sparks flew and portions had to be redone, but the results were worth it. Explore the lapidary branch and have fun! It is a great way to add color to your turnings. Necklaces or strings of tumbled stones are a perfect supply for inlays and are cheaper than buying larger pieces.

__Hinging Cards__ as spacers, using packing tape. By starting out with all of the cards down, each pass will get 1/16” deeper with every card lifted, depending upon how thick both the cards and tape are. For best results, hinge the cards on both sides.



Building Metal Composites

Custom made inlay constructions of metal rods and tubes can be quite the show stopper. I have made targets by varying the types of metals that were nested together, one copper rod surrounded by various sized tubes, alternating between brass, copper and aluminum. I have also made clusters of rods and tubes within larger tubes to make what appear to be flowers. It is also possible to start a construction that is built within a square, triangle or even a petaled tube within the outer, round tube. Be sure that all of the component pieces are matching all of the way through the design, and that the outer tube is as full as possible with it's various components.

Once constructed, draw the glue up into the piece to stabilize it and to lock the pieces together. Marine Epoxy is waterproof, comes in a double syringe and mixes as black. Coloring clear glue may also be a subject you might wish to explore!

The inlay techniques explained here have the potential of giving you a wide range of ornamentation that can be kept quite simple, or taken to an extreme. An example of this would be the walking staff that I made for myself. One of it's design features is a ball that is inlaid as a representation of the night sky. Even though I used purple heart, which is not a period wood for Medieval Europe, I chose to use it because of it's coloring, which would look good as the background for a celestial map. I could not find a piece of purple heart large enough to turn a softball sized map, so I turned that disadvantage to a design opportunity. I glued up pieces of purple heart, using different veneers as dividing lines. Once I turned the ball, I had lines to represent the quadrants, equatorial and sun line. To get the sun line angle correct (and the positioning of the stars), I used a celestial sphere from NASA. I aligned the poles and measured the angle of the sun line to duplicate it in my sphere. Once the glue was set and I had turned it into a sphere, I duplicated the grid on their map, then used this grid to duplicate, one by one, the position and classification of the stars. All that was left was to drill the holes with the proper sized brass rod, then inlay the appropriate metal. When I was finished, I had as accurate of a celestial map as I could manage, with all of the constellations of the night sky duplicated and the stars properly sized to their four classifications. The zodiac, because it was along the sun line, was inlaid in brass, the remaining stars of the sky in copper. I later used a wood burning tool to draw the connecting lines of the constellations to make reading the sphere easier, so it could be used as a spotting map in the field. Because of this, I have often been asked to duplicate constellations on both canes and cups.

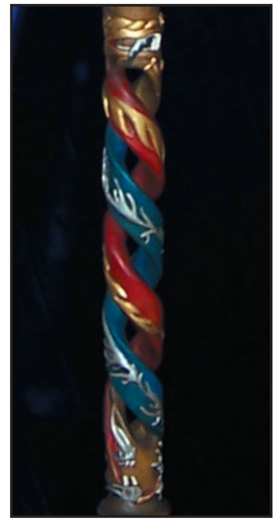
Fluting/Reeding

My wife got a fluting jig for me on my birthday a few years ago. This jig consisted of an MDF table that would fasten to the bed of the lathe. This table has imbedded in it a pair of T-channels that allow another piece of T-channel to be adjusted and tightened down. It also included a pair of stops on the T-channel that acts as a fence. The last item in the jig is a Formica covered MDF sliding carriage that has a riser mounted on it that consists of a plate mounted onto the surface of the carriage with a vertical piece of steel, approximately 1/4" x 2" x 8". Onto this tall piece fits a sliding mortise of steel with an angle iron and a thumb screw. This allows the user to mount a trim router, using two large hose clamps, forced into the interior of the angle iron, the thumb screw enabling the router's altitude to be changed so that the bit is either above, below or at center, depending upon the cut desired. This carriage also sports two padded vertical handles for controlling it against the fence from stop to stop. A very nice jig, if somewhat limited.

The limits of which I speak became obvious to me when I started trying to produce a ruffled collar for a goblet, similar to those seen in Holtz. I found that the fluting jig as it was could only give me about 25° - 30° of total movement out of alignment with parallel to the cup. I needed about 45° - 50° to get the bit to cut along the side of the cup's bottom. The most successful was done by disregarding the jig's fence completely. I found that I had a 6" deep piece of sono tube (heavy cardboard tubing used to cast concrete columns). I cut this to be only 3" tall by using my band saw (very carefully). I found that I could use the inside of the tube as the guide to the sled, giving the bit a curved approach once the trim router's bit cleared over the tip of the tube. It worked, but was not what I really sought.

Notes

Below: *Staff's Open Helix was cut using the Sears Router Crafter, then hand carved into a double Oroboro.*



Above: *Elder Wand with composite inlays in the form of flowers. Wand also features barleycorn and two colors of acrylic inlay in a chevron pattern Fluting can also be seen.*

At one of the wood turner club meetings, someone had brought in a large box of tools that were up for grabs to the members. I found some extruded aluminum channel that I thought might come in handy. Getting them home, I attached a pair of switchable magnets*, one to either end. This made a magnetic fence. Cutting a $^{1}/_{4}$' steel plate to approximately 18" x 24", I drilled pairs of $^{1}/_{4}$" holes, two on one end and two along the long side. I then countersunk the holes so that I could use a set of countersunk screws I had, allowing the magnetic fence to be mounted at any angle, regardless of how the plate was mounted. These switchable magnets are so strong that I can turn them on and pick up the entire steel plate with the fence (watch your toes, sheer strength of the magnet is much lower than the lifting strength)! With this rig I can position the fence anywhere on the steel plate, from parallel to the work to 90^{o} to the work, with every angle included in between! Unfortunately the stops from the original set up will not work with this extruded aluminum, but small Quick-Grip clamps work well as the stops for this newly rebuilt jig. I still use the sliding platform that came with the jig, and have come up with a way to replace the trim router with a Dremel tool if need dictates.

* ***Switchable Magnets*** *These magnets are a wonder. Each magnet is made of a steel base with a thumbscrew at the top that acts as the switch. When first placing the magnet, in the off position, it sits upon the steel like any other tool. When the switch is turned 180^{o}, the magnet is turned to act in concert with a second magnet. The result is a unit that is fastened tight enough to use as a mount for any jig. The magnets that I used were strong enough that I could lock down the fence and pick up the entire sheet of steel by the fence!*

Sneaking Up

To operate a router on a turning, one must take the same precautions that they use when firing up a router to cut the edge on a table. If you take too big of a bite at one time, chipping and burning are inevitable. One must sneak up on the final cut for the best finish — one that doesn't require sanding (one of the hallmarks of ornamental turning is getting a smooth final cut so as *not* to require sanding). Any sharp High Speed Steel (HSS) bit will do this, as well as any carbide faced bit, so long as they are sharp! According to other OT'ers, diamond bits give the best results.

When I first started using the fluting jig I found that sneaking up on the final cut was the answer to getting the smoothest cut. I keep an old Band-Aid box filled with cards — you know, the sort that credit card companies used to send you in the mail. They are not real, but they are of consistent thickness. One of my favorite types of cards are the copy cards that Staples uses on their self-serve copiers. Made of a plastic card stock, they will put up with a great deal of abuse in the shop before requiring replacement. I cut up four cards to match the front edge of my router carriage, then hinged them together with strong packing tape (see graphic on page 16). I then hinged them to the front edges of the fluting jig's carriage. With this, I start cutting with all of the cards down. After the first pass, I raise the first card on either side. This brings the bit about $^{1}/_{32}$" closer to the work, cutting only that amount on the next pass. Cut, lift a layer and cut again until you reach your goal and end up with a nicely finished cut. As always, in OT, Step & Repeat.

Note: *When cutting the cards, cut them slightly shorter than the front edge of your carriage. This way, you will not have to worry about the front edge of the carriage being lifted either by the card's edge or sawdust against the jig's fence. Consistency is the key to beautiful results.*

Below: "Old Age is the Prize for Survival" *is the last cup I turned from green wood. An ambitious undertaking, I got called away from the lathe for too long and it started warping out of shape.*

Spiraling

Cutting a spiral, or a helix down the length of a turning is a job that requires specialized equipment, if your are planning to do it by any means other than by hand. Doing it by hand is the traditional way of creating an actual spiral, and it is relatively easy to do — it just takes time and effort.

Hand Spiraling

With the lathe turning, use a pencil and mark off evenly spaced lines down the length of the area where you wish to make a spiral. Once these lines are drawn, turn off the lathe and make use of your index. Since it is relative, you can use the tool rest as a fixed straightedge and draw lines at intervals to create a grid on your project. Release the pin from the index and begin sketching a diagonal line that connects from one corner to the next in the direction you want the spiral to go (clockwise or counter clockwise). Once you have your lines established, go back and straighten them out to create as smooth a line as possible. I have heard of and tried other methods, such as wrapping the piece with paper or tape, but if there is any profile to the work, other than round, a smooth line is nearly impossible using these methods.

Machine Spiraling

Unless you have one of the pieces of specialized equipment used by Holtz, there is but one mechanical choice: The ***Router Crafter*** from Sears. This machine will do the job, but is intended for rougher work. A newel post is about as fine of a project as this machine was intended to produce. For one thing, it has no center, except on the tail stock end. On the head stock is a cup chuck, but not as nice of one as you are probably envisioning. This is an aluminum cup with a double ridge running roughly at 45º from the outermost to the innermost corners. If you are chucking a 4x4 with crisp corners, you should have no trouble at all centering the blank in the machine. If not, you may have some trouble. Fortunately, my brother had bought one at a garage sale for a fraction of what I had paid for my new one. This meant that I could preserve the better of the two in original condition and alter one to make it work with the lathe.

Through the use of steel cable, springs and pulleys, this apparatus will, as you turn the hand crank, turn the work as it draws a router platform down it's length. This is capable of creating a helix in either direction, of varying pitches. This item will also allow fluting or reeding of the work by disconnecting the cable from the movement of the router's platform.

As mentioned before, the Router Crafter does not have a center drive. In order to hook it up to the lathe, a few modifications had to be made. First and foremost is a means of attaching this jig to a lathe. All of the apparatus must be left intact on the frame for it to continue to work properly. I found that by making a bridge that goes between the two bottom steel pipes of the frame that will, in turn, fasten it to the ways of the lathe. Next up is to cut off the "cup chuck" that was supplied. This is a piece of aluminum, so it is relatively easy to cut, it is just a matter of cutting it off evenly without damaging anything next to it. Ironically, a Dremel tool with a metal cutting wheel works well. Cut the "cup" off as close to the bottom as you can manage. Smooth the edges with a file to make them finger friendly.

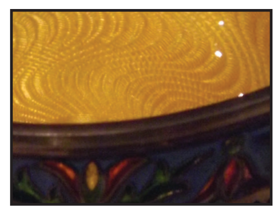
To get the spur drive that you will need to set a pre-turned item into this jig, purchase a matching spur drive to the one you have and cut it off on the Morse taper so that it fits into the working end of the headstock. Be sure to leave enough space so that a crank handle will still be able to fit. You will need a crank handle and extension from a socket drive set to be able to feed it through the head stock of your lathe and into the headstock of the Router Crafter. As long as the jig is held fast to the lathe, it should go ahead and work as the instructions they provide say it will.

To use the jig, set it up as described, using the crank handle and extension rather than the crank handle provided. Set up the jig as described in the instructions from Sears and you should be good to go.

Rose Engine Turning

A rose engine lathe is a different critter altogether from a standard lathe. I had read Holtz three times without realizing a basic part of the lathe's operations, and I did not understand completely how it worked until I saw it in operation on You Tube. Seeing this video created a real "V-8 moment", where I found myself slapping my forehead in disbelief. The head stock of the rose engine is set on a pivot! I had

Guilloche via Fabergé
Last year I had the opportunity to view several of Fabergé's pieces at the Oklahoma Museum of Art. Among these was the Tsarina's sherbert cup. This shows at least a dozen guilloche patterns engraved into the cup, along with backless cloisonne, called Plique-à-jour, just under the rim. The cup/saucer is said to have a matching spoon.



Penny Black, *printed in 1840, was one of the first of Britain's postage stamps. Part of the "Line Engraved" series, the die was engraved via a rose engine, then used to create the printing plate, using rollers.*

Above: *An early cup turned from Chinese Pistachio. The impression of ramparts and corbels are created by indexing the drilling to be phased, or offset, one from the other. Even with such a simple application of a few drilled holes (using a brad pointed bit) against a profile, the suggestion of a castle tower is clear to the viewer. The captured ring, of course, is simply a turner's way of showing off.*

Below: *Bowl & Goblet used as the prize for an annual Arts & Sciences competition. Bowl is rock maple, cup is rock maple with purpleheart & holds 16 oz. Both feature barleycorn, the cup is crenulated and corbelled with crenulated lid and carved bison on a red hill (their Coat of Arms).*

been wondering how it created the various shapes, being a lathe. Upon this realization, I felt as though I had been rather dense.

I am sure that you have seen various dishes that have a non--round edge, being shaped more like a bracket found it text, rather than the edge of a standard plate. This is made by putting the original into a rose engine and cutting it to a chosen profile found in the user's collection of *rosettes*, or profiled cams.

Rose engines can still be purchased — the old ones at quite a high price, but the newer ones at many thousands of dollars less. A pre-built one will still cost you about two or three thousand dollars to start. The less expensive alternative is the Jon Magill MDF machine*, which is a build-it-yourself model. The plans can be had for a reasonable price, but expect to reorder parts of the plans, combining the paid-for plans with those that are available free on the internet. This process can be a bit confusing to decipher. A kit with the most difficult to find parts can be bought for a few hundred dollars.

Most rose engine lathes are intended to ornament items held by one end, rather than spindles, so they do not come with a tail stock of any kind. Some pre-built brands offer a tail stock accessory. Those of us who would like to turn spindles on the rose engine may need to put on our thinking caps for establishing a tail stock. Mine came in the form of an old lathe that I had bought at a garage sale. The headstock was frozen, but the ways and the frame of both head and tail stock were in great condition. After rigging up a 3/8" thick steel support that goes from the pivoting bearings, out past the tail stock area, up to the older lathe ways, I finally had a tail stock that would move with the headstock without any wobble or vibration.

How a Rose Engine Works

A rose engine is a lathe that is ordinarily operated via a hand crank. The reason for this is that it cannot move any faster than 3-5 RPM. To go faster would be to court cutting too fast, resulting in a rougher cut.

A rose engine is built so that the entire headstock will pivot on a pair of points (or in my case, a bearing) at the bottom of the headstock. The actual area where the chuck and work piece is located, is set up with a large pulley and a set of cams, or rosettes — thus the lathe's name. The headstock is set up with either a spring to keep pushing it toward the operator, or an elastic that will do the job in the lighter weight versions, pulling it back toward the user. The headstock's tipping action is limited by a pointer, or *rubber* that rides against the edge of the rosette. This, in conjunction with the spring, causes the headstock to rock in accordance with the pattern on the cam chosen. As a result, when a cutter bit in a trim router is set to cut the work, the lathe will turn the chuck as it simultaneously follows the pattern of the cam. This causes the lathe to tip the work into the stationary powered cutter, which then cuts as the work passes. With the router mounted on a mechanical slide rest, the operator has complete control over feeding the work into the cutter at the depth and speed that the operator chooses. This is how the decorative edges of plates, bowls and service pieces is achieved. Once the edge is cut to profile, the router will be moved, via the slide rest, to the next location needing to be cut. If the operator is to cut a raised rim on the plate, he or she moves the cutter to give the proper amount of edge wanted, then the piece is cut again to lower the inner edge of the plate, leaving the raised edge that matches the rim exactly. As the router is moved in toward the enter, the pattern is repeated, yet reduced in size. It is somewhat like drawing concentric circles, but each circle has a matching pattern according to the rosette chosen. To position the cutter on the opposing side of the work will reverse the pattern in relation to the rosette used.

The pattern can also be phased so that it creates a spiral of the pattern as it goes down the height or across the face of the work. This phasing is done via a set of holes in the rosette and the drive pulley behind it. After cutting the first profile, a pin in the rosette is removed, and replaced so that the pattern is moved one hole in either the clockwise or counterclockwise direction. If the rosette is simply a series of humps, for instance, the result of phasing would create a brick pattern if phased $^{1}/_{2}$ of the pattern each time. Less than half of the pattern phase will create more of a stair step effect. This machine's description is what is known as a basic, or rocking rose engine.

Pumping Rose Engine

A rose engine that pumps creates items in an entirely new dimension, literally. On this type of machine, the headstock can also "pump". This action is created by having a headstock that not only rocks, but moves back and forth along the axis of the lathe, returning to it's resting position via a spring on the main shaft of the lathe, where the work is located. Whereas the standard rosette only has the pattern cut along the edge of the cam, the rosettes for the pumping action have the pattern cut onto the face of the cam. This type of patterning is usually rather small, but I have seen some patterns pump up to 1" along the length of the lathe's bed.

Guilloche

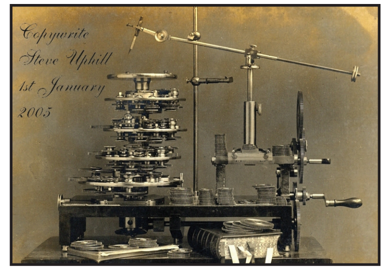
If you do a search on the internet for rose engines, you will find links to a lot of unexpected sites and subjects. One of the most prolific are the Winkle engine that is/was most famously used by Mazda. One of the most useful accidental finds, however, is the term guilloche (ge-o-shay). This is a method of engraving metal, most often used in watch and clock making. If you have ever owned a pocket watch or a very expensive wristwatch, simply look at the patterning that has been engraved on the interior of the case of a pocket watch or on the face of the wrist watch. If you see a brick pattern, a wave pattern, cross hatching, etc., you have seen guilloche. The example that most people will recognize is the circular ornamental finish on the nose of the famous airplane, called the ***Spirit of St. Louis***.

The most famous examples of guilloche are seen in the works of Karl Fabergé and his Easter eggs. All of the patterning that you see under the beautiful enameling be it on an Easter egg or a cigarette box, is guilloche. This is normally a very fine form of engraving that requires a jeweler's loop to see it prior to enameling. The enameling actually magnifies the engraving, making it easier to see. I saw an excellent example of this when an exhibit of Faberge's work was brought to Oklahoma City. One of the dozens of picture frames that were in the exhibit had a bit of enamel chipped from a reeded corner. Even within a couple of feet, I could hardly see the pattern that was engraved there, yet it was plainly visible where the enamel remained.

Geometric Chuck

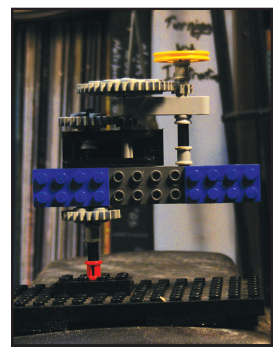
The geometric chuck is a gear box that has a very specific skill set. When you hook up your scroll chuck onto this gear box you will find that it moves the chuck, not only around in a circle of it's own axis, but simultaneously in a larger circle as well. These are known as epicycloidal movements. It is similar to when you wash a dish - if you only go around in circles, you will miss some of the food on the plate. If you make smaller circles as you go around the plate, you are making epicycloidal movements on the plate, effectively covering the entire surface. If, instead of all of the bristles of a brush, we use one point, that scribes a line of these circles. Add to this the built in cross slide, like those that hold a tool on a metal lathe, and you have the ability to position the

Notes



Geometric Chuck *that was restored. This is a four stage chuck, each stage being capable of programming, via positioning, the gear train and amount of offset. This is a vertical chuck. Many are horizontal, being mounted directly onto a lathe, which powers it.*

* ***Jon Magill's MDF Rose Engine***
http://www.whidbeyworks.com/root/MDF_Kits.html



Geometric Chuck *mock up made from Legos. This is a single stage without a cross slide attached. The yellow pulley at the top represents where the four jawed chuck will be set. The gear under the blue Legos would be an idler gear on the supporting shaft, but will be afied to the frame so that a small motor or hand crank will drive the entire assembly. This working model is acting as a guide to making the full scale, functional version for cutting wood and engraving metal.*

Above: Two examples of corbels and ramparts, making these ring stands appear to be castle towers.

point to any offset that the design requires.

The easiest means I have of describing the patterns this makes so that most people (at least the ones over 30) will recognize, is this: It moves the chuck in a way that if you placed a fixed bit to cut the pattern as the chuck goes around, it will cut a Spirograph®-styled design into the wood. This is also used to cut or engrave these sorts of patterns into metal, purely for the purpose of decoration.

In fact, the reason why guilloche was developed so extensively in the 1800's was to create designs so complex that they would aid in the fight against forgery in money and postage. Take out a dollar bill and look at it. All of the spider webbing you see on the US dollar was done as guilloche, cut into steel plates. These plates were printed under high pressure so that the ink would continue to sit on top of the paper, creating a raised image that could be felt, yet could not be easily duplicated, even if you have the proper machinery. Whereas the simplest guilloche is done with a pair of gear boxes, the more gear boxes used, the more complex the design. The machines used for this operation can have seven or more gear boxes working in tandem. Anti-forgery, indeed!

I do not yet have a geometric chuck, but I am researching it, and attempting to build one. Because I do not yet posses the equipment needed to cut gears, I started tearing down broken computer printers and salvaging them for parts. After parting out about two dozen printers, scanners and other mechanical/electronic equipment, I have collected four shoe boxes nearly filled with various types of gears, not to mention springs, steel shafts, micro switches, CPU fans, scanner bars, cameras and lasers.

It is my intention to build a geometric chuck that will be capable of lightweight work, using the plastic gears I have collected. This process will be made far more simple, now that a friend of mine has loaned me his Lego® mock-up (which is sturdy enough to draw a pattern onto paper). With this working model in hand, I will be able to match up gear ratios and build a heavier model than the one I am now using as a guide. Once I have managed to prove the concept by building a working model that will actually rotate a four jawed chuck in an epicycloidal movement, I will set about making metal versions of the needed gears to make an even more heavy-duty gear box(es) that will allow not only engraving metal, but cutting wood as well. I have built my own model using Legos, and have found a link to get more gears:

(http://brickset.com/parts/page-1?query=gear)

They only sell individual gears at this time, rather than a variety pack as I had hoped.

So far I have gathered most of the gears that I will need for the first stage of the chuck.

Making Saw Dust

Up to now, what you have read is a description of the various machinery used and for what effect it is put to use. The following is a series of techniques are laid out, guiding the operator to accomplish various specific tasks. Some effects, such as ramparts and corbels, are effects that are started during the process of simple turning, achieving the profile that, when cut by the drill or router, will give very different results due to the amount of wood that is removed from the finished piece.

First, a statement that does not occur to many turners: Turning and ornamenting wood is a process known to artists as *subtractive sculpture*. Just as Michelangelo said of his sculpture;

"I saw the angel in the marble and carved until I set him free."

The entire finished piece is contained within the raw materials — it is the job of the artist/sculptor/turner to selectively remove the unneeded material so that the finished piece is revealed. Unlike with clay, where if you take off too much, you can just add it back on, turning itself, is not at all additive, merely subtractive. Needless to say, this takes a bit of prior planning, leaving enough material to work with so that when finished, it appears as though the piece simply *occurred* — as though the raised parts just grew like that.

Chucking

Most all of the techniques described are possible with nearly any means of holding the work on the lathe, as long as there is an index attached. All of my various chucks have their own index, so there is virtually no limit on what I can do, regardless of weather the piece is held in a four jawed chuck or on a spur drive. As long as the piece can be held still and relative to the cutter, you are good to go. As I explain various techniques, if a particular chuck is required, I will inform you of such.

Double Drilling

Holes have great potential of being used for decorative purposes, even on their own. I have often drilled a series of holes down the length of a wand, usually in a double or quadruple helix, even lessening the diameter of the drill as I approach the tip. An effect that is often used in ornamental turning is called double drilling. This is when you see a flat bottomed hole with another, smaller hole in the center. This is quite a nice effect, adding depth, shadow and interest to what would otherwise be a plain hole. Before you try to drill one hole and then another within it, let me save you some trouble. Trying to consistently hit such a target is difficult at best, especially when the drill bit gets more flexible as it's diameter gets smaller. The far more effective means of obtaining this effect is to use a brad-pointed bit. This sort of bit is intended for wood and will not wander as badly as the twist bit that was meant for metal. The brad-pointed bit also saves you the trouble of actually double drilling, for the brad that pilots the bit through the wood leaves a smaller hole in the bottom of a flat bottomed hole! The job is finished in one pass. If it saves time and effort, you have found a workable technique.

Faceting, Reeding & Fluting

Reeding and fluting are basically the same thing — lines which run the length of the piece (or a significant section of the piece). The only difference between reeding and fluting is the cut itself — is it convex, concave or flat? If the surface after cutting is flat, it is faceted. If cut concave, the piece is fluted. If the surface the bit leaves is convex, or looking as though it is a collection of sticks or reeds, the piece has been reeded. Interestingly, reeded surfaces are cut with a bit that differentiates the divisions between the reeds, whereas the fluting is cut with a domed bit.

All three effects are accomplished in the same way. The fluting jig is set up on the lathe's ways, the fence is set parallel to the piece being cut, the stops are set and the sledded router is repeatedly run down the length of the area needing to be cut. Use of the index makes this a quick and easy job using the Step & Repeat method described earlier. For effects such as fading reeds or flutes, set the fence at a slight incline to the stock being cut so that the bit will run out of the work, or at least lessen the depth a noticeable amount. This is a nice look, especially when the cuts are staggered in their length, giving the flutes or reeds a longer and shorter effect. In artistic terms, this gives the work movement. It is similar to the yarn ball cage that I made for my wife (facing page) — each spindle could have had the beads in the middle, but this would have been uninteresting to look upon. By turning the spindles with both centered and identically off centered beads, then setting them in the proper order and orientation, it gives the piece movement, for the beads seem to be moving from near to the bottom to nearly the top and back again as the piece is rotated. It gives the piece both movement and visual interest.

Architectural Features

The most iconic form of architectural detailing would have to be a Gothic styled castle. One needs only see certain details to invoke such a structure to mind. Yes, you could do something with a Tudor style, but only those who have studied architecture would immediately know for what you were shooting. Of course, the fact that I am a member of a group who study the Middle Ages, it is a happy coincidence that this is also my favorite architectural style.

One must remember that the singular function of a castle is to defend the occupants and to do away with any attackers as quickly and efficiently as possible. In simple fact, a castle is designed to be a killing machine. It offers a variety of means to defend against attackers via shot, thrown or dropped weaponry, as well as traps to contain and exterminate those foolish enough to end up at the defender's mercy. The way it looks was completely secondary to this function.

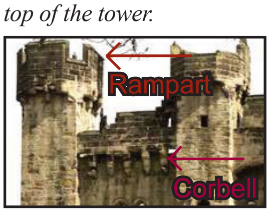
When adding such features as ramparts* or corbels**, the appearance of a castle becomes obvious, once you know what these defences were and how they worked. I will give you the short version for these explanations, so that the reader will get the gist of the matter, enough so that he or she will understand why a castle looks like it does. This will help you to obtain a more realistic rendering. The main trick to this is to first turn the proper profile. Studying pictures of these features on various buildings will help tremendously. Most ramparts are executed by merely extending the wall to the heights required for the ramparts, leaving spaces in the uppermost set for cover in battle. Some have a bevel at the top edge (merlon), others have a rolled bead along the top edge. Corbels, on the other hand, have an extreme variety of profiles. From the simple stepped ceilings of the Egyptians to the rolling profiles of the Spanish or Moorish styles, these corbels open up a wide pallet for the turner to explore. The main thing to keep in mind is what it will look like once the drill press and fluting jig has been used to remove areas, making the turned profile intermittent.

Turning the profile for ramparts and corbels is easy enough. If, for instance, you are creating a corbelled crown for a tower (an area that steps out from the wall — or tower below it), leave an area of extra wood that steps out about $^{1}/_{2}$” or more, depending upon the size and shape of the item you are turning. The center section will be cylindrical, or nearly so, with the lower area reserved for the corbels, the upper area for the ramparts. For the corbels, turn a series of beads, or steps, one on top of the other, angling outwards toward the larger cylindrical section, giving a join between the main wall and the crowning area with the ramparts. A series of beads and coves, similar to a Roman Ogee can also be used. The top area, where the ramparts are to be, should have an extension of the cylindrical area with either a bevel or a small bead on the outermost edge. The wood that extends past this is to insure that the rampart will not chip out as you drill it, just as the wood underneath the ramparts protects the back side of the ramparts as it is drilled. If you find either a rampart or corbel design that you like, by all means try it out!

What actually creates the ramparts is the drill press. Use a bit that when

* ***Rampart***
The top edge of a building, such as on a castle, that looks as though every other block was left out. This was a defense mechanism. The taller portions allowed cover for archers to reload without much fear of being struck by an enemy's fire. The lower sections permitted defenders to throw or roll rocks down upon their enemy's heads, as well as the classic boiling oil, animals or the contents of thier privy — an early form of biological warfare.

** ***Corbel***
The grand gallery of the Great Pyramid is one of the earliest examples of a corbel. Essentially, the simplest form of corbel is when the ceiling is brought inward, each brick or block is set inward a bit so that eventually, the ceiling will be closed. Other uses for the corbel include anywhere that the stonework is jutted outward, such as for a window or a plinth so that the extra width of hte ledge created acts as a support for a staue, or in the case of a castle, corbels were extesively used on towers so that the wall of the tower's top steps outward, affording a greater range for thrown or shot weaponry. Much of the corbels seen are split so that oil or rocks could be used to defeat an attacking enemy. The other reason for stepping the tower outward was the fact that many of these round twowers were simply a circular staircase. It was required to corbel the wall to make space for a room, or the area for men to fight from above at the top of the tower.



Hylton Castle, *Sunderland, England* you drill the array of holes, you will end up with about the same amount of wood remaining, to the amount that you removed. In relation to the top of the rampart, use just over half of the drill bit. If you are using brad pointed bits (recommended), the brad should be pointing just below the edge of the merlon that will be the top of the rampart. Decide on how many spaces you can drill and commit to drilling the set. Remember, it is better to have too few spaces and more wall than too many spaces and no where for the occupants to hide. Set the depth stop on your drill press so that your drill bit's cutting flutes cut just deeper than the thickness of the ramparts so that when you excavate behind the ramparts, the hole will not continue to have a bottom. Drill, Step and Repeat until all of the rampart spaces have been drilled. It is possible to come back with a palm chisel and square the bottom corners of the ramparts, but I find that this is tedious work that rarely turns out as uniformly as you hope it will. The rounded spaces all look very professional and no one has complained about the authenticity of it thus far.

The corbels can be cut in one of two ways. You can repeat the same procedure as with the ramparts, but if your corbels run deeper than the diameter of the drill bit, you will have to align the bit for a series of holes that go straight down the walls. This means that either you will have to overlap the holes down the length, so that they become a series of slots, or you can break out the palm chisel and cut away the leftover webbing from between the holes. By far the easiest and neatest means of cutting the slots between the corbels is to use the fluting jig. This is done by first mounting the jig (or steel plate) to the bed of the lathe, then setting the fence to run parallel to the wall from which the corbels appear to spring. Pick a bit that will allow enough wood to be left between the cuts to leave a reasonable looking set of corbels, without spoiling the coves and beads you turned.

Straight bits work the best to separate the corbels. Set the depth so that when you reach the bottom, the base of the slot you cut brings the surface down to the level of the tower's wall below. A flat bottomed bit is best to use, so that the wall appears to continue up between the corbels that you left, that way it looks as though the corbels were built up from the wall, as they are in reality. Practice on a test piece before you try it on one that will be completed. There is a certain amount of instinct that you will develop so that they look real, even from a short distance. Once you have the jig set up and the stops set (and tightened), it is just a matter of step, cut, repeat. This is the sort of thing that will make you glad that you set up the plastic cards on the front of the sled so that you can sneak up on the depth you need. Remember that it is always better to cut too shallow than too deep. If the wall appears to step outwards just a bit, so be it. That beats cutting too deep into the cup's bowl and finishing with a very pretty colander.

Excavation

To make your ramparts appear more real, hollow the area behind them. This gives a very three-dimensional look, casting a shadow upon the tower wall, behind it. This must be done in the proper order. If you have done much wood working, you will know that the neatest holes are made when you back up the board that is being drilled. Otherwise you will find that the bit will split out the wood on the back side as it emerges from the wood. The easiest way to deal with this issue is to leave the area

Yarn Ball Cage *is a classic project that will benefit from an index on your lathe. Note that the spindles are of only two sorts — the bead in the middle and the bead toward one end. By mounting them in this way, the cage is given "movement", or causes the viewer's eye to move up and down the cage, following the seeming movement of the bead.*

* ***Torus***
A torus is a doughnut shape. A common example would be the doughnut shaped toy made for cats, containing a ball that the cat can chase around the toy. Usually made with cardboard disc in the center to act as a scratching pad.

Masterful Woodturning: Projects & Inspiration *for the Skilled Turner (October, 2000 by S. Gary Roberts)* solid until all of the holes or partial holes are drilled, then unlock the lathe's spindle and carefully turn the back and extended tops away from the rampart spaces you just drilled. Pre cut the top edges of the rampart with a skew for the neatest results.

In actual castles, there must be an area for the fighters to stand while defending the keep, I always cut it so that there is a walkway immediately behind the ramparts. This gives a nice, authentic appearance, and occasionally you will find that cutting this with a small skew will give the walkway chatter marks — which when done neatly, can add a nice, unexpected design feature that the owner of the piece will enjoy. If you feel really froggy for detail, you can leave a band around the bottom of the tower's wall, behind the ramparts. With very little work, you can cut a door and frame from this band, carving the extra wood of the band away to match the level of the wall. The same could be done for window frames if you feel the need for that amount of authenticity and/or ornamentation. If there is enough wood and space, you can cut the walkway deep enough to intersect with the corbel's spaces. This too is a period feature of the castle, called a murder hole. Through these spaces were thrown rocks and poured hot oil, water or sand. The merlons below helped to spread the wealth.

Adding steps, say in a spiral around the work, is done using the same technique as drilling holes for a helix, but the spacing is far tighter, and the drill a much larger diameter. The steps need to be drilled, using the index for proper spacing. The most useful drill bit is a brad pointed bit that has had the brad ground away. This gives you a flat bottomed hole of the diameter you need, but without the brad point, the bit may wander a bit, so be cautious. A bit of work with the chisel is inevitable to flatten the steps and create the corner between the step and the riser, but the drilling will speed up the process considerably. For best effect, carve the area above the steps as though it were roughly hewn stone — it gives more texture, authenticity and dimension to the piece.

Merlons

Another architectural feature found on castles are ledges that jut out from the wall, which are prominently there as a design feature, of angled brick and stone work. The angled brick/stone work is utilized for a pair of reasons: it makes for a smoother transition to a smaller diameter area of a tower or wall, but with a purpose. These are normally positioned under the corbels that were used for murder holes, or places from which to use gravity to deliver items onto the heads of one's enemies. These angled areas of brick or stonework (or merlons) were strategically positioned so that any item thrown down from the murder holes would impact the angled stonework, causing the projectile to break apart and change the angle of trajectory for a scattering effect. In other words, a stone, or even a jar of oil thrown down quickly becomes shrapnel to the people below. Angled brick or stone work also makes it far more difficult to scale a wall via rope or ladder, especially with everything from oil and sewage to rocks and arrows raining down upon your head. Everything about a castle is designed with the goal of being a murder trap for aggressors while keeping the residents safe within. These architectural details enabled the defenders to do as much harm to the attackers as possible. Catapults and trebuchet* were used not only by the attackers, but the defenders as well. They were quite effective at throwing not only rocks, but dead animals and sewage as well in an early form of biological warfare. Kind of takes some of the romance out of the Middle Ages...

Arrow Slits

Seen primarily in the outer walls of castles, arrow slits are thin, vertical and horizontal spaces in the wall that allow an archer just enough space to fire an arrow

*[*]**Catapults & Trebuchet** (treb-oo-shay) Two large siege engines that worked via a long pole and either twisted rope or large buckets of stones to act as a counterweight to launch large stones, flaming bombardments or even dead animals for biological warfare. The difference between the catapult and trebuchet is thus: a catapult has a basket or large cup at the end of the pole. It is wound to the launch position, then released. The weight or tension of the wound ropes cause the pole to spring forward. A cross brace brings the pole to an abrupt stop, where centrifugal force carries the load out of the basket, toward the enemy. The trebuchet, on the other hand, has a sling mounted by a hook on the end of the pole and a tray underneath. When the trebuchet is wound, the sling is laid upon the tray and loaded. The tray can then be slid around to aim the weapon. When released, the armature will spring forward, via a counterweight on the short end of the pole. This drags the sling and load backwards along the tray, then slings it toward the enemy, whereupon one end of the sling comes off of the hook and releases the payload. The trebuchet is a marked advancement, increasing the range and power of the payload as it allows better aim as well.*

upon an attacker who is besieging the castle. Like windows and doors, arrow slits are often framed with a harder stone than that which makes up the field in the walls to prevent an attacker from damaging an open area of the wall, the most vulnerable areas in the entire structure.

Arrow slits are ordinarily too small in proportion to the item you are turning to be rendered properly to scale. If you plan to do arrow slits, it is best to use both the drill and the fluting jig. Use the drill press to drill the rounded ends on the arrow slits, then cut the slits with a pointed bit using the fluting jig. A thin cutting disc (ala Dremel) is also appropriately sized to render most arrow slits.

One thing that is nearly universally misunderstood is the shape of the arrow slit. When drawn, most people will make the arrow slit in the shape of a cross, with the round hole at the end of the arms of the cross. This *is* how they were originally built, but it was soon changed so that the arms of the cross were not even on either side of the vertical. The reason for this is the fact that if you have a hole in the wall in a standard cross shape, this makes it very easy for an archer on the ground to hit the opening in the middle. If, on the other hand, you place the arms of the cross offset from one another, it throws off the archer's perspective and makes it a far more difficult target to hit. A nod to this detail will set your work above your competition to anyone who has studied either architecture or the Middle Ages.

Brickwork

Adding brickwork to a tower can be done using the Dremel tool horizontally in the drill press and doing a very tight series of spiral cuts set as either a true spiral or a classical brick pattern.

The easiest means of accomplishing brickwork, though, is by using the rose engine lathe. This offers the possibility of doing a course of bricks at a time, with the ability of spiraling or a standard brick pattern quickly and easily. The key to this is choosing the appropriate rosette and cutter that will give you a series of cuts that will resemble brickwork to give the impression of bricks. To stagger the brickwork is to phase the rosette. After one course of bricks is cut, phase the next series of cuts by resetting the locator pin in the rosette to be one or more holes off to one side of the previous course of 'block'. To offset them by half and back again is the means of getting a standard brick pattern of each brick overlapping the previous and next course by half. More or less than that will create a spiral to the left or right. Regardless of the effect you are pursuing, just be sure to continuing the offset by the same amount each time for continuity — otherwise it will appear as though your bricklayer was drunk. With practice, you can even reverse the direction of a spiral, like they did during the Gothic and Victorian eras — just be sure that you do so in a way that makes it look like the effect you were after. Try new patterns and layouts on a scrap piece to work out the bugs before doing it to the actual project.

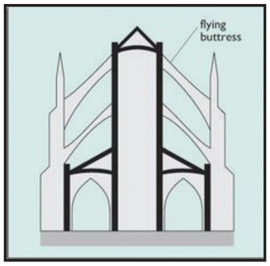
Flying Buttress*

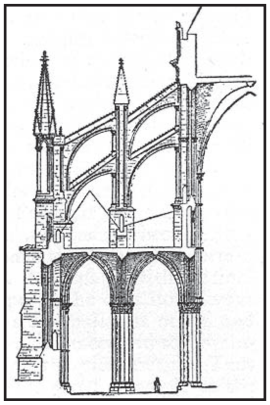
While writing this section on architectural details, the idea of adding flying buttresses and how one might manage to do so just occurred to me.

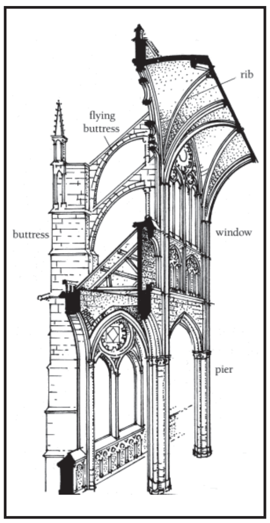
The technique for this goes back to the time when Noah's Arc was a popular toy. Prior to mass production, turners had their own means of creating large numbers of identical animals. Because carving two of each animal would have been too time consuming, the turner would turn a torus with the cross section being the profile of the animal. After the torus was complete, all that was needed was to cut slices of the torus to get the pairs of identical animals. With a torus of each animal, once the Arc had been completed, all that needed to be done was to cut two slices of each torus. Carving and painting, as always, was optional, the slices acting as the blank canvas to either carve or paint.

For flying buttresses, all one needs to do

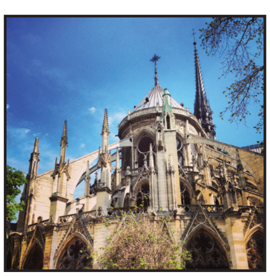
* ***Flying Buttress***
This is what made the Gothic cathedral possible. Until it's invention, large buildings needed to have thick walls to support the weight of what was above. Gothic construction used piers between the sections of wall to support the weight above it. The pointed arch directed the weight down to the piers, then to the ground. Because this was so successful, the walls between the piers started having larger holes left in them for stained glass. These walls became so thin that the tall roof started having difficulty finding proper support. Enter the flying buttress. Basically a half arch, the buttress was given a heavy pier to act as an anchor, then the half pointed arch flew up to meet the wall at the peak, where the keystone should be. The walls have basically been turned 90^o to the building to open up the possibilities of windows seemingly floating in air, allowing the colored light to flood into the structure as never before possible.







Top: *shows flying buttresses in relation to the base structure, which is bold.*
Middle: *A complex form of flying buttress. Above is a cutaway view, showing how the buttress is positioned in relation to the inner structure.*
Bottom: *Notre Dame Cathedral, Paris. The most recognizable flying buttresses in the world.*



is to turn a torus of the buttress, making sure that the inside is first turned to the diameter of the vessel where the buttress is to be added. Make certain that the base of the buttress is the size needed to fit onto the finished piece. Once turned and finished, cut as many buttresses as are needed, sand and finish. Use appropriate sized dowels to attach the buttresses, or fit them into a series of slots cut with the fluting jig. The addition of flying buttresses will give your turning the “wow factor” that makes other turners scratch their heads, wondering just how you managed to turn that. The idea for this came from *Masterful Wood turning: Projects & Inspiration for the Skilled Turner*, where the writer shows how to fit beautiful, fancy handles onto vessels that he has turned.

Other Decorative Features

Ruffled Collars

One of the items that is seen repeatedly in Holtz are cups and tazzas with what appears to be a ruffled collar. Simply a matter of decoration, a ruffled collar will lend an air of delicacy and sophistication that few other embellishments will. By far, the easiest way to make a ruffled collar is to make it separately from the cup — in fact, even though it looks like the most delicate part of the cup, it is actually the part that joins and holds all other parts together, depending upon how you choose to make it. Holtz illustrates making the collar as basically a fancy washer. I prefer something that will stay in place a bit better than that, for age equals wear. A washer, no matter how well fitted it is, will tend to move about with time. My experiences with wood have taught me that an item with thin edges, especially when cut with short grain, will wear against other wooden parts. Back when Holtz was creating, ivory was the preferred media for this type of work. Whereas ivory will wear well, wood, no matter what type, may eventually chip in this type of situation. Seeing as how ivory is now off of the menu, due to poachers and the scarcity of elephants, we will simply focus on what works with wood.

I turn the cup itself first. This way, I have the dimensions I need to make the ruff and the base so that they are in proportion to each other. I like to put a 1/2” mortise in the bottom of the cup to receive the dowel that will be left on the ruff. I also like to turn the ruff from a different type of wood. This gives an opportunity to highlight the ruff with some interesting grain and/or color.

The ruff I will turn oversized so that I can determine the diameter later. I make the ruff blank about 2” thick so that I will have enough stock to remove to create the profile that I want. Ideally, you want to turn the upper side of the ruff as a negative profile of the underside of the cup’s bowl. It should fit as though the weight of the cup is causing the ruff’s blank to sag at it’s center. Determine the angle that will give you the look you desire and turn the underside of the ruff. I find it most helpful to simply turn a 1/2” dowel on either end of the ruff — for one thing, it makes the ruff so that you can chuck it in either direction in a Jacob’s or a four jawed chuck. With this reversibillity you have more freedom when using the fluting jig. This is when you will be happy that you spent the time creating the improved table and fence for the fluting jig. When preparing to rout the ribs in the ruff blank, be sure to use the index to pre mark where each cut will be, on both sides. This will help you to visualize how the ruff will be once it is cut with it’s ornamentation. The profile of the ruff, when viewed from the edge, will be a zig zag. This means that you will have to route one side with a V shaped bit, then reverse it and cut the other side so that the point of the V ends up between the Vs. on the previous side. Setting your depth on the router is very important — if you do not, you may end up with either a very thick ruff, or one that is so thin that it will not support being handled. Always set the fence so that the ruff is thinner at the outer edge, for this creates the illusion that the ruff is thinner than it really is. This method of tapering is known as forced perspective. I recently saw a hand carved basket in the *Bishop's Palace* in *Galveston*. This "wicker basket" was nearly 3' in height and carved from solid wood, complete with a handle and a ribbon tied around the handle. This vessel was intended for visitors to place their calling card so that they might be announced. The ribbon on this basket, from a very short distance, looked as though it were paper thin — that were you to touch it, it would bend under the pressure. In reality, this ribbon was a minimum of 1/4" thick, with the exception of the very edges, where it tapered down to a dull edge. This is the illusion that you will want to create for the ruff on your cup. Make it appear as though it is a lace ruffle like those worn in the days of Shakespeare. This makes the cup look as though it is exceedingly fragile, yet it is that very portion of the cup that holds the rest together. To make it look more like lace, you can always drill holes in a pattern before routing both sides. Leaving the extra wood will protect it from chip out during the drilling process, and cutting slowly, a thin depth at a time could produce some nice looking faux lace. Remember that the holes will elongate as you cut the angles into the ruff, making the design look even more complex.

The ruff can also be cut using the rose engine and a number of rosettes. Of course, just like cutting it with the fluting jig, you must make sure that the sides are 1/2 cut out of phase so that the points cut will create the zig zag profile along the edge.

Of course, turn the stem and base of the cup to suit the style for which you are shooting, drilling a half inch hole in the top of the stem/base to receive the lower dowel of the ruff. I find that the lathe itself is the best place to glue up items that have been turned. The lathe provides even clamping pressure, and you can always turn on the lathe to make sure that everything is properly centered.

One bit of advise for cutting the ruff — be careful that you cut with the grain. If you are cutting the upper side, that which is concave, and your grain goes in the direction of the lathe's axis, then you will want to cut from the center out. If cutting the underside, which is convex, then you will want to cut from the edge, inward. This will save you a great deal of irritation due to torn grain. The freshly routed area should be done in shallow enough increments that there should be no need for sanding. Apply finish to all parts except the dowels and their respective holes. Once the finish is dry, dry fit the pieces together. When all looks as it should, glue the parts together, using the lathe as the clamp.

Other Effects, sans Machinery

An interesting effect that will leave most turners scratching their heads is the placement of raised warts on an otherwise smoothly turned surface. I was once asked if I could place raised warts on the surface of a wand. After a bit of research, the answer was yes, I can not only place warts onto the surface, I can create a double helix of warts that taper down in size as they go down the length of the surface!

To accomplish this seemingly impossible task, I turned a wand to spec, leaving a bit more surface than required. I gridded off the wand as described earlier, and made use of my index to ensure the proper placement of each wart. Locking the spindle in place, I gave the wand support via the V block, then used a metal punch on the wand in the intersections of the grid that I had drawn. Starting with the largest punch on the base of the wand, I began punching the round divots to form a double helix that spiraled down the length of the wand, tapering down in size toward the tip. This leaves a series of circular spots of compressed wood fibres in the wand. Sand the wand down. Once the wand is smooth to the touch, remove it from the lathe and expose it to the steam rising from a pot of boiling water, or place it into a steam chamber, if you have one.

* **(PEG)** *Polyethylene Glycol Green Wood Stabilizer - Available online from Rockler.com*

The steam causes the crushed fibers of the wood to expand, giving rise to a series of cylinders standing proud of the wand's surface. Round them over with sandpaper as you sand down the raised grain of the background, then apply the finish!

Acrylic Infusion

I have recently been made aware of the advantages of infusing wood with acrylic, or what is commonly known among turners as Cactus Juice. Infusing wood with a stabilizing agent is nothing new. When reading the early Bulletins from the Ornamental Turners of Britain, I found articles on using P.E.G.*. This is a water-based product that was used via a vacuum to draw the liquid up into the grain of the wood, making it so that no water vapor could penetrate the wood, causing it to change shape. At no time during these articles did it say whether or not PEG was food safe. According to Rockler, it is used on green wood to prevent cracking and checking. Food safety is not touched upon.

Cactus Juice is a brand name for an acrylic resin that is drawn into wood via submersion in a vacuum. The vacuum draws the air out of the pre-dried wood, the wood, being a collection of microscopic straws, draws the acrylic up through the wood, replacing any air with acrylic, which hardens, making the wood consistently hard throughout. The advantages to the OT community is that it can make virtually any wood hard enough to tolerate ornamental turning processes. Making the wood nearly as dense as African blackwood, virtually any wood is ideally suited for ornamentation.

Below: *The completed Cherry Chalice with finial and flying buttresses turned from rock maple.*

Cherry Chalice

This project involves creating a large goblet or chalice. Unlike most of the "goblets" you see on the internet (that are barely larger than an egg cup), the cups that I make are intended to be used to drink a normal amount of liquid — usually 12 ounces or more. As a result of making them functional, they take a bit more material and time to produce, and are a bit more fraught with potential issues.

First I glued up enough cherry to create a blank large enough for the cup and a lid, using Tightbond III, waterproof wood glue. The blank is glued up, using a set of pipe clamps. To insure stability of the blank, the end grain must be staggered so the forces in the wood are neutralized.

After mounting the blank on the lathe and turning it to round, I cut a dovetail on the headstock end to enable me to mount it in the four jawed chuck. Once centered in the chuck, I parted off 2" from the tail stock end. This end will be the blank that I use to make the lid for the cup. This blank can also be used to center the blank up in the chuck, by matching up both the grain and glue lines.

Hollowing Choices

One thing that I have found to be helpful when hollowing is to use a steady rest. Unlike using it to turn bowls, I set up the steady on the turner's side of the lathe. When you hollow out a vessel, you are working on the side toward the turner, which applies all of the force and leverage onto that side of the form. Since I have started using the steady on the "wrong side" of the lathe, I have had much better success, for the steady is better at absorbing the forces applied. Admittedly, the steady is more in the way (according to my left elbow), but its usefulness more than makes up for it.

The act of hollowing a bowl, or especially a cup, is the most time consuming, harrowing and dangerous part of any turning project. This is why it is first on my agenda — if hollowing goes awry, I do not want to loose any of the ornamental work.

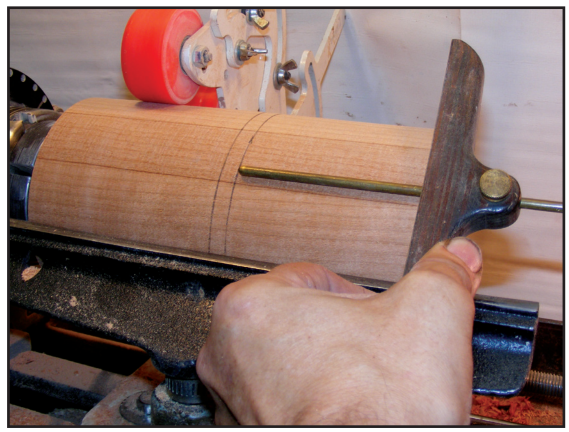
Over the years I have tried many methods of hollowing — some worked well, others, not so much. The standard method of holding the blank with the four jawed chuck and hollowing the unsupported tail stock end takes an inordinate amount of time for a large cup — up to three hours of hollowing and shaping before sanding can begin! This is a method which makes it all too easy to potentially get a catch, knocking the blank off center, or possibly off the lathe completely. This is extremely dangerous. The vast majority of lathe accidents occur when the turner is hollowing a vessel, and if it leaves the lathe, he or she can be seriously injured or killed. One gentleman of whom I read, was turning hard maple croquet balls, when he woke up on the floor with a headache. It seems that he got a catch that dislodged the ball from the lathe, which then proceeded to bounce off the bench, the wall and the ceiling, then hit him on the head, knocking him cold. Proper preparation can prevent years of recovery.

Alternate Method One

A safer and more stable means of hollowing is to leave the tail stock attached until the cup is almost fully excavated. After retracting the tail stock, the remaining cone-shaped center is eliminated by using an appropriately sized fostner bit set into a Jacob's chuck and drilling via the tail stock. Should you use this method, it is important to remember to widen the channel you are cutting to be 1.5 - 2 times the width of the parting tool, all the way down to near center. A jam, especially when at depth, can cause the lathe to completely stop, bending the parting tool in the process (don't ask me how I know this). Also, be sure to keep a firm grip on the tool — a sudden catch *can* cause the parting tool to lever up, with the rest acting as a fulcrum, and the handle can hit you in the jaw, should you be watching from too close of a vantage point.

Alternate Method Two

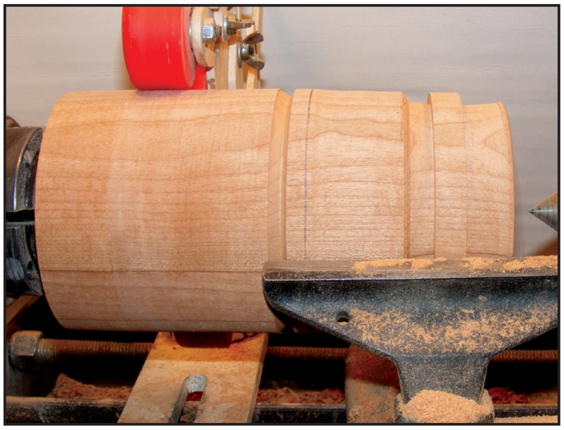
An even quicker, easier and safer means of hollowing is to purchase a large Fostner bit and drill out the center. This avoids the possibility of levering the blank out of the four jawed chuck due to a catch, for all of the pressure from cutting is helping to push the blank squarely into the chuck, rather than trying to lever it out. Should a catch

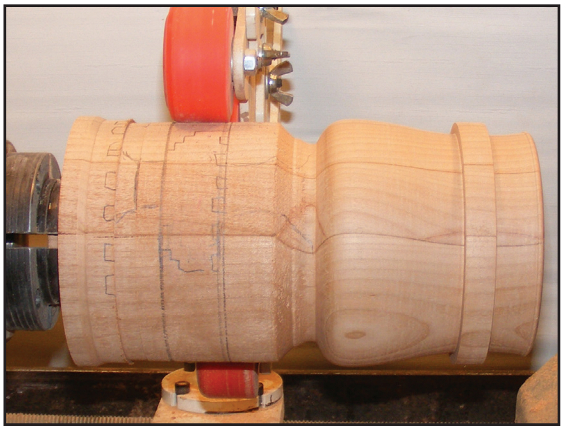


Above: *Watch for smoke, indicating that the bit is getting too hot! Upon seeing the smoke, I spread out the shavings and used the lid blank to snuff out the burning embers. Note: A fire extinguisher* ***is*** *at hand nearby.*

Middle: *Time to use a skew and bowl scraper to round out the corner at the bottom and smooth the interior.*

Bottom: *Using a shop made depth gage to mark the actual depth of the cup's interior, then using that mark to establish the closest I can cut to the bottom of the bowl.*





Top[: *Angled cut on the left is a marker of the limit to how close I can get to the bottom of the bowl's interior.*

Middle: *For the sake of clarity, I have drawn in the various details in their future locations.*

Bottom: *I have moved the steady to the bead on the bowl. This will offer better support than it did toward the headstock, and gets it out of the way so that I could turn the stem. The tower (stem) has been cut to the outermost diameter of the ramparts and corbels. Extra wood has been left as a backup for the drill bit. The raised area will, create a captured ring. If my attempt at turning and installing the flying buttresses is successful, the ring will be caged by the flying buttresses.*

occur, it will simply stop the lathe (assuming that your lathe is belt driven), requiring you to back off the tail stock. Depending upon the size of the bit, you can hog out the vast majority of the waste material in a fraction of the time it takes using conventional hollowing techniques. I used a 4" fostner bit to remove the waste on this cup, taking about 20 minutes to hollow the blank (including two five-minute breaks to allow the bit to cool). Using conventional means would have taken well over 2 hours. This method does generate a copious amount of heat, so you must proceed slowly to prevent jams, overheating of the bit or combustion of the shavings. Care must be taken to make sure that you do not generate enough heat to start a fire, for the shavings may start to smoulder (see page 31, top picture). Diligence and a fire extinguisher are a necessary precaution. Because I was vigilant, I saw a wee bit of smoke coming up from the drill press' ways. I was able to put it out using the blank for the cup's lid to smother the embers before any real trouble started.

After hollowing a few cups with this bit, I started making marks on the shaft of the bit, the depth that created cup hollows that were 12, 24 and 36 ounces. One word of warning: If you intend to drink carbonated drinks from the cup, you may want to go with a smaller diameter bit, and drill a bit deeper. It seems that the larger the surface area that is open to the air, the quicker the drink will go flat. The 4" bit is great for tea and other non-carbonated beverages. For soda, go with a diameter of 3" or less.

Once the sanding is completed, I always go ahead and apply finish to the inside of the cup's bowl — it keeps the inside from acquiring moisture that would raise the grain and helps to protect it from minor damage. For items such as this that will actually serve food or drink, I use a tung oil based, food safe finish. ***Salad Bowl Finish*** from ***General Finishes*** has proven itself to be an excellent product. It is easy to apply on the lathe, dries quickly and can be applied while the lathe is running. It gives a nice, glossy sheen and helps to waterproof the piece at the same time. Two or three coats will do the job, but I prefer to build up a slightly thicker coat. Many of my cups are used in camping situations that have a less than ideal environment for woodenware. I have found that this finish, when built up, will give the cup a nice barrier to minor damage. Should worse damage occur, the finish can quickly be removed with 220 grit sandpaper, then smoothed back, to 600 grit. Do not sand above 600 with this finish. When I sanded to 1,200, I found that, even after more than 24 hours, the first coat may dissolve enough with the second coat that it will start to pull loose from the wood. This is a mess that should be avoided, for it involves stripping off the entire finish, re-sanding and beginning the finishing again, because the surface did not have enough "tooth" to hold the finish.

Notes About Sanding

Sanding is a necessary evil. Grain has a nasty tendency to wander, and as a result, not cooperate. This results in torn grain, especially when hollowing a vessel. Using a skew and various scrapers will help to a ceratin degree, but I have yet to turn the inside of anything without the need to sand.

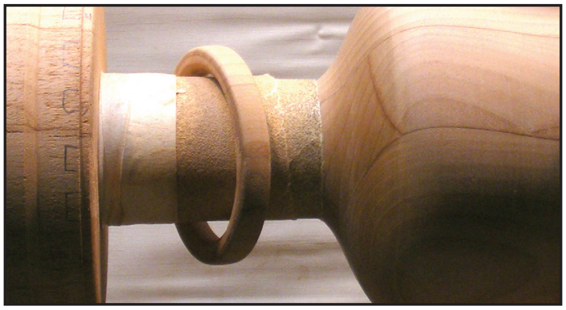
That being said, I have to also say that sanding can be detrimental, not only to your health (wear a mask), but to your turning's details as well. For most exterior sanding, I will begin with 220 grit, and work my way up to 600. Anything under 200 is what I refer to as sculpting paper, because it removes wood so quickly that it can easily reshape a section of that which is being sanded. Detail can quickly be rounded over, then lost.

To avoid these issues, sand your work in sections, and with great care. Long sweeping curves should be sanded as one section. If creating steps for corbels, each surface of each step should be it's own section. Do not hesitate to wrap the sandpaper around a dowel or back it with an appropriately sized block to establish good contact with the section upon which you are working (paint sticks work well). If you fold the paper and put the corner of the sanding block into the fold, you can sand two surfaces at once — but do it very carefully.

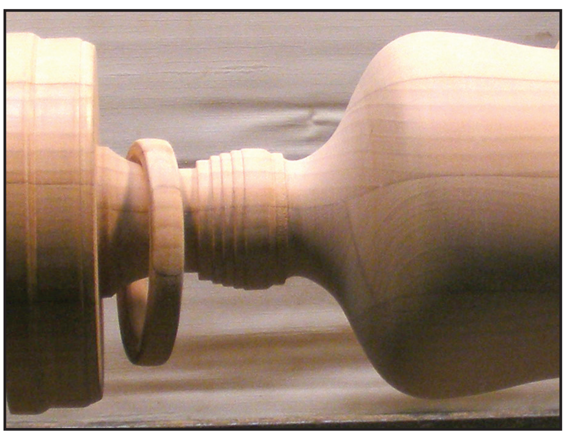
Sanding the inside of a vessel is an entirely different kettle of fish. Most of the cups that I turn have an opening large enough to get at least two or three fingers into with the sandpaper. It takes good judgement, though, to know when you have enough space for an appendage to safely sand the interior. Too little space and you are looking at the potential of breaking or losing that appendage. It is all too easy to have the lathe suddenly grab and twist. My wife, being an X-Ray Technologist, has horror stories about those who did not take appropriate precautions. She tells me that the twisted fracture is the worst sort, and takes the longest to heal, if it can heal. Please do not become a statistic.

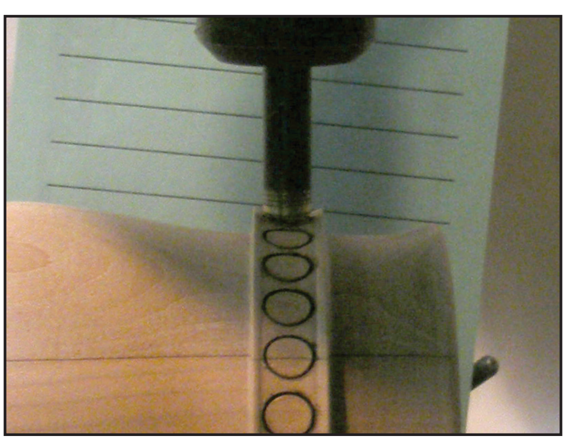
Aids to sanding are an essential. Several years ago I was making a wooden case for my pipe. The pipe being a "churchwarden", it required a case that was about 12' long and 2" in diameter. I had excavated the interior via different sizes of Fostner bits, but needed a way to smooth it afterwards. I had tried long fingered hemostats, but with only limited success. I was contemplating the situation when my eyes came to rest on a miniature wooden flagpole that was about 16" long with a ball and bead finial on the top. I realized that I had a ready-made sanding tool sitting before me. I wrapped the sandpaper over the ball and secured it to the dowel with rubber bands behind the ball to keep the bands from touching the spinning wood. This worked so well that when I was later turning a bowl, I drilled out a golf ball and glued it on the unused end to serve larger diameter needs. For this goblet, I have removed the smaller bead and simply wrapped the sandpaper around the dowel. The finial section worked well for the rounded corner that joins the wall to the base of the cup's bowl. The only improvement I have made to this tool is to replace the rubber bands with the latex strip that hospitals use as a tourniquet to take blood. It easily holds the sandpaper in place, and the extra can be wrapped around the dowel, and the end held by the hand that holds the stick. With this sort of sanding tool, I can easily reach to the bottom of anything I have so far turned, and the length of dowel allows me to apply leverage when needed. The two balls offer the two most usable diameter to reach into most rounded corners.

One more thing about sandpaper: It is relatively inexpensive, so once you have worn it out, throw it away! I too have fallen into the trap of trying to get as much mileage out of these sheets that cost about $1 each, but to do so is to waste your time with fruitless sanding. Also, be sure to use a tack cloth between grits to remove loose grit. A different tack cloth for each grit



***Above:** Once the ring has been parted off, it will be necessary to true up and sand the inside of the ring. By wrapping sandpaper around the stem of the cup, then fastening it to the stem with masking tape (both wrapped so that the lathe would tighten them), I can hold the ring as the lathe turns, sculpting it to shape. Run through the grits as you would anywhere else on the cup.*
***Below:** The ring in it's sanded state.*
***Bottom:** Checking center positioning of tube to the bead.*





is recommended. Simply write the grit number on the package from which the cloth came.

Turning the Exterior

The next item on the agenda is to turn the outside of the cup. I was wanting to demonstrate more of the various techniques to add to your repertoire. Again, this project is for demonstration purposes — you may not wish to use all of these techniques on a single project, for fear of overdoing it. This particular piece is destined for an art show, so a bit over the top might help catch the eye of the judges.

Shaping the Bowl

To effectively shape the bowl's exterior, you must be able to visualize the interior of the cup. You *can* mimic the interior's shape for the exterior. This is how the vast majority of cups in nearly every medium are made. The advantage of working with wood is that turning is a subtractive process, and you have extra material — this enables you to take liberty with the shape that ceramicists and glass blowers wish that they had. The glass artist is restrained, because the thicker the glass, the more it weighs, and the longer and more risky the cool down time. For the ceramic artist, the medium offers little choice. A thicker section of clay is far more likely to hold moisture. Water, when heated in the kiln, turns to steam, making the piece into a miniature bomb (a fact for which others who are firing items simultaneously will not thank you). Wood allows you to keep the piece up to 3/8” thick without much weight gain in the finished piece, or you can take it down to 1/32” if you are clever enough to turn your piece that thin. Of course, if you intend to go that thin, be aware that open-pored woods, when turned thin, may leak. Thus another reason to keep with the tighter grained woods. As a result of the media, you can have the interior of one shape and the exterior another. Be creative. I have turned vessels that have an exterior that mimics the inside, but has a raised bead that seems to constrain the bowl, like on this one. A bead such as this is excellent for adding decorative touches such as barleycorn, overlapping coins or even pyrographic wording to make it into a prize cup (see facing page).

For this type of band, the first thing you want to do is to establish, on the outside of the cup, the actual depth of the bowl's interior. A depth gage makes this quick and easy (see page 31). Once you have the actual bottom marked, make a secondary mark 1/4” - 1/2” down from the first mark. This is the mark to which you turn, making sure that enough space is left so that you will not suddenly end up with a fancy funnel or sieve. I tend to make a notch at this point so that the mark will not vanish until I begin shaping the bottom of the bowl.

When making a cup, I prefer to work from the tail stock toward the headstock. The main reason is that the blank acts as a revolving lever. The longer the blank, the more leverage you have to potentially work against you, possibly displacing the blank from the chuck. The length of the tool only adds to the problem — it acts as a lever as well, compounded by leaning against the tool as you cut. With your weight and two levers potentially working against you, it is best to keep your ballast at the headstock, making it less likely to be knocked off center and ruining the work piece.

Cut down the stem of the cup until you have reached the outermost diameter of the tower's ramparts and corbels. In this case, I have chosen to add a captured ring, so I left an oversized bead around the tower's top (page 32). This assures that the ring will easily travel along the entire length of the tower/stem. Once all of the stem is down to the size of the tower's embellishments, I began to excavate under the ring, using a miniature skew and straight, mini hollowing tool. I have found that the hook-styled ring-making tools work well, so long as you have plenty of extra wood and the stock is of very hard, heavy wood, for these tools are very aggressive. This cherry is about the softest wood I would ever want to do ornamental work upon, for fear of chipping and tearing. As a result, I took the more cautious approach to parting off the ring in a more gentle manner, using the miniature skew and the mini curved hollowing tool. This is the best time to sand and finish the ring — before you part it off. Once it has been freed from the stem, I wrapped 100 grit sandpaper around the tower blank so that the movement of the lathe would help to tighten the wrap, then added masking tape, half on the sandpaper, half on the stem, in the same direction as the paper. Working the ring onto the sandpaper over the narrower area above the ramparts, I held the ring stationary as I turned the lathe back on and moved the ring against the sandpaper to true up the ring's interior, and to bring it to an acceptable finish. Set up each grit in the same way to get a great finish. Once the sanding is complete, move the ring to the side and carefully remove the tape and sandpaper. Tape the ring to the underside of the bowl so that the stem can be turned to the tower profile. Also turn the base to profile so that the crenelations can be drilled. Sand everything to the highest grit before you start on the ornamental cuts.

It is now time to start the decorative work. Again, I prefer to work from the tail stock toward the headstock, partially to keep from having to move the drill press any more than I need. I start by checking different diameter brass tubing to see which will fit within the raised rims of the cuff band on the bowl of the cup. I chucked the tubing into the drill press and sharpened the end of the tube as described earlier in this text. Unfortunately, I had turned the rimmed bead too narrow to use a larger diameter tube, so a barleycorn pattern is out of the question — I need twice the number of holes that I have to get the circles to link. This constitutes an unscheduled design change. Rather than barleycorn, it will have to be a set of circles. With the drill press off, I make final adjustments to the placement of the tube in relation to the bead's raised edges. I have found that using a piece of paper as a backdrop makes it far easier to see the comparative space between the tube and the raised rims of the bead. When the best spot was found, I locked the crank handle with a Jorgenson clamp, set the index to position #1, then drilled the first circle into the bead. I set the index into the next hole, sharpened the tube, then cut the circle. Step to the next notch, drill. Sharpen, step, drill. Do, Step & Repeat.

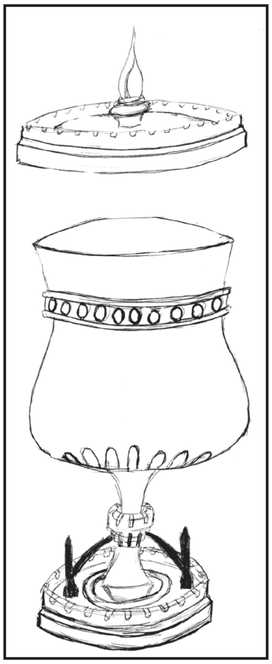
Once all of the circles were finished, I moved the drill press down to the ramparts on the stem's tower. I replaced the tube with the proper sized brad-pointed bit, set the index to #1, then started stepping 4 notches, then drilling the ramparts.

When the ramparts on the tower had been finished, I moved the drill press down so that I could drill the ramparts on the surrounding wall on the base. One of the

Above: *A Jorgensen clamp works well to lock the spindle, keeping the crank in place.*

Above: *A similar cup, made to be the prize cup for the annual* ***Arts & Sciences Prize*** *for the* ***Barony of Eldern Hills****. Barleycorn was used as filler around the pyrographic wording.*

***Below:** Original rough drawing of a lidded chalice with flying buttresses. This is the first project for which I am making flying buttresses. In reality, there will be eight buttresses, which will form a gothic styled cage. For clarity, the drawing only shows two of the eight flying buttresses planned.*



questions I am often asked is “Aren’t you worried about damaging the ramparts?” In reality, I have endured more damage than I have ever imposed upon the ramparts. They are very much like an exposed wooden gear, revolving between 500 and 1000 rpm. This will skin knuckles, catch sandpaper edges and break off fingernails faster than anything else. Be cautious.

After drilling all of the ramparts, I moved the drill press out of the way so that I could start turning the ramparts to height and excavating behind them, determining their thickness. This was why I left so much wood around the ramparts — so they would be less likely to chip out or allow the bit to wander. I begin by trimming the top of the outer wall down to the top of the merlons. This is done very slowly and with great care, using the freshly sharpened mini skew — you are turning half air, and to move too quickly would certainly mean chipping out the ramparts. No more than about 1/16” is removed at a time to keep from tearing the grain. Once I have turned everything above the merlons away, I reposition the tool rest 90º, and began excavating behind the walls with the mini skew. I took the level down to the base of the outer wall, a good 1/2” - 3/4”. I excavated the entire courtyard, finishing off the base of the tower in the process (see page 38). When the courtyard is basically level, I used the mini skew to cut a 1/4” wide path, about 1/8” inside the outer wall. This will be the foundation for the flying buttresses, providing a flat surface that will be filled by the bases of the buttresses. The buttresses will rise from this foundation as piers. Toward the top of these piers, the half arch will “fly” up to the tower, locking into the arches of the corbels.

The last ramparts must now be freed from the surrounding wood. As before, a slow and steady hand is required to trim the tops of the ramparts to keep them from splintering the wood along the gaps or causing torn grain. Once the ramparts are trimmed down to their merlons, I repositioned the tool rest 90º to excavate behind the crenelations. Because the space is so limited, many tools cannot reach the area to excavate. I used a miniature bent hollow cutter.

Fluting

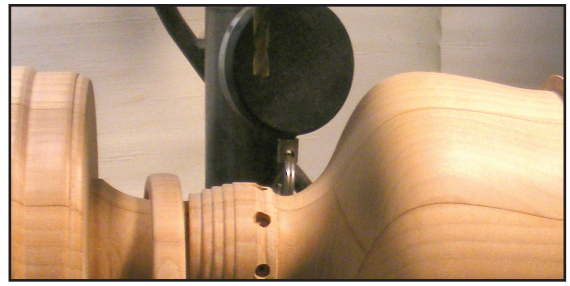
With this preparatory work out of the way, it is time to set up the fluting jig to cut the corbels. The fluting jig that I created will be used, for it is far more adaptable to the odd angles required to complete this project. It will take both the reach of the bit, and stops to cut the corbels on the cup’s tower. To cut the bottom of the bowl with corbels will take an extreme angle from the fence of the fluting jig. I will use a round tipped bit to cut two different lengths of corbels.

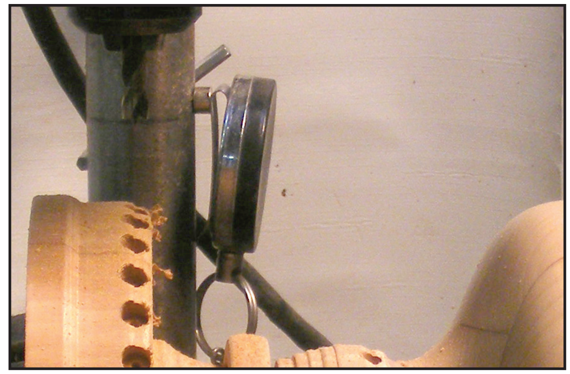
After mounting the steel plate to the lathe, I begin setting the fence to match the angle of the tower/stem. This was simply a parallel setting, I just needed to make sure that the bit was long enough to reach it’s the desired depth. I cut the first corbel and took note of its size and placement. It quickly became evident that I would need to move four spaces on the index for each of the longer cuts. Each spacer card pair would be lifted, routing to full depth (see page 39). Once these cuts were finished, I reset the index by two to center the secondary cuts between the primary ones, but only went down two spacer cards, instead of the full set of four as I did on the longer corbel cuts. These shorter, or secondary cuts will be used as the upper mount for the flying buttresses.

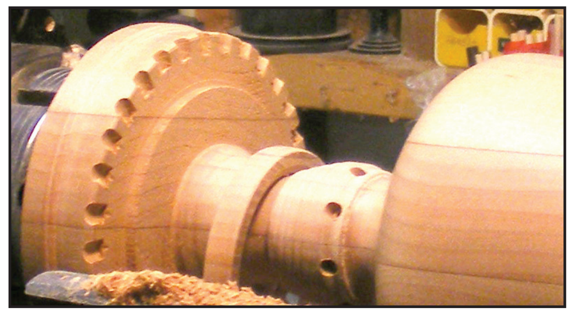
I then set up for the flutes on the bottom of the bowl. These would be deep, straight cuts in an array around the base of the cup’s bowl — similar to the pattern found on the bottom of a cut crystal goblet. With the fence set to follow the bowl bottom, I found that the router bit would not reach, due to the router coming in contact with the goblet’s foot. To save time, I positioned the router so that the bit would reach, and set up the fence from that positioning. To solve the problem, I found that I would require an angled face on the router sled, so that the router could follow the fence, but at the angle required to cut the corbels. Because I needed the angled board to follow with the sled, I put some packing tape onto the bottom of the angled piece of plywood, then placed the sled onto it so that the face of the sled was flush with the back of the plywood plate. This would allow the router to move at a fixed angle to the fence, similar to how one can cut coves on a table saw. I had already used the depth gage to find the maximum depth I could cut without turning the cup into a strainer. I had also marked the furthest I would want the bit to travel toward the stem. Using these marks, I was able to use the router and bit to set the stops on the fence (small Quick-Grip clamps), keeping the bit from traveling beyond its intended borders. After setting up, I double checked all of the set screws and stops, and made sure that the magnets on the fence were turned on. I cut the first of the long corbels, stepped four and cut again, using this setting to cut all of the longer corbels. Now it was time to set up for the secondary, or shorter corbel cuts. I first moved the index two spaces, which centered the bit between the two longer cuts. I cut the first of the secondary corbels to a length that looked good, then turned off the router. Setting the router bit to the deepest point, I used this to place a quick grip clamp onto the fence to act as a stop. From this point on, it was just a matter of step four spaces, then cut. Step & Repeat. The only thing that I had to watch for was that I went at a speed that prevented burning as much as possible. This is actually one of the advantages of using the card spacing system. By removing such a small amount at a time, you can eliminate most of the burning that may have occurred with previous cuts.

Now is the perfect time to finally finish out the captive ring. The ring must be fixed to the goblet to allow me to easily sand it and apply a finish. The quickest way to do this was to wrap masking tape around the corbel/ rampart section of the stem. I chose this area because it is the closest to the size of the ring's interior, requiring less tape than anywhere else. Once I got enough tape wrapped onto the tower, I tore the tape off from the roll and started to look for the proper size. I had to remind myself that this was not the maple that I normally used for cups, for this ring would not put up with as much stress as a maple one. I continued to remove tape until the ring just fit snugly. Once I had found this happy medium, I could then easily sand the ring through all of the grits, then apply finish to it. Once the finish had dried, I simply slid the ring off of the tape, removed the tape that had finish on it or had been sanded through, then I rewound the tape onto the roll. It has lost a bit of it's stickiness, but it is fine for minor work.

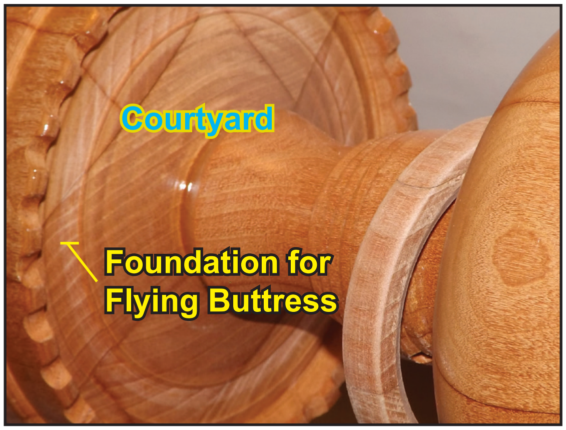
I then used a very light touch with some 0000 steel wool to level out the streakiness of the finish. I ordinarily do not use steel wool with a lathe, for it is all too easy, especially on a piece that is ornamented, for it can easily catch a cloth or steel wool. Steel wool is particularly nasty, for if it gets caught around any appendage, it can instantly cut deeply into skin. In this case, I was holding the pad with my fingertips and only holding it against the walls of the cup very lightly. This was enough to level the finish and take it to a satin sheen.





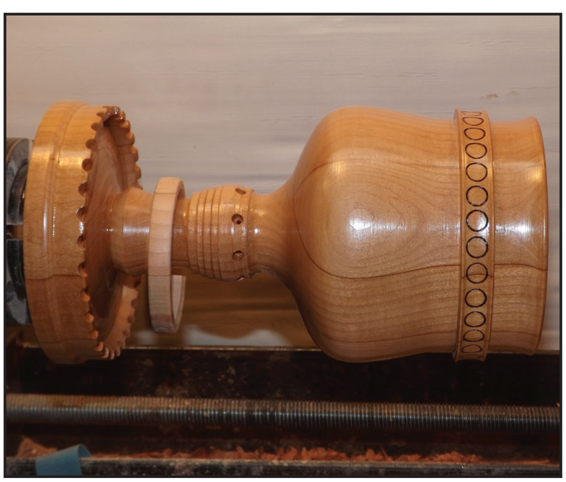


Top: *Drilling the tower rampart spaces.*
Next View 1: *The 1/4" brad pointed bit is chucked into the drill press and positioned so that the point will contact the groove at the top of the merlons. This will allow me to use approximately half of the bit's diameter as the space between the ramparts.*
View 2: *The tops of the holes have been turned away, making the holes look like rampart spaces. The holes go deep enough that they will go all the way through the wall once the back side is turned away, revealing the castle's courtyard. This is the area from where the flying buttresses will rise, landing into or just below the corbels.*



Above: *The "courtyard" of the tower once it had been excavated and the base of the tower finished. Note the 1/4" band just inside of the outer wall — this will be the foundation of the flying buttresses.*

Below: *The entire base has been finished with the exception of the corbels on the top of the tower/stem. Once the ramparts have been freed from the background, the funnel shape of the bowl's base will be thinned further to fall into the center of the stem's ramparts. After that, the corbels of the tower and of the cup's bowl will be cut with the fluting jig. The tape is holding the loose ring in place. Once the flying buttresses have been turned and placed, the ring will be caged beneath them.*



The only thing left to do at this time was to reverse chuck the cup and turn away the dovetail on the bottom .I found that by wrapping the outside of the jaws with a rubber tourniquet, I could hold the loose end of the rubber strip down with the cup as I expanded the jaws to lightly hold the cup from the inside.

Once the cup had been remounted, it was quite easy to turn away the dovetail and to create a nice, smooth finish across the bottom, suitable for signing and finishing.

The nest item on the agenda is the lid. I used the center finder to locate the center on both sides of the disc. Once mounted, I turned the blank true on both sides and the edge. I turned a dovetail on the headstock end, then remounted it in the four jawed chuck (page 41).

I first had to fit the lid to the cup. There are three ways of turning the lid so that it will fit the cup — the first is to simply make the lid overhang the lip of the cup, the second is to have a hump that rests on the inside of the cup's rim. Both of these have potential issues. If you only have the inner hump, the lid may slide off of the cup when the user applies a slight tilt. If the cup has a flaring lip, the lid may just slide off. If it is only held on by a ridge around the outer lip of the cup, the ridge must come down far enough to avoid the same fate as the inner hump. I have had the best luck with a combination of the two, which is the third option.

Having taken the measurements from the cup, I cut a slight recess to create the inner hump of the lid. When I have gotten the fit so that the cup will not move more than a modicum, I take note of the outer rim of the cup against the blank and mark it so that I know how far out to take the concave rest for the cup's rim. I just keep on fitting it until it is as secure of a fit as I can manage. Because this cup is made from a composite of kiln dried lumber, I really do not have to worry about the wood changing shape. Were this made of a log from a cherry tree, that would be an entirely different matter. When turning items that are green, a project of this type becomes a race against time to see if you can get it finished before the wood changes shape. Green wood is not recommended for the art of ornamental turning. I am not saying it cannot be done, for I have — I am just preparing you for the marathon that awaits you.

Reverse chuck the lid. Because my jaws would not open to the necessary diameter, I resorted to chucking the lid into the Cole Jaws. Due to the padded pegs, the Cole set is not the most stable with which to hold your work. It will do the job, but caution must be exercised — more than once I have had a nearly finished piece come off of the Cole jaws, inflicting dents to the piece and bruises upon my fingers. It takes very little sideways pressure to loosen a piece of work upon which you have dedicated many hours.

The next step is to hollow out the inside of the lid's top. The center is to be turned as a pedestal for a finial that will be added later. Making the finial and the flying buttresses of the same wood will also lend some continuity through color. Should the lid and the cup ever become separated, I would like the two to look enough alike that the lid will not be tossed if separated from it's mate. The courtyard of the lid is virtually empty, with a slow rise to the urn, which in turn holds a "fire bowl". Needless to say, the finial that I intend to make will be flame-like in appearance. The center of the fire bowl is drilled out to accommodate a 1/4" dowel that will be turned as a part of the finial.

Once the lid's top was sanded and finished, it was time to create the finial for the lid. I had decided that turning the finial and buttresses from maple would add a nice contrast. Rock maple will also be tough enough to deal with the stresses of being turned as a torus, then sliced into individual flying buttresses. The blank that I chose for the finial, though, was curly maple. The grain ought to shine a light on the flame finial.

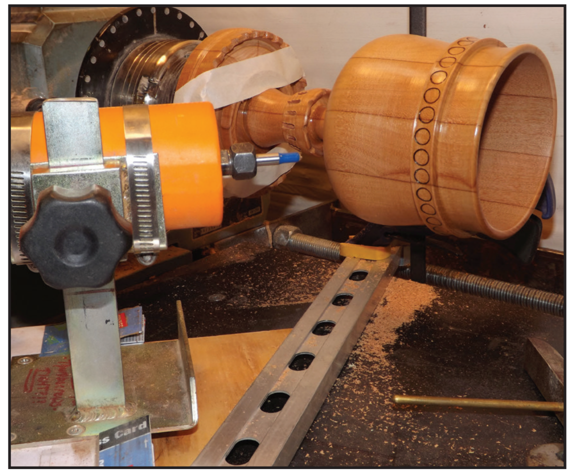
The blank that I chose was about 2" in diameter, it was also about 12" long — plenty of wood to create a small finial, and the maple is hard enough to allow me to turn a 1/4" dowel to join it to the lid.

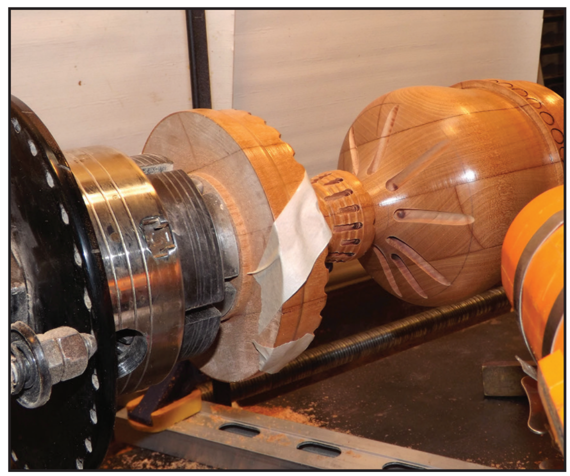
Having mounted the blank in the four jawed chuck and centered it with the live center, I trued up the blank, then turned it to a teardrop shape with an extra point at the thin end. To bring it to the next level I decided to cut it into a double helical hollow spiral. This is much easier to do than it sounds, though it does take a bit of hand work. Staring with the largest Dremel brad pointed bit, I set the depth gage on the drill press to go slightly over half way through the finial. I then set the index for the first hole and positioned the drill press so that the bit would drill toward the bottom of the thickest section of the finial. I drilled the first hole, then set the index to the position 180º from the first and drilled the second hole. By meeting the holes in the center, the possibility of chipping out or blowing out the bottom of the hole is eliminated. I finally drilled 3 holes on each side with the largest bit, then moved on to the next smaller size to drill the next two sets of holes. After that, I switched to the next smaller size and drilled two more set of holes. Ordinarily, when doing a spiral, I make sure to set the holes a reasonable distance from one another. Because I am removing the entire interior of the spiral, I am overlapping the holes. This eliminates the majority of the waste material, leaving nothing but small bits of webbing between the holes. Once all of the waste has been removed with the drill bit, I came in with a straight, bent chisel (back grounder) and carved away most of the webbing, making sure to note the direction of the grain. Next, I used a combination of round and half round files to smooth the interior of the spiral. The files do a great job of shaping the interior of the finial, but it is only after using sandpaper that you will end up with a smooth, well formed hollow finial. After it is smooth, apply the finish. Once it is dry, cut the 1/4" dowel and fit the flame shaped finial to the lid, gluing it in place..

Turning the Torus

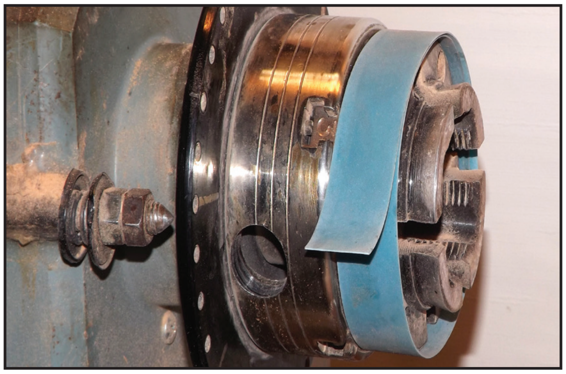
Now comes the great experiment — turning the torus for the flying buttresses. I have done an internet search for any turnings, especially a cup, with flying buttresses. So far I have found no links to any site or images to such a thing, so I am going to assume that mine

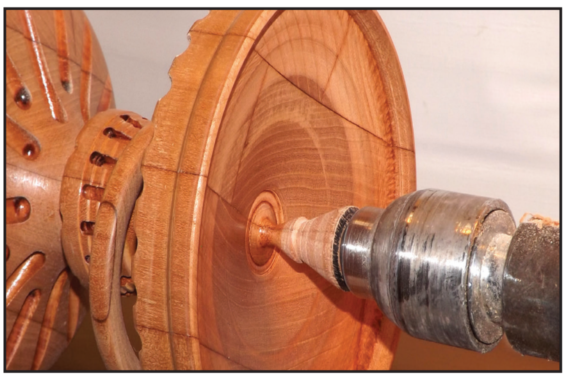
** It was on this portion of the project that I discovered the sides of the switchable magnets would also stick to the edges of the steel plate — not as well, but well enough that it did not move with this process.*





Top: *Router settings to cut cup's corbels.*
Middle: *The primary, or longer corbels are cut.*
Bottom: *All of the corbels have been cut in the base of the cup's bowl. Ordinarily sanding is not required in ornamental turning, but since this cup is made of cherry, a softer of the hard woods, extra care had to be taken not to chip out. Burning is also a side effect of using too soft of a wood, and taking too big of a bite when burying so much of the bit.*





***Top:** The captive ring has been sanded and finished as it sat upon its temporary cushion of masking tape.*
***Middle:** The rubber tourniquet is wrapped around the outside of the chuck to pad it for the inside of the cup.*
***Bottom:** After reverse chucking the cup, it was an easy matter to turn the bottom to a beautiful finish. Because the cup is held by the chuck, there is little worry of loosing control as it is parted from the base that had held it fast in its reversed position.*

is the first. I had first cut up several 4" square blanks, then glued them up to make a blank large enough for the torus to emerge.

The idea for how to make the flying buttresses came from the old means which turners would use to create the animals for a Noah's Arc toy. To keep from having to cut and carve every animal, the turner would instead turn a torus with a cross section in the shape of the animal needed. By slicing the torus, the turner would instantly have as many of that animal as needed. The slice could either be carved, painted or left as it was for the kids to play with. This same method is used to create the number of flying buttresses needed to finish this project. Carving is optional.

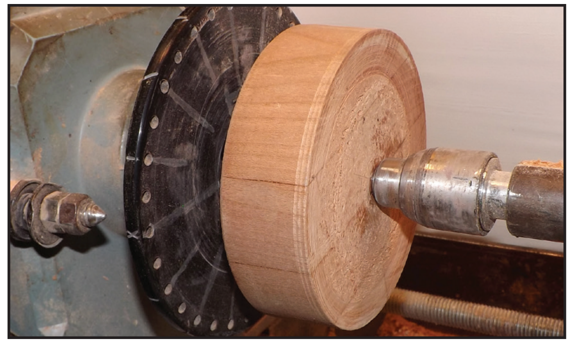
I start by mounting the blank between centers to round off the blank and true up the ends. The blank is now transferred to the faceplate, using double stick carpet tape. The underside of the buttresses is what will be turned first, for once turned, the bottom will give a far superior mounting surface than would the top, for the bottom will have the solid ring that is the base of the flying buttresses. The top, once turned, would have the contact points of only the pointed top of the pier and the point of the arch — not much for the tape to hold onto.

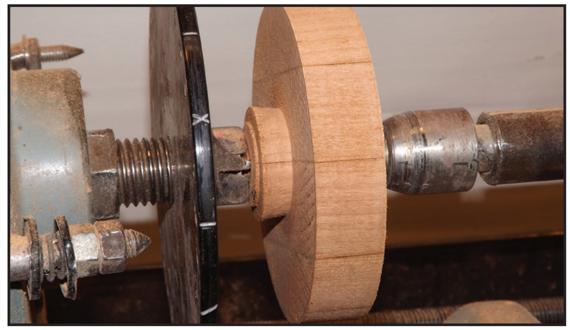
The easiest way of getting the flying buttress torus shaped correctly is to create a pair of stencils. Draw out the entire flying buttress — pier to arch top, full scale. When you have a paper or cardboard pattern cut out that fits the space, create a pair of stencils that will fit on opposing sides of the torus. This way you can turn the internal side, then reverse chuck the torus and turn the exterior. Stop the lathe and feel the arch with your thumb and forefinger to make sure that the arch tapers uniformly from bottom to top.

The first thing that I turn on the torus is the inside hole. This is the area that is taken up by the tower/stem of the cup. This area is removed up to the inside base diameter of the shorter corbels. A bowl thickness gage is used to get this difficult measurement, which is the diameter from the deepest portion of the corbel, to the same on the opposing side. The center space, or oculus, is drilled out with a fostner bit in the tail stock. If need be, it is trued up to that measurement. The depth of the corbel is the amount of wood that stays to form the upper end of the arch, so that it will fill the shorter corbel. The outermost dimension is now established by measuring the outermost rim of the foundation ring in the courtyard of the cup's base. Once you have the inner diameter of the oculus, the outer most diameter of the piers and the height of the entire flying buttress, you have what you need to create the torus. These measurements are marked on the blank. The inside diameter of the foundation is now measured and cut on the torus, establishing both the inner and outer base measurements of the pier's foundation. Hollow out the torus using the interior template, or stencil to measure your progress. I now concentrate on the underside of the arch. It is important that the arch comes to it's apex as it reaches the oculus, making it appear as though the architecture is correct. The changes in pier cross section changes as the pier rises from it's foundation. There is one of these changes that occurs from the point where the arch springs from the pier. It should appear as though the rising arch is an extension of the merlon on the opposite side of the pier. The other reductions in diameter are more or less evenly distributed. When the entire underside of the torus is turned, it is time to reverse the torus on the lathe so that the top can be turned to shape. Make use of the center hole to help center the blank back onto the faceplate. Make sure to use fresh double stick tape so that the torus will not leave the lathe ahead of schedule.

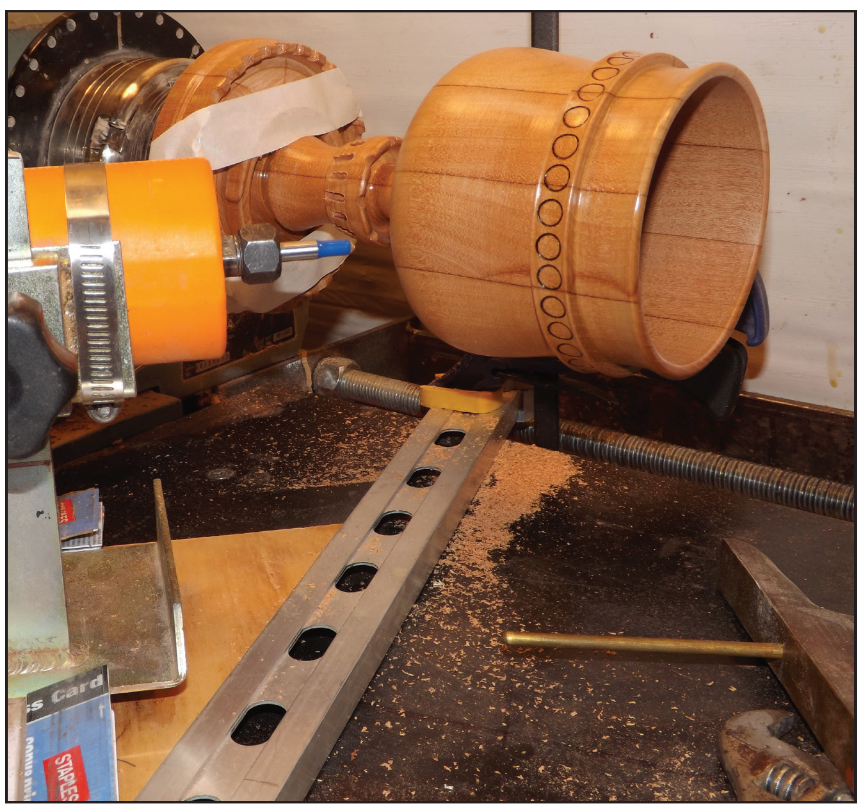
Once properly mounted on the faceplate, I could start turning the upper side of the torus, forming the spire of the pier and the upper side of the arch. I suggest turning the top of the arch first, since this is the most fragile portion of the unit. Because I am turning this in spindle configuration, I cut from the bottom of the arch toward the top, so that I am cutting with the grain. First establish the depth of the buttress's groin, or the spot from where the arch springs from the pier. I turn the pier so that the entire spire is of the largest cross section, then trim it down to it's various stages. Continue to cut, comparing the exterior template often so that you know what still needs to be cut. When the template fits against all sides, it is time to start sanding and applying the finish.

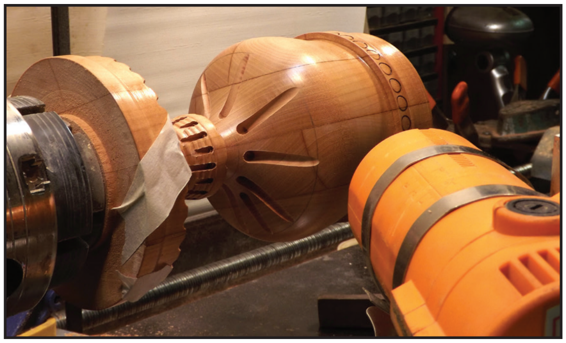
When the flying buttresses are correctly turned, it is time to slice them on the band saw. Very carefully pry the torus from the faceplate with a thin putty knife. To mark the torus for slicing, I established a center line, using my center finding tool. Mark both sides of the hole at the top end, or the oculus. Using a square, I then marked the base of the cut. After marking cut for both sides of the buttress, I took it to the band saw. With the base of the torus flat on the table, I aligned the mark on the exterior base with the blade, making sure to cut outside of the line. I slowly cut toward the center. Turn off the band saw to back the blade out of the cut. Cut outside of the second line, using the same technique as the first. When the blade had passed beyond the pier, I put a finger onto the finial on top of the pier, behind the blade. This was so the buttress would be moved away from the blade as it cleared the arch and became free from the torus. True up the sides of the freshly cut flying buttress on the belt sander to remove any blade marks or irregularities of the cut sides. Test fit it on the cup to make sure it fits. Make adjustments as needed. It is possible to remount the torus, with the removed buttress acting as a shim, and turn the torus to make minor adjustments (see page 47). Do not feel bad if your first torus doesn't fit properly. I was finally able to use the fourth torus I made, but then again, I was

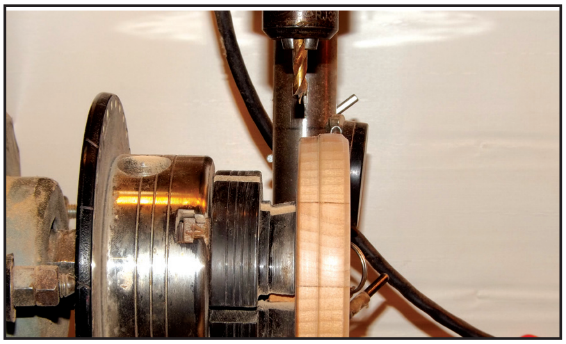


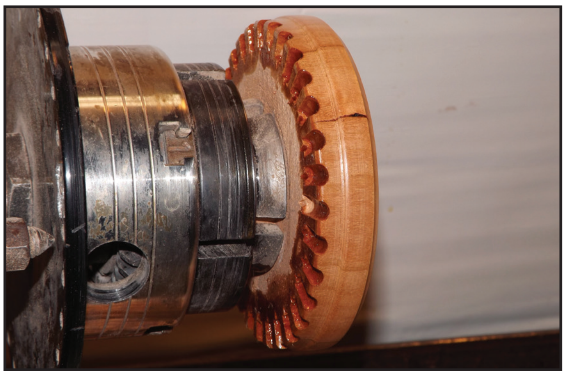


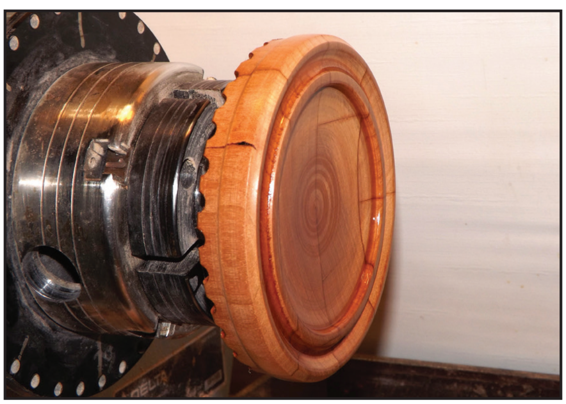
Top: *The blank that was originally parted off of the rest of the blank is returned to the lathe.* ***Bottom:*** *A dovetail is cut into the lid blank so that it can be mounted onto the four jawed chuck, enabling me to turn the underside so that it fits the cup.* ***Below:*** *Plywood wedge is taped to sled base so they move as one.*











***Top:** Positioning of router when cutting corbels on the base of the cup.*
***2nd Down**: The drill press is positioned so that a brad pointed bit can drill the holes for what will be ramparts.*
***3rd Down:** All of the holes have been drilled for the ramparts. How deep they are drilled isn't a matter of concern, as long as they are deeper than the wall will ultimately be.*
***Bottom:** The hump is first formed to fit within the cup's rim. The ditch and rim are then cut to accommodate the entire rim of the cup. By using the double fit, I am eliminating the likelihood of the lid sliding off when the cup is tipped.*

sailing uncharted territory.

The bottoms of my piers were drilled to accept a 1/8" diameter, 1/2" long brass pin to connect it to the foundation as a floating mortise (see page 50). To drill the cup's foundation band, I mounted the cup in the Cole jaws and aligned the drill and guide to the corbel recesses where the upper end of the flying buttress was to be mounted). When the holes were drilled to a uniform depth (see page 49), I test fit all of the flying buttresses in place,with the floating mortises. I then disassembled all of the flying buttresses and laid them out on a drop cloth so that they could have a spray finish applied. When the finish was dry, I glued and replaced them, one at a time, making sure that every one was standing square to the base, with no glue squeeze out. I had decided to mount the flying buttresses so that the captive ring was caged by the buttresses. This would make a further puzzle of it's construction and give the ring something against which to rattle.

Post Script

When reviewing a project recently finished, you often find portions of the project you might have done differently. Especially so when venturing into untried areas, the floating tenons with the brass pins solved the problem of attaching the flying buttress to the ground, but not as elegantly as I would have preferred. Were I to do this again (and I probably will), I would have used a true mortice and tenon joint so that the base of the pier would have fit into a socket in the ground. Prior planning would be necessary, for none of my equipment would reach this area on this cup. Turning the base separately would be an easy way to alleviate this issue, but would also take the mystery from the captured ring.

The remaining photographs and captions will take you through the rest of the

***Top:** The lid is removed from the four jawed chuck and the standard grips changed to the Cole jaws. The lid is reverse chucked to allow the excavation of the courtyard, freeing the rampart wall.*
***Bottom:** With the waste removed, I turned my attention to the base for the finial. I decided on a vase holding a shallow bowl. I wanted it to look like the pedestal for a perpetual flame. A different colored wood for the flame-shaped finial (and the flying buttresses) will make the design pop!*

process as it is described in the text.

Final Concerns

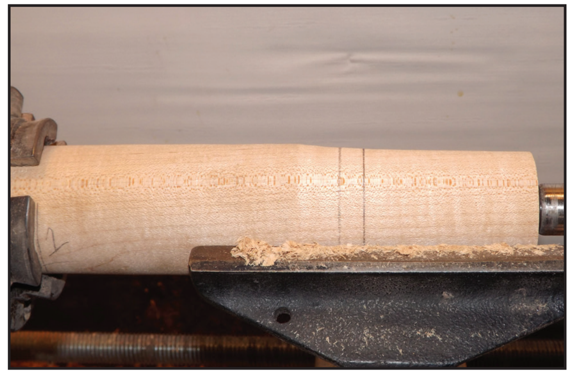
Any time you make an item of wood that is intended to actually be used for food or drink, you have to give the new owners care and feeding instructions. Otherwise you end up with clients who have unintentionally abused an item, come back wanting either their money back or a free replacement. Some items, such as tops, are priced low and meant to be abused, so there are very few who will make such a request. Others will run a wooden vessel through a cycle in the dishwasher and want you to replace it because it split or warped. It is important, especially on higher priced items, or at least those that you have spent a large number of hour upon, that you tell them how to care for their new gift/ purchase.

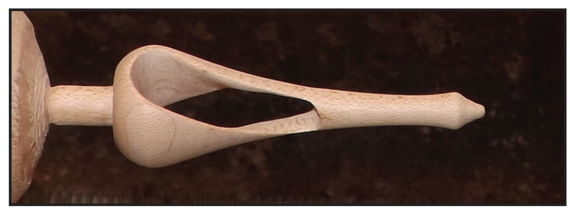
Of course, all of the normal addendum to woodenware applies:

1) Never wash woodenware in a dishwasher.
2) Hand wash, then dry immediately afterward.
3) Even though the finish is watertight, it is advised that you do not leave filled with liquid for more than 12 hours.

If you place a note inside of every piece of woodenware with these instructions, people will start out knowing that what they have is special, and should be treated as such. The price that must be charged to cover the materials, and to hopefully get paid for some of your time and the required knowledge, should reenforce the "special nature" of what they have bought, or have been given. They need to know what they have and how to care for it.

I try to make functional pieces that are of a usable size and will last, under normal usage, for the rest of the owner's life. One of the first cups that I ever made is a magnolia goblet, turned from a downed branch from an ice storm. Even though it still has the pith going right through the middle, I have, as of this writing, been using it for more than a decade. The only issues I have with it are a few dents, due to dropping it in a parking lot. This cup has four coats of salad bowl finish on a green cup (it aged for less than six months prior to turning) that have never had to be refreshed. The two main drinks that have been in this cup have been iced tea and diet Dr. Pepper. Even with this acidic drink, I have seen no damage to the finish at all,





Top: *Finial blank of rock maple.*
Upper Middle: *Finial is turned to final shape.*
Lower Middle*: Drill press & Index are used to drill out the hollow, helical spiral.*
Bottom: *Finial after carving, filing and sanding. Ready for finish.*

nor have I seen any sign of checking.

Conclusion

This has been a mere taste of what is possible in OT. Find a copy of Holtz — if for no other reason but to view the pictures of the works featured. These are all the more impressive when you realize that many of the items are actually miniatures, cut from ivory! You will have to keep reminding yourself that these items were actually made on a lathe!

Above: *Cherry goblet with hollow, spiraled finial glued in place.*

The pages you now hold are the beginning of a book that I am writing, to which I am adding as I continue to learn more about Ornamental Turning.

If you have any comments or suggestions, please let me know so that the final product will be as concise, accurate and informative as possible.

I hope you have enjoyed my Ornamental Turning demonstration, and that you will continue to glean useful information from these notes as you venture forth!

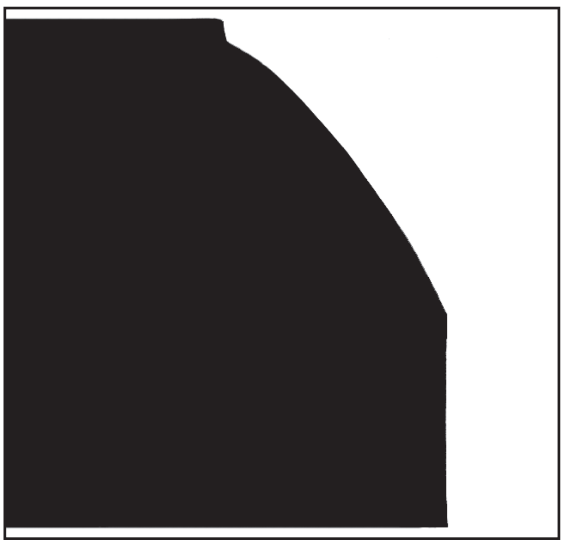
David Swanson
wizardsworkshoppe@gmail.com
580-402-3330

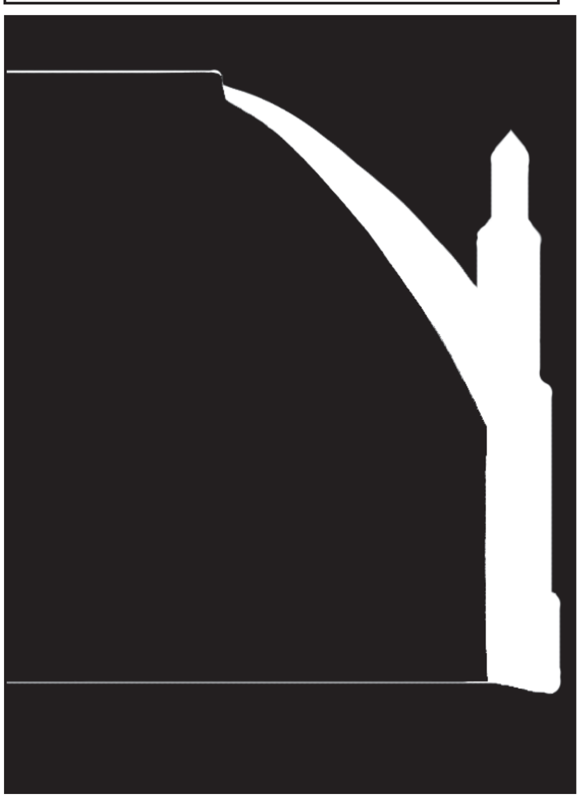
Top: *Card stock cutout of buttress fitted onto the cup.*

Upper Middle: *Torus blank w measurements.*

Lower Middle: *Torus blank turned round*

Bottom: *Interior rough turned.*

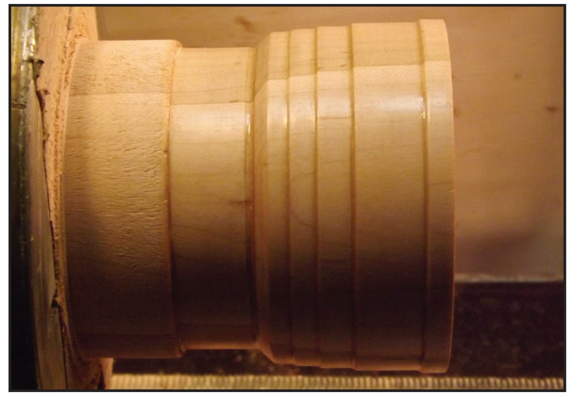


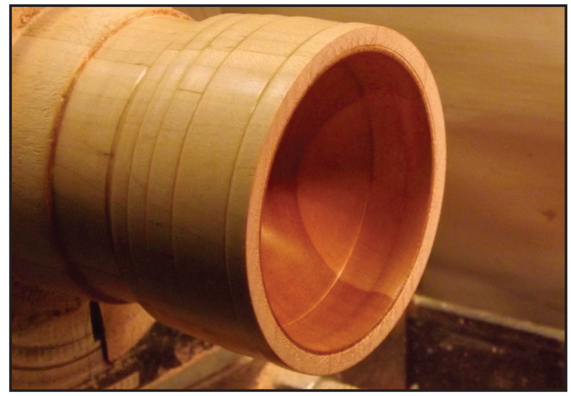


Resources

John Jacob Holtzapffel. ***Principles & Practice of Ornamental or Complex Turning*** *(Dover Woodworking) 1973. (First published by Holtzapffel & Co., London, 1884). ISBN: 0-486-22965-3.*

S. Gary Roberts. ***Masterful Woodturning: Projects & Inspiration*** *for the Skilled Turner. October, 2000*

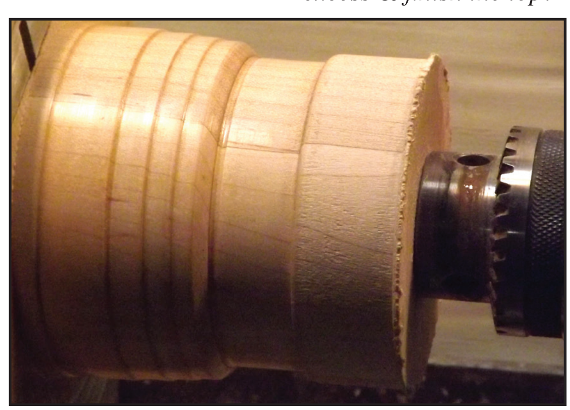




Above: *The finial after it has been filed smooth sanded and finished. The fact that it is still hanging on with only $^{1}/_{16}$" holding it there shows why I use rock maple for OT.*

Top Left: *Torus exterior template using negative space.*
Middle Left: *Torus interior template of negative space.*
Bottom Left: *Combined templates shows what the individual flying buttress should look like. Thin lines on top and bottom show oculus (top) and foundation (bottom).*

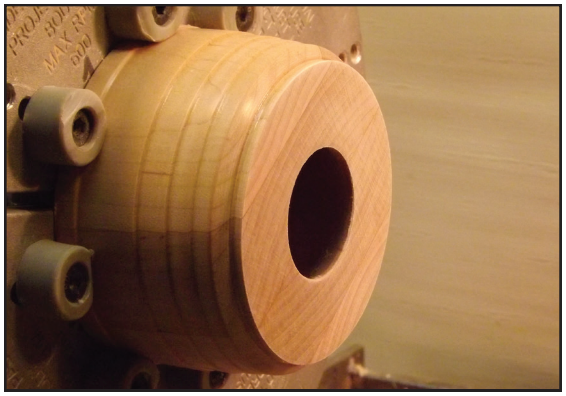
Above: *Exterior of pier.*
Bottom: *Interior and exterior of flying buttresses and pier are finished.*
Below: *Torus has been reversed to trim off excess & finish the top.*

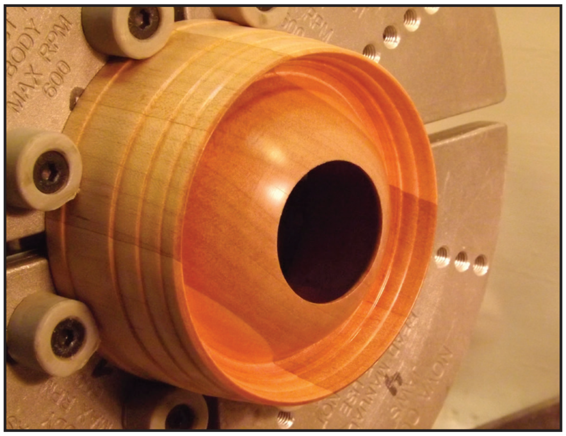


Top Left: *Sanded torus with plans & cutout.*

Middle Left: *Torus interior finished.*

Bottom Left: *Torus reversed to turn top section.*

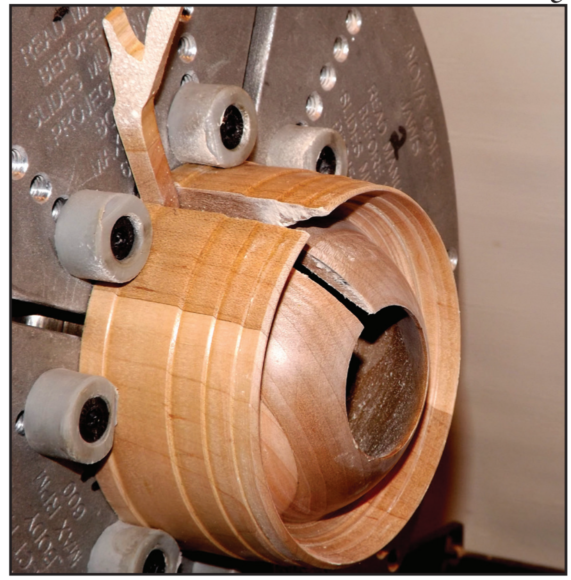




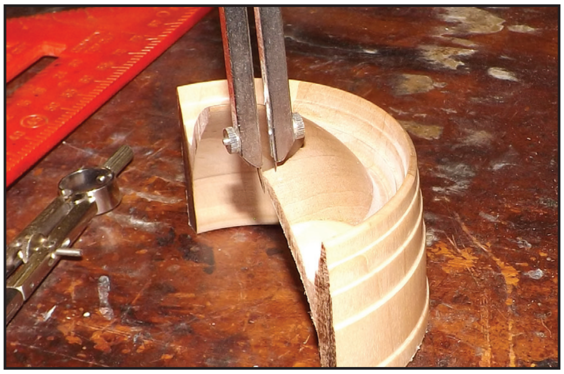
Top: *Excess wood has been removed until the depth gage touches the top of the Cole jaws.*

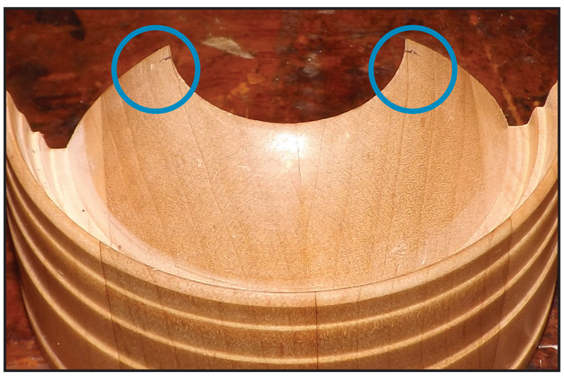
Bottom: *Upper section of the flying buttress and pier fit the template, so they are sanded and finished.*

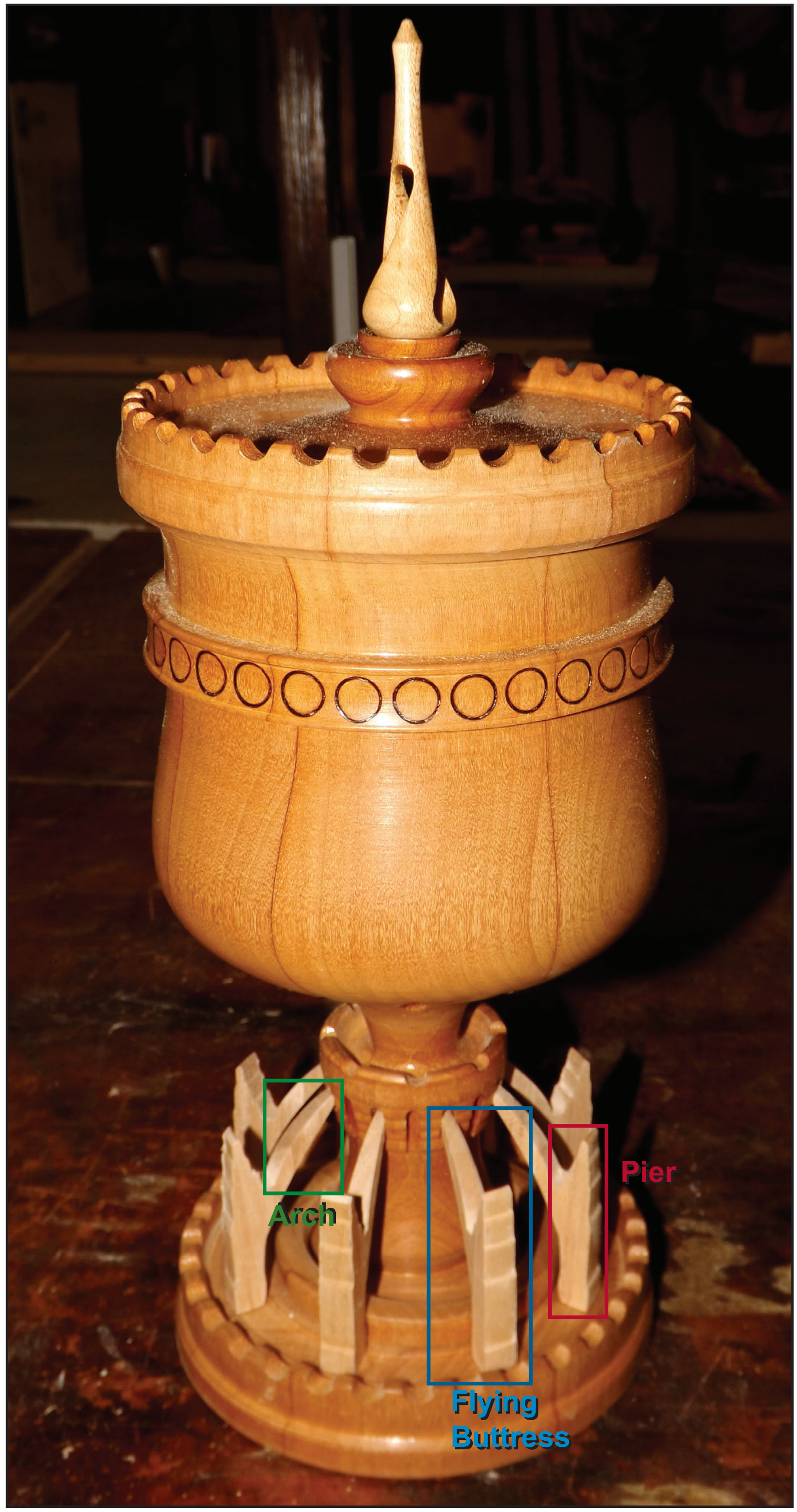
Below: *Cup fitted with flying buttresses that were altered from the first torus. This gives a rough impression of the effect I seek.*



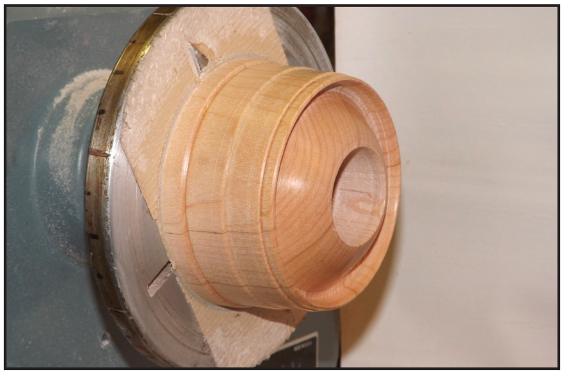
Top: *Slice from torus is used to fill the gap, allowing the jaws to be tightened*
Bottom: *Flying buttresses test fit into their destined places. It came closer, but not close enough. Another attempt is in order.*

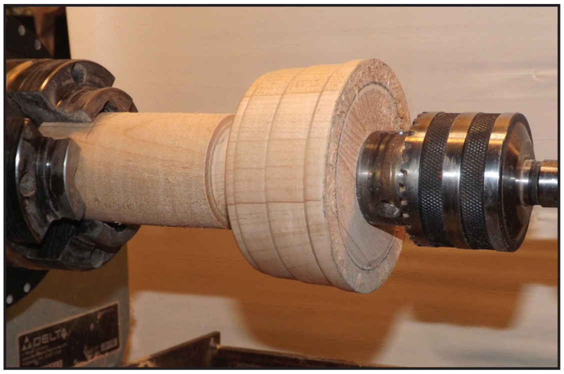


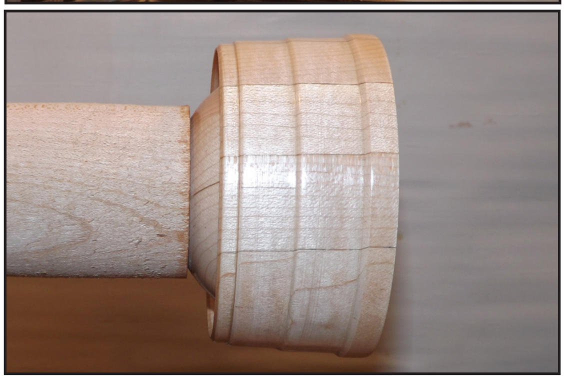


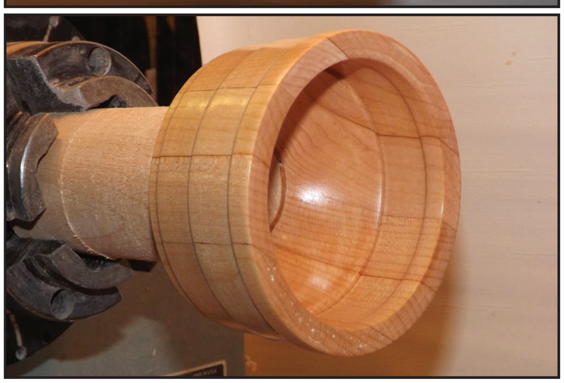


Left: *Tools used to mark flying buttresses prior to slicing: Compass, dividers, framing square, center finder. The blue circles how the top marks. Much of this procedure is done by eye. Cut the buttresses thick to make up for blade marks, if the buttress is square or other possible problems you may encounter.*
Above: *Colored rectangles demonstrate the various parts of a flying buttress.*



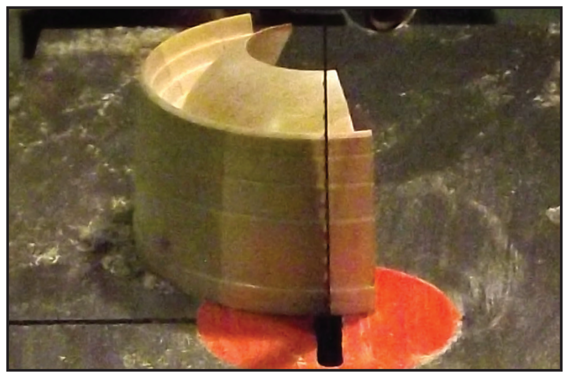


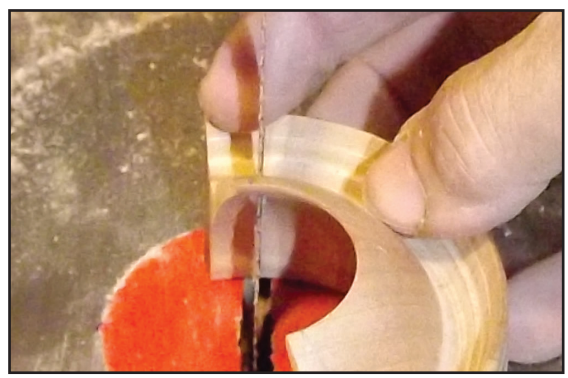




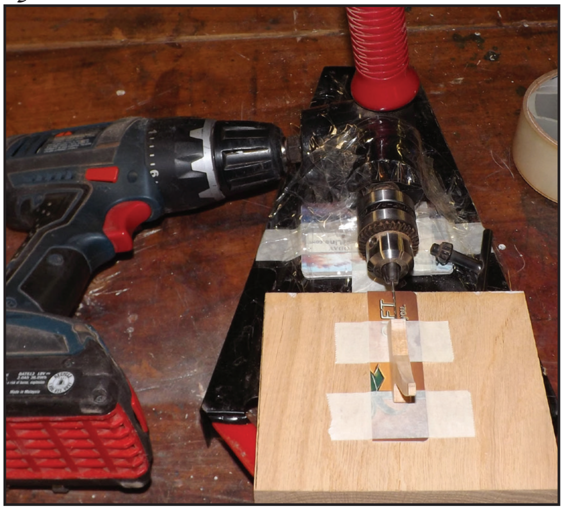
Top: *Finished top of the flying buttress torus.*
Second Photo: *Torus reversed on jam chuck. Centering was done using the stationary Jacob's chuck. The line has bee cut to establish the thickness of the pier.*
Third Photo: *The dowel has been trimmed down so that the torus could be butted up against the shoulder of the jam chuck..*
Bottom: *The inside of the torus has been finished. At this point, only about 1/4" is in contact with the dowel. When it got knocked off center, I found that hitting the tail stock end with an open hand as it spun would re-center the torus quite easily. Caution should be exercised if you attempt this maneuver.*

Above Left: *Finished interior of the flying buttress torus. The ledge at the base of the arch is the supporting corbel often found on these structures. It extends the reach of the flying buttress without taking up any more usable space than necessary.*
Above Right: *Exterior of the torus. The arch is much thicker this time and it has a better taper from base to keystone. This will be revealed when the torus is sliced.*



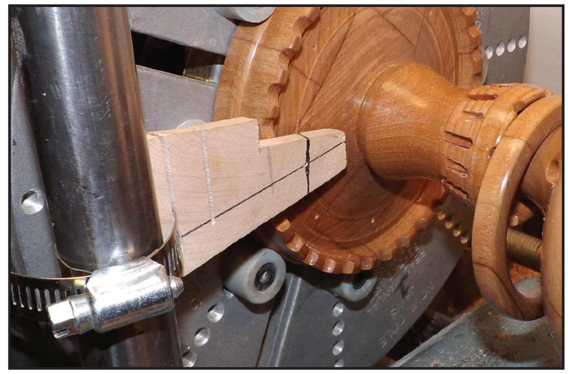
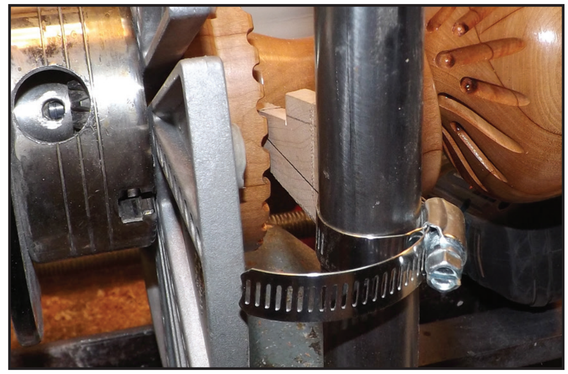


Above: *Cutting the slice with the band saw. The top photo shows how the slice is established. A small cut is made to register the blade, then, from the front, the blade's path is aligned with the mark at the top of the arch. As the blade approaches the top of the arch, speed is slowed and the index finger is carefully brought up behind the blade, to the top of the pier (note the shadow of the blade is on the finger). This is done so that as soon as the blade clears the arch, the finger tips the freshly freed slice away from the blade, preventing it from falling into the blade, or worse, between the plate and the blade of the band saw.*

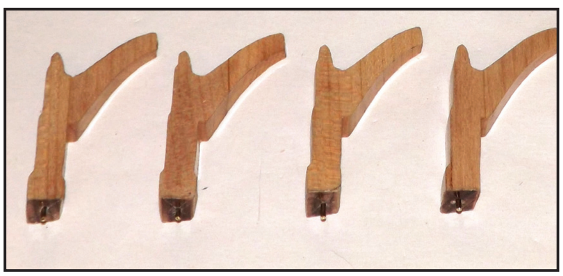



Left: *Because the Dremel Workstation did not have enough clearance, and the 1/2” chuck on my hand drill would not hold a 3/64” bit, I was forced to improvise. I made use of my angle driver, which had a 3/8” chuck that* would *hold such a small diameter bit. The drill was held in the left hand, the angle driver with the right as I eased the bit into the pre-drilled hole in the guide. Even though the drill was hand held, this gave me results that were more accurate than I would have gotten, had I used the Dremel drill press.*

Right: *Rig for drilling the pin holes in the base of the flying buttresses.*

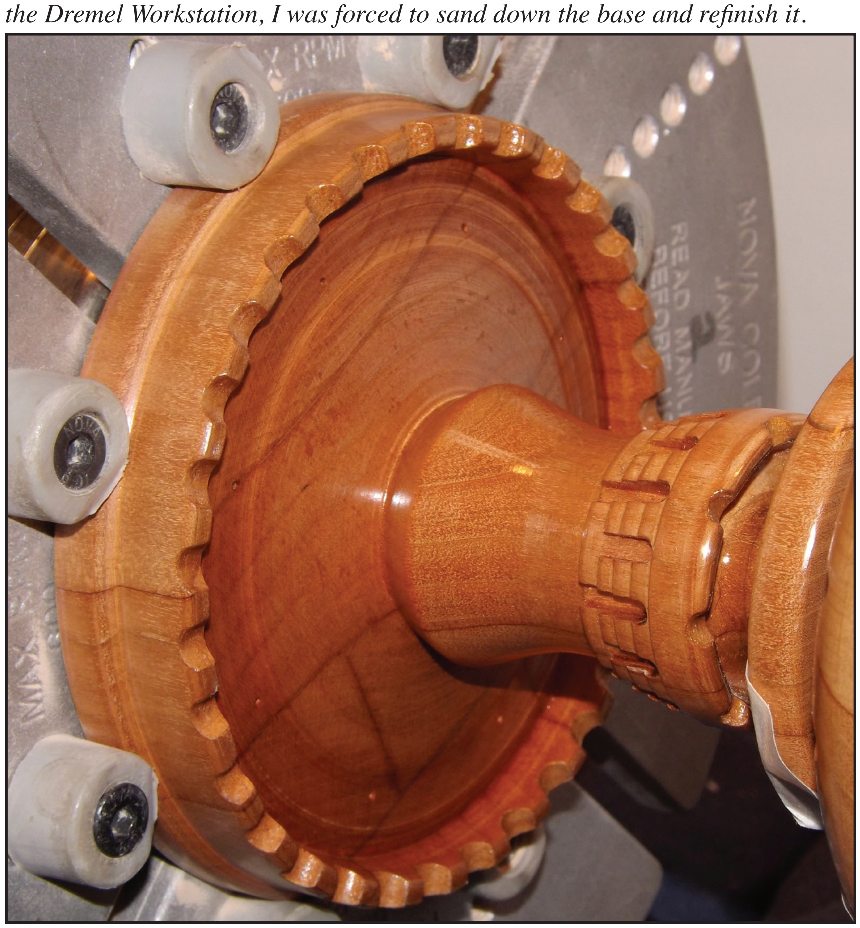



Above: *Front of drill guide for 3/64” holes. a course line is drawn on the top edge of the wooden plate to chart the course for the bit.*
Bottom: *The center lines were drawn on both sides. This one aligned the proper rampart gap with the center line, putting the line at the proper height .*



Above: *Flying buttresses drilled and set with brass pins. The pins will act as floating mortises to hold the base of the piers in place. I used brass to avoid corrosion due to water exposure.*

Below: *Because of scratches inflicted by the drill bit when attempting to set up the Dremel Workstation, I was forced to sand down the base and refinish it.*



The completed Cherry Chalice with maple finial and flying buttresses.