# Building "Aztec" - a Segmented Duck Call

By Ed Glenn

**Introduction**

Building segmented turning blanks has become a fine art among bowl turners in the past few years. The literature documents methods and patterns used in building vessels of various kinds. See Fig. 1 for a 21" tall closed vessel of segmented construction. While segmented duck and game calls are not unknown, interest in the technique recently has prompted this article.

A segmented blank for turning is but one kind of "built-up" construction. Lamination may be correctly applied to those turning blanks built-up by thin layers of material in a fashion similar to plywood and "free-form" blanks are similar to the wedge patterns I demonstrated in the book *Turning Custom Duck and Game Calls* with co-author Greg Keats. Fig. 2 shows both a free-form pattern and a simple laminated call.

As the term "segmented" is used here, it refers to blanks composed of triangles – segments of a circle. These segments are glued up into a ring, and rings are stacked one on top of another to form a blank for turning. Unlike the usual turning blank with the wood grain running the length of the call, the grain of the wood in segmented blanks usually runs perpendicular to the turning axis, as they will in this example. This means segments can be chopped from strips of wood cut along the gain. Segments with the grain running parallel with the turning axis are called "staves" and represent a variation of segmented construction.

***Fig. 1*** *This example of a segmented vessel is from Malcolm Tibbetts in his book: The Art of Segmented Wood Turnings.*

**Planning the construction**

Segmented blanks require much more planning than simply cutting a 1.5" x 1.5" turning square to length and beginning the boring and turning process. The first step is to determine the number of segments you'll use to complete a ring. While some segmented forms are composed entirely of rings, each of the same number of segments, each segment of the same material, most segmented forms include one or two "feature rings." Feature rings are usually located at the largest diameter of the finished form but not always.

Design of the feature ring will often determine the number of segments. For this call, which I've named "Aztec," I used a feature very similar to an earlier call named "Southwest Pottery." Beginning with a .5" thick strip of black walnut, I added a .0625" thick strip of cherry to the top. Then I planned to cut the segments $10^0$ angle off perpendicular, alternate segments and add another .0625" cherry strip between each segment. See Fig. 3 for the plan of the feature ring. I

***Fig. 2.*** *At left is an example of "free form" construction. This form may take on a wide variety of ways to build up a turning blank. At right is a lamination of several layers of thin wood and the unusual effects it lends to the turning shape.*

***Fig. 3*** *The "Aztec" feature ring is composed of .5" thick black walnut alternately bordered and divided by .0625" cherry. The sides of each segment are chopped at $80^0$ rather than the $90^0$ chop used in "Southwestern Pottery."*

drew several versions of the walnut/cherry segments and decided I liked the appearance of approximately square segments (considering the average width and height) By dividing the circumference of a 1.5" diameter duck call by 8 I found a segment width of about .57" close enough to the .5625 height.
Settled on 8 segments per ring, (see Fig. 4) I added a 1/8" black walnut ring top and bottom to set off the black walnut/cherry feature from the base rings.

The next step is to determine the thickness of the base rings. I plan the feature ring to begin at about the second quarter of the barrel length (for a 4" barrel that means 1" down from the stopper end). I randomly decided the rings should be .25" thick. Four rings above the feature ring and nine rings below make up the 4" length. I added a second feature ring to the stopper with two rings toward the barrel and three above the stopper's feature. Each 8-segment base ring would be composed of alternating black walnut and maple, and offset from the one below and above by 1/3 of the segment length or $15^0$. The finished plan is shown in Fig. 5 including the shape of the turned call.

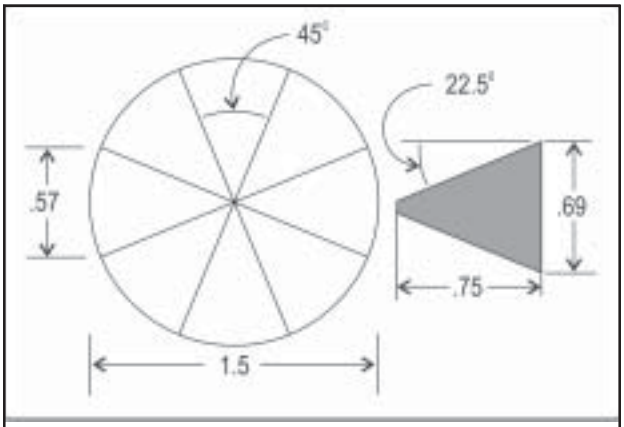


***Fig. 4*** *Plan the number of segments and their dimensions carefully before calculating material requirements.*

**Tools and equipment**

Aside from the lathe to turn the built-up blanks, perhaps the most important power tool is an acceptable grinder to keep lathe tools sharp. An old dull hoe will scrape wood off of a blank with the grain parallel to the turning axis, but with grain perpendicular, sharp tools are essential to prevent the segments from splitting rather than cutting and spoiling the work. I use a slow speed 10" water wheel grinder with a tool rest set at $35^0$ to grind my gouges. A set of diamond hones keeps a keen edge on both gouges and a .25" parting tool. Since I rarely use a skew, it too, stays in good shape with a flat diamond hone. When the parting tool and skew need ground, I use a $25^0$ shop-built tool rest on my bench-top belt grinder to grind each side. I like absolutely flat bevels on both those tools.

A 10" table saw mounting a blade with 60 carbide tipped teeth makes a good rip saw. I check the blade for square before ripping material that has been jointed. Strips are then planed to a uniform thickness. My 12" portable planer will cut as thin as .125" but even thinner material can be planed with a backer board and double sided tape.

I chop segments on a radial arm saw equipped with an 80-toothed blade, also with carbide tipped teeth. A compound miter chop saw, especially the new sliding chop saws will work as well. The key element of chopping segments is an auxiliary table and fence. Build one that can be repositioned to provide tight clearance for the blade on angled and compound angled cuts. While strips are planed to their desired thickness, the high tooth count on a chop saw will eliminate the need for sanding segment sides.

***Fig. 5*** *The finished call design includes two feature rings and base rings of alternating black walnut and maple.*

**Milling the material**

First, calculate the required material for each part of the call. It's much easier and more accurate to mill all the necessary material at one time than to have to go back and reset saws and planer to the former dimensions. Material must be very accurately dimensioned and any strip of wood less than about 24" is difficult to plane. I know from experience that it takes about 5" of strip wood to make a single ring (it will take a little more for a larger number of segments to allow for the additional saw tracks) so I use a 6" length in calculating required material. That would give me a few extra segments and I knew I would need them.

While all the material could be .75" wide as shown in Fig. 4, I used .8125" thick

lumber since that's a standard dimension for S2S hardwood. All the walnut and maple strips were ripped from lumber .8125" thick, but when rotated, this thickness became the width. That means the same face shown on a S2S board will also be the face seen on the finished call. The .0625" thick cherry was purchased in a 3 x 24" sheet.

The two feature rings will require 24" of .5" thick black walnut with .0625" thick cherry laminated to the top. You'll see why later on – we can only use every other segment. We will save the ones we can't use for a different pattern on a different call.

We will need only one 24" x .125" strip for the walnut rings top and bottom of each feature ring.

The 18 base rings will require approximately 108" of .25" strip wood, but I fudged a bit and cut only 96", adequate because the economy of using 24" lengths. The complete material list is shown in Fig. 6. Don't forget the .75" walnut strip that will make the insert portion of the stopper. To assure smooth, accurate dimensions, I rip the lumber oversize and plane it to uniform dimension.

**Materials List**

Feature ring:
- Black Walnut: .8125 x .5 x 24"
- Cherry: .0625 x .8125 x 24" x 2
- Black Walnut: .8125 x .125 x 24"

Base Rings:
- Black Walnut: .8125 x .25 x 24" x 2
- Maple: .8125 x .25 x 24" x 2
- Stopper insert: .8125 x .75" x 6"

***Fig. 6***

**First steps**

The first step is gluing one of the cherry strips to the .5" walnut strip. I use a pair of cauls, spring clams and waxed paper. See Fig. 7 for my setup.

***Fig 7*** *Use a pair of cauls and spring clamps to glue a strip of cherry to one side of the .5" black walnut. I pull the waxed paper up between the cherry and the outer caul to keep from gluing them together.*

The next and most important part of setup is to adjust the chopping miter for the segments. First, make certain your chop saw blade is perpendicular to the auxiliary table. The base ring segments are cut at $90^0$ on the sides. But each side is mitered at $22.5^0$ from the face. This miter must be absolutely precise in order for the segments to fit. Miter gauges on either radial arm or chop saws will only get you close. Test and fit, perhaps many times will be required to find the precise angle. Joint, rip and plane some practice stock for this testing process. I usually cut .75" x .75" common pine strips but any inexpensive wood will do. You'll probably need at least one 24" length.

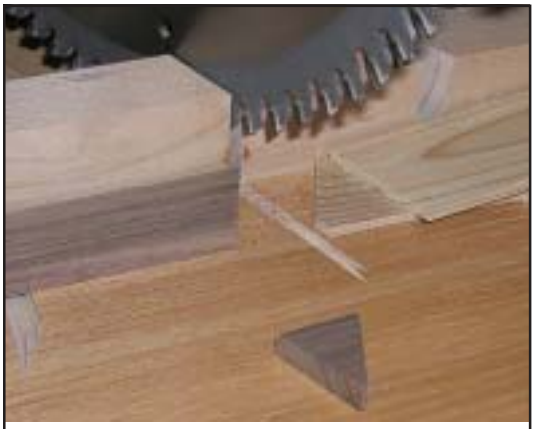

***Fig. 8*** *Here you see the walnut strip ready to be pushed to the stop just to the right of the saw kerf in the auxiliary table. The springy hold down has been moved out of position to show the stop. To function the hold down must be near the saw blade as it cuts the segment. A chopped segment is in front.*

Set your saw to $22.5^0$ according to the saw's miter gauge and chop the end of both your practice strip and a "stop". I use a .125" thick strip of cedar for a stop and another for a springy hold down. See my set up in Fig. 8. Set the stop so you'll have about .050" of the strip on the inside of the triangle. It's very hard to glue up segments if they are cut with a sharp corner on the inside. Set the hold down so it bears pressure on top of the cut off segment. Without a hold down, your chopped segment is trapped between the stop and the saw blade and will be drawn into the blade and against the fence and ruined. The hold down is essential to hold the segment in place until the saw blade can be withdrawn from its kerf.

To chop a segment, chop the end of your practice strip and discard the cut off. Flip the strip over, set it tight against the stop and the fence and chop again. Both miters should be $22.5^0$ from the face. To cut the next segment, simply flip the strip over again and set it against the stop and fence. As you see, the face of alternating segments will be on opposite sides of the strip. Consider this when selecting stock for cutting segments.

Chop a set of 8 segments from your practice strip, arrange them in a circle and encircle them with a rubber band. Adjust the outside corners even with each other and you'll very likely see a gap or two.

Here's the rule: If the gap is on the inside, the miter angle is too great and needs a nudge to reduce the angle. If the gap is on the outside, the miter angle is to small and needs a nudge to increase the angle. Re-set the miter angle with just a nudge or two each time until your practice set of segments fit perfectly. Remember, each time you reset the miter angle, chop the end of your practice strip before you cut the first segment in that set. With patience you'll soon find the precise angle to chop your base ring segments. With all this nudging, you may have chopped out the kerf in your auxiliary fence too much to be safe for chopping segments. If the kerf in the fence (and the table) is more than twice a single saw kerf, reposition the auxiliary and fence to get a fresh, new kerf and reset the stop and hold down. See Fig. 9 for a set of segments that fit precisely.

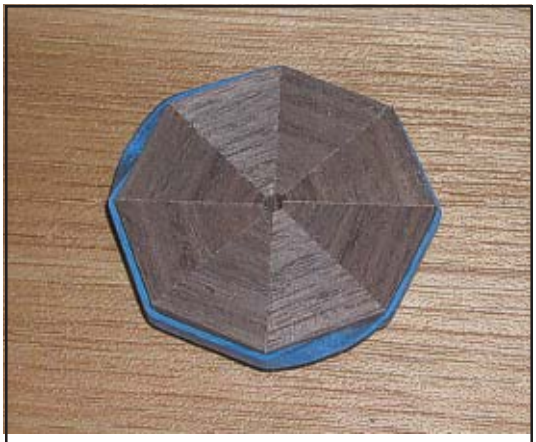

***Fig 9*** *Segments should fit exactly to form a complete circle. Note the small hole in the center that aids in alignment of the segments and an escape route for glue squeeze out.*

**Chopping segments**

With your miter saw set at precisely $22.5^0$, you can begin to chop the segments for your base rings. With a total of 18 base rings plus four .125" walnut rings to bracket the feature rings and one .75" thick ring for the stopper insert, there are 184 segments to chop with this same set up.

Don't chop all of them in succession. Sooner rather than later boredom sets in and when operating power equipment boredom leads to inattention which leads to accidents. Perhaps the most likely that can happen is to cut a few segments without making sure they are seated against the stop or the fence, but the worst that can happen is to chop a finger. I chop a dozen or so, stop, turn off the saw and count what I've done. Stretch my back, wiggle my fingers and chop another dozen. By now I have enough to glue up two or three rings. Then I go back and chop more, glue up a few more rings and so on. It'll take me six or eight hours to chop and glue the base rings, the border rings and the stopper insert ring, and I'll probably spread that over a couple of days.

***Fig. 10*** *Each successive segment was arranged in separate groups. You can see the group on the left have the cherry strip on the wide side, and the group on the right are the ones we'll use in this design.*

The feature rings require just one more adjustment. My radial arm saw, and compound chop saws will allow a $10^0$ bevel without changing the miter angle. There's nothing critical about this bevel, it could be 9 or $11^0$ and work just as well. But it does require re-cutting the stop (I used one only slightly thinner than the .5625" thick walnut/cherry strip we glued up earlier). The compound bevel/miter cut a new kerf through my fence and table which required a new set up for the stop and hold down.

Since we'll flip the walnut/cherry strip top to bottom as we chop these segments, every other one will have a long cherry strip on one side and a shorter strip on the other. Fig. 10 shows how the segments come from the chop saw and why we can use only every other one. I saved the ones we can't use in this design, in case I make one later that will use them.

Now, for the nearly vertical cherry dividers that go between the feature ring segments. Without changing the chop saw bevel, return the miter to a square cut ($90^0$), set up a stop and hold down and chop the dividers with a bevel to match the bevel on the feature ring segments. See Fig. 11. I set the stop so these dividers would stand a bit proud of the thickness of the feature rings so I could be sure the bottom side was flush with the bottom as I glued up the feature rings. (I also chopped dividers to go with the alternate set of segments we saved for a future design.)

***Fig. 11*** *The cherry dividers are cut square to the fence but we maintained the $10^0$ bevel from cutting the feature ring segments.*

**Gluing up the rings**

Start with the base rings of alternating walnut and maple. I organized my work so a walnut segment was always on the left and a maple segment always on the right. There are two tricks to gluing segments. First, before applying glue, mate the two segments together along what will be the glue line and rub them against each other – back and forth on the table several times until you feel the edges slide against each other smoothly. This works out the sawdust, the rough edges and makes for a much smaller glue line. I use Elmer's ProBond, a yellow woodworker's glue that is indeed, "weather resistant." I've wiped my fingers on pant legs often enough to aggravate the lady who does my laundry and the glue is still there after several washings. The better feature of ProBond is that it has a moderately long open time when applied heavily, but with just finger pressure it will quickly squeeze out and tack in seconds. In a minute or two it has set well enough to handle and in an hour the blank is ready to turn.

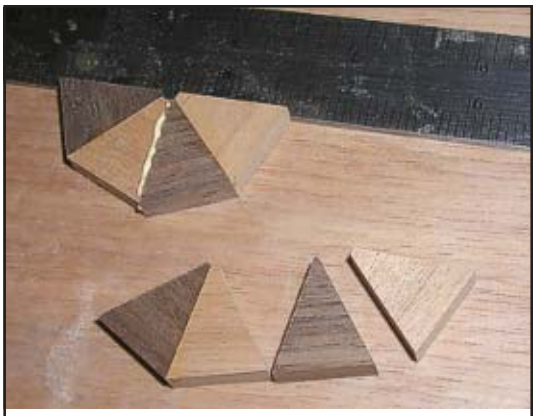

***Fig. 12*** *This photo shows the steps in gluing up a ring. First, glue two segments together to form a pair like the lower left. When all four pair are set, glue two pair together for a half. Finally glue the two halves together.*

The second trick in gluing segments is to keep the outside mating corners as even with each other as possible. I work on a sheet of waxed paper right on my radial arm saw's auxiliary table (saves having to move cut segments from one bench to another). After the rub and scrub of the mating edges, I apply just enough glue to one piece to get a nice little squeeze out when the two pieces are pressed together. My thumb evens the outside corners and I can see the little flats on the inside. I hold the joint under finger pressure for 5 seconds or so, then wipe the squeeze out with my finger, my finger on a paper towel and go on to the next pair.

By the time I glue the four pairs of segments, I can go back to the first pair, lift them from the wax paper, rub and scrub the joining glue line and fit the edges against a steel straight edge. Slide the two pairs together to check the fit. Now is the time to do a little sanding if they do not mate exactly.

With a little glue on one pair, slide the two pair together along the straight edge until they come together and hold for the 5 second tack. Double wipe the squeeze out. Leaving this half of the ring in position, repeat the process with the second two pair.

I then glue up the four pair for the next ring while the first ring's halves cure a bit. Rub and scrub the first ring's two halves together and check to see that the fit is exact all along the mating line. Sanding one or both may be required. I use a "poor-man's thickness sander" which is simply a sheet of 100 grit paper laying on the flat auxiliary saw table. Glue and finger clamp the two halves together, double wipe the squeeze out and let the ring sit until the next is done. When it is, flip the first ring over, wipe away any wet glue and let the ring cure. Fig. 12 shows both a pair and a half glued up.

This sequence can go on as long as you have segments already cut, but it too is boring after a while so alternating between cutting segments and gluing rings helps the mind stay focused.

**Gluing the feature ring segments**

There's an extra step in gluing the feature rings and one step to be omitted. First, mate the feature rings with the cherry strip on top of one segment, and on the bottom of the next. Because these segments are beveled in addition to being mitered, the inside and outside corners won't fit like the base rings did. The outside corners are fairly easy to match, but the inside corners look odd. The segments with the cherry strip on top will come to a point perhaps even before reaching the width of the strip. The segments with walnut on the top will have a broad flat on the inside. Don't worry, though, the same rule applies, try to line up the outside corners as evenly as possible.

With a pair of segments rubbed and scrubbed, apply a heavy coat of glue to one and then rub the two segments together to spread the glue to both pieces. Now, before pressing them together, insert a cherry divider between the two. Be very careful to place the divider with its $10^0$ end bevel the same way as the bevel runs on the segments. Press down on the extra length of the divider to make sure it is flush with the bottom of the segments as you press the segments together. Use the same sequence as before to build four pair.

You won't be able to use the straight edge to join two pair like we did with the base rings, you'll just have to work on faith in your miter cut. And don't join both sets of pairs in two halves. Just rub, scrub, glue, insert a divider and press two pair together. After the glue tacks, take a deep breathe or two and then add one more pair to the first half. When it is

tacked and you've caught your breath again, test fit the final pair. Adjust as necessary. This is kind of tricky now, you'll add glue to both sides of this final pair, spread it on both sides of the three joined pair, drop in dividers on each side and press the whole ring together. Good job! Only one more to go, thank yourself for designing only two feature rings in this call. Fig. 13 shows the feature ring glued up ready for sanding. When the feature rings are cured, sand away the protrusion of the dividers on the top. I did this very carefully on my bench-top belt sander.

Gluing up the walnut stopper insert ring should be pretty easy now, except make sure the two halves fit square and true along he glue line since this ring will be turned very thin and will take some hard use.

With all the rings glued up, use the "poor-man's thickness sander" to knock down any glue squeeze out and flatten the top and bottom of each ring. See Fig. 14 for a stack of rings to make a single duck call. (I had one segment in one base ring so far out of alignment; I had to make a new ring.)

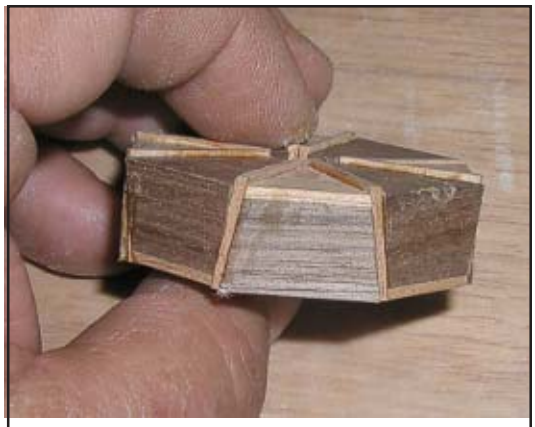

***Fig. 13*** *The glued up feature ring shows the dividers standing proud on the top side. Carfully sand these even with the surface of the segments.*

***Fig. 14*** *This is the full set of rings used to make "Aztec" - 25 in all.*

**Gluing up blocks of rings**

It would be easy to glue one ring on top of another if they were not rotated in relationship to one another as our design calls for. As it is, it's difficult enough to glue up a group with any kind of accuracy. Because there are nine base rings below the barrel's feature ring, I glued them up in groups of three; plus another group for the exhaust end of the stopper and groups of four and two for the barrel and stopper between the two feature rings. To make the $15^0$ rotation as accurately as I could, I stacked a group together and marked the rotation on three sides. See Fig. 15.

***Fig. 15*** *When gluing rings into groups, mark the offset on three side of the rings to aid in getting the rotation even all around.*

When gluing rings together, apply glue to one and then rotate the two rings together to spread the glue and begin to squeeze out the surplus. See Fig 16. Keep rotating back and forth, applying more hand pressure until you feel the glue beginning to tack. Very quickly align the rotation, and the position of one ring on top of the other. You'll see how the corners fit from one side to another and on each of the mating corners and flats. With the third ring beginning to tack on the second, add a spring clamp and check closely for clamp drift. Clamp drift comes from closing a spring clamp at an angle to the joint, causing one piece to drift out of position as the clamp tends to return to a parallel position. Add a second clamp to equalize the pressure on the joint.

My shop, just like everyone else's, is short of clamps and I only had enough to do 4 groups. But by the time the fourth group was clamped, the first was cured enough to reuse the clamps.

***Fig. 16*** *When gluing rings together, make sure the glue is spread uniformly over the glue surface.*

I glued the .125” walnut rings on either side of the feature rings with an offset equal to half the segment width.

**Boring the ring groups**

I no longer bore call blanks on the drill press, rather I bore in the lathe. I find it more accurate and while slower, I get a cleaner bore. It does require a spigot chuck, and if you don’t have one and are not inclined to add one, you can bore on a drill press.

Each of the ring groups was bored .5”, even the barrel groups. See Fig. 17. I have a .5” aluminum rod that I use to glue the groups together.

Select the flattest face of each ring group to seat against the base of the spigot jaws. After boring, face the outside surface to aid in gluing group to group during final assembly.

***Fig. 17*** *I mount each group of rings in a spigot chuck, a drill chuck in the tailstock and bore .5” prior to final assembly.*

***Fig 18*** *Spread glue on groups of rings as you thread them on the .5” rod much the same as the glue up of rings into groups.*

***Fig. 19*** *The final assembly of the stopper includes three ring groups plus the ring that will insert in the barrel. Let the glue cure a few hours befor turning.*

**Final assembly**

Wax the .5” rod before adding ring groups to keep from gluing the whole works together. Arrange the ring groups as they require for the design and thread the first on the rod. Before adding the second group, give it a liberal application of glue, thread it on the rod and rotate round and round until the glue begins to tack. Fig. 18 shows the glue spread between ring groups. Make sure the rotation is right before pressing the groups together for a minute or two. Add successive groups in a like manner. Be especially careful about the rotation of a base ring group to the final end of the feature ring. The spirally effect of the walnut/maple segments in the base rings should continue beyond the feature ring as if the feature simply replaced an equivalent number of base rings.

Adding the two clamp blocks and bar clamps may be unnecessary since by the time you get them in position and tightened, the glue has already set up, but I put them on anyway. See Fig. 19.

I leave this final assembly clamped up for a few hours at least, overnight would be better.

**Rough turning**

I simply remove the bar clamps and clamp blocks and then chuck the rod in a collet chuck to rough turn the blank. Run the tail stock up for such support as you can get with a collet chuck. See Fig. 20.

Here’s where razor sharp tools are essential. Usually I go directly from the wet wheel grinder to the lathe but for the first rough out of a segmented call I hit the fresh ground edge with a diamond hone. Remember, we’re attacking the wood from its sharp corners running with the grain and there is danger of splitting rather than cutting. I made this same pattern in aromatic cedar and Western Larch, both of which split so badly, the call ended up in the fire box.

***Fig. 20*** *Rough turn the barrel to its largest diameter. We’ll remove it from the rod, chuck it in the spigot chuck and counter bore the stopper end.*

I turn the barrel to its maximum diameter and then drive the .5" rod from the blank. It then goes back into the spigot chuck with the tailstock run up to center and hold the blank while I tighten the chuck's jaws on the mouth end. I can then counter bore the stopper end .75" dia. x 2.75" deep. The 2-piece stopper will insert .75" deep and the tone board will be 2" longer. The counter bore creates a bit of resonance chamber and the .5" mouth piece bore remains just that. See Fig. 21.

The stopper can be turned entirely on the .5" rod since the glue squeeze out on the inside pretty much forms it to the rod well enough to tolerate the turning forces. I glue up the stopper ring groups and mount the rod in a collet so the .75" walnut ring is toward the tailstock. That way I can fit the insert to the counter bored barrel blank. I may have to use my regular stopper mandrel to finish up the exhaust end of the stopper.

***Fig. 21*** *I counter bore the stopper end of the barrel .75" x 2.75" deep to recieve the stopper and to create a resonance chamber. The barrel's mounth piece remains at .5"*

**Conclusion**

I'll leave the outside turning details to you since I suspect if you've read this article this far, you don't need my instructions any further. You can see from the original plan and the finished call that I incorporated several of my favorite turning features. It seemed a shame to spend so much time building up a segmented blank to not include some detailed turning features. But it would be equally sensible to turn the outside to a very plain profile and allow the segmentation to dominate. Fig. 22 shows the finished "Aztec" call.

If I have been unclear or left out something you find necessary, feel free to e-mail your questions, critique or comments: flyfisheman@windwave.org

***Fig. 22*** *"Aztec" includes many of my favorite turning features: beads, asymetrical coves, fillets, tapers, cyma curves and half beads.*