The Crow Banjo
Dan Drabek

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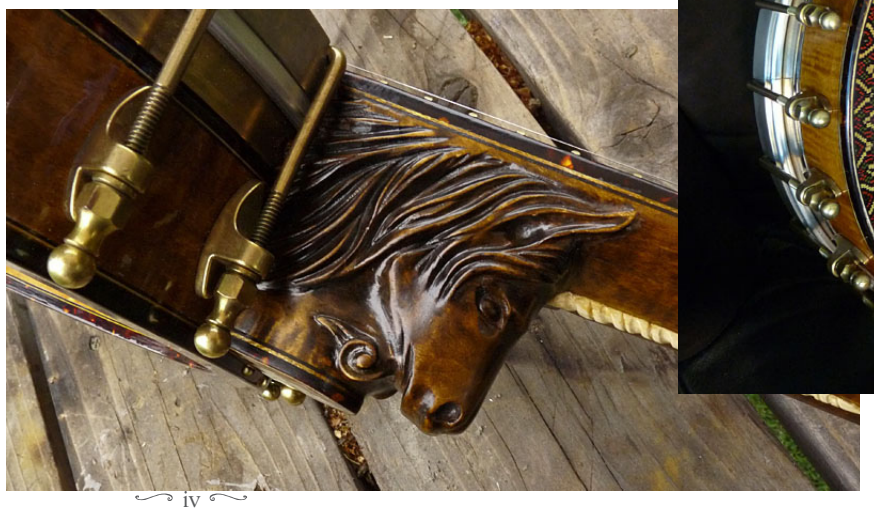
Building A Banjo

Dan Drabek

The Crow

The Neck

The Rim



Most of my recent banjos have been all-purpose instruments. Suitable for both bluegrass picking and open back frailing. I cut my eye teeth on an arch top bluegrass banjo in my early years as a picker, and missed it's unique characteristics. So I decided to build one for myself that would be a straight-ahead bluegrass instrument, but of my own design and esthetics. I wanted to use some of my most successful design elements that I've done in the past and put them all together in this banjo. So while it may look similar to a couple of my earlier banjos, it is one-of-a-kind.

I haven't yet made the resonator, but decided to post it as a work in progress. If it generates any interest, I will post the resonator and metal work as separate projects in the future.

I've also taken many photos of each step in the construction, in case I decide to create a multi-part examination of exactly how it was built. Everything on this banjo, with the exception of the current hardware was made from scratch in my small shop with modest tooling, and almost no special jigs, and some might enjoy seeing how it was done.

There are also a few unique features that are rarely if ever seen on traditional banjo designs, and some might like to try their hand at them. I have it all documented step-by-step.

Anyway, this banjo was built with a curly maple neck, Honduran rosewood burl on the front of the peg head, with ebony overlay on the back of the peg head. The fret board is made of Arizona desert ironwood, which is very rare in large pieces, and while it resembles Brazilian rosewood, it has no pores in the wood and is harder than ebony. Should last forever.

The rim is a combination block and steam-bent construction. with a claro walnut block core, and clad with 1/16" curly maple lams inside and out. The rim cap is a marquetry of colored woods that I made from scratch in the fashion of the sound hole rosettes found on classical guitars. The heel is carved in the form of a unicorn (my fourth unicorn banjo) with the horn fashioned from a piece of fossilized wooly mammoth ivory.

The peg head and all edges of the rim are bound with tortoise colored celluloid, and black/white violin-type purling.

The inlay on the seventh fret was cut from a silver half dollar, and the engraved inlay on the back of the peg head was cut from a silver dollar. The square "dot" inlays on the fretboard were made from square and round metal tubing, black epoxy filler, with a center disc of mother of pearl.

The tone ring is a no-hole arch top made by Prucha, and I stripped off the nickel plating to reveal the bronze. All the metal was patinated to give it a look of age.

The banjo was finished with a mixture of very durable marine varnish types from Epiphanes and applied by brush. It will be several months before I can do a final rubbing out of the finish, but it is pretty shiny already, so I decided to post it as-is.

I haven't yet made a sound file, but will post one shortly in this thread. The banjo sounds great, with lots of snap, sustain and richness of tone. And loud. Intonation is nearly perfect with a straight bridge. Response is very quick, and it has good bass and clear trebles up the neck. And in all, I'm pretty happy with it. It doesn't copy any existing banjo (other than the hardware) but has a bit of the look of the old Fairbanks/Vegas I love so much.

DAN DREBEK

The Neck

Wood Selection and Assembly

I'd like to invite my fellow banjo builders and those interested in the process to follow along during the construction of a fancy banjo.

Being totally self-taught, and working out of a very modest work space with basic tooling, I may do some things in an unorthodox manner, but hopefully the results will show that there are fairly simple ways to solve some fairly complex problems.

This will be a series of posts, one every couple or so which will display the construction from beginning to end in what I hope will be a logical progression. I've been a craftsman for the past fifty years or so, and have developed some modest skills and ideas that you may find interesting and helpful. If I sense that I've lost my audience, I may choose to discontinue the process. It is, after all, time consuming and I don't want to bore anyone.

The banjo that I will be constructing here is one that I displayed last August on this forum. I call it the "Crow" banjo. Here is a link to the original thread for anyone who hadn't seen it:

http://www.banjohangout.org/topic/321487

I plan to present pictures and explanation of every step I took along the way. I'm afraid I don't have the time and energy to provide beautiful diagrams and illustrations like our friend Ken LeVan, but I do have about 150 photos that do a reasonable job of illustrating the construction. In the interest of practicality, I'll be breaking up the process into chunks rather than creating a giant thread.

Before I start, I want to note what power tools I have that were used in this project. I've built banjos with nothing but hand tools, and could do so again, but the power tools do help do things more quickly. My shop contains:

Table saw, band saw, drill press, router with home made router table, miter saw, combination disk sander and 1" belt sander, spindle sander, 12-1/2" planer, hand drill and dremel tool. Most of which can be found in the typical home workshop.

And, of course, I have a wide range of non-powered hand tools, clamps, etc. that I have accumulated over the years. I rarely build jigs, since I build few instruments, and each one is unique. I never plan on making duplicates of the same design, so I would rather spend time building banjos than building jigs, patterns and forms. What few jigs I have made are very simple and designed for limited use.

Notable in their absence above are lathe and jointer. I do not have a lathe large enough for turning rims or resonators, so have learned how to do the work without one. And while I have a jointer, I never used it on this particular project. I do have a little Sherline mini-lathe, and did use it on one small operation (that will be shown) but it was nothing I couldn't do (and have done in the past) with a simple razor saw.

I just want to add that what I show here may not be the best way to work, but it's the way I work. If you copy any process it is at your own risk, and problems or lost digits you may encounter in your own shop are your own responsibility. Work safely. I welcome any comments, corrections or criticisms of what I show in the following threads, and am always willing to learn if you have better ways, though I reserve the right to disagree. :-> Thread drift is not only acceptable, but encouraged. We are here to have fun.

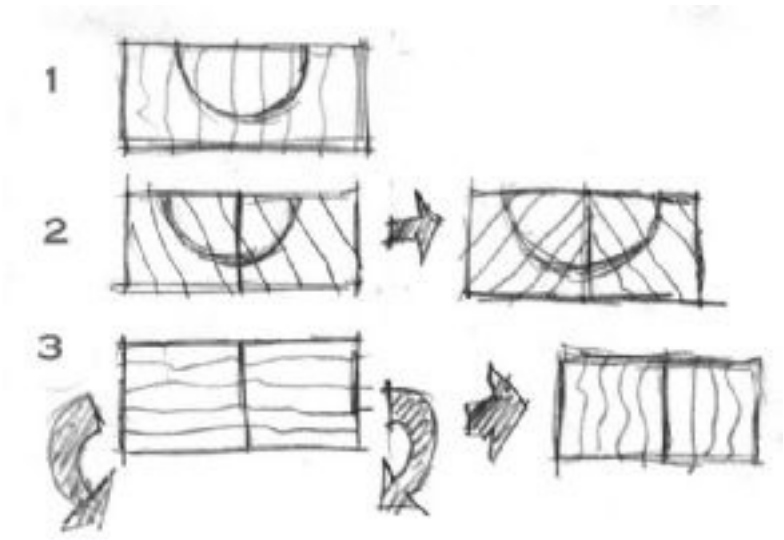
The first step in building one of my banjos is wood selection. It's also one of my favorite steps. I have a lifelong love affair with wood, and often I'm inspired to build something new, not because I need it, but because I ran across a special piece of wood that I just had to turn into something nice. The first banjo I posted on this forum (the sailboat banjo) was given birth because I happened to acquire some century-old Cuban mahogany from an old sailboat that had been dismantled. I love stuff like that. Interesting wood inspires me to do my best work.

On this crow banjo, the catalyst happened to be a piece of desert ironwood. I always was intrigued by this very hard wood—much of which is centuries old and picked up off the desert floor in Arizona and Mexico. Anyway, I always wanted to use some of the stuff for a fretboard. It's harder than ebony, but with the character and color of rosewood. Plus it's extremely stable. So when I found some of suitable size, I snapped it up. And then I began searching for some great curly maple to mate with it.

So far, I've made banjos out of maple, mahogany, walnut and rosewood. But curly maple to my eye is the most beautiful stuff for banjos, plus, it's very traditional. I found a very nice piece of maple on ebay that was quarter sawn, kiln dried and well seasoned. It was a large chunk of wood and I figured I could get a neck and rim and possibly a resonator out of it with careful planning.

Here's a closeup. Once stained and varnished, I knew it would make a special neck.

There are a number of ways to cut your wood for a banjo neck. All of them work, but some are more stable than other ways, and some look nicer. Some cuts will give you a good neck using the least amount of wood, and some cuts are more traditional. You have to decide what's most important to you, but you also have to consider the piece of wood you've chosen to work with. Each cut of wood offers different possibilities.
In the sketch below, I've indicated three ways to layout the cross section of the neck. . I've made banjos using all three methods.



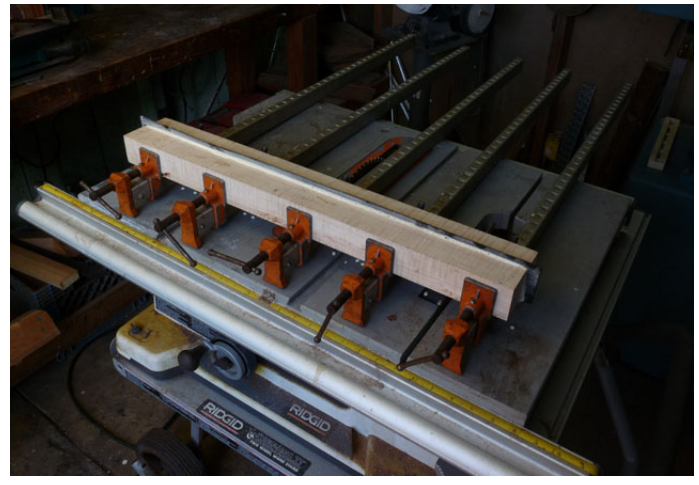
Number one shows a one-piece neck with no laminations. It really can show off a special piece of wood. Maybe not as stable as the other methods, but Gibson made most of their banjo necks like that, and they did OK over the years. With one piece construction, it really pays to use quarter-sawn wood—as shown.

With number two, we are using rift-sawn wood, so to stabilize it, we cut it in half down the middle, then rotate it end to end and flip it top to bottom. Glue it back together with a center strip of contrasting hard wood and you have a very stable neck without requiring quarter sawn lumber. It also shows off the figure in the wood quite well. Old Vega banjos used this method on many of their banjos.

Number three is my favorite method, and it has the huge advantage of making use of less costly and easier to find flat sawn wood. With this method, you simply split the billet down the middle, open it like a book and you have perfect, book matched vertical grain lumber. Glue a center lamination in between the halves and you have a very stable neck, with great figure and at a relatively low cost.

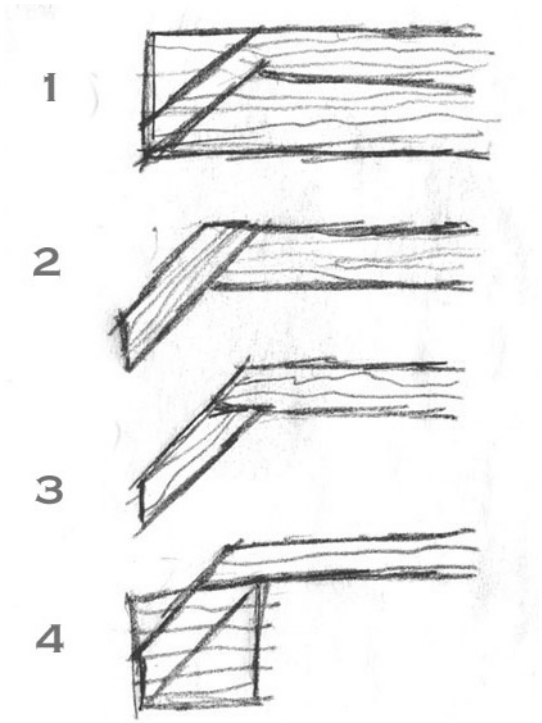
On the Crow banjo, I used method number one, with a variation. The piece of wood I had was highly figured with very tight curls, but there was some significant variation from end to end. So if I flipped and rotated half the blank, I would have had badly mismatched figure. And since it was already vertical grain, method three was not an option. So I chose to leave it in the natural orientation—more like method one, but I split the wood and let it sit for a few months to stabilize.

Then I glued it back together with a thin black veneer between the halves. A compromise between looks and stability. A risk I was willing to take.



By the way, Those clamps I found at the flea market. Cost me $20 for all of them. They're old, but heavy duty and I've used them on countless projects.

OK, the next step is deciding how you want to handle the peghead. Once again, it depends on the particular piece of wood you are dealing with.



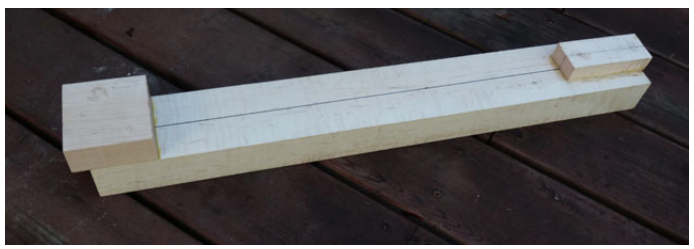
Number one shows the traditional method. All cut out of one piece. Not the strongest construction, but strong enough. Can be somewhat wasteful of wood.

Number two allows you to use a plank that is only 3/4" thick. The fretboard reinforces the joint. The drawback is that the joint is in an awkward spot and is clearly obvious in the finished neck.

Number three is the method used by classical guitar makers. Once again, it uses thin wood and is very economical. It's also one of the strongest constructions if you laminate overlays on the front and back of the headstock.

Number four uses wood with all grain running in one direction. It's about as strong as number one, but saves on wood, and if done right, the joint is invisible.

One of the main benefits of using thinner planks with scarfed head and stacked heel is that there is a higher likelihood of finding nice figure than if you demand a one piece neck.



I've used all but the second method on banjos in the past. On the crow banjo, I decided to go with method number four, because of the dimensions of my plank. The head joint will be covered front and back to hide the joint and give it strength, the glue line will be nearly invisible, and since the center lamination will not run through the added block, I don't have to worry about how it will run out on the tip of the peg head. Here is the neck blank with added blocks.

Peghead number three is particularly strong where the grain runs parallel to the peghead. In most banjos this isn't a problem. But with slotted pegheads--which tend to be extremely weak if using the first method, are much stronger with the third example. In any case, laminating the face and or backof the peghead will give more than adequate strength to any of the layouts.

The center lamination is of very high quality black-dyed hardwood and is .9mm thick. My source for veneers is:

http://www.wood-veneers.com

He has a huge selection of veneer--much of which is not shown on the web site. You can ask him for something special and he'll accommodate. He's a really nice dude.

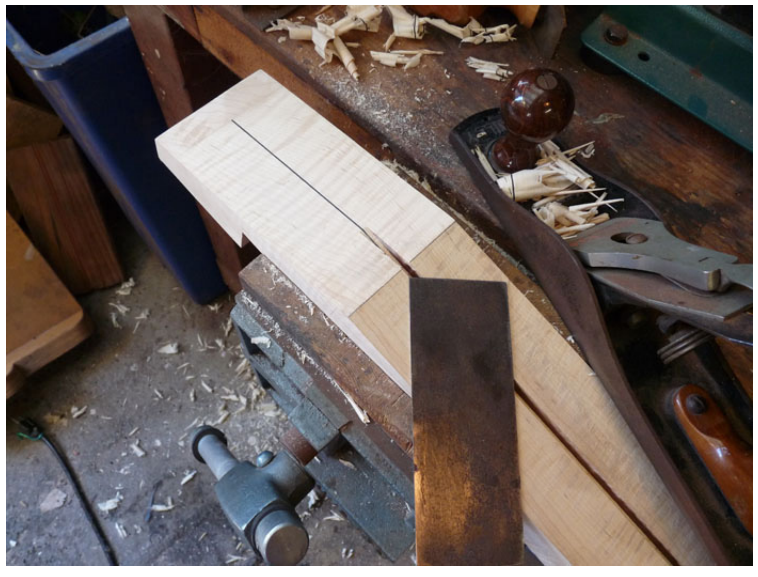
The veneer guy obviously likes wood. I called in my first order and we chatted about woods for at least a half hour. I asked about the color on a couple mahogany veneers because I was trying to get a certain shade. He said, no problem and sent me a veneer of each at no charge. Now that's customer service. I've been totally satisfied with what I've gotten from them so far.

By the way, I have no connection to any of my materials sources, but like to pass on good suppliers when I think they deserve it. So I will likely name my sources throughout this series, as I think it may be of help to the beginners. Recommendation of other suppliers will always be welcome, of course.

After getting the neck block glued up, I first true up the top surface to make sure it's dead flat. I lay a straight edge along the top to make sure I can't see any light under the straight edge. First I go end to end, then diagonal both ways, then across the width. Once I know for sure I have a flat surface, it's time to cut the channel for the neck reinforcement.

Most builders today utilize a two-way truss rod. A few builders, like Rudy, the late Will Fielding, and some others in the guitar world, including myself, prefer a solid neck reinforcement. I won't go into that debate on this thread. Let's just say that either method requires routing a clean channel in the neck, centered on the central lamination--if your neck has one.

I cut my slot on the table saw. I usually make several cuts--removing a bit more each time, and sneak up on the exact fit I am after. On the crow banjo I've used a piece of Chrome moly spring steel. Others prefer carbon fiber for it's lighter weight. I build relatively thin necks, so I use the material that has the greatest stiffness for a given cross section. And that material is steel. The dimensions are 3/16" wide, by 3/8" deep. It's important that the bar be inserted in the neck on edge to get maximum stiffness. I don't try for a super tight fit in the wood, but leave a few thou. of oversize to allow some epoxy to fill the extra space. Epoxy makes for a stronger joint if it's not starved for glue. I also scratch-up the steel bar with coarse sandpaper to give it some texture for a better glue grip.



In the picture to the left, you can see the slot for the bar. Also, in the same picture, you can see the peghead cut. I don't recall the exact angle, since I usually copy the angle off my previous banjos with a sliding bevel gauge. Everyone prefers their own angle. Once transferred to the side of the neck blank, I band saw off most of the excess wood, leaving about 1/16" extra for final planing. I take a 90 degree machinist's square and strike a line across the stock to give me a line to work to. Then I use a sharp smoothing plane or jack plane, followed by a steel card scraper to flatten the front of the peghead till I hit the line. If you just split the line across the stock, you know the front of your peghead will be square to the top surface. Examine the picture to see what I mean.

Here is a view from another angle that shows how the neck reinforcement fits. Notice how it extends into the peghead and strengthens the spot where necks tend to break. Try to get it flush with the top of the neck, but don't let it sit higher than the wood, or it will interfere with the fretboard.

You can see in the above picture how the heel fits into the heel block. I will be carving the heel, so it will not be exactly as pictured, but it gives me a guide line for roughing out the heel.

Also notice how I've tried to roughly match the grain of the wood on the three pieces. This isn't hard to do if the heel block is cut from the same piece of wood as the neck. And it helps to make the glue joint less noticeable when the grain aligns.

I also try to match the grain on the side of the peghead block. The side surfaces are the only ones that will show on the finished banjo, and attention to details like this help make the joint invisible.

I also try to match the grain on the heel block. It's not perfect, but I'll be carving the heel, which will tend to mask any discrepancies.

Sanding Surfaces Flat

Before jumping into the construction, I wanted to say a few words about one of my most useful, and most used tools in my shop.

It's a simple sanding board.

Mine is a slab of marble countertop material. Polished on one side and rough on the back side. It measures 12" x 18" x 1/2". You could also use a thick sheet of plate glass, but it would be worse if you dropped it. There are times when I wished my surface was a little larger, but the stone would get heavier,and I move this thing around a lot.

In the photo below you are looking at the back side of the slab. I've just glued some sandpaper to the smooth side with rubber cement. and am about to trim off the edges with a utility knife. I like rubber cement better than contact cement or carpet tape for attaching the sandpaper. It's less messy; the paper peels off easily, yet holds for months without losing it's grip; it's slightly more positionable, and if your surface is smooth and clean, it will just rub off the surface, or can be removed with a rubber cement pickup. I would buy it in at least 1 quart size. The little jars are too expensive. I have a couple gallons of the stuff~left over from my graphic arts days.

I usually thin it out a bit with rubber cement thinner. Then, like contact cement, I brush on one coat on the stone surface, and one coat on the back of the sandpaper. Let it dry till tacky, and carefully lay it down on the stone and roll it down tight with a rolling pin.

The abrasive I use is red aluminum oxide paper and it comes on a roll in 4" width. I get it in 80 grit. You might want to shop around for the best price, but this is the stuff:

https://www.amazon.com/PERFORMAX-TYPE-READY~ABRASIVE-SANDPAPER/dp/B00N3EUPT6/ref=sr_1_fkmr1_3?s=hi&ie=UTF8&qid=1475701594&sr=1-3-fkmr1&keywords=Abrasive+sheet+roll+80+grit+4%22+wide

I've got a roll that has lasted me for years, as it's long wearing. I just brush it off with a bristle brush when it gets covered with wood dust and it just keeps on going. I'll change the paper maybe every two or three months, depending on how much use it gets. Three strips covers my stone with no gaps or overlaps. The outside excess trims off neatly.

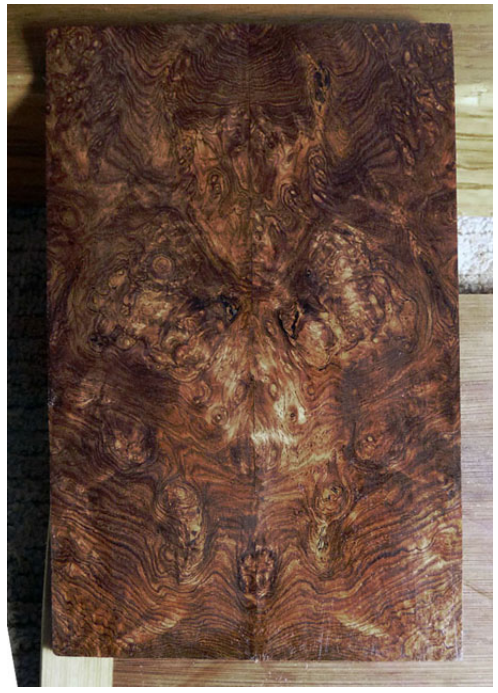
So, what do I use it for? Lots of stuff. Whenever I need to sand a dead-flat surface on tiny pieces the size of a bridge, up to larger pieces the size of a fretboard or neck blank. It takes a little bit of practice to get the feel of it, but I can get a flatter surface than I can on my jointer, plus, it's totally safe to use. No kickback, or lack of control. You just lay the item on the sanding board and rub it back and forth. (I only apply pressure on the forward stroke~like when I use a plane) It cuts faster than you would expect, and if you don't run your workpiece off the edges, it will always create a flat surface. If you run a longer board off the edges, it will tend to make the surface concave, so always keep it as close to the middle of the stone as possible. On longer pieces, like fretboards, I run the piece on the diagonal to get a little extra room, and I use shorter strokes. When sanding something like the bottom of the rim, I will even sand by rubbing the rim around in a circular motion without changing direction at all. It doesn't matter to the sandpaper, it will cut in any direction with no chipping, tearout or other problems.

On the previous page is a typical example of how I use it. I'm sanding two pieces of Honduran rosewood burl to use on the peghead overlay. I want these overlays to be about 1/8" thick so I can later bind the edges. I bought the wood online from a seller who markets it for knife handle material. I took the blank and re-sawed it on the bandsaw into thinner slices. I took the two nicest pieces, and will bookmatch them on the peghead. After sawing, I sanded them on both sides on the sanding board. It smoothed them out quickly, and the 80 grit leaves a perfect surface for gluing. Unlike a jointer or planer, there is no possibility of tearout even on curly or burled grain.

I check the piece every now and then to make sure it's removing the material evenly. If I notice any wedging, I simply rub with a little more pressure on the opposite side,and it will bring it back down to parallel.

Here, I'm squaring one of the edges on each piece. Holding it against the level while sanding gives me an accurate 90 degree angle.

Here I'm gluing the two pieces together. I'm using hot hide glue because it does well at hiding glue lines. Plus, it shrinks as it dries, which pulls the joint more tightly together without clamping.



And here are the joined pieces after a little more sanding on the sanding board and a quick swipe with thinned shellac. Pretty wild stuff, no?

Actually, my marble slab may well have started it's life as a pastry board. Check this out:

https://www.bedbathandbeyond.com/store/product/white-marble-12-inch-x-18-inch-cutting-board/1010713269?skuId=10713269&ioid=HH000032&mcid=PS_googlepla_nonbrand_kitchenfoodprep_&adpos=1o3&creative=43742640949&device=c&matchtype=&network=g&product_id=10713269&gclid=CP2enaayxs8CFYFYfgod8WQOUg

Notes: I don't know why they have to use such aggressive adhesive on sandpaper. Maybe they're afraid it will fly off the power sander and smack you in the face. (law suit) I shudder every time I need to change the paper on my disk sander. I always end up having to scrape the paper remnants off, and haven't yet found the solvent that quickly and easily removes the glue. I'm thinking of giving the back of the next disk a light misting of spray fixative, to reduce the tack. Or maybe fasten strips of masking tape to the face plate so the grip will be less.

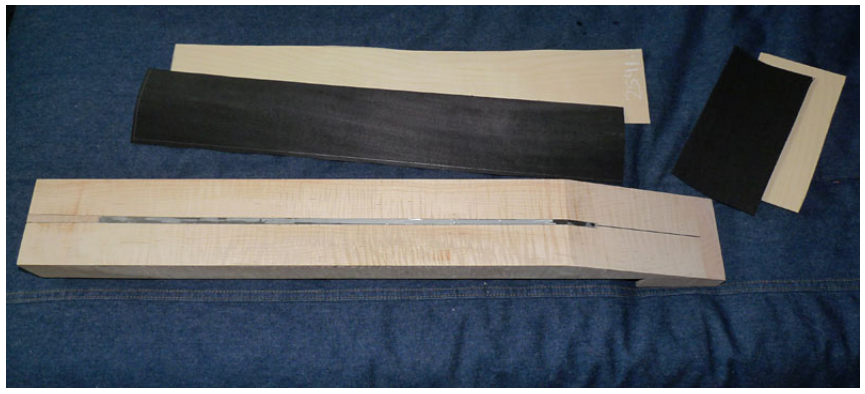
Just speaking from personal experience, a larger sanding board would be great, but be careful about ending up with something that is hard to pick up and move around--unless you have a large shop and have room for a permanent sanding board table. I like to take mine out the door into the back yard to do my sanding. And when I'm not using it, I can stash it almost anywhere. Of course, the larger the sanding surface, the longer you can make your strokes, ergo the faster you can sand. For me, 12" x 18" is a reasonable compromise. 12" by 24" might be a better choice for most purposes. Extra lengrh would be more useful than extra width.

Ken, I thought about velcro too. But, do you get more than one use out of the sheet of velcro? Or do you buy adhesive backed velcro and leave the cover film on the sanding disk?

The Fretboard

OK, we now have a full neck blank glued up and peghead angle is cut and trued up.

On the crow banjo I'm going to laminate black and white veneers to the top of the neck and peghead. I'll be using .9mm veneers--one of black dyed hardwood and one of maple. The neck wood is maple, so the black overlay will go on first, the white overlay on top of that, and the dark fretboard on top of that. I'll be using Titebond glue for this procedure. Here's a shot of the neck with the overlays.



I've cut the overlays a little larger than the neck blank, so I don't have to worry if it slips around a little when clamping. Also I will be gluing one veneer at a time. I could save a little time if I glued both veneers at the same time, but I'm in no hurry and there will be less slippage if I don't sandwich them. If I were adding ears to the peghead, they should be added before the overlays, but my blank is wide enough that I don't need the ears.

Here's the way I glue up the blank. I have an indoor work bench with a top made of a 1" thick slab of polypropylene plastic on top of a 3/4" layer of MDF. The bench top is dead flat and and immovable, so I often use it for doing glue-ups. The plastic is also waterproof, and glue won't stick to it, so I don't need to worry about gluing my workpiece to the bench. In the above photo, you can see that I'm using the neck blank as a clamping block when I glue it to the black lamination. When it sets,I'll add the white lamination that will go under the fretboard. Once the laminations are dry, I'll trim them flush to the sides and scribe a line across the blank where the nut will be located, and using a razor saw and chisel, I''ll trim the top end of the laminates perpendicular to the third string line (not perpendicular to the center lamination of the neck) . Then I'll glue the laminations to the face of the peghead in a similar way, butting up tightly against the neck laminations to give unbroken purfling lines that will run under the fretboard, nut and peghead overlay.

Fretboard construction.

I've made most of my own fretboards in the past, but if I were going to use ebony or rosewood for a fretboard, I would probably buy one ready made. CNC boards these days are super accurate and almost as inexpensive as uncut blanks.

But on this banjo, we are using a piece of desert ironwood, so I will have to cut the fret slots by hand. Here's how I go about it...

The first thing I do is cut the board down to size and make sure it's square and accurate on all sides.

Some may wonder why I didn't thickness the fretboard by running it through my thickness planer. Well, it's partly because I had never worked with desert ironwood before, and didn't know how it would react to planing. It's very hard stuff. I didn't want to take a chance of chipping, and I preferred not to dull my planer blades. So I opted to thickness it with a carbide blade on my table saw.

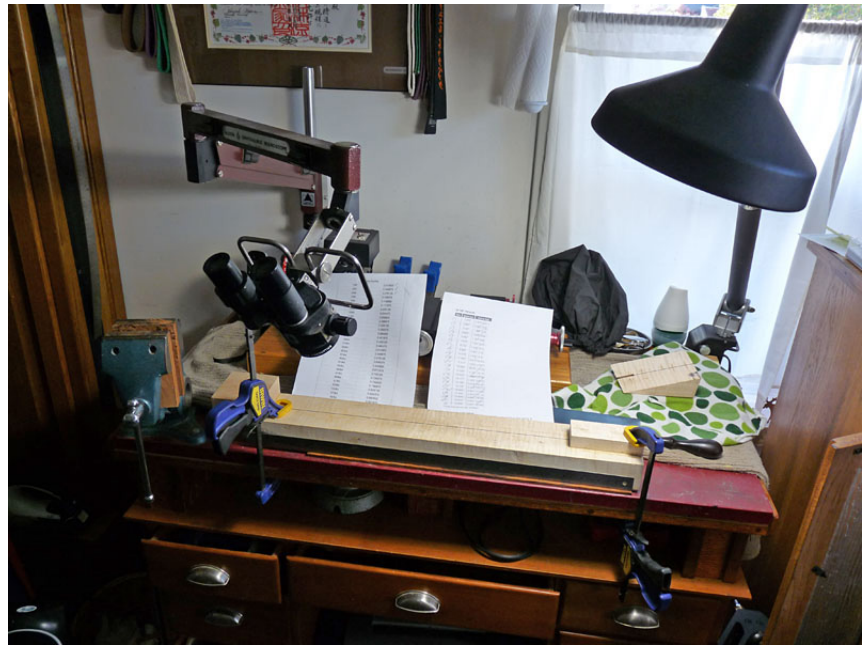
To thickness the board, I first attach it to a straight, and accurately square block of wood using double-sided carpet tape. I use a backer block that is just slightly larger than the fretboard, and wide enough to sit firmly on the saw table. Using a homemade featherboard and push stick I take an accurate but thin cut, just to get one side very flat. Then I flip the board, re-fasten to the backer board and carefully trim the fretboard down close to it's final thickness. (in this case, roughly 3/16") I use a sharp blade to make the cut, and I end up with a very accurate cut with a very smooth surface. I then trim the sides of the blank to make sure they are perfectly parallel to each other.

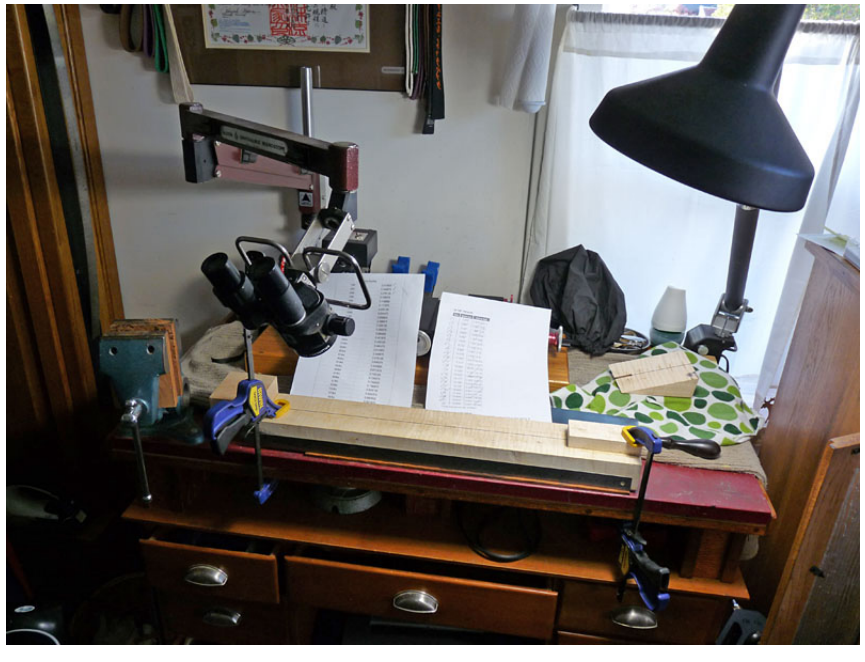
Note from Mark Pollock: If you are interested in an alternative to carpet tape, this guy has a GREAT method. (Long video, but totally worth it.)

https://www.youtube.com/watch?v=ub6PsY4cgwg

If I'm not completely satisfied with the flatness, or thickness of the board, I'll do a final touchup on the sanding board, using a dead flat backing block, just a bit smaller than the fretboard.

The fretboard is now still oversized, but absolutely flat and smooth and of the correct thickness. On to fretting...





Here is my indoor workbench set up as a fretting station. I have the fret scales printed out and set up so I can check the numbers off as I work. There are plenty of scale calculators online, so I won't go through the calculation procedure here. All my banjos have a fairly standard 26-1/4" scale, because that's what I'm used to playing, and have found no particular reason to stray from it. For most of my work I make use of an opti-visor with #5 lenses for modest magnification. But for reading the small ruler scales, I like to use my stereo microscope set up at about 20x. For the measuring, I use a 24" steel rule that has a full scale divided into 1/64". It's made by Gaebel:

http://www.baypressservices.com/acatalog/610A_Stainless_Steel_Ruler_Inches_32___64__8___16.html

If you look at the picture above, you can see that I set the fretboard on the benchtop, clamp a block (the neck blank) on top of the fretboard, and double-stick-tape the rule to the side of the block, resting on the fret board, very near the edge. I find it easier to mark the frets if the rule is held in the vertical position with only about 1/16" of the fretboard showing.

I find that 1/64" accuracy is more than adequate, but I do admit to splitting a few of the divisions if the calculations fall in the middle of the tick marks.

If you look at the picture above and to the left, you can see the table top, the side of the fretboard above that, with only a small amount of the top of the fretboard peeking out from under the rule. And the neck block on top holds the whole assembly in a solid position. To do the marking I slip the tip of the Xacto blade into the engraved mark of the ruler, and press down to make a tick mark on the edge of the fretboard.

Once the board is completely marked, I use a machinist square to scribe the fret slot positions on the fretboard. I find it most accurate to insert the tip of the knife into the tick mark, and slide the square over until it touches the tip of the blade. Then I hold the square down and run the blade once along the square to make a thin cut in the wood. Marking with a thin blade is far more accurate than using a pencil. Plus, it won't smear or rub off.

I had planned to finish the fretting operation on this thread, but it's my turn to cook dinner tonight, and so I have to end it here for now. If I get a chance, I'll finish up the fretting operation tonight, otherwise it will go on the tomorrow's posting. Cheers.

Preparation for Fretting

You can certainly freehand cut the fret slots, and I have done it several times, but I have also had my saw blade skid a few times and scarred the fret board. So I decided to make a simple jig to hold the blade in position as I cut the slot.

The jig, if it merits the name, is as simple as can be. I've made a few of them, and have usually tossed them rather than hang on to them. I build so few banjos, they would just sit and gather dust, and they are so easy to make, I don't bother keeping them. But they are exquisitely accurate for doing their simple job.

The jig is made from two small pieces of scrap wood. The dimensions are not important, but one of the blocks needs to be almost as thick as the saw blade is deep. Almost, but not quite. You need to sand or surface the wooden block so that the saw blade will extend below the block to the depth of the fret slot you want to cut. Here is a snapshot of the complex mechanism:

First I cut a small block (maple in the photo) to the required size as described above.

Then, using my crosscut sled on the table saw, I cut it in half lengthwise. This gives me two vertical sides that fit each other exactly.

Then, I cut a small block of wood (mahogany in the photo) that is of similar size but will extend down from the bottom of the maple blocks at least a half inch. I then glue the two blocks together in the positions shown. I slide my fret saw between the two maple pieces and press them together to firmly sandwich the blade between the pieces, and I clamp it all down and let it dry. When dry, I saw down with the fret saw into the mahogany block. The purpose of the maple block is to keep the saw correctly oriented vertically and at right angles to the edge of the fretboard. The mahogany block is there to keep the whole thing glued together in the correct position, and to act as a fence that rides along the edge of the fretboard. Here it is from a different angle, showing the fret saw in position:

Actually, I have the saw in backwards. I'll be sawing fret slots with the maple side of the jig facing me. Sorry about that.

So you ask-" what is the little piece of rosewood doing sitting on top of the jig? Hold on, I was getting to that.

The saw is stopped in it's downward cut by the spine of the back saw hitting the top of the maple block. My particular saw has an uneven spine. One side extends down further than the one on the other side of the blade. So I glued a thin veneer of rosewood on the short side, so when I reach the end of the slot, both sides of the saw spine will be in contact with the wood. Your saw may or may not need this adjustment.

So, how does it work? Like this:

I clamp a block of wood in the vise. I set the fretboard on top of the block of wood, so that the far side of the fretboard extends slightly further than the block of wood. (positioning is not critical) Then I set the saw jig on top of the fretboard, and slide it toward me until the mahogany block makes solid contact with the fretboard, and the scribed position of the fret tang falls exactly in the center of the saw kerf. Then I clamp the whole thing down as shown in the drawing.

Once it's clamped in position, I insert the saw, and saw down until the saw stops cutting. I can make a perfect cut while watching TV if I like. There is no possible way for the saw to wander off the mark, or cut too deeply.

Once the cut is made, I loosen the clamps, slide the jig down to the next position and repeat. If you're careful not to let the jig slide around, you can even eliminate the clamps.

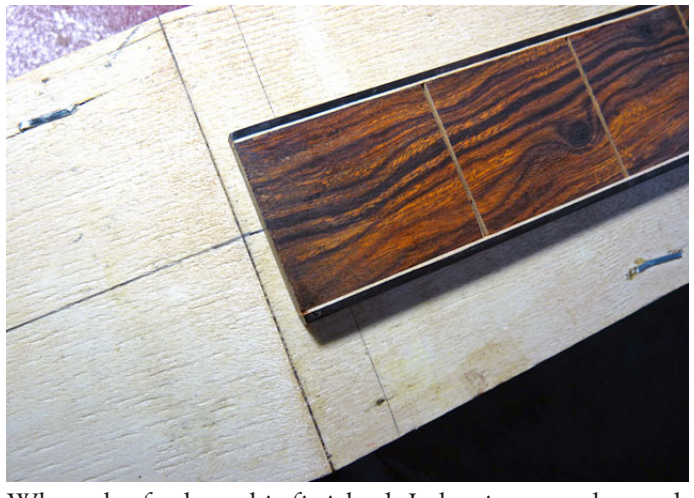
And that's how I cut the fret slot. There are easier ways to do it, but they either require more tools, fancier jigs, or risk inaccuracy, depending on your eye and hand coordination. Mine is not as good as it used to be, so I appreciate turning a critical job into a no-brainer.

Once the fretboard is slotted, it's time to bind it. You can bind the fretboard after it's glued to the neck, but I like to bind it first.

This is the way I do it. I clamp a block down on the table surface, I glue the binding, set it in place, and press the fretboard against the block. When I get good contact, I throw a couple of quick clamps on the fretboard to hold it tight against the binding. Once the clamps are set, I will usually give the edge of the fretboard a few taps with a plastic-faced hammer to get more pressure on the joint. On this banjo, I'm binding with a thin strip of maple veneer on the inside, and a piece of tortoise celluloid binding on the outside. I use Titebond glue to attach the white wood inline to the fretboard, and I use superglue gel to attach the plastic binding to the wood inline. I find it easiest if I glue one piece at a time rather than do them together and chance making a mess of it.

When the glue dries I do the other side in a similar fashion. But before gluing, I put the double-bend into the wood binding by wetting it and shaping it over a hot soldering iron. With the celluloid binding, I shape it by dipping the area of the bend into very hot water for a few seconds, and bending it with my fingers until it fits the curves. Then I glue it in place and let it set up overnight. The following day, I run each side over my sanding board to flush everything up, and make sure it's all smooth and flat.

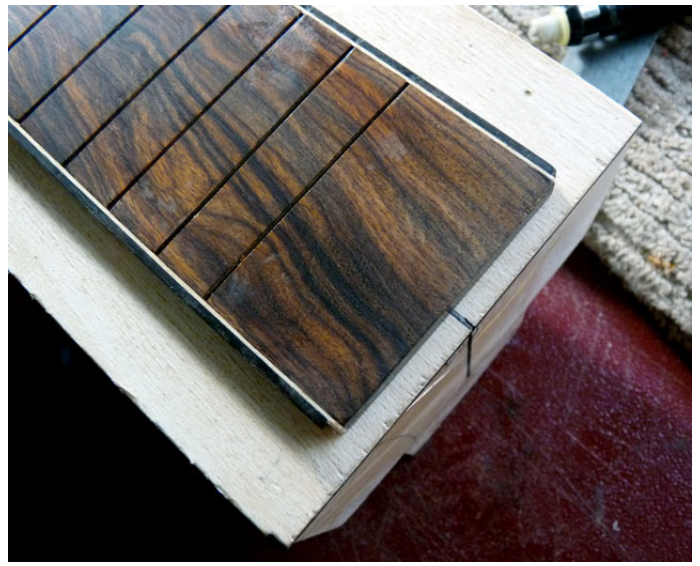
On the page before is the finished board with attached binding. Isn't that ironwood beautiful stuff? Unfortunately, within days it starts darkening, and in a couple of weeks, it is almost uniformly dark. Unless, you take it out and look at it in the sunlight, where it still glows with rich reds and blacks. But the surface of the wood is perfectly smooth with no pores, and very hard. And still prettier than ebony IMHO.



When the fretboard is finished, I glue it on to the neck blank. I prefer to have the nut sitting to the right of the neck/peghead junction, so I set the fretboard in place centered on the center lamination line (NOT the third string line) and drill a small locator hole through the first fret slot and about 1/4" into the neck. (missing the center reinforcement bar, of course) Be careful not to drill too deeply. You don't want to come out the back of the neck!

The other end of the fretboard also centers on the central lamination, and I drill a locator hole through the waste portion of the fretboard. Both holes are sized to fit small finishing nails, which will be inserted when gluing the fretboard to the neck, and removed before final clamping.

I glue the fretboard to the neck with Titebond glue. I apply the glue to both surfaces, push the indexing nails through the fretboard and let them extend about 1/16" , so I can tell by feel when they are aligned with the holes in the neck. Once in position, I clamp the middle of the fretboard, remove the indexing nails and clamp the ends of the fretboard.



The woods scientific name is Olneya tesota. There are several sources for it on the internet. Do a search for Arizona Desert Ironwood.

Ken LeVan: Do you have a mark on the side of the fingerboard to position the slotting guide?

I always like to see someone do something really well by a different method than I would use. We all have our methods. I am intrigued by your work-order. I would do profiling, slotting, inlaying, fretting, binding, gluing to the neck, in that order. What is your logic for your work order, particularly gluing the fingerboard on to the neck blank before inlaying it?

Dan: On the slotting guide, I do not mark on the side of the fretboard. The maple blocks are cut to a slightly narrower width than the fretboard blank, leaving about an eighth inch strip of the fretboard top exposed. I can see the scribed line on the top surface of the fretboard and exactly where it enters the saw kerf. I center the scribe in the tiny gap and get extremely accurate positioning. Thanks for asking, as it's not too clear on the photo.

I like to do final truing of the fretboard surface after gluing it to the neck. And since I don't use adjustable truss rods, I will often create a little neck relief by doing a bit of sanding centered around the 7th fret. By doing the inlays after this step, I don't have any concerns about sanding my inlays too thin.

Also, since there is often a lot of time and work involved in doing a fancy inlay pattern. I shape my neck with the fretboard in position. I'd just as soon get the neck glued-up and shaped and make sure everything is just right before inlaying on the outside chance I make a slip, or feel the need to start over.

Finally, I don't have any problem with the neck being in the way when I do the inlay work. I usually clamp the neck in a vise, which is convenient for me.

I know you cut your inlay cavities with an overhead router setup, and move the fretboard around on a flat surface. If I were to use a setup like that, I would absolutely inlay the fretboard before gluing it on the neck.

Ken LeVan: That makes perfect sense. I wasn't thinking about the idea that you might want to make a little relief on the fingerboard in absence of a truss rod.

When you say you shape the neck with the fretboard in position, is it glued on? I always shape the neck with the fully inlaid, fretted and spiked fretboard glued on. However, as you say, "in case I make a mistake" (which I sometimes do), I would rather make it on the fretboard before it's glued on rather than after - there's a fear factor there. It hurts me to cut apart something I have spent so much time on.

It certainly is interesting how many ways you can do the same thing, which looks simple and straightforward in the end.

Dan: I glue the fretboard on before shaping the neck. If I'm not binding the neck, I glue the unprofiled fretboard to the neck, and then I profile the neck and fretboard at the same time. If I'm binding the neck, I profile the fretboard first, bind it and glue it to the neck. Then I carve the neck down flush with the binding.

Everyone makes errors from time to time. Especially when you build one-off instruments like we both do. I have to constantly remind myself to slow down, measure twice, cut once, etc., because it's a lot faster to do it right the first time than having to repair or re-do what I've already done.

Binding the Peghead

One of the tricky operations.

Peghead binding is far more difficult than binding the neck or rim or resonator for several reasons. The curves on a peghead are usually more ornate with multiple curves, bends, points, etc. Binding an ornate peghead will often require installing the binding in short pieces. Coaxing the binding into making sharp bends and curves can fracture the binding, or cause gaps when you glue it in place. Also, pegheads are customarily angled, with the cuts being made perpendicular to the fretboard rather than the peghead. The basic cutout can be done easily on the bandsaw, but binding those slanted cuts presents a different problem. How can you make an even binding channel when it is slanted? And how can you get the binding to fit the channel when it's being twisted into a spiral shape?

There are several ways to approach the task, and I know my way is only one solution. But it has worked for me, so I'm going to outline the process here. If someone has a better, easier way, I would be very happy to hear it.

I love bound pegheads. They are most commonly done using a single line of Ivoroid. On the crow banjo I wanted something more subtle, so I'm going with a more complex assembly using tortoise celluloid binding with a white, maple inline. Since such multi-line binding doesn't exist in ready made form, I'll be doing the binding one layer at a time. And I'll be using a different type of glue for each layer.

I've been using the same peghead design for the past 40 years, and have re-drawn it in Adobe Illustrator so I can manipulate it and print it out from the computer.

I attached the line drawing to the peghead overlay with rubber cement, and I cut a softwood block to the same angle as the peghead. I mounted the overlay to the angled block with double sided carpet tape.

On the drawing above, the thin black line shows the finished outline of the peghead. The gray area inside that line shows the thickness of the binding. I'll be cutting to the black line on the bandsaw, and sanding down to the inside of the gray area before gluing on the binding.

Here's the cutout peghead before sanding. In the background, you can see the sanding drum chucked in my drill press. to make the drum, I glued sandpaper to a dowel. I don't try to sand the entire block of wood.--just the peghead overlay. I raise and lower the drill press table to get variation in height. By sanding this way, I can maintain an exact and consistent angle of the overlay.

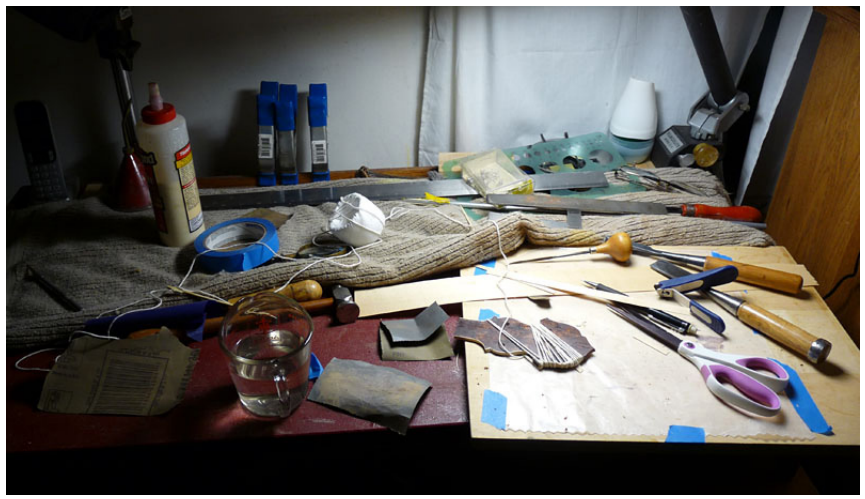
In the tight areas where the sanding drum won't reach, I use small triangular files to get into the small crevices. Once shaped, I remove the overlay from the block and check it for fit.

Here is the finished overlay, It's hard to tell from the photos, but all edges of the overlay are now vertical and ready to take the binding.

First comes the maple veneer. I cut it oversized and will cut it flush after it is glued and dried. In the area of tight bends, I wet the maple binding strip and bent it over a hot soldering iron till it was very close to the correct shape. The oversized binding allowed me to twist it to take the slant of the overlay without twisting it off the edge.

Clamping the angled binding seemed almost impossible, but then I remembered that Spanish guitar builders use string to bind their guitars, so I tried it on the peghead binding and it worked perfectly. If I were more practiced at it, I would bind both sides at the same time, but I decided to do it one piece at a time. I first held the oversized binding in place and tacked it down with a piece of tape. Then I wound the string to tightly bind it to the overlay. I used titebond glue for this operation.

On the very short pieces, rather than bind with string, I "clamped" the binding with push pins on a softwood board. I used wax paper to keep from gluing the overlay to the board. Pushpins through the tuning peg pilot holes held the overlay in place on the board. More pins held the binding strip against the overlay. I left the binding long, so it was easy to handle, and trimmed it flush when the glue hardened. I made no attempt to miter the tiny corners, but worked my way around the peghead, cutting the end of one piece flush, and overlapping the end with each succeeding piece.



This is what my work table looked like a quarter of the way through the process. Amazing how I can make such a mess during such a simple little operation, I guess I just have a talent for it. To me, the important thing isn't the neatness of my work area, but the quality of what comes out of it.

Here it is with the first layer of binding completed. I won't go through the entire process of adding the second layer. I did it in basically the same way, but I used CA gel glue to stick the celluloid binding to the wood binding. But first I dipped the celluloid in very hot water for a few seconds, which allowed me to twist the binding and keep it in good contact with the overlay edge. Binding gets pretty pliable when heated, and can be moulded to the shape needed. Before gluing each piece of binding in place, I painted the ends with acetone that were clamped together, which "melted" the bindings at the point of contact and made the joints invisible. Like with the maple binding I simply trimmed the last applied piece flush, and overlapped with the subsequent piece. Each added piece is left a little long, and is trimmed to fit against the previous piece, and then the other end is trimmed flush after the glue is dry.

Here is the finished bound overlay, ready to glue to the neck. I will be running black and white .9mm veneers between the overlay and the peghead. Black against the neck and white against the overlay.

I chose not to bind the back of the peghead, but I will be dealing with a volute, and the overlay process will require a more complicated approach. Tune in for that next time.

Peghead Assembly

Now that the face veneer of the peghead is bound and laminated, we have to glue it to the front of the peghead. We also have to laminate the back of the peghead, and trim up everything to be nice and flush. Looking closely at the above photo, you can see that the front of the peghead has three laminations. The peghead overlay we just completed, a maple veneer and a black-dyed veneer.

The back of the peghead has a black dyed veneer, a maple veneer and a thick ebony overlay. I could have used more black veneer for the back of the peghead, but I wanted some of the natural color variation in the genuine ebony overlay. It does entail more effort, of course. But I'm a glutton for punishment.

First, I calculate the thickness of the various layers and determine how far the thickness of the peghead needs to come down to maintain a reasonable thickness of the finished peghead. Most banjo pegheads are close to 1/2" thick, but I prefer the look of a 5/8" peghead, plus, all the laminations add to the thickness, and if I went with a half inch thick peghead, the center core would become very thin. I first bandsaw most of the excess wood from the back of the peghead. Then I finish thicknessing the back of the peghead using my Saf-T-Planer. I can also do it with a small block plane, but the Saf-T-Planer is much faster and very accurate in maintaining the thickness.

I can only plane down the back to within a certain distance from the volute, so the final shaping has to be done by hand. I usually start by carving it down with a shallow carving gouge, then I rasp it smooth with a file, flatten it with a card scraper, and do the final shaping with a piece of sandpaper. Rather than scrub the back of the volute with the sandpaper, I press down with one finger and pull the sandpaper out from under the finger. You get pretty fast at this after a while, and it gives you good control over the shaping. And it avoids rounding the edges, which is important. The picture at the bottom left of the page illustrates the action.

Once I get the back of the peghead flattened and shaped, it's time to glue on the veneers. I first cut and shape a block of soft wood to roughtly match the shape of the back of the peghead. I also cut a piece of red, rubber gasket material (available at most hardware stores) to act as a cushion when clamping. The thin black and maple veneers can be soaked in hot water for a few minutes, wiped of excess dampness, clamped to the back of the peghead and left to dry overnight. When clamping, I lay the veneers in place, set the rubber sheet on top of the veneers, and set the clamping block on top of the rubber sheet. The soft rubber layer helps eliminate any gaps in the laminate by forcing itself into any loose areas.

Once the veneers are dry, I take them off the form, brush on a coat of Titebond glue on all surfaces, and reassemble everything and clamp it tight.

The thick ebony veneer is the hardest part and I do that separately, after the thin veneers are glued in place. I used a stock piece of ebony overlay for the back layer and thinned it on my sanding board, using a backing block, to a little over 1/16" thick. Even though it was thinned, the ebony would never take the volute shape without cracking. So I first soaked the end of it in hot water for a half hour and then bent the end over a hot plumbing pipe that I set up with a propane torch heating the inside of the pipe. Just like bending guitar sides. Once I matched the bend in the ebony to the curve of the volute, I was able to glue and clamp it in place as I did with the thin veneers. The picture on the page before shows this stage of the process.

On to the top veneers.

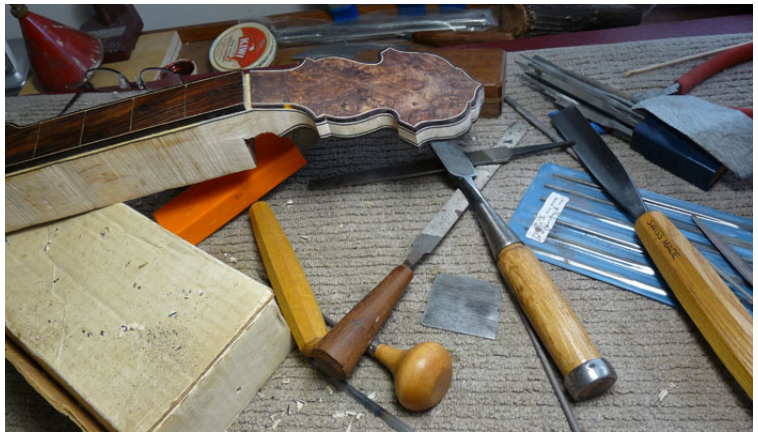
First I thickness the nut, as it will help me locate the peghead overlay. To accurately thickness the nut, I tack it to the end of a piece of wood with either double stick tape or a couple drops of super glue. This allows me to handle it securely and shape it on the disk sander. Using the protractor on the disk sander, I am able to keep both sides parallel.

Once I have the nut shaped to the desired thickness, I can set it in place and press it against the end of the fretboard with the peghead overlay. This gives me a very tight fit when the overlay is glued in place, and eliminates the need to painstakingly fit the nut to the slot after gluing.

I remove the overlay, paint glue on the surfaces, and set it up again. With the peghead overly pressing against the nut, I clamp it down with spring clamps to hold it's position.

Then I replace the spring clamps with C-clamps for final drying. I remove the nut while the glue is still wet, so it doesn't become glued in place. A little plastic wrap under the clamping blocks keeps them from getting glued to the overlay.

With the overlays glued and set, it's time to remove the excess peghead material with the bandsaw, and carefully finish bringing it down flush to the overlay with the drum sander in the drill press.



Final touchup is done with files, chisels, sandpaper and scrapers.

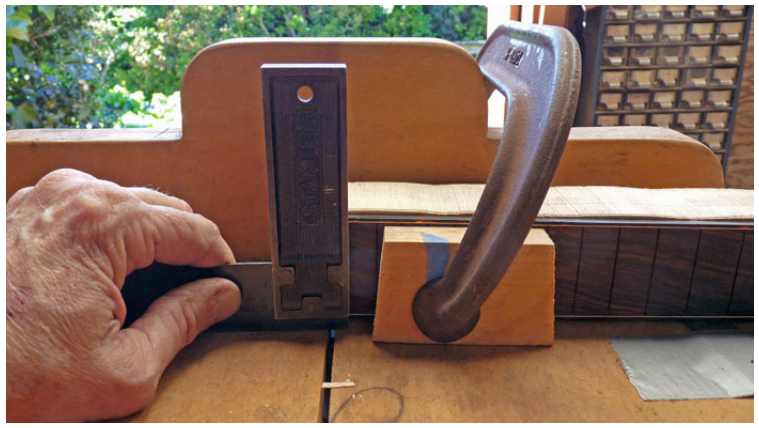
I have a small piece of card scraper for cleaning up the surfaces. It fits nicely into all the tight areas, and keeps all the angles crisp. Here is the finished peghead:

Notes: Sanding down the peghead edges flush is not too difficult. The binding itself is a little thicker than need be, so if it gets a bit thinned a bit when flushing it up, it's OK. I sanded mine down until the spindle sander just touched the binding and then did final smoothing and touch-up work with hand tools. Files, chisel and scraper mostly. Finally a little hand sanding. Doesn't take too long, depending on how perfect you want it to be. And your skill with the tools.

I think detail work is a lot like musicianship. Sometimes the most exciting part of a piece of music is the particularly difficult passage that's played cleanly.

The Neck and the Heel

The first thing I do is to square off the heel where it meets the rim, and create a 3° angle. This is easiest to do before getting into heel carving.

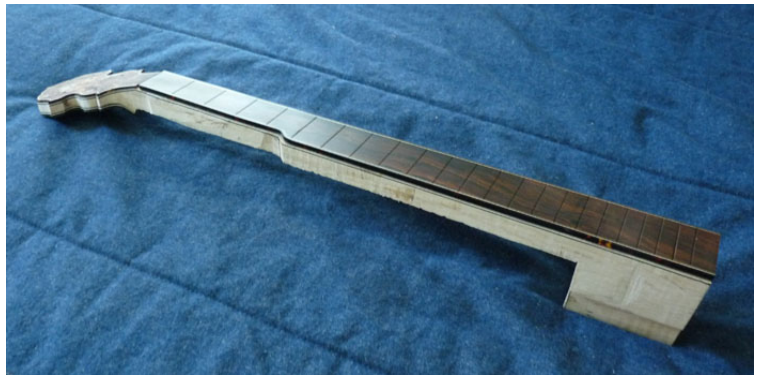


I do this on the table saw using my home-made crosscut sled. The sled is cut with zero clearance around the blade, so it's easy to see exactly where the edge of the cut will be made.

First, I determine how far I want the neck to protrude beyond the last fret, and mark it on the fretboard. Then I clamp the neck blank against the rear fence of the sled, and using shims, I adjust it so that a square laid across the bed of the sled will be exactly parallel to the fret slots. And I position the neck so that the edge of the slot in the sled lines up with the mark on the fretboard.

Next, I take a template that I've cut at a 3° angle, and press it against the face of the heel, and add a shim to hold the neck so that the template is fully touching the neck. Then I clamp everything down tight. This takes a little adjustment, but when I make the cut, I know it will be parallel to the fret slots, and at the correct angle where it clamps against the rim.

Here is the result. The neck is now ready for shaping, and the heel for carving.



I'm not going to get into shaping the neck. Everyone has their preferences on neck shape, and how to achieve it. And there is much information on the net concerning neck carving. I just wanted to show what tools I use for the necks I carve. On the left, next to the shaped neck is a large 12" curved tooth vixen file.

This thing cuts FAST, but it slices rather than tears, so it doesn't pull chips out of the wood. The next one is a 10" half-round rasp. for more controlled shaping. Then comes a 12" half round bastard cut file. This smooths out the surface after the rasp, but still cuts pretty agressively. At this point, I often use a small #3 smoothing plane to make sure my surfaces are straight and not wavy. Then I do final shaping with a half-round mill file. And finally smooth the surface with a palm sander. Everyone has their favorite tools for shaping necks. These are mine. I don't use draw knives or spoke shaves, though I have them. They tend to follow the grain on curly maple and you can end up with a wavy surface. The files and rasps are oblivious to grain. I usually file with long strokes lengthwise down the neck.

Heel Carving

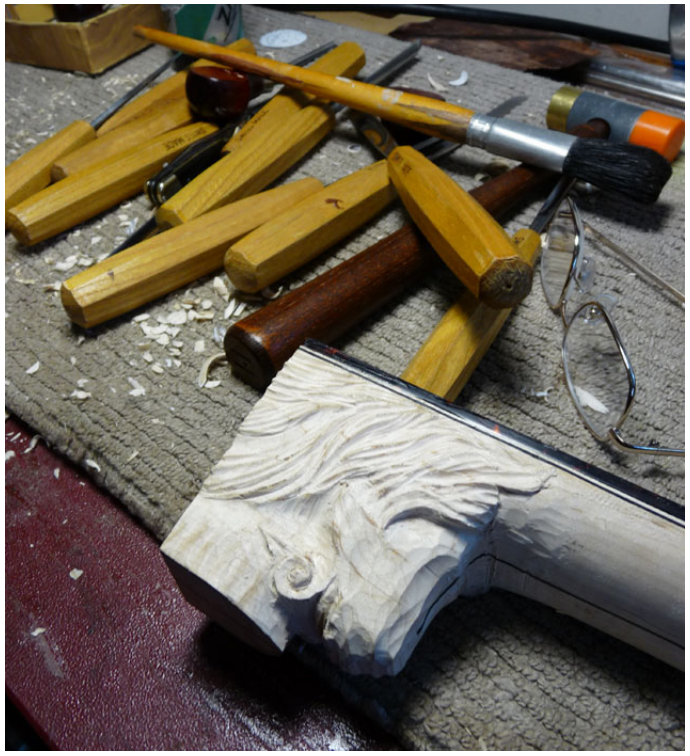
Now we get into a more custom feature. Chances are most of you will never get into carving heels, but you might like to see one way it can be done. I am by no means a master carver, but I understand the basic process and have a pretty good sense of visualization. So I can usually do a reasonable job.

The crow banjo is the fourth banjo I've carved with a unicorn heel. I did my first one about 40 years ago and have always liked how well it conforms to the space alloted, without getting in the way when playing up the neck. Bacon and Day did some figural heels on their higher end banjos and it's an interesting change from the classic relief carving on most fancy banjos.

The first thing I do is draw the unicorn design and scan it into the computer. Then I print out two copies and paste them to both sides of the heel. Of course, once you get into carving, the drawings get carved away, so I use them mostly for locating some of the basic shapes. Here is a shot of the heel after I have just roughed out some of the cuts.

I do this work with a sharp V gouge and mainly just create some channels which I can follow when carving in the contours of the head and mane. As I work closer to the inside of the heel, I will deepen some of these cuts before I lose them. Below shows where I reach a point where the drawing is no longer useful, so I strip off the paper and the rest of the carving is done by "feeling" how the head should emerge. It's an instinctive thing. No different than the instinct an artist uses when he draws a picture.

It's still very rough at this stage, but you can just begin to get the feeling of the head of the beast emerging from the wood. I keep working, shifting from one side to the other, rather than trying to completely finish one side and start all over on the second side. It helps keep things more symmetrical, and helps avoid boredom. (I hate doing something over that I have just finished doing)



We're getting closer. Still a long way to go. The closer you get to the final carving, the longer every advancement takes. At around this point, I will take a short break from carving and make a heel cap that will attach to the bottom of the unicorn's neck.

I've cut a piece of left-over scrap from the rosewood burl I used to cover the front of the peghead. I plan to bind this heel cap with the same design as I used on the peghead. This will be much easier to do, since it's a simple shape and there is no angle to the binding. First I cut some strips of maple veneer and glue it to the cap using push pins to clamp it tight. I'm using Titebond to glue the wood to wood.

Once the maple inlines are attached, I glue on the tortoise celluloid binding using super glue. Once it's fully set I can attach it to the heel.

I've made the heel cap slightly smaller than the heel. Once it's glued in place, I'll carve the heel flush to the cap.

Here I'm clamping it in place, using Titebond glue.

Once the cap is glued on, I can continue carving the heel. It's a long process, but the result will hopefully be worth the effort. It's one of the things that people focus on when they see the banjo, so the hard work has it's payoff eventually. And it helps make the banjo unique. Here it is nearing completion. I've switched now to small modified jeweler's files to get into the tight places and smooth out some of the contours. I still have some parts to clean up, but it finally reaches a point where I simply have to let it go and call it finished. Otherwise I could be working on it for the rest of my life.

Details on the Heel

On the last installment I covered carving of the unicorn neck. Of course, without a horn, it's just another horse. Here's how I shape the horn and attach it to the neck:

This is a piece of Prehistoric Wooly Mammoth Ivory. It's between 10,000 and 400,000 years old. It's not quite as white as elephant ivory, and it's expensive, but it's not on the CITES list-yet-and no elephants were killed to obtain it. So it is a guilt-free material I got this piece from the Rescue Pearl Company, where I now get my MOP blanks. The owner is a very accomodating lady and was able to supply me a piece of the ivory in nearly the exact dimensions I needed for the unicorn horn.

Here I have taken the blank and filed it down to the basic dimensions of the unicorn horn. I rough-shaped it on my 1" belt sander, but if you sand any of the ivory materials, you have to be very careful not to overheat them, or you can cause fractures in the ivory.

Now, as we all know :-> , Unicorn horns have a spiral shape to them-like a narwhal horn, and are not smooth like an elephant tusk. But to inlay such a complex shape would take much more work than inlaying a smooth tapered shape. So I shape the horn only down to the surface of the wood, and leave the bottom of the horn smooth and flat.

So once I make the basic shape of the horn, I need to transfer that shape to the neck for cutting the inlay slot.

I could just set the horn on the neck, and trace around it, but I want the horn to insert into the unicorn's forehead, and that would make the inlay slot too long. So I trace the horn onto a post-it note, cut off a bit of the base end of the tracing, and stick it in position on the neck. Then, following the tracing line, I cut into the neck with an Xacto blade, until I've got the outline about 1/16" deep.

In the picture above, you can see how I not only inlay the horn into the neck, but I also insert it into a hole in the head of the horse. By inlaying it, rather than simply gluing it to the surface, I assure that it will never work it's way loose and fall off.

I use a very small gouge and chisel to carve the excess material out of the slot for the horn, and keep trying it for fit until the horn will just slip into the slot. Then I run a thin pen or pencil line around the horn to mark what part fits into the slot and which part sits above the surface.

Finally, I clamp the horn in my vise, and using a small round file and a small triangle file, I make angled cuts in the horn, and stop them just short of the marked line. Then I glue the horn into the neck. Below is the result. It gives a rough impression of a spiraled horn.

I smooth all the edges, so that it won't feel uncomfortable when playing in the upper positions. Once the neck is stained and finished, it will look like it grew there, and will contrast nicely with the dark-stained maple.

Inlay

DAN DREBEK

I'm not going to go through inlay procedure step by step. Most of you already know how inlay is done, and those who don't can find lots of information on it in the archives of this forum, as well as online from other sources, and in print.

I'd just like to cover a few ideas that may be less commonly covered or possibly unique to this banjo. To start off, I'll just show you my simple inlay setup. It clamps quickly in my vise, so it doesn't need a base. I attach an aquarium pump to the inlay setup with plastic aquarium hose. This blows away the pearl dust as I saw. (Use a dust mask or respirator whenever you are generating pearl dust or getting it into the air).
I have two jeweler's saws. One with a large throat for cutting larger inlays and one with a smaller throat which is easier to handle. I buy saw blades in bulk packs and have both fine and coarser tooth blades.

I often design inlays that can be glued together completely, or in part as separate assemblies. So instead of inlaying a number of pieces into the work piece, I only have to inlay one. If the pieces are adjacent to each other, I will often separate them using a thin strip of veneer.

For example, this photo shows one of the peghead inlays that I'm constructing out of pearl, and veneer strips on a sheet of wax paper. Once the glue is dry, It will come right off the paper and I can trim the excess veneers flush to the pearl. I will then inlay the assembly into the peghead. I find that I can save lots of time by designing inlays in this manner, and the thin veneer strips help visually separate the small pieces of pearl similarly to the lines in leaded glass.

To make the thin veneers, I can slice thin strips cut off of any scrap wood and thin them using the same technique I use for doing rosettes. I simply tape down one or a few thin pieces of wood between two strips of veneer. Then I sharpen a piece of steel card scraper only in the center. The outside edges of the scraper ride on the outside veneers, and cuts the wood only in the center. Once it stops cutting, I know the center piecees are the same thickness as the outer veneers. With a sharp scraper, it can be done quickly.

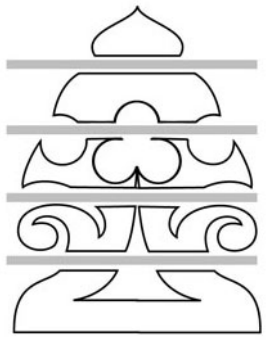
If the thin veneer strips have to take any tight bends, they can fracture. So in that case, I dip the wood in water and pre-bend it over a hot iron. In this case, I clamp an old soldering iron in the vise, plug it in and use the body of the iron behind the soldering tip as a bending iron. Any hot pipe will work. You can see a couple of bent veneer strips on the table. Once bent, I can glue up my laminations.

Pearl isn't the only material you can use for inlays. Below is one I inlaid on the seventh fret. I flattened an old silver half dollar and cut out the shape with a jeweler's saw. Then I fitted and set in place a center disc of mother of pearl. A few scribed lines and it was ready to inlay. I can cut very thin inlays out of metal and they are no where near as likely to fracture as pearl.

Here is the crow against the moon theme logo for the top of the peghead. I decided to inlay it using ebony, pearl, rosewood veneer and a thin strip of sheet brass.

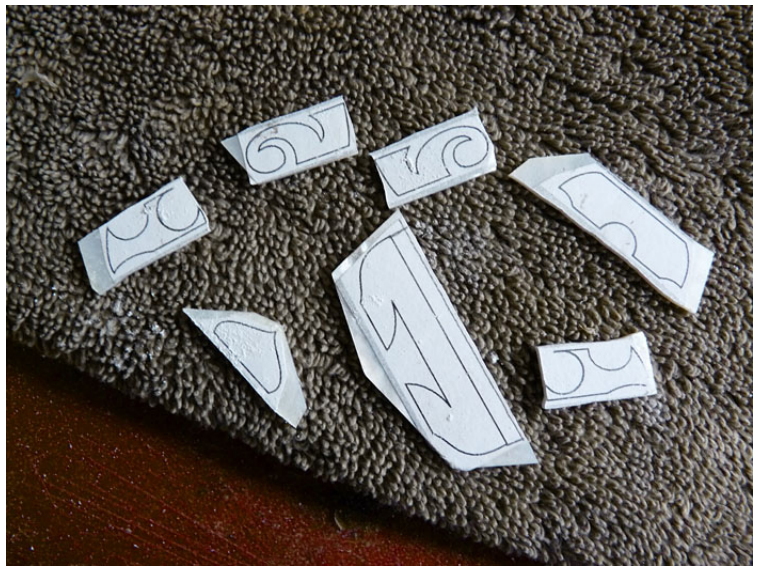
I first lightly pasted a slice of ebony on top of a disc of pearl. Then I cut the crow shape simultaneously out of both ebony and pearl with a fine jeweler's saw blade. Then took the matching pieces and glued them together. Then I glued on thin strips of rosewood veneer to the outside curves of the pearl, and followed that with the thin strips of brass. Here is the finished inlay, in one single piece ready for inlaying.

And here are the finished inlays in place on the peghead.



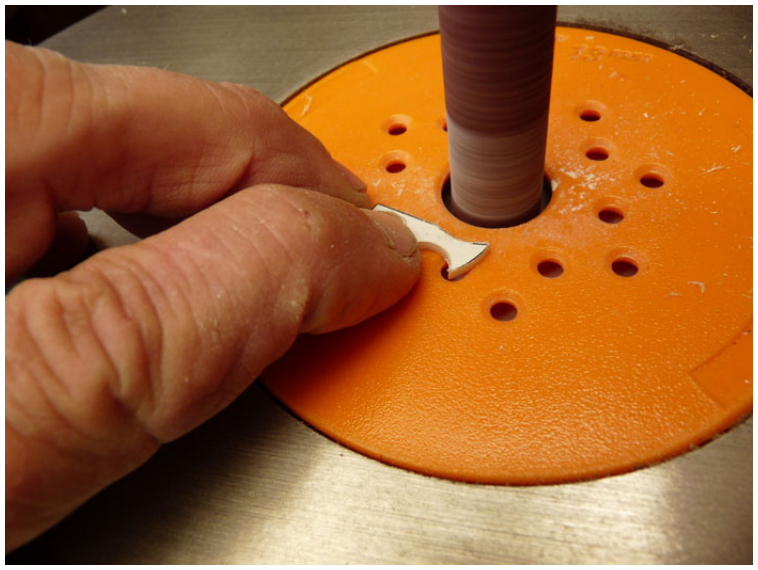
On the bottom of the fretboard I wanted to run an inlay flush with the bottom edge, and that crossed four frets. This is a bit more difficult than simply floating inlays between frets. Some builders cross the frets with the pearl and then saw fret slots through the pearl. In my case, the pearl will occupy a fairly large area, which I think makes fret insertion a little less secure, as well as possibly fracturing the pearl. So I designed the inlay, and then separated each piece by about 3/32" where the frets fall. I drew the fret shape in Adobe Illustrator and printed out a copy of it to paste to the pearl blanks.

Here is the pearl with each piece separated for rough cutting. I use a jeweler's saw with a fairly coarse blade to quickly separate each piece from the others. Most of the final shaping will be on my 1" belt sander.



And here it is ready to start grinding.

I do most of the grinding with my 1" vertical belt sander. I first press a piece of thin board against the belt and clamp it to the sander table to create a zero clearance that won't suck the small pieces into the machine. The control of the grinding is excellent, and the smallest pieces can be mostly shaped on the small belt. I just sand until I split the line on the drawing. Sanding as opposed to cutting it all out with a saw is a terrific time saver. But it won't work for all inlay shapes, of course.



And for the concave areas, I use the smallest sanding drum attachment on my oscillating spindle sander. You could do just as well by chucking a sanding dowel in a drill press.

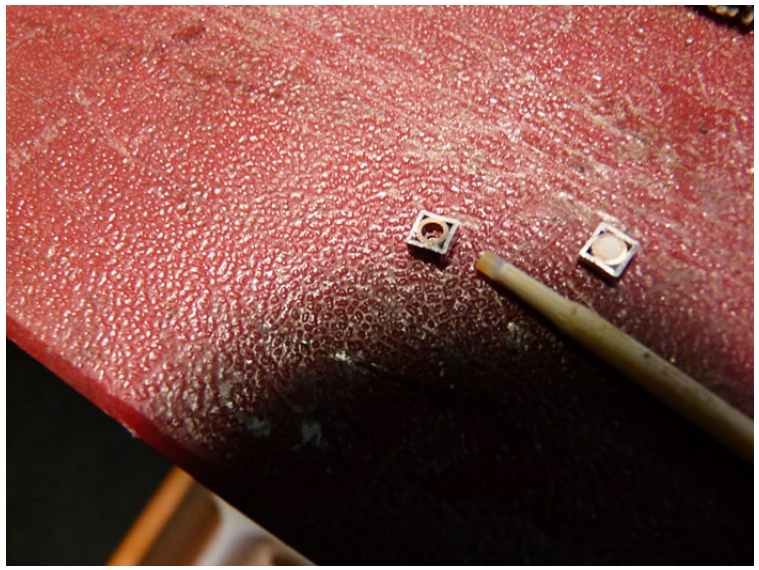
I've gotten so lazy with this process that I purposely design inlays to take advantage of the technique when I can.

I did pretty much most of the inlay with the two sanders, but there were a few small places where I had to go in with a jeweler's saw and file. No big deal. Here are the peices laid out on the neck. If you are careful, you can leave a thin layer of wood between the cavity and the fret slot--eliminating the need to insert anything in the slot to keep the glue out.

If you look at the small inlays above the heel area you will see a brass bound diamond with a black interior and an inset disc of mother of pearl. I was able to buy round pearl dots the size of the larger ones that fit just fine. But the two small ones on the twelfth fret were only about 2-1/2mm in diameter, and I had nothing on hand for those. So I decided to grind out a couple of small discs. The problem is, how to you do it?

The solution was fairly easy. I just took a couple of sticks and super-glued a piece of pearl to each one. I believe they use a similar technique when jeweler's shape small stones. They call them dopping sticks.

That gave me a handle to hold so I could spin them against my sander to shape them into perfect little discs. I just gave it light spins agains the belt until it would _just_ slip into the hole. It worked amazingly well. The photo below shows one of the "large" inlays, and one of the tiny ones, ready to receive it's little pearl disc. Using the built-in handle, I inserted the tiny piece of pearl into the little copper tube, touched it with a drop of thin superglue, which bonded it instantly. Then I just snapped off the handle and I had my inlay.



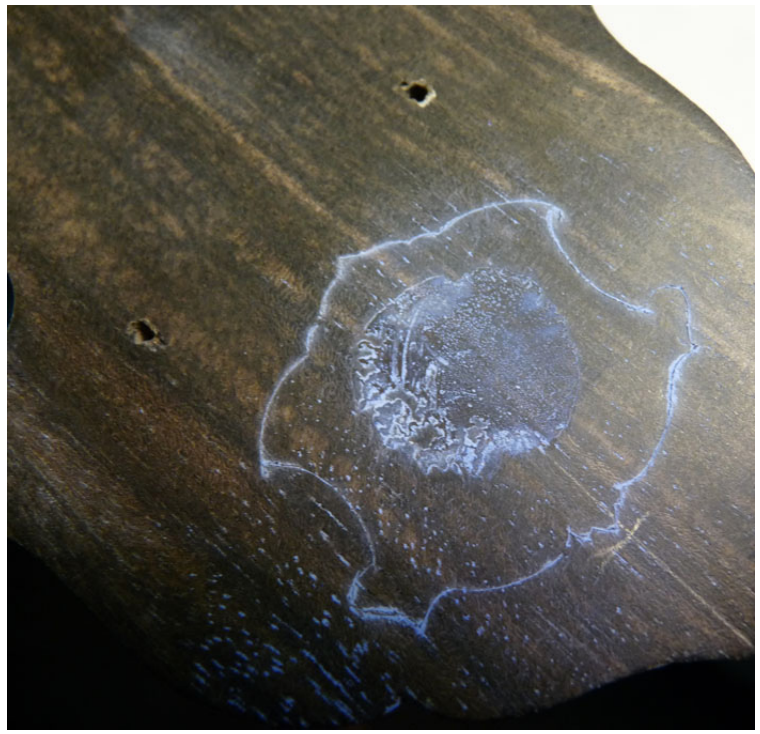
These little inlays are a lot more work than just slapping pre-cut dots into the fretboard, but to me the difference is worth it. They look just like normal diamond inlays until you look close and see that they are pretty little designs. I like layers of details that aren't immediately obvious, but are fun little bonuses when the banjo is examined closely. They were inspired by the "parisian eye" inlays you find on the frog of better violin bows.

I wanted something different on the back of the peghead. Since this banjo doesn't have a dowel stick, I needed a good place to add the makers label. Inspired by old guns and antique European banjos, I decided to inlay a silver sheild and have my name and date hand engraved. I figured it would help give the Crow banjo more of an antique look, which was what I was after on this banjo.

Like the fingerboard inlay, I cut this one out of an old silver dollar, after flattening and thinning it a bit. I cut out the shield with a jeweler's saw.

After a lot of searching I found an old school hand engraver who did wedding rings and trophies. He agreed to engrave the script on the silver inlay, though he complained about the awkwardness of doing it on a banjo neck. In any case, he did a creditable job and I got the look I was after.

I first cut the inlay out of the silver, then tacked it to the neck with a dab of white glue. Then I scribed around the inlay with a fine pointed (#11) Xacto blade. I then removed the inlay and rubbed chalk into the cut lines. I use blue chalk line powdered chalk for this. The blue is very bright and shows up well against dark wood.



Once the inlay was engraved, I polished it, and then I patinated it to give it more age. And the result was just about right. If it wasn't dated, it could almost pass for vintage.

Oh, and one last thing. When scribing around the pearl, it often has a tendency to pop off, which is extremely irritating. So I make a point of holding it down securely when scribing. I've found nothing better than a pencil eraser for doing this job.

Notes: One reason I like to scribe around the inlays with a knife blade is that when I go to rout out the cavities, and I work my way up to the scribe line, the wood fibers tend to fly off as soon as the bit reaches the cut line. It can be helpful in determining when I've hit the outline, and gives me better visibility of the progress.

Fretting

Once the inlays are completed, there are just a few small tasks to complete on the neck before moving on to building the pot. I don't begin shaping the end of the heel until I have the rim built, and the two are carefully fitted together. But that will be done later.

Installing the frets is the next step, and there are a couple adjustments that need to be made before installing them.

Before hammering in the frets, it's important to make sure the fret slot isn't clogged with sawdust and glue. And to verify that the slot is deep enough for the fret tang. I use a thin, 6" rule and insert it into the fret slot. Then I slide it back and forth to measure the depth from binding to binding. If there are any lumps or bumps that need to be removed, I scrape them out now. Stew Mac sells a nice little tool for doing exactly this. Being a cheapskate, I made my own by grinding down an Xacto blade into a hooked shape and attaching a piece of scrap wood for a handle. It's sharp on the end and works well for scraping the bottom of the slot.

Next we need to lightly chamfer the fret slots just a tiny amount. With most frets, there is a slight radius where the fret tang attaches to the fret. If you hammer the fret into a perfectly square slot, it won't quite bottom out on the fret board, and there is a chance your frets will be uneven. So I give each slot a few strokes of a file to ease the edges of the slot just a bit. Also, the fretboard is less likely to pull up splinters if the frets ever need replacement.

To do this, I use a curved jeweler's file. The curve in the end of the file allows you to get the file down into the slot, without the tip digging in. I find a curved end file is handy for numerous small tasks. But, you may say, where can I get such a file? I say, it's easy to make from any small file.

To create the curve, I first heat the end of the file till it turns bright red, then I press the end against a piece of hard wood. This will curve the end of the file to the shape shown above. If necessary, you can reheat it and press again until you get it to the right curve with no side to side bend. Once it's bent, I re-heat it to red hot, and stick the end of the file into a glass of water to harden the file teeth. They will be brittle at this point, but I don't bother tempering the teeth, since the file is generally not banged around and the extra hardness helps keep it sharp. I learned this technique from gunsmiths.

When the slots are ready, I measure each fret, cut it to lenght, with a bit of overhang, and trim off the tang so the fret can ride flush over the binding. To trim the tang, I use a home-made fret trimmer made from a sheet metal nibbler. And I finish the job with a mill file.

Finally, I hammer in the frets, using a brass headed hammer. Before I insert each fret, I first fill the slot with glue. Many builders use CA glue for this, but I prefer Titebond. It's less messy and easier to clean up, plus, it's water based and I suspect that it expands the wood fibers to help them mold around the fret tang. Filling the slot is easy.

Look at the picture above and you can see the slot to the right of the clamp is filled with glue, with no surrounding mess. To do it, I simply run a bead of glue along the fret slot, and give it a single wipe with a damp rag. This forces the glue into the slot, and cleans off all excess glue on the fretboard surface. The glue also makes fret insertion easier.

After driving the fret home, I usually clamp the center down with a spring clamp. This is just for extra insurance that the fret will be well seated as the glue hardens. As I work my way down the neck, I shift the top clamp to the just-glued fret. By then, the glue on the upper fret will already be set.

Once all the frets are set, I file the ends and shape them. I won't repeat this process as there is plenty of instruction on filing and leveling frets on the internet.

Finishing the nut.

Once the neck is fretted, we move on to finishing the nut. There are many good ways to accomplish this task. This is the way I do it:
First I shave a pencil in half lengthwise by running it over the blade on my jack plane. You could do it on a belt sander if you preferred. This half pencil is made long enough to span at least two frets. I sharpen the top of the pencil lead so that the lead comes to a knife edge.

Then, with the pencil resting on the frets, I slide it back and forth across the nut to scribe a line exactly the height of the frets. (It's best to do this before polishing the nut, or the pencil will tend to slide over the surface without leaving a clear mark).

Once the height line is marked, I trim the height of the nut down a bit higher than the line. The scribed line will be the location of the bottom of the strings, so I need to leave a little nut remaining above the line for cutting the string slots. Once the nut is trimmed, I cut it neatly to length, and round the ends. I file the top of the nut so it tapers downward toward the peghead.

With the nut shaped, I measure and mark the locations of the strings.
When the strings are marked, I take a jeweler's saw, or Xacto razor saw and cut slots from the top of the nut, down to just shy of the scribed pencil line. Then using various jeweler's files, I shape each string slot to fit the string properly. Where the strings exit the nut onto the fretboard, they are sitting high in the nut, and

where they exit the nut onto the peghead, they sit more deeply, and have more lateral room to move. In the photo above, it appears that the strings are sitting deeply into the nut, but where they exit on the fretboard side, they are sitting at only about half their diameter.

Let me first say that Everyone cuts their nut slots differently. There is probably no absolutely best way, though there are better ways than others. You want the string to leave the nut cleanly, without resting on flat surfaces, but you do need it to contact enough material to avoid wearing your nut down too quickly. I personally cut my slots almost exactly as described by the luthier Paul Hostetter on his excellent site. Here is a link to his explanation of cutting nuts:
http://www.lutherie.net/nuts.html It's worth studying.

So this ends the neck portion of the Crow Banjo build. The next installment will begin the rim construction. Necks generally require the lion's share of the work on banjos, while the pots often tend to be an assembly of simple parts. (unless you make your own hardware) But where there's a will, there's a way, and I can manage to make my rims and resonators fairly labor intensive. But that's OK. I'm doing this to pass the time. Savor the process, don't rush through it, is my motto.

I'm going to take a short break and get the photos and arrangement worked out before jumping into the rim series. Till then, I hope this part has been somewhat interesting to those who have taken the time to follow the process.

I neglected to take pictures of the fretting operation. But as you say, most know the process and mine isn't any different. For a complete rundown of fret dressing, I would refer anyone to Frank Ford's site:

http://www.frets.com/FretsPages/Luthier/Technique/Guitar/Frets/00028Refret/00028refret02.html

He covers it better than I can on this quick overview.

There is something I can add, however. I use a simple wooden block to aid in dressing fret ends. I cut some slots lengthwise in a block of maple that can hold a flat mill file at right angle and at a 45 degree angle. Setting the block on the fretboard, I can trim the fret ends flush and then bevel them quickly and accurately. I can't remember where I learned this trick.

The inlays are commonly used in the knife making trade and are referred to as "mosaic pins". They are mostly used for pinning handles on to sheath knives. I think I may have been the first to utilize them for inlays on banjos. If you do a search on You Tube for "making mosaic pins" you'll find instructional videos that show how to make them yourself. The ones on this banjo are different from most mosaic pins in that I plugged the center tube when pouring the epoxy resin so it remained hollow. Then, after slicing off a thin piece for inlay I inserted a pearl disc into the center tube.

Notes: It's no different than learning to play the banjo.You just take it one step at a time. Start with something fairly simple and learn as you go along. If you have some previous woodworking experience, and the necessary tools, you've got a good head start.

I'm a firm believer in working with fine woods, as I think it inspires one to work more carefully. And the finished product will be that much nicer. But there is no law saying you can't use inexpensive woods. The fact is, original vintage banjos often utilized plain, local woods, so there is no reason why you can't do the same. I've reached a point where I don't often screw things up, and if I do, I can usually fix it. So I go with the best wood I can find, and have never once regretted it.

But I build instruments for my own use. Since my first banjo, my intentions have always been to make myself an instrument that I could never afford to own otherwise.

And to build to my own design and taste. In other words, something that is not available to buy at any price. If I continue to build more banjos, I hope to push that concept further yet.

If you are willing to give it a try, you might just find that it's not all that difficult. There's no hocus pocus involved. Just careful planning and careful workmanship.

Except for engraving. And I leave that black art to the magicians among us.

The Rim

Cutting and Gluing the Block Rim

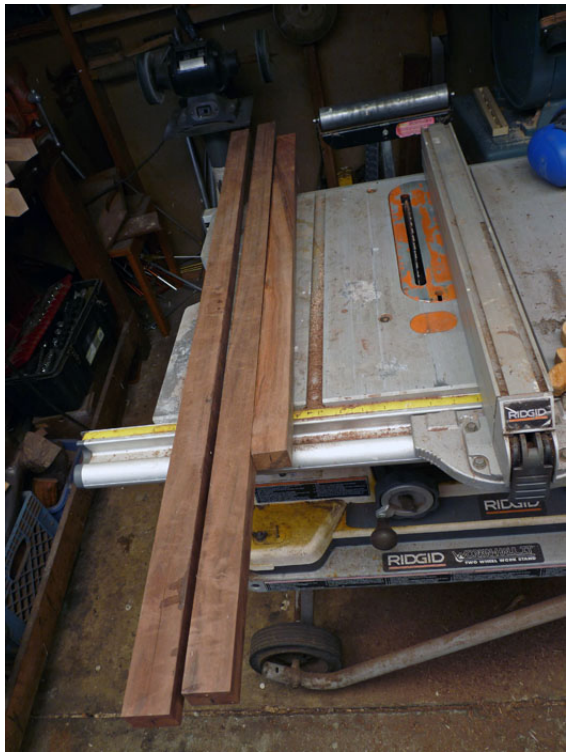
Rims are most usually built using a lathe. I don't have one, and don't care to get one just for rim building. I don't build enough banjos to warrant the purchase of a lathe, and I don't have enough room in my shop to have one sitting around doing nothing. And since I don't build furniture with turned legs, or salad bowls, or anything else that requires the use of a lathe, that's exactly what it would end up doing.

So this series will explore one way to make a high quality rim without the use of a lathe. Kudos to Rudy for opening my eyes to the possibilities of rim building in non-standard ways. There will be a few operations in this build that are unusual and possibly unique to this banjo, that seem to work pretty well. Once again, I am not claiming my methods are better than other methods. And certainly not faster. But they seem to work, with minimal investment in tooling and without requiring the construction of forms and jigs.

This is going to be a hybrid rim construction. There will be a block-rim core, and the core will be covered both inside and outside with steam bent laminations. This has become my favorite method of rim construction. The block rim seems to have some advantages in sound production, while the outside laminations, to my eye give a more pleasing, traditional look. Furthermore, the laminations cover all of the core joints, and add a great amount of strength to the entire rim assembly. I suspect it may be at least as strong, if not stronger than the more customary block or bent lamination constructions.

I was originally going to build the entire rim out of the same maple board I used for building the neck, but I happened to have some left-over claro walnut from another project, and I decided to try a combination of woods on this rim. So the core will be made of walnut and the outside laminations will be curly maple.

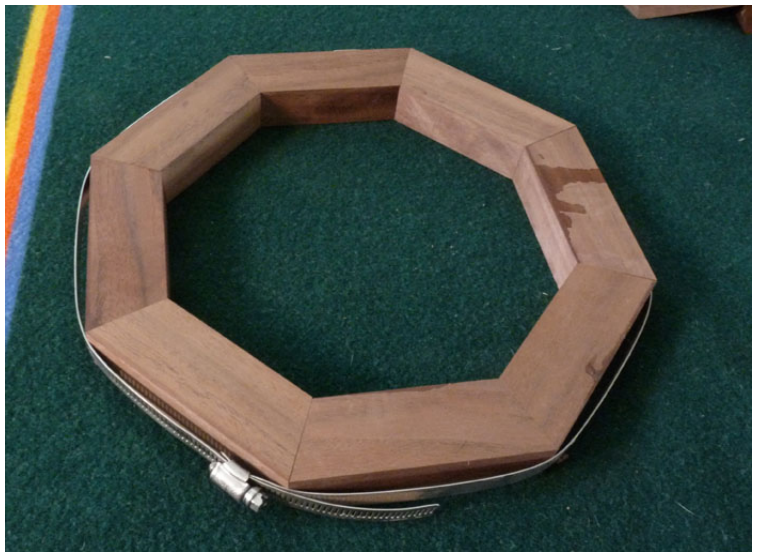
The photo above shows the walnut plank and a plexiglass pattern I made for marking the angles of the rim blocks. As it turned out, I never needed the pattern.



The first thing I did was to rip the walnut plank into long strips. The board was approximately 1" thick and the strips are 2" wide. I used a new blade for making the rim blocks and the surfaces are very smooth and accurate. No sanding or other surfacing was needed.

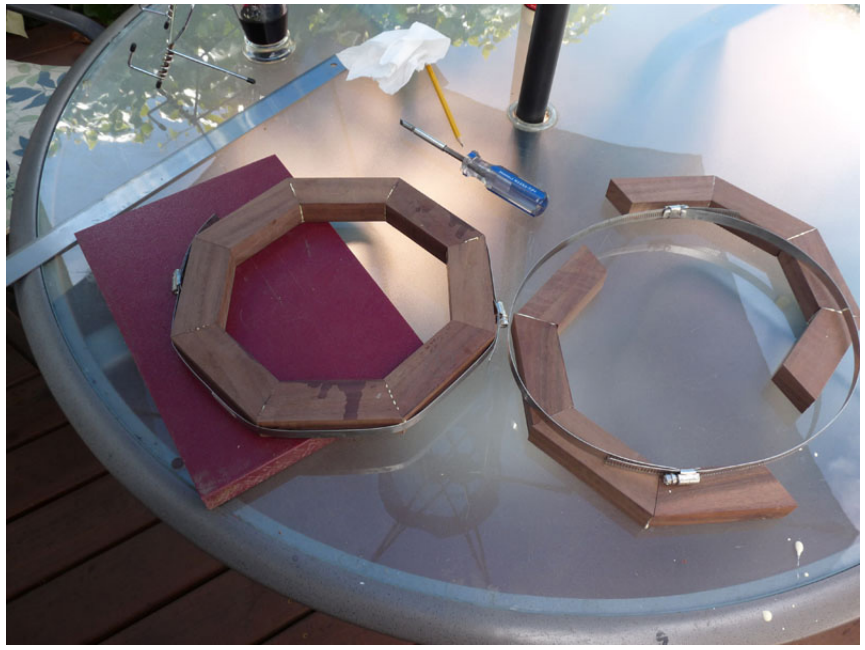
I am making an eight segment rim. To me, eight segments are perfect. The weakest glue joint in a block rim are the end-grain joints. So I see no compelling reason to make more of them than necessary. Eight segments provide a slightly better gluing surface, and have no significant grain runout. In the photo above I was in the process of setting the angle of my miter saw to cut the exact angle needed for the blocks, when to my surprise, I discovered that my saw has a detent that sets the saw at the exactly correct angle for an eight segment rim. Namely 22-1/2 degrees. What could be easier?

So here I am cutting the segments. I made the first angled cut, flipped the board over and clamped a stop block to the saw fence to give me the correct length. Then I was just a matter of cutting, flipping, sliding to the stop block and making the next cut. In a few minutes I had all the strips cut into blocks that all fit together perfectly.



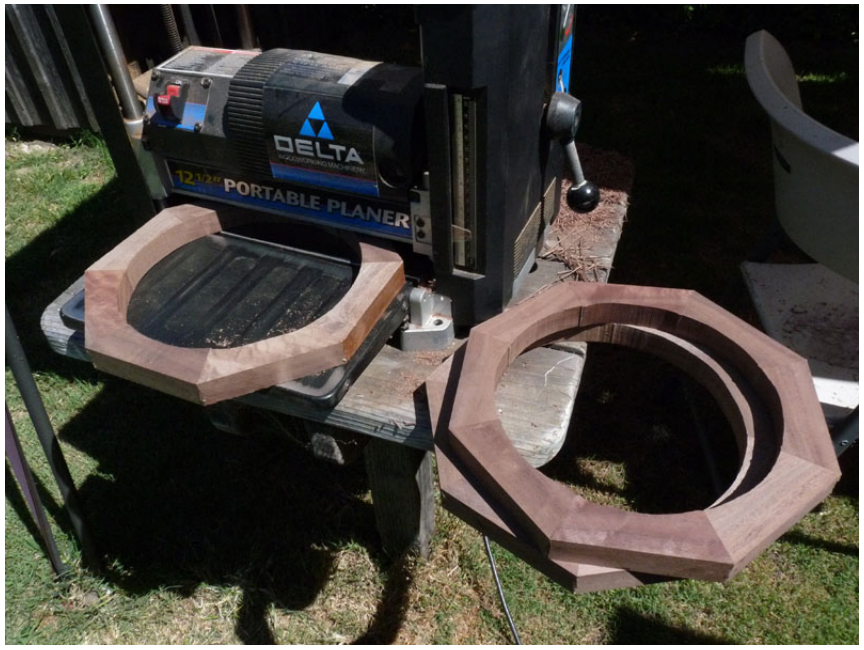
To test the fit, made a simple belt clamp out of two shorter hose clamps, and assembled eight of the block in position. The clamp automatically aligns the blocks and forms a perfect octagon. It also adds all the necessary clamping pressure. As you can see below, the joints are pretty tight.

Ok, now we're ready to glue it up. But before I do, I lay the tone ring on to the assembled blocks and mark the inside and outside circles that will guide me in trimming the excess material.



Now here's a trick I used to bandsaw the inside of the rim. I applied glue to the butt joints, but did not glue two opposing joints. I clamped the assembly (below left) and when the glue was set, I removed the clamps and I ended up with two perfectly aliigned halves. (below right) I then sawed the inside of each half close to the marked lines, only on the inside of the rim, leaving about 1/16" extra to be removed later. Once the inside was trimmed, I glued the two remaining joints and re-clamped. No additional fitting was needed.

I repeated the procedure twice more to end up with three complete rings, trimmed on the insides but still octagonal on the outsides.



The next day when the glue was fully hardened, I took all three rings to my sanding board and got one side good and flat. Then I was able to run them through my benchtop planer. The planer can handle up to a 12-1/2" board, and my rings just made it with a little room to spare.

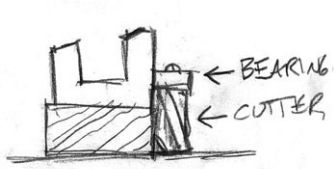
I had decided on a slightly deeper rim on this banjo, which was to have a finished rim height of about 2-1/2", so I thicknessed each ring down to 7/8" thick, which would leave me a little extra for final trimming later on.

Note: I can make my planer snipe if I try, but it's usually the result of bad feed angle, poor delivery of the board into the planer, or trying to take off too much material in one pass. I'm sure that some of it depends on the particular machine as well. I may have just gotten lucky.

Gluing and Turning the Block Rim

OK, In the previous thread we covered making rings for the construction of our block rim. We now have three rim rings. Time to put them together and make them perfectly round. Since I don't have a lathe, I'm going to use a method I learned from one of Rudy's posts a few years ago. His method was to use a sanding drum on a drill press, and that works great. But I've adapted the same idea using my router table, which is quite a bit faster and doesn't generate so much sawdust in my shop.
I utilize flush trim bits in my router table to cut the rim rings to size and shape. So the first question is what do I use for a pattern. I could certainly fabricate a pattern that was reasonably accurate and round, but I already have a good pattern ready made. I'll just use the tone ring itself, which is quite accurate both inside and outside, since it was lathe turned. I don't have to make any jigs or patterns using this method, which saves a lot of time and effort for a one-off banjo. I've used the same process for both archtop and flathead rings and the results have been excellent.

Here's the concept in a nutshell:



Pardon my sloppy drawings. On the cross section above I show the first rim ring sitting on the router table. The tone ring sits on top of the rim ring, and the flush cutter bit rides on the outside of the tone ring and will duplicate the shape exactly on the rim ring. It will work just fine for both the outside and the inside of the ring.

So how do I clamp the tone ring to the rim ring when doing the routing? Good question, but there's an easy answer:

I simply cut a length of scrap wood, laid it on top of the tone ring, and drove a couple of wood screws through the board and into the waste area of the rim ring. Tighten the screws and it's firmly locked in place. As you can see, there is a little bit of rim showing through on the inside to be trimmed off on the router table. Before routing I will trim off the majority of the outside of the rim ring, leaving a couple of tabs that the screws are driven into. I'll cut off the tabs after routing.

Here is a shot of the rim ring being routed. You can see how the bearing on the flush trim bit is riding on the tone ring and is duplicating the outline exactly. (I just noticed that I have the ring mounted upside down from the way I had it in the drawing. I don't want to re-draw it, but you get the picture) The fence on the router table is placed so I can get some leverage and steady support when routing. I never try to rout freehand if I can help it. But there is no way I can screw up the accuracy of the cut as long as the tonering is firmly mounted to the rim.

Once I have the inside cut flush, I adjust the fence to allow me to cut the outside in the same manner. But first I trim off most of the excess material from the outside. Also, since I have two screws in place, I can only rout close to the screws on the outside, but not through them. So after the outside is routed, I simply cut off the two remaining tabs and smooth it out on the disc sander. (see next photo

Since I cut the inside of the rim rings a bit shy of the line, I have extra waste on the inside and lots of waste on the outside. That's fine. I just line up the finished ring with the next ring, making sure I have a little bit of extra wood showing around the inside and glue it together with Titebond glue.

When the glue sets, I trim off most of the outside excess wood on the bandsaw and rout the second ring on my router table to exactly match the finished ring.

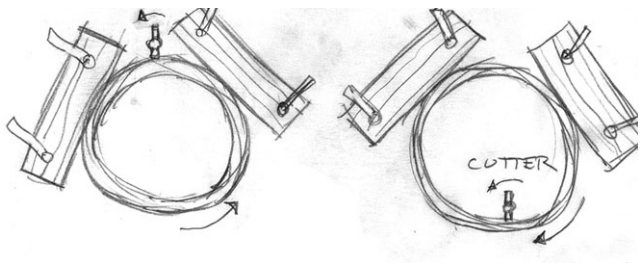
When that layer is flush, I flip the assembly over and glue and rout the third ring in exactly the same way.

Now I have one perfectly round ring, clean on the inside and outside, and two rings that are roughly cut on the inside and uncut on the outside. Now is when I make my first glue joint.

It's not perfectly smooth at this point, but the glue joints are all tight and the ring is exactly the same size as the tone ring.

Now it gets a little tricky. If I were making a simple block rim, I would just need to cut the top of the rim to fit the tone ring, sand it all smooth and I would be done. But this rim will have an added feature. Namely the inside and outside of the rim is going to be laminated with curly maple. I can't just glue it on to the outside and inside of the rim as it now stands, or the rim would stand proud of the tone ring. So both the inside and outside need to be trimmed down to size. How do we do that?

I need to take off an even 1/16" off both the inside and outside. to do it accurately, I have to set up a simple jig made of two pieces of scrap wood. Here's how it works:



In the diagram, we are looking down at the round rim sitting on the router table. The left hand drawing shows us trimming the outside of the rim and the one on the right shows us trimming the inside of the rim. We are using a router bit that does not have a bearing on top. The depth of cut is variable depending on how we set up the two guide blocks, which need to extend higher than the cutter. .

Ttwo boards clamped to the router table forming an angle that the rim is pressed against while cutting. The boards are positioned so that the cutter just barely grazes the rim. With the router turned on, we simply keep the pressure on against the guide blocks and spin the rim. The guide blocks ride on the middle part of the rim, while the cutter removes material from the bottom part of the rim. Taking small shavings a bit at a time, we keep removing material until the tone ring will just slip on to the routed edge of the rim. If you slightly loosen one of the clamps holding the guide block to the table you can lightly tap the loose end of the block to move it in or out in increments as small as a few thousanths of an inch. Then you tighten the clamp and take the next cut. It's impossible to slip and gouge the work piece with this setup. If your hands slip or you accidentally make the wrong move, you will only pull the workpiece away from the cutter.

Be sure when cutting to always move the workpiece into the router bit and not away from it. The arrows in the diagram show the direction of the spin of the bit and the direction the rim needs to rotate.

Once you have the rim fitting the tone ring to your satisfaction, (I like an easy slip fit) you can finish shaving the outside of the rim using your flush trim bit, working off of the pre-fit side. You'll want to up with this:

Note that the tone ring slips over the outside of the rim, with the rest of the rim being of slightly smaller diameter than the tone ring. This will give us the room we need to laminate the curly maple veneer on the outside, below the tone ring.

Now we need to trim the inside of the rim in the same fashion, with the tone ring sticking out by about 1/16" from the inside surface of the rim. See below:

This completes the basic rim core. The next step will be fitting the maple laminations. That's for next time. After we finish that step we get into the fancier stuff.

Laminating the outside of the Rim

Well, on the previous episode we completed the block core of our hybrid rim. We cut it down to about 1/16" shy on both inside and outside surfaces, and carefully fit the tone ring. This session we will laminate the inside and outside with curly maple veneer to match our neck.

I'm using come of the cut-off wood from the same plank as the neck, so there should be good visual continuity between the rim and neck. The first thing is to cut some veneers for the lams.

Here they are, hot off the table saw. I prefer cutting veneers on the table saw over the bandsaw because I get nearly perfect surfaces with a sharp blade and there is little or no need for sanding or scraping the veneers before gluing. Of course, I'm limited by depth of cut, but these veneers are within the reach of my 10" blade.

I make sure I have one nice, flat surface and I slice veneers off the block using a push stick, rather than cutting with the veneer side against the saw fence. I can hold very close tolerances and the surfaces look nearly sanded. The stripes you see on the wood in the above photo are not saw marks but are curls in the maple. Pretty nice stuff.

I cut three, just in case I break one in the bending operation. All three veneers are about 3/32" thick. This gives me just a little extra for the final trimming. You will also notice that there is some heartwood on these strips. That doesn't bother me, as I don't mind a little color variation. However most of the color difference will be lost when the wood is stained. However, the staining process will greatly enhance the curls in the wood.

One final operation--I plane a taper on the end of one of the slats. I am going to use a feathered joint on the outside lamination, and I do the feathering before the steaming operation. The inside veneer will be butt jointed.

The veneers are thin enough that I don't anticipate any problems in the bending process. But there is a lot of runout in curly maple, and the veneers would certainly fracture if I tried to bend them without steaming. (or boiling).

Above you see my very sophisticated steam machine. It's a piece of 4" two-ply polyethylene plastic drain pipe (available at Home Depot for about $7) , two PVC end caps, a short length of reinforced vinyl tubing, a brass nipple, and a couple of hose clamps.

I cut the tubing to length--just a bit longer than my rim veneers--drilled a hole in the side of one end of the tubing for pressure relief. Then I drilled a hole in the end cap on the bottom end and fitted the brass nipple and cemented it in place with silicone adhesive. I clamped one end of the tubing to the nipple, and the other end to the top valve on a pressure cooker. The cooker sits on a camp stove burner, and I fill the pressure cooker about half full with water. I set up the tubing with one end higher than the other, and load a piece of veneer into the pipe. I'm only cooking one veneer at a time, so I don't have to juggle too many things at one time. The wood slat doesn't need any support inside the tube, since the tubing is round on the bottom, there is plenty of air-flow around the slat.

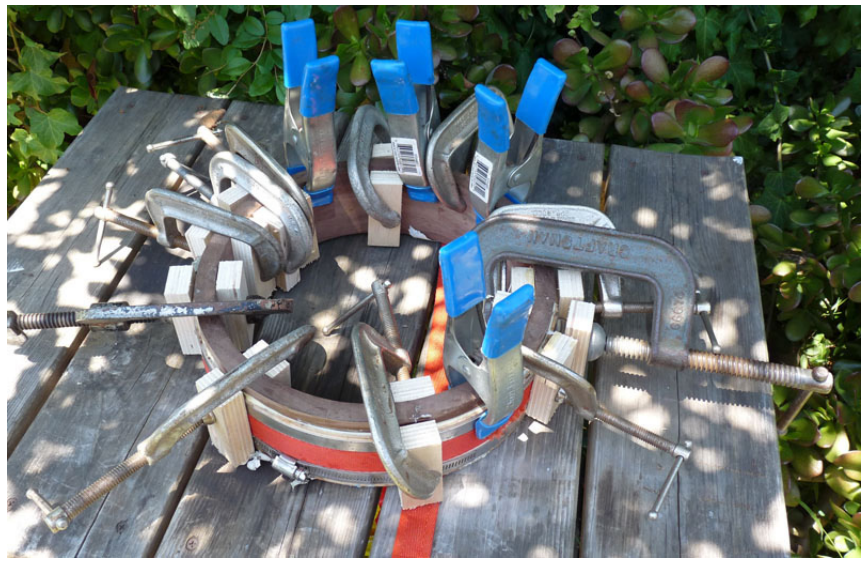
I err on the side of too much steam and let it percolate for about 1/2 hour. If the weather is cold or the wood is thicker, I will wrap an old quilt or sleeping bag around the pipe to give it some insulation. This keeps the inside a bit hotter. But for these thin slats, I don't think I need it.

While the wood is steaming, I've set-up the rim for the bending operation. I have an inexpensive belt clamp, a quick-clamp and two hose clamp assemblies ready to go. This operation involves no gluing. I am only going to bend the wood and let it take a good set, so that it will conform easily when I am ready to glue it up. Once the wood comes out of the steamer, I only have a minute or two to get it clamped up, so I make sure everything I need is ready to go and within easy reach.

You'll also notice that I wrapped the rim with some aluminum foil. I don't want the heat and moisture from the veneer to compromise any of my core glue joints.

Once the wood is ready, I pop off one of the end caps, and pull the wood from the steamer. (wear gloves). Then I wrap the hot slat around the rim, and lock it in position where it overlaps with the quick clamp. Then I wrap the belt clamp around the middle and cinch it tight. Then I add the two hose clamps to the outside edges and tighten everything up. At this point I set the whole thing aside and let it dry overnight.

The next day, I get ready for the gluing operation. I gather all the clamps I plan to use and set them up so I can get it clamped quickly. I pour some TiteBond glue into a dish and have a disposable brush handy for painting on the glue. Then I remove the clamps from the previous day and remove the slat from the rim. You can see in the above photo that there is plenty of springback, but that's OK. I know it will take the bend without cracking when I glue it up.



They say you can never have too many clamps. This is one of the reasons why. First I brush a thin layer of glue on both the outside of the rim and the inside of the lamination. Then I place the lam on the rim and hold it in position with the squeeze clamps Then I add the belt clamp. Then I add the hose clamps. Then I add the C clamps on the spots where I'm not getting enough squeeze out. Eventually I run out of room for clamps and let it set up overnight.

The next day, I remove the clamps and run the rim through my planer a few times to expose a clean edge on both sides, so I can see how my glue joints turned out.

The joint looks good and tight. Since I only feathered one end of the lamination, I have to trim down the outside end so it's flush with the rim and completes a smooth curve. I do this on my disc sander. Here is a closeup of the joint after dressing it down. One tiny void on the end of the scarf, but I guess it's close enough for banjo work. :->

I take the rim back to the router table and using the previous shaping techniques, I lightly trim the outside of the rim to bring the thickness of the veneer down by about 1/32", giving me an exact 11" rim. I happen to have a router bit with the bearing on the bottom, so I am able to use the tone ring once again to exactly match the size.

Once I've routed half the surface, I can flip the rim over, go back to the top-bearing bit and do the other half. It's a lot faster and easier than it sounds.

And here is the rim with the outside lamination in place, with only minor sanding needed to complete it. You can see a very small gap between the bottom of the skirt and the rim. That is intentional. I'll explain that in the next episode.

Notes: I use quarter inch bits. Half inch would be better, but I make do with what I have and they do OK. I replace them when they show the slightest signs of getting dull.

Quickstep, My planer blades haven't eaten any of my rims. Yet. But if I had any doubts, I could just as well plane it down by hand, and finish on my sanding board. But the planer is so fast and accurate, and it keeps the top and bottom nice and parallel.

Oh, and with the planer, I take very light cuts. Many of them, and work my way slowly to the finish cuts. I believe that greatly reduces the chances of tear out or chipping.

There is nothing in my build process that can't be duplicated by any woodworker who is able and willing to work carefully. The're not realistic methods for production work, and use of a lathe would admittedly be faster. But for the amateur luthier with time on their hands, there are alternatives to the lathe that can offer good results. And in the case of custom instrument building, I think the ends always justify the means.

And that's a good thing, because in a few more episodes, this build will be delving into some of the slightly crazy stuff.

I freehanded the lamination taper on my disk sander before steaming. I've also done it by hand in the past by clamping the slat to the end of my workbench and cutting the bevel with a smoothing plane.

From Ken LeVan: Do you mean the scarf joint?

How much of that do you see once the neck is on there?

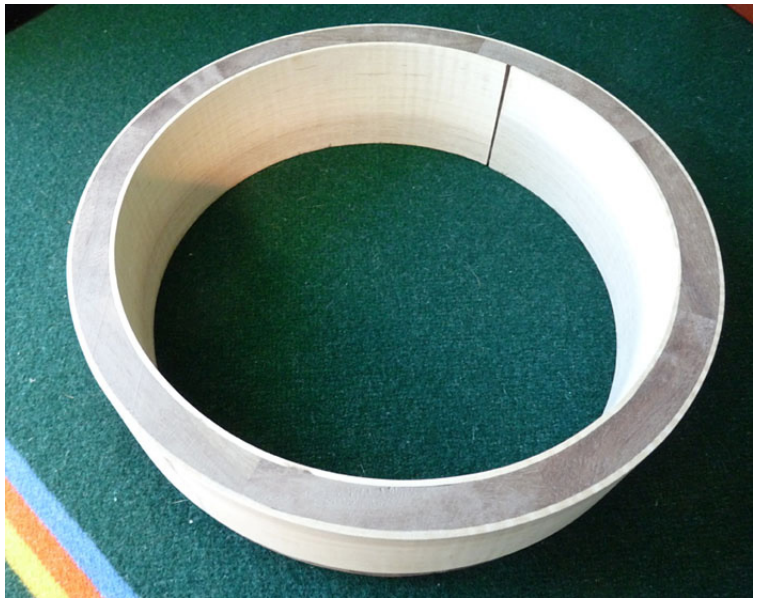
Dan: Yes, the scarf joint. None of it shows when the neck is mounted. And likewise, the edges are both hidden by the tone ring on top and the rim cap on the bottom.

Laminating the inside of the Rim

So in the previous episode we completed the outside lamination on our rim. The next step is to construct in the same way, the inner lamination. I regret to say that I didn't photograph the process so I'll just do a bit of explaining about the method and hopefully I won't confuse the reader.

Running a lamination around an inner rim is quite a bit easier now that I've done both. I got the basics of the method from Ken Levan's excellent examples. Rather than using a tapered splice joint, it makes sense to go with a butt joint. If the lamination is cut to exactly the right length, the lamination can be inserted into the rim and the ends snapped into place, and it will hold itself nicely in position without any clamping.

In order to make the bend, however, you do still need to steam bend the lamination. And the process is exactly the same as I showed in an earlier episode for fitting the outside lam. First I steamed the lamination and fit it in the rim with the ends overlapping, held it in place with a couple of spring clamps until it dried in place. Then, using a fine bladed back saw, I cut one of the ends where it crossed the other one. This gave me a slat of the right length, that would just snap into place. I then glued both surfaces, placed the lamination back in the rim and applied clamps around the entire circumference. Here's what I ended up with:



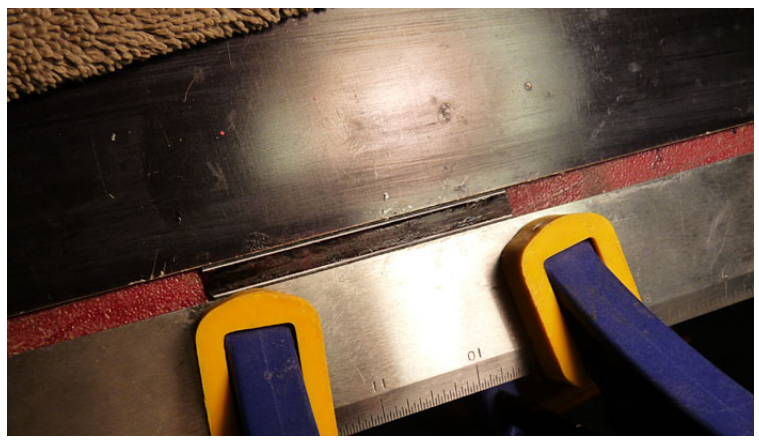
The joints look great, except for the butt joint where the two ends meet. Evidently, during the gluing operation, I clamped the veneer in place, and the tiny bit of extra slack it took up, resulted in the butt joint being pulled apart. I still don't know if this could have been avoided. I could have used a feathered joint instead of a butt joint, but it would have made the gluing-up operation more difficult, and the resulting joint isn't exactly pretty.

Below is another shot of the inside and outside joints. The feather joint on the outside will be covered with the heel of the neck, so that one is no problem. But the one on the inside will be visible.

So I decided to hide the joint, as I have done in the past, with an inlaid binding strip. Much like the inlaid strip that joins the two sides of a guitar where they meet at the bottom:

First thing is to make the binding strip, then it can be inlaid in one piece. To make the strip, I took a piece of the tortoise celluloid binding and to each side I glued a piece of wood violin purfling.

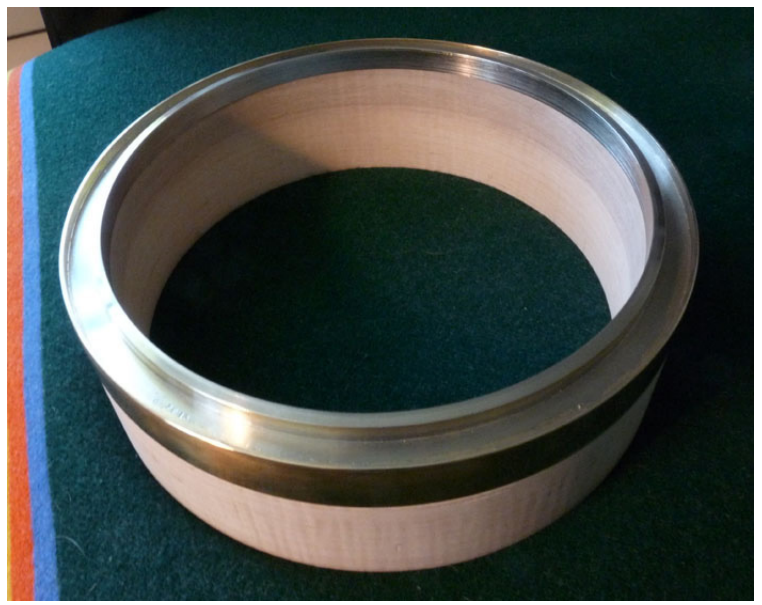
To clamp it straight and tight, I clamped a straightedge to my table top, and pressed a second straightedge against the strip and added a couple of quick clamps.



When that was dry, I held it over the butt joint and scribed a line on each side of the strip with a thin Xacto blade. I removed the strip and went over the lines several times till they were about 1/16" deep. Then I removed the waste wood with a sharp chisel.

Then I glued the decorative strip in place and sanded it flush. Problem solved.

So that completes the inside of the rim –for now. Overall, it looks pretty good, and I believe it is extremely strong. The inner core of blocks has a great amount of shear strength, while the laminations offer a great amount of tensile strength. And every glue joint in the core is reinforced on all sides by the outside laminations. I learned the basic concepts of this type of construction from Ken and Rudy's examples, which are slightly different, but the idea is basically the same. I've learned a lot on this forum from other members and my banjos have been better for it.

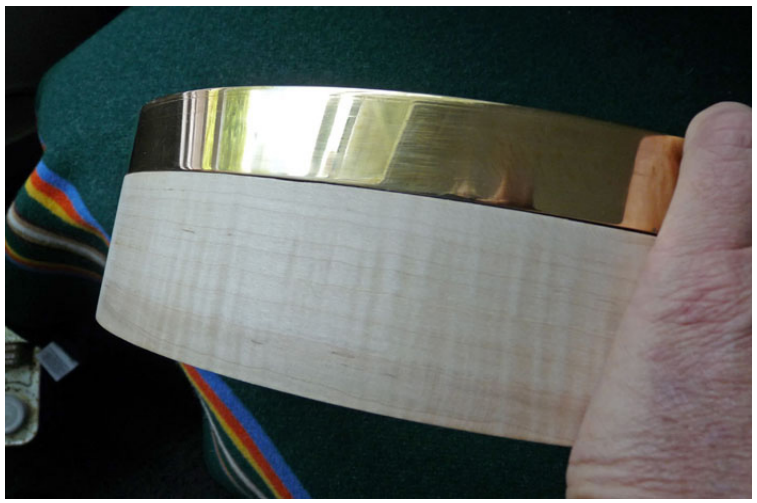


One last thing concerning the fit of the tone ring.

Once the rim is completed, I test the fit by sticking a piece of paper between the rim and the bottom of the tone ring. I work my way around the pot to see if I can pull the paper out when pressing the tone ring down. If I can't, I know I have good contact between the rim and the ring.

From Ken LeVan: Here's another way to glue in the inner lamination.

I also like to leave a few thousanths of an inch of clearance between the shoulder of the rim and the bottom of the tone ring skirt. I want the ring to be resting on the inside of the ring, not the skirt. I do this for both flathead rings and on this archtop ring. I am convinced that it creates more sustain, and I like sustain on my bluegrass banjos.



Binding

I've always loved the tortoise style binding on the old Fairbanks-Vega banjos and have used it several times on my own banjos. The main difference between my binding and the Vegas is that I have added a thin, black/white purfling strip between the binding and the rim. Black goes against the maple and white goes against the tortoise. It's a subtle feature and doesn't add a lot of work to the build. The purfling is available ready-made in 36" strips from several suppliers.

The first thing is to prepare the channels on the rims to accept the binding. To do that, we return, for the last time to the trusty router table.

I prefer to cut binding channels with the router table rather than trying to balance a dremel too on the edge of the rim. And I don't want to bother setting up any kind of fancy jig. This "jig" only requires a couple of clamps and two blocks of wood.

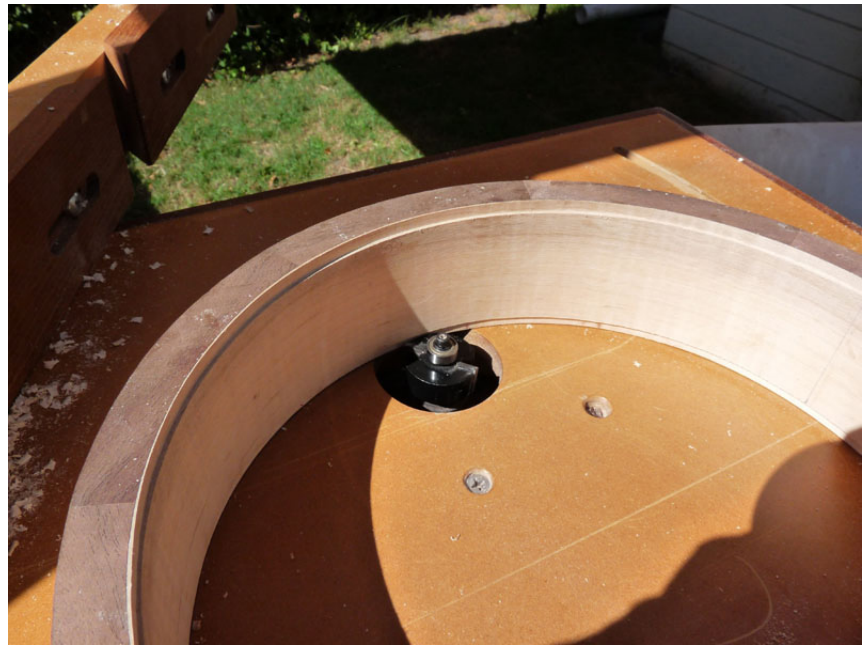
The picture to the left shows pretty clearly the set-up for routing the binding channels. I've moved the fence out of the way, and clamped two blocks of wood to the top of the router table. From the picture, you can see that the rim can be pressed up against the wedge formed by the two blocks, or it can be moved away from them. The only time the router bit will be cutting is when the rim is pressed against the blocks, and it can only cut as deeply as the blocks will allow.

The photo shows me routing the two channels on the inside of the rim. One down by the base of the rim and one just under the tone ring. When routing the outside of the rim, I arrange the apex of the wedge around the cutter. Once again it will let me adjust the depth of the cut and will make it impossible to cut too deeply.

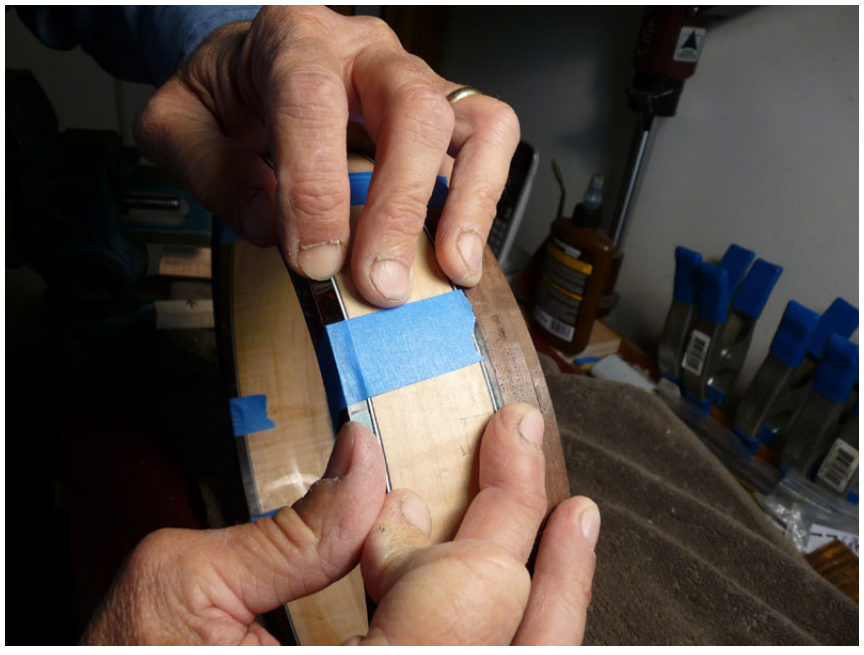
The blocks are easily adjustable by tapping with a small hammer on the free-end of the blocks. This will open the wedge or close it, depending on how you tap. A very slight tap will move the block only a couple thousanths of an inch, depending on the tightness of the clamp. This gives you very fine control over the depth of the cut. The hammer method is something I learned from using old wooden planes, in which you set the depth of the cut by either tapping the end of the blade, or the botton on the body of the plane with a small hammer. I't much more precise than you would guess.

In any case, I'm using a sharp cutter without a bearing. To get the perfect depth, I make a tiny cut that I know will be a bit shy of the depth I'm after. Then I tap one of the blocks (you only need to move one of them) and try it for fit. I then repeat this until I creep up on the correct depth. If I go a bit too far, I tap on the other side of the block.

Here's another view of the inside cut. It will only cut the groove when the rim is pressed against the wood blocks and rotated. I usually make several cuts, going a bit deeper each time, and checking the progress with the binding as I go.



Next, I fit the binding into the channel and cut the binding ends to a tight fit. with a sharp chisel. To do this, I hold the binding in place with a couple of clamps, and start taping down the binding into position. I don't use any glue yet.



I only work on one binding at a time. I'm double binding with a piece of white/black binding inside the tortoise binding. To make things even tougher, I'll be adding black/white purfling under the binding edge on the sides of the rim.

This part is a little tricky, since the purfling is going in the slot on-edge and will want to spring out. I find that if I press the binding downward when inserting the purfling, the binding itself will hold the purfling in place. I slowly work my way around the rim inserting, pressing and taping, until I have it well secured in position, and then I do some final trimming where the purfling ends meet. It takes a little practice to get it right, but it's not too hard.

Once the binding is in place, I remove the tape, one section at a time and flow some thin CA glue into the joint. I will seep in and creep into all the corners by itself. Then I'll replace the tape and move on to the next section. Once I have the glue injected into the joint, I let it dry for a few hours and then I scrape it all flush with a sharp card scraper, I let the binding sit proud of the bottom of the rim by about 1/16", as it will form a dam for inserting the decorative marquetry. Which we will be getting into on the next episode. Stay tuned. I think you will find it interesting.

Notes: That woodworker's vise you see is an antique Sheldon Quick Release vise I picked up at a local street market a while back. One quarter turn up of the handle unlocks the vise and a quarter turn down locks it. When it's unlocked, you just push or pull it by the locking handle to adjust the opening of the jaws. Fastest vise I have ever used. Plus, it's just too cool.
The vise was patented in 1900, and if I recall correctly, it was invented by a shop teacher who designed it for use by students to be effective and easy to use. It's built like a tank and I wouldn't be surprised if they were still using them when you were in Jr. High. The well known woodworker Chris Schwartz built his dream bench and mounted one to act as the mechanism for his end vise. It can be seen in the third photo down on his blog:

http://www.popularwoodworking.com/workbenches/schwarz-workbenches/18th-century-bench-four-month-report-card

Making Patterned Bindings
Rosette Construction

OK, we're headed down the home stretch on the rim. The construction is basically done, but on the Crow banjo I decided to add a fancy rim cap--much in the spirit of the vintage Fairbanks Vegas on their high-end models.

But I'm doing it a bit differently. Rather than doing it with marquetry banding as it is on the Vegas, I'm using a technique that I learned from Classic guitar soundhole rosettes. And the design is constructed of tiny tiles--like a miniature wooden mosaic.

This will be very much like a guitar rosette, but big enough to fit on the rim cap. To the left and above is a closeup of the finished mosaic. At first glance, it appears almost impossible, but there's a trick to it, and while it requires a lot of work, it is certainly do-able.

You can design a tile using pencil and paper, or you can download one of several applications off the net that make the job quicker and easier.

With the above tile, you can flip the tile from left to right, and it will connect with the previous tile to form a pattern. By alternating each tile, you wil get a repeating pattern that you can run around the entire rim.

So this is what the running pattern looks like. I also added the tortoise binding and the black/white purfling in the above drawing to see the finished effect. You can compare this with the actual photo at the top of this thread to see how it actually worked out.

I made a previous rosette of the same design for a Tubaphone-style banjo with a relatively thin rim. On that rim I used tiny pieces that were about .4mm square. On this, thicker rim, I upped the size of each square to .9mm. The smaller the pieces, the more detail you can get within any given space, but of course, the more squares, the more work is involved.

The first step is designing your rosette. The sky is the limit, depending on the size of your tiles and the amount of time you want to spend on the construction. Back when I made a classical guitar, I designed a rosette pattern that I liked a lot. It involved using twelve squares across, and twelve squares down, for a total of 144 squares per tile.

OK, so that's the basic theory, how do we go about making it?

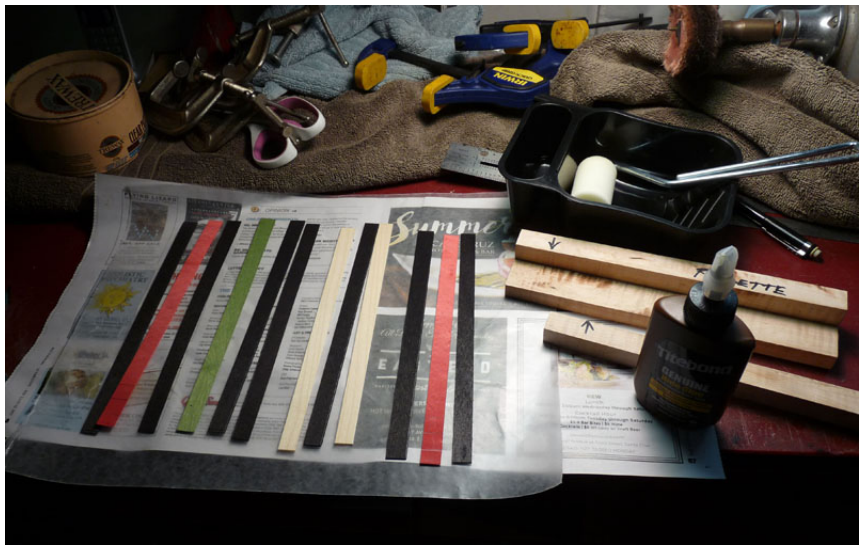
I started with four sheets of colored veneer. On this design I used one veneer each of black, red, green and natural maple. It is certainly possible to make a rosette using all natural woods, but I wanted a bit more color on this one. The first step was to mark off the veneers into a workable size. I made mine 9" long by 1/2" wide.

I calculated how many pieces I would need. Then using a sharp blade and straightedge, I sliced them into strips. I make very light cuts, and repeat them three or four times when cutting through the veneer. If I try to cut through the full thickness in one slice, it will often wander--depending on the direction of the grain.

Here are the strips, ready to start gluing up.

Building the pattern requires going back to the original tile design and gluing up the strips row by row. For this design, we will need one glued up block of strips for each of the twelve rows.

In order to glue the strips tightly, I made a simple form out of three pieces of scrap wood. I heavily waxed each piece of wood with paste floor wax to keep from gluing any of my veneer strips to the form.



The strips of colored veneeers are laid out for the first row and I applied liquid hide glue with a foam roller to all of them, avoiding getting glue on the two sides that will contact the form.

Once the glue dries, The log is removed from the clamping form and one side is sanded flat.

And below is the form in action. The glued veneers are inserted into the "L" shaped form, and the single piece is put in place and clamped down tight. The liquid hide glue gives decent working time, and is the best choice for making the tiles for several reasons. It makes for nearly invisible glue joints, it grabs quickly when clamping, and the tiles can at a later operation be softened by dipping the tiles into warm water, which allows them to be pressed together more tightly.

This will make the first of the twelve logs needed.

This process is repeated for each row of squares. There is enough thickness on the logs to allow us to slice off layers that will later be arranged into the final pattern.

Now, you may notice that I have made only six logs. That's because on the design I created, I can actually flip each slice when gluing up the final log, and can cut the need for twelve logs in half.

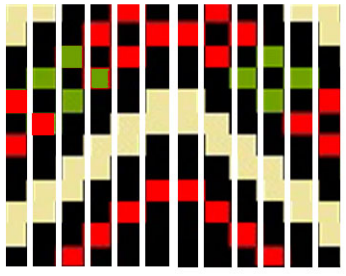
So, we're about halfway through the process of making the rosette tiles. I'll finish the process on the next installment.

I first learned how to make rosettes many years ago from the book "Classic Guitar Construction" by Irving Sloane.

His book is still a great one for exploring practical methods for building stringed instruments, and I think everyone who aspires to be a luthier should have a copy in their library. As far as I know, I am the only one who has used the technique on banjos, but I could well be wrong. I do know that the technique becomes a focal point for anyone who examines the banjos and is well worth the considerable effort to make it.

Rosette Construction Continued

We last delt with construction of the twelve laminate logs that establish the rosette pattern. Each of these will be split lengthwise to create twelve multi-striped veneers. To clarify what we are doing, here's a breakdown of the original mosaic pattern into individual layers.



Each of the stripes above are slices off the six logs we created in the preceeding thread. Each stripe is composed of twelve squares. All of the color pieces are square in shape. Where there appear to be squares that are longer than the rest, it is actually two or three squares of the same color that are next to each other.

If you study the above pattern you will see that the first six stripes are each unique. While the last six stripes are mirror images of the first six. That's why we only needed to make six logs rather than twelve. We just turn the logs over to create the rest of the pattern. This saves half the time involved and is something I was careful about designing into my pattern.
The pattern certainly doesn't have to be symmetrical. You can arrange the chips in any pattern you like. Look at the rosettes on classical guitars to get an idea of how limitless the possibilities are.

Ok, so now we take our six striped logs and our task is to slice off pieces that are as thick as the veneers are thick. I personally think it is impossible to slice it that thin, so I come as close as possible with the band saw and finish with a scraper. In the photo above I'm slicing off one layer. I will need to get at least two layers off each log, because my design has a mirror image. With care I can usually get at least three to four layers off one log, so I will have one extra in case I screw one up. The feather board I made for my bandsaw helps keep the blade from wandering and helps keep the slices regular in shape.

I will slice off one layer with the smooth sanded side against the bandsaw fence. Then I will sand the cut side on the log with my disc sander, and cut the next strip. Etc.(If I had no disc sander, I would flatten the logs on my sanding board.)

As an aside, the bandsaw fence is actually a wall-mount kitchen knife holder. I turned it upside down and the magnetic strips clamp it very firmly to my iron saw table.

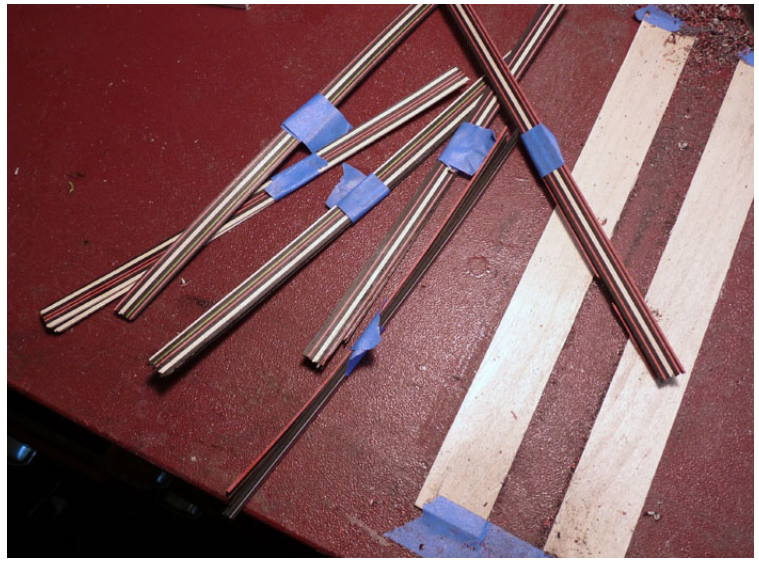
In the above shot, I've resawn each of the logs into multi colored strips. I keep them all arranged in order. I don't want to get them mixed up at this stage! Each of the strips is a bit over the thickness of the original veneer. (.9mm) and each has one smooth side (from the sanding) and one rough side (from the bandsaw.)

From here we go to the scraper.

The setup is the same as we used for making thin veneers for the inlays. I tape two veneers on a flat surface and tape the mosaic strip smooth-side down in between them. I then sharpen my card scraper, and with a file, I dull it leaving only a 1" section in the middle of the scraper blade that is still sharp. I add a couple piece of tape so I can easily keep track of where the sharp portion is. Then I start scraping. I taught myself the following thicknessing technique, though others have probably done it.

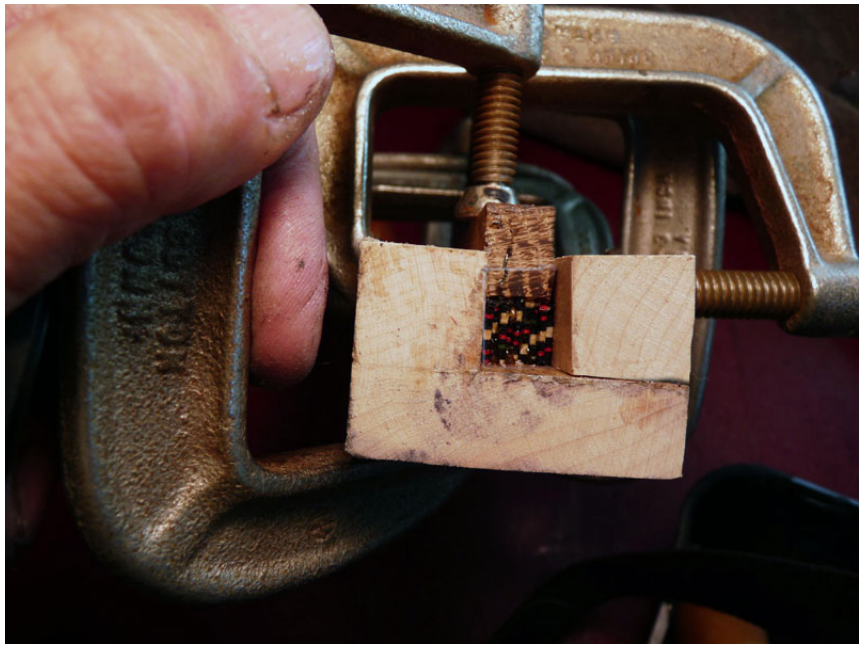
A single C clamp holds the strip in place. The scraper rides on the two outside veneers and slices wood only off of the central strip. The dull sides of the scraper slide over the veneers without cutting, and the central sharp portion of the scraper gradually brings the strip down to the same height as the veneers. Once you feel it stop cutting, and taking off curls, you are done with that strip. Both sides will now be smooth. Note that I keep the scraper at an angle. This gives me a shearing cut which seems to give me a smoother, faster cut than holding it straight.

By the way, the traditional way to use a card scraper is to cut on the push stroke–like you would do with a block plane. the thumbs press against the center of the blade to adjust the depth of cut. The Japanese like to cut on the pull stroke with many of their tools. I think it may be because the traditional Japanese craftsman sits on the ground when working, while westerners stand over a workbench. Each gets the best leverage for their working position that way. At least that's what I tell myself. Many choose to cut on the pull stroke and whatever gets it done is fine by me.



Here are the finished strips. I've got them sorted, bundled and taped together, ready for gluing.

Here I've stacked the strips into my clamping form (after re-waxing it) I apply the glue again with a roller, and this time I clamp from both directions as I want the strips lined up both vertically and horizontally. My extra clamping mechanism is a single strip of wood the width of the finished log. Below you can see how it puts pressure in both directions.



Once again I use liquid hide glue for the adhesive. Once the strips are in the form, I bring both clamping blocks loosely in place and then I tighten one a side bit, then the top clamp a little bit, and so back and forth until they are both quite tight. The new glue actually softens the existing hide glue in the strips so everything can squeeze quite tightly and evenly.

When the glue is dry, I remove the log from the clamping form and clamp it in my vise. First I cut it in half to make it easier to handle, then I taper the two sides of each log into a slightly wedged shape to allow for fitting it around the rim. The little diagram above is something I drew up on my computer to get a feel for how much taper I needed I stop occasionally and stick the end of the log against the drawing to see how close I am to the finished shape. This may seem excessively fussy, but you want as tight a fit as you can get between the tiles. Actually, just getting roughly close to the right angle is probably adequate.

OK, here I get a bit weird. I've got a little mini lathe/ milling machine that I set up with a very thin machinist saw blade that allows me to make very precise cuts to exactly the same thickness (1/16") and do it very quickly. In the past, I just made a small miter box and cut the tiles with an Xacto razor saw. It worked just fine and you don't need to run out and get a mini lathe. Classical guitar makers have done it by hand for centuries.

Unfortunately, I neglected to document the final stages of laying the rosette tiles on to the rim cap. But the process is simple and I suspect you can figure it out by yourself. I had sized the tiles to just fit between the two sets of rim binding. I glued the inside binding in place, and then glued in the tiles pressing each of them against the inner binding. Once all the tiles were set and the glue dried, I ran a mill file with one save edge around the outside edges of the mosaic tiles, just to smooth them a bit and flush them to the binding channel. Then I bound the outside of the rim cap and got a nice tight fit.

Before gluing each tile into place, I picked them up with a pair of tweezers and dipped them into warm water. This slightly softened the glue in the tile and made it more resilient when pressing it into place against the binding and the previous tiles. As I recall it took about 45 tiles to make the circuit around the rim. That will of course be different depending on the size of your rim and the size of your tiles. You'll notice there is a small break in the pattern in the photo below. That's because I didn't come out completely even where the final tiles met. On a classical guitar, the join is hidden under the end of the fretboard. I will somehow live with the flaw in the pattern. So far nobody has noticed, so lets keep this just between the two of us, please. :->

Heel Cutting and Assembly

Well, we have completed the neck and the rim and now is the time to put the two of them together. I like to do final fitting and assembly before I do final sanding and finishing, just to make sure that nothing will need tweaking, or get damaged in the fitting process. A dry run, if you like. I did stain and seal the neck on this banjo because I knew it would get a lot of handling before it was ready for varnishing. But I like to do the top-coating all at the same time.

The first thing I do is fit the hardware to the rim. And the first step in doing that is to drill the holes for the brackets, lag bolts and tailpiece. To do this I need to mark the position of the holes.

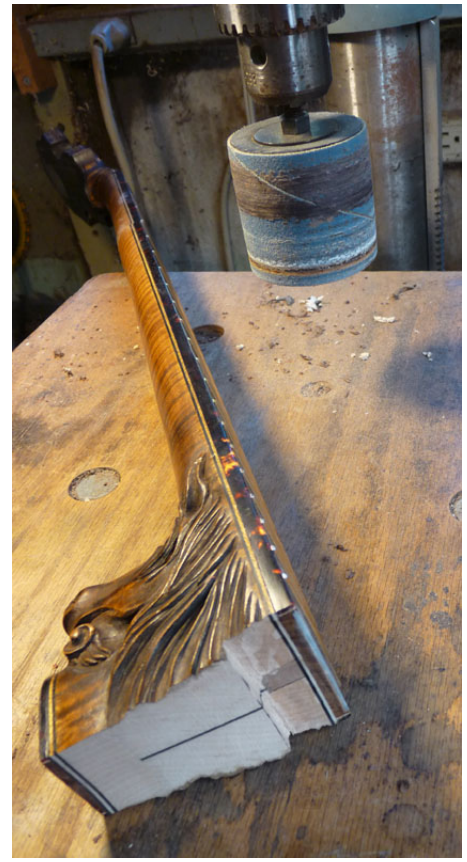
I usually set the rim on a flat surface, and set a pencil on a book, or block of wood to prop it up the the correct height, then I spin the rim against the pencil to mark a line around the rim that locates the vertical positioning of the brackets. Next, I wedge the tension hoop around the base of the rim with the cutout centered in the correct position and make a small mark in the middle of each groove in the tension hoop. Then I take a small machinist square and strike a short line through the horizontal line at each mark. Where the lines cross show me the center of each bracket bolt. I punch an indentation at each point.

I then drill the holes through the rim. I usually clamp a piece of scrap softwood behind each position when drilling to avoid tearout.

Once the holes are drilled, I attach every other bracket shoe and mount the head. (no need to attach all of them at this stage) Then I'm ready to fit the neck heel.

By holding the neck up against the pot, I mark the depth of the tension hoop cutout on the face of the heel and the top of the fretboard. And using my fret saw, I cut out the waste wood.

In a previous thread of this series, I demonstrated how I cut the angle of the heel on the butt of the neck using my table saw. With the waste now removed, all that remains for fitting the neck to the rim is to remove a small amount of material between the edges of the heel in a smooth curve to fit the rim and tension hoop.



To allow me to test fit the neck against the rim, I have to first cut a curve into the upper portion of the heel, by the fretboard. I do this with a shallow gouge that I keep razor sharp. The maple cuts cleanly and easily. But on the Crow banjo I have the mother of pearl inlay running off the end of the fretboard, and I can't trim this with a gouge, so I leave it for later and just cut up to it.

Notice that I use no special jigs or mechanisms to shape the end of the heel. Before I do any sanding, I cut a small block of wood that is just the right height to hold the neck at an angle on the sanding table. With the sander turned off, I press the neck against the sanding drum so that the end of the heel has contact along the full height of the heel. Then I slide the wooden stick back and forth, till it's in the right position to brace the neck at the correct angle. And I clamp the block in position.

Then, I simply sand freehand until I have a curve that exactly fits against the rim. I only need to avoid sanding the outside edges of the heel, and my angles should be just right. I do try to get it as close as possible to perfect, but the heel only really needs to touch on the outside edges of the heel. It only takes a few minutes to get the right curve. I sand a little, check for fit against the rim, sand a little more, etc. I don't bother with carbon paper or other fitting aids. It's easy enough to do it by sight and feel. And very little wood needs to be removed. I just have to avoid removing any wood from the outside edges, or I will lose my good fit.

Once I have the tension hoop cutout completed, I can shape the rest of the heel. I do this on my spindle sander. Though in the past I have cut the entire heel with the gouge, the sander is faster and a bit cleaner. A sanding drum chucked in the drill press would work just as well, and in fact that's what I use to shape the pearl on the end of the fretboard, since the oscillationg spindle sander won't reach it. Below shows how I shape the curve of the heel with the sander.

When I have the heel sanded, I then sand the top of the fretboard to give me a nice curve where the pearl meets the tension hoop.

To the left shows how I check for fit. I clamp the rim in a vise with the neck side of the rim facing straight up.

With the neck carefully balancing on the rim, I tie a weight on the end of a string, and hang a loop over the peghead. I run the string through the third string slot on the nut, and move the assembly until the string runs across the centerline on the bottom of the rim. If the fit is good, the string should run through the center of the fretboard inlays above the fifth fret, down to the rim.

Here is another view from the front.

If this checks out fine, I then clamp the heel to the rim, and place a long straightedge from the nut to the top of a 5/8" bridge to make sure that my action is correct over the 12th fret. (I don't actually measure the action, but just eyeball it to see if it's where I like it.)

In this particular case, I was lucky and the neck was perfectly centered and angled. If it were not, I would go back to the spindle sander and do a little touch-up until I got it right.

If my setup was correct and accurate back when I trimmed the end of the heel on the table saw, I will almost certainly be very close.

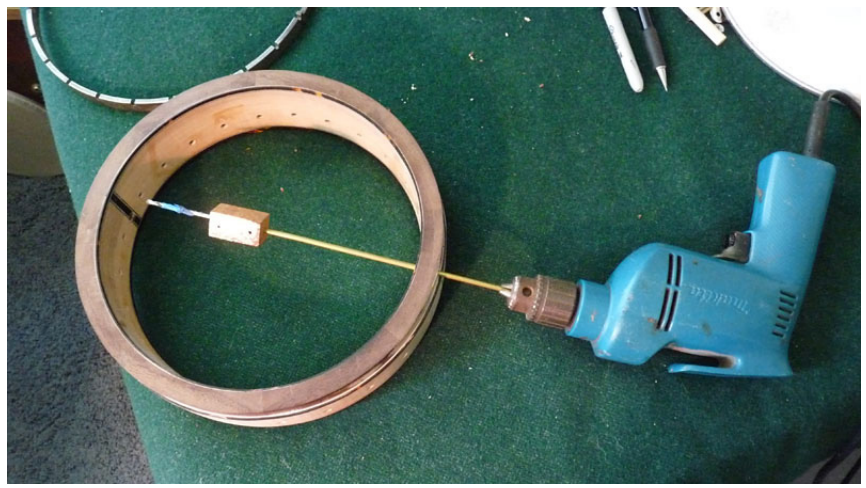
THE RIM

As you can see on the photo below, my fit of the neck to the tension hoop is pretty good. Many builders prefer to leave a small space between the end of the fretboard and the tension hoop, which I have no problem with. I like mine to be just touching, but with no significant pressure that might cause the hoop to bind when tightening the head. (though I've never had a problem with binding. I think that problem may be overstated. It would take a LOT of pressure to cause the hoop to stick.)

Be that as it may, I find it not particularly difficult to get a decent fit on the neck to rim joint without any extraneous jigs, machines, or other devices. The old timers used to cut them by eye, all day long. It's just a matter of taking your time and being careful.

Once the neck is fit, I clamp it in position on the rim and drill the holes for inserting the lag bolts. On the top lag bolt I simply hold the drill inside the rim and eyeball it from the top while my confederate (wife) eyeballs it from the side to make sure I'm holding the drill straight. The top co-rod fits into a closed end hole that is a bit oversized, so absolute accuracy isn't critical.

The bottom co-rod is the more important one of the two IMHO, and to get it straight, I like to drill through the tailpiece hole. through the rim on both sides, and into the neck. They make long drill bits that would work dandy for this purpose, but being a cheapskate, I made my own out of a piece of scrap brass tubing, a drill bit and a small block of wood. I drilled a hole through the wood, using a drill the exact same size as the brass tube. Then I inserted the drill in one side and the tube in the other side and held them in place with small set screws. To drill the pilot hole, I remove the tube from the block and insert it through the tailpiece hole. Then I re-attach the block, and drill my pilot hole. Works perfectly.



That pretty much wraps it up for the Crow banjo build. All that is left is finishing. But everybody has their preferences on that process, and mine is out of the ordinary. If I later post the build of the resonator for this banjo, I may cover my finishing process. But till then...