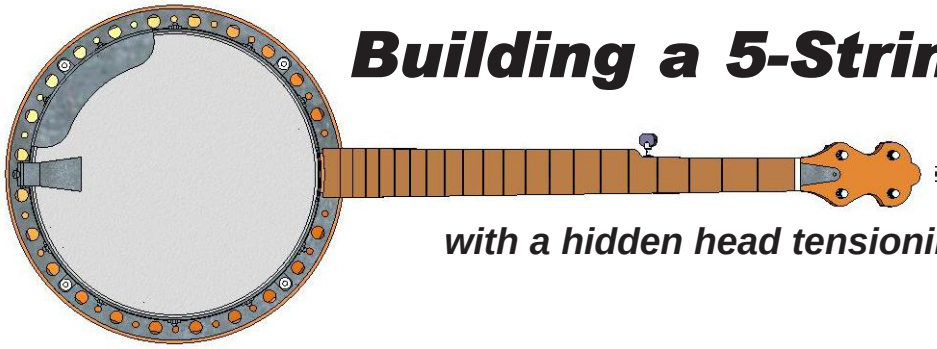


Building a 5-String Banjo

with a hidden head tensioning system

By Jim Chronister

http://jbchron.home.att.net

Before I begin discussing the construction of this 5-string banjo, I first need to give credit where credit is due. This project would not have been possible without the wonderful information that others have placed out on the internet for all to review. The best advice I can give to anyone wishing to build their own banjo is this: ***RESEARCH BEFORE BUILDING!*** I spent a great deal of time researching before I actually drew my own plans. With this being said, here is a disclaimer:

The author cannot be held accountable for the results you obtain by following these instructions. These plans are provided because they worked for me. Before attempting to construct a banjo from scratch, you should be very comfortable with your skill and safety level, as well as the equipment you plan to utilize. If you are not comfortable with certain equipment and processes, you should seek the assistance of someone with woodworking and metalworking skills. It would also be great to have a good banjo player available for advice.

With that being said, I would like to give credit to the following individuals who have helped with website advice:

Hidden Head Tensioning System-
My thanks to Rudy at angelfire.com for his tensioning method. My modifications are built on his ideas. You can find his construction notes at: http://www.angelfire.com/music2/construct/index.html

Treating Bone for Instrument Usage-
My thanks to Sean for providing information to correctly treat bone. That information can be found at: http://www.banjohangout.org/lessons/files/171.txt

Building Banjo Bridges-
Richie Dotson has a great tutorial for building bridges available at: http://members.tripod.com/~banjoist/bridge1.htm

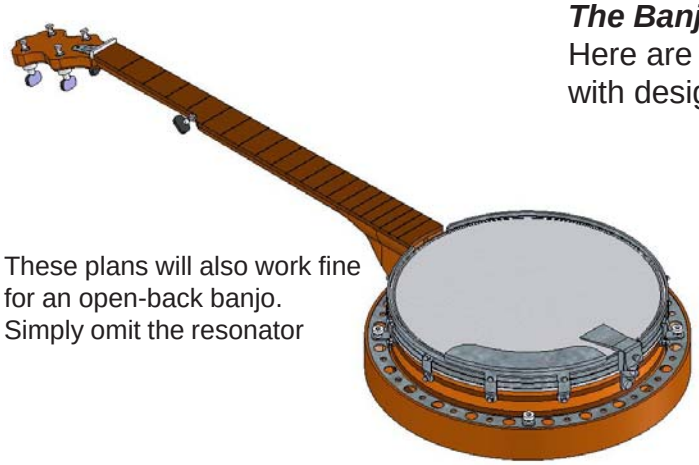
The Banjo Hangout-
This is the number one site for banjo players (and wanna-be players like me). Great forums, links, tabs and lessons. The site is: http://www.banjohangout.org/

Introduction:

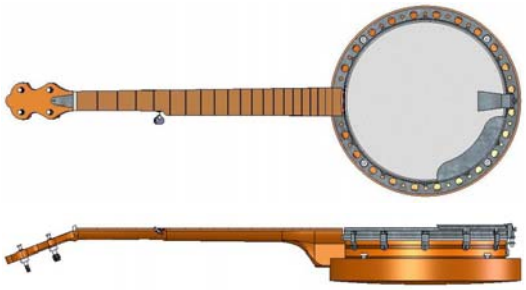
I've never had much musical ability and understanding. I have been a technology education teacher for the past 17 years. Back in college (about 18 years ago), a fellow student was building a simple open-back, fretted, wood head banjo. I thought it was a neat project so I got a copy of the plans. A few months later, a friend mentioned that he was thinking about starting guitar and banjo lessons. This lead to us building 2 of these wood head banjos. I later built 3 more for others. Mine sat on a shelf until 1 1/2 years ago when my interest was ignited by stumbling onto some nice information and tuning software online. It began to make sense! That new interest lead to these plans being generated during the winter of 2004-05 and the end result of the banjo pictured to the left in the spring of 2005. Being a diehard builder, my goal was to fabricate everything I could. The only items purchased were the head, strings, tuners, fret wire and lots of nuts, bolts and screws!

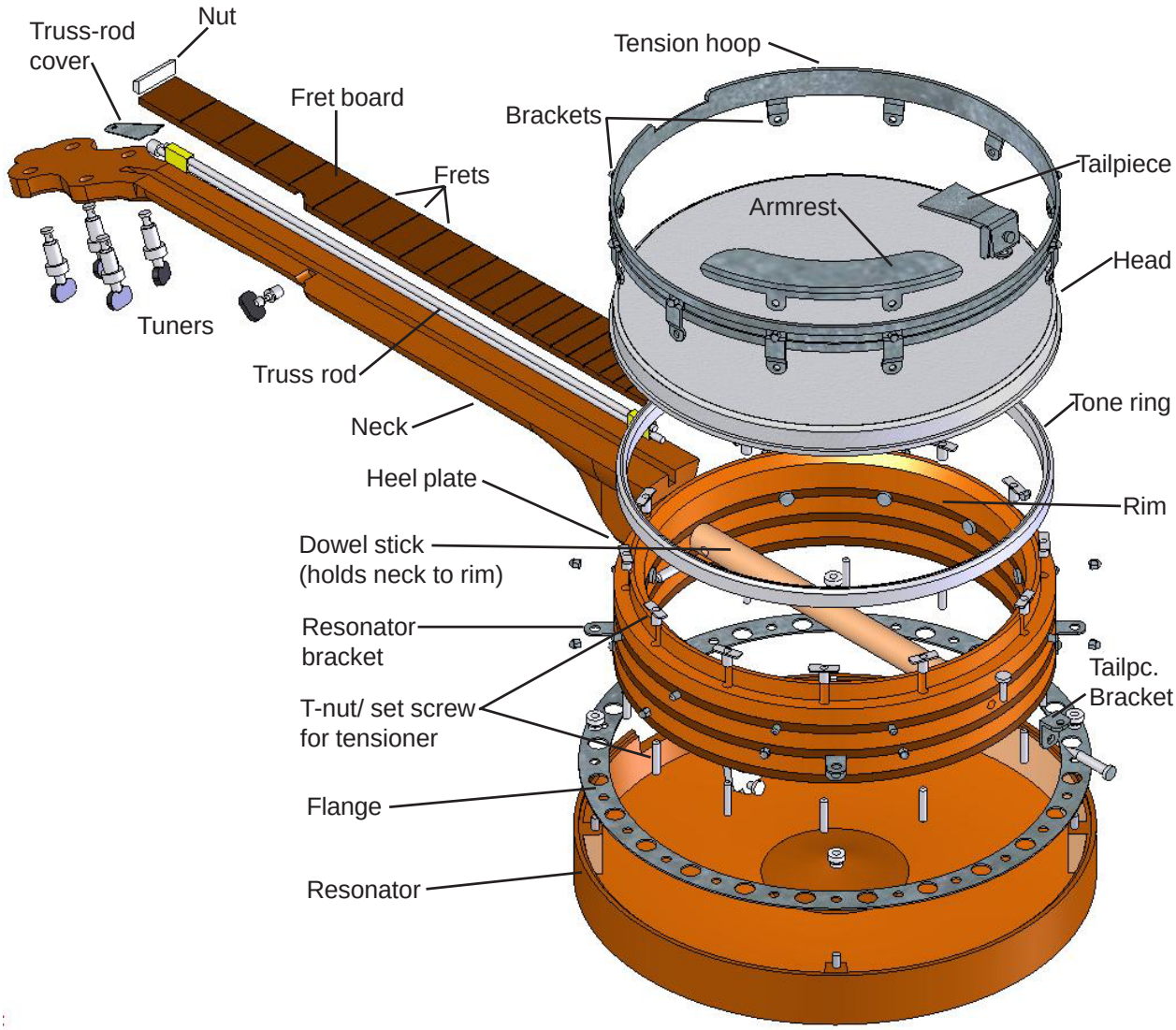
The Banjo:

Here are some drawings of the banjo to help with design understanding.



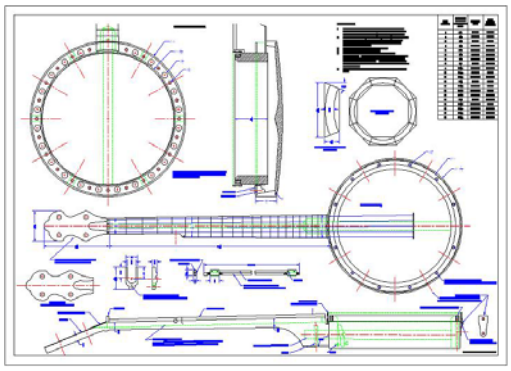
These plans will also work fine for an open-back banjo. Simply omit the resonator





The interesting feature of the tensioning system is that, unlike traditional banjos, the tension hoop remains stationary while the tone ring is moved up under the head creating tension. This allows the builder to streamline the exterior appearance of the banjo. You don't need to have all those rods going around the outside of the rim. My biggest concern was how this would effect sound. I think the results turned out great however! I've even received some good comments about it from some real players!

Step #1- Securing the Plans-



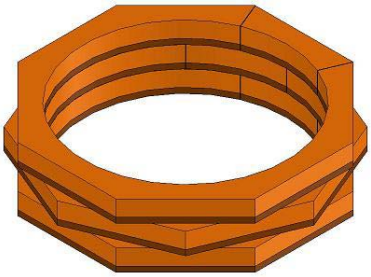
The plans were drawn, full scale, in AutoCAD and available for download at my website (http://jbchron.home.att.net). You have several options. If you have AutoCAD and an “E” size plotter (36” x 42”), then just download the AutoCAD (.dwg) file and go. You can also take the file to a printing shop like Kinkos to have the file printed, or ***download the .dwf drawing file, then go to AutoCAD’s website (www.autodesk.com) and download the free DWF file viewer software.*** From here you can tell it to print the drawing full scale to a regular letter size printer. You’ll go through a few sheets of paper, but it will be printed with registration marks and can be assembled into a usable drawing.

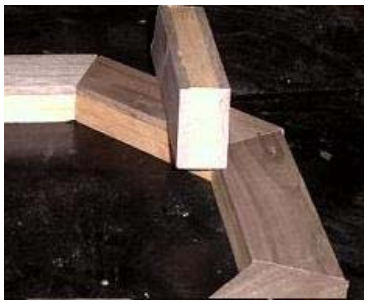
Step #2- Securing the Materials-

As I mentioned before, my goal was to make a banjo from scatch, that even included harvesting my own lumber from the woods. I wanted to use my favorite local hardwoods- cherry and walnut. With chainsaw in hand, I harvested all the lumber I needed from my inlaws woods. This process needed to start long before the actual building since the lumber needed to dry to an acceptable moisture content. Although cherry and walnut are not necessarily the ideal lumber choices for a banjo, they were my choices. You will need to make your own decisions on that. I created an interesting effect layering the cherry and walnut to make the rim, but again, that will need to be a personal preference and the actuall lumber sizes and amounts will vary according to your design. Stay away from using a lot of open-grained wood like oak. I imagine that open-grained woods could harm the sound quality.

Step #3- Building the Rim-

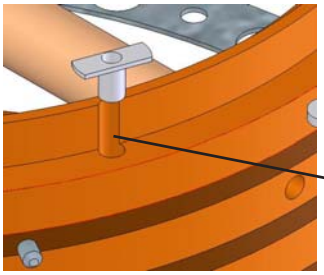
The first step is to build the octagon shapes needed for the rim. The total height of the rim is 2-3/4”, made up of three rings with staggered joints for strength. Since I wanted thin layers of walnut between the cherry layers, I glued the walnut strips to the cherry before cutting the angled pieces.

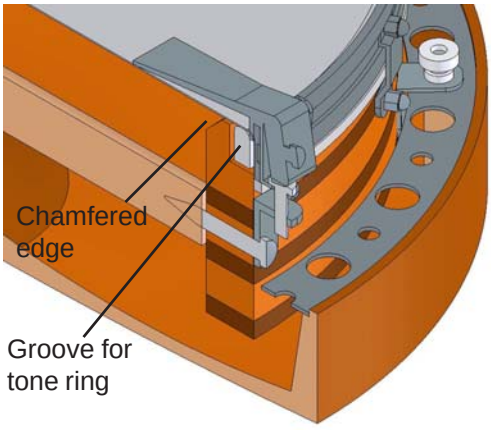




I also cut the inside rounded edge before gluing the small pieces together. This made it easier to sand and shape after the final assembly.

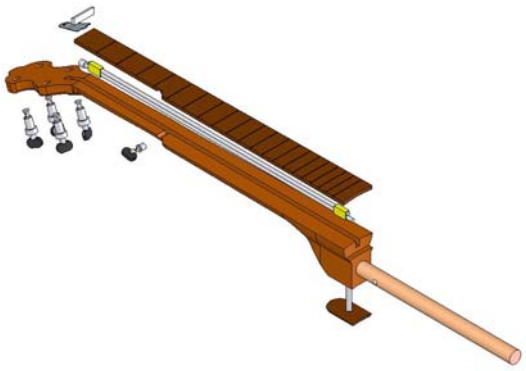
The next step is to sand and shape the rim. A lathe could be used for this step, but was easy enough to use the disk and drum sanders.A step then needs to be cut in the top of the rim to allow the tone ring to sit. A groove 1/2” deep by 3/8” wide was cut using a straight router bit and router table. Care must be taken with small cuts to reach the required depth. It would be very easy to make a mistake at this point. This is also the time to drill the 1/4” diameter holes for the tensioning screws. Sand the entire assembly and place to the side for the time being. For more detailed steps in this process, visit http://www.angelfire.com/music2/construct/index.html. Rudy does a nice job of walking through the steps if you need them.

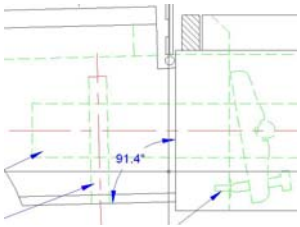




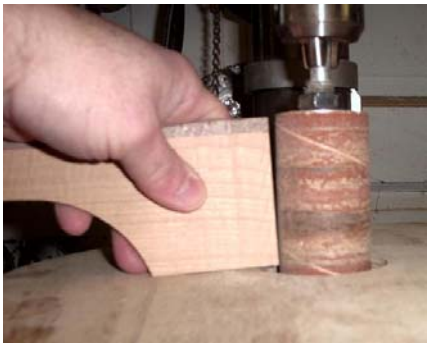
Step #4- Building the Neck-

This is probably the most difficult step of the construction process. If the neck is not straight, has a twist, or is not angled properly, you may have problems that will be difficult- if not impossible- to correct. This was a big worry for me since I was using “home treated” wood. Thankfully, the wood didn’t move at all after cutting. Glue up the wood you plan to use for the neck. It can be solid stock or laminated. I placed a strip of walnut between two 1-1/4” slabs of cherry for an “old-time” look. If you plan on doing this more than once, you may want to glue your paper patterns to some 1/4 plywood so your templates last. Trace the top and side views on your stock. Before cutting them on the band saw, you may want to cut the groove for your truss rod now. I liked the style of a 2-way truss rod called a Hot-Rod truss rod. It allows adjustment both up and down due to the 2-rod configuration. One rod is fixed while the other rod is threaded at both ends. This allows the one rod to be lengthened and shortened as desired. Works great. I spent a lot of time cutting the two brass blocks, finding a left-hand tap and die for the one end, and finally assembling the thing. If I were to do this again, I would spend the $15 plus shipping to buy one rather than build one. After cutting the groove for the truss rod, cut the top and side profiles on a bandsaw, then finish cutting the shape of the tuner head. Use rasps, spokeshaves and files to finish shaping the neck. You may wish to wait to do the final shaping until after you glue on the fret board. For a clean look, add a layer of veneer to the top of the head. Drill holes for tuners. You’re now ready to work on the fret board. This is a 1/4” thick piece that needs to be accurately cut for the fret wire. I have included a chart with both inches and millimeters on the detailed drawings. These measurements work for the 25-1/2” scale length, but if you decide to lengthen the neck, you will need to make adjustments. They make some wonderful tools for doing this. I found that I had a bandsaw blade with minimal tooth set that cut the appropriate width groove. All I needed to do was create a fixture that controlled the depth of cut as shown. Glue the fret board on the neck assembly being careful not to get glue in the truss rod cavity. You may even wish to cut the frets and fastened the board to the neck *before* you cut the profile and top. At this point, you can install the truss rod by sliding it into the end of the channel. Be sure to coat the rods with silicone to prevent buzzing.

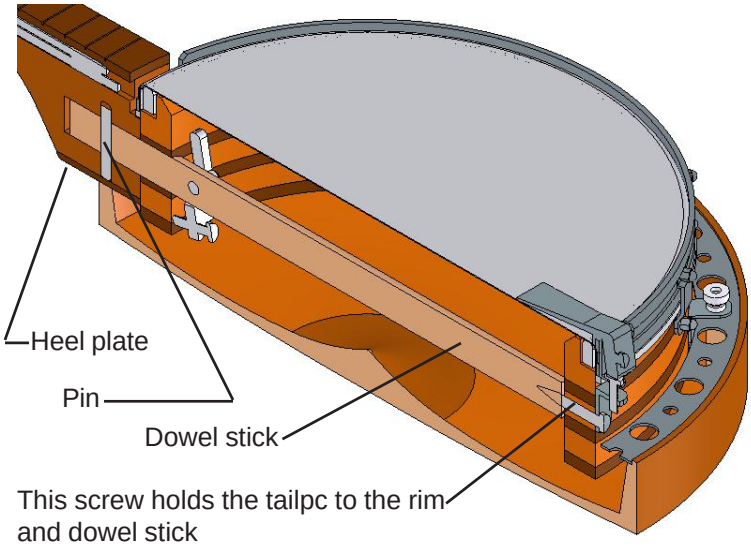




You are now ready to do some final work to the base of the neck and heel where it joins to the rim. It will need to be cut at a slight angle and rounded to fit the rim. I decided a neck angle of about 91.5 degrees would work to give me about 5/8” of bridge. You can check this by holding the rim to the neck where it will be mounted and place a straight edge where the strings will ride. The best way to sand the angle is to use a drill press where the table can be rotated. Keep checking the fit to the rim as you work. You will notice a deeper groove is cut near the top of the neck where it joins with the rim. This space is needed to accept the tension ring and head. I would wait to cut this until you are ready to assemble the head and rim. At that time, you can take more accurate measurements for what you need to remove. You’re now ready to join the neck to the rim!



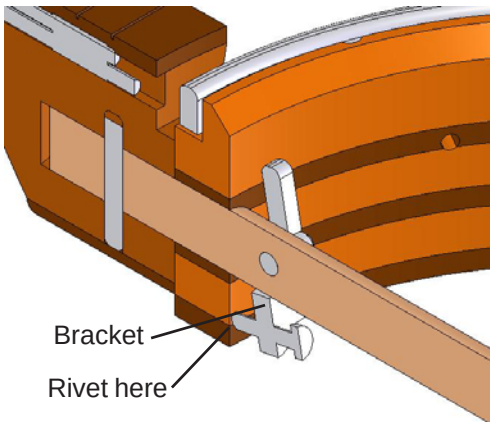
Step #5- Joining the Neck and Rim-



This design uses a single dowel stick to hold the neck to the rim. Modern banjos use two coordinating rods to do this. The benefit of two rods is that the banjo is more adjustable. The dowel stick is more traditional and easier to assemble.

First, mark the rim at 2 spots, exactly 180 degrees from each other. one side will be drilled with a 3/4" bit while the other is drilled with a 3/8" bit. I drilled my holes about 1-5/8" below the top of the rim. Double check your location.

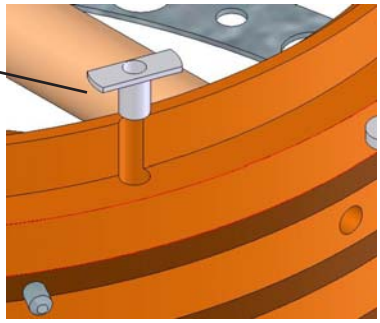
Now, clamp the rim to the neck. To do this, I clamped the rim to the tabletop, then used band clamps to hold the neck to the rim. You need them to be secure and in the exact assembly location. I needed to use a 3/4" spade bit in an extension to go through the rim and drill the hole in the neck at the precise angle and location. You're now ready to install the dowel stick in the neck assembly. Remove the clamps and measure for the length of the dowel stick. Cut it an inch longer than the final length to be safe. Glue the stick in the neck, then drill a 1/4" hole up through the heel and insert a 1/4" metal pin to hold the stick in place. Cover the pin with the heel plate. You now need to fabricate the bracket that holds the neck to the rim. This is made from a 1/4" x 1" x 2" piece of aluminum (or brass) and a 1/4" metal pin. Place a rivet under the screw so it doesn't cut into the rim. Rudy at angelfire.com has a lot of nice detailed pictures of this assembly.



Step #6- Making the Tone Ring-

There are a lot of tone ring purists out there. This banjo is not for you. My tone ring is a simple aluminum band, 1/4" x 1/2" x approx. 3' long. I rolled mine on a slip-form roller, but if one is unavailable, you can create a wooden form to wrap it around. After rolled, you will need to cut it to exact length, drill the ends with a 1/8" bit and pin the ends together to keep them aligned. File the top profile to create a filleted edge and adjust it to fit the rim evenly all around. Take the T-nuts and cut the edges so they fit into the holes. Screw in the set screws from the bottom and you're done.

T-nut with sides cut and fitted into the holes previously drilled into the rim. The set screws adjusted from the bottom will push the tone ring upward against the head.



Step #7- Making the Tension Hoop-

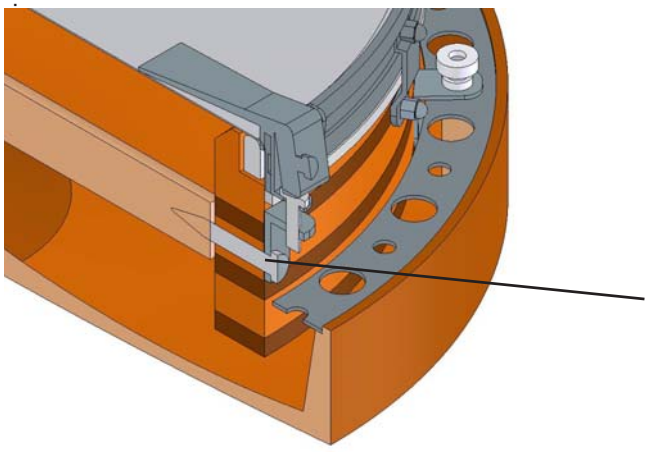
I had a piece of heavy guage nickel-silver that had been sitting around forever I decided to use for this banjo. The hoop could also be made from a 1/8” x 3/4” x approx 3’ long section of band material if you choose. I decided to create mine from the sheet in two 1-1/4” wide by 18” sections. I used a break to fold two 1/4” wide hems for strength and decoration. I then had to solder them together to make the band long enough. Why 2 sections instead of one? My break wasn’t long enough to fold one long section.

My next step was to create the bracket tabs used to hold the hoop to the rim. My original plan was to solder the tabs to the hoop, but decided to bolt the brackets to the hoop instead for more strength. I used flat-headed screws, countersunk into the hoop to prevent them from damaging the head. They were finished off with stainless acorn nuts. It’s now time to trial fit the head to the rim! With the rim assembly temporarily together, measure and cut the top of the neck to fit the head and hoop. If you notice, I put a spot finish on all metal components. This is easily done by sanding and polishiing the metal, then using a 3/8” dowel rod and emory cloth in the drill press to create a swirl effect.

Step #8- Making the Tailpiece and Armrest-

Once again, buying the components can make more sense than fabricating them. On the website, I have patterns available for the adjustable tailpiece. I had to go back a month after it was finished and reinforce the main joint with a piece of 1/8” thick brass bent in an “L” shape. The strings exert much more force on the structure than I originally expected. Two months later, the repair is still holding and I expect it to last.

The armrest was hammered on a stake to get the desired shape. The armrest and tailpiece actually provide structural support to the assembly. The armrest strengthens the hoop in that location while the tailpiece adds force against the tension of the tone



Tailpiece bracket and mounting assembly. Since the hole through rim was oversized to allow the drill extension, you may need to shim the screw that goes into the dowel stick

Step #9- Finishing and Final Assembly-

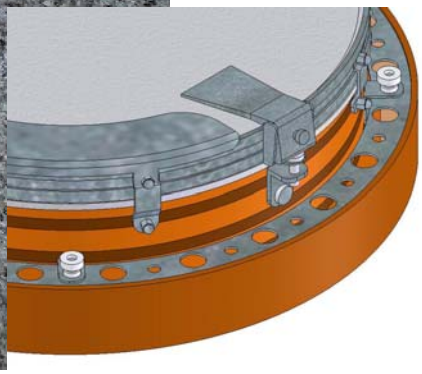
You're ready to disassemble your banjo, sand and apply finish. That's a personal preference, but whatever you use, apply at least 4 coats for a good seal. You're now ready to insert the frets. Again, there are a lot of nice tools and techniques out there so check them out. I prefer to dremel the frets to length and hammer them in with a special piece of aluminum I shaped to go over the frets. With some practice, it works well.

You can either make or purchase a bridge. On the first page I mention a website with a good tutorial for making your own. I used maple and bone for mine. I decided to get a few soup bones at the store and treat them for all bone components. It saved money and produced a lot of blanks, but the process was time consuming. To summarize, I first boiled the bone in ammonia and water for about an hour (out in my workshop of course), cut the bone to rough sized blank, then soaked them in white gas for 3 weeks to degrease them. I finished them up with another boil in ammonia and water. Turned out great. I also used the bone to mark frets and create an inlay by the tuners.

You should be ready for strings and final setup. Be careful adjusting the truss rod and head tensioners. It will be a slow process and will require readjustments for a while after construction until the banjo stablizes. This will take some time and knowledge. If you're unsure, seek help or look at www.banjohangout.org in the tutorials for assistance.

Step #10- Optional Resonator-

You already have a nice open-back banjo, but if you want a resonator model, here's how I developed my own which is working out well. I needed to make 4 brackets (although the AutoCAD drawing shows 6) to screw to the sides of the rim. The sides of the resonator were glued up into an octagon with staggered joints for strength and turned on the lathe by gluing the assembly to a piece of scrap plywood. The back was then turned like a plate on the lathe to fit the sides. If you notice, I tried to turn a shape like a parabola to channel sound. You could also use veneer plys and glue up the shape if you do not have a lathe. Blocks were glued in at the 4 locations where the resonator is to be fastened to the rim with threaded studs mounted in the blocks (see pictures). You will also need to notch the side at the neck. I lined those edges with felt to prevent vibration. The flange was cut from nickel and drilled to create the pattern. I applied a thin layer of clear silicone caulk under the flange to prevent vibration. In order to maximize materials for the flange, it was designed in 4 sections, then soldered together.



Additional Images-

Here are a few additional images to help in construction. Good luck and happy building and picking!