



Resonator Guitar: Banjo-like Preliminary Plan

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A banjo-shaped instrument was assembled using a resonator guitar cone as its soundboard. The purpose is to isolate and study the sound coming off the cone top (or front). In a proper resonator guitar, the sound off the cone bottom (or back) fills the body and radiates off the body top and from the sound holes.

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There is certainly great variety among wood-topped acoustic guitars. But their sounds have much in common, while the resonator stands out as something rather different. Originally designed for its unamplified loudness, its unique sound has kept it as the instrument of choice for many players. The common element of all resonator guitars is a very thin aluminum cone or cones, much like the paper cone of a large speaker. String vibrations produce cone vibrations, which transduce the string motion into sound. Within the guitar, the air above the cone is separated from the air behind it. The former radiates sound directly, typically through a protective grill. Within the resonator guitar itself, the air disturbance created by the back of the resonator cone excites the air inside the body. This, in turn, produces sound radiation from the sound holes and from vibrations of the body's top. This body sound is a major and perhaps even dominant part of what the listener hears.

However, a first step in understanding how it all works is to examine the string-driven vibration of the cone. It is not a drum head. It is not thin wood. Described here is a first step. The instrument pictured on page 1 and below gets essentially all of its sound from the top of the cone. The notion is that this is the same as what comes off the front of a resonator guitar cone. So, this instrument separates that first step of the strings exciting the cone from the more complex working of the body.

Almost from the outset, the inventors, Dopyera brothers, competed with each other. Essentially, three different ways were invented to connect the strings to the cones. The simplest is the one used here. A bridge sits on a substantial $2\frac{1}{2}$ " diameter disk (known as a "biscuit") that sits atop the center of the cone. I decided to go with that biscuit design, knowing it was the final solution of a brilliant inventor. With a plan to compare to a single cone guitar, I chose a standard guitar biscuit and bridge. (Cone, biscuit, and bridge were purchased from master resonator builder Mike Replogle.) That is what is shown in the photos. Appreciating the enormous impact bridge weight has on banjo sound, at this point I also made a lighter biscuit and bridge out of 3mm 5-ply birch and a standard three-footed banjo bridge. The guitar combo is about 14 gm, and the lighter one is 9 gm. For future comparison with banjo, that lighter set could have the biscuit drilled and the bridge thinned...

Before any measuring and confrontations with theory, the obvious question is, "What

does it sound like?” This deserves (and usually gets) more care. The recording room was inappropriate; the playing was hurried and sloppy; there is no place to anchor when picking... Nevertheless, I put on some picks and did some frailing.

So, here are two sound samples with the guitar biscuit and bridge:

<http://www.its.caltech.edu/~politzer/resonator/picked-heavy-1.mp3>

<http://www.its.caltech.edu/~politzer/resonator/frailed-heavy-1.mp3>

And here are two sound samples with the lighter biscuit and bridge:

<http://www.its.caltech.edu/~politzer/resonator/picked-light-2.mp3/>

<http://www.its.caltech.edu/~politzer/resonator/frailed-light-1.mp3>

