

Folded Horn Acoustic Guitar Patent # 10,777,172

How do I put this:



+



Inside of this:



To get a far more powerful acoustic guitar that rocks, can be played with less effort, and is battery powered – UNPLUGGED.

Folded Horn Acoustic Guitar Patent # 10,177,172



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All components not shown

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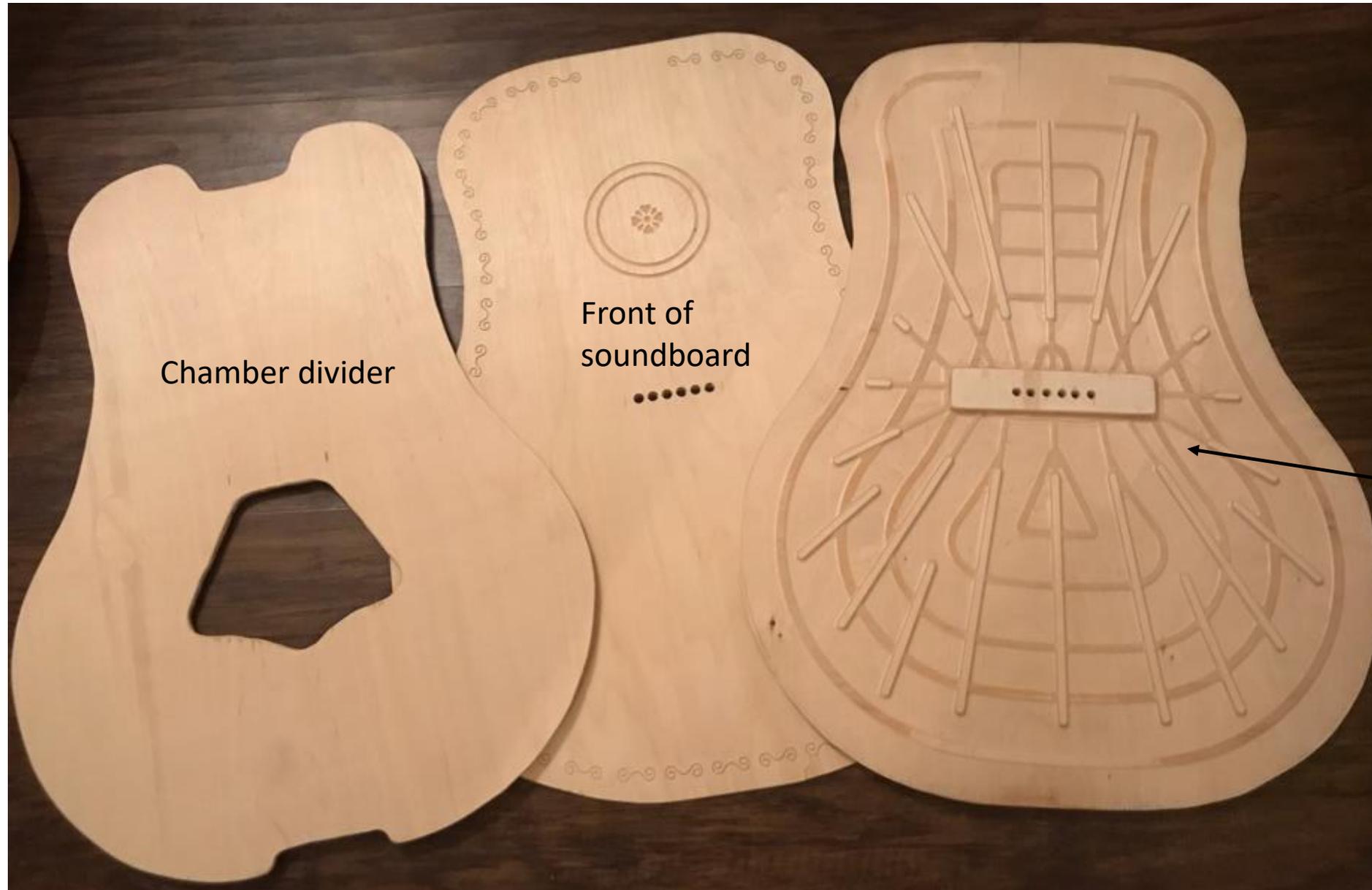
Chamber divider (not shown) is placed on top of folded horns.



Soundboard (not shown) is placed on top of guitar sides.

Folded Horn Acoustic Guitar Patent # 10,177,172





Chamber divider

Front of
soundboard

Back of
soundboard
CNC machined
from one
piece of Baltic
Birch (except
bridge support
is glued).
Moves like a
speaker, light
but very
strong. I can
move this
thing ¼" with
my hand. You
try that with
Sitka Spruce
(which I love),
it will snap.

Folded Horn Acoustic Guitar Patent # 10,177,172



Folded Horn Acoustic Guitar Patent # 10,177,172 7-16-22 Updates



Folded Horn Acoustic Guitar Patent # 10,177,172 7-16-22 Updates

(12) **United States Patent**
Katzenberger

(10) **Patent No.:** US 10,777,172 B1
(45) **Date of Patent:** Sep. 15, 2020

(54) **FOLDED HORN ACOUSTIC GUITAR**
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(*) Notice: Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
U.S.C. 154(b) by 0 days.

4,987,815 A 1/1991 Shockley
5,208,410 A 5/1993 Foley
5,333,527 A 8/1994 Janes
5,461,958 A 1/1995 Dresdner
5,442,986 A 8/1995 Cota
5,549,027 A 8/1996 Steinberger
5,567,896 A 10/1996 Gottschall
5,661,252 A 8/1997 Krawczak
5,682,003 A 10/1997 Jarowsky
4,995,293 A 11/1999 Anderson
6,040,510 A 3/2000 Yuan
6,124,536 A 9/2000 Hoshino
6,646,191 B1 11/2003 Martin
6,664,452 B1 12/2003 Teel
6,800,797 B2 10/2004 Steiger
6,833,501 B2 12/2004 Jagmin
(Continued)

(21) Appl. No.: 16/431,553

(22) Filed: Jun. 4, 2019

(51) **Int. Cl.**
G10D 13/02 (2020.01)
G10D 3/02 (2006.01)
G10D 1/08 (2006.01)

(52) **U.S. Cl.**
CPC *G10D 3/02* (2013.01); *G10D 1/08*
(2013.01)

(58) **Field of Classification Search**
CPC G10D 3/02; G10D 1/08
See application file for complete search history.

(56) **References Cited**
U.S. PATENT DOCUMENTS

2,001,723 A 5/1935 Hammond, Jr.
2,228,463 A 6/1942 Kisingbury
3,194,870 A 7/1965 Tondreau et al.
3,549,775 A 12/1970 Kaminsky
3,612,741 A 10/1971 Marshall
3,656,395 A 4/1972 Kaman
3,892,159 A 7/1975 Houstma
4,464,967 A 8/1984 Trimbom
4,748,886 A 6/1988 De Byl

OTHER PUBLICATIONS

U.S. Appl. No. 10/686,839, filed Oct. 14, 2003, Henry Langeman.
U.S. Appl. No. 11/142,487, filed Jun. 1, 2005, Kenneth Preece.
U.S. 11/810,948, filed Sep. 7, 2007, Jan Anders Linden.

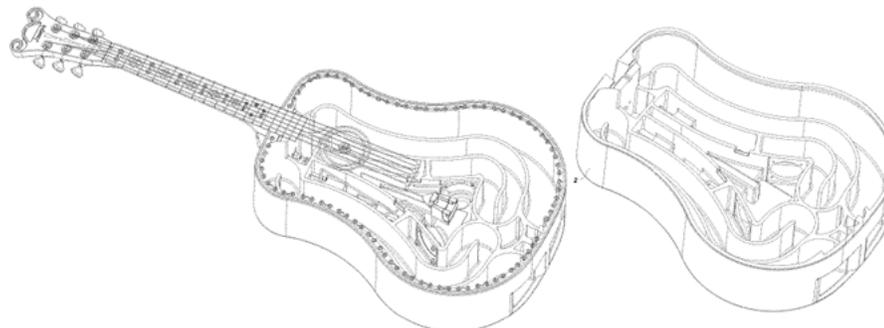
Primary Examiner — Kimberly R Lockett

(57) **ABSTRACT**

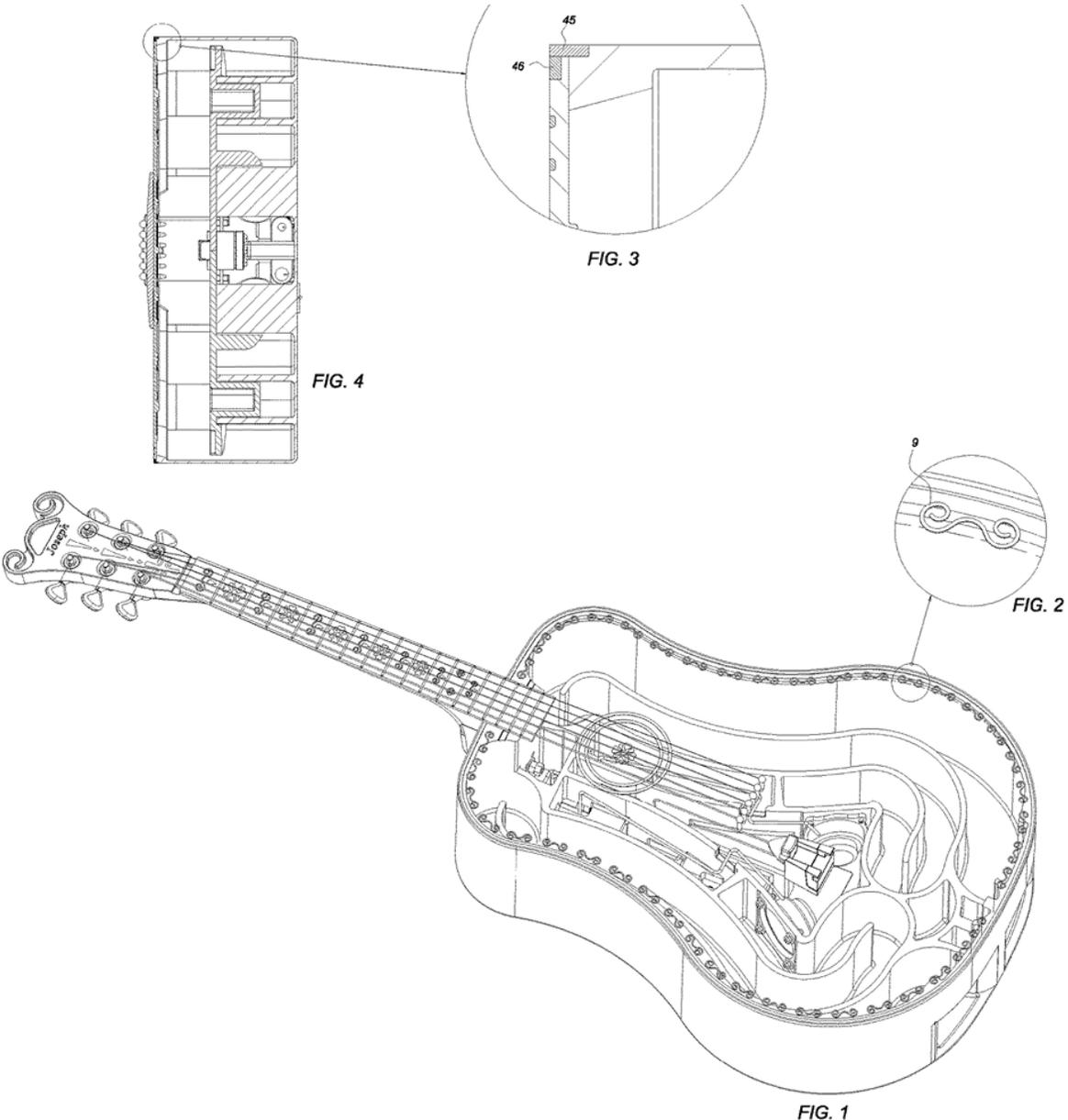
This invention is an acoustic guitar with two internal folded horns built into the guitar body. Each left and right horn is five feet long. The natural acoustic sound inside the guitar is captured by a microphone (not a pickup under the strings), inside the guitar's upper chamber. It is then sent to an internal preamp, which sends the signal to left and right speakers, which are mounted to the compression chamber at the start of each folded horn. It then travels through the throat of each folded horn, which increases exponentially until it reaches the end of the horn. The sound waves are concentrated throughout this shape (does not lose sound energy), and are also directed to left and right exits out the end of the instrument. The material for the body is Rock Maple, and the other materials are Sitka Spruce, Rosewood and Mahogany.

6 Claims, 5 Drawing Sheets

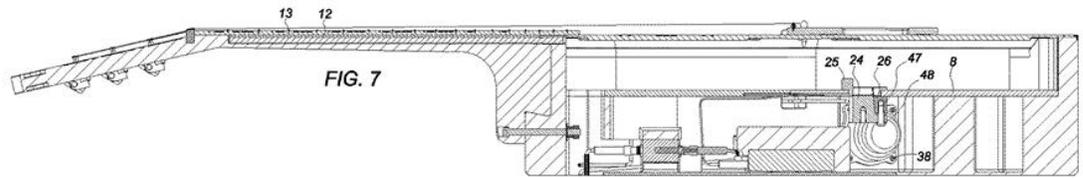
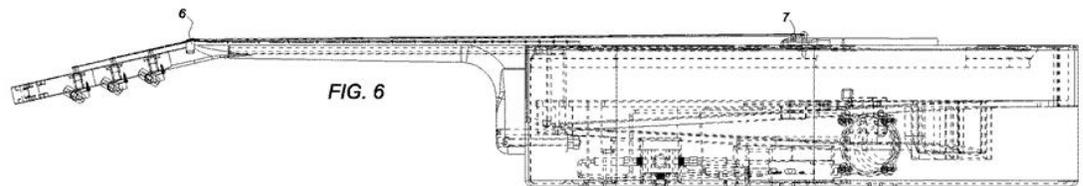
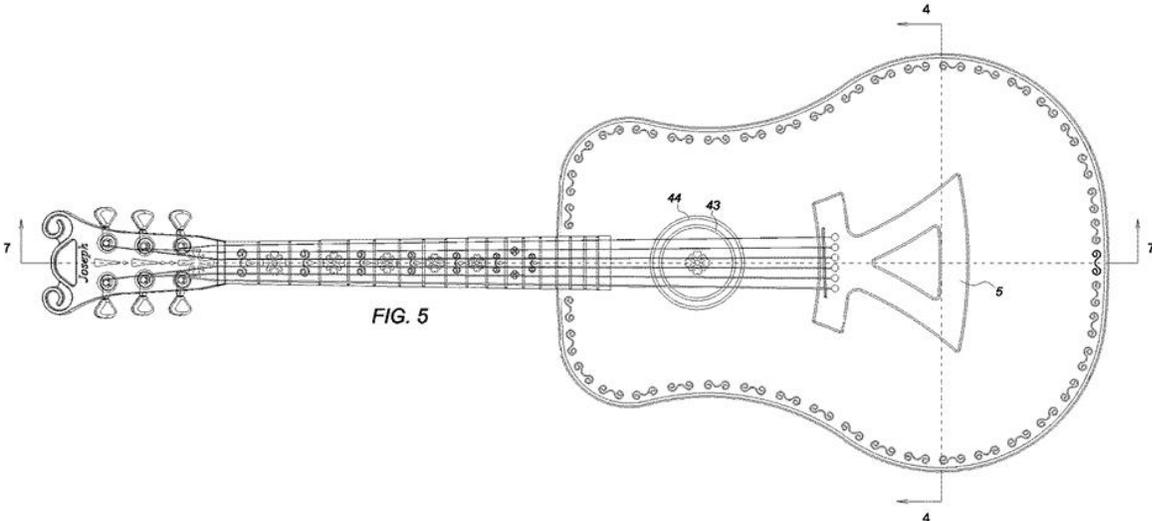
NOTE: a good strength of patent indicator is number of citations. The average is (7), I have (29). They are not all shown on this page as noted with the continued note under citations.



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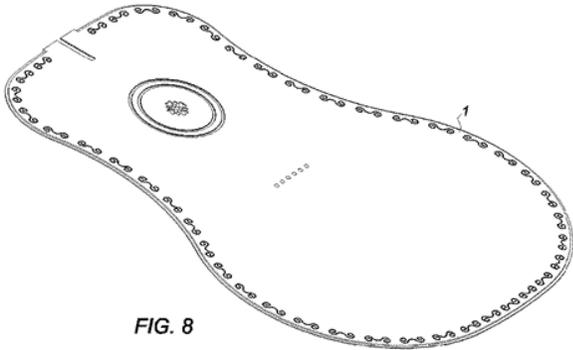


FIG. 8

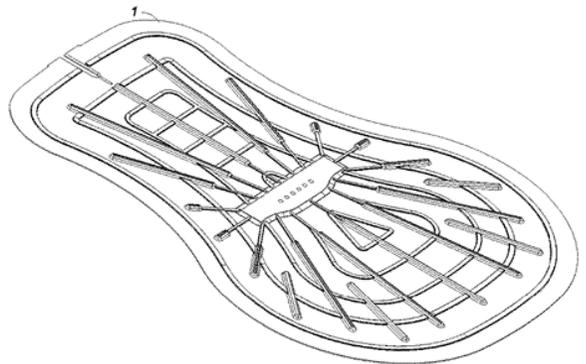


FIG. 9

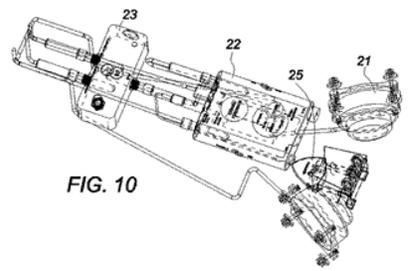


FIG. 10

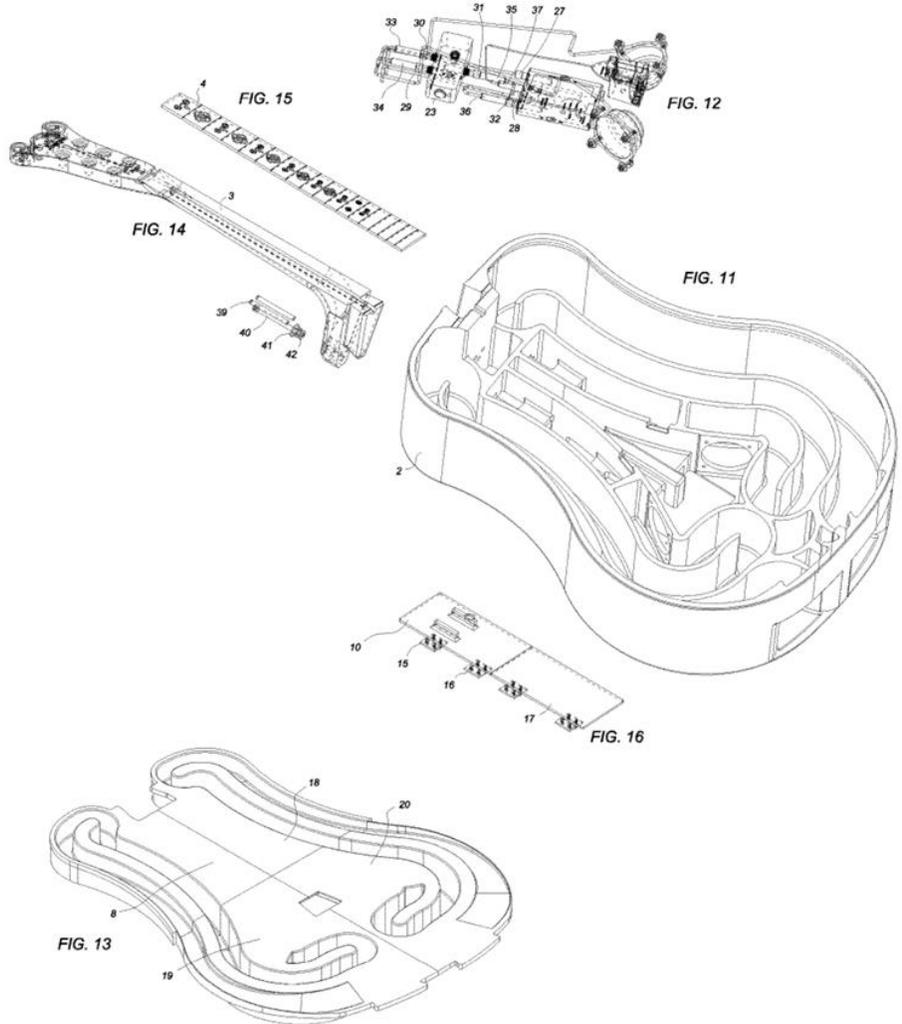
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Body wood is 100% Hard Maple, same as a violin.



CNC machine start.



CNC machine about halfway through.



CNC machine almost complete. I can cut the entire body and horns in about two full days, runs at night.



Solid stock on the CNC machine.



Not final shape, but close!

This speaker
not being
used.



Speaker in cabinet, 117 dB max, bass is OK, but obviously missing a woofer.

Same speaker



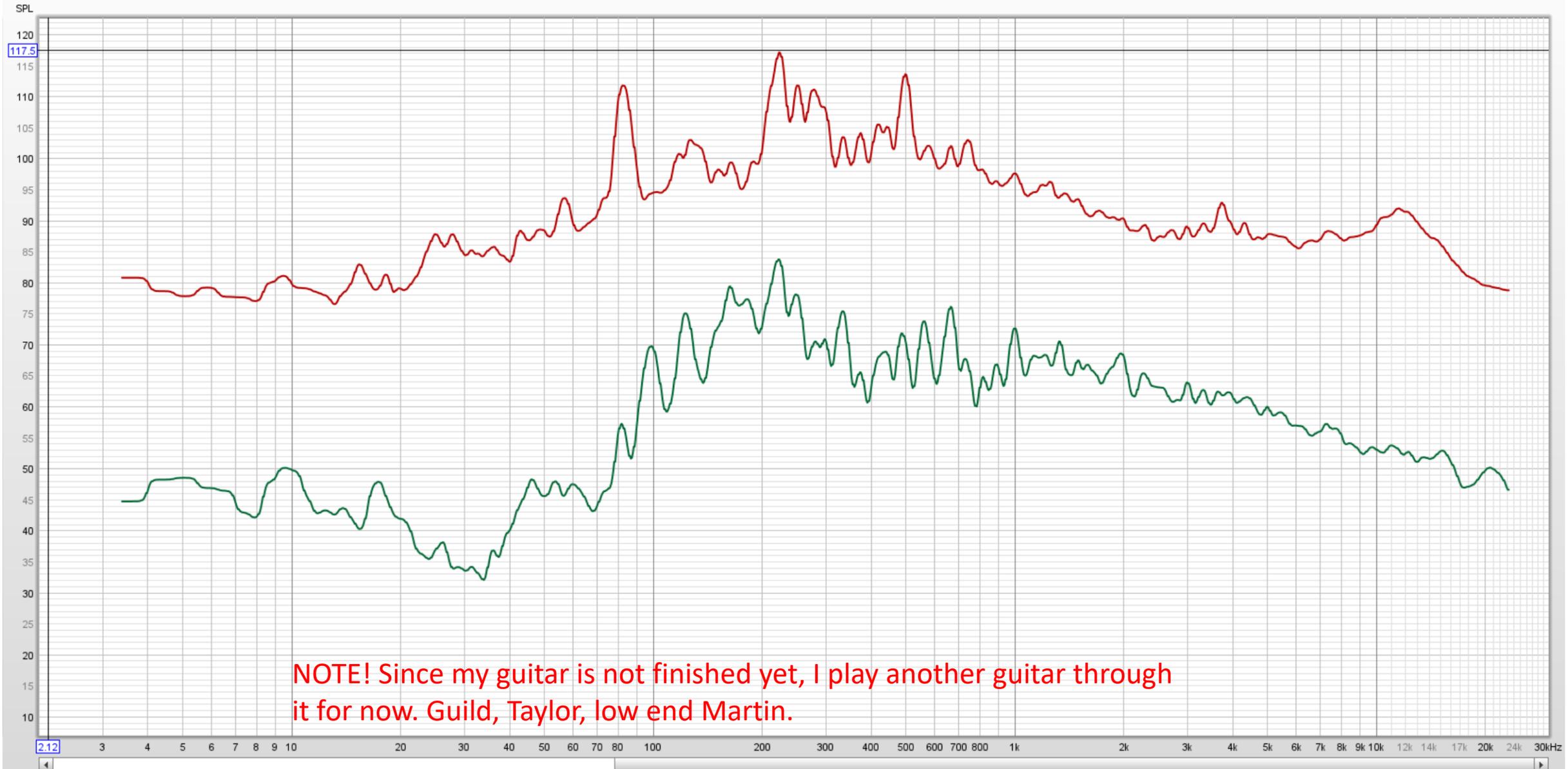
Speaker in guitar 125 dB max, very strong bass.

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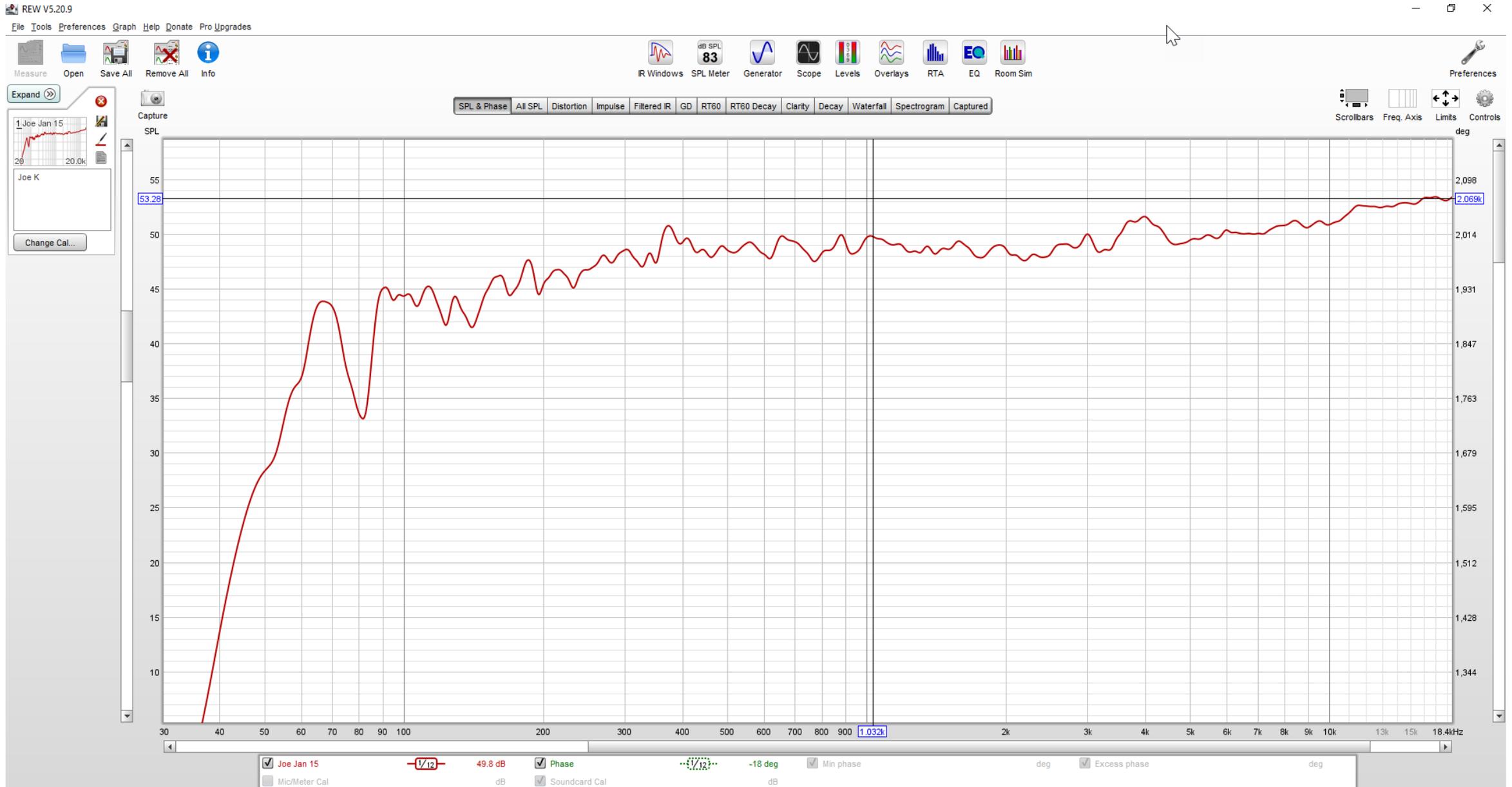
I was pleasantly surprised by this Bose Waveguide CD player. It is only 14" across, and does indeed fill a 15' x 15' room with sound, bass was pretty good. Speakers are almost exactly the same physical size as mine, and dB was also similar, encouraging.

My waveguides are much longer. The Bose waveguide is 27" long, one only. I have two five foot long waveguides, and you can hear the richer bass in mine, capturing $\frac{1}{4}$ wavelength of about 80 Hz.

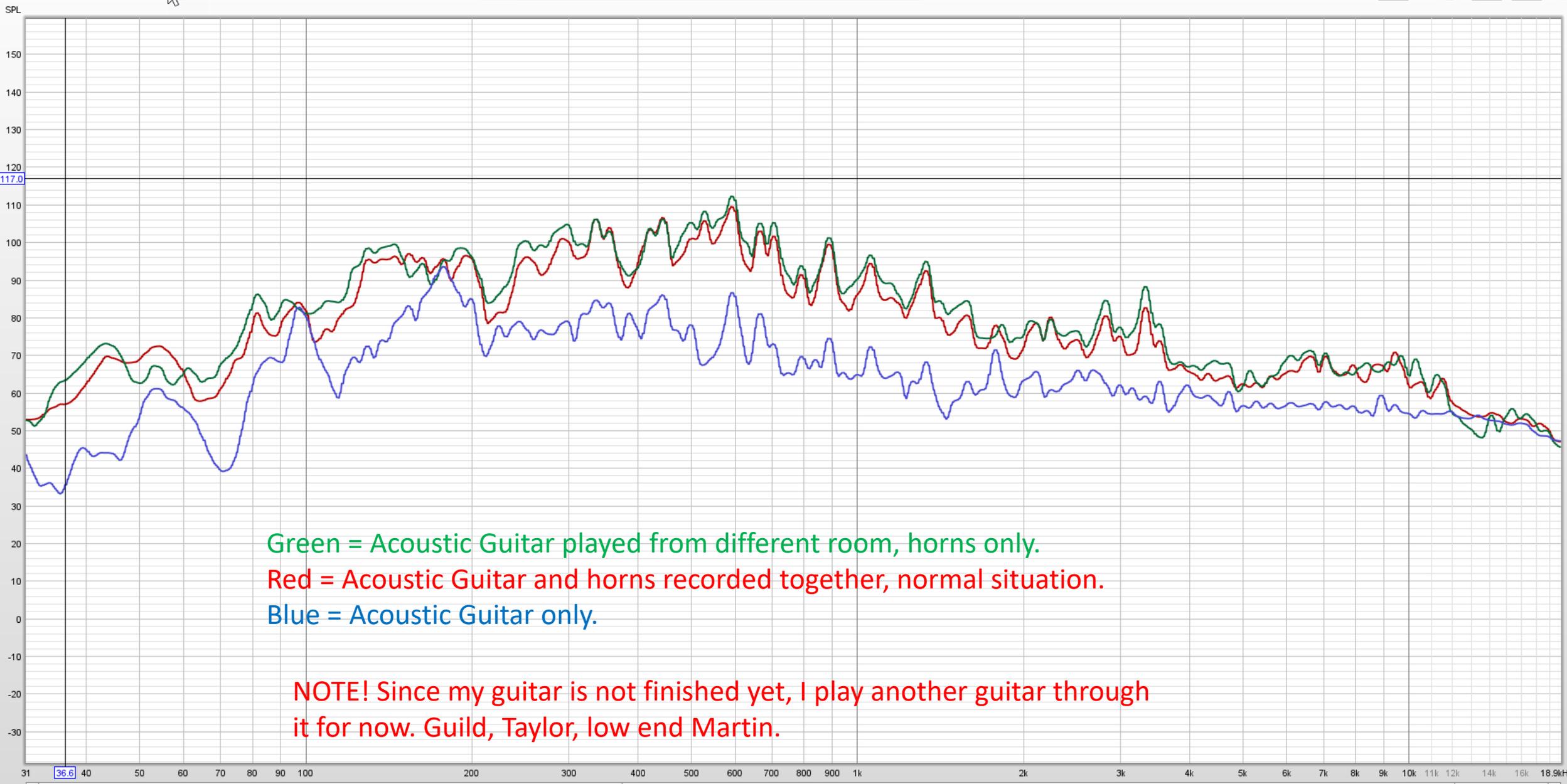


NOTE! Since my guitar is not finished yet, I play another guitar through it for now. Guild, Taylor, low end Martin.

Folded Horn Acoustic Guitar Patent # 10,177,172



1-15-23 Sweep – need to repeat process to ensure validity, just a start, so not 100% confirmed.



Green = Acoustic Guitar played from different room, horns only.
 Red = Acoustic Guitar and horns recorded together, normal situation.
 Blue = Acoustic Guitar only.

NOTE! Since my guitar is not finished yet, I play another guitar through it for now. Guild, Taylor, low end Martin.



Body and horns - really more like a waveguide with horns on the end. Speakers shown, amp and battery pack go here (charge at night like your iPhone).

Folded Horn Acoustic Guitar Patent # 10,177,172 7-16-22 Updates



Made three guitars to start.

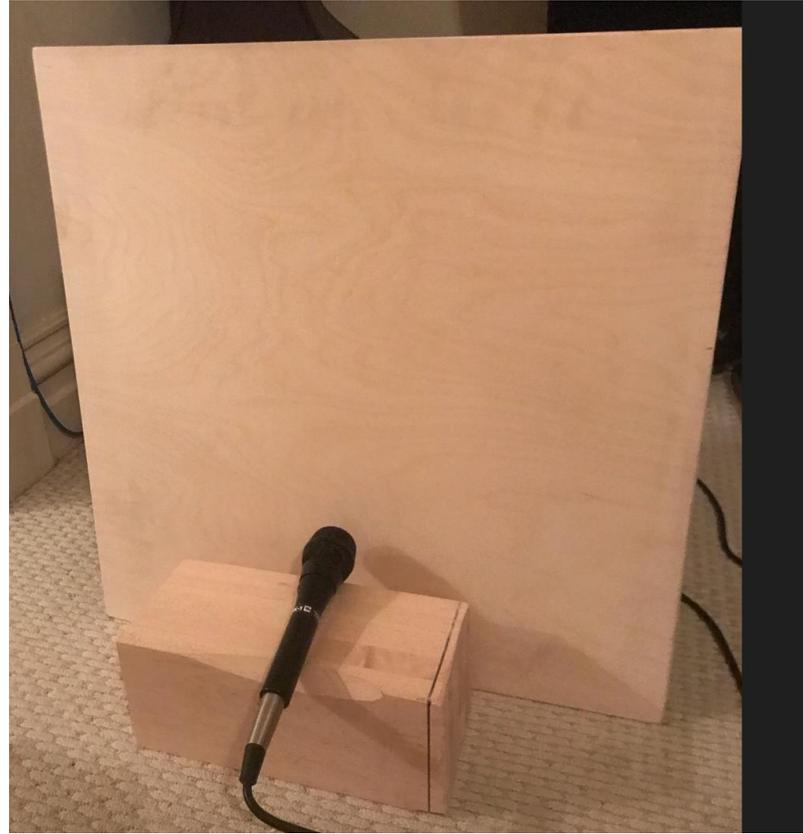


Dovetail neck fit is great! CNC machining is accurate to 1/5 the thickness of a human hair (.001"). Straight as an arrow.

Folded Horn Acoustic Guitar Patent # 10,777,172 Feedback Test



Leave this on full volume Master and Gain, for more than a second and your ears will split of course.



Try this at full volume Master and Gain, with 1/4" Baltic Birch, and IF you find the right spot, it will feedback like a mother.



Try this at full volume Master and Gain, with 1/2" Baltic Birch, and it WILL NOT feedback at any position!

Folded Horn Acoustic Guitar Patent # 10,777,172 Highlights January 2022

(12) **United States Patent**
Katzenberger

(10) **Patent No.:** **US 10,777,172 B1**
(45) **Date of Patent:** **Sep. 15, 2020**

- 1) The guitar body and soundboard on this guitar are three inches longer, so the soundboard is louder. The soundboard is made from light yet strong material (Baltic Birch Laminate), so it moves more, which also makes it louder. The natural sound of the acoustic guitar provides much of the great tone of this guitar, in addition to speakers and folded horns.
- 2) Two folded horns are built into the guitar body for true stereo sound.
- 3) Each folded horn is five feet long, which captures the lowest frequency of the guitar (80 Hz). This can not be done with small speakers only, that need to fit inside guitar, without these horns.
- 4) An 80 Hz wavelength is actually (14) feet long. The speed of sound is 1,125 feet per second, divided by this frequency of 80 Hz gives us a 1/4 wavelength of (3.50) feet. Horns that are (5) feet long easily capture this wavelength, with room for side ports, and still will not break this critical 1/4 wavelength rule. The 1/4 wavelength rule is a truth in physics and acoustic engineering. If you do not capture this, the sound will be greatly diminished. Do not take my word for it, Google it!

Folded Horn Acoustic Guitar Patent # 10,777,172 Highlights January 2022

- 5) The folded horns (also known as wave guides, if not tapered) provide sound directivity, and does not lose sound energy. It is not possible to amplify a sound wave once it is in air, but it is possible to prevent sound loss, by directing sound to a desired source.
- 6) Battery powered. Can use standard batteries or Lithium Ion batteries, similar to what Tesla and all other Electric Vehicles use.
- 7) The guitar body is cut from a 6" thick maple block, and the walls are ¼" thick, which resonates more like a piano than a standard acoustic guitar that has very thin walls (needed for traditional bending of the sides).
- 8) The vibrations are so powerful, you can feel them in your body as you play, similar to a violinist that can feel the vibration of the instrument through their neck.
- 9) A piano is powerful due to a large soundboard, thick wood and substantial size. This guitar has a larger soundboard, thicker wood, and a more substantial size than a standard dreadnought guitar.

Folded Horn Acoustic Guitar Patent # 10,777,172 Highlights January 2022

10) A violin, which is approx. 1/3 the size of a guitar, produces greater volume because it is bowed, not plucked or strummed like a guitar. Also the soundboard has only one brace and a bass bar, which allows it to vibrate more.

11) Soundboard and chamber divider are made of Baltic Birch. This ¼” thick wood is laminated with (5) pieces of Birch, each one having the grain 90 degrees from piece below it, for exceptional strength. This is NOT plywood, it is solid Birch on every laminate. The soundboard is machined down to a much thinner size, while leaving braces in solid. This requires only two CNC machining processes (top and back sides). This provides great soundboard movement, which increases natural acoustic volume, before the sound is captured and fed into the folded horns. Many harps have Baltic Birch sound boards due to strength required on such a large soundboard, with tremendous amounts of string pressure.

12) The nut is pocketed and floats for ease of removal. The saddle and nut can be easily removed, and both replaced with different heights of nut and saddle. This allows action adjustment at the nut, and also the saddle/bridge. Action height combinations are available in many combinations not seen previously with standard acoustic guitars.

13) The volume of this guitar body (wood only, not air inside), is 270 cubic inches, which is approx. 3X more volume than a standard dreadnought acoustic guitar (due to waveguides and also ¼" thick walls). This provides resonance far greater than any other acoustic guitar can produce, even without the speakers and electronics. Then include speakers and electronics, and the resonance is unmatched by a factor of 5X sustain (5 seconds sustain vs. 25 seconds sustain – tested with a strummed E chord).

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Testimonials #1:

What a remarkable, beautiful bit of work you've put into this! And CNC skills *to the moon!* Wow. Can you see how green I am?

Unbelievable work.

I HATE !!!! the fact I did not think of this, I play guitar and would love to hear this, it's a great idea. So very fricken cool !!!!

Done right, I would think this to be a revolutionary instrument.

Jaw-dropping just to see part of it.

Beyond impressive!

Beautiful, a work of Art.

This is frigging wild, awesome, crazy cool!

Intriguing acoustic design.

Wild idea, flying close to the sun.

I'd like to see the guitar. Do It. Play it.

Very, very interesting.

Cant wait to hear this thing, and please have someone with a slide rip a riff, love the concept!

If its a success tonally then I'd expect a good audience for such an instrument.

The patent is notably well written. Much of it is a re-cap of the guitar's weaknesses and a teaching of new fabrication technology for complex but natural shapes.

Testimonials #2:

If it is truly better and takes over the world, that is a blessing for all. But if sales are tiny until 2039, Joseph gets little to no compensation for his effort. The telephone, the electric car, the vacuum tube, burbled in small sales for most of their patent periods.

Very cool and great job sticking with your idea!

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It's going to sound a little bit weird, but sound takes on the characteristics of the surfaces that it strikes. As a good example, sit in your car in your driveway and shut the engine off and leave your stereo on. Listen to that sound, that's glass sound. Most of the surfaces in your car are glass so you're going to get a really good idea of what glass sound is. If you have a tone control, turn the low frequency all the way down, maximize the treble and really listen to the reflections in your car. You won't be able to stand it for too long nor should you.

Why? The natural materials on this planet produce the best sound. All the materials that the Earth produces or that we produce from the Earth make the best sound. Synthetics like plastics and glass are no good. Wood with its cost, ease of manufacturing, ease of build and selection, and there are so many great woods to choose from. Woods can be easily stained and sealed, they're readily available in all parts of North America that I'm familiar with so it's a good choice. Some other softwoods such as alder, pine, and birch work well and are economical.

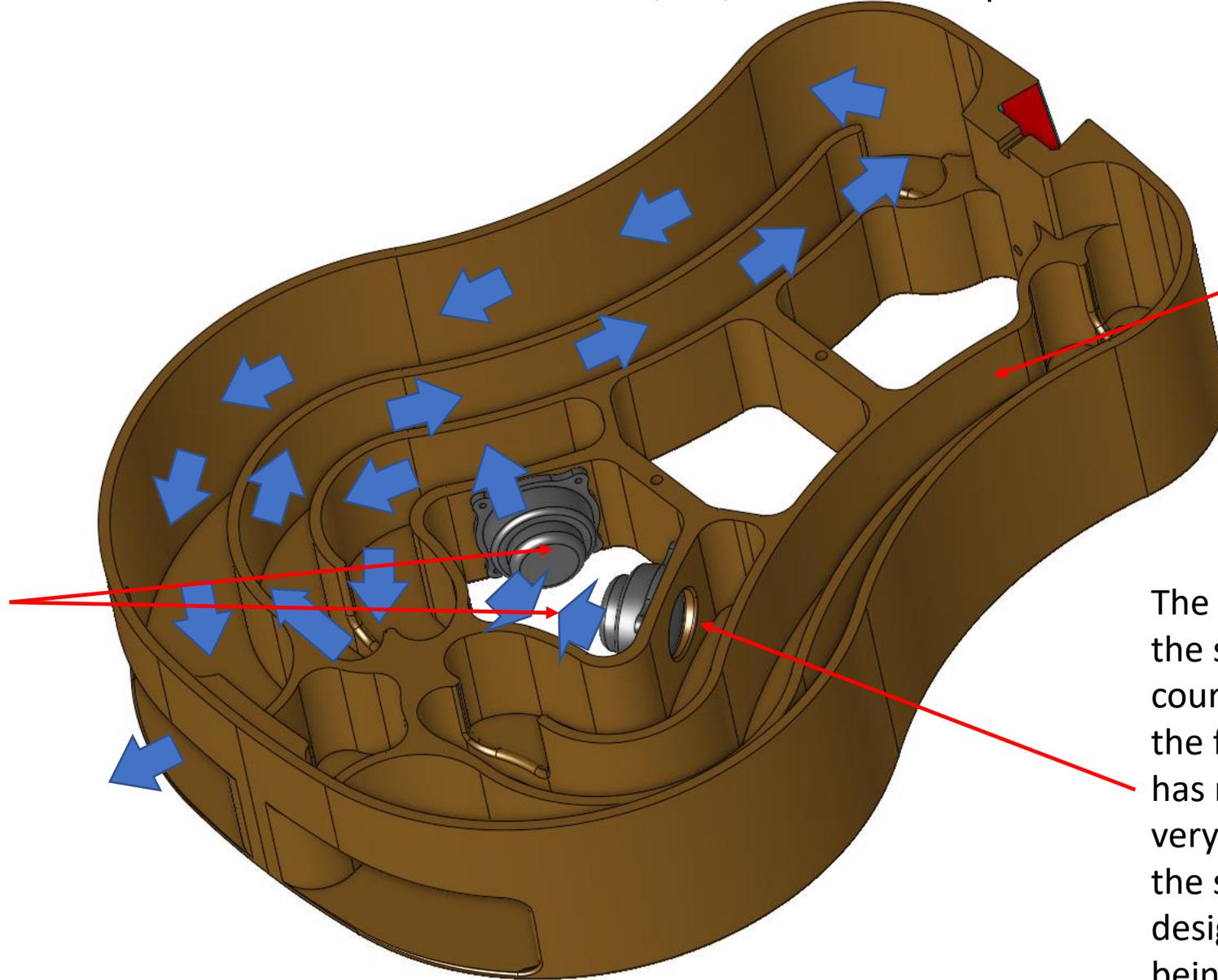
The purpose of materials used in instruments (which '**produce**' sound) and those used in audio playback devices (which '**reproduce**' sound) are different.

Please pay attention to bold words. "Produce" and "Reproduce" have rather completely different meanings. You see, wood, brass and some other chosen materials are selected in instruments because they react to various physical forces (from vibration, airflow friction, brute force, etc) and make interesting sound based on their properties.

But for playback devices, the main purpose of materials containing transducers is prevent unwanted sound from the transducers (because they cannot physically perfectly transfer electronic signal into physical sound wave.) So, for speakers and headphones, we have to deal with enclosures/damping materials. For the purpose, materials with good acoustic absorption and highly resonance-resistant are highly desired for the job.

The sound coming from the back of the speakers is constructive interference with each other (no loss of sound) due to design.

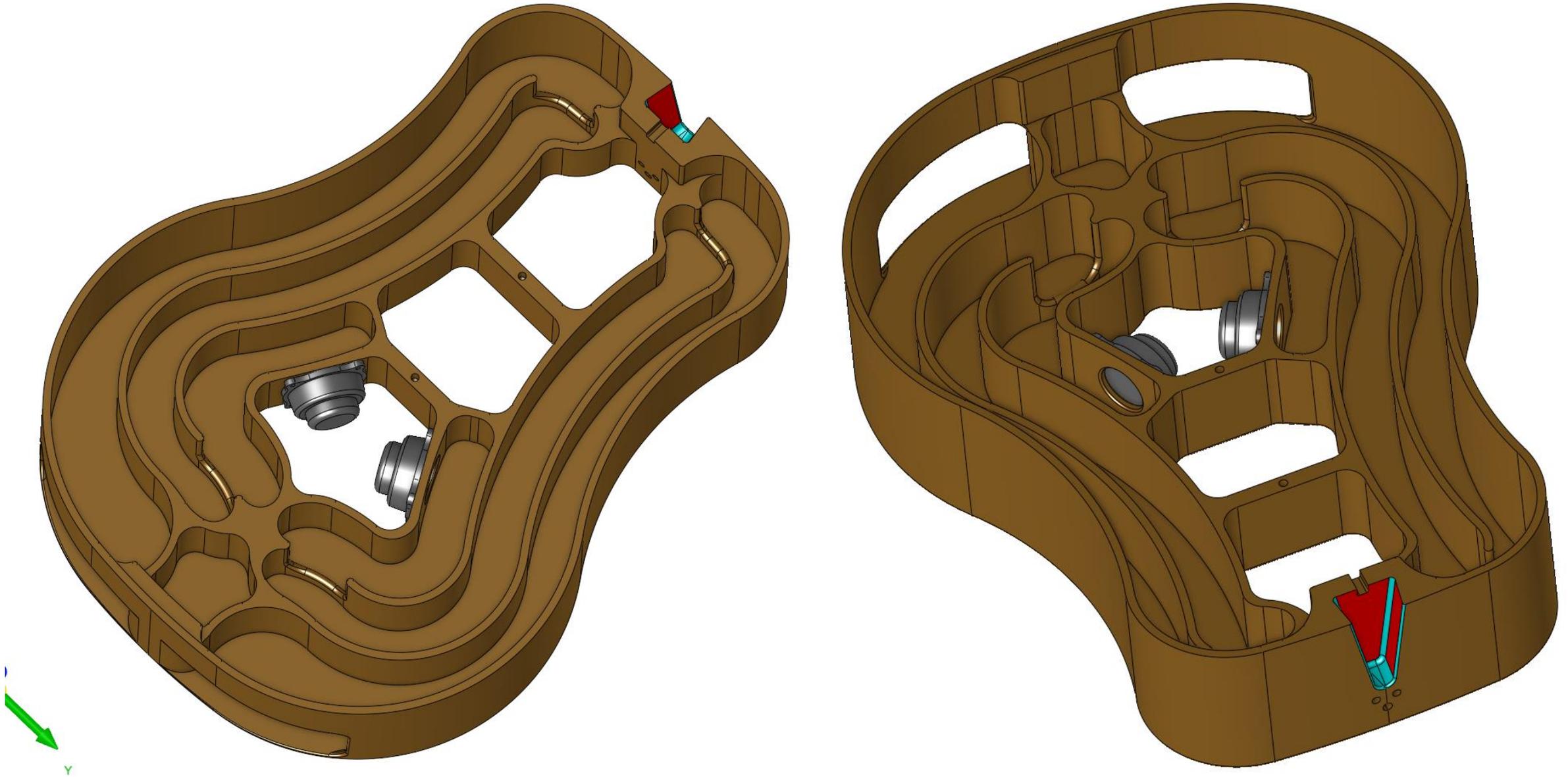
The sound from the back of the speakers goes out the back of the guitar, and is covered on the top, to provide a pressurized air chamber.

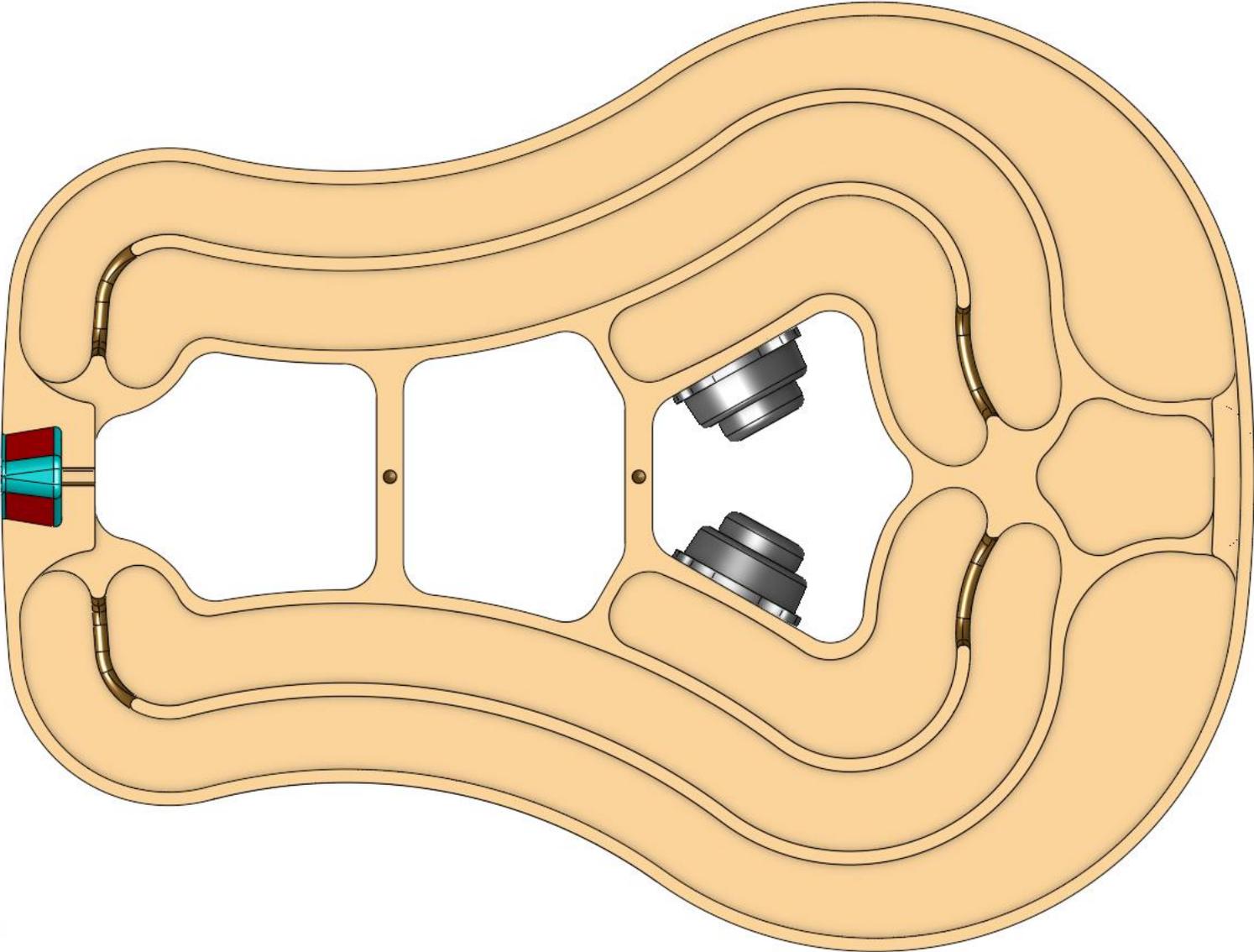


Please note the waveguides are shown uncovered for clarity, they are fully covered at final assembly.

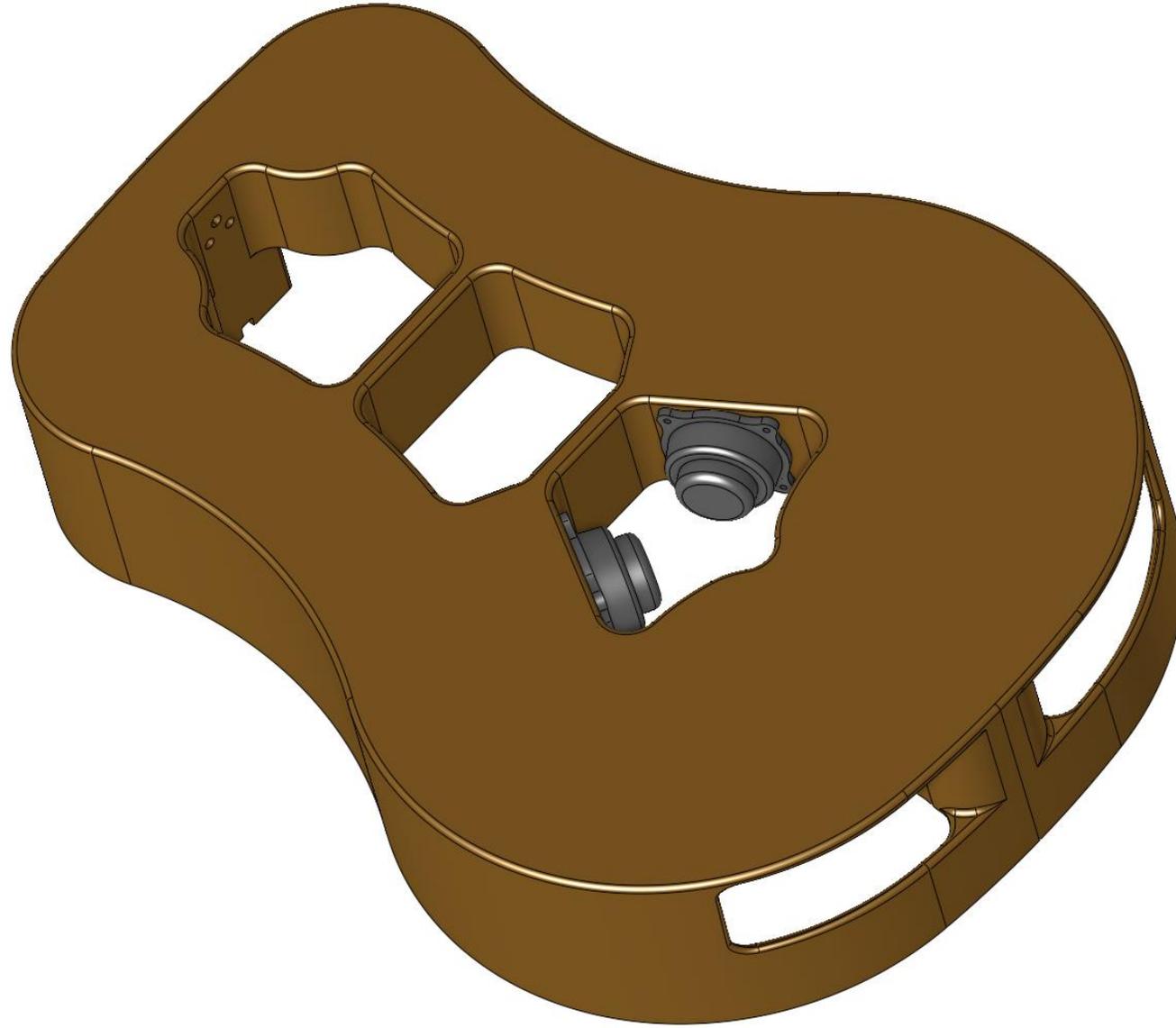
The sound from the back of the speaker (which of course is out of phase from the front of the speaker) has no interference (or very little) with the front of the speaker due to guitar design and waveguides being covered.

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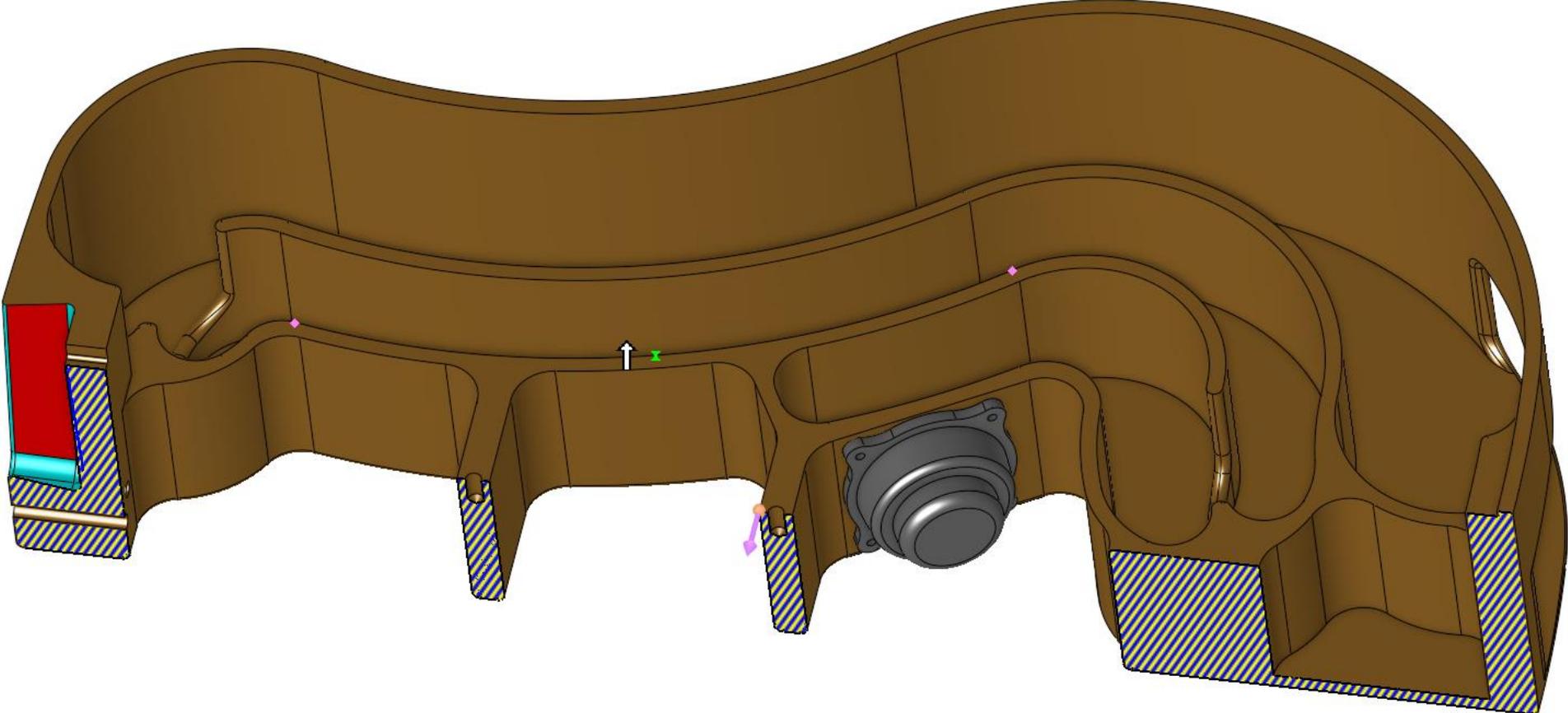




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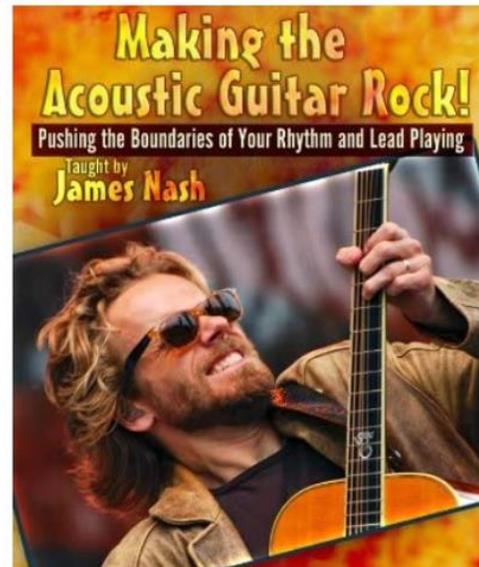
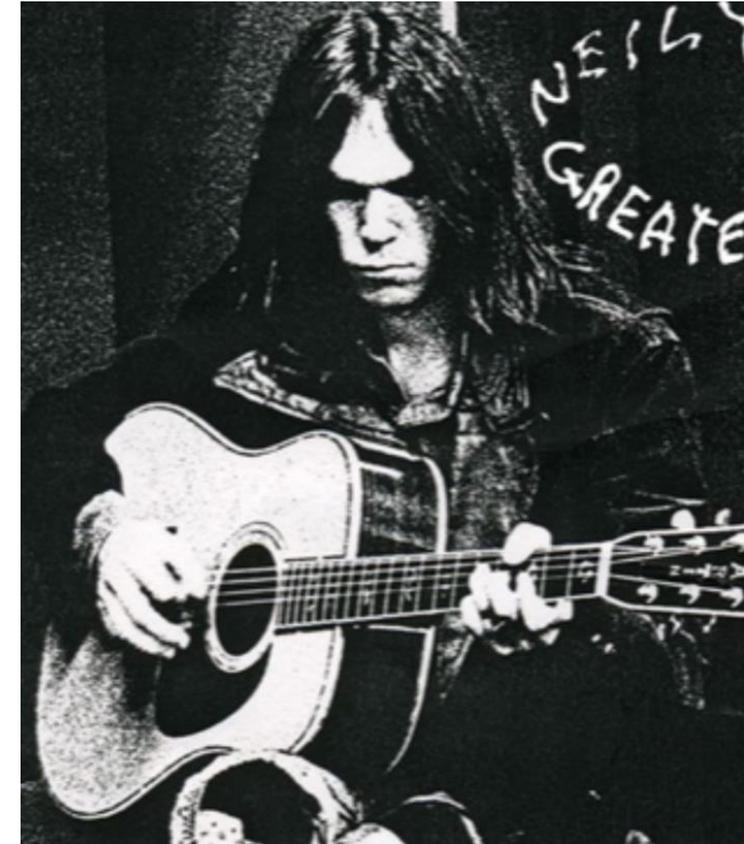


ADD NEW AMP AND ALL ELECTRONICS

Less of this:



More of this:



What did I learn?

Happiness lies not in the victory...but in the struggle.

Experience is the name we give...to our mistakes.