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Adventures in the Lower Tones

A Baritone Story

David Berkowitz with the scalloped braces nearly finished on his baritone guitar.

Article
by
David Berkowitz

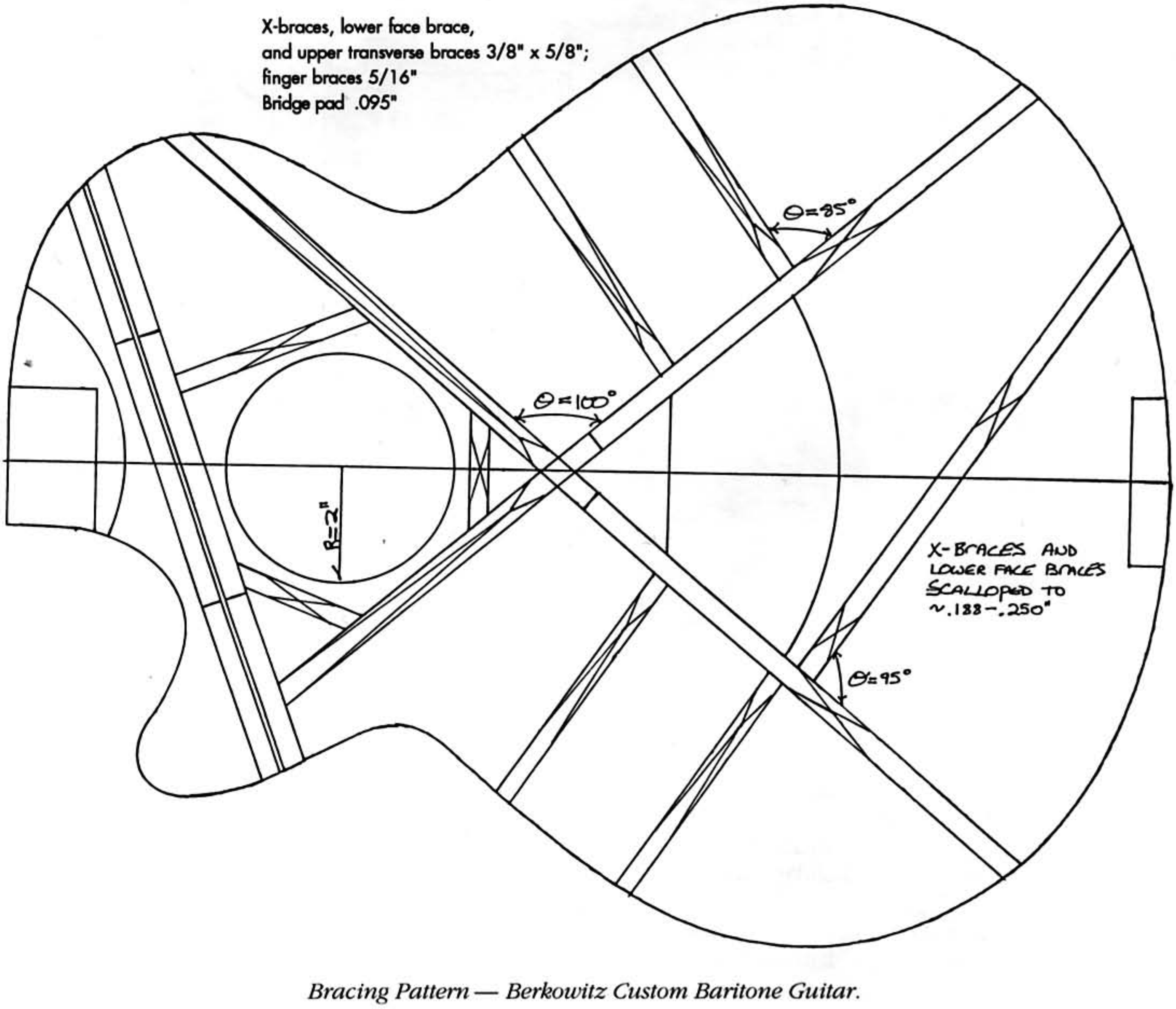
In the fall of 1994, I'd never heard of a baritone guitar. Several of us at The Guitar Shop (Stephen and Lynda Spellman's store) in Washington, D.C., were sitting around, talking about what guitars we liked and why. John Jennings, co-producer and guitarist for Mary Chapin Carpenter, was there, too. Jennings was having repairman Mike Dove work on several of his and Ms. Carpenter's instruments. I mentioned to Jennings in passing that I had a few instruments on my bench. He said what he really was interested in was a baritone, something tuned A to A. I said I'd be interested in trying to build one, so we exchanged phone numbers, and the journey began.

I had no idea where to begin. I called Dick Boak, who told me of several baritones he'd seen, but that the nicest was one owned by Martin Simpson. So I phoned Simpson, who told me the instrument had been made by Ralph Bown of York, England. I also talked with many ASIA and G.A.L. members and others (Danny Ferrington, Rick Turner, Linda Manzer, Steve Klein, Bill Cumpiano, Steve Henderson, Charles Fox, Tom Ribbecke, Bob Taylor, Larry Breedlove, Tim Olsen, and Don Kendall) to find out more about these beasts and other technically-related matters. The result— a wealth of information on how to approach all aspects of this project.

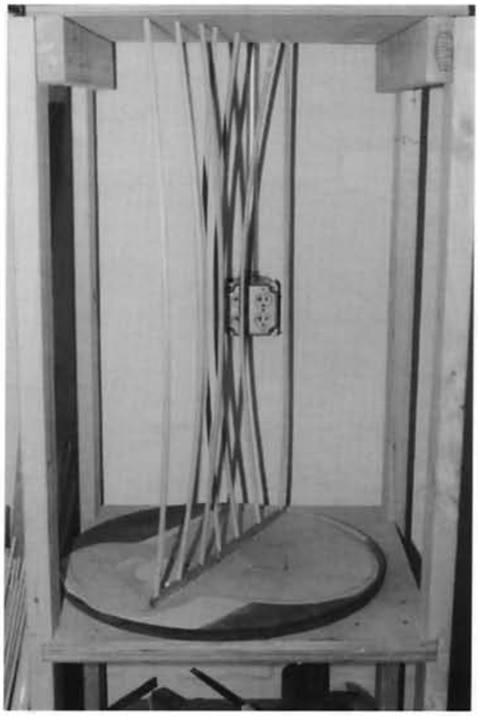
I found that there is little consensus on the design of acoustic baritone instruments. In fact, several people I contacted asked, "What's a baritone?" Mr. Bown's instrument was built on a 30.5" scale. Linda Manzer, Danny Ferrington, and Rick Turner have all used the old Danelectro scale of 29.750"; however, both Turner and Ferrington have used scales as small as 27". Everyone regarded 27" as the floor for baritone scale lengths, because it's marginally long enough to provide enough tension, but it's very close to a regular guitar. The longer scale lengths have mechanical advantages, and not only in tension: their length provides greater support to the notes, which are low and thus consist of long waves.

In regard to body sizes, Bown's was based on a Gibson J-185; Turner has used jumbo and dreadnaught bodies succesfully; and Ferrington has used a variety of Ferrington shapes with cavity volumes ranging from grand concerts to jumbos.

With a grasp of what the project entailed, I fired off a



Bracing Pattern — Berkowitz Custom Baritone Guitar.



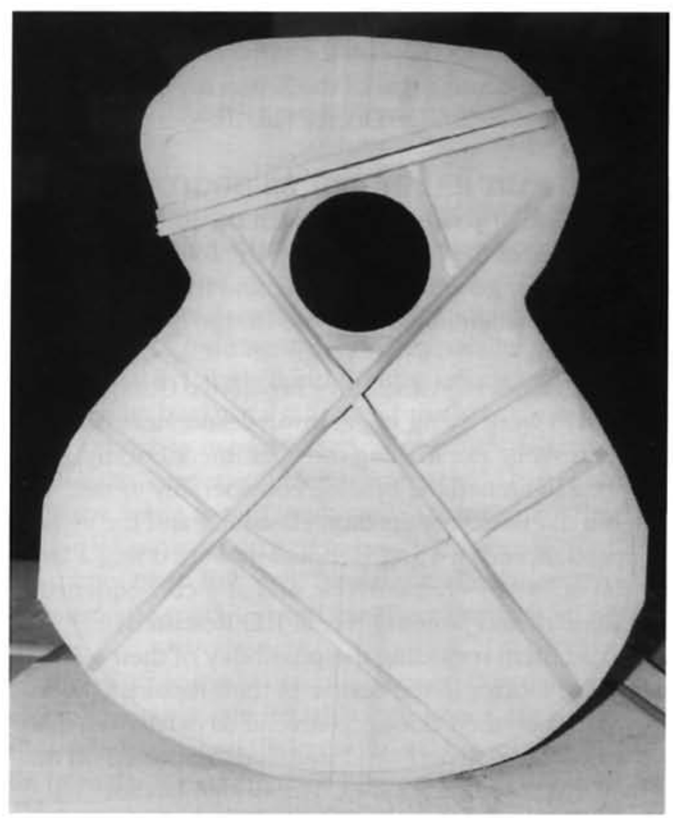
The "go-deck" or "go-bar," exerting pressure for gluing the first transverse brace.

letter to Jennings, telling him what was out there and asking him to define the design parameters in terms of aesthetics, neck feel, body shape, and materials. When Jennings was in D.C. in early January, 1995, he looked at my preliminary drawings and settled on one.

I was very interested in building an instrument for him and offered to do so, insisting on no deposit, although he had offered one. If he liked the baritone, he would buy it; if not, he could walk away. This might seem to be a risk, but this was my chance to get an instrument into the hands of a prominent player. Besides, Jennings had never played any of my instruments and had never custom-ordered a guitar before. If I pulled it off, I'd be in great shape; if, on the other hand, I contracted for the instrument and he hated it, the relationship would have been scuttled. Although the question of whether he'd buy it would play out on my face as he strolled up to the store on the day of delivery (I turned quite white), I was more concerned about the possibility of spoiling the relationship, if he didn't like it. So this is how the project was brokered.

There are many aspects to new instrument design to consider, especially when an instrument itself is uncommon and its nature not quite fleshed out. All things being equal, it's easier to execute the gross woodworking than to extract the desired tone out of any one system. In my case, the baritone was an instrument in its infancy. I wanted to know about its dynamics: string tension on the top, air cavity size and resonances that had worked for other builders, and bracing the instrument for lower frequencies. As I'd never had any contact with a baritone physically or audibly, the design process was forged of intuition based on the information I was able to obtain from other builders. In terms of trying to build for Jennings, the task was daunting because he is both particular about the sound he likes to hear and about the diversity in the timbre he seeks. His acoustic instrument choices run from both large- and small-bodied Lowdens, an Ehlers, Martins, and others, to the ubiquitous Martin Backpacker, which he's used on just about every one of Ms. Carpenter's albums.

But there was one more aspect of instrument design I was curious about. Among the many instruments the shop sells, one was the Breedlove guitar. I was intrigued by the roundness and the piano qualities of the sound and, in particular, the lower frequencies. For those unfamiliar with Breedlove guitars, all these instruments incorporate the JLD Bridge Doctor. I thought the Bridge Doctor would be something to explore as a portion of the design, so in March 1995 I took my vacation in San Francisco to visit friends and spent a day to fly up and visit Breedlove. Steve Henderson has a wonderful, cozy shop with a great bunch of craftsmen working on the desert side of the Cascades in Tumalo, Oregon. He generously discussed the engineering of the Bridge Doctor in terms of his theories on its effect on tone as well as on the structural parameters of bracing necessary to incorporate it into a complete system. I left with a head full of ideas and spent the drive and plane ride back to San Francisco distilling the options.



Design considerations required a relatively sharp-angled X-brace on the top.

BRACING

Ralph Bown braced his baritone with a modified Gibson double-X bracing. Although everyone I spoke to raved about Mr. Bown's baritone, my interest in incorporating the Bridge Doctor into my design moved me away from using that bracing. Some of this came from my research on the Breedlove instruments. For structural reasons, on which I'll elaborate later, Breedlove tightens the X-brace and moves it toward the fingerboard. The result is a slight elongation of the major structural braces of the system. Bass notes are long waves, and I felt that longer braces would contribute to these lower tones I was trying to extract. To that end, Rick Turner and Steve Henderson were my primary sources of information and encouragement. From an article on acoustic basses by Tim Olsen in an old issue of *American Lutherie* ("Building the Flattop Bass," Spring 1987), I had an idea of how the instrument would need to be braced. I modified the bracing in consultation with Turner as well as Henderson and Don Kendall (of JLD Research) for a better understanding of the structure necessary to incorporate the Bridge Doctor into my design.

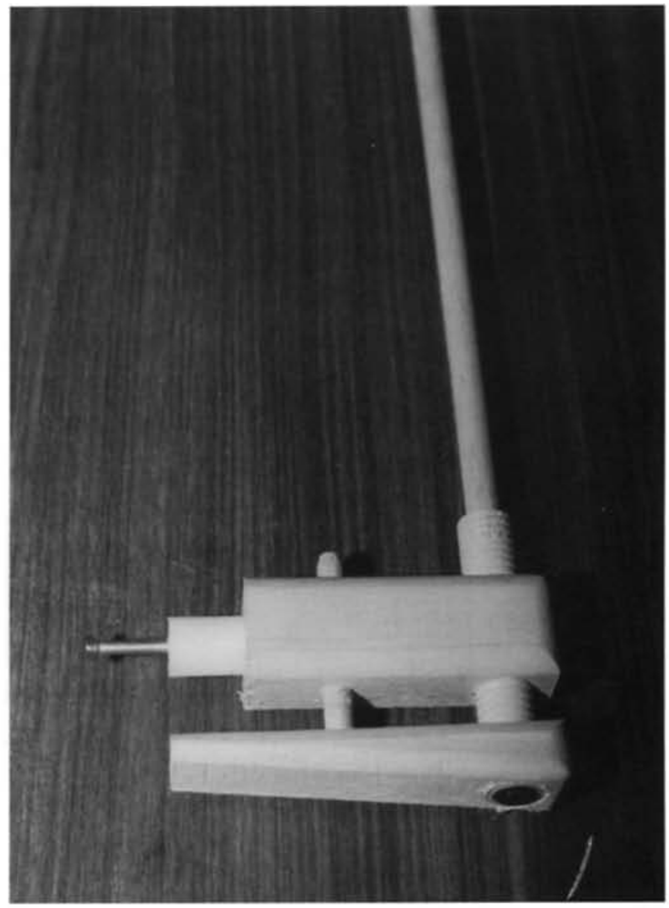
I braced the baritone with an acutely angled X-brace and only one lower face brace. The tight angle of the X was necessary for two important reasons. First, the longer scale length puts the bridge farther down the face of the top. As a result I had either to move the entire X-brace down so that the wings of the bridge crossed the arms of the X-brace or, preferably, close the angle of the X to accomplish the same end. The second reason for the acute angle of the X was my choice of incorporating the Bridge Doctor into the design.

BRACING PART II: THE BRIDGE DOCTOR

For those of you unfamiliar with Breedlove guitars and their use of the Bridge Doctor, the following will be useful both for general knowledge and for seeing what can be done when integrating the Bridge Doctor into guitar design.

Steve Henderson and Larry Breedlove (founders of Breedlove) were trying to get lower resonances out of the guitar while not making the instrument boomy. They had lightened the bracing considerably to that end, but the initial results didn't last long and the tops collapsed. Breedlove and Henderson were doing a large portion of Taylor's repair work, and as a consequence Don Kendall and James Oliver at JLD Research contacted them regarding the possibility of their using the Bridge Doctor in the course of their repairs. Oliver showed up on their doorstep several days later (all the way from New Mexico!) and installed the device on one of their collapsed prototypes. The Bridge Doctor corrected the structural problem and brought back the tone they were looking for.

The Bridge Doctor is a device that counterbalances the torsional component of string tension on the face of the instrument. The result of incorporating this device into an instrument is the ability to lighten the bracing and thus lower the resonance of the braced top, smooth out the harmonic structure around each note, giving the instrument piano-like tonal qualities while adding a depth and clarity to the lower registers without being boomy.



JLD "Bridge Doctor," which permits lighter bracing.

In Figure 1 we have a cross section of a guitar at the bridge. X+ represents the force placed upon the bridge from string tension, while X- represents the equal and opposite force from the sheer strength of the glue joint holding the bridge to the top. T+ and T- represent the tortional component of the string tension on the face of the instrument and the forces that make the bridge (and top) rotate in the direction of the string tension. T+, in the direction of the string tension, is the result of the strings' downward pressure on the saddle, while T- is the equal and opposite torsional component provided by the stiffness of the top, bracing, and bridge. Tops in instruments of any design that have bellied have failed that battle, and they were not able to counteract the torsional component of string tension.

In Figure 2 we see that same bridge with the Bridge Doctor in place. The Bridge Doctor consists of a wooden block through which an adjustable dowel

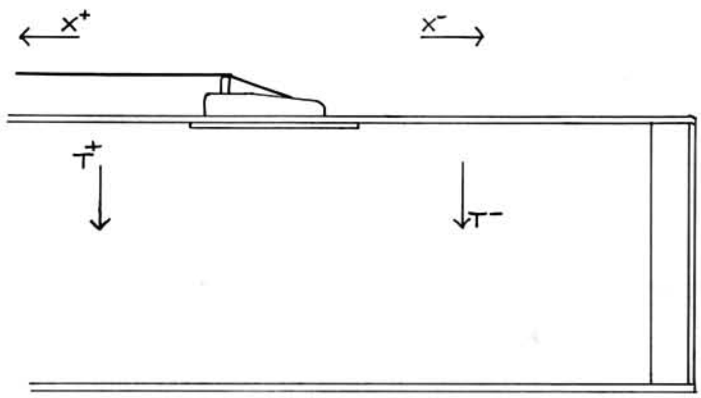


Fig. 1. Guitar cross-section at bridge location.

passes and makes contact with the endblock of the guitar. The Bridge Doctor is attached by means of a single screw through the bridge. The dowel is adjusted so it just makes contact, and the dowel can be rotated with finger pressure; too much contact and the Bridge Doctor will interfere with the sound, making it dead and muddy.

In Figure 3 note what happens to the forces and torsions when the Bridge Doctor is in place. We still have forces X+ and X-, and T+ and T-, all acting on the bridge and face of the instrument. The Bridge Doctor provides an extremely efficient lever to counteract the torsional component of string tension. We now have the additional forces Tb+ and Tb-, which represent the counter-rotational torsion in the system provided by the

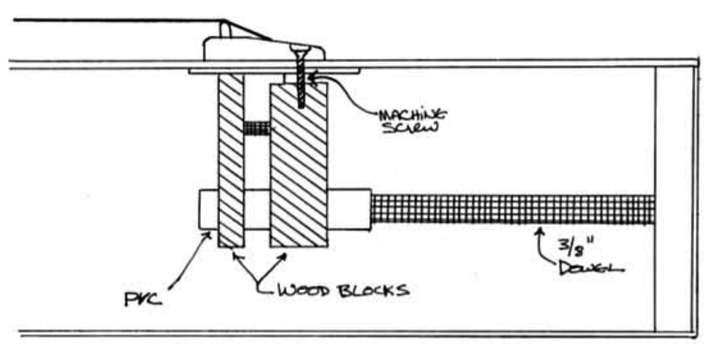


Fig. 2. Bridge again, but this time with Bridge Doctor in place.

Bridge Doctor as well as compressive forces C+/- on the dowel.

Returning to Figure 2, the lever counteracting the torsion is the bracing, which for most 6-string, steel-strung instruments ranges from 1/2" to 3/4" in height. By comparison, the Bridge Doctor is about 2 1/2" in height and a much more efficient lever. The result — the face of the instrument and braces no longer carry the entire resistant torsional load, T- and thus can be lightened considerably. Henderson and Kendall believe the result is that the top is no longer "kinked" and consequently is more responsive to lower frequencies.

In bracing for the Bridge Doctor, the redistribution of forces requires that the area around the soundhole be stiffened. Some of the stiffness comes from tightening the X-brace, as well as using wide, flat braces around the soundhole in lieu of the thin, tall ones used in many instruments. In the case of my instrument, the X-brace was closed to an acute angle of 80°, whereas Breedlove's X is closed to 82° — both much tighter than traditional X-bracing. Because the area was already well reinforced as a result of closing the X-brace (as well as the angled upper transverse

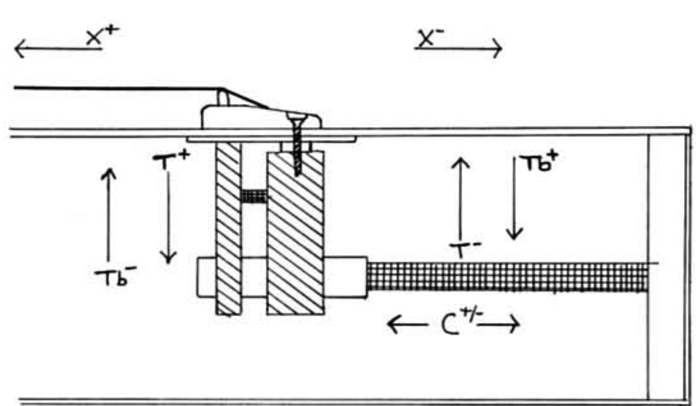


Fig. 3. The effect of String Doctor on force and tension.

braces), I used heavier peaked braces instead of the flat ones.

In discussing the bracing for the instrument, Henderson pointed out that as the angle of the X is narrowed, the finger braces play a more important role in the structure and voicing of the top. Because the Bridge Doctor increases lower resonances, he suggested that, instead of running these braces parallel to the arms of the X-brace, I angle them slightly, which I did. Additionally, because the angle of the X-brace was so acute, I chose to use just one scalloped lower-face brace. Both Turner and Henderson agreed that this bracing scheme would work well. Acoustically, these bracing parameters proved to be a wise choice, for the instrument has a full, rich, fundamental balance across the harmonic spectrum and excellent clarity from note to note.

Rick Turner made one other suggestion that I was unable to incorporate into this instrument. He suggested using what he called "flying buttress" braces that would run from the top of the neck block down to the sides aft of the waist and just above the back. Steve Klein and Bob Taylor use a similar brace ("the wall") in Taylor's new acoustic bass, as well as in the "Baby Taylor."

Those of you familiar with Andy Adams's work will notice a similarity. This kind of brace eliminates the need for an upper transverse brace and frees the top above the soundhole for greater vibration. I chose not to use this kind of brace primarily because of panic: I was incorporating a slew of new techniques, new bracing, a bolt-on neck system, radius forms, and so on. I already had a few technical and supply snafus, and those braces were one thing I could eliminate from my plate to make things more manageable. I do intend to experiment with them, however, in future instruments.

The time had come to determine how stiff I needed the top to be, in terms of both the plate and the braces. With the Bridge Doctor, Breedlove is able to thickness its tops to around 0.115" and less for six-stringed instruments (Taylor thicknesses its grand concert instrument tops to 0.110" and its dreadnought and jumbo tops to 0.115"). Breedlove then scallops the X-braces (3/8" by 5/8" rough stock) and lower face braces down to around 0.110" on six-stringed instruments. Their designs for twelve-string bracing has varied, including systems with scalloped X-braces and lower face braces and scalloping only on the lower face braces.

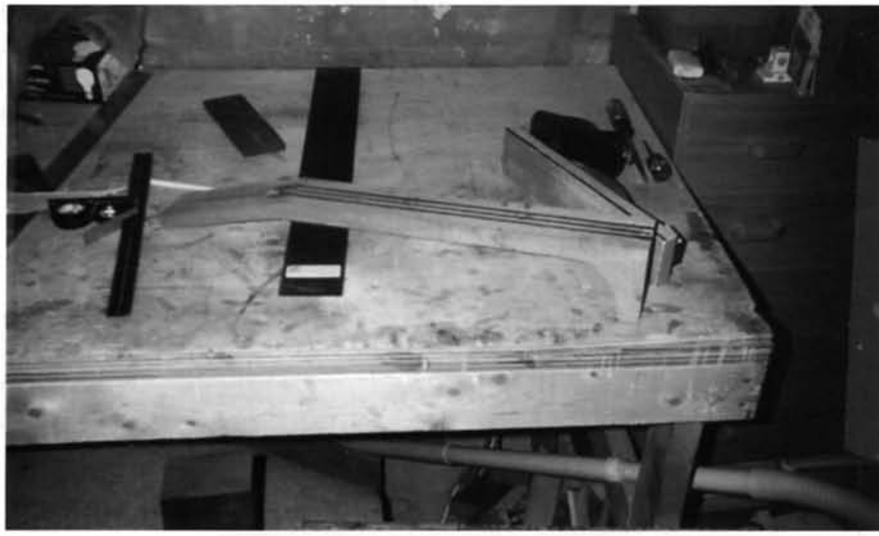
I didn't know, however, how much pull I was going to have on the top. What strings would be used on such an instrument? Ferrington, Simpson, and Turner all gave me the general guidelines, but because I had no experience with these things, I talked with James Rickard of Rickard Engineering to round things out. We discussed the tunings, scale length, string gauges, and the like and came up with a set of strings that would work. As a result, I was able to find out that the tension on the top would be about 190-200 lbs., or about 25 lbs. more than a set of medium-gauge phosphor bronze strings. The gauges are 0.080, 0.065, 0.045, 0.032, 0.025, and 0.018 (plain steel). I decided to split the difference between the six- and twelve-string Breedloves in terms of the bracing and top thicknesses as a starting point.

Dimensions

SCALE LENGTH:	30.0"
NUT:	1.875"
STRING SPACING:	2.375"
BODY LENGTH:	20.5"
UPPER BOUT:	11. 50"
WAIST:	9.0"
LOWER BOUT:	16.625"
BODY DEPTH — NECK:	3.375"
BODY DEPTH — END:	4.50"
COMPENSATION:	.156"
SADDLE SLOPE:	.3125"

Figure 5.

The baritone I constructed was built on a 30" bass scale and was designed to be tuned A to A. The instrument has a 15-fret neck joint, which puts the bridge comfortably in the sweet spot of the top.



Neck blank with graphite-rod reinforcement.

Although everyone I consulted suggested that the voice of the instrument would come comfortably in a dreadnought or a jumbo-sized body, the Bridge Doctor allows me to get more bass, and so I decided to make the instrument a bit shallower.

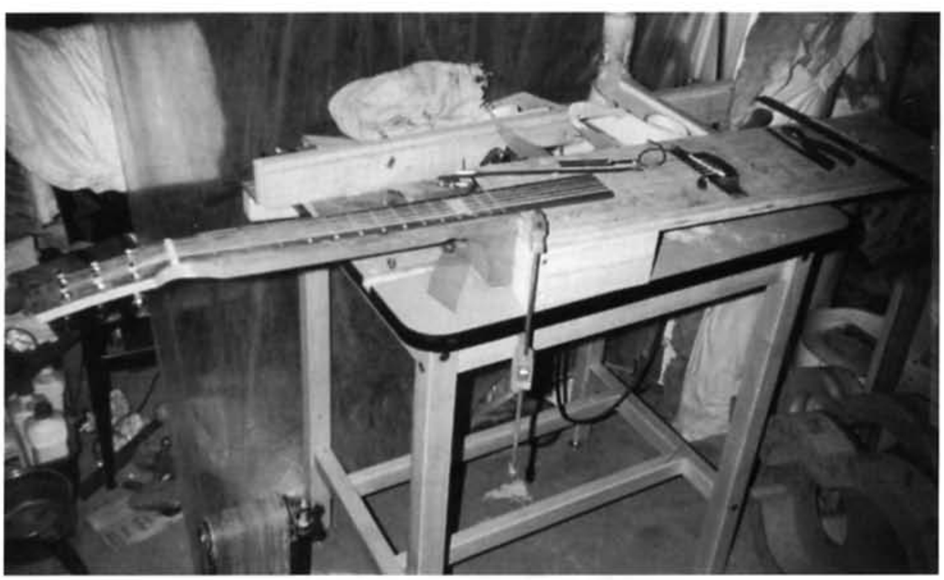
In the course of my research, the issue of body materials came up. Martin Simpson's baritone was made with koa for the top, back, and sides.

I chose to use a spruce top; but I'm currently building another using cedar. Linda Manzer, among other builders I spoke with, also recommended koa or other hardwoods of similar tonal qualities, such as walnut or mahogany. Each of these would give a different flavor, but all are fine, controlled tone woods. I wouldn't recommend using rosewood, because of its dark timbre, which would probably make a baritone — which is designed to work in the lower registers— muddy. Alternatively, maple would be contraindicated as well, being very bright, indeed. One might argue that cellos and bass viols are made with maple, so why not a baritone? To that I'd suggest that although they are made of maple, their air chamber and scale lengths compensate for their bright timbre: guitar-size instruments are too small to escape the brightness of maple that would be likely to color the timbre of a baritone or a bass instrument. This is certainly not an absolute, however, and I know that someone is going to disagree. I built my instrument with koa and spruce, bound in rosewood, with a rosewood peghead veneer and bridge. The rosette, truss-rod cover, and heel cap are manzanita. The neck is mahogany, with a truss rod and two 1/4" x 3/16" carbon graphite bars on each side. This instrument was built with a nut of 1 7/8" and 2 3/8" string spacing at the bridge. Because I don't have many power tools (with the exception of a router, drill press, and laminate trimmer), the instrument was built entirely by hand, including thicknessing of all the plates. The final dimensions for the instrument are provided in figure 5.

When the instrument was ready for finishing, I took it to Andrew Holland, who generously allowed me to use his new HVLP spray rig and booth. I sprayed the instrument with Guardsman lacquer. Technical assistance from Bryan Galloup got us back up and running when environmental and generally silly conditions hampered our efforts.

BRIDGE PLACEMENT AND INTONATION

Bracing the guitar with a 15-fret neck joint and a 30" scale wasn't a big deal to figure out; it was another thing entirely to figure out the location and slope of the saddle. I had never used a 30" scale before and didn't know what the compensation would be, so I constructed a test rig consisting of a test neck and fingerboard bolted to a plywood box. A fixed tailpiece with my string spacing was screwed to the face of the



Intonation test jig.

box. A scrap of hardwood fitted with a wide saddle blank was positioned under the strings at the approximate spot for proper intonation. A soundboard transducer that was stuck to this blank was fed into an electronic tuner and amplifier. With the strings tuned to pitch, the bridge was moved around to get the closest intonation. I then used small sections of strings placed on top of the saddle to fine-tune the intonation. The saddle was filed accordingly, the blank replaced in the rig, and everything tuned to pitch for a final check. Once the intonation was rechecked for accuracy, I took the final measurements for the compensation to the center of the leading edge of the saddle slot, and the slope of the slot itself. A bridge made from those measurements was glued in place accordingly.

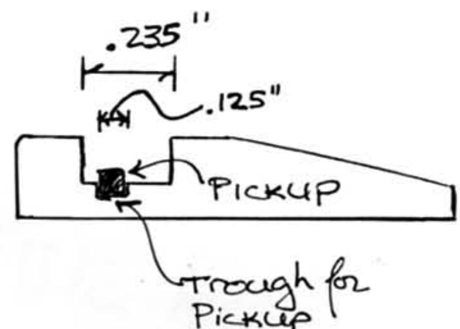


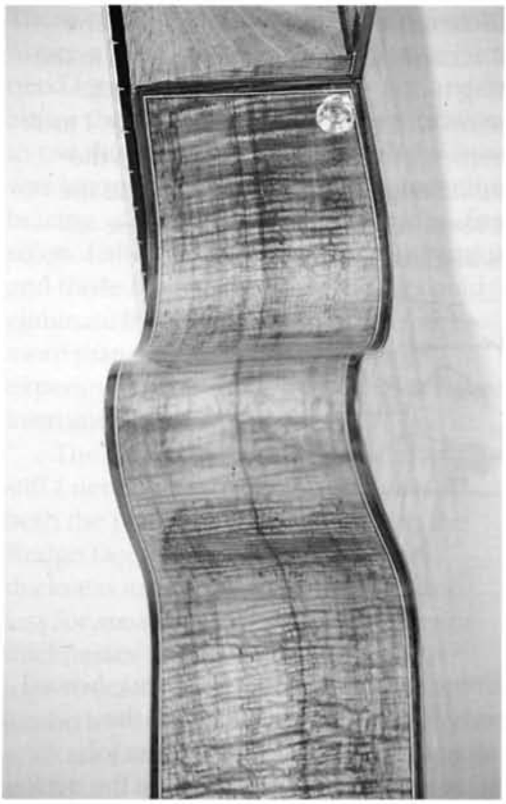
Figure 4.

When it was time to fret the guitar, Holland showed me how to properly fret an instrument and in the process did the most critical portions of the fret job. Using the fretting jig, we were able to stabilize the neck for both truing the fingerboard and filing the frets. Despite the fact that the neck has both a truss rod and a carbon graphite reinforcement, its length allows for a certain amount of flexibility, which would have been difficult to avoid without the use of the fretting jig.

At Jennings's request, the instrument was fitted with a Fishman Matrix Natural pickup. The techies at Fishman recommended that since I was using a wide saddle (around 0.230"), I should put the pickup in a shallow trough, a little more than half the thickness of the pickup, toward the front of the saddle slot (figure 4). This worked perfectly.

Jennings received the instrument in November of 1995 and couldn't have been happier, saying after a few chords, "It's a hummer." Having spent almost a year from the initial discussions to delivery, I was ecstatic, exhausted, and relieved.

Jennings played the baritone almost exclusively during a broadcast on TNN of *An Evening with Mary Chapin Carpenter and Paul Brady from Dublin* (March 12, 1996). The instrument can also be heard on John Gorka's new album, *Between 5 and 7* (track 9, "Paradise, Once"), and on Mary Chapin Carpenter's new album, *A Place in the World* (track 10, "Sudden Gift of Fate"), and on the single release extra track



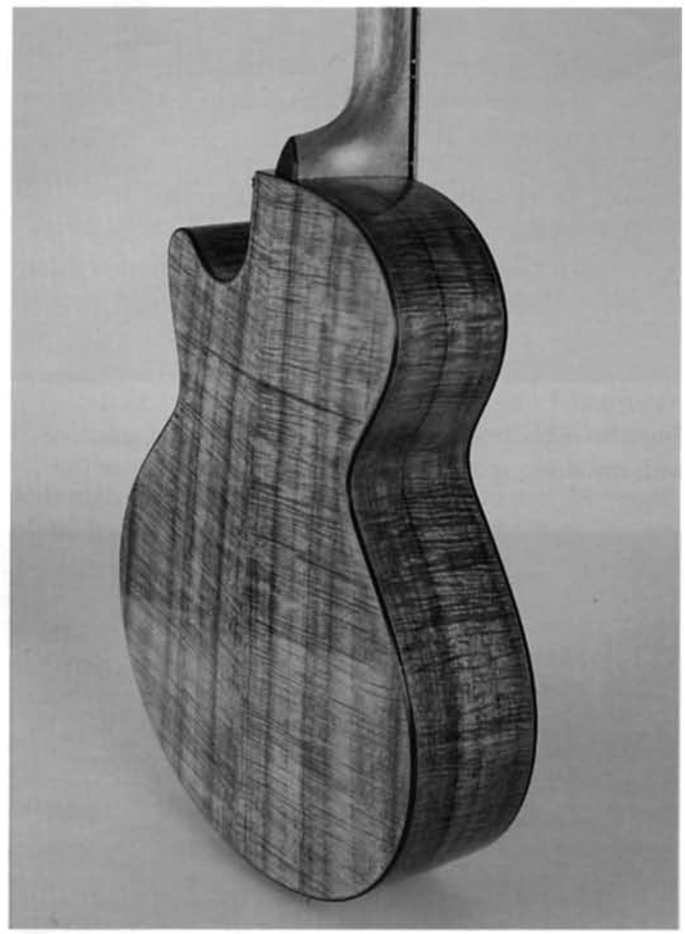
"Downtown."

Not all adventures prove successful. This time it was, but not without supply problems, design problems, and so on, all of which at times required me to have the sense to back away from the project for a few hours or even a few days. It was most certainly a labor of love and not one of profit — few R&D projects are. But in the end it was well worth it.

No discussion of this instrument would be complete without further mention of Charles Fox, Tom Ribbecke, Andrew Holland, and Mike Dove, who were patient and generous in technical assistance and encouragement through a variety of technical glitches. I'd never have made it through the project without their help; Professor David Dobson at Beloit College for his friendship and kind lesson in mechanics over the phone one night. And of course, the Bank

of Ma & Pa, which generously offered a temporary line of credit to get me past some snafus, er, um, artwork.

I'd also like to thank my friends at The Guitar Shop: Gus Wanner, Jay Dickson, Bob Fener, Curt Heavey, and Paul Bell, and especially the proprietors, Stephen and Lynda Spellman, who provided a wonderful forum — a round table discussion in which the project's design was bantered about and codified, not to mention the much-needed lightheartedness they brought throughout this project. And I cannot overestimate the value of being able to constantly observe and evaluate some of the finest instruments currently available. There is, in addition, great value in getting out of the shop to elicit



the customer's needs and in gaining exposure to the creative drive and vision of other luthiers. The restless natives won.

My deepest thanks to John Jennings, who blindly believed in me and continues to encourage me. Although I may have distilled and executed the knowledge so generously provided by so many of my friends and colleagues, I consider this instrument to have been a group project. Thank you, everyone.

[Editor's note. The author has donated his proceeds from this article to The National Guitar Summer Workshop in Lakeside, Connecticut, in memory of James "Rick" Rickard.]