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Repair of
A. F. Kochendorfer
Concert Zither

Performed by Ron Cook

December 2006 - May 2007

For Ken Effinger of Birmingham, Alabama

Background

Ken Effinger found my previous zither repair logs on my website and inquired about the possibility of having his concert zither restored. He told me that his great, great grandmother from Gruel, Germany, bought it, and his grandmother brought it over when she immigrated. He said it was one of the few possessions she brought over, other than her clothing.

When I received the zither, I found it to be one of the most beautiful I'd ever seen, but, alas, it was also in the worst shape I'd ever seen a zither. As I do with all my repairs, I took several "before" photos. The damage was extensive. In one e-mail, Ken mentioned he thought there was no hope. The early plastic bindings had become extremely brittle and were falling apart. Many crumbled when touched. Large cracks had developed in the top and back, and the frame was racked by age and string tension. Some glue joints were failing. Many strings were missing, and several remaining ones were unsalvagable. The fingerboard had also formed small fractures, and a couple of pieces had fallen out. The fingerboard tuning gears were corroded and could barely turn.

On the plus side, all but one tiny piece of the top inlay was intact. All the tuning pins were still in place, and the wooden string guides by the hitch pins had not lost any "teeth".

On the following pages, I will show and explain the entire repair/restoration process. Also at the end of this log are tuning diagrams and charts for the concert zither.

A. F. Kochendorfer Label

Valuation

Concert zithers and the unfretted versions, often called “guitar zithers”, were manufactured on both continents in the late 1800s. The older zither companies were primarily in Germany and Austria, and the newer companies were in the eastern and mid-western part of the United States, run by German and Austrian immigrants who brought to us their musical knowledge and skills.

Because of the number of manufacturers, and also due to the popularity of the instrument at that time, hundreds of thousands were made. Quite a few of those have been destroyed and thrown away when they warped and developed cracks. However, many more, some in perfect condition, were stored away in attics, closets, and damp basements, some for the last 100 years and are finally being brought to light as estates are inherited or sold.

Stuttgart, Germany, seemed to be the center of musical instrument manufacturing for over a hundred years. Not only were zither manufacturers located there, but also bowed instrument and piano manufacturers. Many were family-run and were passed down generation to generation. I found two listings for Kochendorfer: Frederich Kochendorfer, and A. F. Kochendorfer. Frederich is listed as a violin maker, and A. F. as zither maker, both from around the same time period. Whether or not these are father and son, brothers, or the same person could not be determined. (The F. in A. F. could stand for Frederich.) I could find very little information on either name.

Putting a value on instruments of this style is difficult. Many German-, Austrian-, and U.S.-made zithers from 1870 to 1935 or so show up on auction web sites, often going for as little as $25 (with cracks and very few or no strings), or as high as $300 or more (in near-perfect to perfect condition). However, I did find one Kochendorfer concert zither, in fair condition, with absolutely no decoration, that went for $750 on a musical instrument dealer web site.

But for many people, the value is not monetary, but sentimental. To be able to have a restored piece of family history on display, to know its use, its background, and who played it, and to be able to pass it down to future generations, is priceless.

Day 1: Assessment

On the first day, I always look over an instrument to see how much work is needed to restore it. Very often I make preliminary repair estimates based on customer photos, but I can't really determine the amount of work until I can look at the instrument in person. When I took this concert zither out of the shipping box, I saw a once gorgeous, high-end instrument in need of some of the most extensive repair work I've ever attempted.

Veneering was a common practice on furniture for centuries, and in the late 1800s and early 1900s, a lot of stringed instruments had exotic woods veneered over lesser grade wood. This Kochendorfer zither is the same way. Very thin pieces of Brazilian rosewood were veneered over pine, and these were glued over a pine and maple frame. This combination of hard and soft woods is one of the main reasons so many of these instruments have cracked and their glue joints failed over the years. In environments with extreme humidity changes (humid to dry, dry to humid), woods expand and contract as they absorbs moisture then dry out. Hardwoods absorbs moisture much less than softwoods, and don't expand and contract as much. On thin veneered soundboards and instrument backs, this uneven expansion/contraction causes the veneer to buckle. After many years of this stress, cracks form and glue joints fail.

Note: Glue failure is common in old instruments. The reason is hide glue. Hide glue is derived from the collagen found in animal hides. It is very similar to the gelatin we eat and is not toxic. In the U.S. edible gelatin is made from pork skins and hide glue from beef hides. Hide glue is mixed with water and "cooked" as needed and brushed on to surfaces being pieced together. The mixture has to be made in the correct proportions, and if done improperly or with inferior powdered glue, often won't penetrate the wood very well. As hide glue ages, even the best mixtures, it becomes brittle, and any severe bump can cause a glued joint to fail. Sometimes, extremely dry climates, or even the changes of climates from humid to dry and back again, can cause wood joints to "pop" apart, especially if the strings are at pitch, which keeps strain on the instrument's body.

If an instrument is to be stored away for long periods of time, it is always best to loosen the strings. An instrument humidifier should be kept in the case for dry climates, and a dehumidifier for damp climates.

Another problem that came up right away was the strings. At least half the original strings were gone, and a lot of the remainder were broken. Some wound strings were unraveling. A new set of zither strings can run up to $300 or more. I did a search over the internet and found only two suppliers. Nearly two months later, I found a full set of new strings being offered on Ebay, so I put in a bid. Unfortunately, the bidding got too high. I kept checking Ebay every week, and nearly two months had passed when an unused "antique" set came up for bid. It was nearly a full set. I put in my bids and got it. (One other bidder kept me on the edge of my seat up to the final minute of bid time.) I was able to salvage a couple of the originals strings to fill out the set.

Because of the poor condition of this instrument, I knew I would have to remove the back to be able to completely seal up and strengthen all the cracks and work on the frame. This would be a long, laborious process, which I've chronicalled in the following pages.

Day 2: Remove Strings, Pegs, & Gears

On day 2, the real work began with the string removal and dismantling of all the hardware. Even though many of the strings were unusable, I labeled and numbered their placement anyway. I removed the tuning gears and tuning pins and bagged them. Dampness had rusted the tuning pins quite a bit, and the underside of the tuning gears was green with corrosion, which is the reason they would hardly turn. All would take quite a lot of cleaning.

The metal of the tuning gear's base and plate are probably German silver (nickel silver), which actually has no silver but is an alloy of nickel and copper and sometimes zinc. It gets the name from its shiny silvery appearance.

Day 3: Cleaning Tuning Gears & Polishing Gear Cover

On day 3, I spent part of the day cleaning the gears and the decorative plate. I used WD-40 on the gears to loosen them up, and wire brushed them, keeping any solvent off the mother-of-pearl grips. It didn't take too long, and the gears began turning very easily.

On the decorative plate, I used 0000 steel wool to rub out the tarnish inside and out then used a metal polish to give it back its original shine.

Day 4: Cleaning Tuning Pins & Binding Channels

The next day, day 4, was another cleaning day. Because all the tuning pins were covered with rust, I spent quite a while at my wire wheel cleaning the rust off. I didn't wire brush the threaded portion because that could reduce the pins' holding power. Already, the pin holes in the zither frame were dried out and slightly oversized. When the time came to reinstall the pins, I knew I would have to do something to make them tight enough to hold the strings well.

Another cleaning process was to get all the years of caked on dust and grime out of the binding channels where the binding had broken out. Even this cleaning broke off more small pieces of the extremely brittle plastic binding.

Days 5: Removing the Back

With all the open cracks in the front and back, I had to remove the back to make the repairs. A few sections of the back were already pulled apart from the frame. To pull apart the rest, I worked a heated palette knife and thin X-acto blade all the way around the glue joint. The heated palette knife helped break down the hide glue that was still holding. In fact, a couple of places, the hide glue held a little too well. I had to carefully work the knife and blade back and forth for several hours to finally get it loose.

As you can see from the bottom picture, I found a maker's stamp on a section of top bracing.

Day 6: Gluing the Back Cracks

Now that the back was off, I could easily work on all the surfaces and frame. On day 6, I began working on the back. One large crack ran the entire length of the back right down the middle, and a few smaller cracks were on each side of that. This is a soft wood, and new glues, like the Titebond brand I use, soak in and hold very well. I applied glue, closed up the cracks, and clamped it for 24 hours.

Days 7: Gluing Cleats to the Back

After the glue cured, I made up a bunch of “cleats” from small pieces of scrap maple and glued them across the cracks. The grain on the cleats runs perpendicular to the back’s grain, which helps strengthen the back and keep that section of back from separating again.

Day 8: Gluing the Soundhole Cracks

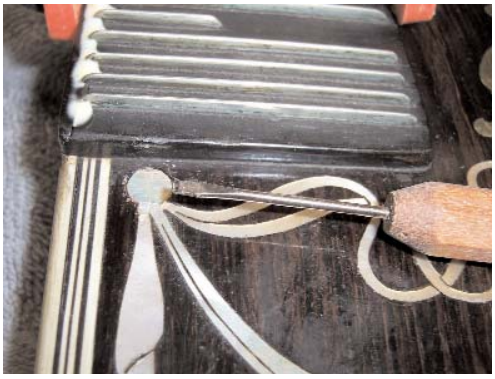
The top had a few thin cracks into which I injected glue and clamped shut. I also added cleats to strengthen the top, like I did to the back. The soundhole still had all the binding in place, but a lot of it was loose. The parts that came loose were right where small cracks had formed. I also injected glue into these. To help strengthen the weak area of pine around the soundhole, I glued on a piece of Douglas fir, with an oversized hole I drilled, completely surrounding the opening. This will help keep that section of top stable.

Day 9: Gluing Pin Block Pieces

When I removed the tuning gears and pins, sections of the pin block fell out. Most of the frame is pine, except for the pin block, which is either maple or Baltic birch. This wood, like the pine, had expanded and contracted quite a bit over the years from humidity changes, and it, too, fractured in a few spots, especially at the tuning gear channel and between the pin holes and bridge.

It was easy to fix the gear channel pieces, but the pin hole pieces kept coming out almost to the end of the project, often falling into the pin holes. You can see in the picture the tiny fractures next to most of the pin holes.

Days 10: Inlay and Fingerboard Repairs



The metal and mother-of-pearl inlays on the top are beautiful. Most zithers from this era have painted decorations or decals. One with this amount of inlay was definitely made for the elite.

There was only one piece of top inlay missing, which was a small circle of mother-of-pearl. I have a small stock of mother-of-pearl circles of various sizes that I use when crafting my custom instruments. With a little judicious whittling, I was able to size one to fit.

On this day, day 10, I also began repairing the edge of the fingerboard. For some reason, the outside edge, right next to the fret ends, was crumbling. A few pieces fell out when I started the project. (Fortunately, I found them.) I glued the pieces back in, and injected glue into the remaining fractures, then used painter's tape to hold it all in place.

Day 11: Fixing Soundhole Binding

This is day 11, but it's actually now several months into the project. I exhibit at several craft shows and arts festivals throughout the year, and they seem to cluster around February through April, and July through November. Before each trip, I spend a lot of time completing new instruments and artwork, setting up photo shoots, preparing the booth, and making travel and lodging arrangements. (It's hard work being an artist!)

Some time ago, I strengthened the soundhole on the underside of the top. With the top cracks fixed, I could re-attach the binding around the soundhole. This early plastic was just as brittle as that around the outside edges and had broken in several places. However, since it was layered in a circular manner, it kept together. I used a special plastic-to-wood liquid glue to glue it back onto the soundboard, and some "instant" glue between the plastic pieces to keep them all together. Once the glues hardened, I was able to take the tape off and lightly scrape off the excess.

Day 12: Strengthening the Frame

Before reassembling the parts, the last thing to do was strengthen the frame. Many zithers from 1880 or so up to 1940, had frames that warped from the constant string tension. And with the glue joints failing on the earlier ones, the rack could be almost 1” out of plane. It wasn’t too bad on this Kochendorfer, around 1/8” to 1/4” out of plane.

I clamped the top down to flatten the frame, the glued additional supports at the weakest points. I also added kerf strips around the inside top and bottom. Kerf strips are thin pieces of word added to inside edges where binding channels are cut out for the binding and purfling inlays.

Day 13: Gluing on the Back

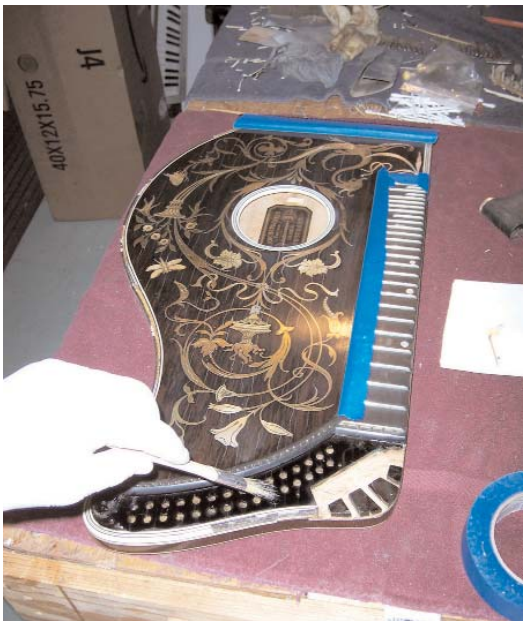
A major turning point in a project like this is when I start putting it back together. Day 13 was the day to reattach the back. This part of the project takes quite a few clamps, and over the years I've accumulated many of them. The combination of cam and spindle clamps makes this work progress quickly before the glue begins to set.

The type of glue I use produces an extremely good bond, but it begins to set up in 5 to 10 minutes. I have to have all my clamps at the ready before I apply the glue.

Day 14: Sanding and Applying a Protective Coat

The glue had been curing for several days by now. On day 14 of this project, I sanded down the back finish, removing any glue that had seeped out of the cracks or on the edges. I used a very fine grit sandpaper on the orbital sander, then followed with hand sanding with 400 grit paper and 0000 steel wool. There is still a lot of work to do, and I wanted to protect the back and front as much as possible from the additional clamping and taping that will be coming up. I applied several coats of tung oil varnish and let it cure for a few days.

Day 15: Ebonizing & Protective Top Coat



I applied the same protective coating of tung oil varnish on the top. I also “ebonized” the pin block where I had to reglue several small pieces and replace a few that had disappeared with new wood. Ebonizing is basically staining or painting a light-colored wood to look like ebony. This “faux” finishing process has been around for centuries, especially in the furniture industry.

Days 16 through 24: Filler Strips and Installing Back Bindings






I knew reinstalling the binding and purfling was going to be a very long, laborious process. The original binding and purfling was applied in up to 8 layers, along the top and down the side. Some pieces were no wider than 1/32” and several were around 1/16”. Many were barely 1/16” thick. To match the original bindings as much as possible, I purchased several thicknesses of black and white wood bindings. No supplier carries any 1/32” to 1/16” x 1/16” plastic binding pieces any longer, but there are several suppliers who carry wood bindings of that size, especially for violin purflings and guitar bindings.

Some of the new binding pieces were preglued in thin strips of white and black. I was able to shift these around to match the pattern of the original bindings as much as possible. Day after day, for 9 days, over an entire month, I glued each layer of the binding. The outside edge binding was the largest, and I had to use my steam bending techniques to get it to fit around the small radii of the tuning pin block area.

Days 25 through 30: Installing Top Bindings

The top binding didn't take as long, since there was less area to repair, but still lasted six project days. The binding along the fingerboard was still intact, and most around the pin block was also still in place. Only the corner pieces were missing. (Top right photo.)

The tape I use is a special binding tape sold by Stewart MacDonald Guitar Shop Supply (www.stewmac.com). It's a very strong tape that peels off easily without harming the surface. It is used to actually clamp the binding in place.

Several sections of the top had some of the original binding still intact, especially along the fingerboard edge, hitch pin area, and around the tight curve of the pin block. I wanted to keep as much of the original binding in place as possible for historical reference.

Days 31 through 35: Preparing and Applying Finish

A week or two later, I was able to spend time on the surface preparation for the finish. All the new binding had to be scraped down to the same level as the rosewood, and the edges had to be rounded to match the old binding. The orbital sander helped level the binding.

I did another round of hand sanding, this time with up to 600 grit sandpaper and with the 0000 steel wool. Everything was then blown clean with compressed air and wiped down with a tack cloth.

Once a day, for the next five days, I hand-rubbed a coat of tung oil varnish onto the surface. I let the application cure for 24 hours, then rubbed it with 0000 steel wool to wipe out any dust specks or other impurities, cleaned again, and applied another coat of tung oil. I let the final coat rest and cure for several days before turning the zither over to do the top and sides.

Days 36 through 39: Applying Four Coats of Finish

Before turning the zither over, I temporarily screwed in the spiked feet so the back wouldn't lie directly on the cloth where it could scratch or even stick if the finish was still a little tacky.

With the feet in place, I turned the zither over, put painter's tape around the fingerboard and lower string guides, and for the next four days, applied more tung oil varnish in the same manner as I did on the back.

Day 40: Staining Fingerboard Repairs

The fingerboard appears to be an ebonized maple. Where I made the edge repairs and sanded the glue seepage down, the wood showed through as a light wood. Like I did with the pin block, I applied a black stain to ebonize the repairs.

Day 41: Applying Fretboard Oil

I let the ebonizing stain soak in for several days, and when I felt it had cured enough, I oiled the fretboard. Fretboard oil is a special mineral oil mixture that is formulated mainly for guitar necks. The oil takes a day to cure, but soaks into the wood and keeps it from drying out.

Day 42: Polishing, Installing Tuning Gears, Bridge Cleaning, and Swelling Wood





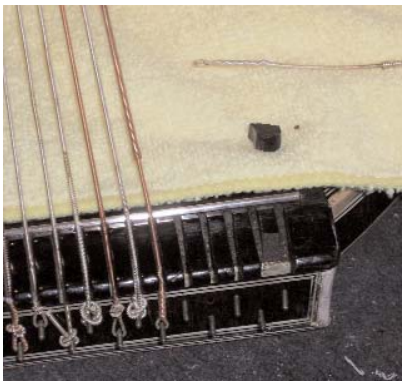
Day 42 was a very busy day. The finish had a couple of weeks to cure, and I was able to finally give the zither a good polishing, which took several hours of hand rubbing. Once I finished polishing, I reset and installed the tuning gears, cleaned the corrosion off the metal bridge and nut pieces, and, before re-installing the tuning pins, dropped some “Swellock” liquid into the pin holes. Swellock is used by furniture restorers to make things like chair rungs fit more snugly. It slightly swells the wood, and I use it to make tuning pins fit and hold better.

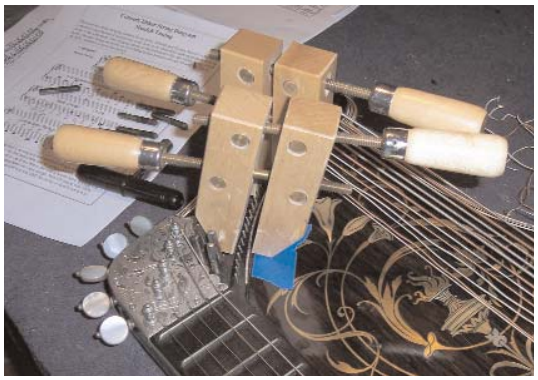
Day 43: Installing Tuning Pins

It was time to screw in the 31 tuning pins and get ready to string it up. These tuning pins are reverse threaded. They tighten by going counter-clockwise and loosen by going clockwise. German and Austrian zithers of this age all had reverse threaded pins. Those made in the United States had standard threaded pins. That makes it hard to replace missing pins on European zithers, since the old style of pin isn't available anymore. Fortunately, this Kochendorfer had no missing pins.

Some of the pins still fit too loosely, so I added a little more Swellock and put a tiny wood shim inside the pin holes as I re-inserted the pins. This tightened them up nicely.

Days 44 and 45: Stringing and a Little Bad Luck





Day 44 started out great, then....

Two pieces of bad luck occurred, first one day, then the next. I had installed all the pins and nearly had all the strings installed, when I tried to slip the first contrabass string through the guide and a little piece broke off. Not too bad. Easy repair, especially since a couple of the other string guides had broken off much earlier in the process, and I was able to glue them back quite easily.

The next day, I put on the remaining strings and started to tune the zither up to pitch to test it. The bridge didn't like the tension, and a piece popped out. Very frustrating. What I discovered was I had turned the tuning pins in the wrong direction, putting more stress than necessary on the pin-like string guides in the bridge. I corrected that. I also had to remove a few of the pins to reglue the broken section of bridge. Fortunately, it was a clean break and went back together with minimal effort.

Day 46: Completion

Finally! The big day arrived, and I was able to finish stringing up the zither and try it out. Beautiful tone. I tried to play the Anton Karras “Third Man Theme” and was relatively successful. I loosened the strings a little for shipping. I loosened the strings for shipping.

As for care, if this is kept in its case in Birmingham, it would be wise to purchase an instrument dehumidifier to keep in the case. These are available through many music stores or online. Also, if left in storage, make sure the strings are loosened. If it will be out on display, there shouldn’t be any problem, unless the indoor environment is very dry. Then an instrument humidifier is needed. With the humidity controlled in the instrument, no further cracking should ever occur and it should last another 100 years or more.

This has been a very challenging and exciting project. With over 35 years of instrument building and repair behind me, I still find new things to interest me and learn from. And this project was quite a learning experience for me. Enjoy!

Day 47: A Little Extra

The project was done. Another day went by and I was thinking about the case that the zither came in. I remembered that the top was off and taped in place. I thought, gee, here's a beautiful zither that's going to be sent back in a broken, dirty case. Why don't I see if it can be fixed.

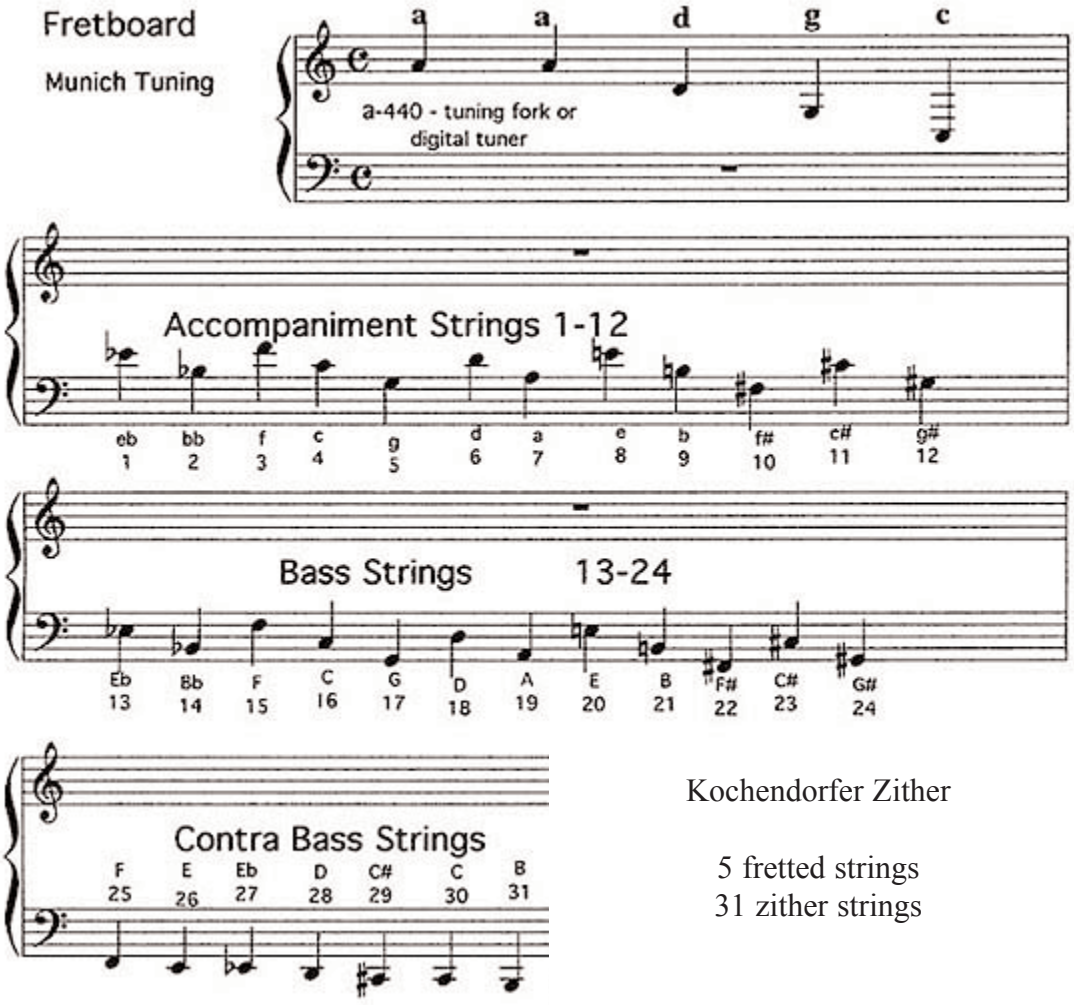
Well, the hinges weren't broken, they just rusted and frozen. When the case was opened after years of storage, the frozen hinges probably pulled right out of the case. I was able to unscrew the hinges, apply WD-40 and a lot of wire brushing, and got them to work again. When I put them back on and fastened them to the top and bottom, they worked great. Then I noticed the torn cloth restraining strap. I pulled the short end, and an old upholstery tack pulled out. I found the second at the bottom. The remaining strap was long enough to reinstall, so I tacked it back in close to where the original position was. Worked fine.

I then cleaned and polished the case, bought a couple of brass hooks for latching and cleaned out the inside. The embroidered zither cover is still in great shape, for its age, and the felt lining is fairly intact. This will make a much nicer case to send this beautiful zither back to Birmingham.

String Charts for Concert Zither

Munich Tuning

There are two zither stringing formats in use today: Munich and Vienna. Munich is the most commonly used because it incorporates every note in the chromatic scale encompassed by the scope of the instrument. The stringing pattern on the fretboard is like the violin family, a fifth apart. The open strings are in the circle of fifths, broken between Eb and Ab and laid flat on the zither, similar to a accordion layout.



Kochendorfer Zither

5 fretted strings
31 zither strings

In addition to the basic 29 fretboard, accompaniment and bass strings, zithers may have 2, 3, 5, 7, 9 or 13 contra bass strings - the full harp zither has 42 strings (5 fretboard and 37 open strings). In some early versions, and on perfecta zithers, the contra basses were arranged in the same circle of fifths as the accompaniment and bass strings. Munich tuning was often expressed in treble clef (violin key, or similar to guitar clef) but today is mostly written in bass clef.

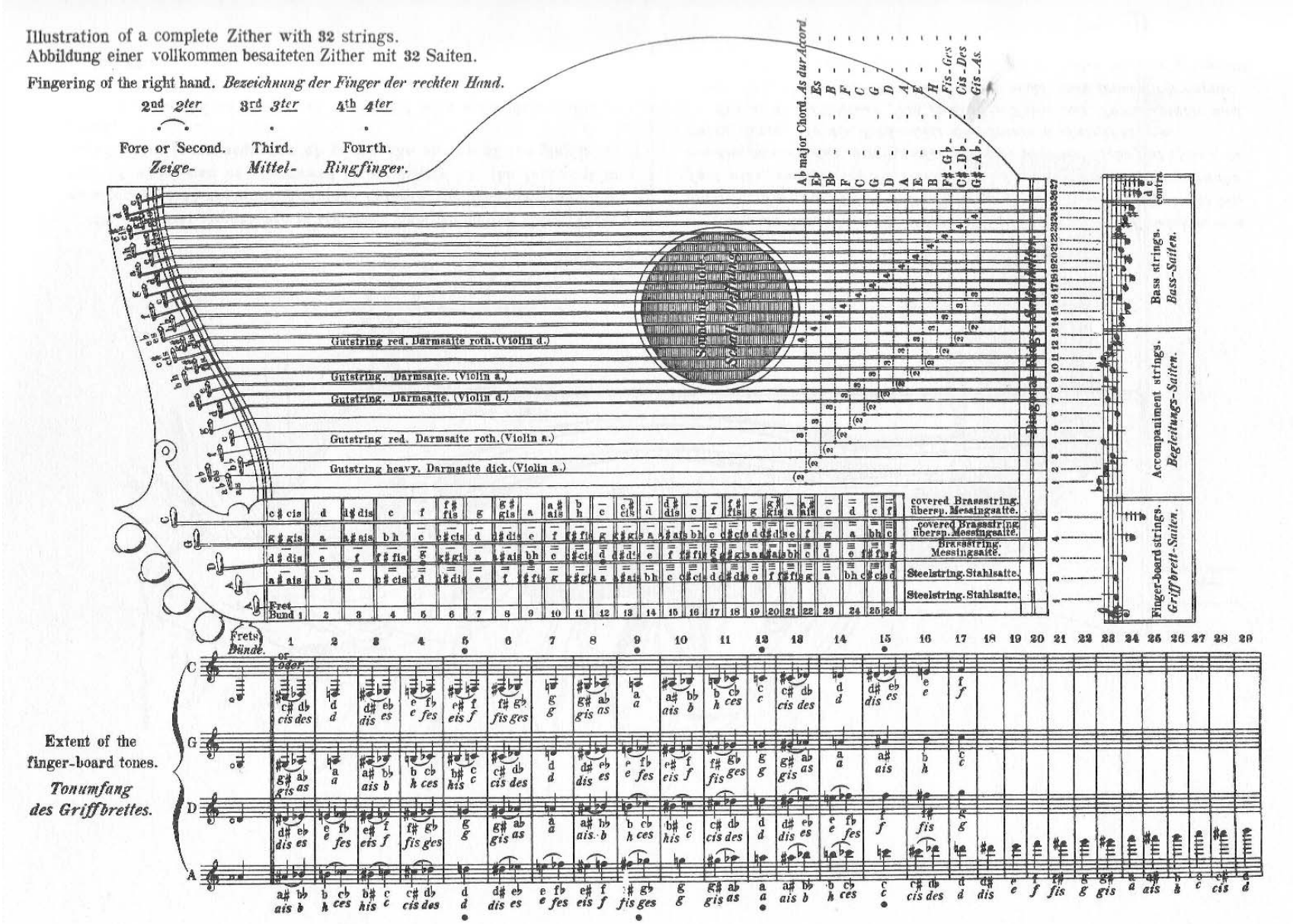


Illustration of a complete Zither with 32 strings.
Abbildung einer vollkommen besaiteten Zither mit 32 Saiten.
Fingering of the right hand. Bezeichnung der Finger der rechten Hand.
2nd 2ter
3rd 3ter
4th 4ter
Fore or Second. Zeige-
Third. Mittel-
Fourth. Ringfinger.
Ab major Chord. As dur Accord.
Gutstring red. Darmsaite roth. (Violin d.)
Gutstring. Darmsaite. (Violin a.)
Gutstring. Darmsaite. (Violin d.)
Gutstring red. Darmsaite roth. (Violin a.)
Gutstring heavy. Darmsaite dick. (Violin a.)
covered Brasstring. übersp. Messingsaite.
covered Brassstring. übersp. Messingsaite.
Brassstring. Messingsaite.
Steelstring. Stahlsaite.
Steelstring. Stahlsaite.
Fret Bund
Bass strings. Bass-Saiten.
Accompaniment strings. Begleitungs-Saiten.
Finger-board strings. Griffbrett-Saiten.
Frets Bünde.
Extent of the finger-board tones.
Tonumfang des Griffbrettes.