



## 17/16 HAMMERED DULCIMER KIT

### Assembly Instructions



- 1 assembly instructions
- 1 tuning chart on transparency

#### WOOD PARTS

- a) 1 back (1/4" plywood)
- b) 1 soundboard/top (solid wood)
- c) 2 pinblocks (walnut and maple)
- d) 1 long front rail (walnut)
- e) 1 shorter back rail (walnut)
- f) 2 inner braces (hardwood)
- g) 2 bridges (maple)
- h) 1 tone bar (hardwood)
- i) 1 bridge support block
- j) 1 pair playing hammers

#### HARDWARE

- 66 tuning pins
- 33 rh 1" screws for top (square drive)
- 2 black delrin rods (24" each)
- 2 brass tubes, 3/8" dia (21" each)
- 1 tuning wrench
- 4 walnut plugs, 3/8" dia
- 4 wood screws, 1-1/4"
- 1 drill bit, 3/16"
- 1 drill bit, 9/64"
- 1 square drive #2 bit for top screws

#### Music wire:

- 4 ea. - .032" dia. loop-end wound strings
- 8 ea. - .024" dia. loop-end wound strings
- 20 ft of .016" dia. music wire
- 50 ft of .018" dia. music wire
- 50 ft of .020" dia. music wire
- 75 ft of .022" dia. music wire

## BEFORE YOU BEGIN

\_\_\_A. Inventory and inspect all your parts carefully. If anything is missing or defective, please call us right away.

651-439-9120

\_\_\_B. It is a good idea to read through the entire assembly instructions before you start, just to get an overview of the project.

### A NOTE ABOUT GLUE

We strongly recommend that you use a common woodworking glue like Elmer's Carpenter's Wood Glue or Titebond because they hold the parts more securely than most other adhesives, and they are inexpensive and easy to use. DO NOT assemble the wood parts of this project with 5-minute epoxy or super-glue or hot melt glue. The yellow colored Elmer's or Titebond is best.



When gluing parts together, be sure to put enough glue on the joint to wet the entire surfaces to be joined. A good sign of proper gluing is that a little excess will squeeze out around the joint when clamping pressure is applied. Too little glue may cause the parts to separate later, whereas too much glue makes things messy. Always keep a damp rag handy for quick cleanup, as necessary. It is especially helpful to keep your fingers clean while gluing, because gluey fingerprints have the embarrassing tendency to appear on the finished product in prominent places.

## ASSEMBLE THE FRAME

\_\_\_1. Test fit the four frame parts together (two PIN-BLOCKS and long and short RAILS) without glue to see how they fit. Position the frame pieces on top of the Back panel and check to see that the corner joints fit tightly. (fig. 1) Make minor adjustments to the ends of the rail pieces if necessary.



FIG. 1

Notice that the front and rear RAILS are pre-drilled with a 3/8" countersink for wood screws. Make sure these countersunk holes face outward on the box. The close-up photos here (figs. 2 and 3) should help you confirm the proper orientation of the parts.

The upper edge of the front and rear RAILS are rabbeted just to give as much open vibration to the top panel as possible.



FIG. 2

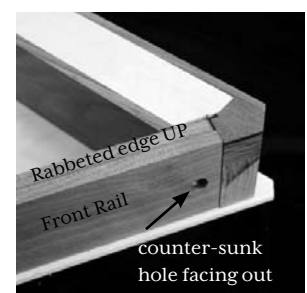


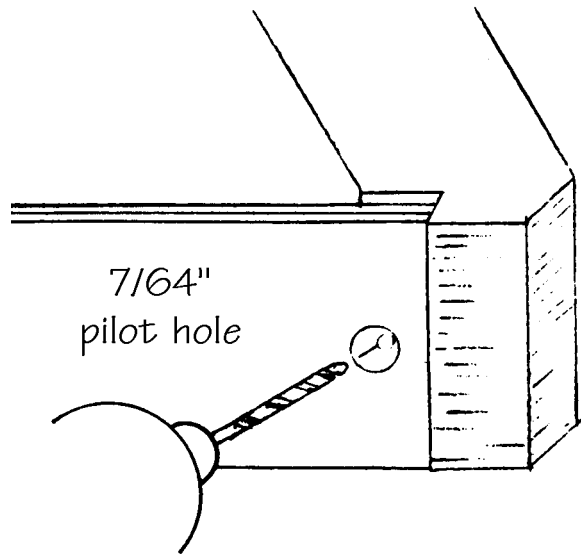
FIG. 3

The PINBLOCKS should have the maple side facing up.

The RAILS should have the rabbeted side facing up



- \_\_\_2. Use a 7/64" drill bit (not provided) to drill a pilot hole into each end of the PINBLOCKS to make it easier to screw the rails to the PINBLOCKS. Drill through the holes already located in the RAILS, making sure the parts are perfectly aligned as you drill. Note the slight angle of the holes -- that will help pull the joints tightly together.
- \_\_\_3. It is also a good idea to open up the holes in the RAILS so the screws slip through easily. Use the 9/64" bit provided to make the holes larger in the RAILS only, not the pilot holes you just drilled in the PINBLOCKS.



When pilot holes are drilled, and you are satisfied with the fit of the parts, go ahead and assemble them permanently with glue and screws. The screws serve as clamps to draw the parts together, but the real strength lies in the glue joint. Use enough glue so that some of it squeezes out of the joint when the parts are drawn together. Put wax paper under each corner to avoid gluing the frame to your work table.



**IMPORTANT:** Hold the frame over the BACK PANEL to make sure it is symmetrical and fits properly on the BACK. Force the joints into symmetry, if necessary, before the glue dries.

## THE BACK

- \_\_\_4. Look carefully at all the joints of the dulcimer frame, and clean up any glue blobs that would interfere with a good fit of the back. Also smooth out any unevenness of wood at the joints.

Find yourself a good collection of c-clamps or heavy weights (cement blocks or bricks). It pays to be prepared -- the strength of your hammered dulcimer depends on how firmly you glue it together! The back forms a critical part of the structure of this instrument, so take care to clamp it well all the way around the frame.



Before gluing check that the walnut side of the BACK is facing out and the maple side of the PINBLOCKS are facing up. (fig. 1, previous page)



**FIG. 4**

- \_\_\_5. When you are satisfied with the fit, go ahead and glue the back to the frame, using plenty of clamps and/or weights to hold the parts together. BE CAREFUL to prevent the frame from sliding out of position as you glue and clamp it to the back. Wet glue makes the parts slippery. Perfect centering is not necessary, but you don't want the frame to slide right off the edge of the BACK! You should have some of the BACK showing all the way around the box, and you will trim that excess off later. (fig. 4)

## INNER BRACING

- \_\_\_6. The two INNER BRACES are cut with a slope at each end. The function of these braces is simply to support the TONE BAR, which, in turn, supports the middle of the SOUNDBOARD. These BRACES do not need to touch the PINBLOCKS. Measure the distances (shown in fig. 6) from the long FRONT RAIL to determine the proper placement, then glue them to the BACK, using heavy weights and/or clamps until dry.
- \_\_\_7. When the INNER BRACES are dry, position the TONE BAR on top of them. Orient it at an angle to the centerline of the instrument. (fig. 6) The TONE BAR should overhang the two BRACES equally. Mark its position on the BRACES so you can glue it down accurately with weights or clamps holding it until dry
- \_\_\_8. One more BRIDGE SUPPORT BLOCK is needed for the internal bracing. We like to chamfer the bottom corner of this block just to make sure we can glue it firmly to both the back panel and the rear rail without any interference from dried glue residue along the inside corner of the box. (fig. 5)
- \_\_\_9. Glue the BRIDGE SUPPORT BLOCK to the BACK and the REAR RAIL, 5" from the inside left corner so it stands the same height as the PINBLOCKS. (fig. 6)

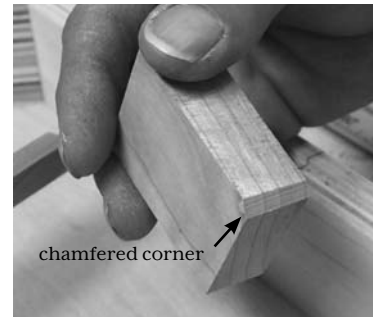


FIG. 5

NOTE: The TONE BAR may be slightly higher ( $1/64$ ") than the SUPPORT BLOCK and PINBLOCKS, and that's OK. We like to "crown" the TOP PANEL (soundboard) slightly to counteract the natural flexing of the box when the strings are under full tension.

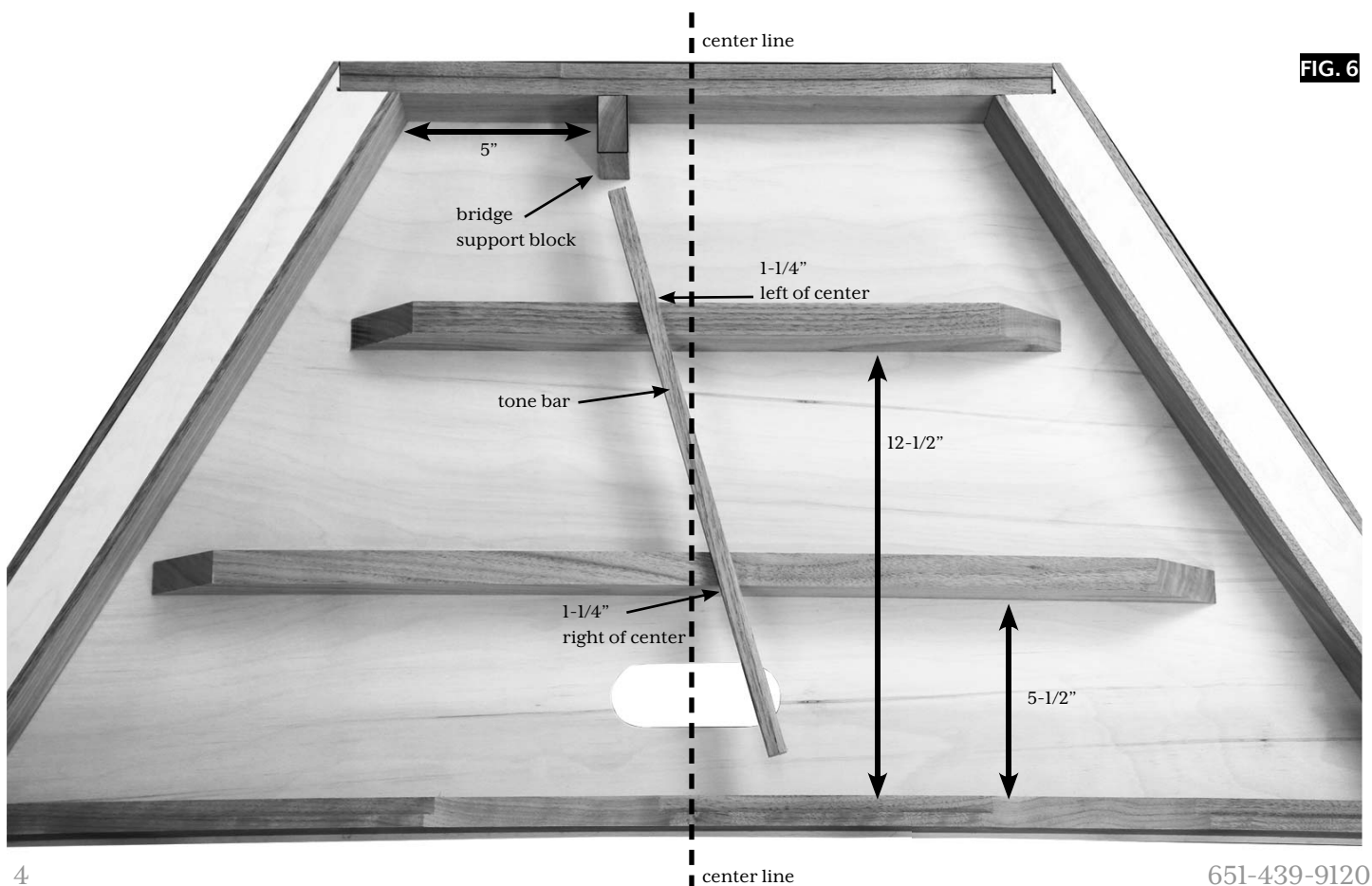


FIG. 6

- \_\_\_10. Now is a good time to sign your name to your instrument. Put your signature, date, location, and any message you have for posterity on the inside of the back where it can be seen through one of the soundholes.

## GLUE ON THE SOUNDOBOARD

- \_\_\_11. Test fit the SOUNDBOARD to the box. The goal is to have equal overhang all around the frame. Check for dried glue blobs or uneven surfaces on the box that might interfere with a good fit.



**CUSTOMER SUGGESTION:** It is common for the soundboard to slip off-center when the first clamps are placed. To avoid that problem, one person (Clem Rook) suggested drilling a 1/16" diameter hole through the soundboard into the pinblock at the punchmarks in two opposite corners of the box. This allows you to push a small nail temporarily into the holes to prevent the soundboard from drifting as you clamp it to the frame. Pull the nails out when done. The holes will be drilled larger later, for tuning pins or hitch pins, so you don't need to worry about filling them.

- \_\_\_12. When satisfied with the fit, glue the SOUNDBOARD to the frame and the TONE BAR, using plenty of clamps and/or weights to ensure complete contact all the way around the instrument. *Read the hints below before you start*, and then look for glue squeezing out around the edges as a sign of good contact.

If the soundboard is warped upwards in the middle, you may need to add a clamping board across the top to press the middle down against the Tone Bar inside. (fig. 7)

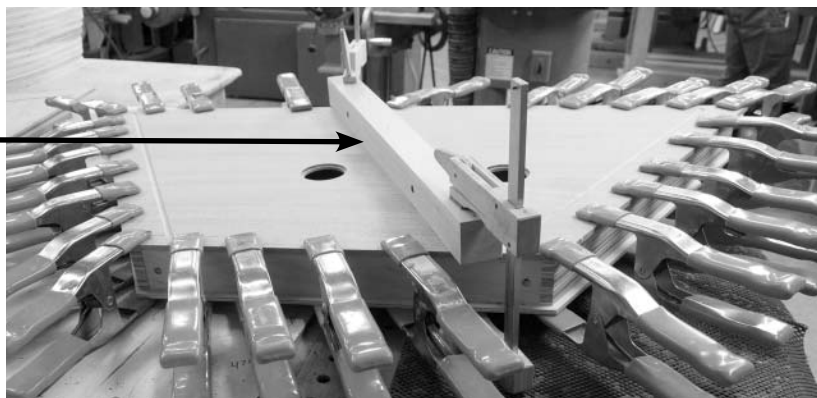


FIG. 7

Be sure to avoid clamping over the openings along the front rail. Those gaps allow the SOUNDBOARD more freedom to vibrate in the bass range, balancing the sound of the instrument. (fig 8)

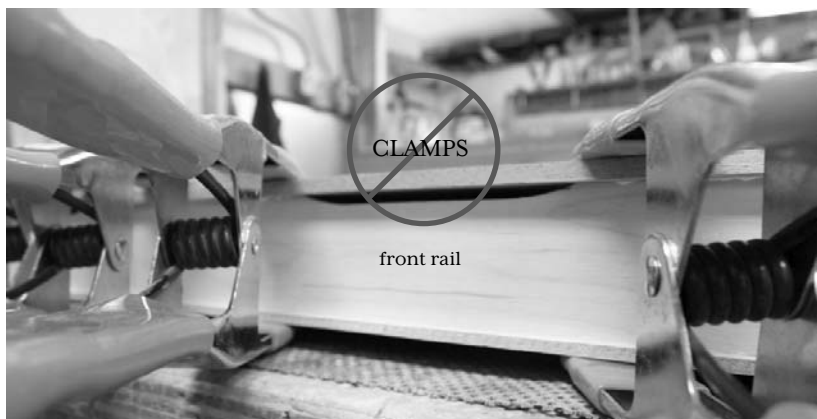


FIG. 8

Pad the jaws of your clamps with wood blocks to prevent damage to the top. (fig. 9) If you are a little short on clamps, lay long pieces of stiff wood around the perimeter of the box and fasten your clamps down against them to distribute the pressure. Or use padded spring clamps as shown in fig. 7.

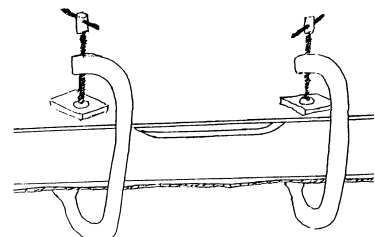
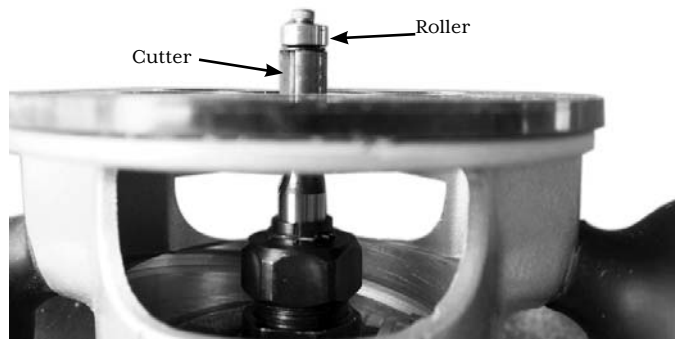


FIG. 9

## TRIMMING AND SANDING

- \_\_\_13. Once the box is dry, you need to trim away the excess wood from the **SOUNDBOARD** and the **BACK**. One easy way to accomplish this is with a belt sander. This tool will also even out the corners of the **PINBLOCKS** that may protrude slightly beyond the **RAILS**.

If you use a router for this trimming operation, use a very sharp flush-trim bit and move the router clockwise around the perimeter of the box (i.e. in the same direction as the spin of the bit). That helps prevent tear-out. Also, take care to avoid letting the roller “fall” into the open slots in the **FRONT RAIL**. (fig. 10)



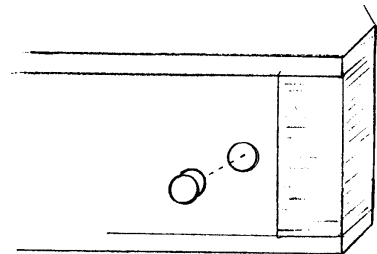
**FIG. 10**

Flush-trim router bit



Check your router base and work table for any foreign matter that might scratch up your instrument. We recommend covering your work table with an old towel or a carpet scrap for padding from now on as you sand and clean up the box.

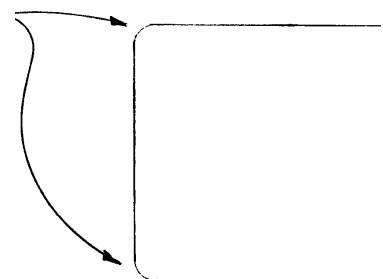
- \_\_\_14. Plug the countersunk screw holes in the front and rear **RAILS** by gluing the four walnut plugs into the holes. (fig. 11)



**FIG. 11**

- \_\_\_15. Sand the plugs flush with the surface of the **RAILS** so that you remove all ridges and all glue residue on the surface.

- \_\_\_16. Round over all sharp edges of the dulcimer box so they feel smooth to your hand. (fig. 12) A router with a 1/4” rounding over bit makes this job simple, but you can do the job by hand with a sanding block, or use a random-orbit palm sander. Follow up with medium sandpaper (by hand) to remove any scratches.



**FIG. 12**

## DRILLING FOR HARDWARE

- \_\_\_17. Now you can drill the holes for the tuning pins and hitch pins. A drill press would be helpful on this step, but not absolutely necessary. You can achieve good results with a hand electric (or cordless) drill, if you work carefully. Try your best to hold the drill straight (vertical) as you work. Wrap a piece of masking tape around the drill bit to mark the correct depth, as shown on the next page. (figs. 13 and 14)

One customer recommends making a drill guide out of a thick scrap of wood to help you hold the drill vertically for each hole.



If the punch-marks are difficult to see, blow the dust off and shine a bright light at a low angle to help locate them. Use an awl to enlarge any that are difficult to see.

#### TUNING PIN HOLES:

Drill the 66 tuning pin holes on the two outer rows of punch-marks on each side of the top (34 on one side and 32 on the other) using the 3/16" drill bit provided in this kit, boring at least 1-1/4" deep (we do not want the tuning pin to reach the bottom of the hole).

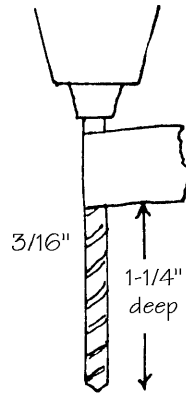


FIG. 13

#### HITCH PIN HOLES:

Drill the 33 hitch pin holes in the center row of punch-marks on each side of the top (17 on one side and 16 on the other) using a 9/64" drill bit, boring ONE INCH deep.

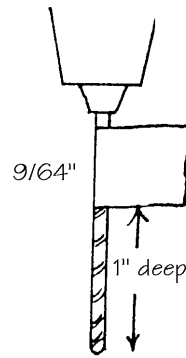


FIG. 14

### POINT OF INTEREST

Some people ask about using different HITCH PINS than the round-head screws provided with this kit. You can make that exchange if you wish, but here are the reasons we like the screws:

- a) You can drill straight (vertical) holes for the screws -- no need for tilting your drill.
- b) Some people find stringing to be particularly frustrating. The head of the screw is very handy for keeping the wire from jumping off the pin as you tighten the tuning pins.
- c) If you happen to chip the soundboard a little with your drill bit, the head of the screw helps hide your boo-boo.

If you decide you'd rather have plain HITCH PINS, then check the pin diameter before selecting the drill bit, and make sure to tilt your drill about 10-15 degrees away from the center of the instrument so the strings won't be so apt to slide off the tops of the pins.

### SANDING AND FINISHING

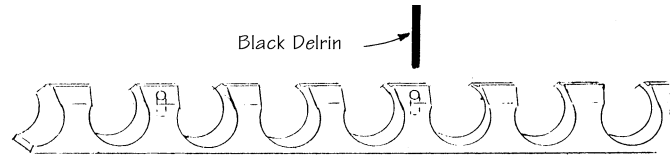
\_\_\_18. Sand the entire box to smooth out the surfaces and round over the edges so they feel good to your hand. Use medium (150-180 grit) sandpaper, working with the grain so you don't scratch the surface.

Carefully check all the joints and glue seams to remove any glue residue that might remain visible, as that will show up as ugly smudges under the finish.

\_\_\_19. Sand the maple BRIDGES to remove any burrs or rough spots.

**Side note:** The bridges in this kit have been cut by laser. This gives us perfect accuracy and it avoids the problem of splitting that often occurs when using a drill bit on such thin material. The dark area inside each hole is actually charred wood from the laser beam. We like to leave it dark, finishing it without sanding that area -- it looks very sharp on the finished instrument.

\_\_\_20. Notice that the BRIDGES have a few tiny holes drilled along the tops. These are for marking dots to help guide you in your playing. You need to fill these holes with black DELRIN (from the excess length provided in the kit). Push one end of a DELRIN rod into a hole and clip it off as close to the wood as you can with a wire cutter. Repeat this procedure for each hole, but be careful not to use too much DELRIN from one rod. You must leave the rods long enough to span the entire length of the maple BRIDGES. (fig. 15)



Sand these marking dots flush with the surface of the bridges.

\_\_\_21. If the BRASS TUBES are tarnished, use steel wool or a scouring pad to clean and brighten them up.

\_\_\_22. When satisfied with your sanding, apply the finish of your choice. Here are a few suggestions:

STAINS or DYES -- These are coloring agents and should only be used if you want to change the natural color of the wood. We usually do not apply stains to our projects, especially when they are made with naturally beautiful hardwoods such as cherry or walnut. These woods look best with a clear finish. But, if you want to color the wood, your staining should be accomplished before applying a surface finish such as oil, varnish, or lacquer.

OIL or WAX -- Be very cautious about using an oil or wax finish. If this type of finish gets into the tuning pin holes, it will act as a lubricant, and you may have trouble keeping the instrument in tune. Oil finishes will give your wood a low luster appearance, bringing out the natural color of the grain, but it tends to soak into the wood and appear dry and "thirsty" after awhile. Some people are fond of a beeswax finish for a natural look, but it can show water spots if it gets wet, so you may end up needing to re-wax or touch up the surface in the future.

POLYURETHANE VARNISH -- Any regular varnish will work fine on this project, but we think a wipe-on (gel) polyurethane is the easiest to apply because it does not drip or sag -- just wipe on a thin coat and wipe off the excess. Our complete finishing kit includes a half-pint can of satin gel polyurethane (instructions printed right on the can), plus sandpaper sheets, and foam applicator for the first coat. The advantages of this finish are its simple application, minimal odor, good durability, and deep, soft luster.

LACQUER -- Many professional instrument makers use lacquer for their finish. The most readily available lacquer is called Deft Clear Wood Finish. It is best to purchase a can of liquid to brush on as a sealer coat first, and then use an aerosol can of the same product to spray on the final coats. The advantage of this finish is its quick drying time, but the disadvantage is the strong odor of the toxic lacquer fumes.

Don't forget to apply finish to the maple BRIDGES! We also like to apply one clear coat on the BRASS TUBES to keep them shiny.

ROSETTES - Lightly sand and apply finish to the rosettes before installing them in the soundboard. When dry, the rosettes can be glued in the soundboard holes using regular woodworking glue or super glue.



## INSTALLING THE HARDWARE AND STRINGS

Once the finish is dry, you can install the hardware. We have a helpful video online that walks you through this entire process. [www.harppkit.com/1716-hammered-dulcimer-kit.html](http://www.harppkit.com/1716-hammered-dulcimer-kit.html)



**CAUTION:** Be very careful not to damage the finished surface as you install the tuning pins and hitch pins! We usually lay a long scrap of wood next to the pins as we work, so if the tool slips, it will just nick the scrap instead of the finished top.

- 23. The 33 holes in the center row of each side (17 on one side and 16 on the other) are for the HITCH PINS (round-head wood screws). Use the square-drive screwdriver bit to screw them down until the screw heads are just slightly above the wood surface. (fig. 16)

*You can leave out the lowest two hitch pins on the left side of the instrument and the lowest four on the right side of the instrument. You'll need to slip some strings on these hitch pins before you install them.*

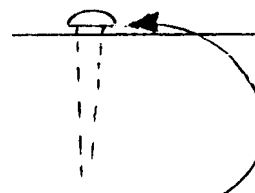


FIG. 16

- 24. The 66 holes in the two outer rows on each side of the box (34 on one side and 32 on the other) are for the TUNING PINS. Insert these pins THREADED END FIRST into the holes using a hammer to tap them until they stand about 1 inch tall. The hole in the TUNING PIN should be about 1/4" above the SOUNDBOARD. (fig. 17) Note that they are threaded, so they drive themselves deeper as you turn them to wind wire around them.

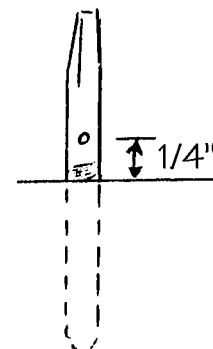


FIG. 17

- 25. Center both brass tubes in the grooves along either side of the instrument, holding them in place with a little tape until you have a few strings installed.
- 26. Cut the black DELRIN rods just a little longer than necessary to fit the length of the maple BRIDGES, and use masking tape to hold the delrin temporarily in the groove along the top of each bridge. We like to have the DELRIN extend about 1/8" beyond each end of the BRIDGES.

- 27. Stand the TREBLE BRIDGE (the longer one) on the instrument so that the upper end is about 7-3/4" from the rear left corner of the box, and the lower end is about 16" from the front left corner (fig. 18) Hold it in place temporarily with a little masking tape.

**NOTE:** The black dots are important playing aids. The TREBLE BRIDGE should be oriented so the end with the black dots are at the top (rear rail).

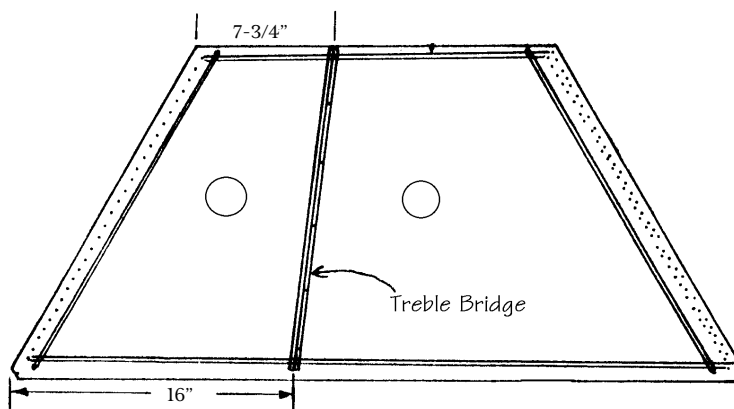


FIG. 18

Now you are ready for stringing! You may want to ask a friend to help you with this part of the project, as it goes easier with more than two hands. You also will need the tuning wrench, some masking tape, and a wire cutter for these next few steps.

## STRINGING - TREBLE BRIDGE

You will begin by installing all the strings that cross the Treble Bridge first. Forget about the Bass Bridge for now -- we don't want to get you confused.

- \_\_\_28. Find four of the loop-end wound strings (size .024"). These will form the first two "courses" (pairs) of strings near the bottom (wide) front rail of the dulcimer. (fig. 19) Insert a HITCH PIN through two of those string loops and use the Square Drive Bit provided to install the HITCH PIN into the wood, leaving a little space under the head of the screw so the wires can be pulled into alignment. (If you forgot to leave the bottom two hitch pins out - don't worry. Just remove those pins, add the strings, and re-install.)

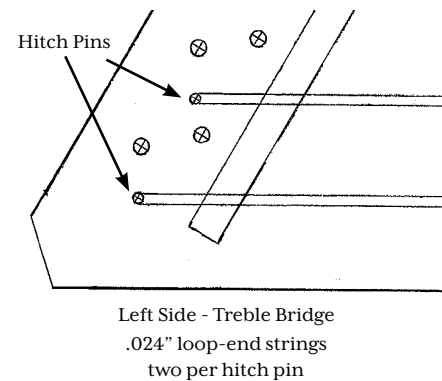


FIG. 19

- \_\_\_29. Trim one of the bottom loop-end strings about 2-3 inches longer than necessary to reach the first tuning pin on the right side of the instrument. (fig. 20)

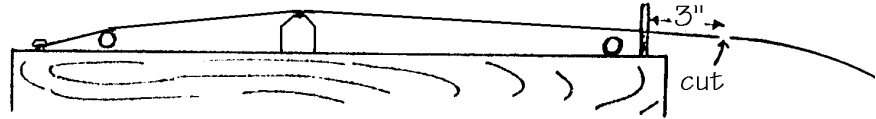


FIG. 20

- A) Poke the end of the wire into, but not all the way through, the small hole in the first tuning pin at the lower right corner of the dulcimer on the inside row. (fig. 21)
- B) Use the tuning wrench to turn the pin **CLOCKWISE** about one-half turn before putting tension on the wire.

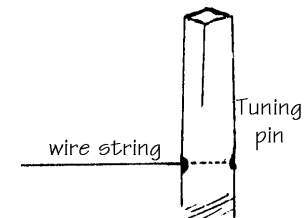


FIG. 21

- C) Pull on the wire to "set" it in the pin. (fig. 22) This puts a kink in the wire at the point where it enters the tiny hole in the tuning pin. If the wire pulls out of the pin when you pull on it, cut off the kinked end and try again.

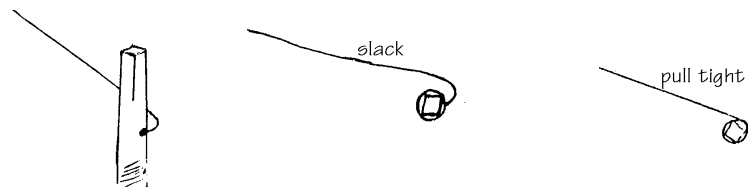


FIG. 22

This may seem like a silly exercise, especially if the wire keeps coming out of its place when you pull. We install strings this way because the sharp ends are left hidden in the tuning pins where they can't poke fingers or catch on clothing. It really does work, and it is worth learning the technique.



FIG. 23

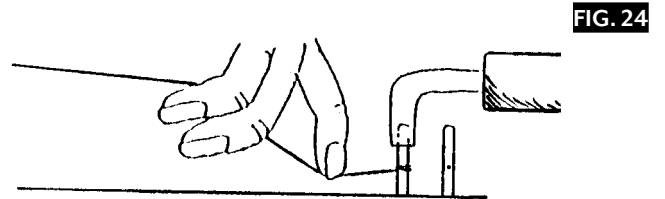
- D) Keeping tension on the wire at all times, turn the pin about two complete revolutions with the tuning wrench, guiding the wire **DOWNWARD** as it winds around the pin, just enough to take up the slack and pull the wire slightly taut -- **BE CAREFUL** -- if you tighten too much the wire will break! Consult fig. 23 at right to check your work.

Install the second string of that pair to the next tuning pin, to the right of the first tuning pin. Then go to the next pair and install them in the same way. Then you will switch to plain music wire.

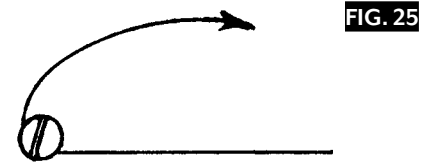
- \_\_\_30. To hold the upper end of the treble bridge firmly in place, we recommend attaching the highest course (pair) of strings at the rear of the instrument. FIND THE COIL OF WIRE MARKED .016” FOR THIS COURSE.

Installing the bulk wire is more complicated because you don't have a loop at the end. The first four steps are the same as what you just did:

- A) Poke the end of the wire into, but not all the way through, the small hole in the tuning pin at the top right corner of the dulcimer (on the inside row).

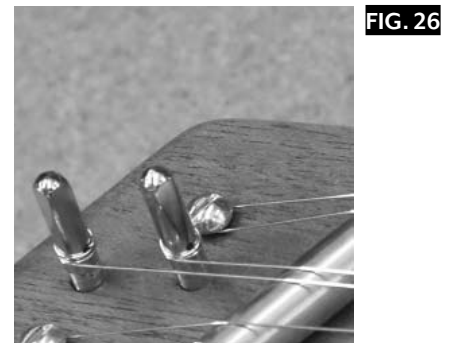


- B) Use the tuning wrench to turn the pin CLOCKWISE about one-half turn before putting tension on the wire.



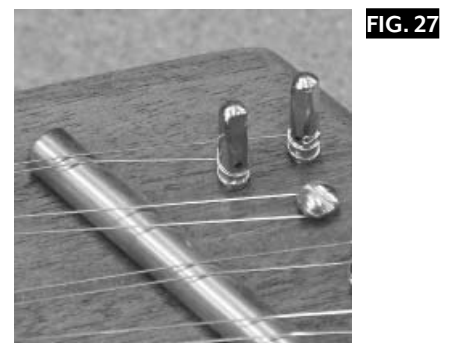
- C) Pull on the wire to “set” it in the pin. This puts a kink in the wire at the point where it enters the tiny hole in the tuning pin. If the wire pulls out of the pin when you pull on it, cut off the kinked end and try again.

- D) Keeping tension on the wire at all times, turn the pin about two complete revolutions with the tuning wrench, guiding the wire DOWNWARD as it winds around the pin. (fig. 24)



- E) Maintain tension on the wire as you stretch it across the dulcimer (over the treble bridge) to the upper left corner and wind it clockwise around the top wood screw (hitch pin). (figs 25 and 26) Just a single pass around the screw is fine, although it won't hurt anything if you want to wind a complete 360 degree circle around the pin. The final tension will be equal on each pair of strings, so you don't need to worry about slippage.

- F) Pull the wire back across (over the treble bridge) to the right corner again and cut it off from the coil so that you have about 2 or 3 inches excess wire to wind onto the tuning pin at the top (in the outer row).



Double-check your work against the photos at right for the top treble pair of strings. (figs. 26 and 27)



It is important to have these strings make firm contact with the brass tubes on both sides of the box. That is why the windings must go down toward the surface of the instrument.

**IMPORTANT NOTE:** The rest of the strings that cross the treble bridge will be attached to THE TUNING PINS on the right and THE HITCH PINS on the left. The pins on the opposite sides will be used for the strings that cross the bass bridge. We will get to those later.

\_\_\_31. Continue stringing the wires across the TREBLE BRIDGE, bringing them up to a reasonable tension, but not trying to actually tune them yet. Be sure to change sizes of wire according to the chart at right.

### STRING SIZE CHART TREBLE BRIDGE

|                |                  |            |
|----------------|------------------|------------|
| .024" loop-end | Front 2 courses  | (longest)  |
| .022" wire     | Next 5 courses   |            |
| .020" wire     | Middle 4 courses |            |
| .018" wire     | Next 4 courses   |            |
| .016" wire     | Rear 2 courses   | (shortest) |

There a total of 17 pairs of strings on the TREBLE BRIDGE, one over each "foot".

### STRINGING - BASS BRIDGE

\_\_\_32. When all the wires are installed over the TREBLE BRIDGE, turn the instrument around so the rear rail faces you. This makes it easier to string the BASS BRIDGE in the same right-handed fashion.

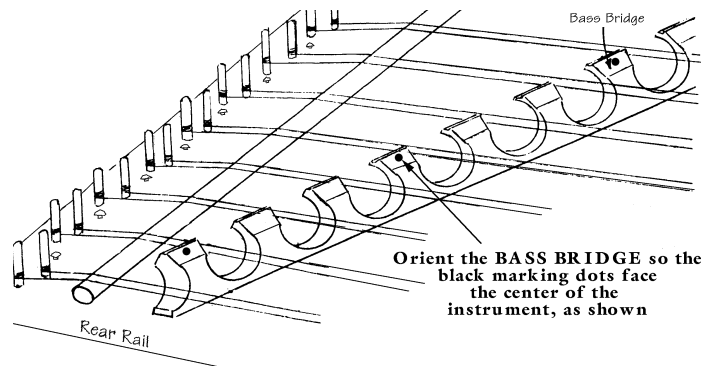


FIG. 28

Slide the BASS BRIDGE under the treble strings by tipping it on its side and then standing it up so the "feet" stick up between the treble strings. (fig. 28)

HINT: You'll want the black dots to face inward on the instrument -- they will be easier to see as you play. (fig. 28)

Place the BASS BRIDGE about 4" from the right corner of the box at the rear, and 11-1/2" from the right corner at the front. (fig. 29)

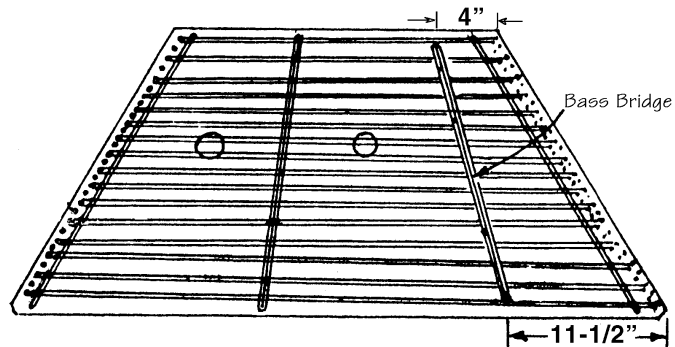


FIG. 29

The BASS BRIDGE can be shifted around somewhat to fit the spacing of the treble strings. Unlike the TREBLE BRIDGE, it doesn't matter if you angle it a little differently than shown, because you will only play the strings on one side of this bridge.

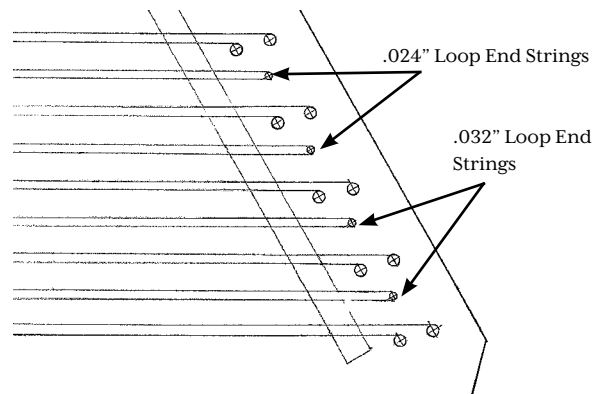


FIG. 30

\_\_\_33. Install the bass string wires in virtually the same manner as you did the treble strings, WITH ONE IMPORTANT EXCEPTION: the bass strings must go OVER THE BASS BRIDGE, and UNDER THE TREBLE BRIDGE! Just an interesting twist to complicate matters a little for you...

Begin stringing with the loop-end wound strings at the bass end, placing them as shown at left.

After those four pairs are installed, you'll switch to bulk music wire according to the string chart on the next page.

\_\_\_34. String all 16 bass courses in the same manner you did the treble ones, changing wire sizes according to the chart at left.

**STRING SIZE CHART  
BASS BRIDGE**

|                |                  |            |
|----------------|------------------|------------|
| .032" loop-end | Front 2 courses  | (longest)  |
| .024" loop-end | Next 2 courses   |            |
| .022" wire     | Next 2 courses   |            |
| .020" wire     | Middle 4 courses |            |
| .018" wire     | Next 4 courses   |            |
| .016" wire     | Rear 2 courses   | (shortest) |

There a total of 16 pairs of strings on the BASS BRIDGE, one over each "foot".

HINT: The loop end strings are fairly straight-forward to install but the bulk wire presents a bit of a challenge. We find the easiest way to put the bulk wire strings under the TREBLE BRIDGE is to put a bend in the wire about 2-3 feet from the end, then push that bend under the treble bridge and hook it around the hitch pin. After that the two ends can be cut to proper length and attached to the tuning pins.

## TUNING

\_\_\_35. Before you can successfully tune this instrument, you must make sure the TREBLE BRIDGE is in just the right position. It must divide the vibrating portion of its strings into a perfect ratio of 2:3 in order to play a proper scale, because you will play some notes on the right side and some on the left, and the length of the strings helps determine their pitch.

You can slide the TREBLE BRIDGE sideways one way or the other to achieve this proper placement. You may make careful measurements and calculations to verify its location, or you may verify it "by ear", which is perhaps the better approach, since your ear is what will complain if the thing is out of tune!

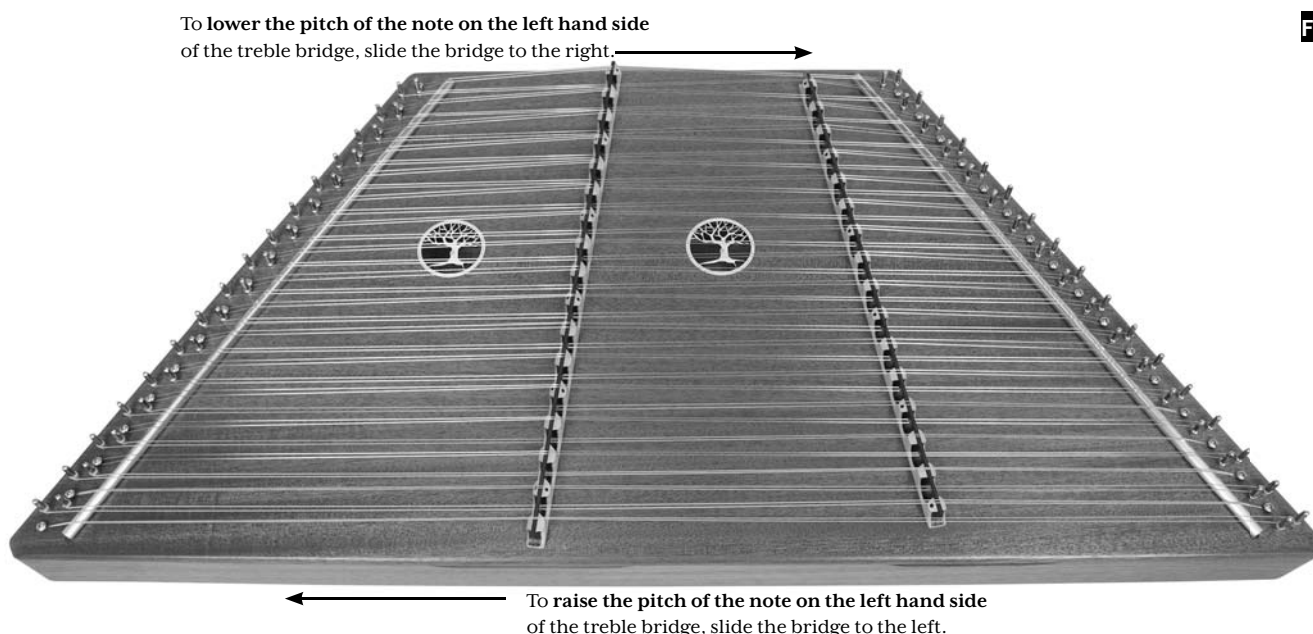
Here's how to go about it:

- A) Pluck the lowest string (at the front of the instrument), on the right side of the TREBLE BRIDGE. If the string is so loose that it just "twangs", then tighten it up until you get a clear sound.
- B) Pluck THAT SAME STRING on the left side of the bridge to see if that note is a musical fifth interval above the first note. "So, what is a musical fifth interval?", you ask.

The FIFTH INTERVAL is the span between "do" and "sol" on the scale. If you pluck the string on the right side of the TREBLE BRIDGE and consider that note as "do", then you can sing "do, re, mi, fa, sol" and check to see if the note on the left side of the bridge (same string) matches the note "sol". Or, a quicker way to sing the fifth interval is to hum the song "Twinkle, Twinkle, Little Star". The span between the first "Twinkle" and the second "Twinkle" is a fifth interval. Of course, if you can't sing in tune, then you'll need some help.

The most accurate method of tuning is to use an electronic "tuner" device that listens to the string as you pluck it, tells you what note it hears, and how accurately that note is tuned. Musicmaker's offers such devices in our catalog, and they make tuning any instrument a much more pleasant (and accurate) experience.

- C) Now, if the note on the left of the bridge is HIGHER than it should be (more than a fifth interval above the right side), then you must LENGTHEN the amount of wire on that left side of the bridge to lower the pitch. Do that by sliding the bridge to the right, just a little (you may need to use a scrap wood stick and a hammer to tap against the bottom of the bridge). Then test the interval again. (fig. 31)
- D) If the note on the left side of the bridge is LOWER than it should be (less than a fifth interval above the right side), then you must SHORTEN the length of wire vibrating on the left side of the bridge to raise the pitch. Do that by sliding the bridge to the left, just a little. Then test the interval again. (fig. 31)
- E) Once you are satisfied with the interval on the longest string at the front of the dulcimer, test it also on the shortest string toward the rear of the dulcimer. Use the same technique for adjusting until you hear a perfect fifth.
- F) Now that the front and rear of the TREBLE BRIDGE are correctly placed, you need only make sure that the rest of the bridge is lined up in a straight line between the ends. That should ensure that all the strings give a fifth interval from the right side to the left.



**FIG. 31**

If, after completing this exercise, you happen to find a string that does not sound a fifth interval across the TREBLE BRIDGE, then something else is amiss. Chances are, the string is not making firm contact with the BRASS TUBE along the right-hand side. To correct this problem, you must unwind the string part way and then re-wind it so that the windings go DOWNWARD toward the wood, so the wire makes firm contact with the brass tube. (This is only important for strings that cross the TREBLE BRIDGE. No need to worry about those that cross the BASS BRIDGE.)



- \_\_\_36. WHEW! Now you can actually begin tuning! Start with just the BASS BRIDGE strings first, beginning at the lowest strings near the front of the dulcimer. You may want to cut out the TUNING CHART provided in the kit and slide it under the strings for ease in determining what note to tune the strings to. These strings will be tuned by turning the pins on the left side of the instrument.

## TUNING CHART

**All pairs are tuned in unison.**

The lowest pair of strings crossing the bass bridge will be tuned to the D below middle C (the middle line on the bass clef). The next pair crossing the bass bridge will be tuned to E below middle C and the next to F# below middle C, etc., as shown on the TUNING CHART.

Some builders have tuned their instrument an octave lower than shown here, just to be cautious, but that makes the instrument sound dull. It pays to start off on the correct pitch!

| Treble Bridge          | Bass Bridge      |
|------------------------|------------------|
| <b>F6</b> • <b>Bb5</b> |                  |
| E6 • A5                | <b>Eb5</b>       |
| D6 • G5                | D5               |
| <b>C6</b> • <b>F5</b>  | C5               |
| B5 • E5                | <b>Bb4</b>       |
| A5 • D5                | A4               |
| <b>G5</b> • <b>C5</b>  | G4               |
| F#5 • B4               | <b>F4</b>        |
| E5 • A4                | E4               |
| <b>D5</b> • <b>G4</b>  | D4               |
| C#5 • F#4              | <b>Middle C4</b> |
| B4 • E4                | B3               |
| <b>A4</b> • <b>D4</b>  | A3               |
| G#4 • Middle C#4       | <b>G3</b>        |
| F#4 • B3               | F#3              |
| <b>E4</b> • <b>A3</b>  | E3               |
| D#4 • G#3              | <b>D3</b>        |

Bold letters denote marked courses (black dots) for illustrating the boundaries of diatonic scales.



We have added a number next to each note on the tuning chart to indicate the correct octave. Middle C is C4, and all the notes below Middle C are marked with the number 3. The scale above Middle C is all marked #4 until you get to C above Middle C, which starts the next octave #5.

\_\_\_37. Because the TREBLE BRIDGE is placed to give you a fifth interval from the right side to the left, you need only tune one side of that bridge -- the other side will automatically come into correct pitch. These strings will be tuned by turning the pins on the right side of the instrument.

Tune the longest pair of wires at the front of the instrument to a G# below middle C on the right side of the TREBLE BRIDGE. Double-check to verify that the same wires sound at the D# (Eb) on the left side of the bridge. If the left side is flat, slide the bridge to the left a little and try again. If the left side is sharp, slide the bridge to the right. Once the bridge is correctly placed, you should never have to move it again.

Tune the next pair to A below middle C (on the right side) and the next to B below middle C, etc., as indicated on the TUNING CHART, working your way up the TREBLE BRIDGE. Double-check the notes on the left side occasionally to be sure the bridge does not angle off course.

Now, don't expect the instrument to be playable yet.... By the time you finish tuning the highest string on the TREBLE BRIDGE, the bass strings will have already gone out of tune. Don't give up! This won't happen every time. Two things are occurring that contribute to the problem on a new instrument: 1) the wire is actually stretching a little, and 2) the box is flexing slightly under the tension of all those strings.

We usually tune a new instrument twice and then give it a little time to adjust (say, overnight) before tuning again. It should hold pretty well after the third tuning.

**CONGRATULATIONS! YOU REALLY DID IT.** We hope you enjoy learning to play your hammered dulcimer. With proper care, it should give you many years of musical pleasure.

## CARE AND FEEDING

**STRINGS:** You should not need to replace the strings of your instrument unless they break or become rusty. To prevent rusting, simply wipe the strings occasionally with a rag dipped in household oil.

**TUNING PINS:** Tuning pins can also rust if they are exposed to excessive moisture or salty ocean breezes. If you live in a humid climate or near the ocean, treat the tuning pins to an occasional oil rub-down too.

We occasionally hear from a customer with loose tuning pins. This can happen if the holes are drilled with a dull (or oversize) bit, or if the drilling was not straight and clean. Musicmakers stocks liquid “Pin-Tite” for swelling the wood fibers, and if that is not sufficient, we keep a few oversize tuning pins for that situation. Check our catalog (hardware page) or web site for details.

**CLEANING WOOD SURFACES:** The main challenge will be to clean the dust from under the strings. Not that a little dust hurts anything, but when you decide enough is enough, you can try to push a rag through the narrow spaces with a small dowel or thin stick. Better yet, we like using a bristle brush along with a furniture polish such as Endust. Our “Dandy Duster” brush has long bristles that reach into tiny spaces that can’t be reached with a rag.

