SPURLOCK SPECIALTY TOOLS
web site: www.spurlocktools.com
707-452-8564

# Grand Hammers . . . . . boring, tail shaping and installation



The hammer has a greater affect upon the tone and touch of a piano than any other part that we routinely replace. Today we are fortunate to have many quality replacement hammers available, allowing us to remain true to the original design concept of quality older instruments as well as fitting appropriate replacements on newer pianos.

Many technicians find it easiest to purchase hammers ready to install, while others prefer to do their own boring and/or tail shaping. These instructions will present information on hammer selection, boring, tail shaping and installation that apply in either case.

## Reasons you might do boring and shaping yourself

▸ **Custom fit:** You can bore, taper, arc tails and adjust hammer weight as desired for the best result in each particular job.
▸ **Availability:** You can keep unbored sets of hammers on hand for best selection and rush jobs.
▸ **Educational:** There is much to learn from figuring hammer dimensions yourself and then evaluating the end results.

## Selecting hammers

▸ **Tone:** You must be able to voice the hammers to a tone that will bring the piano to its potential and satisfy the owner. And, the hammers should maintain their tone for a reasonable period between servicing. One factor here is your own preference for voicing soft hammers up versus bringing harder hammers down. Hammers at either extreme are generally less practical, requiring more work and being less stable.
▸ **Number of bass/treble:** Many replacement sets come with at least 30 bass and 65 treble hammers, so they accommodate almost any scale.
▸ **Length:** the overall hammer length must allow for adequate tail length for proper checking.
▸ **Width:** Replacements should generally match the width of the original hammers. Wider hammers may cause clearance problems in the tenor and bass, and extra width adds weight.
▸ **Size:** Large treble hammers may cause clearance problems in the treble of some pianos where the belly rail is close to the capo bar. If there are agraffes in the top section, big hammers cannot be located for the best strike point without hitting the plate. Occasionally very fat bass hammers will interfere with damper wires.
▸ **Weight:** Touchweight and action inertia are strongly affected by hammer weight, so replacements should usually be similar in weight to the originals. Hammer weight is the result of felt density, hammer size, width, type of molding wood, and molding shape. Where weight is a consideration, use soft maple, walnut, or mahogany moldings over birch or hornbeam.

## Choosing boring dimensions

Whether you bore your own hammers or order them pre-bored, you need to determine the correct measurements. Here are some guidelines:
▸ **Bore distance:** Usually equal to the distance from the hammer shank centerpin to the string. This is measured indirectly by subtracting centerpin-to-keybed distance from string-to-keybed distance. This measurement will result in the hammer shank being parallel to the keybed at strike position. However, it is wise to estimate the bore distance of the original hammers (taking wear into account)—if it is different from your calculated measurement you should bore a sample hammer and test regulate one note. Some actions work better with the shanks slightly over or under-centering (i.e. above or below horizontal) at hammer/string contact; for example, sometimes boring at the "theoretical" bore distance will require let-off or drop screws to be at one extreme of their adjustment. On quality pianos it is often safer to copy the original bore dimensions unless you see a good reason to change. In all cases you should test regulate a sample note using your new shank, wippen, hammer, etc and confirm that touchweight, friction, and regulation are acceptable.

▸ **Rake:** If the shanks are to be level (parallel to the keybed) at strike position, then a 90° rake will cause the

hammer to be 90° to the string at strike position, assuming the strings are parallel to the keybed. If the shanks will over or under-center, then you might vary the rake to maintain a 90° hammer-to-string orientation.

▸ **Bore angle:** Theoretically the bore angle should match the string angle. However, with wide hammers and/or very angled strings the bore angle will have to be reduced to prevent rubbing hammers. Copy the original bore angle if you are using the same width hammers, or reduce if there was a clearance problem. The tenor bore angle can be graduated every 2-3 hammers as the strings straighten out, rather than changing abruptly at wider intervals.

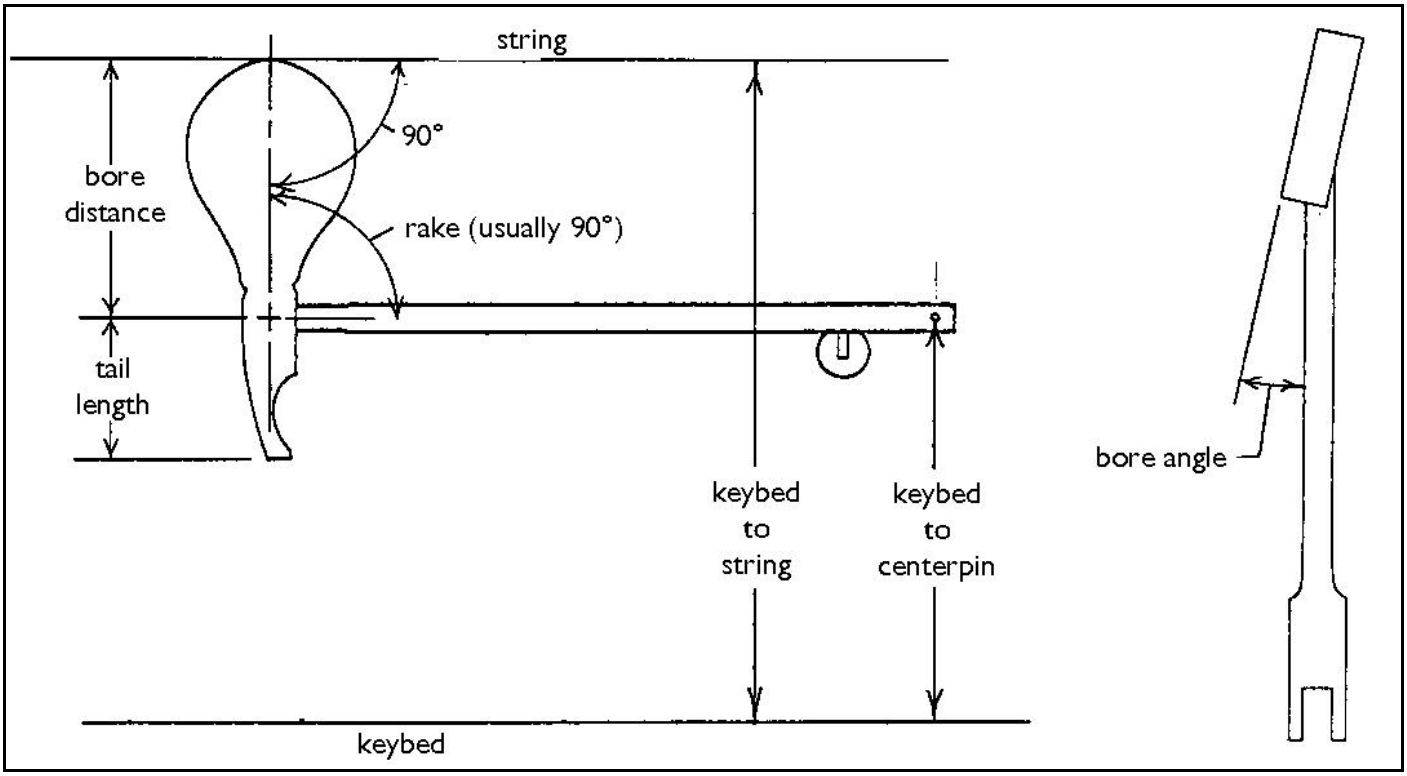


***Figure 1**: Hammer boring dimensions*

▸ **Tail length:** Make sure replacement hammers are long enough to provide adequate tail length for good checking, as shown in Figure 2. Sometimes backchecks can be raised to improve checking when tails are short, but not if this causes large bass & tenor hammers to bump into the backchecks at rest. Tails can usually be 1/8" to 1/4" longer than original without any problem—in fact extra length will often improve checking and repetition. As a general rule 1" is usually a minimum workable tail length.

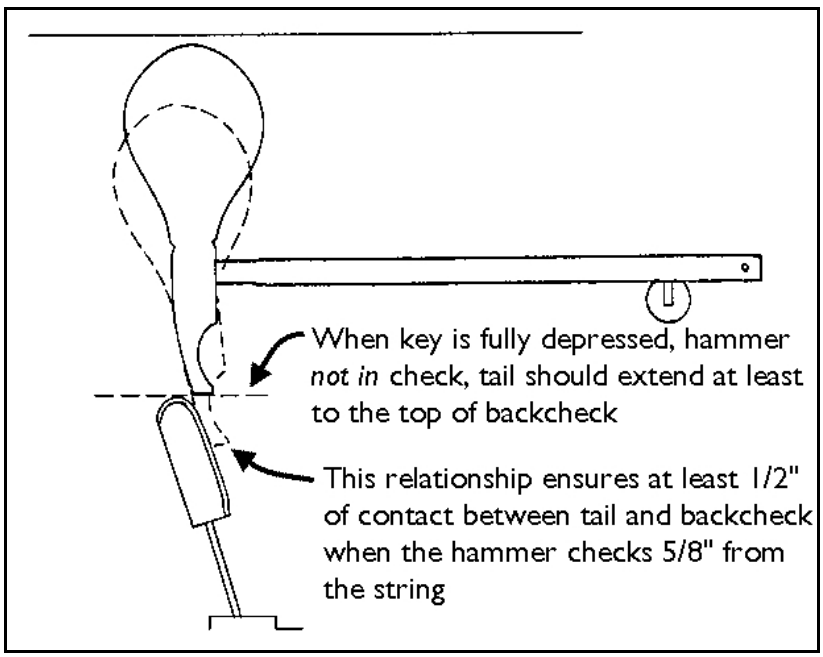


***Figure 2:** Proper tail length*

## Preparing Hammers For Installation

**1. Numbering:** Upon opening the package, select all excess hammers from the set and push them slightly out of line with the remaining 88. Then, number the 88 to be used, marking the discards with an adjacent number and an "X" (if they are not factory numbered). This way, you will know what number the extras are and can use them as replacements in case you damage one from the set. They can also serve as tone samples to test on future jobs.

**2. Pre-filing/needling:** If you are familiar with the replacement hammers and know they will need a certain amount of needling or filing, it is usually simpler (and easier on action centers) to do your basic rough voicing and shaping before installing the hammers. The fixture at right allows you to clamp one section at a time in a vise; they can be needled and filed easily and quickly as though they were one long hammer. Before removing them from the fixture, blow or vacuum off the dust and smooth with a warm iron. This will create sharp square edges on the shoulders that will make alignment more accurate during installation.

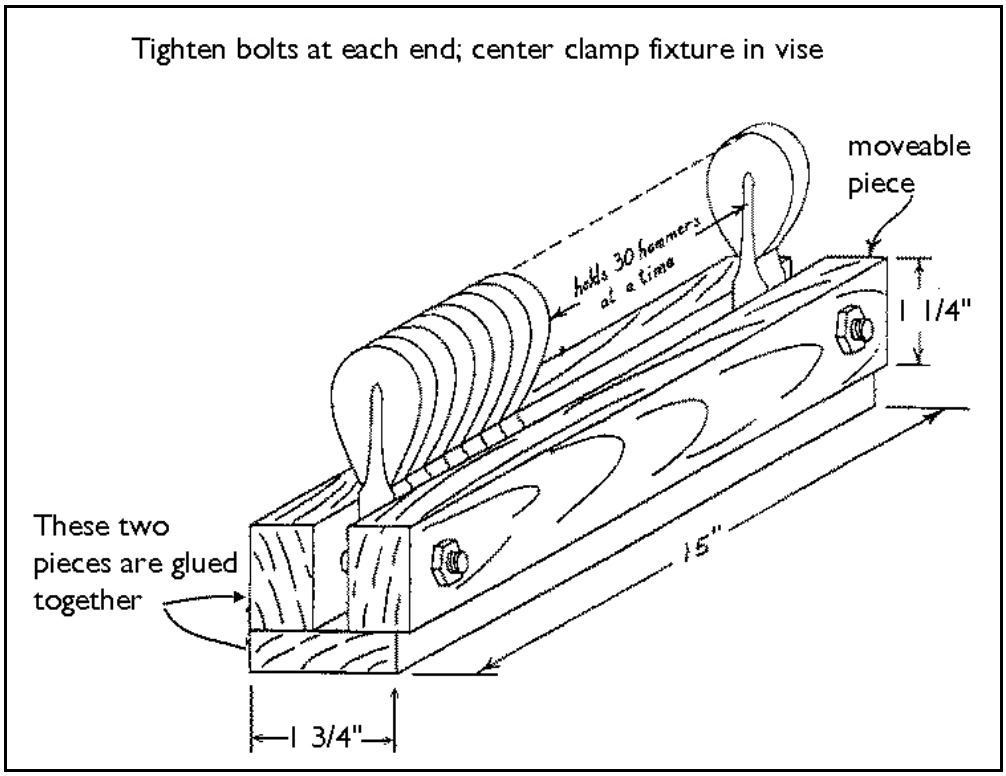


***Figure 3:*** *Hammer pre-filing & voicing fixture*

**3. Boring:** I favor the Renner USA boring jig for its accuracy and ease of use. Choose a drill size that will give a good fit to the shanks with minimal reaming. Use a high quality brad point drill running at high rpm to minimize wandering.

**4. Cove inside of tails:** If you need to remove as much weight as possible to match light-weight original hammers, you might gain a slight benefit by removing excess wood from the coved area inside of the tails, as in Figure 4. Most brands of replacement hammers already have a generous coving here so this method is most useful when preparing completely unshaped moldings.

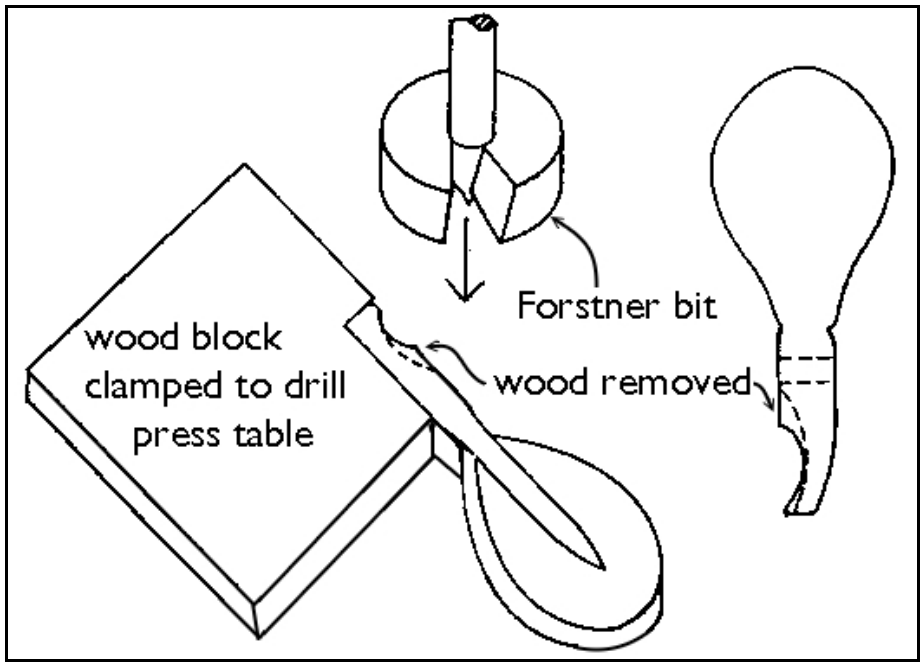


*Figure 4: Removing weight from inside the tails using a Forstner bit in a drill press*

**5. Taper sides:** Tapering has traditionally been done with a sander, which tends to taper unevenly and stain the hammer felt with wood dust and underfelt dye, especially if you are tapering the entire length of the hammer. Our tapering jig (www.spurlocktools.com/id35.htm)

uses your table saw instead, and does very precise tapering with no discoloration of the felt. With this tool it is very easy to taper the entire length of the hammer for maximum weight removal and passing clearance. Typically, if a hammer initially measures 11mm, and you want the end of the tail to be 8mm, you would adjust the jig so the cut tapers from zero at the hammer crown to 1.5mm deep at the tail. For absolute maximum weight removal, you can reduce width at the crown to 10mm by adjusting the front of the hammer closer to the blade and tapering the cut from .5mm deep at the crown to 1.5mm deep at the tail, on each side of the hammer.

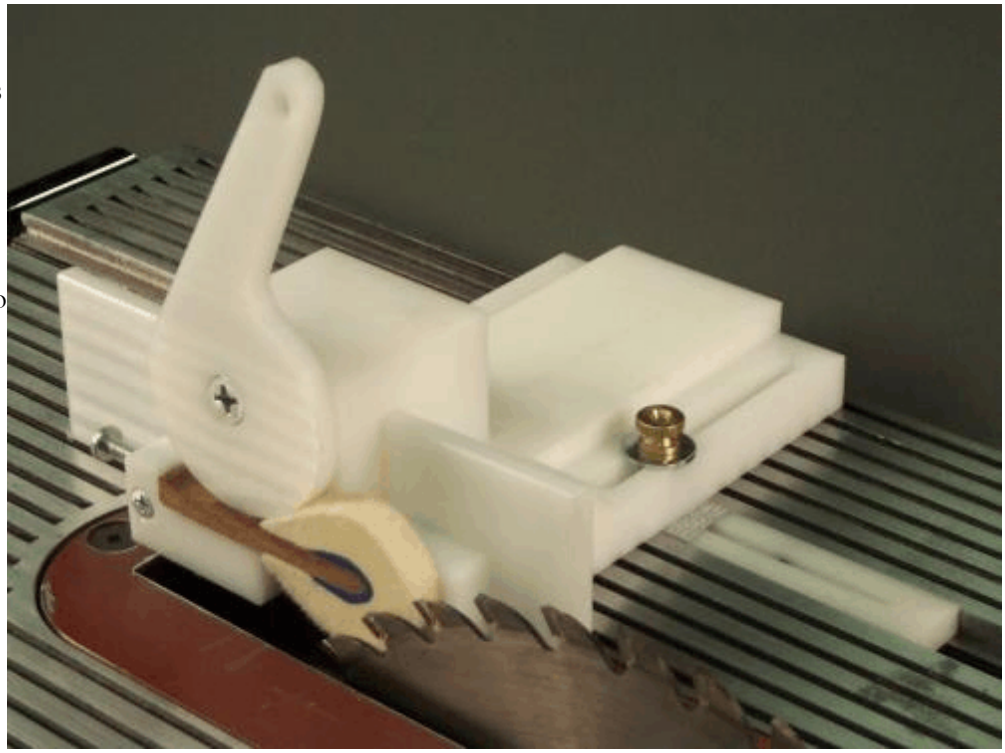

***Figure 5**: The Spurlock Specialty Tools hammer tapering jig*

Tapering must be done *before* arcing the tails. Complete instructions are supplied with the tapering jig, available as a free download at www.spurlocktools.com/id35.htm

**6. Arc tails:** Use either a disc sander or stationary belt sander, with new sandpaper and a slow speed (if variable). Our arcing jig (www.spurlocktools.com/id34.htm) shown in Figure 6 gives a consistent arc on each tail, and features an adjustable radius of arc. Coarse (60 grit) sandpaper will texture the tails at the same time.

Arcing the tails in this way, with a smooth 2½" to 3" radius (rather than a sharply curved or humped tail) gives more passing clearance as the hammers rise and thus allows closer checking. It also improves checking on a light blow by maximizing hammer-to-backcheck contact area. See our arcing jig instructions, available as a free download at www.spurlocktools.com/id34.htm for a complete discussion of tail shape and checking.

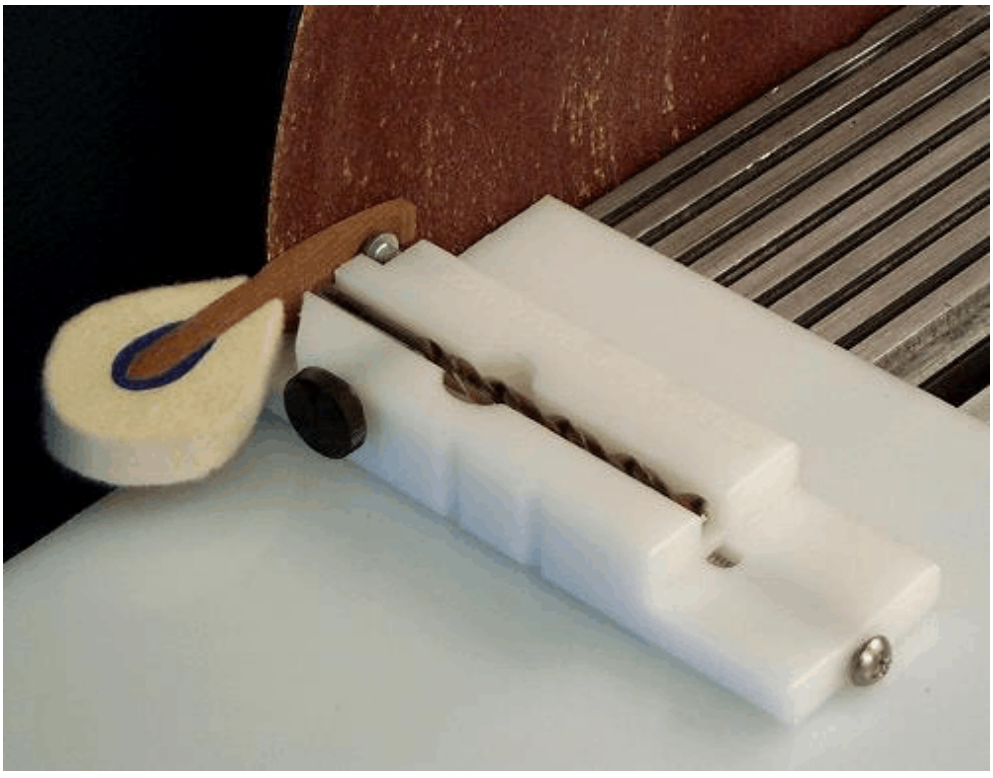

*Figure 6: The Spurlock Specialty Tools hammer tail arcing jig*

The drawing at right shows a simple alternative method of tapering when you need to taper the lower tails only. This method uses a disc or belt sander and a simple stick fence clamped at an angle to the sanding surface.

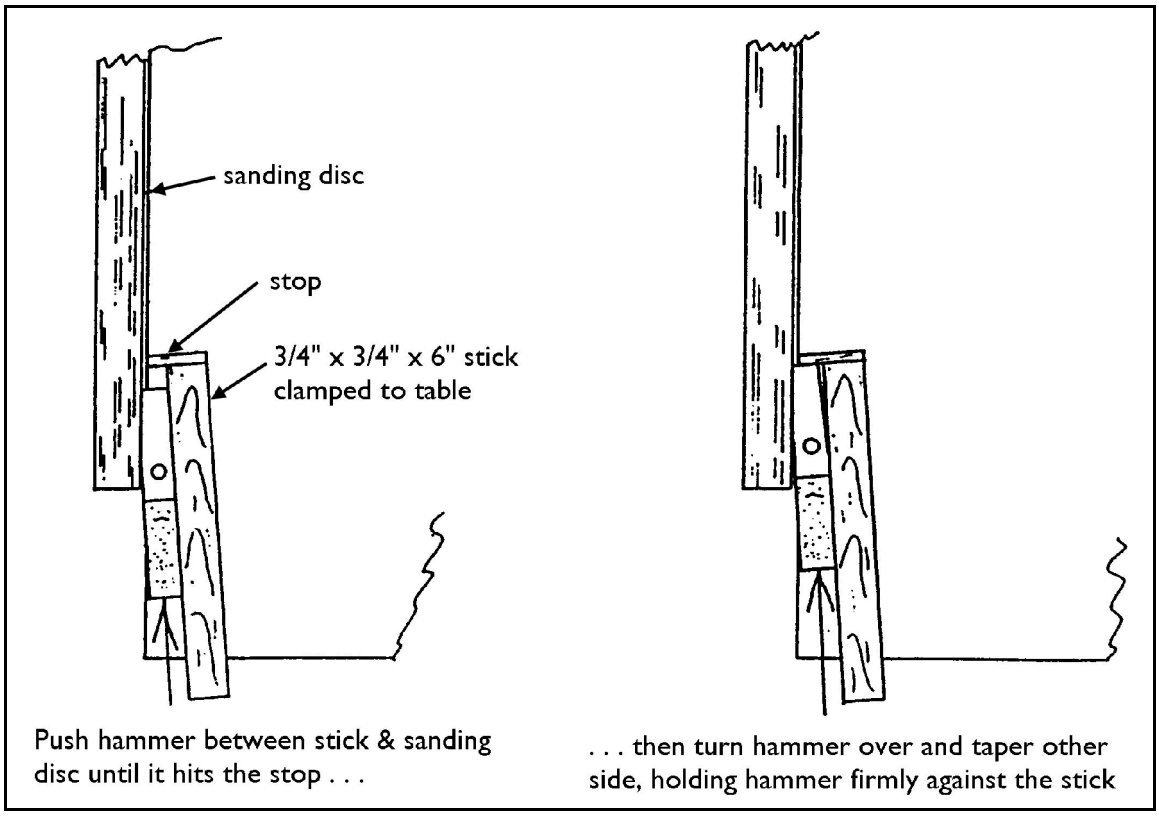


*Figure 7: Jig for tapering lower tails only*

▸ To further reduce hammer weight, you can remove the T-pins or staples from the hammers. Additional weight can then be removed by sanding felt from the low shoulder area using a small drum sander in the drill press. The affects of various operations on hammer weight and touchweight are shown below:

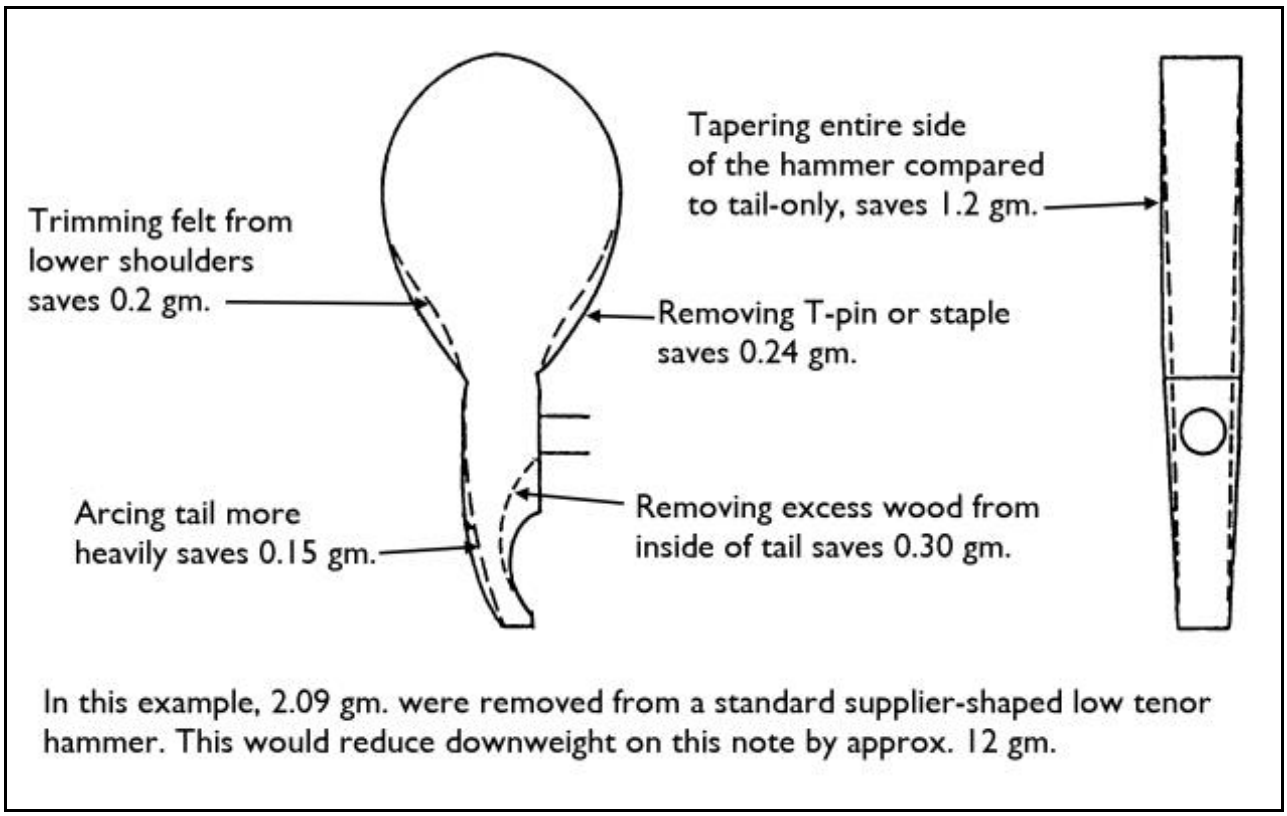


***Figure 8**: The effect of various shaping operations on touchweight from further shaping of a supplier's hammer*

## Preparing The Shanks

**1. Sort by action center tightness:** Test a few shanks for centerpin tightness using the swing test with a bass, tenor or high treble hammer dry fit onto the shank. I like to have 5 to 6 swings in the bass tapering to 4 swings in the high treble. Sort the shanks into bass, tenor and treble piles accordingly. For instance, a shank that swings 3 times with a treble hammer would probably swing 5 times with a bass hammer, so it would go in the bass pile. Shanks that are too loose or tight go into a pile to be repinned. By sorting this way you minimize the number you will have to repin. Note: Some sets will come with thinned treble shanks, so they will automatically go in the treble.

**2. Thinning treble shanks:** Thinned treble shanks can improve tone by reducing the woody collision sound of hammer impact. If your set does not have thinned treble shanks, you can machine them yourself with a table-mounted router and the home made jig in Figure 9.

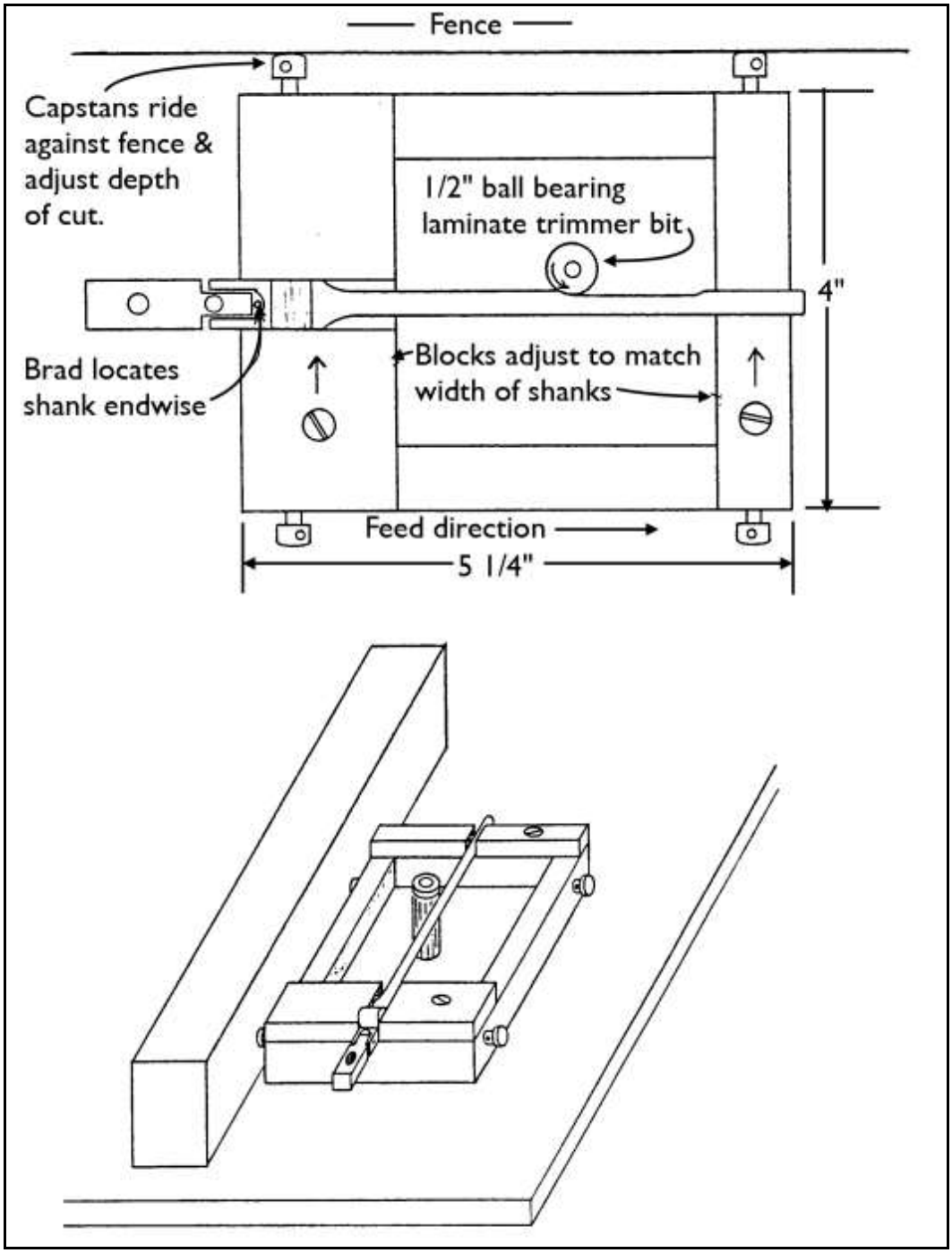


*Figure 9: Router table jig for thinning treble shanks*

## Installing the New Hammers

This may be done using hand-held straight edges to align each new hammer as it is placed, or with a hammer hanging jig. The following instructions apply to either method.

**1. Install the new treble guide hammers:** I normally install new hammers at the ends of each section to serve as guides in hanging the rest. The first and most important guide hammers to be installed are in the high treble. Since the striking point in the top section is critical to tone you should make sure to position your new treble hammers at the correct place on their shanks such that best tone is obtained when the action is positioned for proper clearance between white keys and keyslip, and between the rear of the sharps and the fallboard. Testing worn original hammers for proper strike point, to see if they are correctly positioned, can be deceiving as explained below:

Because of over centering, a worn hammer will strike the strings closer to the capo bar than it did when new, as shown at right. (A hammer worn 1/8" shorter strikes the strings almost 1/16" closer to the capo bar than it did when new). Therefore your strike point test with an original, worn hammer #88 may show that the action needs to be pushed *in*, leaving too much gap between keys and keyslip, and you might think that the original was hung too close in on the shank (too close to the centerpin). Realize however that a new, longer hammer hung in the same position as the original #88 will strike the strings further from the capo bar and the action will have to be pulled back out again when positioned for best tone.

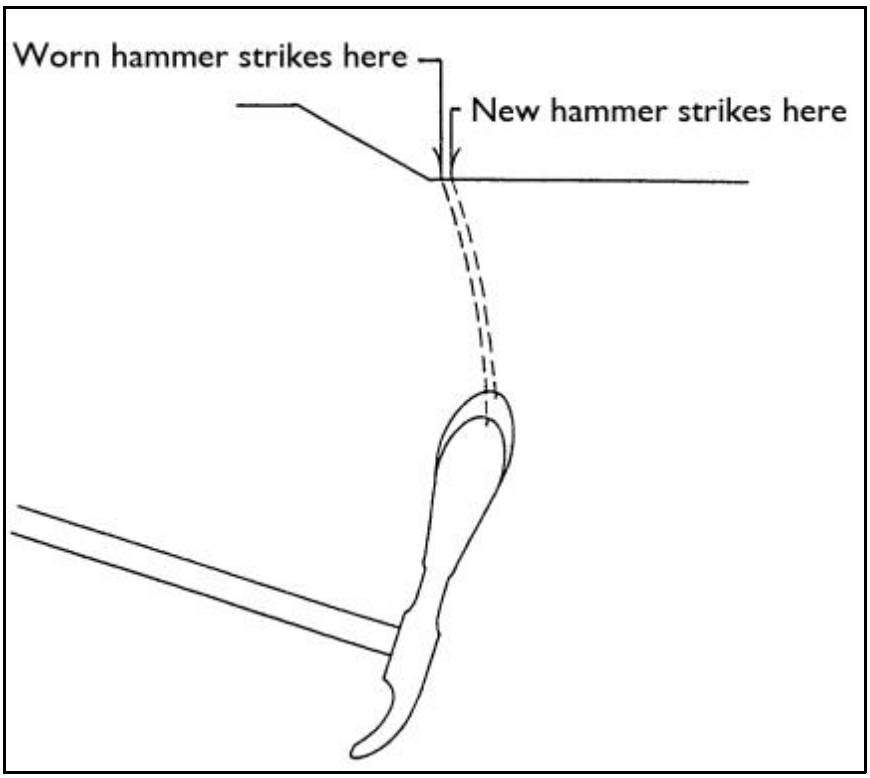


***Figure 10**: How strike point varies as hammers wear shorter*

The easiest and surest way to locate your treble samples is just to mount a new sample hammer & shank at each end of the top treble section and establish the best location before removing the action to the shop. Mount the hammers with a tight dry fit—do not glue. Then adjust them in or out on their shanks until you have the best tone when the action is in the position that best fits the case. When correct, glue them in place. You can then install the remaining guide hammers away from the piano, confident that the treble will be correct.

**2. Install remaining guide hammers:** I mount the remaining guides in a straight line from the lower treble guide down to hammer #1 as follows:

· Confirm that original hammer #1 is in line with its neighbors (has not been re-glued out-of-line in the past).

· Remove all remaining original hammers & shanks, first noting whether the original bass or low tenor hammers were mounted vertically or slightly tilted, and whether spacing or clearance problems exist.

· Replace the sandpaper on wooden hammer rails, or the rail cloth on a Steinway, and install the new shanks. Be sure to space each flange evenly between its neighbors to prevent rubbing knuckles. Center the end of each shank over its wippen screw hole to allow working clearance when hanging the hammers.

· Travel the new shanks, as in Figure 11.

· Mark the center point of original hammer #1 by sighting down the molding and marking a pencil dot on the center of its crown. Make sure to sight down each side of the hammer and center the dot side-to-side. Mark all new guide hammers as well, and ream to fit their shanks.

· Support all 88 shanks approximately at strike height on a straight edge. Install new guide hammer #2, aligning it

with a thread stretched between the dot marks on original #1 hammer and the new lower treble guide. Install new guide hammers at the ends of all remaining sections, lining them up to the same line.

**3. Setting up the Spurlock Specialty Tools** Grand Hammer Hanging Jig: (www.spurlocktools.com/id33.htm)

• Set the action stack on the bench with the wippen screws toward you, and lift up all the shanks of one section. Set the hammer hanging jig between you and the action and drop the two new guide hammers onto the lower deck as shown in Figure 12. Adjust the lower deck parallel to the action rail, i.e. both ends of the deck should be the same height above the bench top. Make sure the tails contact the aluminum edge of the lower deck.

• Adjust the top deck such that the plastic strip will contact the hammer shoulders at their widest point. Adjust the plastic strip up against the shoulders of the guide hammers. It helps to loop a rubber band from the guide shanks to their wippen screws as shown, to ensure the guides hold the jig securely in position. Adjust the base screws to eliminate any rocking.

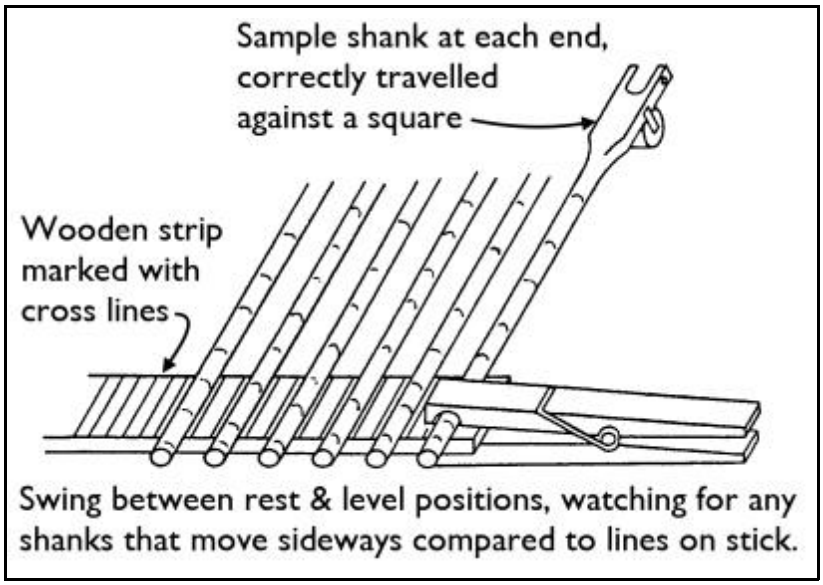


***Figure 11**: Traveling shanks*

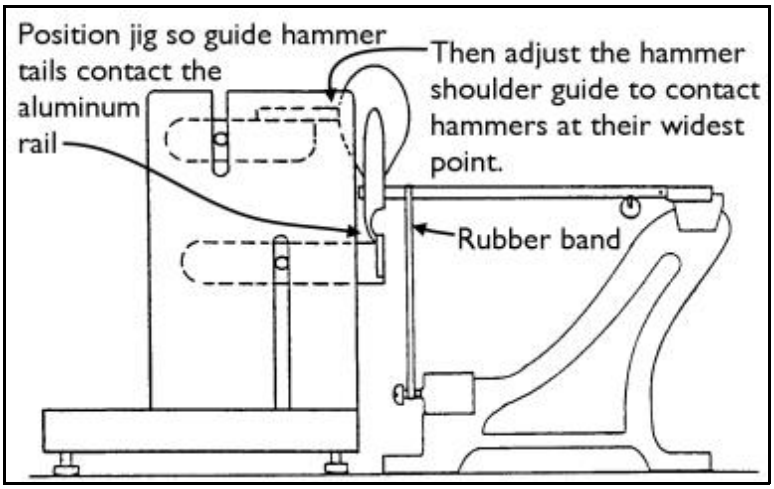


***Figure 12**: Adjusting hammer hanging jig to guide hammers*

## Gluing On The New Hammers

**1. Ream all hammers for a proper dry fit:** They should fit freely onto the shanks with a minimum of play. To test, slide each hammer onto its shank dry. Holding the shank horizontal, the hammer should be just loose enough to swing nose-down when turned sideways. Inconsistent boring will require a looser fit to allow proper alignment.

**2. Gluing:** Both hot hide glue and yellow wood glue are suitable. Always apply glue to *both* hammer and shank to ensure a strong joint. The device in Figure 13 makes it easy to thoroughly coat the shank.

Spin the hammer onto the shank and drop it down into the jig. Use one hand to pull the shoulder back against the plastic strip as the other hand reaches between the decks and pushes the tail up against the aluminum edge.

**3. Check vertical alignment:** Initial vertical alignment can be sensed by feel, by pushing down lightly with the hand that's holding the shoulders and rocking the hammer slightly side-to-side to feel when the tail is sitting squarely on the deck. Then, after every 2 or 3 hammers you can check visually to see if the tails are sitting squarely on the deck. The smooth finish of the lower deck makes any tilt of the tail easily visible as shown in Figure 14. **Note:** in some cases the hammers should be

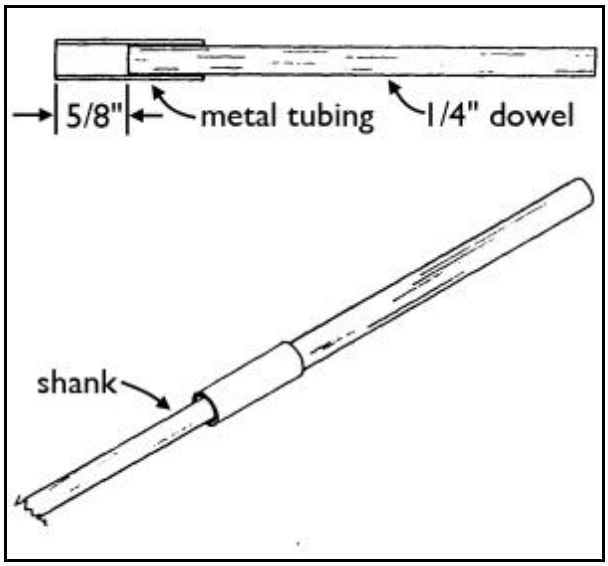


***Figure 13**: Hammer shank glue applicator*

deliberately tilted. Shorter pianos, especially, may require their bass hammers to be tilted very slightly toward the tenor, and their tenor hammers tilted slightly to the bass in order to provide adequate passing clearance. Copy the original tilt, and avoid installing wider-than-original hammers if clearance was tight to begin with.

Repeat this process for each section, then allow the glue joints to fully harden before trimming the shank stubs.

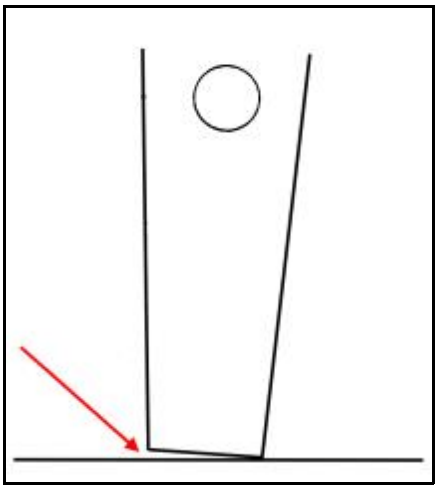

***Figure 14**: Visually checking tails for vertical alignment*

## Trimming The Shank Stubs

**1. Clamp the shanks together:** Our Hammer Shank Clamp (www.spurlocktools.com/id62.htm) is shown in Figure 15. The large aluminum square tubing is crowned to hold shanks securely, preventing damage to the action centers during trimming.

**2. Saw the stubs flush:** With the shanks still clamped, lay a very fine-tooth hand saw flat against the tails, teeth up. Hold the saw almost horizontal, so the teeth span several shanks at once as shown in Figure 16. Our #2410 Fine Cut pull-stroke saw (www.spurlocktools.com/id37.htm) cuts extremely fast and smooth with no splintering of the shanks.

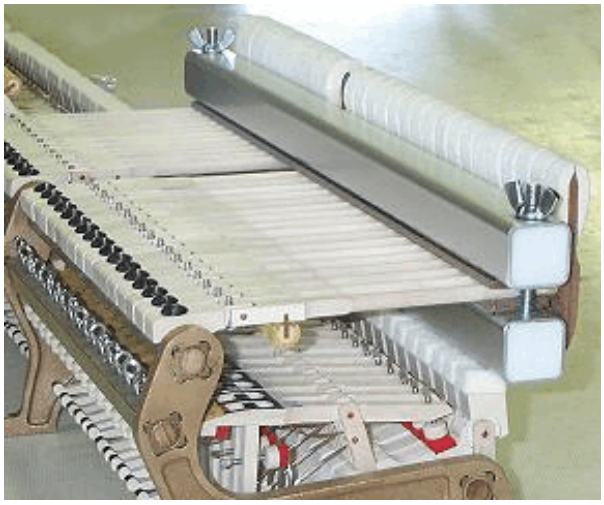

***Figure 15**: The hammer shank clamp*

**3. Final trimming:** While still clamped, use coarse sandpaper on a flexible rubber sanding disc in an electric drill to dress the cut shank ends perfectly flush, as shown in Figure 17. Do not alter the tail arcing that was done before hanging the hammers—just lightly smooth the shank ends. Lastly, lift the clamped section of hammers and lightly sand any sharp edge at the bottom of the tails using a hand sanding block.

I do not recommend "checkering" or roughening the hammer tails further. If you used coarse sandpaper to arc the tails, and if your tail length, tail arc, backcheck height and backcheck bevel are correct, the hammers should check well. If these things are not right, no amount of roughening will solve the problem and will only wear out the backcheck leather.

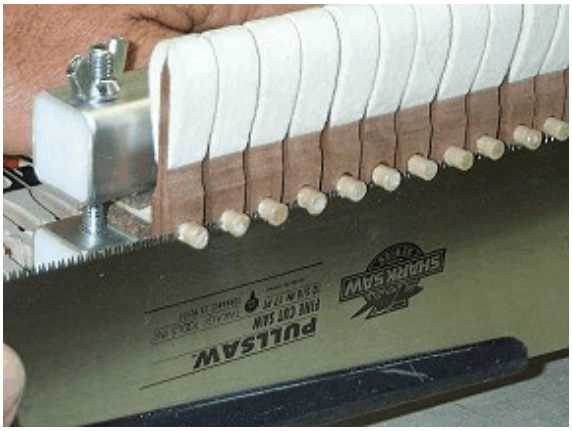


***Figure 16**: sawing off shank stubs*

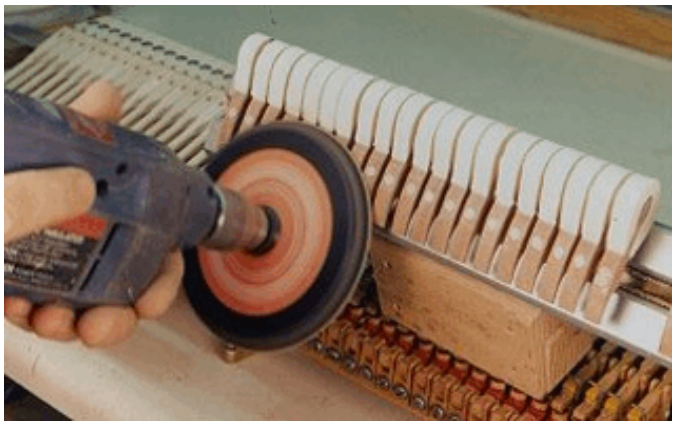

***Figure 17:** sanding off the shank stubs*

# HAMMER-BORING DATA SHEET

Piano:

Owner: Date:

| | Bass | Tenor | Mid-treble | Treble |
|---|---|---|---|---|
| Keybed-to-string | | | | |
| Keybed-to-centerpin | | | | |
| Bore distance | | | | |
| Original bore distance | | | | |
| Rake | | | | |
| Original rake | | | | |
| String angle | | | | |
| Bore angle | | | | |
| Original bore angle | | | | |
| Tail length | | | | |
| Original tail length | | | | |