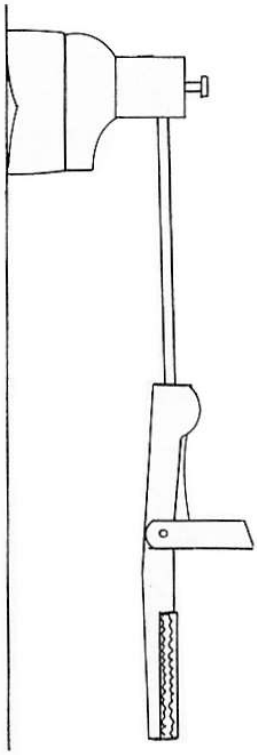
Vertical Damper Replacement



Many technicians dread damper work, and it *can* be troublesome on vertical pianos because access and visibility are limited, and the work stance of bending over the keyboard is uncomfortable. Because of these difficulties, some tend to avoid dampers and thus never develop the skills that would make it easy for them. However, with a systematic and practiced approach, good damper work is not only possible and pleasant but also offers an opportunity to improve a piano's performance by upgrading its damper design.

Here I will cover the complete damper replacement job, including making improvements to poor original designs and a unique method of pre-adjusting damper heads *before* installation of new felts.

Diagnosing Existing Damper Problems

Poor damping results in excessive after-ring after a key or keys are released, and can be caused by any of the following conditions:

1. Poor felt-to-string contact, caused by any of the following:
   - felt misaligned to the strings
   - damaged felt (moth-eaten, torn, etc.)
   - weak/broken damper lever springs
   - weak/broken pedal spring
   - binding trapwork
   - damper lever wire adjustments off
   - spoon adjustments off
   - unison strings not level
2. The wrong type of damper configuration for a given string (e.g. flat damper felt for heavy, low tenor strings).
3. Dampers that are too short or located at the wrong point along the strings' length so they fail to silence certain partials, even though the dampers may be in good condition and adjustment.
4. Ringing non-speaking length string segments due to loose or missing stringing braid.

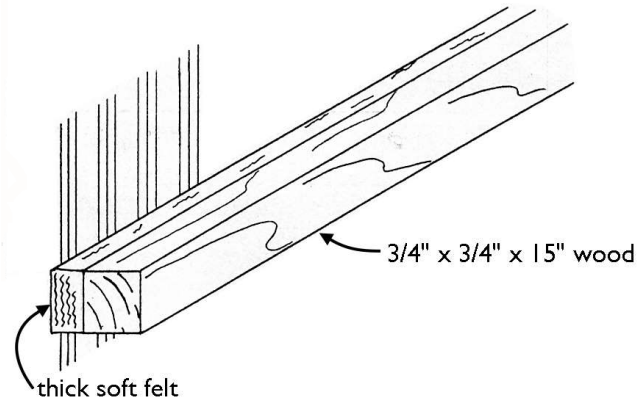
Given this number of possible problems, it is important to approach an after-ring problem with a logical sequence of tests. Only in this way can you get an overall picture of the damper system and distinguish between trapwork problems, individual problem dampers, and design deficiencies inherent in a given piano. I suggest the following sequence of tests to diagnose poor damping:

1. Check for broken damper springs. Step on the pedal two or three times and watch to see that all dampers lift and return to the strings. If one or more do not return, they may have broken springs, causing poor or no damping on those notes and allowing them to ring whenever any key on the piano is played.

2. Make sure that the trapwork, damper lift rod, or spoons are not holding the dampers slightly off the strings. After checking that the pedal return spring is intact, confirm that you have lost motion in the pedal dowel. Next, push a few strings toward the plate to make sure that the dampers follow the strings for at least 1/16". If they do not, remove the pedal dowel; if the dampers *now* follow the strings, the trapwork is somehow failing to return fully. If the problem *remains*, the damper lift rod may be binding and thus not falling back away from the damper levers. If there is lost motion between the lift rod and damper levers but there is still no "follow," the spoons are holding the damper

levers up. This can be confirmed by pushing down slightly on a wippen to force its spoon back toward the action rail; if that damper then follows, its spoon *or* its damper lever wire are out of adjustment. Of course, lack of damper follow caused by the trapwork or lift rod will normally affect *all* dampers, whereas lack of follow caused by spoons may only affect individual dampers. You have now identified or ruled out mechanical interference preventing the dampers from resting snugly against the strings.

Figure 1: Muting stick for locating ringing strings



3. Locate the string or strings that are ringing. To do this, play a staccato chord to excite the ringing, and alternately mute out different sections of the piano to locate the source of the problem. Although you can use your fingers or forearm to press against the strings, I like to use a felt covered wooden stick as shown at right, which allows test muting of entire sections quickly. By alternately playing your chord and pressing this long mute against different sections of strings, you can quickly find out which section contains the ringing strings. With a 6" length of mute stick (or a dry hand) you can zero in on smaller areas and find out whether there is just a single damper, a group of dampers, or a whole section at fault.

4. Determine the cause of the ringing. Having located the offending dampers, you must determine whether poor damper alignment or seating is at fault, or whether the dampers are just the wrong length or in the wrong location to work well. Use your muting stick to press all damper heads in the offending section slightly harder against the strings immediately after playing a staccato chord. If the ringing is vastly reduced, either damper alignment is slightly off, the damper felt is worn or damaged, or the damper springs are weak. (By pushing on the dampers you force the felt into better contact with the strings, overcoming alignment, felt condition, or spring problems.)

Very poor alignment will be obvious as the felt may not be contacting all strings of the unison. Slight alignment problems may not be so obvious. Plucking individual unison strings or lightly muting the individual strings with one finger will tell whether all unison strings are being evenly damped. If you find that only one string of a unison rings on and the other two do not, the damper is misaligned or damaged and not contacting all three strings evenly. Inspecting the grooves on the surface of flat dampers will show whether they are sitting flat on the strings. For wedge and single bass dampers, watch closely as they lift on and off the strings; they should not deflect to one side as they come to rest.

To test the springs, pull damper heads back one at a time with your finger. If the springs feel very weak, strengthening them may correct the ringing; you can experiment on individual dampers to find out. *A common mistake here is to strengthen springs in an attempt to overcome poor alignment or bad felt*. This is really treating the symptom rather than the cause and will only work if so much extra spring tension is added that the touch becomes unbearably heavy.

If pushing against the dampers *does not* greatly reduce the ringing, the problem has to be in the damper length and location on the strings; in other words, poor damper design. Such dampers will typically dampen the fundamental tone reasonably well but will leave one or two partials ringing. Replacing these dampers with new felt of the same length will have no affect in this case, and is a waste of time.

Choosing New Damper Types for Improved Damping

The tests above should tell you whether damper problems exist, and whether they result from the original dampers being in poor condition or from poor original design. If the problem is simply due to felt in poor condition, replacements of the same design as original should work fine. In the case of poor design the next step is to determine what style of damper you can use that will improve upon the originals.

Older uprights commonly have a lot of after-ring in the bass that can be reduced with a change of damper type. To experiment with different bass damper designs, first mute all strings in the piano except for a single bass bichord.

The lowest bichord notes will usually be the hardest to dampen, and so are good notes to experiment on. Use your felt-covered muting sticks (held against the strings by a couple of hammers wedged off the hammer rail) to mute out the tenor and treble. Insert temperament strips between *each* bass string (except the test unison) both above and below the keybed. Now the entire piano should be well muted, making it easy to compare different damper designs on the test note.

Play the test note to get a good idea of the original damper's sound. You will usually hear a combination of the 5th and 6th partials ringing in the bass. This is because these partials are fairly strong in this section of the piano, and because the bass dampers usually sit near 1/5 to 1/6 of the speaking length.

Replacing the original 1⅜" or 1¾" length dampers with 2" to 2¾" ones will always make a major improvement. Sources of longer dampers are: piano manufacturers that use them or piano supply houses selling Tokiwa brand parts. Or they can simply be made up from scratch as described in figure 2.

After listening to the original damper, replace it with a longer one and listen again. (Remove the original from the damper head, then apply a spot of yellow glue to the new one and fit its wedges into the strings above the bare damper head. Pull the head away from the strings, slide the damper down the strings to the correct height, and release the head. This ensures correct alignment to the strings. The damper can be tested immediately). It is useful to have three base bichord test dampers on hand: a 2", 2½", and a 2¾". Longer is usually better, but sometimes a 2" or 2¼" will work best. Bass dampers longer than 3" can be troublesome; they lack rigidity and their bottom ends may not lift far enough from the strings. All longer dampers may require slightly stronger springs to seat properly. The only further improvement some pianos respond to is angling the top ends of the dampers; this allows them to be mounted higher without interfering with the hammers. When testing, do not expect to achieve instant damping—a certain decay rate is normal and desirable.

Figure 2: Making your own long bass dampers

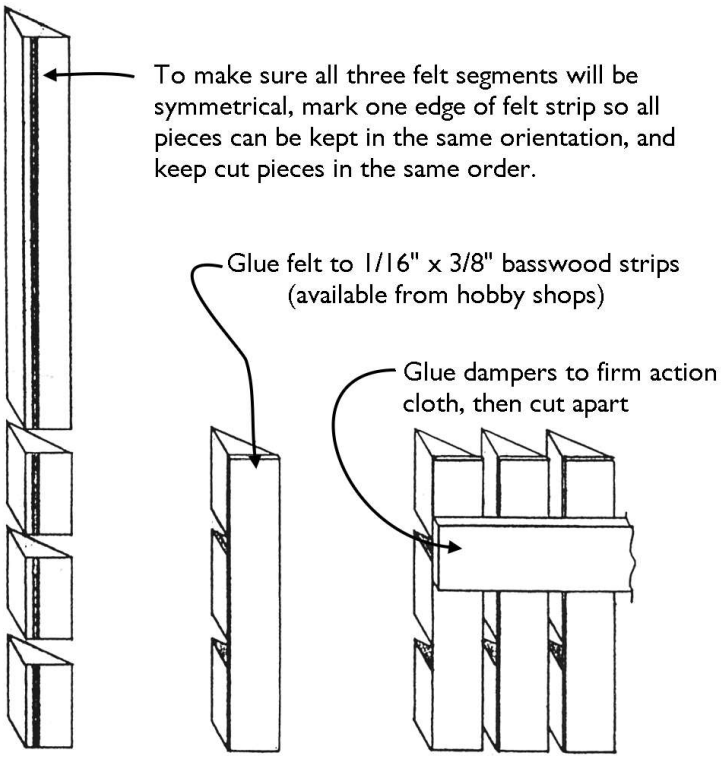
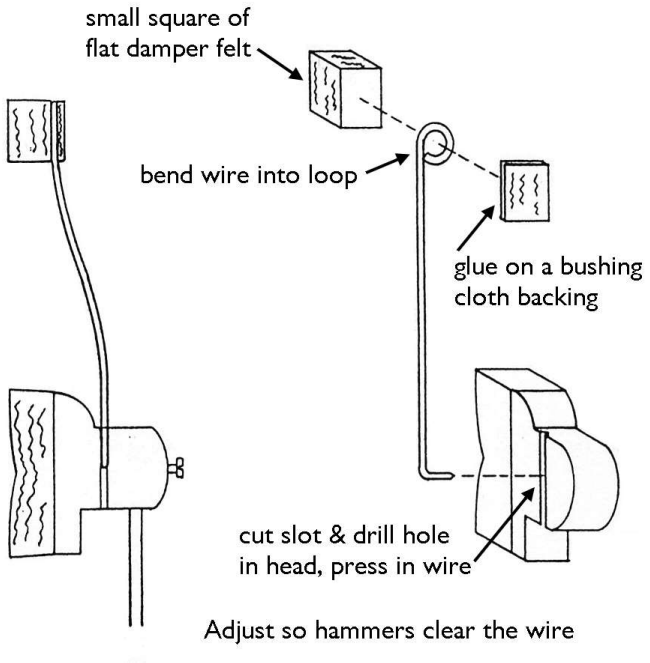


Figure 3: Adding an over-damper



Realize that a bass test note played in a hard, staccato fashion is a very severe test, and a noticeable improvement heard in a single new test damper will mean a major improvement overall when all bass dampers are replaced with the new style.

On many pianos the worst damping is in the low tenor, especially on the first couple of tenor notes whose dampers must be very short in order to clear the topmost bass string. Again, mute out all other strings of the piano to experiment on a problem note. Frequently the problem is not so much the short length of the damper as it is the use of flat felt. If pushing slightly harder on the test note damper gives adequate damping, and the problem is not simply a very weak spring, then switching to trichord felt will probably work fine. However if a ringing partial persists even with extra pressure, damper length is the problem and you have to either lengthen the damper or add an over-damper. If hammers are to be replaced on the action you have the opportunity to curve the hammer line upwards on the first 4 or 5 tenor hammers to allow longer dampers to be installed on the first two tenor notes. (Raise the first tenor hammer 5/16", the second 1/4", the third 3/16", etc.) Alternatively an over-damper can be installed as shown in fig 3. These are usually only necessary on the first 1 or 2 tenor notes. They are troublesome and should only be used as a last resort.

Once you are 2 or 3 notes above the bass break, there will be room to lengthen the tenor dampers if necessary. Just changing to trichord felt will usually correct problems, but once again the pressure test will confirm whether fit or placement is at fault. A typical scenario is to install long bass dampers, raise the low-tenor hammer line to allow longer dampers there, and use trichord felt on the first 6-8 tenor unisons. The higher in the scale you go, the easier the strings are to damp and the less critical damper placement and type become.

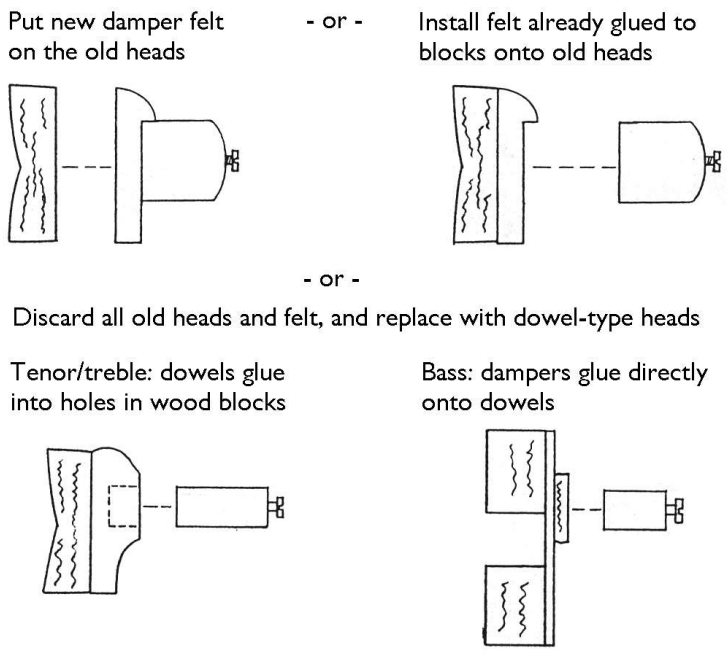
Finally, it is important to only use the best quality damper felt. Since dampers have to be very accurately adjusted to work properly, uneven or poorly cut felt will sabotage the job no matter how well the rest of the work is done.

Removing the Old Damper Felt

Depending upon the condition of the original damper heads, you may decide to replace only the damper felt, or replace heads and all (see fig 4). New dowel-type heads have the advantage that only *one* side-to-side wire bend is necessary; this centers the head over the unison, then the felt is aligned parallel to the unison at the time the dowel is glued into the head. Tokiwa brand parts are available that make this an easy conversion.

To remove only the old felt, mount the action in a cradle and rotate it horizontally, damper side facing the workbench. Tear off the front sections of the bass dampers, leaving only the small mounting felts; but leave the flat dampers intact. Fill a tin can with a water/wallpaper remover solution and bring it up under groups of damper felts, allowing them to soak up all the solution they can hold. Do not submerge any part of the wood blocks unless you are going to be separating them at their glue joint. Leave the felt sitting in the horizontal position for about two hours, or until the dampers pull away easily leaving no felt behind. (Excessive soaking risks penetration of the front wood block and weakening of the wood-to-wood glue joint). As soon as you have removed the old felt, stand the action back up and lightly scrape any glue residue from the wood blocks.

Figure 4: Damper replacement options



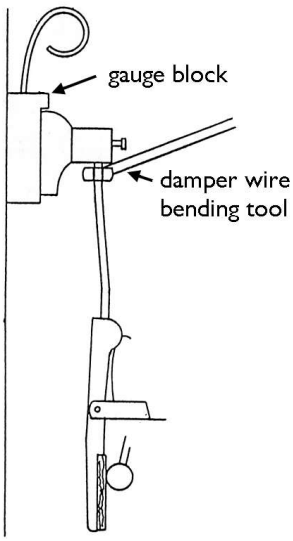
At this time the damper lever pinning should be checked. It should be quite firm, since sloppy pinning allows the dampers to move side-to-side with the vibrating strings, reducing damping ability. Replace the damper lever felt if worn. The springs should be replaced if they show any signs of corrosion or past breakage. In addition, the damper lift rod and spoons should be polished as necessary, and the lift rod hanger bushings replaced and lubricated.

Adjusting Damper Heads Prior to Installing Felt

Bending damper lever wires in place, with the felt already installed, is difficult. Although the side-to-side bends (to center the damper over the unison) are simple enough, the fore and aft bends are complicated because each bend has two effects: it changes the parallel mating of the damper to the strings, and it also changes the timing of the damper lift with the pedal. Compounding the problem is the difficulty of visually judging when a spongy piece of damper felt is meeting the strings perfectly parallel. Thus we end up chasing back and forth between these two adjustments and either taking way too long or settling for a mediocre job.

To get around all of these problems I prefer a method of adjusting the heads *before* the felt is glued on, with the action on the bench. This method eliminates most of the tool access and visibility problems, leaving only minor touch-up and spoon bending to be done after the felt is installed.

Figure 5: Gauge blocks used to set sample dampers



Overview of Procedure

Evenness of pedal lift results from the *lower ends* of all damper levers being in a straight line, so as the lift rod moves it engages all the levers simultaneously. Therefore we can eliminate this one variable and guarantee even pedal lift by holding all damper levers in a line prior to doing any adjustment. Do this simply by propping the lift rod up so all levers rest on the rod while the wires are bent to position the heads the correct distance from—and parallel to—the strings. This bending is done with bare wooden damper heads, so the variable of spongy damper felt is also eliminated. A few sample damper heads are first adjusted with the action in the piano (with the damper lift rod propped up), using wooden gauge blocks in place of damper felt, so parallel alignment of heads-to-strings can be most easily seen (see fig 5). The action is then removed to the workbench where the lift rod is again propped up and elastic thread "straightedges" are strung between the sample heads. All other heads are then adjusted to match these samples. The action is then placed back in the piano, where the felt is installed and final adjustments made.

When the piano is in the customer's home, rather than in the shop, my procedure is to do the diagnosis work at the piano, then bring the action to the shop for old damper felt removal and any other necessary service. If I determined during my diagnosis that special dampers would be needed to correct problem areas, I would make them up in the shop. I would then return to the customer's home and do all adjustment, felt installation, and final "tweaking" as explained below. This method gives better results, is physically easier, and takes less time than doing all of the wire bending with the damper felt in place and the action in the piano.

Step 1: (action back in the piano) If you are re-using the original heads, use a straightedge to check that they are even in height. If you are replacing heads, duplicate the original felt height. Make sure that the hammers clear the damper felts by at least $\frac{1}{8}$". In the bass, make sure there will be clearance between each damper and the next hammer to its right". Make sure each damper head is rotated square to the strings as viewed from above. Space the heads side-to-side so they are centered over, and parallel to, the unison strings.

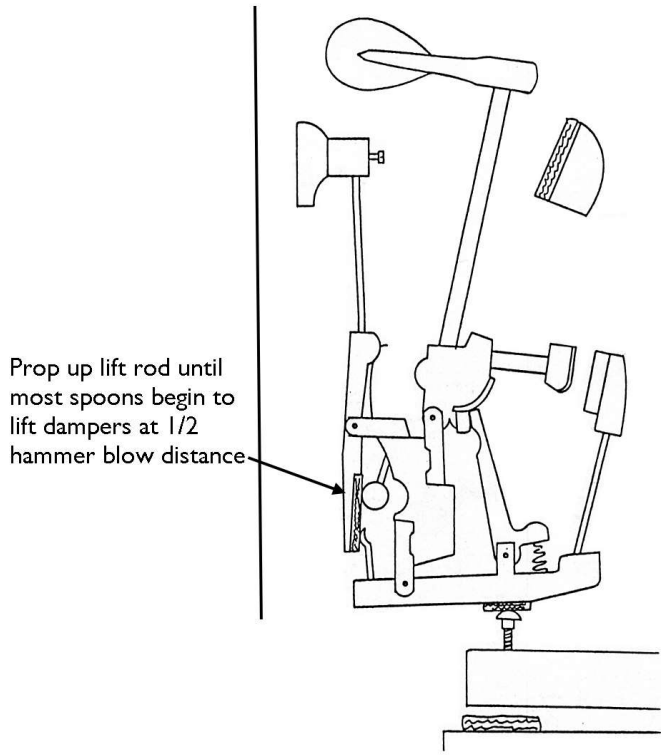
Step 2: Select the damper felt you will be using. Make up a wooden gauge block to match each of the various felt types: For bass dampers, put a new bass damper in place (no glue) between a damper head and strings and choose a gauge block that will hold a neighboring head an equal distance from the strings. In other words, choose a gauge block

that will represent the dimension of the damper felt to be used. Test both a monochord and a bichord. Select a gauge block to match the tenor trichord felt in the same way, and also for the flat dampers. Most sets of flat dampers are tapered in both length *and* thickness, so you will need one gauge block for the first tenor flat damper and another for the last treble flat. These gauge blocks will be used to accurately set the sample damper heads in the piano.

Step 3: Determine how far to prop up the damper levers with the pedal when adjusting the samples. This will determine the position of the levers when the damper felts are installed and resting against the strings.

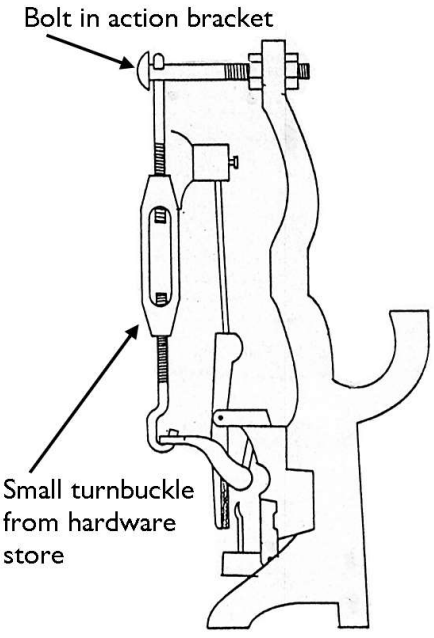
▸ Parameters: The lower ends of the levers must rest far enough away from the action rail that when the pedal is released the lift rod can move back away from them, otherwise ringing dampers will result. However they should not be so far away from the rail that the spoons have to be angled outward severely, causing them to dig into the lever felt. Normally, it is easiest to just gradually prop the pedal dowel up until most spoons begin to engage when the hammers are halfway to the strings, as shown in figure 6. This setting will minimize later re-adjusting of the spoons.

Figure 6: Propping up lift rod prior to adjusting sample damper heads



The pedal dowel can be propped with a wedge against the bottom board; however my preference is to use a turnbuckle between the damper lift rod and the top action post, since this is easiest to adjust and very stable.

Figure 7: Turnbuckle used to prop up lift rod with action on the bench



Step 4: With the damper rod propped up in the desired position, carefully adjust your sample damper heads using the gauge blocks chosen in Step 2. Normal samples would be the first and last bass damper heads, one head which will have trichord felt, the first and last heads to have flat felt and one around note 55. Spend time to adjust the samples accurately, so that the gauge blocks just fit between the heads and strings without moving the heads back, and so that the heads sit parallel to the gauge blocks, as shown in figure 5.

Step 5: Place the action on a bench, and prop the lift rod up with the turnbuckle between the lift rod and a bolt placed in the action bracket, as shown at right. The position of the rod is not important, as long as all the levers are resting on the lift rod rather than on the spoons. Do not prop up the lift rod using a rubber mute between the action rail and the rod; this puts a horizontal force against the rod, distorting it into a different shape than normal. The turnbuckle exerts force vertically, in the same direction as the damper lift rod, and therefore gives the most accurate result.

Now set up a "straight edge" between two samples by running two strands of *fine* elastic thread (from a fabric store) between each pair. Fasten the

thread to the side of each sample head with masking tape or a drop of CA glue, and *space it slightly away from the face of the sample head with a piece of business card.* See figure 8. Temporarily bend any other damper heads back away from the threads if they interfere with a straight line between samples. Working from the damper side of the action, you now have unobstructed access and visibility to adjust all damper heads in line with the samples. Adjust each damper head until it is the business card's-thickness away from the threads. *No heads should touch the threads, otherwise they will upset the straight line.* Repeat with each pair of samples.

Figure 8: Using elastic thread straightedges between samples

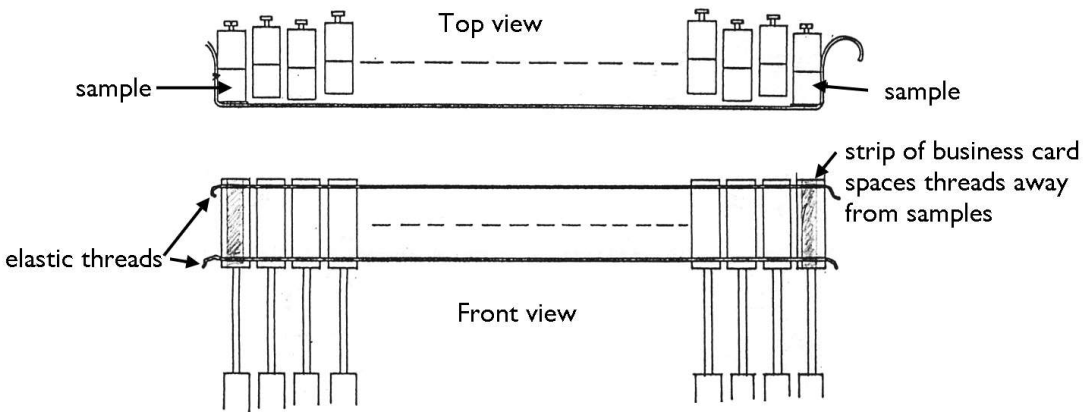
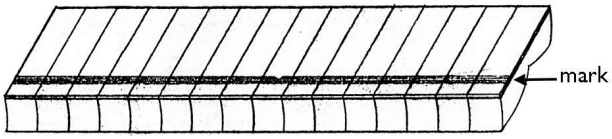


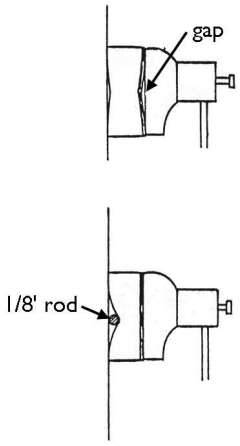
Figure 9: Preparing flat felts

Flat felt pieces "lean" one direction because of the way they are cut. They should all be installed the same way they sit in the box for a neat, uniform appearance. Before removing from the box, mark as shown, then install all pieces with the marks up (or down).



Step 6: With the action back in the piano, re-check that the heads are lined up side-to-side with the unison strings and adjust as needed. With the pedal no longer propped up, glue the felt to the heads, letting the damper springs clamp the felt against the strings. Gluing the dampers on in-place is the best way to ensure perfect alignment of the bass and trichord felts with their strings. Just apply glue to the felt backing, set the damper into the strings above the head, pull the head back, then slide the damper down the strings into position and release the head. Flat dampers need to be clamped in the center or else they will not glue flat against the blocks, and their crease will be less. To do this, glue on the first flat damper and one up at the tenor/treble break. Put a length of ⅛" dowel or rod between these two dampers and the strings, positioned so that it rests in the crease of the felts; these dampers will hold the rod in place as the other dampers are glued on. The rod will clamp the dampers flat against the heads so they have a deep crease as shown at right. Repeat for the section of flat dampers above the treble break.

Figure 10: Creasing flat dampers during gluing

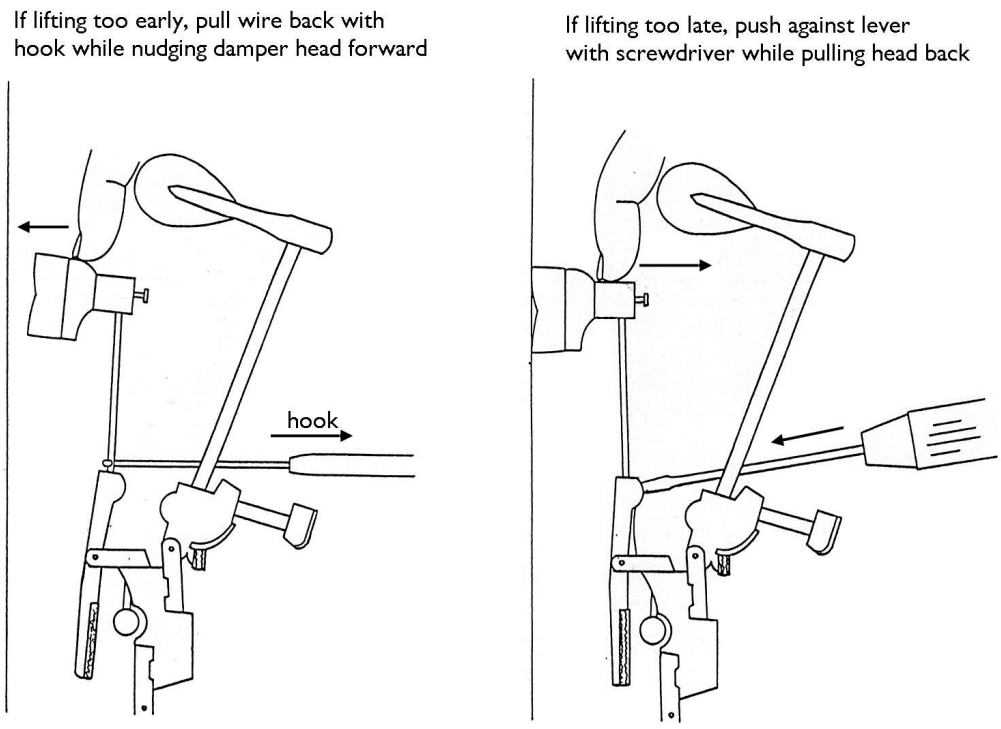


Fine-Adjust Damper Lift With the Pedal

All dampers should now lift fairly evenly with the pedal. Before doing any fine adjustment, check to see whether one end of the damper section lifts sooner than the other; if so, remove the action and bend the lift rod hanger slightly for that end so the rod rests closer to the action rail (push that end toward the rail while pulling the other end away). Be careful-a very slight bend makes a big difference.

At this point the wire bending required to even out the pedal lift should be very minor, and not enough to upset the parallel mating of the felt to the strings.

Figure 11: Adjusting for even damper lift from the pedal



Here I find the usual wire bending tools counter-productive because they can easily upset side-to-side alignment slightly in the process of making fore and aft bends, especially in the bass where the wires are very angled. Instead, I prefer to just use my fingers and a hook or screwdriver, as shown above, to make these small changes. When the adjustment gets quite close, use your foot to barely wink the pedal to identify the first few dampers to move. These can be slowed down by depressing the pedal fully and nudging the heads slightly with a finger. Remember that your bass and trichord felts are now perfectly aligned with their strings, so try to avoid any bending that will change their side-to-side position.

Regulating Damper Lift With the Keys

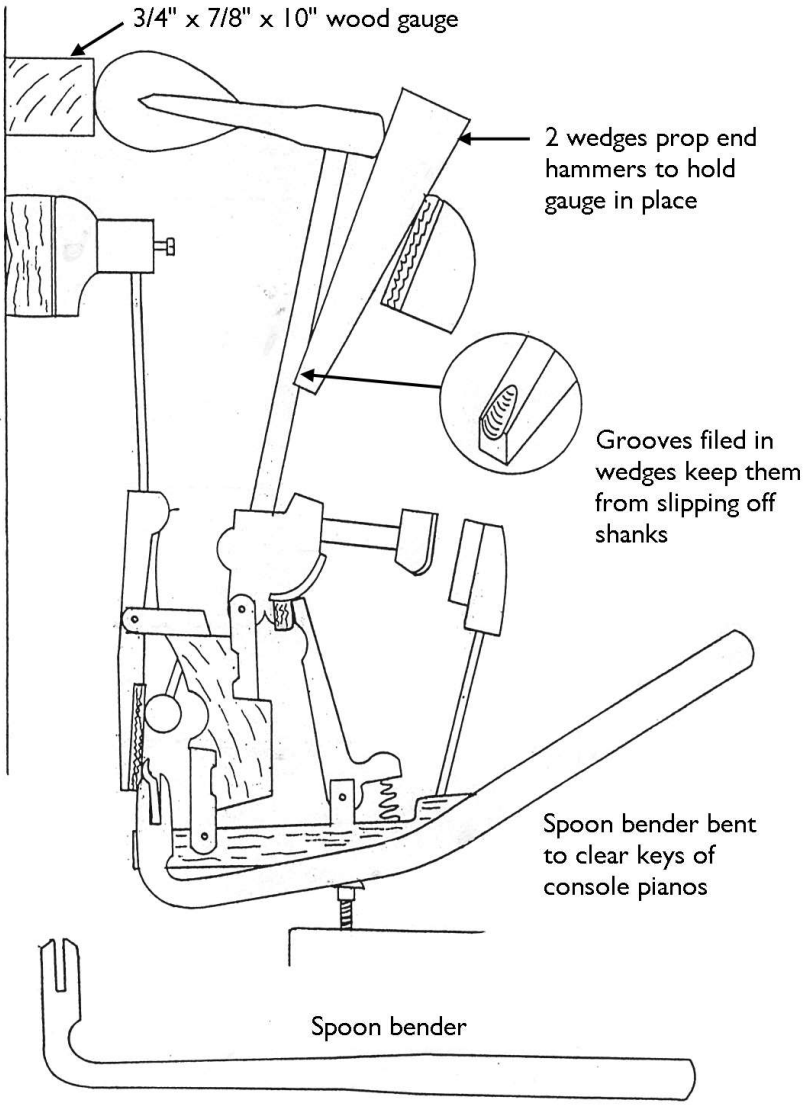
Dampers *must* lift evenly with the pedal before adjusting spoons. Damper lift with the spoons greatly affects the touch resistance of a piano, so it is important that spoon adjustments be as uniform as possible. Although there are methods of adjusting spoons with the action on the bench, they are not as accurate or as fast as using a well-designed spoon bending tool with the action in the piano. The first requirement is *the proper spoon bender*. Fig 12 shows the type that I favor. Yamaha sells a good one. I suggest getting two and bending the handle of one as shown for use on compact console actions.

Unlike most adjustments, spoon bending is done blind, so first we must teach our fingers what the tool feels like as it slips onto the spoon. I suggest the following procedure:

- Choose a full size upright for learning, not a console or studio. Also, practice first in the center of a section, not on a note at one end of a section.
- Remove the action nuts, tip the action back toward you, look down in and put the tool on a spoon. *Notice that the tool must lean to the side, toward the spoon.* Also notice that in the bass section the spoons lean toward the treble, so the spoon is placed to the right of the wippen being adjusted. In the tenor the spoons usually (but not always) lean toward the bass, so the tool goes on the left side. Then above the tenor/treble break the spoons usually lean toward the treble again. Thus you will hold the tool in your right hand in the bass, left hand in the tenor, then back to the right again in the treble.

- Slip the tool on and off the spoon, noticing what it feels like. Notice that lifting the wippen slightly moves the spoon away from the action rail, making it easier to slip the tool in place. Close your eyes and notice what the bender sounds like as it clicks against the spoon.
- Next, with the tool still on the spoon, push the action forward and, while holding the end of the wippen in one hand, move the spoon bender up and down slightly with the other to feel how it engages the spoon. Then slip it down off the spoon and try to slip it back on again without looking. Remember to lift the wippen slightly to make the spoon more accessible, and to lean the tool to the side. If you're not sure where you are, pull the action back and look. You may find it helpful to place a piece of tape around the handle corresponding to the end of the wippen, so you know how far in to reach with the tool. With your senses of feel and hearing thus trained, you should be able to grab the spoons without looking.
- Prop a damper-lift gauge against the strings as shown at right. You can then lift each wippen, causing its hammer to bump against the gauge, to test damper lift. If the gauge dimension is half the hammer blow distance, each damper should just wink as the hammer bumps the gauge.
- When making adjustments, hold the spoon bender in one hand and the end of the wippen with the other, and work one against the other.
- Each piano design is different so you may have to repeat the initial step of tilting back the action occasionally with new designs. Many compact actions require that you remove the keys to get enough room to operate the tool. On spinets the spoons are adjusted just like on larger uprights, except that the tool is held under the keybed.

Figure 12: Adjusting damper spoons



Regulating the Pedal

The sustain pedal should have a minimum of lost motion, but enough to ensure that the damper lift rod is well clear of all damper levers at rest so that all dampers rest against the strings with their full spring force. Test by deflecting some strings inward; the dampers should follow the strings at least 1/16". The sustain pedal travel should also be limited by blocking felt, to limit damper lift by the pedal to approximately the same amount as the dampers would lift with the spoons. This adjustment is commonly neglected, even by manufacturers, resulting in excessive stress on the trapwork and leading to noise and breakage of pedal springs.