PIANO TECHNICIANS
Journal
Official Publication of the Piano Technicians Guild

February 1995 Vol. 38 • #2

New Feature: The Editor's Roundtable
This Month: Capo d'Astro Bars

SOUND THINKING

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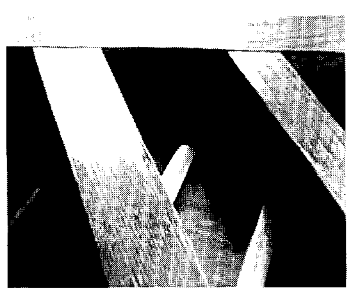

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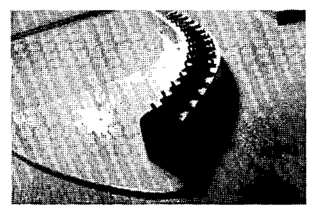

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Editorial
Piano Technicians Journal welcomes unsolicited materials, photographs and ideas from our readers. Please submit by mail or FAX. MicrosoftWord 5.1-Macintosh format preferred. We'll acknowledge all submissions and return those we can't publish. DEADLINE: No less than 45 days before publication date (i.e., September 15 for November issue) Send materials and letters to: Piano Technicians *Journal*, Managing Editor, 3930 Washington, Kansas City, MO 64111-2963.

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Editorial Perspective

Which Journal do YOU Want?

Steve Brady, RPT
***Journal* Editor**

What kind of publication should the *Journal* be? There are probably as many answers to that question as there are *Journal* readers. I'm sure there are those who would like our official publication to be a solemn academic volume, heavily footnoted and devoid of illustrations. Others might prefer a glossy, commercial magazine brimming with stunning color photographs and breezy prose. Recognizing that these two conceptions are at the ends of the spectrum, and that the real answer for us lies, as usual, somewhere in the middle, I'd like to share with you my own vision for the *Journal*.

I think it's obvious that neither of the scenarios given above are possible — or even desirable — for the *Piano Technicians Journal*. The membership we serve is too diverse, and the economics governing the situation too limited, for either type to be a real possibility. What seems to fill the bill for us is a 60-page monthly with a variety of types of articles, ranging from the popular to the profound, and from the rudimentary to the advanced. The *Journal* needs to contain some information which will be appealing and useful to each reader, but since our readers vary so much in their background, it must follow that the content of the *Journal* be similarly varied.

In addition, our *Journal* needs to reflect our changing society. We live now in what has been dubbed the "information age." In nearly all disciplines, there has been an explosion of knowledge and literature so monumental that just keeping up with it all seems to be our primary challenge! We struggle to utilize and organize all the information we have available to us. One of the things we're learning through all this is that none of us knows everything about our field. I certainly don't.

Although my own technical background is both broad and deep —including substantial involvement in concert work, major rebuilding, teaching, and historical instruments and temperaments — I think the day of the editor-as-oracle is behind us. It seems to me that the best roles an editor of our *Journal* can play in this era are those of organizer (making sure the *Journal* is organized to meet the changing needs of our members and the demands of our age), facilitator (creating opportunities for free discussion of technical and other issues), and mediator (trying to avoid personal bias in mediating the flow of this interchange of ideas, in favor of letting the ideas — on their own merit — advance the common good of the profession). These are the roles I will attempt to fill as your editor.

With this in mind, I want to encourage your involvement in the *Journal*, and to promise you that your contributions will be carefully considered. We may not be able to use everything, but we will attempt to see that all viewpoints are represented fairly. I would like very much to see a thriving Letters section, and I'm willing to devote enough space to that to let it happen. To make it easier for you to send "letters to the editor," I'm publishing my e-mail address and fax number below.

If you have more to say than you can fit in a letter of reasonable length, try putting it into an article. If you feel that your writing skills are not the best, send it anyway; I'm willing to help you organize and express your thoughts. One thing I would request, however, is that your article submissions be legible, meaning (if on paper) either typewritten or — if written by hand — printed in ink. At this time, though, my preferred mode of article submission would be a word processor file (Word Perfect or MSWord format) on a 3.5" disk.

One of the exciting new developments of the computer age is called the Internet. It is the Internet which allows us to correspond across great distances by e-mail (e for electronic) and which has made it easy to set up e-mail-based forums on a dazzling array of topics. I know there are already several such virtual communities — either "bulletin boards" or "listservers" — on the subject of piano technology. I belong to one called Pianotech which consists (at this writing) of approximately 60 subscribers, most of them college & university technicians. In the short time I've been on-line with this group, I've witnessed several fascinating discussions on different topics, one of which I'm using as the basis for an article in this issue.

In "Soylent Green," a sci-fi film from the 1970s, Charlton Heston discovers that his society's staple food has, uh, rather grisly origins. Ultimately, because we live in a democratic society and belong to a democratic organization, the Guild — and indeed the *Journal* — both reflect who we are. The *Journal*, like Soylent Green, is people. It's made of people!

I'm tremendously excited about working with you on the *Journal*. I'm confident that, together, we can make it something we'll all be proud of.

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PIANO TECHNICIANS
Journal
Volume 38 • Number 2 • February 1995

DEPARTMENTS

COVER ART

To kick off a new Journal feature, "The Editor's Roundtable," which appears for the first time on page 22 of this issue, Editor Steve Brady contributes a photo of the capo d'astro bar of a Falcone model 74 grand piano.

PACE

Professionals Advance through Continuing Education

LESSON PLAN

PTG*Review*

IN ADDITION

FEATURES

Getting The Work Done!

Have you ever wondered who gets all the work done in this organization? The Piano Technicians Guild has over 3900 members, including many International members. PTG consists of (164) local chapters, over 20 committees, the PTG Auxiliary, the PTG Foundation, membership in the International Association of Piano Builders and Technicians (IAPBT), many regional and state seminars, a monthly *Piano Technicians Journal* publication, an annual directory of our membership, an Annual Convention and Technical Institute, an annual meeting of the Council of Delegates, a Board of Directors, a Home Office with a staff of five, and a budget of almost $900,000. The work required to keep up with all this is monumental yet it is done with a full time Home Office staff of five and the work of member volunteers.

The Home Office in Kansas City is the nucleus around which the management of PTG revolves. The job of our Executive Director, **Larry Goldsmith**, can be easily described. His job is quite simply to know everything there is to know about what's going on in the organization and to make sure everything that needs to get done gets done on time! Assisting him is **Mary Kinman**, Director of Member Services; **Sandy Essary**, Conventions Coordinator/Journal Subscriptions; **Catherine Wilane**, Director of Finance; and **Midge Sheldon**, Administrative Assistant.

The PTG Board of Directors is made up of the President, the Vice President, the Secretary/Treasurer and seven Regional Vice Presidents, all elected annually at Council. The Board is responsible for implementing and carrying out all of Council's orders, and to administer the business of PTG in conformity with the Bylaws.

PTG President
Leon Speir, RPT

At least three times a year the Board meets and between those times takes care of volumes of paperwork and phone calls. RVPs attend chapter meetings in their regions and maintain close contact with local chapter officers.

Each year at the Annual Convention and Technical Institute, the PTG Council of Delegates meets to establish the rules by which we are governed. Every PTG chapter can send a voting representative to Council to act on behalf of their chapter. For two days in July this body intensively examines the policies and sets the direction of PTG.

Fred Fornwalt is Institute Director for our Annual Technical Institute to be held in Albuquerque, NM, in July. He is aided by the other Institute Committee members, **Paul Olsen, Steve Brady,** and **Wally Brooks.** Planning and administering the Institute is a big job requiring extensive planning, contacting prospective teachers, establishing curriculum, assigning classroom space, and ensuring that all the equipment is where it's needed when it's needed. The Institute Committee personnel are member volunteers who donate their time to PTG.

Other groups include the PTG Auxiliary; **Paul Cook** President; the PTG Foundation, **Roger Weisensteiner** President; and the International Association of Piano Builders and Technicians (IAPBT), **Ed Hilbert** President. These groups play an important role in support of piano technicians and piano technicians' causes.

The *Piano Technicians Journal* is our most visible member benefit. **Steve Brady** was recently appointed to serve as *Journal* Editor and this month's *Journal* is the inaugural issue of his tenure. Steve's job of accumulating material and formatting it for the *Journal* requires at least two *full* weeks out of the month. Steve will be working very closely with the Home Office staff to ensure publication deadlines are met. Those of you who publish a monthly chapter newsletter can appreciate in measure the amount of work involved to publish this magazine each month.

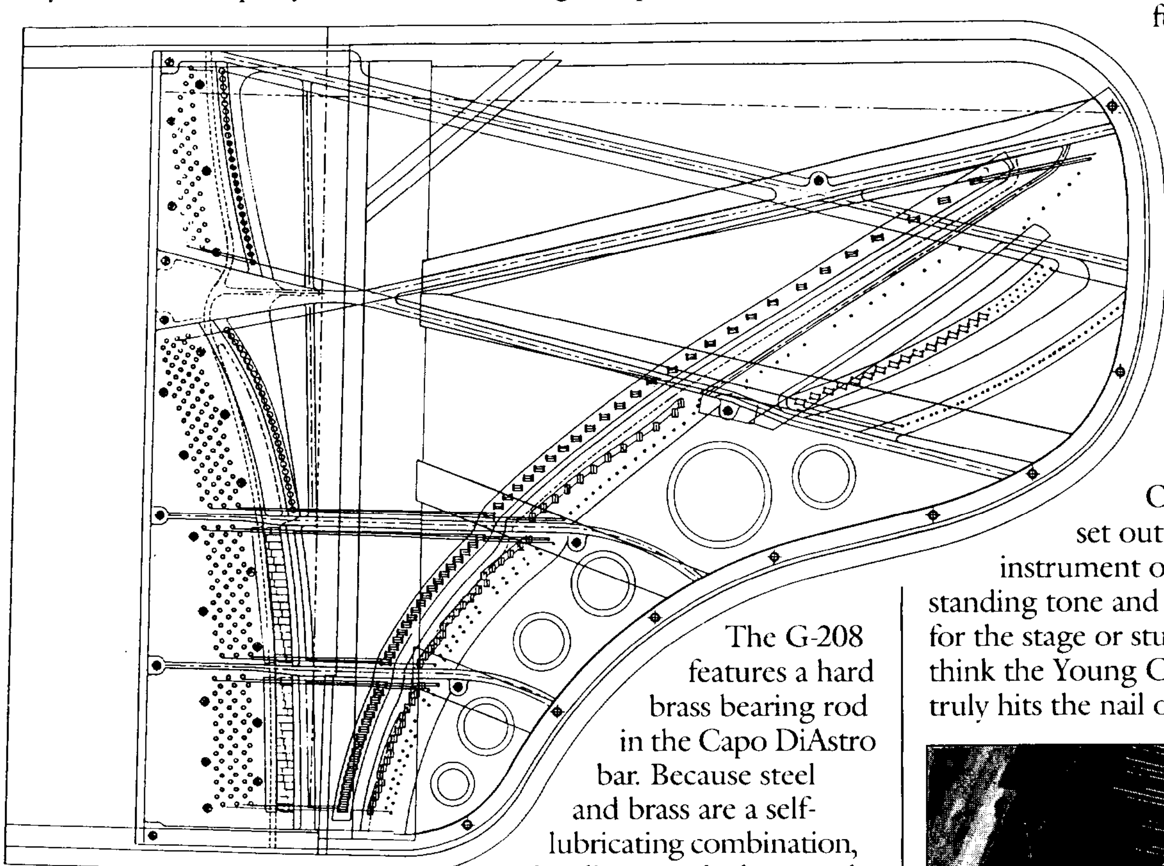
Local chapters and committees are the foundation of PTG. Without local chapters, PTG would not exist. Without committees, the organizational work of PTG would be stymied. The work of local chapters and committees is the key to building a professional organization that responds to the needs of all its members. Local chapter officers and committee personnel donate their time as member volunteers to serve PTG.

I want to thank everyone, from our professional staff to all member volunteers, who work within PTG to build an organization that represents the interest of piano technicians to the industry and to the public. PTG is marching ahead because of you who volunteer time and talent to improve the profession.

A nuts and bolts guide to the new Young Chang G-208.

Our engineers are obsessed with the little things because they recognize the importance of attention to detail. But lately, they've become equally obsessed with big things, and the result is 6′10″ long. Our new G-208 grand is a departure for us and represents the smallest and largest of our latest innovations.

The G-208 is a 6′10″ grand piano of an entirely new scale design. It features our new "Asymmetrically Crowned" soundboard which places the highest part of the crown in each rib directly under the bridge providing maximum support under the downbearing pressure of the strings. This new soundboard design exhibits improved power, projection and tuning stability, and offers a longer soundboard lifetime. We're so pleased with this new design, we're now incorporating it into all our grand pianos.



The G-208 features a hard brass bearing rod in the Capo DiAstro bar. Because steel and brass are a self-lubricating combination, we've discovered a brass rod offers better control of strings during tuning. In addition, the brass rod is easily replaced later in the life of the instrument eliminating the need for reshaping of the capo bar.

We also took a close look at our action and developed an all-new action design which improves response without loss of projection or clarity.

Our new double duplex system terminates the strings at the rear of the bridge and near the tuning pins with duplex bars. Both duplex lengths of the strings for each note are then terminated in equal length offering improved sustain, projection and clarity.

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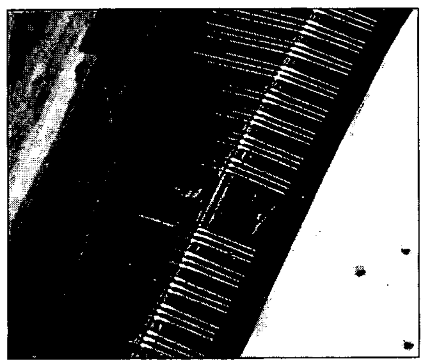

Because strings bear against a replaceable brass rod, tuning control is improved.

For technical information on our new G-208 grand piano, write to us at Young Chang America, Inc., 13336 Alondra Blvd, Cerritos, CA 90701. Or call 310/926-3200, ext. 237.

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Regarding PACE Lesson #15

I see a problem with the assumption made in Step #7, namely that C#4 can be finalized without having F3 and F4 finalized.

Let's say that seven beats per second is the correct setting for F3A3. Seven beats per second also comes out to about 14 cents that this third is widened. To make the thirds progress evenly, they should all be widened the same number of cents.

Example 1

F3		A3		C#4		F4
	14 cents		14 cents		14 cents	

All three contiguous 3rds are progressing evenly

Since you said we could establish C#4 even if F3A3 was set incorrectly, I propose the following example which will show why Step 7 has a problem. Let's say that F3A3 is set to six beats per second on 12 cents widened (The number of cents is double the beats of this third). (Beats occur at A4.)

Example 2

F3		A3		C#4		F4
	12 cents		12 cents		? cents	

Since the F3F4 octave is tuned the same as in Example 1, C#4F4 will equal 18 cents. The total of the three thirds was 42 cents in example 2. It will also be 42 cents here. Therefore 42-(12+12)=18

If we widen the A3C4 third three cents, we can even out the A3C#4 and C#4F4 thirds. However, the F3A3 and A3C#3 thirds will be uneven.

F3		A3		C#4		F4
	12 cents		15 cents		15 cents	

C#4 cannot be established using contiguous thirds if the F3 and F4 are incorrect. They are established by trial and error so that the beat rates progress evenly.

Electronic tuners or electronic aural tuners can establish the proper beating of the thirds by using some simple math. After setting up A2, A3 and A4 as described in Lesson 15, measure how much each of the six thirds is widened in cents. Add those amounts together and divide by six. That result will be the ideal cents widening that will establish an even progression of thirds within the framework you have set with A2, A3 and A4. This approach will not help the strictly aural tuner, however.

Fred Yonley, RPT

Michael Travis replies:

You're right, if you take the first sentence, "Tune C#4 to A3 so that there is a 4:5 ratio between FA-AC# and AC#-C#F (ascending series of thirds)," literally rather than as a suggestion for a place to start. A more exact wording for the first sentence would perhaps be "Tune C#4 to A3 so that there is *an identical ratio* between FA-AC# and AC#-C#F." That constant ratio can be 4:5 if your guess for F3 happened to be correct, and the F3-F4 octave were correctly tuned. However, even if your guess for F3 was slightly off (and the F3F4 octave were okay), you would still be able to find only one place for C#4 where the ratio between the lower pair of thids and the upper pair of thirds is the same. The ratio would not be exactly 4:5 (though it will usually be very close), but it would be identical for both pairs of thirds.

Another way to look at the results of Step 7 is by way of example. Assuming our three thirds add up to 42 cents wide for a good F3F4 octave (all beat rates shown are approximate), note how the AC# third stays the same width whether F# was initally tuned correct, sharp or flat.

1. If F3 is correct:

FA=14¢	AC#=14¢	C#F=14¢
7 bps	8.7 bps	10.9 bps

Ascending ratio: approximately 4:5 (x 1.25)

2. If F3 initially tuned 2¢ sharp:

FA=12¢	AC#=14¢	C#F=16¢
6bps	8.7 bps	12.6 bps

Ascending ratio: approximately 4:5.8 (x 1.45)

3. If F3 initially tuned 2¢ flat:

FA=16¢	AC#=14¢	C#F=12¢
8 bps	8.7 bps	9.5 bps

Ascending ratio: approximately 4:4.4 (x1.09)

Thus, no matter how you initially tuned F3 and F4, you will find only one setting for C#4 which satisfies the requirement that the lower pair of thirds and the upper pair of thirds have the same ratio. In cases 2 and 3 above, you would discover and correct any error in the Fs in Steps 8-9. However, you're finished with C#4 after performing Step 7.

Michael Travis, RPT

Piano Rentals as a Side Business

One thing I would like to bring to mind in this wonderful field of piano technology is the feasability of technicians being in the piano rental business along with their repair and rebuilding business. Consider the advantages for a moment:

1. You have someone else storing your assets for you.
2. You have a consistent income receivable every month.
3. The percent return on the investment in used pianos is better than anything else I can think of.
4. Your rental customer pays all expenses such as: moving, tuning, insurance, and monthly rental.
5. You are building a nice estate inventory for your family in case you should become disabled or worse.

Continued on page 14

Sticking Key Traced to Damper Spoon

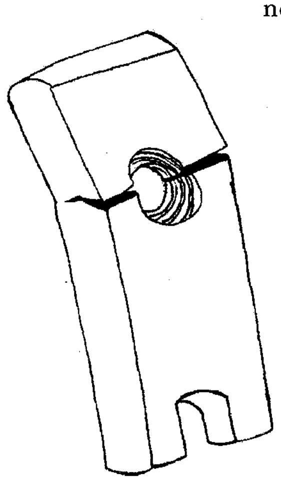
From W.R. Sullivan, RPT

Over 20 years ago, I encountered a sticking key problem (on a soft blow only) that baffled me. After checking every point I could think of, I called on Ted Snyder, RPT, of the Washington D.C. chapter. I knew Ted was good at action work. After thoroughly checking the action, he found that the damper spoon on the offending note had become corroded and rough, and had worn a hole in the damper lever felt down to the wood. Smoothing the spoon and replacing the felt corrected the problem.

Temporary Field Repair for Cracked Brass Butt Plate

From Ken Churchill, RPT

Suppose you're just finishing a tuning on an old upright, and a hammer assembly pops out of place in the middle of the piano. You shine your light in and behold a continuous brass rail. You remove the action and find the butt plate on that note cracked, but not broken all the way through. You knew there was something you needed to order, and now you know what.



Remove the butt plate and lightly clamp one side with your vise grips. Put a tiny drop of cyanoacrylate (super glue) in the crack and tighten the vise grips slightly until the crack is nearly closed. Remove the butt plate and do the other side. Now put the butt end-to-end in the vise grips and tighten carefully. Start the screw in the butt plate and work it back and forth to clean the threads. You may add a little glue to each side while the screw is in place. Remove a good butt plate from the top note of the piano and use it to replace the broken one. Carefully install the top hammer with the repaired butt plate.

Tips on Tuning Antique Pianos

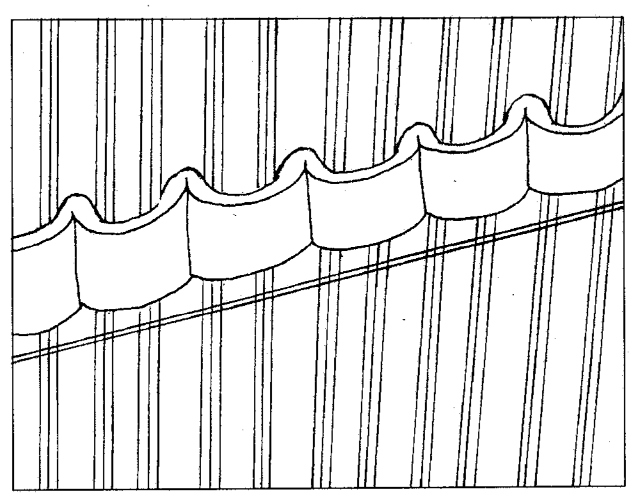
From Sid Stone, RPT

After reading the Q & A portion of the October *Journal* regarding antique pianos, I was prompted to share my experience with squares and "birdcage" pianos.

How to tune a square? It has been suggested that you roll the kitchen table up to the piano, lie down on it, and tune away. I have never done that but have tried other methods. In fact, there has been an evolution in the art of tuning square pianos; I can now tune a square or a "birdcage" in less than an hour, and I have never had a complaint about the tuning. Before starting any work on an antique piano I let the owner know that when I am through, it will sound better, but not like a concert grand. Conditioning the client is an important part of our service.

When tuning a square piano, I remove the lid and damper mechanism. I then move the piano away from the wall enough for me to get behind it. Using an electronic tuning device as a reference, I pluck the strings and tune, starting with A1 and going all the way up to A85 or C88, whichever the case may be.

In tuning a birdcage I remove the action and strip-mute the piano in the normal fashion all the way up and down. With the action back in, I tune the middle strings as usual. Then I remove the action again, this time strip-muting every other note (see illustration) and tuning the open unison strings.



Finally, I remove the action one last time and take out the mute strips, allowing me to tune the remaining unison string on each note to the other two strings. Can "birdcages" be tuned to Standard Pitch (A-440)? They can, according to Ralph Long, one of England's top tuners. Ralph says he tunes all "birdcage" pianos up to A-440.

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Q

On the level?

My love of playing the piano and rebuilding things led me to the piano technology field two years ago. During that time the tips I have gotten from the *Journal* have proven to be invaluable. I have two questions that have arisen during my limited experience:

1. When I read about voicing, it always mentions that among other things the stringer must be leveled among unisons. With the stringer having a common resting point at the V-bar and bridger, how would they ever become out of level, and if you can explain this question, how would you accomplish the leveling job?

2. On some of the older uprights I have rebuilt, I have been plagued by bobbling hammers. I realize this is caused by inadequate jack escapement but I am hard-pressed to resolve the problem without compromising the piano's regulation specification. I can always solve this problem by increasing the key dip to achieve a longer stroke, thus ascertaining an adequate escapement ,or I can adjust the regulating screw for an earlier escapement. Are there any other ways of solving this problem while keeping ideal regulation?

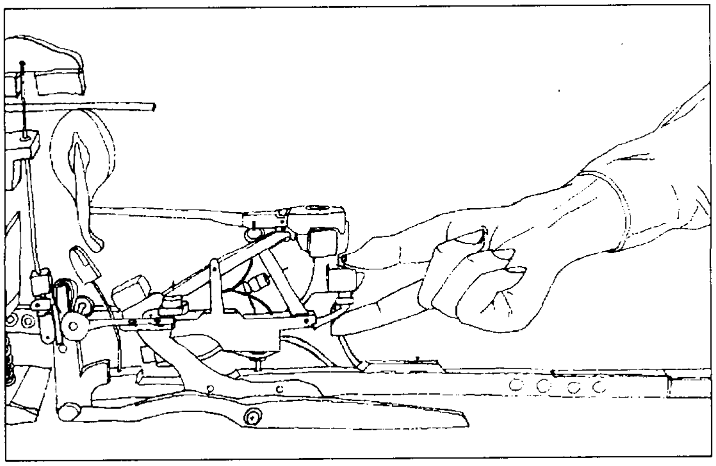
Douglas A. Loriz

A

From Steve Brady, RPT

I can think of at least three reasons why the strings of a unison group might not be level with each other. First, the holes in the agraffe are not always drilled in a perfectly straight line, meaning that strings passing through them will naturally not be level. Second, imperfections in the casting and finishing of the capo bar can have a similar result. Finally, music wire always has a natural curvature from being stored in coils. This curvature doesn't seem to disappear completely even when tension is put on the string. Depending upon the plane in which this curvature occurs in each individual string as it is put on the piano, there is ample opportunity for one string to curve slightly up while its neighbor curves slightly down, thus producing an out-of-level unison group.

To test for string level, play the key in question and step on the sostenuto pedal to keep the damper off the strings. Then, block the hammer against the string by applying your finger to the tender of the jack as shown here, pressing the tender into the let-off button felt until you can feel the hammer coming into contact with the strings. This is only possible when the let-off is set fairly close to the string.

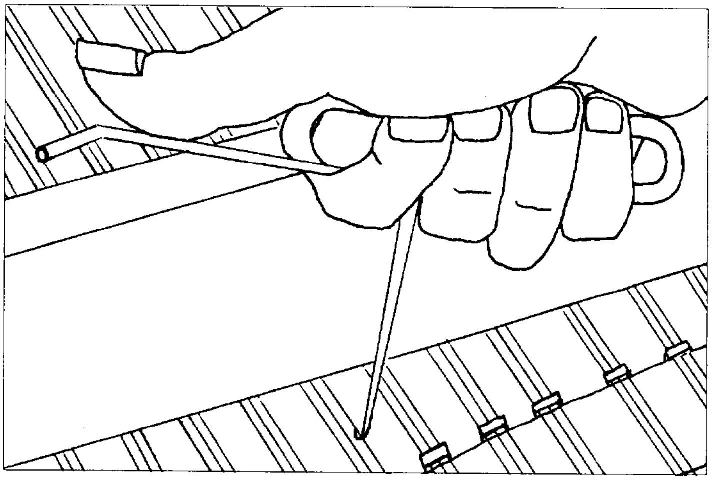


With the hammer blocked against the strings and the damper lifted, pluck each of the strings in the unison group to hear what kind of sound it makes. What you want to hear is the muted sound of a damped string. If one or more of the strings sounds clearer than the others, it indicates that the string is being contacted by the hammer later than the others, which will mean an out-of-phase condition when the note is played. This usually makes the unison difficult or even impossible to tune, as well as making the tuning on that note less stable. The out-of-phaseness will also make the tone of the note sound "twangy" and lacking in focus, power, and clarity.

To correct the condition, first make sure that what you have is actually a string leveling problem. Look at the hammer from the front to see if the top is level and square to the sides, or if it slopes off one way or the other. If it slopes, correct the shape with a sand file and perform the plucking test again to see if the problem goes away. If the problem is still there, feel across the strings with your fingertip right in front of the damper. Do the strings feel to be the same height?

At this point the problem usually needs to be corrected by lifting the strings which are low, since it is more difficult to persuade a string down than it is to bring it up. If one string feels higher than the others, lift the remaining strings to the level of the higher one. If one string feels lower than the others, lift that string level with the others. The lifting is done with a small string hook applied as shown on the next page, about an inch or so from the termination point.

Q&A



As you pull up on the string, draw it towards the termination so as to produce a bend in the wire at the termination point, rather than a kink at the point where you applied the string hook.

This process is essential to good tone regulating, and though it can be time-consuming, yields rich rewards in improved tone quality and tunability. The same procedure applies to vertical pianos.

For a comprehensive answer to Douglas's second question, see this month's PACE Technical lesson on page 40.

Editor's note: The following question was submitted several months ago and assigned to Del Fandrich, RPT, who decided to answer the question by writing a substantial article on the subject. That article, "Tuning Stability in Pianos," appears on the following pages

Q

How can I improve tuning stability?

This concerns tuning stability. I have some customers whose pianos seem to stay in tune longer than others. I suspect that it is because of humidity that some pianos go out of tune quickly. (Now I also realize that I do not have a lot of experience and that it may be my lack of skill that causes pianos to go out of tune quickly). I have some customers, one school and several churches, where the tunings hold very well — even with only one tuning a year. These pianos are in houses, churches and schools that are air conditioned throughout the summer.

Then I have several pianos where I receive call-backs because the piano is out of tune. When I checked these pianos, one school had the outside doors open and there was a terrific rainstorm outside. Others were really hot and un-air-conditioned. Also, there are several churches that only get air-conditioned on Sunday and during the week the building gets hot.

If I suspect that a piano is having humidity problems, what can I do to find out? How can I convince my customers that it is not my fault if they do have humidity problems? And if it is my fault, what can I do to improve? How can I get a piano to stay in tune for a long time?

David Vanderhoofven

Del Fandrich

Letters

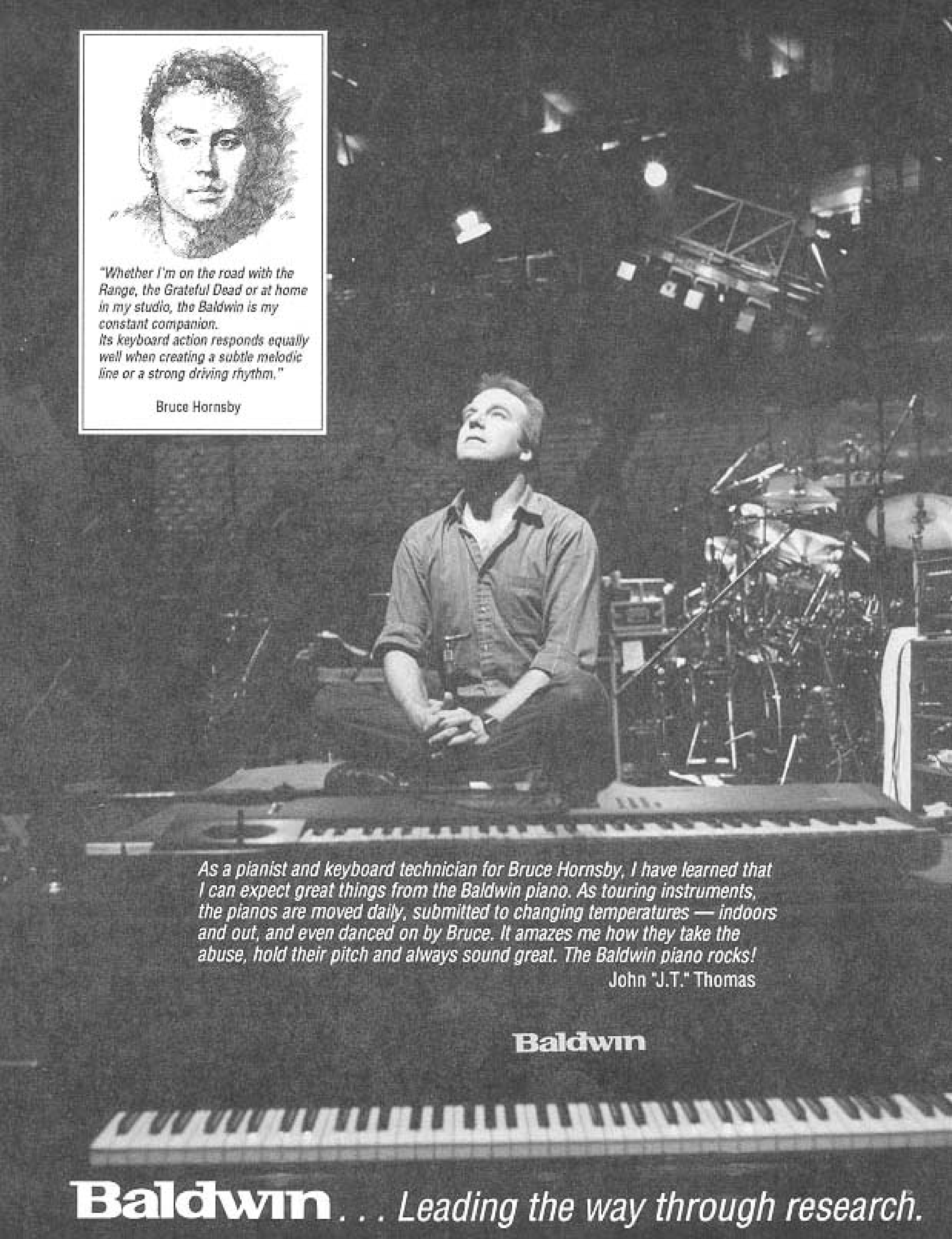
Continued from page eight

Here in San Antonio I can buy a good used spinet or console piano for between $250 and $400. I put it in good playing condition and rent it out for $35 to $45 per month. The piano pays for itself within one year and I still own it. You repair someone else's piano, collect the money and spend it, and look for another piano to repair. The only repeat business you have is the tuning business. Every six months to a year you collect a tuning fee. With rental pianos you collect a good fee every month and require the rental customer to pay to have this piano maintained every six months at their expense. So you are creating a service customer and a rental customer in one person.

How to get into this beautiful rental business? First of all make up your mind to do it. Then plan a budget to spend a percentage of your piano service income on buying pianos. If you buy only one piano per month, in one year you will own 12 pianos bringing you the second year (at $35 each per month) $420 per month. The third year would bring $840 per month, and the fourth year $1260 per month, etc. This is better than repairing and buying and selling. Lump sums of monies seem to disappear. But monthly incomes seem to always be there. The big challenge is within yourself, because the market demand is out there waiting for your rental product. Tax advantage: You can depreciate the pianos and charge off your repairs on them.

If you have any questions, I will gladly join in any answer discussion on the subject.

David M. Dacbert, RPT


"Whether I'm on the road with the Range, the Grateful Dead or at home in my studio, the Baldwin is my constant companion.
Its keyboard action responds equally well when creating a subtle melodic line or a strong driving rhythm."
Bruce Hornsby
As a pianist and keyboard technician for Bruce Hornsby, I have learned that I can expect great things from the Baldwin piano. As touring instruments, the pianos are moved daily, submitted to changing temperatures — indoors and out, and even danced on by Bruce. It amazes me how they take the abuse, hold their pitch and always sound great. The Baldwin piano rocks!
John "J.T." Thomas
Baldwin
Baldwin . . . Leading the way through research.

A: Tuning Stability In Pianos

By Del Fandrich, RPT

Piano tuning instability has plagued both piano owners and piano tuners since the dawn of time — as defined by the invention of the instrument — and will probably continue to do so as long as they are made mostly out of wood and iron. Some causes of tuning instability are normal. The effects of 220 - plus steel strings under high tension stretching are normal. The twisting and racking effects of somewhere between 35 and 45 thousand pounds of string tension acting on a fairly simple wood and iron framework are normal. There isn't much either the piano owner or tuner can do about those things. But there are some other causes for tuning instability that we might be able to do something about.

Sometimes abnormal tuning instability can be blamed on inconspicuous design and/or construction problems, about which more will be said later. Other times both the reason and solution are obvious. For example, is the piano located next to, or in front of, a heating or air-conditioning duct? Is it sitting in direct sunlight? If the home or building is not well insulated, is the piano located against or near an outside wall. Simply moving the piano to a kinder location may be all that is necessary.

As implied above, the basic overriding problem leading to tuning instability is the ever-changing climate of the world our pianos live in and its effect on the wood parts of those pianos. Pianos like the same climate conditions that our own bodies like best — a temperature of 72° F. (22° C.) and 40 to 45% relative humidity (RH).[1] This combination of temperature and RH will result in wood stabilizing with an equilibrium moisture content (EMC)[2] of approximately 8%. Pianos, specifically the wood in them, would prefer that neither of these conditions ever change. Varying either temperature or RH will bring out any stability problems lurking inside a piano. Of the two, a change in RH will have the most effect on tuning stability.

Wood is a hygroscopic material. That means it absorbs (takes on) moisture from the air when the RH is high and it desorbs (gives up) moisture to the air when the RH is low. As the RH increases and decreases throughout the year the moisture content of the wood parts of the piano rises and falls as it tries to maintain equilibrium.

When wood absorbs moisture its cell structure swells and when it desorbs moisture it shrinks. This happens fairly quickly in soundboards since they have so much surface area and are so thin. Soundboards in most good-quality pianos are still made of solid spruce planks edge - glued together to form a large, so-called solid, panel that is only about 5 to 10 mm thick. Left on its own a wood panel of this type will expand and shrink a great deal with varying climate conditions.[3] For example, in the winter when the board is fairly dry (in a room at 70° F. and 15% RH wood will stabilize at an EMC of 3.5% to 4.0%) it will be lightly crowned and there will be relatively little upforce[4] against the string plane. When summer comes and the temperature and the RH goes up, let's say 80° F. and 80% RH, the EMC of wood will now increase to about 16% causing it to expand. With this change in moisture content the soundboard will try to expand across grain by approximately 3.0% to 3.5%.

A small experiment illustrated this phenomenon: I took a solid Sitka spruce studio piano soundboard panel (see Figure 1) from a climate - controlled conditioning room and tested a control sample for its moisture content.[5] The initial moisture content of the control sample was 4.0% by weight. I drew a line diagonally across the panel (across grain) and made two marks exactly 1500 mm (59.06") apart. Then I put the panel in a warehouse that was not climate controlled. The temperature varied from 90 to 100 degrees F. and the RH from 85 to 95%. Within 24 hours the soundboard had grown so that the marks were 1531 mm (60.28") apart — an expansion of 31 mm (1.22"), or just over 2.0%. After 48 hours the two marks were 1546 mm (60.87") apart — a total growth of 46 mm (1.81"), or about 3.1%.

Now, this is what soundboards would like to do if they could. As installed in pianos, though, soundboards are not unrestrained panels. On one side of the board are glued a series of stiffening ribs. Because the ribs are glued more or less perpendicularly to the grain angle of the soundboard they effectively prevent the panel from expanding or contracting across the grain as it would if it were unrestrained[6] (see Fig. 2). also, the perimeter of the soundboard is glued onto a fairly rigid rim (or back assembly) so even without the ribs its ability to expand would be limited.

Because the soundboard is prevented from expanding across the grain, the compression building up within the panel will try to find somewhere else to go. It will next try to belly the soundboard out a little more (away from the ribs) and create more crown.[7] Of course, it can't go very far since, again, it is restrained. This time by the string plane pressing down against the bridges. An (almost)

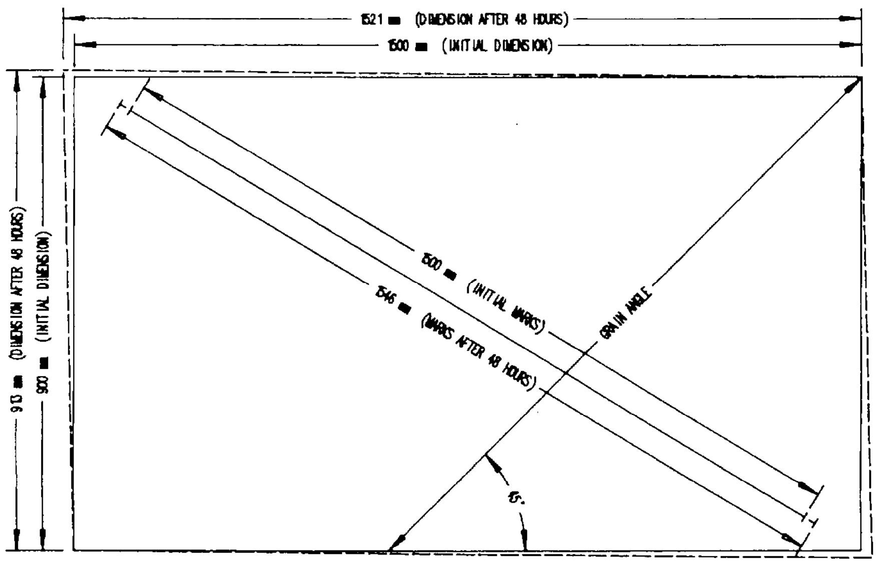


FIG. 1. Growth of an unrestrained Sitka spruce soundboard panel starting at 4.0% moisture content and exposed to a climate of 80 to 85 degrees F. and 80 to 85% relative humidity for 48 hours.

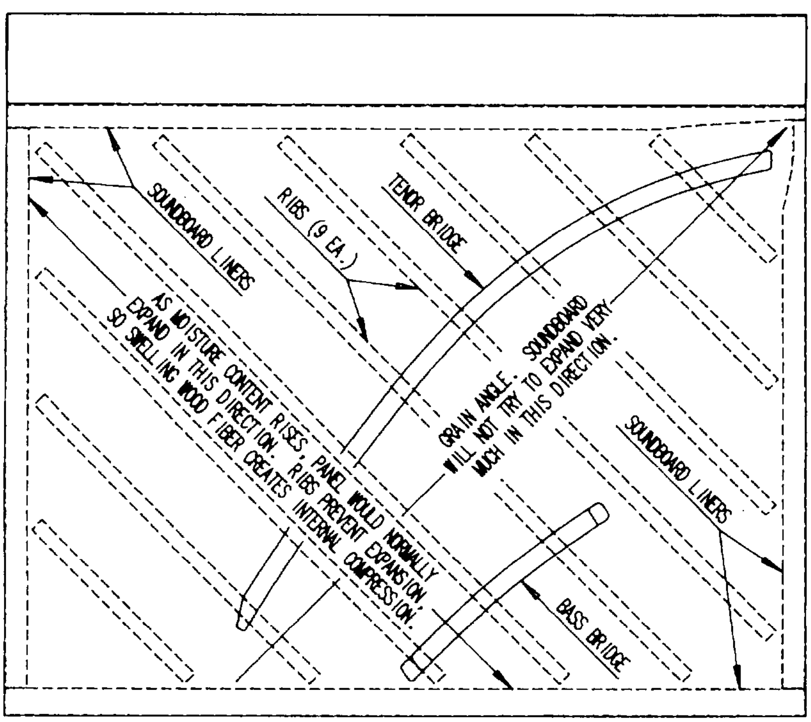


FIG. 2. A typical upright back and soundboard assembly. As the moisture content of the wood soundboard panel rises, it would normally expand across the grain as indicated above. Since the ribs glued to the back of the soundboard prevent this, the expanding wood fiber will create internal compression within the panel.

irresistible force meeting an (almost) immovable object. The string plane is not quite immovable though. It will allow the soundboard to belly out a bit more if the force acting against it becomes great enough. As the compressive force created by the expanding wood cells becomes great enough it will belly the soundboard enough to overcome the downforce from the string plane pressing against the bridges. So, as the wood goes, so goes the pitch. The string plane will deflect a little bit, the strings will be stretched tighter — their tension will increase — and the pitch will go up by some amount. (See Figure 3)

Exactly how much the pitch increases is a function of many variables. Among them are:

- the actual change in the wood moisture content,
- the actual increase in fiber compression inside the soundboard,
- the condition of the soundboard, its age, etc.,
- the overall design of the soundboard and rib system,
- the amount of downforce resulting from the piano's downbearing settings, etc.,
- the compliance of the rim and belly rail assembly,
- the overall design of the string scale including the total amount of string tension — usually somewhere between 35,000 and 42,000 lbs.

(The foregoing has been a description of what happens when RH increases and wood is expanding. The opposite takes place when RH drops. Soundboard crown decreases and the upforce against the string plane decreases. The downforce of the string plane presses the bridges back down and, because there is a slight drop in string tension, there will be resulting drop in pitch).

Pianos with laminated[8] soundboards are much more resistant to humidity - related problems than are their solid- panel cousins. Because the wood veneers are cross-banded

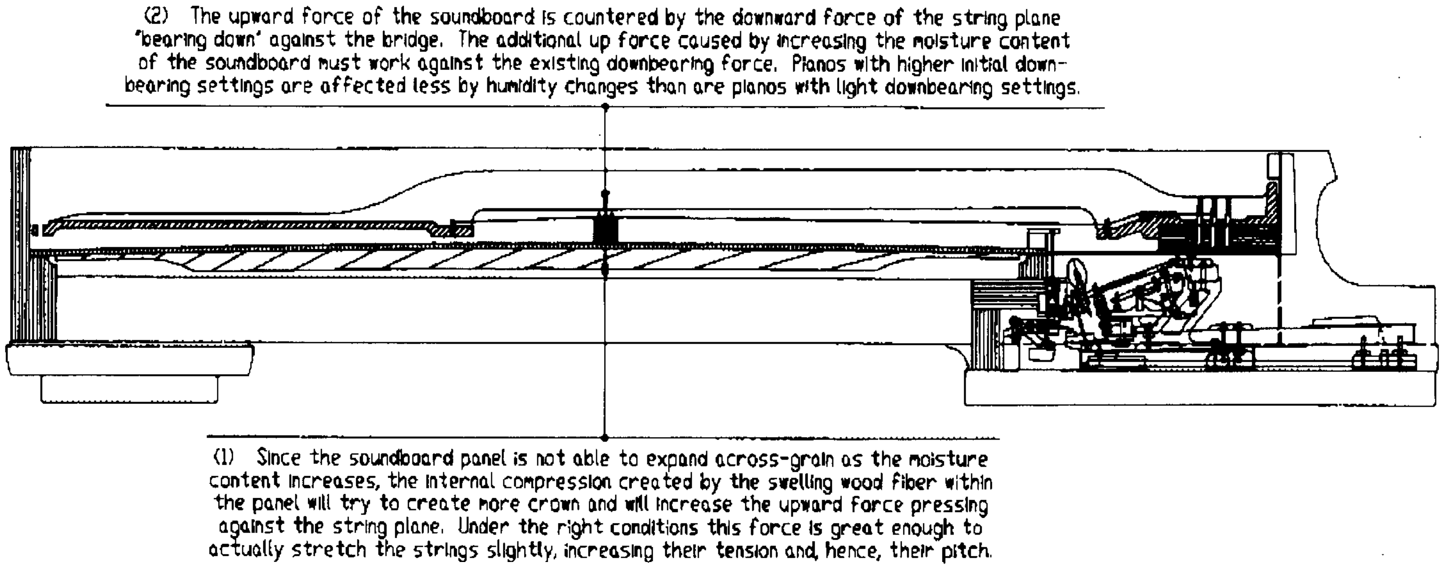


Fig. 3. A typical grand piano rim, plate and soundboard assembly. The soundboard is held rigidly in place by the rim of the grand piano (as shown in the cross-section above), or by the back assembly of an upright piano.

(one veneer is laid on top of another, each crossing the other at 90 degrees), the expansion and contraction of the soundboard panel is restricted to little more than the normal longitudinal rate of dimensional change — usually around 0.25% to 0.5%. Since the panel is not trying to expand or contract dimensionally, it places a more constant upforce against the string plane, hence at least the potential for better tuning stability.

Pianos with relatively thick soundboards seem to drift slightly higher and lower than those with thinner soundboards in the same climate. I don't have hard numbers on this, just my general impressions over the years. They also have fewer humidity - related problems such as compression ridging and cracking. This seems to be due to the greater potential for internal strain due to the larger cross-sectional area of the soundboard panel. Alas, these pianos generally don't sound so good either, so you pays your money and takes your choice!

Other factors besides the soundboard can cause a piano to go out of tune as the climate changes. Although the annual ups and downs of a piano's pitch are pretty much inevitable, a piano should stay fairly well in tune with itself even as it goes through these cycles. Pianos with structurally weak rims and belly rail assemblies (you know who you are!) tend to go out of tune more with themselves as opposed to a fairly uniform drift up and down in pitch. This appears to be due to their greater tendency to shift, twist and just generally move around more erratically than more solidly built instruments.

Poorly fitted pinblocks (mostly in grands) can also have an effect on tuning instability, although the instability is not always climate- related. The pinblock must make some minimum amount of contact with the plate flange to prevent it from shifting around under stress. And, no, wedging a few pieces of veneer and/or your business card between the pinblock and flange will not solve the problem of a poorly fitted pinblock.

I have looked at some pianos in which I'm sure the pinblock was deliberately installed with a gap between the block and flange. Usually these pianos use lots of pinblock screws used to make up for the lack of contact between the block and the plate flange. It could be a little cheaper to install a pinblock this way, maybe. I think it could actually work if done properly, but on the pianos I've seen built like this the screws had worked loose over time and the pianos were impossible to keep in tune.[9]

I remain unconvinced that plate bushings have any long - term effect, either good or bad, on tuning stability. They were originally developed as an aid to center the drill bit while hand drilling the pinblock. After stringing and one or two seasons the remaining wood is so badly crushed as to be of no practical value in stabilizing the tuning pin. In my own experience, I've never found that pianos with plate bushings were either more or less stable than those without them. Other factors always seem to override the presence (or the lack thereof) of the bushings. (To every rule there must be an exception. This time it is the phenolic bushing used in some Knight pianos — they seem to work pretty well).

Other instability problems not directly caused by humidity changes include those provoked by excessive friction at the various string-to-plate contact points. This friction can make it next to impossible to get the string to render smoothly while you are trying to adjust their tension. You can too easily end up with gross variations in string tension between the different segments of the string. The most glaring example of this design defect are those grand pianos which draw the string up and over a 40 - to - 50 mm rounded and felted section of the plate between the agraffe and the tuning pin. Even the slightest amount of corrosion and/ or rust makes it very difficult to properly equalize tensions on both the speaking side and the tuning pin side of the string.

Too little deflection angle at the string's speaking length termination, i.e., across the bearing bar (or "V-bar"), the capo d'astro bar or agraffe, can also contribute to tuning instability. In this case there is so little friction at the bearing points that pin setting becomes an elusive goal at best. Usually low string termination angles at the tuning pin end are used to accommodate "tuned" aliquot string segments — a practice which is counter-productive and usually costs the piano both power and clarity in the very sections it is designed to help, especially in upright pianos.

Pianos that have been strung with uneven tuning pin height cannot only be hard to tune, but can exhibit considerable tuning instability as well. It is virtually impossible to equalize the twist along two adjacent tuning pins of unequal height.

Loose plate bolts and/or screws can contribute to tuning instability problems. They should be checked periodically. And no, aside from an initial inspection of a piano you have never worked on before, I do not recommend that you tighten each and every screw, nut and bolt in the piano before every tuning. Once every couple of years or so is adequate in most areas[10].

But, back to our humidity problems. If a piano is showing signs of instability that you believe are humidity - related there may not be much you can do about it without adding things to the piano. And you may need to prove this to your customer. To demonstrate how changes in RH are affecting the piano's tuning stability you'll need some records. A recording hygrometer monitoring climate conditions at the piano for a year or so along with a daily or weekly measurement of absolute pitch would be ideal. Unfortunately, good recording hygrometers cost upwards of $1,000 and require a lot of attention. Few of us have either the money or the time to devote to a project of this magnitude, so on to plan B.

Get one of the electronic hygrometers offered by PianoTek[11] or one of the other suppliers. They're fairly cheap and should be accurate enough for what you need. (Also, being electronic with their glitzy digital readouts, they look way cool and should impress just about everybody !) Every time you are called to tune or service one of these pianos record the temperature and humidity along with the pitch of every A or C in the piano — you'll need an Accu-Tuner[12] to do this with any precision. Every time you're called back to check the tuning, make sure you have your trusty hygrometer with you. You'll soon find that when the RH is high the pitch will also be high and when the RH is low the pitch will also be low. This isn't rocket science. Within a few months — at most one or two seasonal changes — you should have enough evidence to demonstrate a pattern that even the most jaded church committee or school board can understand and appreciate.

So, what to do? Since RH depends on both temperature and the absolute moisture content of the air, it's not possible to maintain a uniform level of RH by regulating just temperature[13]. Ideally, the rooms or buildings where the pianos are located should be climate- controlled, meaning both temperature and RH are controlled — although if those responsible for the piano can't figure out how to come in out of the rain and close the door nothing is going to help!

Since this is not likely to be done — committees or boards will happily spend the $40,000 to $60,000 necessary to purchase just the right piano for that hard - to - please artist, but they seem to have a hard time spending $4,000 to $6,000 necessary to ensure its longevity and long-term performance — your second option is to climate-control the instruments themselves using Dampp-Chasers [14].

The complete system consists of a humidifier for adding moisture to the air when it is too dry, a heating rod to raise the temperature either within the instrument itself, or at least within a close proximity of it, to lower the RH, and a humidistat or control switch which senses the RH and operates either the humidifier or the heating rod as necessary. The complete system is designed to maintain the RH within the piano at a level of approximately 42%.

Use your own judgment as to how much of the system any given piano needs. For example, it's not likely that you'll need to add much moisture to the air in Missouri. So just install heat rods and a humidistat. Follow their directions and mount them under the soundboard area. (Never put them under the pinblock of a grand unless you really like replacing pinblocks and restringing pianos at your own expense just for the experience! Also, never install just the heating rod without the humidistat switch. No matter what the janitor or the wife/husband tells you, they won't remember to unplug the heaters when things dry out in the winter.) You'll probably need at least two — sometimes more — heat rods for grand pianos. One should do it for uprights. On the other hand, in Arizona or New Mexico you'll probably not need to do too much to dry things out, but you may need to add moisture to the air just about all year.

None of the above is intended to negate the need for regular tuning. Nor is it intended to provide excuses for the lack of proper tuning technique. I can't count the number of times I have encountered a piano with a reputation for tuning instability, only to have it suddenly, miraculously, stabilize once it has had that magical stability elixir called pin setting and "pounding in" applied. (And, no, I don't mean hitting the keys so hard you drive them through the bottom of the keybed, but you do have to strike the key hard enough to shake things up at least a little bit).

"Tuning for Stability" is not the theme of this article, but it is a technique (art?) that needs to be mastered before one can be considered a professional tuner/technician. If you think this may be a problem, either sign up for a tutoring session at one of the PTG Conventions or seek out an experienced tuner in your area for some assistance (and, yes, you should be prepared to pay him/her for their time at their going rate).

I also recommend having available copies of the excellent PTG Technical Bulletin #3, "Humidity Control" for any customer whose piano is having what you believe to be an abnormal problem with tuning instability. Just being able to give them a copy of an official technical document will add much authority to what you are telling them.[15]

[1] **Relative Humidity**(RH). "The ratio of the amount of water vapor present in the air to that which the air would hold at saturation at the same temperature. It is usually considered on the basis of the weight of the vapor." In other words, the amount of moisture in the air compared with the amount of moisture the air is capable of holding at a given temperature.

[2] **Equilibrium Moisture Content** (EMC). "The moisture content at which wood neither gains nor loses moisture when surrounded by air at a given RH and temperature." In other words, it is stable, neither swelling nor shrinking.

[3] **Soundboard Finishes** The finish applied to the soundboard, whether varnish or lacquer, will only slow this process. Even though some finish materials are called "water proof" there are no wood finishes that are vapor proof.

[4] **Upforce** Upforce is the opposite of downforce. Downforce is the strings, load against the soundboard resulting from the strings bearing down (hence, "down bearing") against the bridge. Upforce is the force the bridge is.

[5] **Measuring Moisture Content — The Oven-dry Method** Electronic moisture meters are not accurate below about 6.0%. The only reliable test for moisture content below 6.0% is to weigh a small sample — in this case a piece of Sitka spruce measuring 25.0 x 25.0 x 8.0 mm - that has been conditioned identically to the test panel. This is its initial weight, or **Wi**. The sample is then dried in an oven at 100 to 105 degrees C. for 24 hours or until a constant weight is reached. The sample is then weighed again. This is its oven-dry weight, or **Wod**. The initial moisture content of the original sample was **MCi = (Wi - Wod)/ Wod x 100**.

[6] **Soundboard Expansion and/or Contraction** In normal atmospheric conditions throughout the U.S. a typical soundboard panel without ribs would expand and/or contract by approximately +/- 1.5% across its width. By gluing the stiffening ribs across the back of the panel this is held to less than 0.25%.

[7] **Compression Crowning** Compression crowning — the practice of drying the soundboard panel to 3.8 to 4.0% before ribbing and then allowing the internal compression generated by the expanding wood fiber after the panel is exposed to normal climate conditions to create soundboard crown — was the only technology used to crown, or belly, soundboards for the first few decades of the piano's development. Indeed, it is still the method of choice for some manufacturers.

[8] **"Laminated"** A much more expensive word than "plywood."

[9] **Upright Pinblock Flanges** The pinblock flange is not really necessary in the vertical piano — at least not to provide for tuning stability. The back post assemblies (or — in the case of the Fandrich Vertical Piano, the Grotrian Upright, the Yamaha WX-7 and perhaps others — the back panel) provide the necessary pinblock support. Upright pianos without back structures must have pinblocks fitted to proper pinblock flanges if they are to be stable instruments.

[10] **Threaded Plate Bolts** Don't tighten the plate bolts on Baldwin grand pianos using their floating plate mounting system. Ever. Unless, of course, you really like drilling out and replacing hardened steel bolts. These bolts are threaded through the plate and require no tightening after the piano leaves the factory. The Fandrich Vertical piano uses a similar plate mounting system and should be treated the same way. The plate screws in both pianos are normal wood screws and screw into a wood pinblock. They should be checked from time to time as per your normal procedure).

[11] **Electronic Hygrometers** To learn more about electronic hygrometers, contact Pianotek at:

Pianotek Supply Company
Robert Marinelli
214 Allen Street
Ferndale, MI 48220
Phone: (810) 545-1599
(800) 347-3854
FAX: (810) 545-2683

[12] **Accu-Tuner** To learn more about the Sanderson Accu-Tuner, contact the company at:

Inventronics, Inc.
Paul L. Sanderson, Business Manager
9 Acton Road
Chelmsford, MA 01824
Phone: (508) 250-9292
(800) FAST-440
FAX: (508) 250-9293

[13] **Changes in Temperature and RH** In a typical home, and to a lesser extent schools, churches, etc., temperatures are controlled at a fairly constant level throughout the year. RH, however is rarely controlled. To do so requires adding moisture or removing moisture to maintain a constant RH level. During the winter the cold outside air brought inside will be quite dry once it is heated to comfortable temperatures even if the RH outside is high — cold air cannot hold much water vapor in absolute terms. Summers are usually a little easier to cope with since the process of cooling the air with an air conditioner will remove at least some of the excess moisture on very humid summer days.

[14] **Dampp-Chaser** To learn more about Dampp-Chasers, contact the company at:

Dampp-Chaser Electronics
Robert Mair, President
PO Box 1610
Hendersonville, NC 28793
Phone: (704) 692-8271
(800) 438-1524
FAX: (704) 692-8272

Or you can contact one of their many distributors.

[15] **Technical Bulletins** All PTG Technical Bulletins are available from the PTG Home Office. You can find their address on the masthead of this magazine.

EDITOR'S ROUNDTABLE

TOPIC: Capo d'astro Bars

Steve Brady, RPT
Journal Editor

Welcome to the Roundtable, a feature which explores a different topic each time, with input from a number of sources. The Roundtable will be a recurring feature in the *Journal*, not every month, but several times a year. If you like simple answers and bland agreement about technical issues, you probably won't like this feature. The idea behind it — in the spirit of the meetings which appear transcribed in the book "Piano Tone Building" — is to examine as thoroughly as possible some of the subjects in our profession about which there is not a consensus at this time, in the hopes that we will eventually come to a consensus as ideas are aired, tried out, and discussed again.

The topic I've selected for discussion this month is grand piano capo bars and their related issues, such as: What is the real purpose for capo bars, as opposed to agraffes? What is the most effective and durable shape for the capo bar profile? What causes capo-related string noises, and how do we get rid of them? This topic was a recent item of discussion in the "Pianotech" gab group on the Internet. I've used some of the contributions from that interchange of ideas as a nucleus for this "virtual discussion," expanding it to include some other viewpoints, and making a few modifications for the sake of flow and clarity.

Our participants in this roundtable include the following:

- Bill Spurlock, RPT, independent technician and vendor of specialty tools for the trade.
- Michael Wathen, RPT, technician at the University of Cincinnati College Conservatory of Music.
- Ron Torrella, RPT, technician at the University of Illinois.
- Dennis Johnson, RPT, technician at St. Olaf's College in Minneapolis.
- Vince Mrykalo, RPT, technician at Brigham Young University.
- Ed McMorrow, RPT, independent technician and author of "The Educated Piano."
- Harold Conklin, piano designer and engineer.
- Chris Trivelas, RPT, independent technician and co-developer of the Fandrich Vertical Action.
- Phil Sloffer, RPT, technician at Indiana University in Bloomington.

Background

The capo d'astro bar (see Figure 1) performs the same functions as the agraffes, that is, to terminate the speaking length of the strings by providing a resistance to the up-bearing force of the strings upon it. Some argue that the mass of the capo bar provides longer duration of tone than do agraffes. William Braid White, on the other hand, stated "...the mass of metal employed is considerably greater than in the 'agraffe' method, and the resultant influences upon tone-quality are clearly disadvantageous. Further, the work of tuning is rendered more difficult..." Samuel Wolfenden, a contemporary of Braid White, explained why capo bars are necessary: "In the top octave of grand pianos it is somewhat difficult to place [agraffes] of the ordinary pattern, because the room required for the hammers does not really allow sufficient space for the tapped holes to receive the [agraffes], even though they be made to overhang considerably." Although a few European makers may still use agraffes all the way to the top in some of their pianos, the capo bar is the norm and the reality we work with in grand pianos today. Good rebuilders pay attention to the condition of the capo bar before installing new strings. Many technicians now also reshape capo bars in the field, without replacing the strings.

Bill Spurlock initiated the current discussion by asking for input on a new tool he's carrying, shown here in Figure 2. The tool was designed by Ken Slater, RPT, of Cleveland, Ohio, to make re-shaping the capo bar profile faster and easier than with conventional files. It is about 4" or so long, and the "business end" is a groove which fits over the point at the bottom of the capo. Industrial diamond abrasives, embedded in the groove, act to resurface the capo bar quickly as the tool is drawn back and forth along it.

Spurlock: I'm getting ready to have a new order of these tools made up, and I would like your input. Several technicians have suggested that the radius of the tool, where it contours the capo bar, be made smaller...

Wathen: By smaller radius of the capo bar do you mean a sharper curvature? My own quasi-scientific research leads me to believe that a not-so-sharp curvature is more beneficial than one that is sharp. Why?

First: The strength of a surface is dependent upon the mass density just below the surface. For example, craftsman woodworkers are well aware that a sharp chisel will remain sharp longer if the bevel of the chisel is not too acute. In the case of the capo bar it seems that you could expect more string definition or better termination with a sharper curvature just like you could expect the chisel to have a sharper end with a more acute bevel, but this good string definition deteriorates rapidly to a level below that of a moderate curvature. Razor blades do not remain sharp very long.

Second: a larger surface for the string to contact on the capo bar ultimately aids in the duration of the tone, the reason: static friction. It has been shown that a string vibrates not only in the direction of the hammer blow, but in fact the direction perpendicular to the hammer blow can be viewed as an energy reserve that captures a good portion of the energy from the initial blow and gradually gives it back to initial blow direction which in turn gives it over to the bridge-board system (Weinreich, J. Acoust. Soc. Am., December, 1977). In terms of a grand with a capo bar this means that the termination of the string needs to be not only the obvious up direction but just as importantly it needs to have a side termination at the capo bar. This can only be accomplished with a strong enough static friction force that can keep the string from moving sideways. It is my conjecture that the zinging sounds that are so often annoying in this section of the piano most likely occur because static friction becomes kinetic friction; energy is lost by sideways movement of the string at the capo bar. By the same reasoning one should probably not use any type of lubricant on the capo bar.

I also remember some discussion maybe ten years ago about hardening the capo bar through heat treatment. I guess the belief was that a harder surface would resist the tendency of the strings to cut into the capo. That seems good enough, but is it desirable?

Brady: I think Michael's first point is correct. Other things being equal, a sharper edge will indent more easily than a blunt one. I guess the real question is whether string grooves are always the culprit when capo bar noise is present in a piano, and indeed, whether grooves in a capo bar — per se — are necessarily a problem at all.

McMorrow: Weinreich does not seem to realize that proper tone regulation involves fitting the hammers to the strings so as to minimize the hammer energy that is distributed into a horizontal mode. In my experience, horizontal mode equals bad tone.

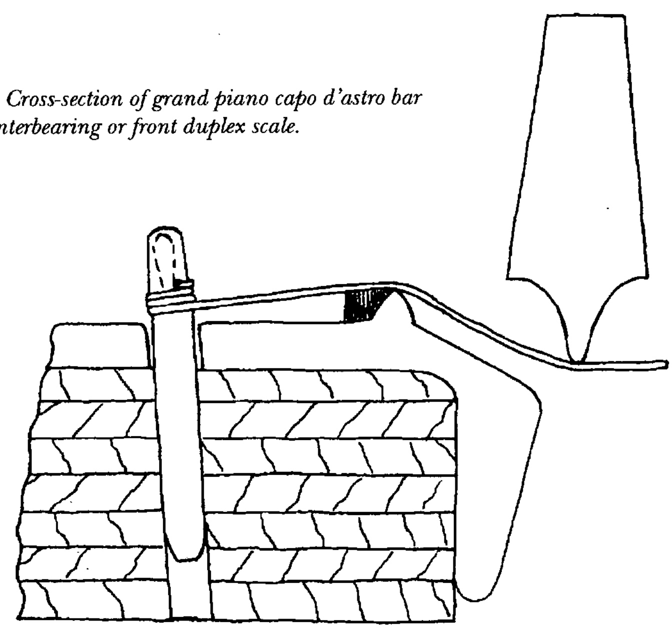


Figure 1. Cross-section of grand piano capo d'astro bar with counterbearing or front duplex scale.

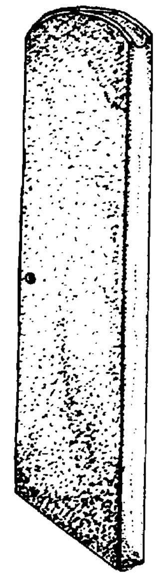


Figure 2

Piano manufacturers are usually lax about establishing the proper profile to the capo in the grand or the V-bar in the vertical. Most pianos will not display overtly objectionable symptoms of their less-than-ideal profile when the strings are new (although a few will buzz right from the start). The buzzing or breakage problems usually arise only after the piano is a few years old or a few years after it is restrung. However, over time, as the strings form permanent bends around the capo bar, they will: begin to buzz with a metallic, snare drum-like sizzle at all dynamic levels or only with loud playing; lack a warm singing tonal character even during soft playing (yet the agraffe section sounds fine); exhibit too-frequent string breakage at the capo considering conditions of use.

Wathen: My preference for capo bar profiles is a question mark. The best system I have seen is that of the SD-10 and SF-10 Baldwins. A 1/16" radius seems about right. Next chance I get, I'll measure it. I have dressed many capo bars in my time but... if I have gotten good results it has probably been more the result of chance than of calculation.

McMorrow: I did extensive study and experiments with capo bar hardness, shape, and other relevant piano design features about 15 years ago. The results are addressed in my book. I have continued to use these specifications and procedures on countless pianos in the most demanding circumstances and have never had further capo problems.

What I found to be the most durable, serviceable, and tonally significant specifications for the capo bar are these: The ideal capo shape is a definite V shape, with the contact point at the wire held to a .5 mm width. There is no magic angle for the V shape; what is important is that the string is not able to vibrate into the bar. Keep in mind that the capo is a V bar, not a U bar. The capo must be softer than the string so that the string can self-machine a groove for itself. The string will not cut into the capo bar like a cheese cutter! It is not the grooves that buzz, it is the profile of the capo that lets the grooves buzz!

Consider the nature of piano wire and you will conclude that we must treat it gently. If you deform the outer circumference of a piece of piano wire even slightly, and then flex it back and forth at that point, it will readily break there. Also, piano wire is very stiff. To impart maximum energy into a string, you must deflect it as much as possible. The shorter and stiffer the string, the more important it is that you have the undamped pivot termination like I am advocating. A pivot termination allows the best tone, and string life is maximized by the minimal internal flexing of the string at the V-bar.

Wathen: Several years ago I felt proud to have discovered a roughly cast capo that had not been dressed at all in a Steinway D from the mid-sixties. I was going to get it right. I carefully filed and checked and refiled then continued dressing the bar with various grades of emery cloth. This piano was going to be so improved! I had been tuning it for nearly 10 years. When all was put back together it did sound better than it had but it was still a big letdown. The capo section was full of zingers. I tried the big Robinson lever and numerous other remedies all to no avail. In the end we jammed little mutes in the duplex, which killed the zingers and the sound. Now about three years later it is sounding better and many of the zingers have disappeared...

Torrella: Wouldn't this have been solved with some voicing? I seem to get good results getting rid of zingers — after some persistance — by doing some deep needling on the front and back of the offending hammers, gradually getting shallower as I approach the nose. Maybe I'm thinking of a different type of zinger...

Wathen: The type of zinger that results from poor termination at the capo bar is immediately detectable. Place a finger in the duplex portion of the string and it will disappear. The tone will also be noticeably duller. No hammer voicing here.

Torrella: On the contrary, the problem you describe as "zinging," at least as it manifests itself to me, seems to have more to do with voicing than with shape of the capo bar. I, too, once thought the capo bar (i.e., poor termination) was the problem, but no amount of dressing and redressing the capo bar worked for me. Frustrating, too! Especially when you're in the customer's house and they're watching everything you do (out of curiosity) and asking questions. Nothing is more demoralizing than, after explaining what you're doing and why you're doing it, the expected result isn't achieved.

Without trying to sound like an advertisement — rather giving credit where it's due — I found what I think is the answer to the "zing enigma" in Rick Baldassin's publication, "Voicing the Renner Hammer" [Renner USA, 1992] (it comes with every set of Renner hammers). Rick does a thorough job of covering what voicing entails, and one of the entries is "Noise in Capo Section." — which is what I think we've been referring to as "zing." Following is what Rick has to say:

Noise in Capo Section — This is most noticeable in the first capo section. Play a note in this section, then mute out the front duplex section while playing. If there is an objectionable tone which goes away when this first front duplex segment is muted, then deep needling higher in the shoulder is required. Do not permanently mute this front duplex section as this will cause a substantial loss of power. Deep needle from 10:30 to no higher than 11:30, and from 1:30 to no higher than 12:30, to the full extent of the needles. Be sure that the needles are aimed toward the two points to the side of the molding [see figure 3], thus preserving the triangle-shaped area under the crown in which we do not needle. We would suggest that you proceed very carefully here, one stitch at a time, and do as little as possible, as too much needling in this area will reduce power.

I have used this method of eliminating that "zing" successfully (knock on wood) for the last six months. While there may be some merit to the speculation that the shape of the capo bar has some bearing (sorry about the pun) on capo section "zinging," my decidedly unscientific experience shows that eliminating that "zing" requires hammer voicing. That's not to say that one shouldn't bother to reshape the capo bar. I think the condition of the capo bar is quite important in good tone production/duration as well as decreased likelihood of string breakage.

McMorrow: Solving true capo bar buzzes by needling is not possible. Almost all capos can be reshaped on location, without restringing. I developed a procedure that is detailed in my book.

This brings us to front duplex tuning. Capo buzzes "sizzle;" duplex segments "whistle." Once you have shaped the capo to eliminate the sizzle, you may find some notes or groups of notes now have a whistle. This is the one that goes away with a very, very light touch on the front duplex segment. Softening hard hammers definitely will improve this situation.

Johnson: Ever wonder why we never

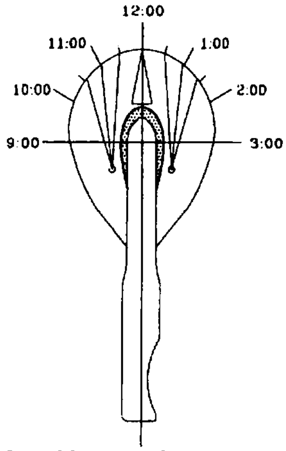


Figure 3. Grand hammer showing two points for aiming needles (Reprinted from "Voicing the Renner Hammer," by Rick L. Baldassin. Reprinted with permission)

have this problem on pianos without the duplex? Have you noticed that when we shape and polish the bar perfectly these high harmonics often get worse, or appear for the first time? That is because we made the string contact less under the bar, and now the duplex more easily resonates. The real solution is what Mason & Hamlin did years ago — individually moveable duplex termination string rests. I can't remember if the new Masons have this feature, but they should. The old Baldwins at least had a moveable bar that we can reposition. But the ideal place for each will not form a straight line with its neighbors, rather, if it was a straight line, it should follow more closely a mirror image of the angle formed by the front bridge pins for each note. But that would not fit in the space available. Sometimes, I have taken a carefully cut piece of felt, just the right size not to put pressure on the duplex wire segment, and placed it under the duplex on the plate. This will dampen those high harmonics that continue to offend after mild voicing, without noticeably hindering sustain or power. This is only a last resort, however, preferred to major needling.

A few years ago, I took the trouble on a Baldwin with the moveable duplex termination, to calculate an ideal location for each note, and it was impossible to satisfy each note given the straight line duplex piece (presuming the given tension). In each duplex section, there are at least a couple of notes that will resonate with some octave or fifth partials of the string length.

Can it be that expensive to use individual, adjustable duplex termination string rests? Does someone not trust us with this power?

McMorrow: Exactly. The old plates had tunable front duplex string rests that the tone regulator could adjust to compensate for casting variables. Newer plates don't have this feature. I have found it possible to shape round brass stock to insert under the string between the capo and duplex string rest so this segment can be carefully "detuned" from a prominent harmonic of the fundamental.

Sloffer: These are some of the tricks I know about capo bars or the things I try when a piano needs help in the "cash register." Any of these things may or may not work, and if they work they may either be short term or last longer than you expect. None of these things would work on new Baldwins with the "termination pieces." However, old Baldwins respond pretty well.

Not necessarily in this order:

Push the string back and forth on the capo bar, i.e., move the string back and forth, in and out of the string cuts. I use a brass stick but a dull screwdriver will work too.

Loosen one end of the string about a half to three quarters of a turn and pull up the slack on the other side. This puts a new string surface against the capo bar. This also works on agraffes.

Loosen the strings (I do this one unison at a time). Rub the capo bar back and forth with a dull screwdriver in and out of the string cuts. Rub the capo bar with 220 grit sandpaper. Rub the strings where they touch the capo bar.

Reshape hammer, level strings, travel hammer, fit hammer to strings.

Try moving the action in and out and test for the best sound. Make a note of the difference and then rehang that one hammer accordingly. I sometimes have one or two hammers in the capo area that are hung at 1/16" closer to the hammer flange than the rest of the hammers.

Check front-to-back angle of hammer. As old hammers are reshaped they will over-center. Re-hang as needed.

If you decide to put a mute in the strings try this method. I use a piece of buckskin about 1/8th" wide or less and usually not longer than 1/4". Stick this piece of leather between the 1 and 2 or 2 and 3 strings just in front of the capo bar and behind the front aliquot. As you play the note, move the leather forward and backward and leave it where it sounds best.

Torrella: In my experience, the screwdriver idea (leaves burrs on the capo bar) and rubbing the strings back and forth on the capo bar (the grooves do a nice job of marring the string) are probably good recipes for broken strings! I've not had good luck trying to pull strings around the hitchpin without winding up having to contend with false beating strings.

Spurlock: I think Michael has pointed out that there is more to clean treble sound than just the shape of the capo bar. I, too, have had pianos that continued to zing after a "proper" shaping, even after string leveling, reshaping, and checking string deflection angles. I suspect capo bar smoothness is very important, but some other factors include updraft angle, string tension, length of front duplex wire and diameter of wire, hammer hardness, as well as the profile of the capo.

Like Ron, I too have had the experience of eliminating string noise in the capo section by resorting to hammer voicing after all capo remedies had failed. I felt like I was treating the symptoms instead of the problem by needling the hammers, since I could stop the noise by touching the front duplex section with a finger. However, some deep shoulder needling stopped it without appreciably changing the tone.

Johnson: Absolutely! Voicing can usually take away or minimize the noise which remains even after shaping and cleaning the bar. But I am convinced that the real problem is that the duplex segment sympathetically resonates with the speaking lengths on these problem notes. Compare the angle of string termination lengths by the front bridge pins with the angle of the duplex string rests. Ideally the duplex should be just the correct tension and length not to be activated audibly by the speaking length. But these duplex lengths are approximated and cast into the plate. That is why some notes are problems and others aren't. I believe that the real function of the duplex is to enable the wire to vibrate more completely at the bar, as Ed McMorrow described, giving more power and sustain, and less inharmonicity. These noises are a by-product of that objective when the length and/or tension is not ideal.

Also, notice how much the hall or room acoustics can affect this problem. Our hall has a movable stage which they change from the west to the north wall occasionally. Against the north wall this problem is nearly impossible, but on the west side there is no problem. Fortunately, most faculty prefer the west side, too. Actually, I'm not sure how this works, because the north side is a wall of windows (if you can believe it, in a concert hall) and somehow, all high frequency noises are more audible against that wall. But I thought glass would absorb sound waves, not reflect them.

Brady: Actually, glass is one of the best reflectors of sound waves, especially high-frequency waves. According to a chart on page 152 of "The Acoustical Foundations of Music," by John Backus, plate glass absorbs only about two percent of high frequency sound waves, as opposed to nine percent absorption for plywood, and 87 percent for acoustical plaster. That explains why you hear more of this kind of noise with the stage against a glass wall.

Spurlock: Where capo zings are a problem not solved by dressing the terminations or voicing, Kent Webb of Baldwin recommends applying a tiny drop of glue to each string in the front duplex section. This will change the mass (and therefore the natural frequency of vibration) of these wire segments, and eliminate undesirable noise without dampening or weakening the tone of the note. I know it sounds mickey-mouse, but it's a whole lot more practical than moving string rests. I've tried it on an SF-10 with the capo termination pieces with good success.

Mrykalo: This may not be important, but I've used PVC-E glue on the front duplex to cut noises. It seems the closer you get to the capo bar itself, the more effect it has.

Trivelas: I tried this on a particularly nasty and stubborn buzz and it worked without adverse effect on the tone. But did it work because it lowered the resonant frequency of that section of string, or because it partially damped it?

McMorrow: The glue drop on the front duplex segment has to touch the string rest to work, in my experience. It most certainly does not change the tuning; it can only work by stiffening the upper duplex termination, thus inhibiting the free vibration of the duplex.

Spurlock: I do not advocate dampening the duplex segment by gluing the string to the string rest. When the problem is an unpleasant or too-loud duplex sound (as opposed to a metallic buzz) I have found the drop of glue usually works very well. And while there may be a slight dampening effect on the string segment's vibration, there is definitely a major effect on the pitch of the duplex segment. Using an Accu-Tuner, I measured the (plucked) pitch of one front duplex wire and found it to drop by 54 cents after applying a small drop of white glue to the middle of the wire. The net pitch drop after the glue had dried was 23 cents. It seems to me this method works by significantly de-tuning the segment, changing its resonant frequency.

[Editor's note: Harold Conklin, designer of the Baldwin SD-10 and SF-10 pianos, was kind enough to contribute the following explanation of his designs to our discussion. He reminds us that he no longer works for Baldwin, and that his statement may or may not represent Baldwin's current position.]

Conklin: If a piano designer attempts to tune the fundamental frequencies of the treble counterbearing string lengths (the string lengths between the capo bar and the ridge on top of the tuning pin panel) to frequencies of partials of the speaking lengths of the string, the result will likely be unpleasant noises. The "unpleasant noises" come from beats between the excited resonant frequencies of the short counterbearing string lengths and the frequencies of those speaking length partials that are near in frequency to the counterbearing length frequencies. In casting piano plates it is impossible to control the counterbearing lengths closely enough to end up with the counterbearing lengths tuned zero beat to partials of the speaking lengths. Therefore, in order to avoid "extraneous" noises due to beats, it is desirable to dimension the counterbearing lengths so that their fundamental frequencies will lie between two speaking length partials and will be separated from the nearest one preferably by at least a few hundred Hz. It is possible to do this with plates of conventional design by careful positioning of the counterbearing ridges on the casting pattern, and use of careful casting techniques.

To provide a long-wearing termination that does not change its shape and to control closely the counterbearing lengths so as to avoid the above problems, later model SD-10/SF-10 instruments used an individual termination bar for each treble note. By carefully selecting termination bar dimensions it was possible to achieve good results by using only two different types of termination bar (Type I and Type II). The only functional difference between the two was in the length

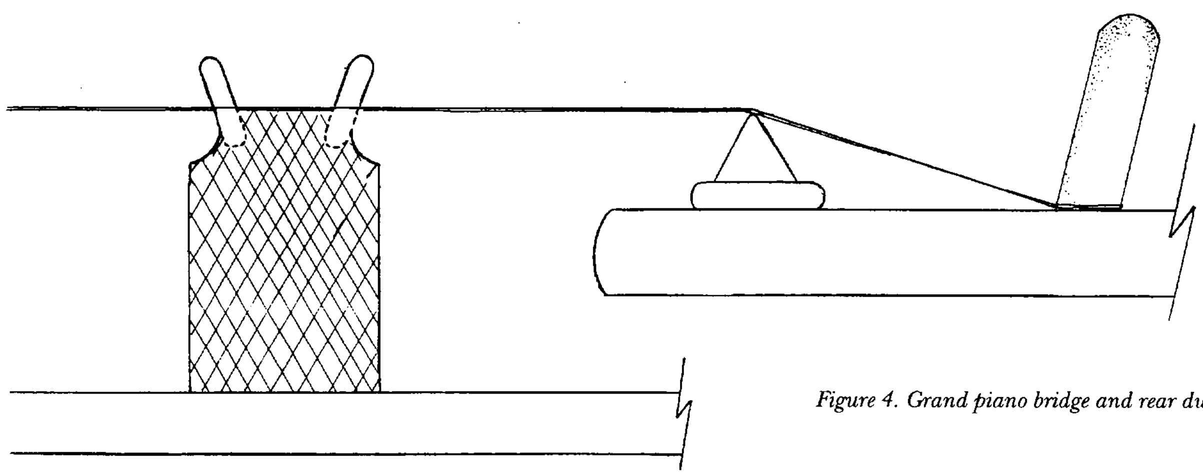


Figure 4. Grand piano bridge and rear duplex scale.

of the counterbearing. Only two to four Type II bars were used, the other bars being Type I.

These individual termination bars were precision steel castings that were hardened (harder than piano wire) for long wear without changing shape. Steel has lower internal losses than cast iron and gives improved tonal duration. After hardening, the bars were plated with electroless nickel, used as a "solid lubricant" to produce a surface on which piano strings can move with the right amount of friction to provide stable tuning, but not too much friction, which might cause excessive string wear and difficult tuning. Before the initial stringing operation, the bearing surfaces of each bar were to be covered with a very thin coating of petroleum jelly (Vaseline). This treatment should be repeated before any subsequent restringing of these instruments. It should never be attempted to file or re-shape the precisely cast string-bearing surfaces because the electroless nickel plating would be damaged.

The "duplexed" portions of the strings (between the bridge and hitch pins, see Figure 4) operate under quite different conditions than the "counterbearing" portions discussed above because the coupling within the string between the duplex length and the speaking length is much less direct due the use of a pair of deflection points (two bridge pins) to terminate the speaking lengths, instead of just one (the capo bar). Consequently, no undesirable effects result from tuning the "duplexed" portions near to the frequencies of the speaking length partials. In fact, an enhancement occurs which increases the apparent duration of the upper treble tones. However, when the lengths between bridge and hitch pins become longer than about four or five inches, the duration of their own vibrations can become undesirably long, and may require a damping means such as muting tape.

McMorrow: I agree with Conklin's first sentence, although it is my untested opinion that the unpleasant noise is not so much the front duplex beating with partials of the speaking length, but rather the front duplex sucking energy out of the speaking length, which weakens the sustained tone and unbalances the normal distribution of energy amongst the relevant partials.

Although some manufacturers may disagree, I have found overwhelming evidence of a direct correlation between string breakage and hard capo bars, My question is, to those who think that the capo must be as hard as or harder than the string: Why, then, do brass agraffes work so well? Brass is certainly softer than piano wire. Agraffes that are properly chamfered (I use the same spec as given for the capo) never buzz, in my experience. Those makers who harden the capo or worse yet, install hard metal inserts, invariably end up with treble string breakage and/or buzzing there.

As there is no magic angle to the V-bar, there doesn't seem to be any magic counterbearing angle either. It must be steep enough to have a little friction, as Conklin states, or the piano will be impossible to tune and the string spacing will not be stable. It must not be too steep, or the friction is too high and stable tuning is slowed tremendously.

Trivelas: What is the best shape and/or hardness for the capo bar? If there was a simple, straightforward answer to this question, I think we would have found it by now. What if it depends on other factors? The optimum shape for a capo on a high tension scale with a small string deflection angle may be different from the optimum shape on a piano with a lower tension scale and higher angle of deflection. And if the shape of the capo counts, so must the shape of the counterbearing bar (though less so). The length of the front duplex must also be a factor. And the hardness of the capo. We'd better throw in the weight and hardness of the hammers (my anecdotal evidence says that pianos with really hard hammers have more capo problems, and notes with longer front duplexes are also somewhat more likely to have problems). On some pianos, I've changed the strings, hammers, capo shape, string angle, and front duplex length and they still sounded the same and had some (fewer, thankfully) zingers. So I wouldn't be surprised if the bridge/soundboard system had something to do with it too.

Does this leave us in a featureless mush? Not quite featureless, I hope. We can probably find some parameters. Most of us would agree that a front duplex length of two inches (the typical speaking length of C88) is too long. Its pitch is too audible and tuning gets problematic as we feel the string pull through one friction point, then the next — not good for pin setting or tuning stability. As we get down to half an inch (depending on the angle of deflection and tension), we approach a clamped string termination instead of the preferred pivoting termination (preferred, that is, for the sake of this discussion). Similarly with the other factors, we can find the ballpark, but within that there is still significant variability. Unfortunately I know of no arrangement of factors which is completely immune to "zingers." My preference is a little more towards the more pointed and softer capo. That makes me feel like I have the most options (it's very difficult to change the shape of a hardened capo, for instance), but as for a defensible scientific basis for this preference, that has yet to be established. The theories I've heard on exactly how and where the buzzes occur are interesting but need more research before I'll be convinced. Does the string flatten a measurable amount at the capo? Does it flatten more on a hardened capo? The question of lateral termination of the speaking length is interesting. If moving the string back and forth on the capo had any effect on lateral termination, it would be to reduce it. Then why does moving the string often get rid of the buzz? It's amazing how much we still don't know about the little beasties.

McMorrow: I must admit it puzzles me that so many technicians still don't understand this relatively simple problem. It is one of the few in the piano structure that allows a fair amount of isolation so that they can be sure they are testing their "model" properly.

But what is most frustrating to me is how negligent most manufacturers are about capo and V-bar shape. Especially regarding vertical pianos where the design and circumstances do not easily allow for reshaping in the field. We as professional piano technicians should demand that they begin manufacturing pianos with the proven and proper configuration of plate-string termination points. There are plenty of old pianos still in use which have plate termination points like I described. They don't buzz and they sound good and they don't break strings excessively. I have 15 years of applying these specs to most of the pianos I service. Let's solve this one; to be free of capo and V-bar buzzes would make the service of pianos less frustrating and more satisfying, and it can be done.

Well, I think we're out of room for now. Perhaps we've raised more questions than we've answered, and maybe that's for the best. Obviously, there's room for research and experimentation here, and it's possible that we may come to a consensus on the topic of capo bars someday. As I edited this article, I was reminded how even our nomenclature is far from standardized. For example, some of our writers prefer to use the term "duplex" for the "front duplex" only, others for the "rear duplex" only. I've tried to make their references as clear as possible for the purposes of this article. Many thanks to all who have shared their perspectives in this Roundtable. Please remember that our purpose is not to make any individual or company look good or bad, but to share ideas and advance the common good of our profession. Letters of response are encouraged, and I look forward to continuing this discussion in future issues.

INHARMONICITY & THE TEMPERAMENT

ARTICLE • 6
Inharmonicity In Real Pianos

Daniel Levitan, RPT
Contributing Editor
New York City Chapter

Over the course of the five previous articles in this series we have developed a theory about the effects of inharmonicity on the beat rates of temperament intervals. However, our theory has up to now been purely speculative; we have yet to listen to a piano or lift a tuning hammer to confirm or deny it. *In this article, we will see how well our theory explains the inharmonicity of real pianos.*

The Theory Reviewed

There are three principal aspects of our theory, all of which we can confirm on the piano. The first concerns the kind of inharmonicity that I have been referring to in these articles as primary inharmonicity—the inharmonicity of a single string.

We made two assumptions about the fundamental nature of the primary inharmonicity of piano wire, assumptions which served as the basis of the rest of our theory:

- that the partials of a piano string are sharp of their theoretical pitches, and
- that they go increasingly sharp as they ascend the harmonic series.

The other two aspects of our theory concern the kind of inharmonicity that I have been referring to as secondary inharmonicity—the inharmonicity of intervals.

- First, we theorized that increasing levels of secondary inharmonicity tend to make an interval appear too narrow; and
- Second, that most temperament octaves in small pianos are positively inharmonic, and that all the temperament intervals contained within those octaves widen as the temperament octave widens.

Finally, if we can confirm that our theory is valid, we need to discover how secondary inharmonicity changes within the temperament section of a typical small piano. Then we will have in hand all the information we need to begin actually tuning temperaments.

Confirmation by Experiments

I am going to describe a series of experiments designed to demonstrate our theory of inharmonicity, and to allow us to discover the inharmonicity conditions present in any particular piano. Every piano is different, and the world—especially the world of pianos—can be a messy place. No matter how carefully you perform these experiments, you should expect to get some anomalous results. Our goal, however, is not to explain every aberration of each piano we come across. Rather, we wish to arrive by induction at a general understanding of inharmonicity. This general understanding will be much more helpful to us in our everyday tuning than a detailed picture of the inharmonicity of a single particular piano. If you work through these experiments with reasonable care on several different instruments I am confident that you will be able to generalize what you hear into a basic understanding of the phenomena involved.

All these experiments are designed to be done aurally. There is a reason for this. You may recall from earlier articles that primary inharmonicity is most easily observed with an electronic tuning device, such as the Sanderson Accu-Tuner, while secondary inharmonicity is most easily detected with the ear. Since we are for the most part seeking to understand secondary inharmonic effects, an aural approach is simply the most efficient. However, if you do have a tuning device on hand, you can use it to help you zero in on and fine tune the coincident partials in the aural tests. This will enable you to perform the experiments with a greater confidence in your accuracy and reliability, and will give you an insight into the underlying conditions of primary inharmonicity which result in a particular condition of secondary inharmonicity. Doing the experiments entirely by ear, on the other hand, will stretch your aural tuning skills and give you a better practical understanding of the effects of inharmonicity on aural temperament tuning.

It's true that the first aspect of our theory, our original assumptions about the nature of the primary inharmonicity of piano wire, could be more easily confirmed with a tuning device than by ear; still, I'd like to take the aural approach for that experiment as well. The fact that we don't need a tuning machine to reveal the underlying nature of piano string inharmonicity is quite interesting, I think, in light of the fact that this primary inharmonicity was a mystery to most piano tuners until well into our own century, when the use of electronic frequency counters finally made its nature clearly evident to all—almost a hundred years after the development of high-tension steel wire first brought significant amounts of inharmonicity into pianos. I believe that the reason for this lag in understanding of inharmonicity resulted from several factors. One is the lack until relatively recently of a clear and widespread understanding of the phenomenon of coincident partials and of the basic aural tuning tests which we all take for granted but which were not in com-

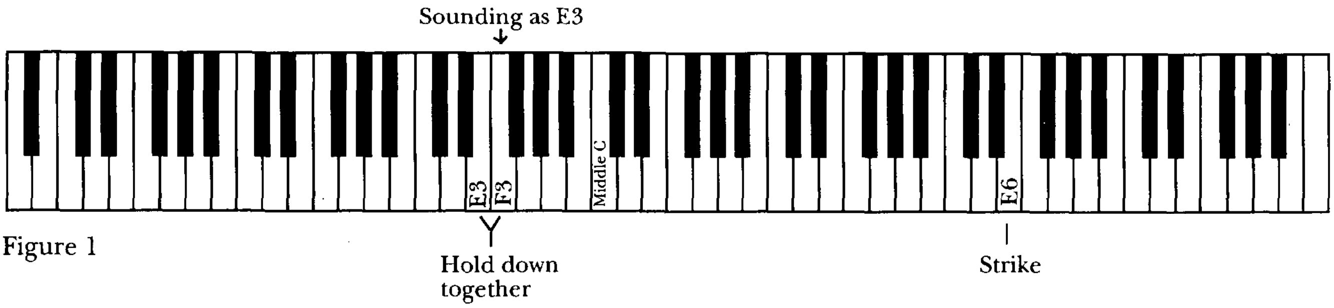


Figure 1

mon use until the early decades of our century. Familiarity with these tests is a necessary prerequisite for the kind of aural exploration of primary inharmonicity which I will describe. Another is surely the more artistic, less formally scientific approach to tuning which was much more prevalent in earlier centuries. In this approach, specific beat rates were probably rarely sought, or at least were considered subsidiary to other, more subjective considerations. Finally, of course, we must keep in mind the relatively low levels of secondary inharmonicity typical of the larger uprights and grands typical of the 19th century. It was in our century that piano makers first began seriously to shrink their products while at the same time seeking to retain volume and tone by maintaining high levels of tension, a process that culminated in our century in the development of the spinet. Not until these very abbreviated, highly inharmonic scales arrived on the scene did the difficulties presented by secondary inharmonicity to temperament tuning become so painfully obvious.

Proofs of Primary Inharmonicity

We will begin, then, by exploring primary inharmonicity by ear. The principal difficulty presented by an aural investigation of primary inharmonicity is the fact that we can't hear the primary inharmonicity of a single string with any degree of accuracy, if indeed we can hear it at all. Our ears can only apprehend secondary inharmonicity, the inharmonicity of intervals. But we can work around this difficulty by exposing the primary inharmonicity of the component strings of an interval as much as possible by making that interval a unison. The unison has no secondary inharmonicity when its component strings have the same levels of primary inharmonicity, but it does have secondary inharmonicity that can be clearly heard when its component strings each have different levels of primary inharmonicity. If we can create a unison whose component strings have greatly differing levels of primary inharmonicity, we can then hear secondary inharmonicity clearly exposed.

The Kind of Piano Needed for the Experiments. The following experiments require that you use a piano whose lowest plain wire note is F3, followed by a wound string which produces the note E3 on the same, unstepped, treble bridge. Quite a few small pianos, ranging from spinets to studio uprights, are scaled in this way. For the purposes of this experiment, avoid pianos in which the bass break occurs elsewhere, or in which there are no wound strings on the treble bridge, or in which the bridge steps back towards the upper bridge as the wound strings begin. In some cases you will be able, if necessary, to adapt the experiments to a piano with different scaling.

We can create an inharmonic unison pretty easily on our piano, even if its stringing is in perfect condition. We would expect a plain wire string and a wound string of nearly indentical lengths to have quite different levels of primary inharmonicity, and therefore we have good reason to suppose that a unison between F3, the last plain wire string, and E3, the first wound string, would have a significant level of secondary inharmonicity.

Preparing the Piano. Strip-mute the piano from F4 down. Flatten the single open string at F3 down one semitone so that its pitch matches that of E3. We now we have two strings, one wound and one plain, both sounding the same pitch, E3. If we attempt to tune them as a pure unison, we will find that we can't do it. The partials won't all line up at once. This is the sound of secondary inharmonicity in its purest form. Just as primary inharmonicity makes the partials of a piano string vary from pure multiples of the fundamental, secondary inharmonicity makes the coincident partials of an interval vary from their ideal matched condition. In the interval of the unison, of course, all the partials are coincident.

Let's tune the unison beatless at least at the level of the fundamental by using as a test note C1, whose fifth partial is E3. Flatten C1 a bit so that it beats as a wide major 17th with E3 at whatever is a comfortable rate for you to hear—for me, about four beats per second. Now tune F3 (sounding E3) to C1 to beat at the same rate. F3 and E3 are now a perfect unison at the fundamental. (To check this step with an electronic tuning device, set the machine to E3 and tune both notes to that pitch.)

Now let's isolate the various coincident partials of our unison and see how quickly they are beating. To do that, we'll "ghost" them—hold down the two notes that form the unison and strike the note corresponding to the partial we want to hear with a short, staccato blow.

First Aural Experiment. Ghost the unison at the level of the eighth partial by holding down keys E3 and F3 and striking note E6 (see Figure 1). Since

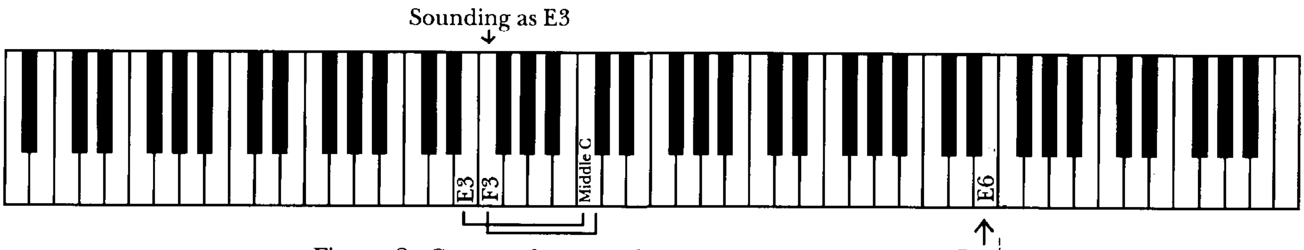


Figure 2: Compare beat speeds

Compare speeds of these minor sixths.

there may well be no damper on that particular note, damp it immediately after you've struck it by pushing the hammer up to the string on an upright or, on a grand, by muting it quickly with the butt of a rubber mute or wadded-up temperament strip. You will hear a beat, probably somewhere between four to five and nine to ten beats a second.

Now let's descend the harmonic series and see how the beat rates change. Release notes E3 and F3 to clear any residual beating, hold them down again, and ghost the unison at the level of the seventh partial, D6, by striking the note D6. You'll hear a distinct beat, but it will be slower than the one at E6.

In like manner, ghost the unison at the levels of the sixth partial, B5; the fifth partial, G#5; the fourth partial, E5; the third partial, B4; and the second partial, E4. By the time you get to the fourth partial the beats may be almost too slow to hear with confidence, and lower than that you may hear no beats at all. Ghost the eighth partial, E6, again; now compare its beating to the beating of the ninth partial, F#6, which will be quite a bit more rapid. The beats of partials much above the ninth or tenth (G#6) will be difficult to hear, both because they get to be so fast and because they become so faint.

Clearly, the two sets of partials are diverging at a rate that increases geometrically as they climb the harmonic series. Now let's explore our unison further to see if we can deduce the underlying nature of the primary inharmonicity which is causing this secondary inharmonicity.

Second Experiment. First, let's see if we can determine which string's partials are sharper. We can do this by adapting one of the interval tests that we are familiar with from aural temperament tuning. To discover which string's partials are sharper at the level of the eighth partial, E6, we can use a fifth-partial test, using test note C4, or a ninth-partial test, using test note D3. D3 is often already tuned to a pitch the produces a clear beat at three to four beats a second, whereas C4 will probably have to be sharpened a bit to produce an easily counted beat. In either case, ghosting the coincident partial, E6, is a necessity.

In the first case, compare the beat of the narrow minor sixth, E3-C4, to that of F3 (sounding E3)-C4 (See Figure 2). F3-C4 will beat faster, meaning that the E6 produced by F3 is sharper than the one produced by E3. In the second case, compare the beat of the narrow second, D3-E3, with that of F3 (sounding E3)-D3. D3-E3 will beat faster, meaning that the E6 produced by E3 is flatter than the one produced by F3. Or, just zero your tuning device in on E6 as produced by E3 and compare it with that produced by F3 (sounding E3). In any case, it should now be clear that the overtones of the plain wire string are sharper than those of the wound string.

We have discovered something about the relative pitches of the partials of the two strings. However, we still know very little about the nature of the primary inharmonicity of each string. The fact that the partials of the plain string are sharper than those of the wound string could be due to a variety of combinations of primary inharmonicity in the two strings. For example, we could be listening to a wound string with zero inharmonicity and a plain string whose partials go progressively sharper; or a plain string with zero inharmonicity and a wound string whose partial go progressively flatter (exhibiting negative inharmonicity); or even to a positively inharmonic plain wire string and a wound string with an equal amount of negative inharmonicity! Any of these combinations of primary inharmonicity in the two strings would create the same secondary inharmonicity.

How can we discover what the true nature of the primary inharmonicity of the two strings is? Before we run for our tuning devices, let's see if we can think of a way to find out aurally. Right off the bat, we can eliminate some of the possibilities by making a couple of common-sense assumptions. In spite of the fact that one of them is wound, the two strings of our unison are physically quite similar to each other. Therefore, we will assume that neither string has zero inharmonicity, since, if at least one of them exhibits inharmonicity, we would expect the other to do so as well. We can also assume that both must be inharmonic in the same direction, whether that direction is positive or negative; again, because it wouldn't make sense for two such physically similar strings to be so acoustically different.

Both strings are therefore either positively or negatively inharmonic. If both strings were positively inharmonic, then the partials of the plain string would have to be farther apart than those of the wound string; in other words, the plain string would have to have greater primary inharmonicity. If both were negatively inharmonic, then the wound string would have the greater inharmonicity. Circumstantial evidence, such as the well-known tendency of tuners to tune sharp in the treble, or the absurd conclusions about the inharmonicity of the rest of the piano's strings that we would be forced to draw under the second scenario, make it obvious that the strings must be positively inharmonic. But there's also a way to demonstrate the fact conclusively, by ear.

Remember that we observed that the partials of our inharmonic strings diverged more rapidly the higher they were in the harmonic series. It follows that if the plain wire string were negatively inharmonic, then its fourth and eighth partials, E5 and E6, which are in theory an octave apart, would in reality be noticeably narrower than a true octave. If the plain wire string were positively inharmonic, then its fourth and eighth partials would make a wide octave.

We can test which of these two possibilities is in fact the case by comparing the octave between these fourth and eighth partials of E3, E5 and E6, with a more or less true octave. Where can we find a relatively true octave like that on our piano? Earlier we saw that there was little increase in inharmonicity between the first and second partials of piano strings; let's therefore assume that the note E5 and its second partial, E6, make a relatively pure octave, and compare that octave with the same octave as it is produced by the fourth and eighth partials of our plain wire F3 (sounding E3).

Tune the major third C3-F3 (sounding E3) to beat at a comfortable rate, say four beats a second. Now tune note E5 so that the major 17th C3-E5 matches the beat of C3-F3 (sounding E3). Now the fourth partial of F3 (sounding E3), E5, is at the same pitch as the fundamental of note E5.

Now compare the eighth partial of F3 (sounding E3), E6, with the second partial of E5, which is also E6. Tune C4 so that the major tenth C4-E5, whose coincident partial is E6, beats at a comfortable rate, say four beats a second. Now compare that beat with that of the minor sixth F3 (sounding E3)-C4, whose coincident partial is also E6. The latter interval beats more rapidly, indicating that the E6 produced by F3 (sounding E3) is sharper than that produced by E5. Therefore, the octave E5-E6 produced by the fourth and eighth partials of F3 (sounding E3) is wider than that produced by the first and second partials of E5, and consequently F3 must be positively inharmonic.

Confirming Primary Inharmonicity with Tuning Device. We have now derived, from aural observation alone, all the information about the primary inharmonicity of piano strings that we needed to create our theory of secondary inharmonicity. We stand, in other words, where we stood at the beginning of the second article in this series. True, we could have done the same thing more clearly with a tuning device; but not necessarily more easily. To discern primary inharmonicity with a tuning device, we have to compare a reading of the fundamental of a note with the readings of its overtones. Unless we want only to read the partials which are powers of two—in other words, those that form octaves or multiples of octaves with the fundamental—we must remember that the machine reads in equal temperament, while the overtones of a note stand in a just relationship to the fundamental, and that therefore we have to go through the awkward step of compensating for equal temperament those readings of partials which are not a power of two above the fundamental. (The octave is the only interval which is just in equal temperament.) If you care to do this, the compensation factor is up 2.0 cents for partials three and six, down 13.7 cents for partials five and ten, down 31.2 cents for partial seven, and up 3.9 cents for partial nine.

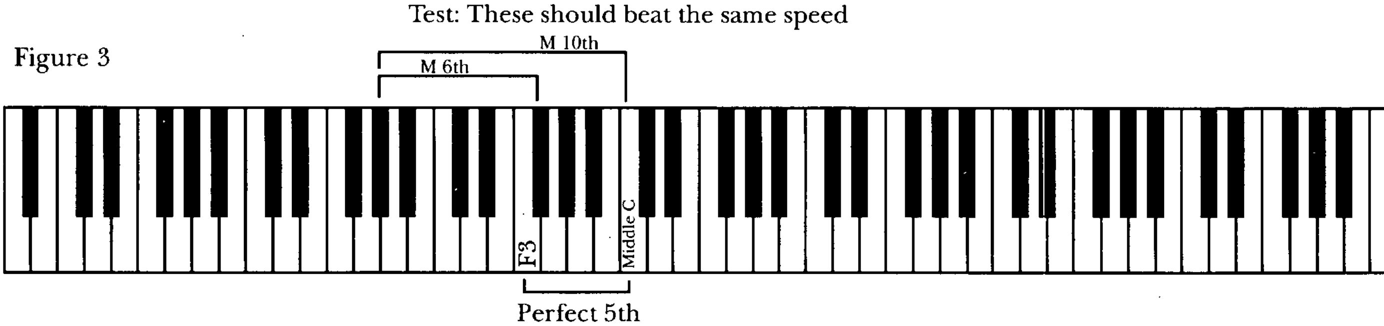
A series of compensated readings of the partials of a piano string shows that, indeed, the higher partials are sharp of their expected pitches, increasingly so at higher levels. Sometimes, however, the lower partials—the second or even the third—read flatter than expected, even appearing at times to be flatter than the fundamental. This could be construed as an example of negative primary inharmonicity; however, the negative inharmonicity in such strings is always confined to just the lowest partials, and therefore probably represents the effect of a different factor, such as the dampening effect of the back stringing, rather than true negative inharmonicity in the string. (See David Merrill's excellent article in the November, 1980, *Journal* for more on this effect.)

Aural Proofs of Secondary Inharmonicity

Proving the second aspect of the theory. Let's move ahead with the aural confirmation of our theory. Our next step is to confirm that, *when the fundamental pitches of its component strings remain constant, increasing positive secondary inharmonicity tends to make an interval appear narrower.* This is very easy to do with our piano in its current state. Our theory tells us that an interval whose upper note is a plain string and lower note is wound—in which the lower note, in other words, has a significantly lower level of primary inharmonicity than the upper—tends to have lower levels of secondary inharmonicity than one whose strings are both either wound or plain. Let's compare, then, the beat rate of the minor sixth, E3-C4, with that of F3 (sounding E3)-C4. E3 and F3 should already be in tune with each other at the level of the fundamental. If not, tune them so. Now compare the beat rates of the minor sixths, F3 (sounding E3)-C4 and E3-C4. The latter interval, with lower secondary inharmonicity, beats more slowly. Similar tests, which are sometimes less conclusive, comparing the major thirds, E3-G#3 and F3 (sounding E3)-G#3, and the minor thirds, E3-G3 and F3 (sounding E3)-G3, confirm the same results—

- Intervals produced by two plain strings have greater secondary inharmonicity, and so they appear to be narrower than similar intervals whose upper note is plain wire and whose lower note is wound.
- Intervals both of whose strings are

Figure 3



wound similarly have higher secondary inharmonicity than intervals whose upper string is plain and lower string is wound. To hear this, compare the major thirds C3-E3 and C3-F3 (sounding E3), and the minor thirds C#3-E3 and C#3-F3 (sounding E3). Those intervals, both of whose strings are wound, will appear narrower than those whose upper note is plain wire.

Proving the Third Aspect of the Theory. Confirming the first part of the third aspect of our theory, that octaves in smaller pianos tend to be positively inharmonic, is hardly even necessary; every tuner runs into that fact each time he or she sets the temperament octave of a small piano. The coincident partials of these postively inharmonic octaves run increasingly sharp as they ascend the harmonic series.

The fact that all the intervals contained within the temperament octave widen as the octave widens also hardly needs confirmation. Consider, for example, the major thirds; if one raises the upper note of an octave, the highest of the three contiguous major thirds that bridge the octave will widen and speed up, and that extra speed can only be distributed among the three major thirds by widening the lower two major thirds as well.

Additional Confirmation

While we're on the subject of octaves, though, let's confirm in a *different* way that *secondary inharmonicity levels tend to be higher in intervals both of whose component notes are either plain or wound strings than in intervals having a plain string on top and a wound string on the bottom.* We'll do this by comparing the secondary inharmonicity of the octave F3 (sounding F3 now)-F4 with that of the octave E3-E4. As in the unison, the more the coincident partials of the interval diverge as they ascend, the greater the level of secondary inharmonicity in the interval.

Procedure. Retune F3 to its correct pitch, and tune a pure 4:2 octave F3-F4 with the M10-M3 test, using test note C3. Now get a sense of the secondary inharmonicity of the octave by checking the octave at the 6:3 level with the m3-M6 test, using test note D#3. Tune E3-E4 as a pure 4:2 octave, and then check it at the 6:3 level. It is less out of tune at the 6:3 level than F3-F4 was, and therefore it has lower secondary inharmonicity. If it is pure at the 6:3 level, then the octave has no secondary inharmonicity. And if it were wide at the 6:3 level, then the octave would have negative secondary inharmonicity.

Negative Inharmonicity

It would be rare for this octave to be negatively inharmonic, although octaves a little further down in the piano sometimes are. But we can possibly hear some negative secondary inharmonicity right now. The most likely place to look is in an interval with a highly inharmonic top string and a lower string with much less inharmonicity. The major third C#3-F4 is a good candidate.

The Test. Tune the major third C#3-F3 pure at the 5:4 level with the M6-P4 test, using test note A#3. Flatten F3 until the major third C#3-F3 ceases to beat. The perfect fourth F4-A#3 will now have a healthy beat to it. When the major sixth C#3-A#3 beats at the same rate as the perfect fourth F3-A#3, then the major third C#3-F3 is pure. Now listen for a beat at the 10:8 level by ghosting the interval at F6. Assuming that there is a beat, we could use a test to see if the interval is wide or narrow at this level—for instance, we could compare the wide 10:9 major second, C#3-D#3, to the narrow 9:8 major second, D#3-F3. However, it will probably be easier for us simply to discover how we must retune the note F3 to bring the partials into tune at the 10:8 level. If we sharpen C#3 slightly, narrowing the interval, and that brings the partials at that level into tune, then we know that we are dealing with a negatively inharmonic major third. Ghost the major third C#3-F3 at the 10:8 level again, and while it is still beating, gently sharpen C#3. If the beats disappear, then the interval is negatively inharmonic. By the way, if you can't hear any beats at all at the 10:8 level, don't be alarmed—probably the major third simply has zero secondary inharmonicity.

Variance of Secondary Inharmonicity Across the Temperament Octave

We have now confirmed all the principal points of our theory at the piano. It remains for us to determine, for any particular piano, how secondary inharmonicity varies across the temperament octave. Let's use, as in earlier articles, F3-F4 as our temperament octave. To simplify our task somewhat, we'll assume that the secondary inharmonicity of all the intervals in the temperament octave progress in a more or less consistent fashion from one end of the temperament to the other. We are justified in this assumption by the observation that in almost all pianos the bridge curves smoothly in this area, and wire sizes increase by half or whole sizes. Awkward jumps in wire size, defects in bridge notching, or any other anomalies in scaling will tend to make the progression of intervals less consistent, but since we are looking for general trends we will not be concerned for now with such low-level deviations.

The Interval of the Fifth. To determine the degree of secondary inharmonicity in an interval, again, we must discover the degree of mismatch among the various pairs of coincident partials. The temperament interval smaller than the octave for which this is most easily done aurally is the perfect fifth. Let's compare, then, secondary inharmonicity of the lowest fifth in the temperament, F3-C4, to that of the highest fifth, A#3-F4, to get a sense of how the secondary inharmonicity of the fifths, and therefore, probably, of all the temperament intervals, progresses along the temperament.

To hear the secondary inharmonicity of the lower fifth, F3-C4, compare its beat at the 3:2 level with that at the 6:4 level. This is most accurately done by first tuning the fifth pure at the 3:2 level, and then seeing how it beats at the 6:4 level.

Fortunately, tests for the 3:2 and 6:4 fifths are already part of our repertoire of temperament tests. First tune the fifth pure at the 3:2 level using the major sixth-major tenth test (See Figure 3). In other words, make the major sixth G#2-F3 beat at precisely the same rate as the major tenth G#2-C4. Take great care in making sure the beats are identical; using a tuning device to zero in on the coincident partial, C5, will make your results more precise.

Now check the fifth at the 6:4 level using the minor third-major third test. Tune the major third G#3-C4 to beat at a comfortable rate—say, four beats a second. Listen to the beat rate of the minor third, F3-G#3. If it beats the same as the major third G#3-C4, the fifth is pure at the 6:4 level as well as at the 3:2 level, and so it has no secondary inharmonicity. To the degree that the minor third beats more quickly than the major third, the fifth is positively inharmonic.

Now see how the level of secondary inharmonicity in the lowest fifth compares with that of the highest fifth, A#3-F4. Tune the latter fifth pure at the 3:2 level by making the major sixth C#3-A#3 beat at precisely the same rate as the major tenth C#3-F4. Again, take great care here, using, if you wish, a tuning device to match the intervals at the coincident partial, F5. Now tune C#4 so that the major third C#4-F4 beats at exactly the same rate as the major third G#3-C4. Compare the beat rate of the minor third A#3-C#4 to that of the minor third F3-G#3. If the upper minor third beats the same as the lower, the two fifths have the same secondary inharmonicity, and we can expect there to be little or no progression of secondary inharmonicity through the temperament. If the upper minor third beats more slowly, then we can expect secondary inharmonicity to increase towards the lower end of the temperament. If the upper minor third beats more quickly, then secondary inharmonicity increases towards the upper end of the temperament.

Practical Application. You may find it useful for future reference to relate your results to the curve of the bridge in the temperament area. Quite often, a straight bridge in this area results in a temperament octave exhibiting little progression of secondary inharmonicity. A sharp reverse curve is usually associated with greatly increasing secondary inharmonicity towards the bottom of the temperament. By making several such observations, you will soon acquire a sense of what progression of secondary inharmonicity to associate with a particular bridge curve, obviating the need to take the time to test individual temperament intervals for secondary inharmonicity.

Wound strings in the temperament area present us with another level of difficulty. The progression of secondary inharmonicity through such a temperament could be charted by checking the secondary inharmonicity of several more fifths; particularly, the highest fifth whose lower string is wound and the lowest fifth whose lower string is plain. In general, though, this is not necessary; secondary inharmonicity will almost always be found to decrease as the lower notes of the intervals move onto the bass strings.

Over the course of this article we've arrived at a detailed practical understanding of the layout of the secondary inharmonicity in our temperament octave. Our next step, of course, is to actually tune a temperament; and that will be the subject of next month's article, the last one in this series.

FULL-SERVICE PIANO WORK

By Nick Gravagne, RPT
Contributing Editor

While recently driving through my home state of New Jersey, (which has become exceedingly famous as a sometime butt of David Letterman's wisecracks), I pulled into a full-serve gas pump. What a fall day it was, a crackling day. A half-grinning guy of college age approached, wiping his hands with a towel. Obviously born and bred in the great Garden State he strode up to my window and in characteristic Jersey groove asked, "Full service?" I asked what that meant. As if to tell a private joke he narrowed an eye, leaned closer, extended four smudged fingers, and enumerated the service in poetic gush as "In The Tank, Under The Hood, In Your Face and On The Ground." He froze, waiting to see if I "got it." I said I understood this to mean gas, oil/fluids, window cleaning and tire pressure. I agreed. He instantly broke into animation and I sat in the clean car. Before driving off I did one little extra thing that I'm sure he thought about for the rest of the day.

Full service. Expectations. Appreciation. A natural flow that used to be standard operating procedure. Actually it still exists with certain industries, businesses, and customers. Our business in piano work lends itself perfectly to a full-service approach rather than a tuning-only one. At my service station stop I could have serviced the car myself. But our piano customers haven't a clue as how to service their instruments. Thus we have not only an opportunity to increase our knowledge, skill, reputations and incomes, but something of a responsibility as well to inform our customers that their pianos require more than "just tuning." Servicing is the word. We service pianos for those who wish us to. This idea is especially heightened when customers owning finer instruments desire a higher level of technical service and piano performance.

If the idea is obvious and worthy, why isn't full-service piano work more widely practiced? Some competent technicians have expressed a willingness to begin, but they don't know where to start. Others, having gotten started, didn't know where or when to stop on a particular job and grew frustrated wishing they'd left well enough alone. As explained in the October and November '94 issues, we technicians must know how to separate those pianos which are good candidates for in-home prepping (a day or two of on-site work) from those which require more extensive in-shop work. To this end a Piano Evaluation Checklist was presented in the November '94 *Journal*. It is usually not possible to introduce a maintenance program on a piano which suffers a sub-standard existence. So at this point we are going to have to assume that the piano technician has the requisite tools and skills, even if not of the highest caliber, to tune, regulate and voice pianos, and that the instrument is in decent shape. Given this a suggested schedule of on-going piano maintenance follows. As with the Evaluation Checklist you may wish to modify this schedule, but you will at least find it a good starting point. At the end of this article we will discuss pricing the service.

Again! Before a schedule of on-going maintenance can be worked out the piano must be in decent if not perfect condition either as a result of your having "brought it up" in a one- or two-day prepping job, or because the piano is new or rebuilt, reconditioned in part, or simply was not too bad when you first encountered it. Starting here, what are the procedures for maintaining the instrument at a reasonable level or even increasing its performance level?

Now if this schedule seems *too* extensive and aggressive to do in a two-hour time frame you are right! Understand that the items in the schedule do *not* and should not need attention every time you visit the piano. Much of the time you will simply be *checking* the item to determine whether you are going to deal with it now or later, in part or in full.

Record-keeping should be kept simple. Make up your own traveling Master Schedule such that it exists as two pages laminated back-to-back. Showing this to your customers will impress them that you routinely engage in this kind of work. On your billing pad make a record in duplicate of what technical items were done on the bill that you leave with your customer. You keep a copy and advise your customer to retain a copy in the piano bench where you can fish it out each time you visit the piano. If you can't be sure that your customer's records will be reliably handy you will have to "pull their file" before each appointment so as to review what items you did at the last visit. Your customer's file may be in your computer or stored elsewhere. However you keep these records they should be easily and instantly retrieved when you need to refer to them or take with you to the appointment.

Pricing

Pricing can be set based on your tuning fee. This

On-Going Maintenance Schedule

(Based on at least two visits per year. Adjust as necessary if more than two visits per year, or to suit prevailing conditions).

PROCEDURES TO DO WITH EACH TUNING

- TUNING — Always tune to A440 where possible

- TONE — Check every time, but as required do following as condition dictates
  > non-radical hammer refacing
  > hammer fit to strings
  > shallow needling in hammer crown area
  > chopstick voicing

- PEDALS — Check each time and adjust if necessary
  > sustain and shift
  > sostenuto
  > noises, correct

- KNUCKLES — Check for squeaks, lube

- KEYBOARD — With every tuning
  > check front pin wobble, where excessive turn front pin! (It's OK, really. Advise customer and replace bushings when wobble is too pronounced).
  > check easing at balance holes and balance bushings by lifting keys at front and dropping.
  > check key level and spot-correct with special tweezers and punchings from underneath (if a grand).

- AFTERTOUCH — Check with every tuning, always do *something* with *some* or *one* of the following:
  > adjust repetition springs
  > level out or adjust hammer line
  > wink jacks and re-check hammer line
  > check dip, spot-correct as necessary
  > let-off
  > drop
  > jack position, fore and aft
  > backchecking (spacing, angle, and catch)
  Note: If hammers are being dressed save all aftertouch procedures until hammer work is finished.

- HUMIDITY — Check and report to customer

PROCEDURES TO CONSIDER WITH EVERY OTHER TUNING:

- PLATE / STRINGS — Snug up plate bolts and seat strings on bridges; lift strings w/hook if necessary

- TIGHTEN SCREWS / BOLTS
  > action
  > lyre
  > case
  > bench

- CLEANING — Depending on conditions, do a complete inside and outside cleaning at least once a year. Coordinate cleaning work with action-removal work, especially hammer filing work. (Good time to McLube)

- SHANKS AND CENTERS
  > tight or loose centers (be aware of unusual humidity condition)
  > shank travel

- DAMPERS
  > check timing and correct
  > damper upstop rail and correct
  > free in guide bushings
  > even lift at tray
  > check sostenuto rod, adjust

- ACTION PARTS ALIGNMENT
  > wippens to knuckles
  > hammers to strings
  > hammer angles, burn-in where necessary
  > jacks in window
  Note: alignment adjustments will slightly change action regulations !

- KEYBOARD
  > front rail knocking
  > balance rail knocking
  > key square and spacing
  > end blocks
  > hammer rebound rail (where existing)
  > keystop rail brass nuts
  > McLube keybed and return spring/action contact

- POLISH CASE — once or twice a year

concept has been around for a while now, and we have RPT Newton Hunt to thank for it. If the average tuning takes one and half hours to complete, and the fee is, say $65 (it ranges widely around the country), then a pro-rated hourly fee schedule works out to be $65 times 0.67 which is about $44. Thus any work over the basic tuning time and fee will be charged at $44 per hour.

Most technicians engaged in full-service work figure one hour to tune (remember these pianos will never be too far out) and one hour of technical work. Or the balance will be one hour and fifteen minutes to tune and 45 for other items. Do not get locked in. Be flexible but keep the visits to around two hours, or two and one-half at the most. The charges for a typical two-hour visit would be $65, plus $44, for a total of $109. If you schedule only two or three appointments a day you will be doing very well. There are many ways to play with the pricing but beware of confusing your customer! Set one price for tuning and service and leave it alone unless special conditions warrant otherwise.

This clientele takes building, but once built is very reliable and usually proud to be linked to your elite customer base. Typically, your customer base will run the gamut from tuning-only to full-service types — same as gas stations. A usual week might be scheduled with half full-service customers and half everything else. But the effort to build the full-service business is worth it from many standpoints.

Selling Full Service

The easiest way is by selling an inexpensive cleaning of the piano inside and out. Most piano owners quickly agree. Cleaning won't be outlined here but you can imagine the need for a strong Suck-o-Matic little vacuum cleaner such as the Eureka Mighty Mite, along with an assortment of rags, small brushes, etc. Bill Spurlock offers a set of adorable grand piano soundboard cleaners that work great. Anyway, as I'm sure you can perceive, cleaning can lead to other services, *which sometimes eventuate in the customer requesting full* service on a regular basis. Another approach requires you the technician to briefly explain the benefits straight out along with the time and fee additions. The customer may not go for it right away, but as Webb Phillips suggests, if you leave them with professionally printed publications as offered by the manufacturers and the PTG Home Office, you will have tapped into a vast support network which corroborates your efforts. And clearly, if you have just recently rebuilt or reconditioned in any way all or part of their piano you have an immediate entre into recommending followup and routine maintenance.

Finally, in the spirit of professionalism and courtesy, if the customer wants "just tuning" each time then "just tune" each time, and with good cheer. As your full-service customer base grows you will begin to weed out the casual customer in favor of the more focused one.

A final word on pricing, don't sell yourself short, don't cheat yourself. But stay loose and cool. Things have a way of evening out. If you're the type that watches every minute and begins to get prickly when you have worked "past your allotted time" then stay with "tuning only." Time spent in piano work cannot always be punched in and out on a time clock. And let's not forget the natural byproducts of good customer relations. People of the sort who request full-service are usually level and reasonable folk. They will appreciate your work and dedication more than you know, and many of them are blabbermouths — good blabbermouths. Which brings me back East.

In New Jersey this past fall the leaves were electric, and that day at the full-service pump I watched as the young man snapped about his work In The Tank, Under The Hood, In My Face, and On The Ground. He accomplished these tasks with silent but good cheer. I found myself liking him. When he counted the cash he informed me that I gave him two dollars too much. A tip, I said, thanks for the good work. As I drove away his shrinking form appeared in my rearview mirror, slightly dumbfounded and holding the two dollars like a pair of nines in his right hand. Make things happen! It works in New Jersey of all places, and even Letterman can't argue with that!

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LESSON PLAN

Technical Lesson #18

Vertical Troubleshooting — Diagnosing the Bobbling Hammer

by Bill Spurlock, RPT
Sacramento Valley Chapter

This monthly lesson plan is designed to provide step-by-step instruction in essential skills. Chapters are encouraged to use this material as the basis for special Associate meetings, or for their regular meeting program, preferably in a hands-on format. This method allows the written information to be transformed into an actual skill for each member participating

In brief:

Lessons #8–17 covered the basic steps of vertical regulation. The last two lessons of this series on verticals will conclude with troubleshooting common action problems. This lesson will cover the common causes of bobbling hammers, a condition often found on poorly regulated pianos.

Getting started:

In order to pursue any serious study of piano technology, one must obtain basic resources. Catalogs from several piano supply houses, both large and small, are essential. Besides offering the necessary supplies, their pictures and item descriptions are valuable sources of information. Piano manufacturers' service manuals are also essential sources of valuable information. Most are available at no cost. Most important to participating in this Lesson Plan series are the PTG Exam Source Books, both the tuning and technical versions. Articles in these books will serve as reference material for the lessons.

Hands-on session setup:

To teach this lesson in a hands-on format, you will need one or more vertical pianos. If used pianos with some bobbling hammers are available, the lesson can consist of participants diagnosing and correcting the causes of the problem, following the sequence under *Diagnosing the cause of bobbling hammers* below. If new or well-regulated pianos are used, participants can follow the instructions under *Lesson exercises for pianos without bobbling hammers,* deliberately changing the regulation adjustments to cause bobbling hammers, then returning the adjustments to normal to correct the problem.

Depending upon time and pianos available, this lesson may consist of participants working individually on separate pianos, or taking turns observing and adjusting on a single instrument.

Estimated lesson time:

1 1/2 hours

Tools & materials participants must bring:

For this lesson, participants should bring a selection of regulating tools, including:

- 6" ruler
- key level stick
- key dip block, preferably adjustable type described in Technical Lesson #10
- capstan wrenches for both square and holed capstans
- let-off adjuster
- wire bending tool (for adjusting backcheck angle)

Assigned prior reading for participants:

Review PACE Technical Lessons #10–14.

General Instructions

The term "bobbling hammer" refers to a hammer that strikes its strings multiple times when the key is depressed only once. In a properly regulated action, the following takes place: As the key is depressed the jack pushes the hammer and butt assembly toward the strings. Just before the hammer strikes the strings, the jack trips out from under the hammer butt, getting out of the way so the hammer/butt assembly can rebound freely until the catcher is caught and held by the backcheck. A bobbling hammer occurs when the hammer fails to check for one of two reasons:

- the jack does not trip far enough out from under the hammer butt, so the butt bumps against the jack top and bounces back toward the strings instead of checking, or
- the backcheck angle or the condition of the backcheck felt and catcher leather prevent the catcher from being caught and held in check.

Both causes can be (and often are) present at the same time. See Figure 1. Bobbling hammers are most likely to occur on soft playing. Diagnosing this problem is simply a matter of observing some basic points of action regulation.

Diagnosing the cause of bobbling hammers

To test for bobbling hammers, play each key two or three times softly. If any are discovered, use the following steps to determine the cause:

1. Inspect for adequate jack escapement— The jack must disengage completely from the hammer butt so it will not interfere with the hammer/butt assembly rebounding from the string.

a. Depress and hold down the key using a medium blow.

b. Next, place the hammer 5/8" from the string (if it did not already check there) and look at the top of the jack. There should be a slight space between the jack top and the hammer butt leather. No space indicates minimal jack escapement.

c. Still holding the key down, push the hammer to the strings and bring it slowly back to the 5/8" checking point—if the butt leather bumps into the jack before the hammer reaches the checking position, the jack is clearly interfering with hammer checking. This is proof of inadequate jack escapement leading to bobbling hammers.

d. If at least 1/16" space exists between the jack top and the butt leather when the hammer is 5/8" from the string, jack escapement is adequate. Proceed to step #3.

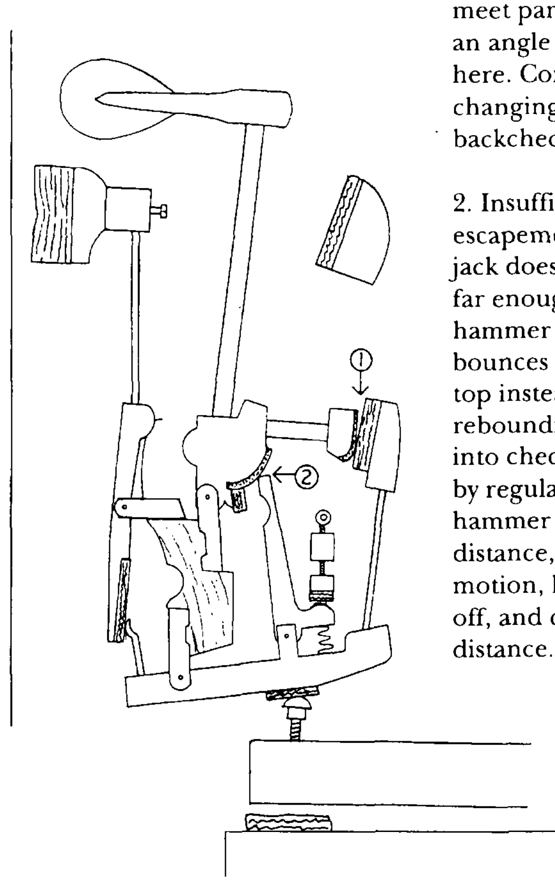
2. If jack escapement is inadequate, determine the cause— The following adjustments control the amount of jack escapement:

- **Let-off**— Let-off on most vertical pianos should be at least 1/8" (slightly more if a felt muffler rail is present). If let-off is set closer than this, the hammer might block against the strings on a very soft blow where the key may be depressed to less than full depth, thus not tripping the jack completely. Correct the let-off if necessary, but do not set wider than 5/32". Although wider let-off increases jack escapement, it reduces power and control during soft playing.

- **Lost motion**— Lost motion reduces the amount of wippen lift, and therefore the amount the jack trips. Any lost motion beyond the minimum needed to allow the jack to slip back under the hammer butt upon a slow key release is excessive. Raise the capstans to eliminate excessive lost motion, and recheck jack escapement. Note that raising capstans will reduce the checking distance, so checking must be re-set (or the hammer manually positioned 5/8" from the strings) when retesting jack escapement.

- **Key height & dip**— If key height has settled, key dip will also be reduced. Insufficient key dip means less wippen lift and thus less jack escapement (the less the wippen lifts, the less the jack is pushed against the regulating button and the less it rotates out from under the hammer butt). Inspect for a sagging key level, especially on the worst bobbling notes. Re-level the keys as needed. Or, if key level is good, measure key dip on the white keys. If dip is less than 13/32" measured at the front ends of the white keys, suspect insufficient dip as a problem. However, as discussed in Technical Lesson #10, it is the *proportion* of key dip to hammer blow distance that determines the amount of jack escapement, so hammer blow and key dip need to be evaluated together.

Figure 1: Two main causes of bobbling hammers



1. Backcheck angle is incorrect: The catcher and backcheck should meet parallel, not at an angle as shown here. Correct by changing the backcheck angle.

2. Insufficient escapement: If the jack does not trip far enough, the hammer butt bounces off the jack top instead of rebounding back into check. Correct by regulating hammer blow distance, lost motion, key dip, let-off, and checking distance.

- **Hammer blow distance**— Key dip must be adequate to raise the wippen enough that the jack can push the hammer to the let-off point, *and* there must be enough wippen rise left at that point to fully trip the jack. The longer the hammer blow distance, the greater the distance the wippen must lift to complete that cycle, and thus the more key dip required. Measure and evaluate the hammer blow distance.

You would normally expect to find around 1 5/8" blow distance on spinets and small consoles, 1 3/4" on consoles and studio pianos, and 1 7/8" on full sized uprights. Specific recommendations for both blow and dip may be available in manufacturer service manuals or the PTG Piano Action Handbook. However,

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LESSON PLAN

it is the jack escapement test that will ultimately determine the dimensions that satisfy a given piano. *This test is only valid on keys with let-off, lost motion, and checking distance correctly set.*

If you determine that key dip is too shallow and/or blow distance is too great, correct these adjustments as needed to give adequate jack escapement.

3. If jack escapement *is* adequate, inspect the backcheck and catcher— Inspect the following:

- **Backcheck and catcher condition—** Catchers should have adequate soft leather covering. The leather on some older instruments may be worn completely down to the glue line, and some more modern pianos may have a synthetic material on the catchers that has hardened. Either condition can prevent reliable checking.

- **Backcheck angle—** Backchecks and catchers should meet approximately parallel. If they meet with a gap at the top as shown in Figure 1, the backchecks will not hold the catchers reliably. Adjust backcheck angle as necessary as described in Technical Lesson #14.

- **Over-strong damper springs—** In some cases jack escapement will appear to be correct when the key is deliberately played all the way to the bottom of its stroke. However, hammers may still bobble on a very soft or hesitant blow if very strong damper springs stop the player's key stroke part way down. Beginning students sometimes have this problem when playing professional uprights, which typically have firm damper springs and a touch that becomes suddenly stiffer when the damper spoons engage. In some cases the damper springs can be weakened without reducing damper effectiveness. However, the technician should proceed cautiously. If the springs are not unusually stiff, it may be best to educate the player to concentrate on using a full key stroke before changing spring tension.

Lesson exercises for pianos without bobbling hammers

If this lesson is given on pianos without bobbling hammers, participants can still learn the causes and corrections for this problem by following the sequence below.

1. Choose a note to work on. Play the key very softly to get a feel for how softly it can be played without the hammer bobbling or blocking against the strings.

2. Reduce let-off to 1/16" and play the note very softly again. There should now be an increased tendency for the hammer to block or bobble slightly on very soft playing, where the key stroke may be incomplete. Readjust let-off to 1/8".

3. Lower the capstan until when the key is depressed very, very slowly the jack just begins to trip but does not pull out from under the hammer butt. The hammer should now bobble when this key is played softly (it may not bobble on harder blows, where the hammer rebounds from the strings with enough force to knock the jack out of the way).

4. Note that lowering the capstan has caused the checking distance to increase. Bend the backcheck inward to set the checking distance to 5/8", play the key with a medium blow and observe the lack of jack escapement. Readjust the capstan for the correct lost motion setting, readjust the backcheck for 5/8" checking, and see that the bobbling stops and jack escapement returns to normal.

5. Gradually reduce key dip by adding thick paper or card front rail punchings until when the key is depressed very, very slowly the jack just begins to trip but does not pull out from under the hammer butt. The hammer should again bobble on a soft blow. Restore the proper key dip and see that the bobbling stops.

6. Change the backcheck angle so the backcheck and catcher meet with a gap at the top, as shown in Figure 1. To do this, use a wire bending tool to hold the wire stationary just below the backcheck head, then bend the top of the backcheck away from the action with your fingers. If necessary, readjust checking distance to 5/8". Now, with the backcheck angle incorrect, the hammer should not check reliably. Play the key with varying force and note that although jack escapement is correct, the hammer tends to bobble on a soft blow because the backcheck will not hold the catcher well. Correct the backcheck angle and checking distance, and note that checking becomes reliable again.

Conclusion

Reliable checking is essential to the pianist's control of the instrument. With wear and use, action regulation changes, and many of these changes make checking less and less reliable by decreasing jack escapement and increasing checking distance. Specifically, key height settles, reducing key dip and changing key leverage; wear of the hammer butt leather and capstan cushion increase lost motion; hammers wear shorter; and backcheck felt and catcher leather wears. At some point these changes manifest in bobbling hammers. Solving this problem is simply a matter of putting basic action adjustments back into proper regulation.

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LESSON PLAN

Tuning Lesson #18
Parallel Interval Tests

by Michael Travis, RPT

Washington DC Chapter

This monthly lesson plan is designed to provide supervised practice of tuning skills as a supplement to independent study and practice. Chapters are encouraged to use this material as the basis for special Associate meetings, or for their regular meetings, or for their regular meeting program. Each lesson is designed to take about one hour, with about four participants. Participants are assumed to have essential reference materials and tuning tools (see PACE checklist) and access to a well-scaled large upright or grand piano for independent practice.

In brief

This lesson consists of extended practice in listening to parallel interval tests and of making small improvements to an already-good tuning based on tests of this type. Participants should gain an understanding of how to nitpick and improve their tuning with parallel interval tests.

Background

An essential feature of equal temperament is the similarity of adjacent like intervals. Semitone differences in pitch of the notes of these intervals show up as little-to-no differences in beat rate at most coincident partial levels. A series of three or more like intervals played in parallel ascending or descending fashion thus provides a very useful test for equal temperament; beat rates out of sequence indicate a problem. Jumps in beat rates may be the result of scaling irregularities, especially in a transition area or "break" in the scale, but more often are the result of one or more slight tuning errors. Often, a compromise is necessary between those intervals that change smoothly and those that do not.

There are two broad types of parallel interval tests, corresponding to the beat speeds of the intervals being tested. In the *faster-beating* tests, the interval in the middle of a parallel series of three should have a beat rate midway between the other two. Interval beat rates usually accelerate or progress towards the treble, and decelerate or regress towards the bass. In the *slow-beating* tests, parallel intervals should sound virtually the same; any differences may indicate a problem.

In every range of the keyboard, there are one or more useful faster-beating parallel interval tests. In the tenor/low midrange, parallel m3s, M3s (minor and major thirds), M6s M10s and M17s (major sixths, tenths, seventeenths) are most useful. In the upper midrange and treble, M10s and M17s work well, and in the high treble, M17s may be most useful. In the upper bass, all the above, and in the low bass, the wider M10s, M17s and m21s (double-octave minor sevenths) are most useful.

Each faster-beating parallel interval test may have several variations named according to the spacing between the intervals. A wider interval spacing yields a greater difference in beat rate which can be easier to detect. For example, you could play parallel major thirds, ascending or descending, in the usual chromatic, semitone-related fashion, as in the series C3-E3, C#3-F3, D3-F#3. If you think C#3-F3 is too slow but you're not sure, you could try the whole-tone-related parallel major thirds, B2-D#3, C#3-F3, D#3-G3, or the minor third-related parallel major thirds, A#2-D3, C#3-F3, E3-G#3. This wider perspective on an interval's beat rate is often useful. Contiguous thirds, like A2-C#3, C#3-F3, F3-A3 are a special variety of parallel thirds, having a regular ascending beat-rate ratio of 4:5 among any two "linked" thirds. This fact makes them especially useful in setting up a temperament.

Tests using parallel series of sixths, tenths or seventeenths have similar varieties as the thirds, including the contiguous third-related varieties that beat in an ascending 4:5 ratio. For example, we have seen that the contiguous third-related tenths are useful in testing the first phase of the Baldassin-Sanderson temperament (PACE tuning lessons #15-17), where we observe a 4:5 ratio while playing the parallel series A2-C#4, C#3-F4 and F3-A4.

Parallel series of slower-beating intervals, including fourths, fifths, octaves, twelfths, and double octaves, are also useful to locate some tuning problems. However, to correctly diagnose a problem among the slower intervals you may need a different approach, since playing a series of three or four may not give you enough information to know what to do. You can apply nearly any appropriate faster-beating interval test in a second-order parallel fashion to judge consistency of slower-beating consonant intervals. For example, to more accurately judge midrange octaves C3-C4, C#3-C#4 and D3-D4, you could play the M10-M17 test for 2:1 octaves in parallel: G#2-C3 vs. G#2-C4; A2-C#3 vs. A2-C#4; and A#2-D3 vs. A#2-D4, listening for a similar relationship between the tenth-seventeenth pairs, thus confirming the similarity of octave widths, or discovering the cause of a problem that playing the octaves alone did not clearly reveal. This procedure imposes a second-order test in parallel fashion over the parallel interval test, in this case using a parallel series of M10-M17 tests to clearly hear any discrepancies among the parallel 2:1 octaves. Likewise, you could play parallel series of M6-M17 tests for 3:1 treble twelfths, or parallel series of m3-M6 tests for 6:3 bass octaves, or parallel series of m3-M10 tests for 6:2 bass twelfths, etc. A strike-tone or ghosting technique applied to intervals in parallel may also be useful to detect their beat rates at a desired coincident partial level, especially in the low bass where such beats may be nearly inaudible within the overall richness of sound (see PACE tuning lessons #4 & 5 for practice with ghosting and coincident partials).

In general, when you detect a problem using a parallel interval test, it is likely that a tuning error occurs on one or both notes of the interval. A basic procedure for nitpicking your tuning involves testing both ends of a problem interval to see whether one or both notes should be changed slightly. Sometimes you find that neither note can be changed to improve a particular parallel relationship without upsetting others, and in that case you might shift your focus to adjacent intervals to smooth out the parallel interval beats. Working out the best compromise is the name of the game.

These concepts should be more clear as you apply parallel interval tests to a well-tuned piano during this lesson, listening for discrepancies and making improvements where possible.

Chapter meeting set-up

These lessons are most conveniently taught to a small group of four or five. Each group should have its own piano and RPT instructor. Each piano should be in a quiet environment for close listening. Avoid using pianos that present serious obstacles to tuning, such as deeply grooved or misaligned hammers, string termination noises, etc.

For this lesson, a thick-skinned RPT should prepare each piano in advance by giving it a good tuning that is ready for nitpicking, muted to single strings as normally done when master-tuning an exam piano. This person should be psychologically prepared to admit that even Associates can find mistakes in this tuning (under his/her guidance, of course!), since that is what will happen during the lesson.

Tools & materials participants must bring

Tuning hammer

Home study assignment for participants

Study *The PTG Tuning Examination: A Source Book*, "An Encyclopedia of Tests for Equal Temperament," by Michael Kimbell, pp 149-63, esp. part 3, p. 155, and think about how you might apply each test in parallel fashion. Tune a temperament octave or a 2-3 octave expanded temperament on your practice piano, and once you have the fourths, fifths and octaves sounding OK, use as many parallel interval tests as you can to look for tuning errors. Remember to apply tests to both ends of a questionable interval to see which end you might best re-tune to correct the problem. Make the correction, and re-test to confirm the improvement.

General instructions

On a tuned and strip-muted piano, each participant should apply parallel interval tests to discover and correct one tuning error in each of at least four of the following ranges: temperament (F3-F4), midrange (C3-B4), upper bass (C2-B2), lower bass (below C2), treble (C5-B6) and high treble (above B6). The RPT instructor should suggest intervals to test in parallel that are typically most useful for each of these ranges, and briefly demonstrate each test. For this lesson, use only parallel chromatic or whole tone tests; contiguous interval tests will be the subject of another lesson. Each participant should apply several different parallel tests in each range. Where appropriate, insist that the participant make further tests on both ends of a problem interval before making a correction. The person with the tuning hammer should be able to convince everyone else that there is a problem, and of how it should be corrected, before proceeding.

Think of this lesson as a trial game. The person with the tuning hammer is the prosecutor, whose job it is to find a suspect note in each range, build a case against it based on the evidence of parallel interval tests, and try to convince the grand jury (other participants) that the note should be summarily sentenced to a certain correctional measure. The judge (RPT instructor) will ensure a fair trial, and see that the best evidence is properly heard. If the jury agrees that the suspect note is guilty of being at the wrong pitch, the prosecutor will then execute the sentence by retuning and retesting the note to everyone's satisfaction. If there is a hung jury who can't agree on what should be done, the prosecutor must appeal to the judge for a verdict. The judge can call for more evidence, or declare the suspect guilty, fix a sentence and have it carried out, or let the suspect go free for now and have the prosecutor seek another suspect.

Avoid getting stuck in one small area during the lesson, or using non-parallel types of tests, or an insufficient variety of tests. Each participant should have ten minutes or so to find and correct four notes in various ranges. If the piano has been well-tuned before the lesson starts, this should provide a lot of practice listening to parallel interval tests, since errors will be subtle. The lesson can continue for as long as time permits. You can always find more notes to correct.

Though not necessary for this lesson, if a Sanderson Accu-Tuner or other measuring instrument is available, the instructor may wish to follow a procedure of measuring and documenting the tuning before making changes. After detecting a possible error, decide which note to change. Then measure an

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LESSON PLAN

appropriate partial of the note so you can put it back where it was originally if the change is not an improvement. This is a useful procedure that can provide insights into the accuracy of parallel interval tests. Participants will discover that by using parallel interval tests they may be able to hear tuning errors as small as perhaps 0.2-0.3¢!

Note: *Do you find these lesson plans valuable? Do you have specific suggestions for changes or clarification? Please direct any comments or suggestions to the author c/o the* **Journal**.

PTG Business Resource Manual: *RPT Business Forms*

Beverly Kim, RPT • Marketing Committee

Like many of you, I have collected many wonderful sample forms from other piano technicians: their invoices, appraisals, sales and service forms. As helpful as they were, I thought I would eventually put together something specifically for *my* business. Like many of you, I never got around to it. So imagine my delight (and relief) to discover the sample RPT Business Forms enclosed in the PTG Business Resource Manual. The discovery was as satisfying as playing with a new tool or tasting my first mocha latte!

In keeping with our Bylaws, the PTG business forms are only available to RPTs, and so are included as a special insert to the RPT version of the Business Resource Manual. Hopefully this will serve as an incentive and reward to Associate members to pursue RPT classification.

The RPT business forms, like the client newsletter templates described in the October *Journal*, are pre-formatted and professional in appearance. All include space at the top for your name, address and phone number. You can print up your own header using a laser printer, or have your print shop lay out and paste it in for you. While you're at it, make up duplicate headings that you can use on any of the forms you might want to use. Based on the frequency with which you provide different services, you may decide to have some forms — such as invoices — printed in larger quantities, and others — such as the sales or lease agreements — photocopied just a few at a time as needed. Here's an overview of all the new RPT business forms:

Piano Evaluation & Estimate Sheet — Have you ever returned to the office after estimating a piano repair only to discover that you forgot to inspect for moth-eaten key frame felt or stripped action frame screws? This form can help you do a thorough evaluation the first time by prompting you to inspect every aspect of the piano. It provides a comprehensive checklist of all major components, from case pieces to actions parts, along with space for comments on their condition.

PIANO TECHNICIANS GUILD
REGISTERED PIANO TECHNICIAN

Piano Evaluation & Estimate Sheet

Customer ______ Piano Make ______
Address ______ Model ______ # ______
______ Year ______ Finish ______
Phone ______

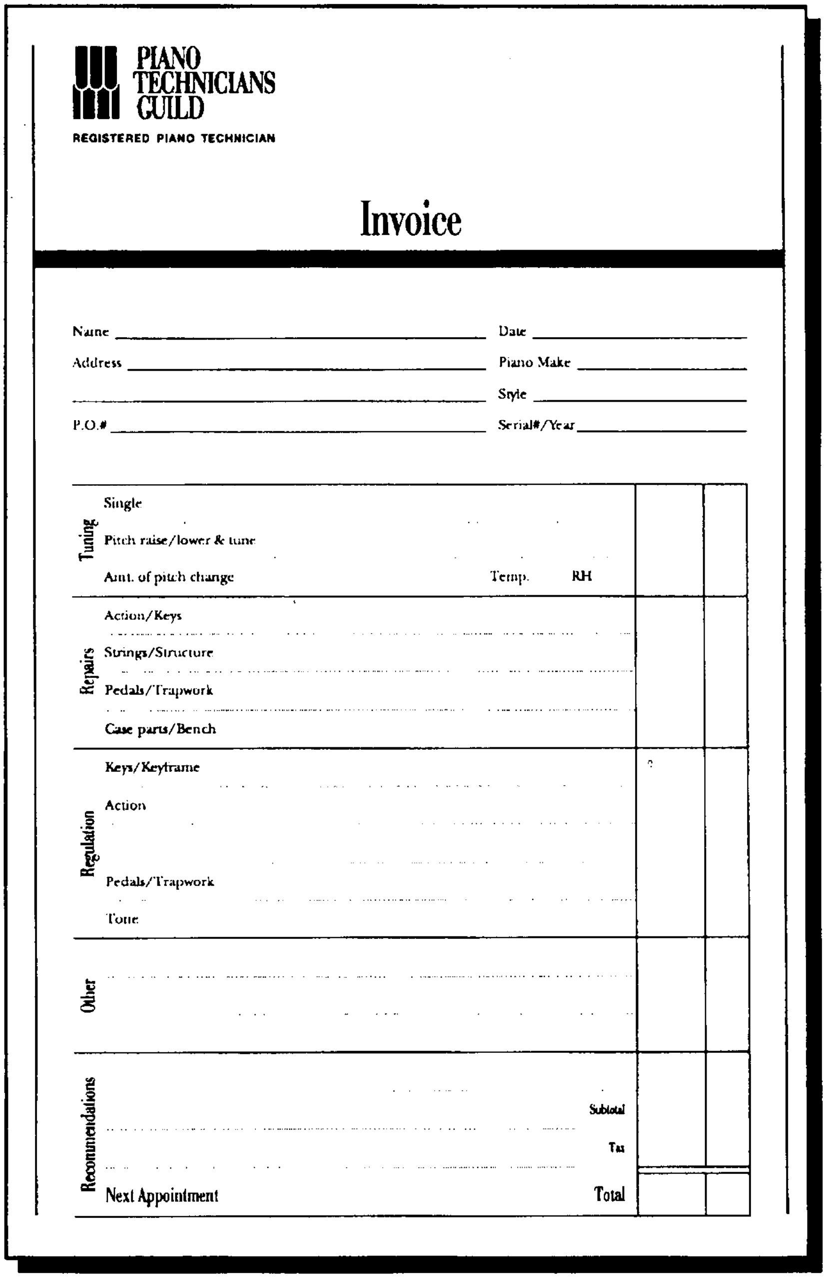
Case	Good	Needs Service	Needs Replacement	Comments
Finish				
Veneer				
Case Parts				
Hardware				
Legs				
Lyre				
Pedal/Trapwork				
Structure				
Soundboard/Ribs				
Bridges				
Bearing				
Pinblock				
Plate				
Strings/Pins				
Agraffes/Capo				
Damper System				
Regulation				
Damper Felt				
Damper Lever Felt				
Pinning				
Springs				
Lift Rod				
Damper Wires				
Guide Rails				
Stop Rails				
Tray				
Sostenuto				

The Piano Evaluation & Estimate Sheet ensures you'll do a complete inspection job. Two pages. 8 1/2 x 11 (second page not shown)

Whether used as your personal worksheet or copied for the client, everyone can be assured that the evaluation has been thorough.

Piano Repair Contract, Piano Restoration Contract — These are two separate forms which allow space for a description of the repair or restoration proposed. Also included are estimates of costs, financial arrangements, statements regarding your warranty and a place for client and technician signatures.

Piano Appraisal — This one-page form provides key elements of a complete appraisal, such as the current new replacement cost, condition report, appraisal value, etc. There is space for comments about the finish, action and structure. A disclaimer statement protecting the piano technician from obligation is included above the signature line.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Invoice

Name ______ Date ______
Address ______ Piano Make ______
______ Style ______
P.O.# ______ Serial#/Year ______

Tuning: Single; Pitch raise/lower & tune; Amt. of pitch change; Temp.; RH
Repairs: Action/Keys; Strings/Structure; Pedals/Trapwork; Case parts/Bench
Regulation: Keys/Keyframe; Action; Pedals/Trapwork; Tone
Other
Recommendations: Subtotal; Tax
Next Appointment; Total

This unique new invoice form combines both detail and space to write comments. 5 1/2 x 8 1/2

Invoice — How do you help customers understand that there is more to piano service than just tuning? One way is to detail all additional work on your invoice. But all that writing takes time, and some of us are lacking in legible penmanship! An invoice form that details common service steps is helpful here.

Three such forms are provided in the BRM. They vary in degree of detail, writing space and structure, thus providing several options for individual preferences. One style has mostly blank space, so it allows the most room for writing comments specific to each piano. Another has many check boxes and little blank space. This makes it easy to record individual service steps without doing a lot of writing, but leaves little room for comments.

The third and newest design (shown here) provides both detail and writing space. It lists general categories of service rather than specific jobs. This makes it easy to indicate that much more was done besides tuning, without a lot of writing. Yet space exists for writing a word or two to explain just what work was done in each category.

Sales and Lease Agreements — Again, these two forms have universal application. Both include information concerning the piano's value, date and location of delivery, financial arrangements and signature space.

Piano Service Proposal — This form is particularly useful for institutional contracts in which the technicians takes responsibility for servicing a

Peggy Garland

Garland Named Sales Manager At Dampp-Chaser Electronics

Robert Mair, President of Dampp-Chaser Electronics Corp. of Hendersonville, NC, has announced the appointment of Peggy Garland as Sales Manager. Garland, a resident of Greenville, SC, has 14 years experience in industrial sales and will be responsible for domestic and foreign sales.

Dampp-Chaser manufactures humidity control systems for Pianos, Closets, and other confined spaces. Presently Dampp-Chaser is marketing in the US, Canada, Mexico, Central & South America, Europe, Asia, and Japan.

Marketing...

number of pianos. It includes space for listing the pianos, a service schedule, price per piano and signatures for client and technician.

You will find these forms to be immediately useful. They will lend an element of professionalism to your image and credibility to your effort. Equally important, you will have the confidence in knowing that your written materials are complete. As someone recently said about the PTG Business Resource Manual, "You'll recover the cost of the manual within the first month you use it."

New CEO At Baldwin

Baldwin Piano & Organ Company has announced the appointment of a new President and Chief Executive Officer. Karen Hendricks, most recently Executive Vice President and General Manager, Skin Care Division of the Dial Corp, in Phoenix, joined Baldwin as President and CEO effective November 21, 1994.

Hendricks, who, prior to Dial, was employed for 21 years by The Proctor & Gamble Company, will spearhead the evaluation of strategies within Baldwin's three operating units and the movement of the Company toward growth opportunities. Dick Harrison, currently Baldwin's CEO and President, will serve as Chairman of the Board, while current Chairman, George E. Castrucci, will remain as Director and become Chairman of the Executive Committee of the Board.

Hendricks holds a B.S. in chemical engineering from the Ohio State University where she graduated as one of the top ten outstanding seniors in a class of 8,000. She began her career in 1971 in Product Development at Proctor & Gamble. After a series of promotions in product development, she was promoted in 1987 to General Manager of the Vidal Sassoon Hair Care Company.

At Dial, Hendricks served as Executive Vice President and General Manager of the Skin Care Division, where she had full responsibility for the U.S. bar and liquid soap business. During her tenure in this role, both revenues and profits grew significantly.

Hendricks will draw on her product development, marketing and operating background to evaluate Baldwin's three businesses: musical products, financing services and electronic contracting. In recent years, the Company has experienced major growth in both the financing services division, offering in-house financing of musical products, and its contract electronics business, which provides electronic and electro-mechanical engineering and manufacturing services and products. Baldwin plans to focus future growth on its core businesses: pianos — both acoustic and electronic — and contract electronics.

Hendricks is a native of Shelby, Ohio. She is relocating to the Cincinnati area with her husband and their son.

Gary Champion

Champion Named To Quality Post

Gary Champion, RPT, has joined Baldwin Piano & Organ Company as Quality Control Manager for upright production at the company's Trumann, AR, facility. Champion will add an extensive technical knowledge from the field to assist Baldwin quality programs which have been designed to continuously improve product quality and enhance field serviceability.

Champion received B.S.E. and M.ED. degrees from the University of Arkansas in 1974 and 1977 and taught music in the public school system in Kansas. After becoming interested in piano technology, Champion owned and operated a retail piano store and provided rebuilding services. He later moved to Utah and added player piano rebuilding to his existing skills.

He was formerly a member of the Salt Lake City Chapter.

PTG *Review*

PIANO TECHNICIANS GUILD

Dedicated To PTG News • Interests & Organizational Activities

Exam Tips For Associates

EXAMINATION & TEST STANDARDS COMMITTEE

Movin' On Up!

Mitch Kiel, RPT

Taking responsibility for your own education

• Be sure to take advantage of PTG's newest and most powerful educational tools: the Pre-Screening Manual, the PACE checklist, the Written Exam Study Guide, and the Tuning and Technical Exam Source Books.

• Some chapters offer group exam preparation classes, usually called "Associate Days." These commonly last an entire day. If your chapter doesn't offer them, ask your RVP for a list of chapters in your area that do.

• Attend chapter technicals, seminars, and conventions. The PTG Annual Convention has recently instituted a special set of classes for Associates called the PACE Academy, designed to help prepare Associates for the RPT exams.

• Read back issues of the *Journal*; maybe your chapter maintains a library. View instructional videos (call the PTG Home Office to inquire about borrowing from their library). There are some excellent non-PTG books on piano technology available (supply house catalogs, *Journal* classified ads, libraries).

• Try teaching another Associate! If you can explain it so someone else can understand it, your knowledge is well grounded.

• Re-inspect a piano you tuned or regulated yesterday, last week, or last month. The time lapse will give your judgment a fresh perspective, and also help you understand stability.

• Compare your aural tuning to a memorized electronic tuning or to a FAC tuning on an Accu-Tuner. Use the ETD's tuning as an aural study guide.

• Strip mute an RPT's well-tuned piano (get permission first!), randomly detune a few open strings, then retune those notes. When you're done, unmute and listen to how your strings compare to the RPT's. When you're done, retune your strings to match the RPT's strings and thank the RPT for his/her indulgence.

• In the Pre-Screening Manual or in the Tuning Source Book, read about exam tolerances and points-off multipliers to learn how accurate your aural tuning needs to be.

Aural tuning tips for ETD users

The incidence of ETD examinees who fail the aural portion of the tuning exam is too high. This is unfortunate and unnecessary. It cannot be stressed strongly enough that all Associates who use ETDs should be sure to acquire good aural tuning skills - and practice those skills - to have a realistic chance of passing the RPT tuning exam.

Ironically, ETDs can be among the most useful of aural teaching tools, if used properly and in conjunction with a mentor.

Some tips:

• Never "turn off" your ears when tuning electronically.

• Study the tuning your ETD creates to learn about proper beat rates, inharmonicity, intervals and coincident partials, natural stretch vs. artificial stretch, etc.

• ETD s are particularly useful to learn about unisons and stability. Use the ETD in conjunction with exam scoring parameters to "calibrate your ears."

• Compare your aural tuning to the ETD's (and vice versa), either one note at a time or after finishing an entire tuning. Is your ear as consistent as the ETD? Is there an octave (or a size of piano) where the ETD makes different choices than your ear? Why? Which do you prefer? (Your ear may be right and the ETD wrong.)

• The Baldassin-Sanderson Two-Octave Temperament is a good temperament for ETD users to learn. It's very programatic and conveniently covers most of the notes included in the midrange section of the tuning exam. Attend classes at conventions or refer to Dr. Sanderson's relevant article on pages 95-96 of the Tuning

Source Book.

- Read Kent Swafford's article "Aural Tuning for Visual Tuners" on pages 115-118 of the Tuning Exam Source Book.

Changing horizons

When first learning piano servicing, it's a struggle to get even one thing **right**.

As our skills grow, so do the tasks we can do correctly. At some point we learn to switch our focus to search for that which is **wrong**. It's what you do as you progress from pitch-raising to polishing unisons.

This ability to shift your perspective is important in all piano work, including success on the exam.

Speed Trials

Tempus fugit. Time flies. Piano technicians deal with time pressure every day on the job, in the home and on the concert stage.

It's also true for the RPT test. Time limits are deliberately set tight. You have to hurry to complete all tasks. That's why your preparation for the RPT exam should include practicing to the exam's time limits.

But racing can be fun too. You can learn a lot by breaking the speed limit.

Improve your efficiency and panic control by practicing to **much less** time than the RPT exam allows. Be radical and unreasonable. For example, try to set a temperament in five minutes, splice a string in three minutes, or tune an entire piano in a half hour.

Don't worry that you won't be capable of your best work. These "speed trials" can help you break overly meticulous habits, force away fixations, highlight weaknesses, increase efficiency, and create a higher gear.

Test anxiety and time management

"I'd have passed if I'd had just five more minutes."

"I got too excited and broke a part." (which the technical exam requires you repair with no additional time allowed) "Oh, well. I expected to fail anyway. I've never done very well on tests." Associates - don't let this happen to you!

Test anxiety and poor time management are the most common causes of RPT exam failure.

The good news is that it's easy to learn to conquer your nervousness. Look at it as simply one more skill you need to acquire. The techniques are simple to learn and only require study and practice.

First, let's acknowledge some unavoidable truths.

Piano service is by its very nature fraught with frustration. It's the very first lesson we learn as beginning technicians.

Remember your first few tunings? Remember saying "Why won't that (expletive deleted) string stay put?" If you took a deep breath and tried again, you passed your first lesson in frustration management. If instead you kicked the piano and broke a toe, you learned the same lesson but the hard way.

A prerequisite for successful stress management is to have the proper skills and tools. Review your PACE checklist with your pre-screener to find out where you stand.

Next, you need the confidence to accept whatever challenges the piano throws at you. Good training and feedback from peers and experts will help. Involvement with your chapter and attendance at seminars and conventions will give you the confidence you need.

Here are some tips:

- Know what to expect. Learn about exam procedure. Look at a blank scoreform.
- Practice with a time limit that matches the exam's. Speed trials — practicing with time limits that exceed the exam's — are also useful.
- Get pre-screened to learn which skills need the most improvement. Practice your weakest skills the most.
- For the tuning exam, make multiple passes of increasing accuracy. Continue through a circle of refinement until your time's up. You can even bring a sheet of paper with a schedule for yourself. See Michael Travis's excellent series of articles in the Tuning Exam Source Book.
- For the technical exam, get a tool on every part at least once; the jigs have been thoroughly de-regulated. Remember that point deductions on the technical exam are the same if you're off by a lot or a little. Read the Technical Exam Source Book, especially Bill Spurlock's wonderful article on pages iv-x about exam strategy.
- If you feel your self-control slipping away during the exam, take a very quick break . Stand up, walk to the window, and take a few deep breaths. Try to clear your mind for a few seconds. Return to your task and look for a new way to solve the problem.
- Get a good night's sleep, arrive early, wear proper clothes, bring some water into the exam room, wear a watch or ask for a clock, and ***don't touch the exam room ventilation controls.***
- It's your right — and a good idea — to go get the examiners any time during your exam if you suspect an equipment problem, break a part, or have any questions. It'll only take a few seconds and might save you from wasting 20 minutes.

One description of a good tuning

A great resource for reading about tuning is PTG's Tuning Exam Source Book. Jim Coleman's article (p. 71-75) is short and very good. Mike Travis's series (p. 1-70) is much more extensive and excellent too.

Here's one brief description of a good tuning, described using aural terminology. Not everyone uses this terminology nor all these tests, but most good tunings end up being remarkably similar to the one desribed below. Of course, a good electronic tuning will, by definition, fit these same parameters.

No claim is made that this is everyone's definition of a perfect tuning. Because every serious tuner develops a unique tuning style, there will be disagreement on the relative importance of a particular interval or test. However, most experienced tuners would probably agree that any tuning meeting the description below is a very good tuning. Such a tuning would certainly pass the RPT exam.

- clean unisons (by far — by light years — a good tuning's most important feature)
- pitch: A4 less than 1/4 beat from

Exam Tips...

calibrated A fork to score 100 on the RPT exam; less than 3/4 beat to pass

- temperament: smoothly changing beat speeds of parallel 3rds and 6ths; beat speeds of contiguous 3rds in 4:5 ratio; clean-sounding yet slightly wide 4:2 octave(s); slightly contracted 5ths and slightly more expanded 4ths; 5th slower beating than 4th sharing a common top or bottom note
- expanded 6:3 octaves inoctaves 1, 2, and (beat speed of M6th slighly faster that m3rd)
- sometimes on large grands, 8:4 (m6th:M3rd) or 10:5 octaves (M24th:M17th) in octaves 1 and 2
- expanded 4:2 octaves in octave 4 and 5 (beat speed of 10th slightly faster than 3rd)
- expanded 2:1 octaves in octave 5 and 6 (beat speed of 17th slightly faster than 10th)
- for the RPT exam, conservative artificial stretch in octave 7, aiming for clean-sounding single octaves. Beat speed of 10th and 17ths equalize; audible sympathetic resonance of note an octave below; and octave+5th (P12th) cleaner-sounding than double octave+5th (P19th). Don't over-emphasize arpeggio tests for octave 7.
- consistent and relatively quiet 4ths, 5ths, 12ths throughout
- contiguous 4ths have similar beat speeds; likewise contiguous 5ths
- smooth progression of beat speeds of parallel 3rds, 6ths, 10ths, and 17ths over entire piano
- smooth transitions between octave types (generally, 6:3 in bass, 4:2 in tenor, 2:1 in treble)
- octaves fairly clean but not necessarily pure; for double octaves a bit more noise is allowable
- in low bass, smooth progression of parallel octave+m7 (m14th) and double octave+m7 (m21st)
- notes don't drift after your final pass (good hammer technique, strong test blows, efficient multiple passes, and knowledge of unavoid-able instability). Great stability is the mark of a true master.

If you can meet most of these conditions, you're probably a good tuner, and have a strong chance of passing the RPT exam in the 80s. If you can surpass all these conditions consistently and quickly, you're probably an excellent tuner and are capable of a score 90 or above.

EVENTS CALENDAR

All seminars, conferences, conventions and events listed here are approved PTG activities.

Chapters and regions wishing to have their function listed must complete a seminar request form. To obtain one of these forms, contact PTG Home Office or your Regional Vice President.

Once approval is given and your request form reaches Home Office, your event will be listed through the month in which it is to take place.

Deadline to be included in the Events Calendar is at least 45 days before the publication date, however, once the request is approved, it will automatically be included in the next available issue.

February 17-19
California State Convention
Torrance Marriott Hotel
Contact: Teri Meredyth
1666 W. 126th street
Harbor City, CA 90710
310-326-6447

March 21-23
Pacific Northwest Conference
Vancouver, BC
Contact: Paul Brown
749 West 66th Avenue
Vancouver, BC V6P 2R4
604-321-7357

March 30-April 2
Pennsylvania State Convention
Ramada Inn-Wilkes-Barre, PA
Contact: Earl Orcutt
141 Fort Street
Forty Fort, PA 18704
717-287-0940

April 21-23
Florida State Seminar
Orlando, FL
Contact: Robert Carr
320 West Rich Avenue
Deland, FL 32720-4120
904-736-0551

April 27-30
NEECSO
White River Junction, VT
Contact: Ed Hilbert
40 Pleasant Street
Bristol, VT 05443
802-453-3743

May 5-7
Central West Regional
St. Louis, MO
Contact: Ken Jones
42 Cynthia Court
Florissant, MO 63061
314-839-1220

July 19-23
PTG 38th Annual Convention & Technical Institute
Hyatt Regency/Albuquerque, NM
Contact: PTG Home Office
816-753-7747

Concerted Effort Brings Success On Several Fronts

TRADE RELATIONS

Jack Wyatt, RPT, Chair

As most of you know, during the past few years a concerted effort has been made to improve relationships among retail dealers, manufacturers, teachers and other related trades in the piano and music industry.

Progress of any kind is slow at first, as ours has been, but we are now seeing improvement. At our convention in 1993 the factory technical representatives requested meetings to help this effort along. President Fern Henry seized the opportunity, and we have made good progress. A suggestion was made to have some kind of program to spur this goal along.

A first-time ever program was initiated in the form of an Industry Roundtable Discussion at the 1994 Convention. The discussion was moderated by Fern Henry. The panel included Brenda Dillon of the National Piano Foundation, who is in charge of the S.P.E.L.L.S. Program for the manufacturers. Lloyd Meyer of the Mason & Hamlin Co. presented sales figures and trends from manufacturers showing that sales of pianos were up over the past few years, and also how the factories were joining to fund the S.P.E.L.L.S. Program.

I represented the PTG as Chair of the Trade Relations Committee. Since this was a first time effort, no one knew how such a program would be received by the members. To our delight there was standing room only, with many even in the hallway. Many questions were taken from the members, and much interest was generated on the subject of cooperation within the industry. Brenda Dillon pointed out how far we had come in the S.P.E.L.L.S. Program, recounting its successes and new S.P.E.L.L.S. Programs being started.

The follow-up Factory Warranty Class that I taught was well attended with 47 present. There was a lengthy discussion on what factories do and don't do, and why.

One point we stressed was that people have a right to buy any quality piano they choose, and other people have a right to build any quality piano they choose. It is not my, your or anybody else's business. Most technicians would like all their customers to have fine concert grands. While this is a very appealing thought, it does not square with reality. The entire program was very successful, including the Industry Roundtable and the Factory Warranty Class.

We had two messages to deliver: one, that piano technicians are integral players in the piano industry with a personal stake in its success; and two, that technicians should be aware of their personal and collective reputations, analyzing whether or not their behavior contributes to the overall health of the industry.

President Leon Speir has informed me that a similar Industry Roundtable Discussion is being planned for the 1995 Convention. This discussion will be expanded as international participation will be incorporated into the program.

It is clear that our profession is in an ever-changing mode and is beginning to be recognized by the rest of the industry as an equal partner. This is something far different than when I began my career, and it is something for which I have worked for more years than I care to remember. To see our profession take its rightful place in this industry and be fairly compensated for it has long been a dream of mine. While some of us may not be around long enough to see this materialize, I believe we owe it to our profession and to those who follow us to see that this does indeed become a reality.

Passages

In Memory...

John Little, RPT
June 18, 1910
November 11,1994

We recently lost one of our long standing members this past fall. John Little passed away in November of '94.

John was born June 18, 1910 in Evansville, IN. He was a graduate of the University of Wisconsin in 1934. In 1938 he received his law degree and was admitted to the Wisconsin Bar.

Some of his work experiences before entering the field of piano technology included personnel management and industrial relations nalysis. He was an avid tennis player and was willing to play the role of instructor to anyone who wanted to listen.

One of the accomplishments he was proud of was his ability to self teach himself to play the trombone, sax and clarinet. He was accomplished enough to sit in with some of the name bands in the area.

John began tuning pianos in the mid 1950's and worked his business into piano sales and rental service. His attendance record and participation in meetings was a good indication of his dedication to improve his own skills as well as share what he knew with his fellow technicians.

Those of us who knew and worked with John will always remember his smile.

—Paul Monroe, RPT

Richard J. Kawiecki,RPT
June 21, 1923
November 20, 1994

Dick died at the age of 71 after suffering a stroke. As the minister said at the funeral, "He started out with nothing and accomplished so much."

He was raised in an orphanage in New Jersey. Early in his life he was a guide at the Grand Canyon. In World War II he served in the Army Corps of Engineers building airfields in the Philippines. His decorations included the Purple Heart.

Dick was a Charter Member of the Baltimore Chapter, PTG. Earlier in his career, after having attended PTG meetings in the Washington, DC Chapter, Dick became a strong force for creating a Baltimore Chapter. He along with seventeen other technicians, including Jack Sprinkle, Aubrey Willis and Wendell Eaton, held the first Baltimore meeting in 1966 and established the Baltimore Chapter. He continued to be an active member, serving on the Chapter Examination Committee in the 1970's.

The Kawiecki Piano Service was a one-man business. His clientele included individuals, churches and professional pianists. After retiring from the Baltimore City School System in 1985, Dick continued servicing pianos on a lighter schedule.

Dick had a zest for life and activity. He was an avid motorcyclist and took great pride in his BMW touring bike. Aviation lessons became a passion for him and he enjoyed some solo flying. Another pleasure for Dick was his 23-foot cabin cruiser. He and his wife never missed attending the sports activities in which their grandsons participated.

We thought very highly of Dick and respected him as a fine person. His death was a surprise as he was seen at our most recent meetings and he seemed in good spirits and fine health. He is survived by his wife of 43 years, Dolores, a daughter, a sister and two grandsons. The Baltimore Chapter will miss Dick and he and his family will be in our prayers.

—The Baltimore Chapter, PTG

Passages

In Memory...

December, 1994

KENNETH GENTRY, RPT
NORTH CENTRAL LOUISIANA

PAUL LAWRENCE, RPT
BLUEGRASS, KY

Reclassifications To RPT

REGION 1

059 - QUEBEC
MICHEL LACHANCE
154, DES DIAMANTS
FLEURIMONT, QC J1G 3Z8
CANADA

REGION 3

767 - HEART OF TEXAS
CHARLES W. FRY
RT. 3, BOX 161
LORENA, TX 76655

REGION 4

612 - QUAD CITIES, IL
JOHN P. DUDA
830 HALL STREET
BETTENDORF, IA 52722

REGION 6

921 - SAN DIEGO, CA
GARY W. NYLAND
960 MADISON AVENUE
ESCONDIDO, CA 92027

New Members In December

REGION 1

021 - BOSTON, MA

MATT GUGGENHEIM
184 EAST STREET
WRENTHAM, MA 02093

SAMUEL LOBEL
1 FITCHBURG ST., #C221
SOMERVILLE, MA 02143

040 - NEWFOUNDLAND

DAVE LUSH
BOX 6406
MANUELS, NF A1W 1L3 CANADA

041 - MAINE

DAVID W. WHITEHEAD
175 WHITES POINT ROAD
STANDISH, ME 04084

064 - CONNECTICUT

ROBERT M. ALECHNOWICZ
48 FRONT AVENUE
WEST HAVEN, CT 06516

142 - BUFFALO, NY

GRAHAM J. HOWES
3854 MCKINLEY PKWY.
BLASDELL, NY 14219

191 - PHILADELPHIA, PA

JOHN J. CAMPBELL
236 SECOND AVE.
PHOENIXVILLE, PA 19460

JOHN J. PERRY
5212 WESTBROOK DRIVE
CLIFTON HEIGHTS, PA 19018

REGION 2

217 - SHENANDOAH, VA

FRANCIS A. CHILCOAT
HC-71, BOX 33
AUGUSTA, WV 26704

223 - NORTHERN VIRGINIA

DAVID L. BAESEL
5913 TERENCE DRIVE
CLINTON, MD 20735

REGION 3

727 - NORTHWEST ARKANSAS

DEBORAH S. GILL
P. O. BOX 638
633 BUTTERFIELD
WESTFORK, AR 72774

731 - OKLAHOMA

DARIN P. NIEBUHR
4132 CASTLEROCK ROAD
NORMAN, OK 73072

761 - FORT WORTH, TX

CARL EARL, JR.
908 E. BALTIMORE ST.
FT. WORTH, TX 76104

REGION 4

481 - DETROIT-WINDSOR, MI

DAVID C. LOHNES
3485 SASHABAW ROAD
OXFORD, MI 48371

MATTHEW B. LOHNES
3485 SASHABAW ROAD
OXFORD, MI 48371

STEVEN H. SCHULTE
3310 LUDWIG ROAD
OXFORD, MI 48370

REGION 6

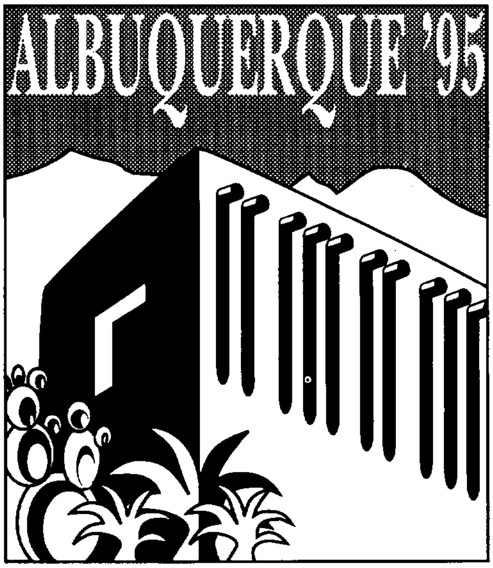
901- LOS ANGELES, CA

JOHN BARBATI
20431 ARMINTA STREET
CANOGA PARK, CA 91306

917 - POMONA VALLEY, CA

SHANE D. FAIRE
P. O. BOX 1010
LAKE ARROWHEAD, CA 92352

International Flavor...



...Southwestern Spice!

A Lot of New...
A Lot to Do...
in New Mexico

New Classes • New Instructors • New Excitement
New Friends • New Ideas • New Inspiration
New Mexico!

July 19-23, Albuquerque is the place to be to renew your passion for "Old World Craftsmanship" in the piano.

Fred Fornwalt, RPT • Institute Director

This month, I will highlight a few of the exciting new classes offered at this year's institute.

Anyone who has ever faced the dilemma of trying to meet the diverse performance demands of many artists with a single piano will be intrigued by Ken Sloan's unique solution. He built a second action ! In his class, Ken documents the process, illuminates the problems and challenges, and demonstrates the distinct personalities of this instrument.

Pitch-raising is something every technician faces. However, what really happens to the piano as tension is added? Joe Garrett will provide some very enlightening answers as he demonstrates the art of pitch-raising and monitors several strategic notes and their activities throughout the process.

You are called by an insurance company to appraise a piano damaged by fire or other natural disaster — is the piano salvageable? Tom Patten in "Rescue 911" will tell you how to spot the red flags when doing this type of an inspection; how to differentiate between cosmetic and structural damage; as well as how to perform an accurate appraisal for repair or replacement. Tom will also provide practical tips for dealing with insurance companies.

John Hartman will discuss wood characteristics and behavior, and will shed some light on why wood fails to perform as we sometimes expect it to. John will also demonstrate some basic woodworking skills and techniques.

Time is all we have — the more effectively we utilize it, the more prosperous we will be. C. Des Wilson in "Time Management" discusses proven ways to take control of your time and your business.

Star Finishing Products will present a one half day hands-on seminar on finish repair and touch-up.

We all have been awestruck by Bill Smith's amazing hammer carvings. Bill will be centerstage to demonstrate and teach his unique artform.

Seeing is believing — but only in Albuquerque. I hope to see you there!

Keep Up The PACE:

Make Your Plans Now For Albuquerque!

Paul Olsen, RPT • PACE Academy Coordinator

It may seem like the 1995 Institute is a long way off but you may want to begin making plans to take in what is shaping up to be a great Itinerary of classes. Last year's PACE academy proved to be so successful that we have been busily preparing for a second round this year in Albuquerque. We have scheduled a group of excellent instructors to help make this a most memorable educational experience.

It is the experience coupled with our knowledge that makes us proficient at our job. The real learning doesn't take place until we apply the knowledge to an actual experience. For piano technicians, this is where the PACE academy comes into play. PACE stands for "Professionals Advance through Continuing Education" and those who are serious about their education should definitely attend this year's institute and take in a PACE class. The cost is minimal, considering the value received. This year's PACE Academy will include more than 20 classes with the availability of individualized hands-on experiences. The classes will be similar to last year's, with the exception of a few small changes and a bit of refinement.

A portion of classes will focus on preparing for the PTG exams. If you are considering taking the PTG exam, these classes are a must. One class will be devoted exclusively to preparing for the written exam. Questions, similar to those on the exam, will be examined and discussed and a mini-exam will be given so participants can evaluate their readiness to take the real thing. Those wanting to take the actual written exam may do so in another PACE Academy class which will be offered during the institute.

One class will be devoted to preparing for the PTG technical exam. Participants will have an opportunity, first hand, to see what the technical exam entails. Tips on string repairs, hammer repairs, various felt replacements, use of tools, vertical and grand regulation will be discussed.

Tuning classes will be divided into five separate classes each focusing on a specific area. They will range from examining partials and Inharmonicity to setting the temperament. If you still would like more individualized atten-

Continued on next page

Ancient Peoples In Modern Times

The New Mexico Indian Tradition

Fred Sturm, RPT • Host Chapter Chair

This is the second in a series of articles about New Mexico, site of the 1995 Convention/Institute, and in this article, I will focus on our Indian heritage.

New Mexico is a place where history lives. Many of the ancient people of New Mexico still live in the same locations as they did before Europeans appeared in America, and they live with many of the same customs. This is especially true of the Pueblo Indians, who continue to inhabit 19 towns which were here when the Spanish first explored New Mexico. "Pueblo" means town in Spanish, and the Pueblo people built communal villages of about 500 people where they grew corn, beans, and squash, among other crops. They have always been known for their peaceful way of life, with strong religious traditions that focus on a regular annual sequence of group dances. They are also well known for their distinctive styles of pottery and silver/turquoise jewelry, which are available for sale at many locations.

Acoma, also known as "Sky City", is one of the most spectacular of the pueblos to visit. About two hours drive southwest of Albuquerque, the old village of Acoma is built on top of a mesa, a couple hundred feet above a broad valley, and has a beautiful view of the surrounding country. Early remains in the village have been dated to 850, AD, making Acoma the oldest continuously inhabited village in the US. Tourists are welcome, and handmade pottery is offered for sale.

Other pueblos are also open to visitors, but for those who lack transportation out of town, there is the Indian Pueblo Cultural Center (IPCC for short). Built and operated by the 19 pueblos, the IPCC houses a museum, gift shop, and restaurant, and presents traditional dancing every Saturday and Sunday afternoon in a courtyard. The gift shop is an excellent source for Indian made jewelry and pottery at reasonable prices, and the restaurant offers a unique Indian menu.

Besides the pueblos that are currently lived in, there are many sites throughout the state of abandoned towns and settlements, many within easy driving distance of Albuquerque. One of the most accessible is Bandelier National Monument, located about two

Continued on next page

Tradition...

hours drive northwest of Albuquerque, near Los Alamos. The buildings there are mostly in the form of cliff dwellings, with some rooms being caves, and others built on ledges out from the cliff face. The Monument also has wonderful trails for mountain hiking.

A bit less accessible, but well worth the effort, is Chaco Canyon, easily the largest and most magnificent archaeological site in the US. Built around 900-1100 AD and abandoned shortly thereafter, Chaco contains many town complexes with buildings up to three stories high built with very sophisticated masonry techniques. It had a large and complex road system leading to outlying sites, and there is a lot of mystery as to why it was built and abandoned. There are two routes to reach Chaco, but each ends with twenty miles (it seems like much more) of rough gravel road, so this is definitely an all day trip for the more adventurous.

Other Indians besides the Pueblo people live in New Mexico. Of these, the most important and populous group is the Navajo, the most numerous of all American Indian tribes. In contrast to the Pueblos, the Navajo never settled in towns, being nomadic originally. There are now settled very sparsely over a huge territory. Many of them continue to build their traditional "Hogan," a mud-covered hexagonal log house with a low doorway facing the rising sun. After the Spanish arrived and introduced domestic sheep, the Navajo became very famous as sheepherders and as weavers of very special high quality rugs. In Crownpoint, NM, about 100 miles from Albuquerque, regular rug auctions are held in which Navajo weavers sell their rugs, mostly for well in excess of $100. The best-selling mystery novels of Tony Hillermann are set in Navajo country, and describe the countryside and Navajo way of life in vivid terms.

Altogether, Indians make up about 8% of New Mexico's population, a very significant proportion. When grouped along with the Hispanic population of about 43%, they outnumber the "anglo" later-comers. My next article will talk about the Hispanic heritage of New Mexico.

PACE...

tion you may attend one of the tuning tutoring sessions offered during the institute.

Hands-on classes will be filled with valuable information on easy and efficient ways of doing many of the piano repairs we encounter. String repair, flange bushing and repinning, hammer shank replacement and other repairs will be covered. In some cases, unique tools and jigs will be used which help make our tasks easier, faster and more accurate. Proper and efficient tool use will also be demonstrated and applied.

Both grand and vertical regulation will be covered in depth. Participants will be able to go through the entire regulating process using an assigned action model.

Advanced hands-on classes will also be offered for those who would like some specialized training in specific areas. Included in these classes are bridge capping, damper replacement and regulation, hands on voicing, and chisel sharpening.

If you plan to attend any of the PACE classes, make sure you check the tool requirement list which will be published prior to the institute. Remember that tools are needed for many of these classes.

This is some of what will be included just within the PACE Academy. There will be many more general classes offered stemming from business to rebuilding along with some international classes taught by technicians from other parts of the world. This should be a great Institute so begin making plans.

AUXILIARY EXCHANGE

Dedicated To Auxiliary News and Interests

Something To Look Forward To...

One of the greatest pleasures in life is having something to look forward to. Whether it be something as simple as attending an opening of a new store or a vacation trip that will take you to new lands and adventures. There is an element of anticipation and excitement that can only be measured in the joys received during and after the experience.

Those of us who live in a four season climate have the opportunity to always be anticipating the next season and what it holds. During the cold and sometimes snowy winter we look forward to the early flowers of spring and the new directions of the sun's rays indicating that the days are growing longer and warmer. As the days lengthen and the sun warms the earth, greening up the grass and awakening the buds on the trees, we think toward the picnics and the outdoor activities that are enjoyed at poolsides or lakes. As summer wanes, we look forward to resuming organizational meetings, hikes in the woods, raking leaves and getting wood for the fireplace. During the golden Fall days of breathtaking beauty we are planning holiday gatherings, gifts and celebrations. Yes, indeed, life is full and no matter where you live there is something always exciting to be looking forward to.

Last November as I planted almost two hundred crocus, tulip and anemones in front of the stone wall, which Chuck and I made in our front yard four years ago, I was thinking toward March and April of 1995, when the flowers, now resting under six inches of soil, would be blooming, heralding the rebirth of another spring. I will look forward to seeing the many colors I so carefully selected and what fun it will be to see the joggers and walkers that go by our house everyday smile as they enjoy the color and beauty of these harbingers of Spring.

Other Springtime events to be looking forward to are several regional conventions and seminars. Two conventions to be held in the Northeast in 1995 are the Pennsylvania State Convention to be held March 30 - April 2 in Wilkes-Barre, PA at the Ramada Hotel on the Square, and NEESCO to be held April 27 - 30 in White River Junction, VT at the Holiday Inn. The planning committees of both groups have put together not only topnotch classes and exhibits for the technicians, but an OUTSTANDING program of sightseeing and luncheons for the spouses attending. If it is possible for you to attend either or both of these seminars with your husband/wife you will certainly want to participate in joining in the fun and fellowship shared by those who venture out into the community where the seminars are held and see America first-hand.

Check your calendar now and plan to attend a seminar this spring. Both you and your spouse will benefit and before you know it you will be LOOKING FORWARD TO attending not only the 1995 International Convention and Seminar in Albuquerque, NM July 19 - 23, but future regional seminars as well.

Shirley M. Erbsmehl,
Recording Secretary, PTGA

My dear friends of P.T.G.A.,

It has been a long time since you have honored me with company of such prestigious members of our organization. Thank you so very much for the honorary life membership from our group. It means so very much to me.

We haven't come these recent years to the convention — but happenings in these years have prevented it. Now, we are moved to a new address in a condo with a marvelous view, and just the perfect place to live. We loved our active times with all of you. They are happy memories!

My love goes out to all of you and I wish you all the best ahead.

Appreciatively yours,
Virginia Seller

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Classified Advertising rates are 35 cents per word with a $7.50 minimum. Full payment must accompany each insertion request.

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Send check or money order (U.S. funds, please) made payable to Piano Technicians Journal, 3930 Washington, Kansas City, MO 64111-2963.

FOR SALE

SANDERSON ACCU-TUNERS from Authorized distributor. Tuning lever note switch for Accu-Tuner: $35/coiled cord, $30/straight cord. Consignment sale of used Accu-Tuners and Sight-O-Tuners or new Accu-Tuner customers. Call for details. Rick Baldassin, 801-292-4441.

ACTION PARTS AND HAMMERS for the rebuilder. Highest quality Encore, (by Abel) and Nu-Tone (Knight) piano hammers. Try the new refined Tokiwa Action Parts (now some of the finest action parts made today). For the classic American piano sound, we recommend Encore hammers on walnut moldings. Encore hammers are made to the strictest specifications of Wally Brooks by the Abel Piano Hammer Company of Germany. Quality boring and shaping. We also specialize in pre-hanging grand hammers on new shanks for a $99.00 pre-hanging fee. Write or call: Brooks, Ltd., 376 Shore Road, Old Lyme, CT 06371, Phone: 800-326-2440 or 203-434-0287; Fax 203-434-8089

SOUNDBOARD AND PINBLOCK PANELS: Finest quality Bolduc Soundboard Panels made from Canadian white spruce. Pinblock panels of 1/4 sawn Canadian rock maple. For information and price contact Wally Brooks, Brooks, Ltd., 1-800-326-2440, Fax 203-434-8089.

ENCORE GERMAN SHANKS & FLANGES—now available for replacement on New York STEINWAY grands. The Finest Quality Workmanship Available. The value of a Steinway is determined by its final tone and action. "When you're striving for excellence—begin with quality." Encore Hammers and Actions Parts available only through Wally Brooks, Brooks, LTD., 376 Shore Rd., Old Lyme, CT 06371; 1-800-326-2440.

SANDERSON ACCU-TUNERS. Give me a try before you buy! 1-800-776-4342

KORG MT1200 TUNER. $295 (list$375) Hears A0-C8. Plays C2-B5. Shows pitch, note, octave. Can program calibration, temperament. KORG AT12 TUNER. $175 (list $250). SONG OF THE SEA. 47 West Street; Bar Harbor, ME 04609; 207-288-5653. Brochures.

BALDWIN MINIATURE PIANO. Measures H33"xW28"xD18". Brand new prototype, four octaves, mahogany. Cost $30,000+ to build, will accept $6800 plus shipping. Pictures and details on request. Call David, 501-253-5221.

GRAND PIANO STRING covers. Are you ready for an item that can keep the piano clean, prevent corrosion, improve tuning stability, make your clients happy and make you money besides? Custom made, it rests above the strings, covering soundboard, tuning pins and plate for complete protection inside the piano. Made from finest quality woven wool, available in black, brown and white. Personalized name applique also available. No inventory or investment required. For free brochure and samples call: Edwards Pianos, 408-426-1295, 145 S. River Street, Santa Cruz, CA 95060.

HAMMER BORING GUIDE. All metal, weighs 15 lbs. Accurate and easy to use. $180.00. Instructions and photo available on request. Kent Gallaway, 709 Thorne, Ripon, WI 54971; 414-748-3265.

GRAND PIANO STRING covers starting at $69.95 +s/h. Custom made from quality wool. Wool absorbs moisture and keeps strings, tuning pins, plate, soundboard looking new. Also, Accu-Tuner thumbswitches, $28.95. Action Piano, 714-364-1073

HANDCRAFTED SOUNDBOARDS BY NICK GRAVAGNE. Ready to install crowned boards or semi-complete. Your choice. Ordering and installation instructions $15.00. 20 Pine Ridge; Sandia Park, NM 87047; 505-281-1504.

HARPSICHORD PARTS & SUPPLIES including "Harpsichord Regulating & Repairing" by Frank Hubbard. For catalog write: HUBBARD HARPSICHORDS, INC.; 31 Union Ave.; Sudbury, MA 01776; or call 508-443-3417F WONDERWAND: Try the Tuning Lever you read and hear about. Enjoy Less Stress; Better and Faster Tunings: $65.00 p.p. Charles P. Huether, RPT, 34 Jacklin Court, Clifton, NJ 07012

COMPONENT DOWNBEARING GAUGES (bubble type) give readings in degrees (string angle) and thousandths of an inch (dimension). Available at supply houses. Box 3247; Ashland, OR 97520

KEY COVERING MACHINE call or write Bruce Ryndflietz; 339 West Nicholai St.; Hicksville, NY 11802; PH. 516-822-5936.

BOLDUC SOUNDBOARDS now available! The best rebuilders know the superior quality of Bolduc Pinblocks. Now you can experience this same superior quality with Bolduc Soundboards. Call for prices and details. Pianotek Supply Co., 1-800-347-3854 or Fax: 810-545-0408

BUCKSKIN for recovering grand knuckles and backchecks, upright butts and catchers. The "original equipment" supplying the industry for 140 years. Richard E. Meyer & Sons, Inc., 11 Factory Street, P.O. Box 307, Montgomery, NY 12549; 914-457-3834

PIANOS FOR SALE — Spinets, consoles, studios, grands. One or a carload. Excellent brand names. As is or rebuilt. Lowest possible prices. Owen Piano Wholesalers; 2152 W. Washington Boulevard, Los Angeles, CA 90018. Telephones 213-732-0103, 818-883-9643.

PIANO SCALING SOFTWARE for IBM & compatible computers. Plot inharmonicity, tension, break %, loudness/sustain, hammer contact, and more. 18 graph types, automatic bass rescaling, string winding data sheets, detailed users manual and money back guarantee. $80.00. Write or call: Tremaine Parsons, Box 241, Georgetown, CA 95634, 916-333-9299

STEINWAY B, 7ft., Hamburg, Germany, #395776. Artist owned and selected from factory. Pristine condition and maintained to the highest standards. $32,000. 513-948-1367.

CUSTOM PIANO COVERS MADE TO YOUR SPECIFICATIONS. Perfect for any storage or moving situation. All work guaranteed. Also available, many gift items. Send for free brochures and samples. JM FABRICations; 10516 Ohop Valley Extension Road, Eatonville, WA 98328, 206-832-6009

SOUNDBOARD PRESS - Designed and built by Chris Robinson and his welder, Ned Lisella. Only two in existence, all custom clamps and bolts included. No reasonable offer refused. Call Brad at: 914-358-6995.

RELIABLE ACCU-TUNER NOTESWITCH! One year guarantee! Includes coiled cable, thumb switch and attaching hardware. Fits all tuning hammers. $49.00 includes s/h. Dean Reyburn, RPT, Reyburn Piano Service; 2695 Indian Lakes Road, Cedar Springs, MI 49319, 616-696-0500.

MASON & HAMLIN 6'1" Grand, Piano Disc, mahogany - $16,900; Steinway 7' Grand, art case, circasian walnut - $30,000 o.b.o.; Chickering Grand Fancy Square Tail, mahogany - $6200; Wm. Knabe Grand, walnut - $4695; Steinway "O" model Grand, mahogany - $16,000; (GE-1) Kawai, high gloss ebony - $6300; Yamaha 5'10" Grand, walnut - $6800; Mason & Hamlin, mahogany, "A" - $10,800; Knabe Grand, 5'8", mahogany - $3695. Refinishing, refurbishing and tuning. Call for complete listing: Schroeder's Pianos, 13119 Downing Avenue, Paramount, CA 90723; 800-923-2311.

PIANO TUNING/REPAIR business for sale. Established 13 years—Long Island's affluent North Shore. Excellent repeat customer base. Successful, prosperous. Great opportunity. Motivated seller. 516-928-8123.

THE MOST ECONOMICAL precision key bushing cauls on the market. All sizes in stock all the time, custom sizes usually within one week at no extra charge. Phone orders welcome. Immediate shipping. Spurlock Specialty Tools, 3574 Cantelow Rd., Vacaville, CA 95688. Phone/FAX 707-452-8564.

MICRO-FINE TEFLON POWDER - the best lubricant for grand knuckles. Half the price of the commercially packaged product, and longer lasting. Reduces knuckle friction better than any other lubricant, greatly helps accuracy and speed when making touchweight measurements. Stops all but the most stubborn knuckle squeaks. 3/4 oz. =$3.75, 2.5 oz. = $10.75. For free catalog of all current products call or write Spurlock Specialty Tools, 3574 Cantelow Rd., Vacaville, CA 95688. Phone/Fax 707-452-8564.

400 FINE GRAND PIANOS. Largest selection in USA. Need piano technicians. Victor's - Miami, FL.; Ph. 800-325-8212.

PIANOS - Yamaha and Kawai grands $1850 and up. 23 Steinway grands and verticals. Large quantity of used American grands from $700 up. We buy pianos. Ed's 504-542-7090.

REPAIR CHIPPED IVORY IN 20 MINUTES. "AcryliKey" ivory restoration system produces a strong, color-matched, nearly invisible repair. Kit contains material enough for 50+ repairs plus pigments, mixing utensils, sanding pads, and complete instructions. $39.95 ppd. Richard Wagner, RPT; 7709 S.W. Pfaffle, #40; Tigard, OR 97223; 503-624-7360.

STEINWAY DUO-ART MODEL O.R. #242682. Clean case, ivories. Player complete, partially disassembled, needs rebuilt. Rehammered and restrung. $8000, Orcas Island, WA. 360-376-8863.

PIANOS FOR SALE. Grands, consoles, spinets. Excellent reconditioned brand name pianos. Floor ready-wholesale prices. Also available, "as-is" pianos. Any quantity. Call or write Piano Wholesalers, 5817 Wickfield Drive, Parma Heights, OH 44130. Call us first!! 800-438-3814.

SERVICES

STRAIGHT SIDES, SQUARE FRONTS and crisp notches are the benchmarks of our quality key recovering. Tops with fronts $100 plus return shipping and insurance. Call or write for free list of our key and action restoration services. Yvonne Ashmore, RPT and Associates, 12700 La Barr Meadows Road, Grass Valley, CA 95949, 916-273-8800.

KEY BUSHING: We use over 20 different sizes of Spurlock Precision Cauls. Send the micrometer measurement of the key pins and we will give you a perfect fit. Both rails high quality felt $75.00 or leather $80.00 plus return shipping and insurance. Write or call for free price list of our key and action restoration services. Yvonne Ashmore, RPT and Associates, 12700 La Barr Meadows Road, Grass Valley, CA 95949, 916-273-8800.

ADD ADDITIONAL $'s to your income. Rebuild player pianos for your clients. Send us the player parts. You restore the piano and we will return the mechanism in restored condition. We guarantee our work. For more details, call or write: Jim Brady, 2725 East 56th Street, Indianapolis, IN 46220, 317-259-4307.

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SOUNDBOARDS INSTALLED, topsides rebuilt. Bridge-conformed, scale-diaphragmized boards with truly quartersawn ribs (sitka, eastern, or sugar pine). You send us the case, we'll return you a piano. Quality's the bottom line. David G. Hughes, RPT. 410-429-5060. Baltimore.

REFINISH PIANO HARDWARE in nickel, brass, or chrome. Metal finishing specialists for over thirty years. Parts shipped back to you in 2-3 weeks. Rush jobs can be accommodated. Whitman Company, Inc. 356 South Ave., Whitman, MA 02382. 1-800-783-2433.

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WELL-TEMPERED TUTOR. Learn to tune by ear with your Macintosh computer. Use pre-programmed temperaments or create your own. If you have trouble hearing beats, this program can isolate the beats for you. Score yourself with the PTG exam. Twenty-one historical temperaments also available. Demo disk available. Mark Anderson, RPT: 510-524-0390 (California). Great teaching tool!

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DISPLAY AD INDEX

THE RANDY POTTER SCHOOL OF PIANO TECHNOLOGY — Home Study programs for beginning students, associate members studying to upgrade to Registered Piano Technician, and RPT's wanting to continue their education. Tuning, repairing, regulating, voicing, apprentice training, business practices. Top instructors and materials. Call or write for information: RANDY POTTER, RPT; 61592 ORION DRIVE; BEND, OR 97702; 503-382-5411. See our ad on page 3.

VIDEOS

INSTRUCTIONAL VIDEO TAPES. Victor A. Benvenuto. Piano tuning, $50.00*; Grand Regulating, $50.00*; Grand Rebuilding, $100.00 (2)*; Key Making, $50.00*; Soundboard Replacement, $29.95*. (*Plus S/H). The Piano Shoppe, Inc., 6825 Germantown Avenue, Philadelphia, PA 19119-2113; Ph. 215-438-7038, Fax, 215-848-7426.

PIANO TECHNOLOGY EDUCATIONAL MATERIALS. Vertical Piano Regulation by Doug Neal, $115; Plate & Pinblock Installation by Cliff Geers (2 reel set), $148; Wood Repairs by Cliff Geers, $68. Soundboard repair by Cliff Geers, $86; Grand hammer replacement by Cliff Geers, $86. Add $5 per order for shipping and handling. Questions? Call 712-277-2187. Mail orders to PTEM, 3133 Summit, Sioux City, IA 51104.

WANTED

WHEREABOUTS OR AVAILABILITY of any Leckerling pianos. Contact Bill Leckerling, 802-425-2736, RR1, Box 1657C, Charlotte, VT 05445.

ACCU-TUNER!!! TECHNICIAN WANTS TO BUY new or used Accu-Tuner. Call Paul (310)49TUNER.

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WANTED!! DEAD OR ALIVE: "Steinway uprights and grands." Call collect, Ben Knauer, 818-343-7744.

WANT TO BUY PIANO TUNING BUSINESS in rural/semi-rural area, within 3 hours drive of NYC. Near excellent skiing and hiking preferred. L.I. RPT wishes to relocate. 516-928-8123.

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STEINWAY & MASON HAMLIN WANTED!! "Dead or alive." $$$ Grands, uprights, consoles—any size, cabinet style or quantity. Cash and immediate removal. Finders fee for successful purchases. Call us first!! 800-438-3814 toll free or write to be listed in our worldwide data banks. Piano Wholesalers, 5817 Wickfield Drive, Parma Heights, OH 44130. Call us first!! 800-438-3814.

PianoDiscussions™

February 1995

News From The World Of PianoDisc

Dick Hyman records for PianoDisc

Famed Baldwin artist Dick Hyman stopped by PianoDisc during a recent round of West Coast performance engagements and left us with a PianoDiskette unique in our library—a collection of blues and boogie–woogie that only the PianoDisc system can reproduce effectively. "You almost expect the piano to start dancing, the music is so exciting," said one onlooker who attended the record session."It's hard to believe that one man with only ten fingers can make that much music come out of the piano!"

All selections on the soon–to–be–released Artist Series addition were selected by Mr. Hyman, who decided to honor PianoDisc by allowing us to be the first to record some of these masterpieces. "I've never recorded most of this music, but it's always the most popular at my concerts", says Mr. Hyman. "I thought this was a novel way to preserve some of this very interesting and intricate music".

Some of the standards recorded include "'T'ain't Nobody's Business If I Do", "Begin the Beguine", and the perennial favorite, "St. Louis Blues". Mr. Hyman's expert renditions of these songs alone make this PianoDiskette worth having. But, in addition to these were some Dick Hyman originals, including a composition written especially in honor of the record session and titled, appropriately enough, "PianoDisc Blues".

Another unique addition to the record session was Mr. Hyman's rousing rendition of "Beat Me Daddy, Eight to the Bar", in which he performs a piano duet with—himself. "It's harder to do than you might think," says Ketil Wright,the music editor who helped engineer this feat. "Even accomplished pianists have difficulty recording in this fashion."

Mr. Hyman recorded on a Baldwin SF–10, and had high praise for the instrument, which was provided by Baldwin for the use of Baldwin artists who record performances for the PianoDisc system. PianoDisc plans to continue an aggressive program to record Baldwin artists for the PianoDisc Music Library Artist Series. "There are a number of Baldwin artists that have been requested by PianoDisc customers, and we are doing everything we can, with the cooperation of Baldwin's Concert Artist staff, to bring these artists into living rooms across the country," said Steve Merritt, Talent Booking.

Mr. Hyman's PianoDisc performances will be available for all PianoDisc systems, including the new PianoCD system, by May 1995.

PianoDisc Installation Training

- February 21–25
- March 21–25
- April 19–23
- May 10–13
- June 20–24
- July none

Continuing Education Series

- May 4–5
- June 15–16

Tuition for the Installation and Continuing Education seminars is free, but a $50.00 refundable deposit is required for confirmation. The PianoDisc Continuing Education Series seminars are restricted to PianoDisc certified technicians in good standing. For more information about attending a PianoDisc Installation Training seminar or a Continuing Education seminar, call PianoDisc during our office hours (see below).

PianoDisc
4111 North Freeway Blvd.
Sacramento, CA 95834
Phone: (916) 567-9999
Fax: (916) 567-1941

Tech Support: (619) 258-1460
(916) 567-9999

Our telephone lines are open daily (except weekends and holidays) from 8 AM–5 PM Pacific Time.

Here we grow again...and again...

The PianoDisc family continues to grow and grow. By the time you are reading this newsletter we will have over 100 employees working daily at our Factory and World Headquarters in Sacramento. That's five times more than just a few years ago!

Of course we are all delighted with this growth, and happy to welcome on board many of our newest employees, who have jobs ranging in function from music licensing to software engineering, unit assembly and accounting. We also want to give special notice to some of our more senior employees who have moved into newly established and higher positions, such as:

- Account Executive **Mark Johnston**, who was recently promoted to the position of North American Sales Manager. "Mark has been instrumental in increasing sales in the Eastern United States, and is, in my opinion, one of the best Account Executives in the piano industry today," says Tom Lagomarsino, Vice President/Marketing. "He is a big reason why our sales in 1994 of PianoDisc pianos are up over 110%. We are confident that his activities will further boost PianoDisc's sales, market share and profile in the industry in 1995."
- Administrative Assistant **Tammy Perkins**, who has been promoted to fill the newly created position of Account Executive, Hospitality Sales. In her new position Tammy will be responsible for facilitating sales of PianoDisc products to hotel chains, restaurant chains and education facilities, either through cooperation with local dealers or directly. "Tammy has been a star player on our PianoDisc team for some time now, and we feel she is well suited to head up our new hospitality sales unit," says Tom Lagomarsino.

So congratulations to you both from your co-workers. And keep up the good work!

In Memoriam for...

Charolette Jincks, a delightful woman beloved by all her fellow employees, whose life was tragically cut short in an automobile accident recently. Charolette was our assembly floor supervisor, and is missed by all. Her passing is a tragic reminder to all of us of the fragility of life...

YAMAHA PIANO

Silent SERIES

Yamaha's Other "Four in One Piano"

You are already acquainted with the Disklavier as Yamaha's original 4 in 1 piano. Now meet Yamaha's *other* 4 in 1 piano—THE SILENT SERIES PIANO.

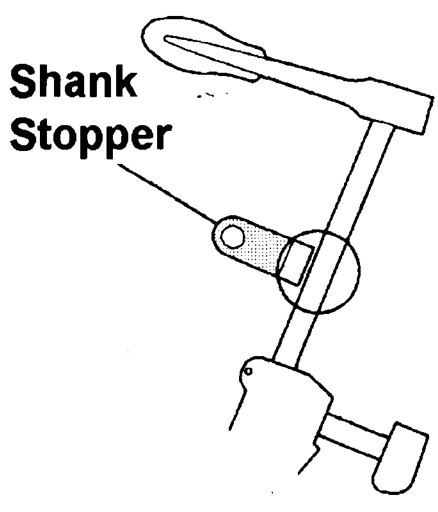
1. ◆ **It is a Traditional Acoustic Piano.** Everything you can do on a regular traditional piano, from practicing piano lessons to playing in Carnegie Hall can be done on a Silent Series piano. All of the electronic components that have been added to the Silent Series to make it different, are completely transparent to the musician when playing the piano in it's traditional mode. Nothing interferes with the touch and tone.

2. ◆ **It is a Silent Piano.** Press the center pedal down, and a "shank stopper" is activated inside the action. Each key of the piano still feels the same to the pianist, but the strings are never touched by the hammers. The piano is silent!

A sensing system detects precise key and pedal movement, sending the information to an on-board tone module where a sampled Yamaha CFIII Concert Grand sound is made available to the two headphone jacks. Now, whatever music is being played on the keys is heard only in the headphones!

3. ◆ **It is an Amplified Piano.** By connecting audio leads from the piano directly to an amplifier and speakers, volume can be increased or the sound sent to another room.

4. ◆ **It is a *real* PIANO KEYBOARD that is MIDI capable**. The one thing missing from all electronic keyboards is the true piano touch found only on real pianos, and all Silent Series pianos are real pianos. The MIDI out port allows Silent Series pianos to be connected to a computer, sequencer, tone module, or any other MIDI device. For example, in the case of small churches, a Yamaha Silent Piano, equipped with a tone module can become the church organ or any other instrument in the tone generator — from harpsichord to string section. And of course, it is always a traditional piano.



Now available in Yamaha consoles, studios, uprights, and even in grands. More details next month.

PARTS & SERVICE: (800)854-1569 FAX: (714) 527-5782