PIANO TECHNICIANS
Journal
July 1991

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Concert Technician

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Piano Technicians
Journal

July 1991 — Volume 34, Number 7

Official Publication of The Piano Technicians Guild, Inc.

About The Cover:

This month's cover is a happy accident — a double exposure taken by Tucson, AZ, Chapter member Bob Anderson, while preparing a technical presentation for his chapter.

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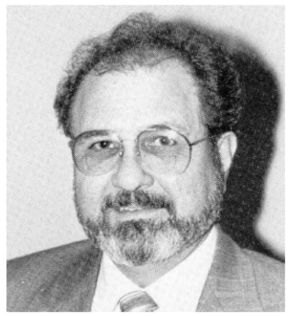
President's Message

Thank You

With this month we wrap up another year in the life of PTG, and a year as President for me. It has been a lot of work, but it sure has been one great learning experience for which I am eternally grateful. There is not a way to describe what it has meant to me to have been able to share the contacts and experiences of this past year. It most certainly gives me something to be with me for the rest of my life. For this I thank you.



Nolan P. Zeringue, RTT
President

I set the committees up this year a little bit different than in past years, and the results sure seem to be impressive. We have received reports which represent many hours of work; much concentration has been put on the affairs of PTG. Without the work of the committees and of the PTG Council, nothing would be accomplished.

I would like to thank every member of each PTG committee for their time and commitment to serve. I appreciate the time taken from your busy schedule to answer my call to you on behalf of PTG. I know it may seem thankless sometimes, but I assure you there are those members out there who do recognize what you do. There are many who would be very good committee members, but for one reason or another just don't have the time to serve. I thank you for having helped with running PTG this past year.

Many members may not know what the Home Office does besides collect dues. I assure you I, as well as the rest of the PTG Board, am well aware of how important they are to the operations of PTG. Without these good people, Larry Goldsmith, Mary Kinman, Sandy Essary, Patti Chapman, and Lisa Gray, we would not be operating as well as we are today. I thank you all for your assistance and cooperation which was indispensable to me through this past year as president. Without you it would not have been as successful.

I hope all of you have an enjoyable and rewarding convention. I look forward to seeing all of you in a couple of days in Philadelphia.

Industry News

Randy Potter School To Use Aubrey Willis Course

In a joint statement issued by David Pennington, former Director of Instruction of the Aubrey Willis School of Piano Tuning and Repairing, and Randy Potter, President and Director of Instruction of the Randy Potter School of Piano Technology, it was announced that copyrights to the Aubrey Willis Home Study Course in Piano Tuning, and license to use the Aubrey Willis name, were transferred to the Randy Potter School. The transfer has been in the works for several months, and was completed in May 1991.

Pennington, who was trained by former PTG field secretary Aubrey Willis in the early 1970s while dating his daughter Rose, whom he married, became president of the school in 1978, and later Director of Instruction shortly before Willis' death in 1981, a post he held until 1988, said, "When Aubrey published his course in 1968 it was the most comprehensive course available, and remained so until 1987. I assisted in the 1978 revision and, as always, his goal was to provide the best training available for those wanting to learn piano tuning.

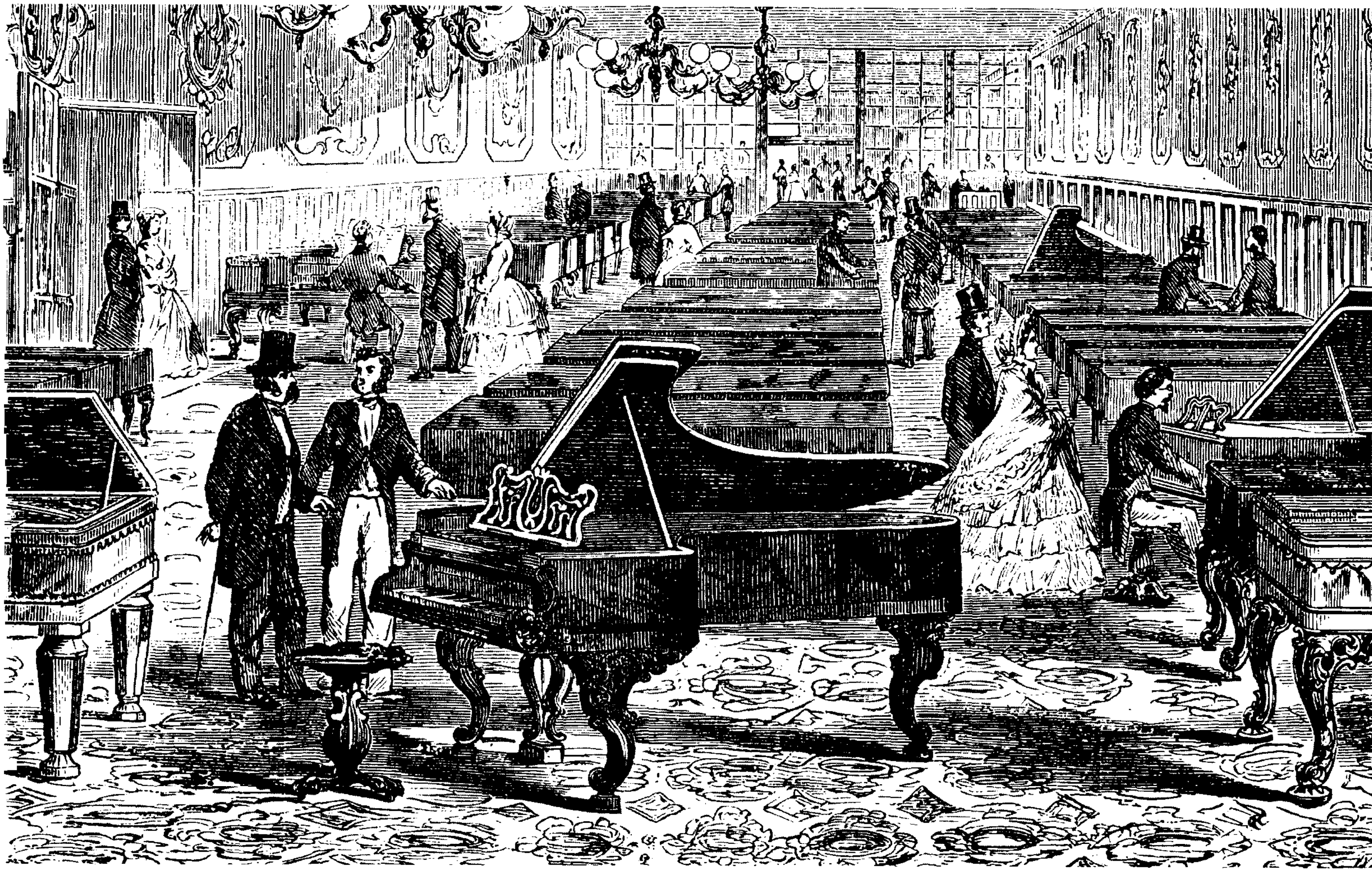
"I was director of the school for several years, before deciding to license publication to an Arizona school in 1986. That didn't work out, student enrollment dropped dramatically and the school closed in the fall of 1990. I prefer tuning to teaching, and maintain a very heavy tuning schedule at Walt Disney World and the Epcot Center, so starting up the school is not in our plans.

"The Aubrey Willis Course was the best course in its day. But it has needed re-writing for some time. When the Randy Potter course was published (in 1987) it was more complete and up-to-date than anything even my father-in-law had conceived of. They have become the industry leader in teaching piano technology. I have been recommending Randy's course for some time, and when the license recently became available I approached him to see if he had any interest in acquiring it."

Potter went on to say, "When we were approached about acquiring the copyrights and license, I was pleased. Aubrey was a leader in our industry, and in the Piano Technicians Guild. He did a lot right.

"At the Pennington's request we have agreed not to market the course, though we do intend to incorporate some

Some manufacturers ask your customers to invest in their past.



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From The Home Office

The More Things Change...

Larry Goldsmith
Executive Director

As you read this, the Piano Technicians Guild will be preparing to gather in Philadelphia for its 34th Annual Convention and Technical Institute. I hope you will be there to take part in this historic event.

Although we say that this is our 34th year, this convention marks only the anniversary of the formation of our current legal entity. We are fortunate to have as members many of those who were involved in the two organizations that joined 34 years ago to form what is now PTG — people like John Travis, who with the late Erroll Crowl served as co-president of the new group. We now have more than 120 charter members — those who were members of one of the two earlier organizations.

It's quite a tradition. In fact, efforts to bring piano tuners together in a united organization began much earlier. The earliest copy of a magazine claiming to represent an organization of piano tuners we have is dated 1913. It was called *The Tuners' Magazine*, and was published by Sumner L. Bales in Cincinnati, OH.

Here are some remarks by William Braid White quoted in the July 1913 issue regarding the American Guild of Piano Tuners. His remarks were presented at a convention of merchants in Cleveland.

> *...it is creating a distinct and definite standard of technical attainment. It is, in other words, setting apart the member from the non-member, not merely by giving the one a card of membership and withholding it from the other, but by requiring that the issuance of that card of membership be conditioned upon the passing of a qualifying examination in the theory and practice of piano tuning. In other words, the guild is establishing a standard which, whether it be a perfect standard or not, is at least the only standard that has ever been established. Hence, it is doing the first great thing necessary to make the profession of piano tuning a consistent, recognized and respected profession. Not only so, but by this standardization, as it is more and more successfully carried out, the guild is enabling the trade and the public alike to learn that when they deal with a member of the guild they deal with a man in whom they may have supreme confidence. That is the first and most important thing the guild proposes to do, and is doing, is to bring about a spirit of confraternity and good will among its members as against that painful spirit of ill will and that lack of sympathy which are so frequently to be observed among piano tuners. By associating its members together, especially in the branches; by getting them to know each other, it is bringing about a vastly improved condition of affairs within the profession itself, a condition which means much for the dealers and manufacturers as well as for the tuner himself.*

Now, 78 years later, there's not much to add. The challenges apparently haven't changed much. Hopefully, neither has the will to deal with them.

***

In the same July 13 issue was printed a listing of prices which were standard for Bradway's Piano Hospital in Baton Rouge, LA.

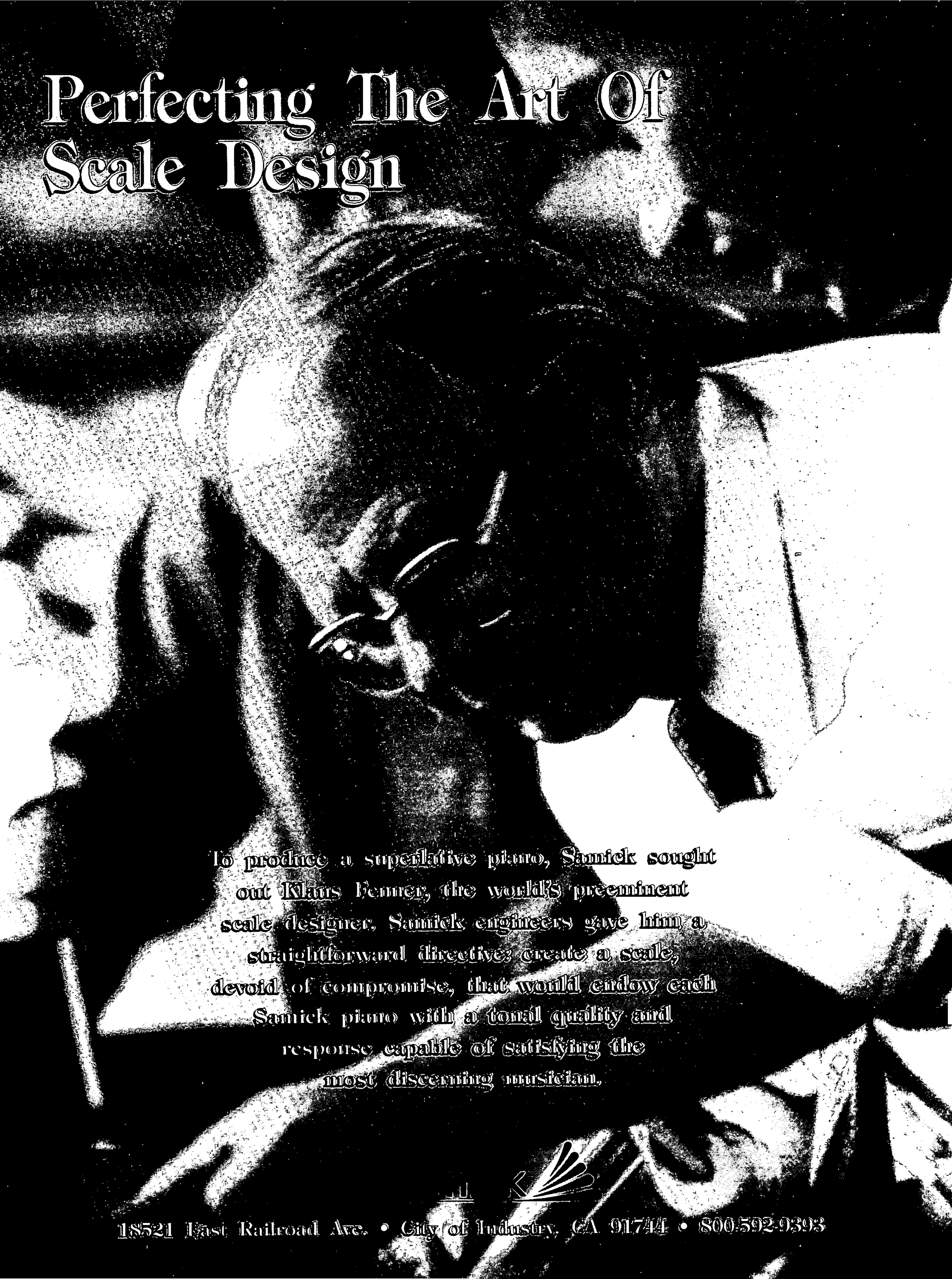
"In the tuning profession prices very greatly in different parts of the country. In the East, some tuners take as low as 75 cents for tuning a piano; in the West, nearly all tuners command $5.00 per tuning."

The article went on to list the price for action regulating at $2.50, complete restringing at $25 to $40, split sounding boards at $5 to $12, mouse-proofing the piano at $5 and "miscellaneous professional work, per hour, $1."

of Aubrey's material into our course. Instead of what he did just disappearing, some of it will remain with us. Our students will benefit by this collaboration.

"We have notified the Arizona Department of Education that we will do what they call "teach out" for Aubrey Willis students who were stranded when the company went out of business in 1990. Or, students may transfer into our program as Continuing Education students, as many have already done.

"Our approach is different than Aubrey's was, because our course is designed to train beginning and more advanced students, not just beginners. And modern technology has allowed us training options, such as video tapes, not possible before. But our goal is the same as Aubrey's was; to provide the best possible training to piano tuning students."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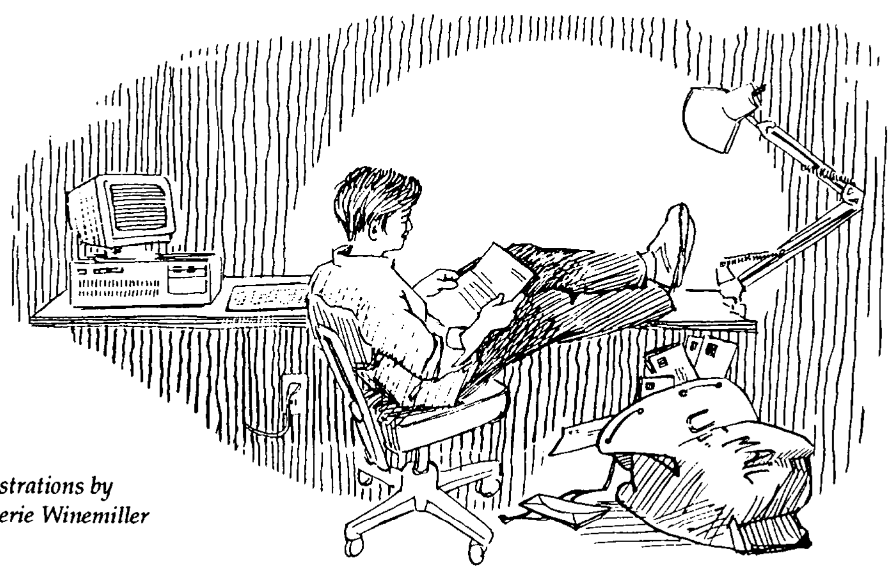
More From The Mailbag

Susan Graham, RTT
Technical Editor



Illustrations by Valerie Winemiller

As you might guess from the illustration, this is another "mailbag" forum. The format seems especially appropriate for summer reading (take the *Journal* to the beach?) Not only that, but as I contemplate these last few months as technical editor, I realize how much good material which has been submitted I've been saving for an editorial rainy day. Now is certainly the time to use it! (Better use might have been to run more of it as it came in — oh, well.) Thanks for your patience, all you contributors out there — surprise! here's your material.

I can think of no better start than a few of what he calls "ramblings" from Jim Harvey. Jim has one of those great, inventive minds with a capacity for keeping things simple as well as useful (he's also one of our official PTG characters, but I don't need to tell you that). It's a pleasure to share a few of his ideas:

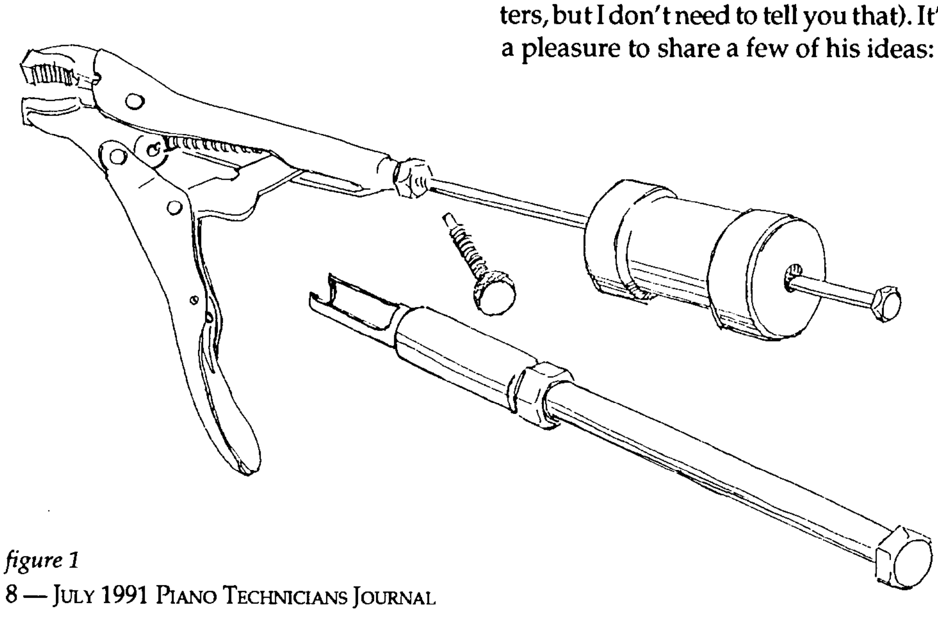


figure 1

Ramblings

Re: January 1988 Forum/Kids, Don't Try This At Home

For removing backchecks, instead of the vise grips and the two-foot crowbar, try using a plier-type (i.e. Hale) hammer extractor. Use a small, tapered (to counter the existing wire angle) and notched (to bridge the backcheck wire) wooden wedge (to protect the keystick from the lower foot of the plier). For just the heads — same tool; use padded vise grips somewhere on the backcheck wire to press the extractor foot against. Was that as clear as mud? Sorry, the words will have to do. I don't have AutoCad implemented on the computer.

Re: February 1988 Forum/D&C (Dusting and Cleaning)

According to my findings, "One-hour Martinizing" is about the only dry-cleaner left using perchlorethylene, at least around here. Other commercial cleaners are using petroleum-based fluids, which are not good for leather products (dries it out). A leather reconditioning facility says that they use a "charge" to circumvent this drying process — something to do with mineral spirits, but I couldn't get clearer answers, since the person I was talking to on the phone apparently died during our conversation, having already been brain-dead from working with these materials. Anyway, I finally found "Renuzit," when built a glass bead-blaster (for like-new knuckles), so gave up the pursuit. Note: "Sterno" seems to be getting scarce too. See the quandary we're in? First it's dry-cleaning fluid, then Sterno. It's becoming progressively harder to find a good all-around shop drink.

For extracting keypins, I've modified the non-business end of my impact coil-lifter to permit screwing on a pair of trusty Vise Grip Jrs., making both ends business ends, and giving me another multiple-use tool. The end of the shaft of the coil-lifter is threaded to match (and replace) the adjustment screw of the vise grips. I will be show-

ing this hideous-looking-but-effective device in "Nickel and Dime Quality Tools," a.k.a. "Tools, Part II" at the convention.

As a punch for inserting new keypins, try an appropriate-sized dowel (for inter-pin clearance) which has been blind-drilled to "x" depth. The end result is the same as your rounded punch, but you can just start driving without worrying about the subsequent height of the keypins — they're all the same!

Re: November 1988 Forum/Leg Repair

For anyone using hydraulic jacks for under-the-hood piano jobs: (I understand that) in some jacks there is metal-to-metal contact for the pumping and/or lifting mechanism, as opposed to gaskets, grommets and so on. Translated, this means that there is a potential of the jack failing when least expected, instead of developing slow leaks and giving visible signs of seal deterioration.

Although I'm guilty of using one in a pinch, I feel that the idea of using the bench for backup is questionable. Taking a tip from the automotive industry, a jack should only be used for lifting purposes; it is not a substitute for proper blocking and support. If benches fail with obese people sitting on them, what would happen with 900-1300 pounds falling on them? Has it ever been tested? For years I used a modified van/pickup jack stand as my fail-safe while doing leg repairs. The triangular configuration made it a storage nightmare, but I sure felt a lot safer!

Re: Your upcoming friction article

Plated capstans on which the plating is starting to deteriorate. On these I have removed the capstans, removed all the remaining plating, including the threaded part, using a fine wire-wheel; soaked the capstans in ammonia; polished and replaced them. Since the plating was thin or inferior enough to fall off in the first place, I've not had any problems with the capstans being too loose in the keysticks due to the missing plating.

In uprights (if anyone other than me still works on these), Harvey says it's OK to replace damper lever (spoon contact) felt with action cloth. Look at the condition of the spoons as well. The combination seems to cause the spoons to oxidize or loose their plating.

Disclaimer: As always, if you or any of my esteemed colleagues should be injured or seriously killed trying any of these procedures, I will personally disallow any knowledge of having made these statements.

I'm not sure how Jim modified his impact coil lifter, but I did it simply by finding the size of bolt which would thread into the five-inch vise grips, which turned out to be 1/4". I had to extend the threads up the shank so the bolt would thread in far enough to completely close the pliers. Works great!

Another alternative to using the bench for backup support is to purchase one of the all-metal, folding sawhorses that specialty mail-order woodworking suppliers offer.

How do you store your damper felt? Here's a useful idea gleaned from the February 1991 "The Piano Wire" (newsletter of the Dallas Chapter):

Uses For PVC Pipe

That white plastic PVC pipe can be used for a storage container for many piano items that need to be stored in a straight line. I use one to store those grand damper strips from Schaff.

I also have a smaller diameter pipe to store various sizes of straight music wire for springs. Any hardware store has PVC pipe and they will saw off the length you want. You can buy two caps with your pipe to enclose your container. I also have a couple of 3 1/2-foot lengths of 3/4" PVC to telescope the skids on my vertical action cradle. The length of the cradle will then adjust automatically.

Will Nieberding

Speaking of gleaning from newsletters, this article by Michael Travis comes from the January 1991 "Alpha News" (Washington, D.C. Chapter):

Velcro-ize Your Tool Kit

Velcro-ize your tool kit? Do you have one of those tool kits with pallets that seem to rain tools when you open it, or when you're rummaging around in the lower level? Here's an idea you might use. Go to an office supply store and buy a box of Velcro with the strips on a continuous roll. Remove tools from pallets, and stick a long strip of female Velcro along the pallet pocket openings. Then wrap a ring of male Velcro around each tool at the area where it protrudes from the pocket and crosses the female Velcro. Problem solved, no more tool fall-out problem. You'll find you can also add strips between some of the pockets and neatly hang even more tools there in the same way.

A source which prefers to remain anonymous sends me items from time to time. Here with a few of his offerings:

Kimball Player Pianos: Although Kimball players have a low failure rate of the vacuum motor, it does happen. The easiest and least-costly method is replacement with a generic pump. This may require a bit of added effort and ingenuity. But, for the purist, a replacement vacuum motor is available from the Grainger Catalog. (Motor only, not the pump.)

A word of warning: the OEM Kimball units weren't made for rebuilding. It will take a lot of effort. Grainger Company has 300 locations nationwide. (800-225-5994)

Tuning lever tips — imported pianos. Grind off about 1/32" to 1/16" of tip face (and bevel edge). Reason: I have encountered a problem whereas the tuning tip hits the coil which keeps the tip from seating on the pin.

I sometimes use a dial indicator for seating glide buttons on grand actions. Use an indicator clamp to attach above action near glides to be adjusted.

Capstans: For those small (5/32") capstans as used on some vertical pianos (like older Wurlitzers) I modified a standard damper regulator tool (example Schaff #61 B) by grinding the slot wider with a grinder bit mounted in a Moto Tool. This offers a tool for the combination handle.

As climate control devices (commonly referred to as damp-chasers) become more sophisticated, many of us are installing complete systems, finding that they can be tremendously helpful in stabilizing tuning and action function. It is important to realize that randomly sticking the parts into or under a piano isn't enough. The system should be "fine tuned" by placing the humidistat the proper distance from the components (see "Fine Tuning A Piano Climate Control System" in the November 1990 issue) so it can read and respond to changes correctly. It also needs periodic checking and maintenance, as the following very clearly states:

Dear Susan,

A number of years ago I installed a complete damp chaser system in a console piano. It worked very well and I left an extra set of pads with instructions to install them at an appropriate time.

Last month I had an opportunity to tune this piano again and found that the pads had never been changed. The hard water left a very hard crust over the heater bar which resulted in reversing the operation of the system. The bar was warm, but was no longer moist due to the calcium deposits! Of course I installed the new pads, but it was a very short time indeed before I was called back. It took three trips before the piano finally settled down again!

I don't believe I have ever heard of a situation like this before; so thought you

might like to pass on a caution to the technicians in the field.
Dick Beaton, RTT

Some technicians like to ream pinblocks when they restring with an oversize pin in old blocks (others prefer to clean the holes with gun cleaning brushes, and others simply cram in the larger pin). For those who prefer reamers, the following may be useful:

Dear Susan,

Information regarding use of reamers for replacement of tuning pins: I feel certain that in a situation where individual pins are randomly replaced or an entire piano is repinned, the use of a reamer can assure the consistent tuning pin torque throughout. My first choice was to use a straight flute reamer, but a spiral type can also be purchased.

The letter (J) reamer, diameter .2770 part #EDP30810 works well for the 3/0 tuning pins. The letter (K) to be used for 4/0 pins part #EDP30811 with diameter .2810. For the 5/0 and 6/0 tuning pins one must use the metric size, 7/3mm at .2874 diameter and reamer 7.4mm at .2913 in the respective order. All are high-speed steel cutters #700 reamers. The ends can easily be filed or ground to fit the common regulating tool handle. Simply angle file one side.

Note: the size reamers mentioned are approximately .010 under the tuning pin size. The reamers I suggest using are only if you wish to keep the purchase price of these tools at the selling price of $11.00 ranges. The previous sizes stated are normal stock reamers. However, if you require more precision, the reamers could be made to order with any size, increments of .001". "Try it. You'll like it." These tools can be ordered through: Jack Benedict, Austin For Logan, Inc.; 1500 Kenmore Avenue; Buffalo, NY 14216 (716) 875-3770 or FAX (716) 875-8280 "Cutting Tools For Industry."

Jim Mosier

In reply to a query about sticking keys in small vertical pianos (August 1990), Jack Caskey has kindly found the time to write this detailed and informative response.

Dear Susan:

There's been frequent mention of a perplexing problem usually captioned "sticking keys" and, usually attributed to Asian vertical piano actions even tho' you have pointed out it can also be encountered on U.S. makes as well. The solution is now becoming known by some, but I'm sure there are quite a few out there who have not run into this strange, and at first, vexing problem. I hate to be accused of beating on a dead horse, but I do think it's important to cover a few of the basic factors involved so that the solution and the problem itself might make more sense. I would also suggest a couple of simple tests to make that will save a tuner some valuable time and anxiety.

This problem 99% of the time will be found on a small vertical, usually a console, that employs a compact action. It reveals itself as a slow, or, non-repeating key, sometimes intermittent. You'll also notice that the key often does not completely return all the way — thus the suspicion of a key bushing or key leading problem. I'd like to add that with more severe cases the wippen and hammer butt assemblies can even actually lock in mid-air if the key is given a quick stinging blow such as when a sharp test blow would be given while tuning. You can imagine how frustrating this can be to a tuner stumbling onto this for the first time, not to mention a piano player.

The typical diagnostic search will begin with the key, then suspicion of weak coil springs, tight hammer or whip flanges, jack dragging on coarse inferior buckskin on the inner contour of the butt and finally in desperation, one might introduce lost motion to the key and action.

Fortunately none of complicated above points is the cause of or the solution to the problem. The cause of the problem, pointed out in Mark Mandell's letter, (August 1990 Journal) is that the "let-off/jack stop-rail" has been inadvertently (carelessly) set too close toward the jack and the solution is really very simple: Loosen the screw on the slotted bracket that holds this rail in place, move the rail away from the jack and retighten the screw. We are apt to overlook the fact that in a compact action the traditional let-off rail has a dual purpose — that of let-off and jack stop.

In the past whenever I've told tuners how to correct this, they acted like I totally flipped for good, and often I could not get them to even check the rail since they said they'd already checked that and it was OK. However, since we as a company with a warranty needed to make the piano right always found later that the improper position of the rail was the problem. Therefore if you'll permit I would like to bring in some specifics.

Why, we ask, doesn't the wippen fall back down just from gravity? Not being an engineer or scale designer I'll have to give a layman's explanation — later on someone with a slide-rule can maybe clean up my act.

From some of the past PTG classes I've attended I've been told that keys and actions are designed using the multi-circle principle. Actually, the wippen and hammer butt assemblies as well as the keys do not travel straight up or down. They travel in an arc. So, back to our problem: When the stop rail is nudging the jack at the end of the blow, the jack tries to return in its normal arc but it cannot. It doesn't have this freedom since the stop rail prevents it; consequently there is a very deliberate and hesitant return that doesn't quite make it in the normal accepted way. Furthermore, remember that both the wippen and butt assembly are trying to return. The wippen arc of travel sends the jack slightly into the soft felt of the stop rail, and the arc travel of the butt returning down compounds the problem the jack is having by putting a slight squeeze on the top of the hesitant jack. So there are three factors involved here; the returning arc of the whip and the but, and a stubborn stationary stop rail set too close for the jack travel.

Below are two tests one can make when this condition may be suspected:

Test #1: Depress the key and hold it down. This causes the jack to be at its most forward point toward the stop rail. While still holding the key down, use your fingernail of the other hand or a small thin screwdriver blade placed on top of the jack tender, or behind the stem of the jack and try to move the jack toward the stop rail. The jack should move approximately 1/8". If it is against the felt strip of the rail and you cannot move it, then the rail needs to be adjusted as discussed earlier. Adjust it so that there is at least 1/8" travel of the jack while the key is being held down.

Another and quicker test #2: Depress the key as before holding it down. The hammer assembly will then be in check. Now with the forefinger of your free hand pull (force) the hammer back against the "hammer rest rail cushion." Now gently release the key. If the stop rail is too close to the jack, you will find that the hammer and wippen assemblies are locked together in mid-air upon the releasing of the key. You can even gingerly work the key up and down without unlocking the action parts.

Remember, when ever you find this problem on one key, a test should be performed at each of the nine brackets that hold the "let-off/jack stop-rail" along the entire action. It only takes a few minutes and is time well invested in eliminating a nuisance return call.

We seldom find this problem on full scale upright actions since having the luxury of more space, a separate jack stop rail is designed into the action rather than having to make dual use of the traditional let-off rail. Also the jacks are longer. No doubt since the larger action is a more expensive design and in a more expensive piano the regulation of this auxiliary stop rail may be more closely monitored at the manufacturing level.

Jack Caskey

R.E.T. LONG MEMBER OF P.T.A.; F.I.M.I.T.; RTT. P.T.G. (U.S.A.) I.A.P.B.T.
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ARRIVED .... Yours faithfully,

DEPARTED .... R. E. T. LONG

Speaking of tuning pins, bushings and related matters, here's an interesting response to the item about torque printed in the January 1991 issue (which was actually a reprint from Don Galt's Forum in May 1972).

Dear Susan:

I was entertained to read your comments concerning the sloppy use of the word "torque" in the January issue. There is one further aspect of torque that concerns me.

Torque is rotational force and its units are the units of force multiplied by the distance from the center of rotation about which that force is applied. Thus ounce-inches and gram-centimeters are correct units. The distance is as important as the weight. Consider child number one on a see-saw who is lighter than child number two but wishes to up-end child number two. He can do so by sitting further out on the see-saw than child number two, thus creating more torque at the see-saw fulcrum.

This is more than a semantic quibble since very real errors can result from failure to appreciate the importance of the distance element in torque. Flange torque is often specified in grams without specifying the distance from the center pin that the force is applied. The reader is left to assume this, possibly to be the center of the hole used to attach the flange. When applying a force gauge to measure flange torque it is rather difficult to apply it to the center of a hole. I have seen technicians apply the gauge to the wood at the end of the the flange instead. This would introduce an error, maybe as much as 50%, in the resulting reading. It seems that bad physics has gotten ingrained here through traditional practice. Anyone not ingrained with traditional piano culture would assume five grams meant five gram-centimeters. The flange mounting hole is seldom exactly one centimeter from the center pin.

While I have your attention, (if I still have), another unit that bothers me is that of inharmonicity. (Would that a different description had been chosen for it rather than the tongue twisting moniker inharmonicity!) It is referred to as the inharmonicity constant. Neither from the mathematical nor semantic point of view could it be called a constant since it clearly is no constant. The beauty of a real constant, like (pi) the ratio of the diameter of a circle to its circumference, is that you know its value ahead of time and it does not have to be calculated. This cannot be said of inharmonicity. I have seen several students trying to understand the concept of inharmonicity befuddled by is being a non-constant constant. Could we not call it something like the inharmonicity factor perhaps?

Sometimes the big picture is clearer if the little details are taken care of so I thought these points were worth mentioning, perhaps before someone lifted my computer as well.

Christopher Day

The following comes from Ralph Long, a PTG member who resides and works in England. He writes in reply to the articles on no-show appointments, and also in response to the Guild survey results. I find it quite interesting to see how different the same business can be!

Dear Susan:

This is the first time I have ever written anything with reference to how we go about our work, but after reading your article in the November Journal *under business operation, I thought it might raise some eyebrows or surprise some people what some of the English piano tuners do.*

In reading through the survey which was carried out and unless I am totally wrong, the majority of technicians in the United States tend to do four tunings a day. It seems that the majority of English piano tuners tend to do five a day. I myself, and our President of the Pianoforte Tuners' Association, Les Sherlock, carry out six a day, usually starting at around 8:30 a.m./9:00 a.m. and sometimes as early as 8:00 a.m. This normally means that our day finishes at around 6:00 or 6:30 p.m. before making our journey home.

Now I personally book all my regular work together and the majority of these are six-month and yearly. At this present point of time I have three clients that are bi-yearly. I have very few clients that have them done on a four-month period though I must admit I have some clients where I tune them twice during the winter months and once during the summer months. I was very fascinated to read the way appointments are made. In my early days I used to post my appointments on a monthly basis as this was cheaper than telephoning, but used to find this was not very satisfactory and would often find clients out when arriving to carry out the work on their pianos. One of our members found that it was far better to make the appointment with the client after tuning the piano and leaving them with an appointment card giving date and time and the year, which not only has your address but telephone number in bold print at the top. I myself have since of recent years introduced a non-cancellation charge. This is half the tuning charge plus an area charge which covers some of the time with reference to travel and also running costs. This is also charged per unit or per piano. Now for this I wait one full half-hour, stating time arrived and time of departure, stating the clause now becomes valid and this will be added to their next tuning charge where I give them a new date and time. I find this works very well as if people do have to cancel, they let me know promptly, but if they are in the wrong, they pay up. It also saves you having a massive loss of earnings. (I am enclosing one of my appointment cards so that you can see what they are like.) Since introducing this system I do not think that I *have had any more than three cancellations, maybe four, within one full year although I must admit I have not kept a full check on this, but I know it is low.*

I have a full diary and I try to fit four new jobs in one day, allotting two hours a piece to start off with and then allowing further time according to the requirements of the instrument and what needs to be carried out. At the time of writing this letter I have a waiting list of 26 new clients, and the majority of these people know that I possibly will not be able to get these done until well into the new year, as my regular bookings are naturally already booked in my diary, from making the appointment with my client at the previous appointment.

I spend three days out on the road, one day paperwork, one day workshop work, but at this present time my workshop day is being taken up by trying to clear up new clients. But I only book a few at a time in case major work has to be carried out of an evening time and my concert work is carried out as and when it is required, mainly at weekends.

I hope this preamble may be interesting to many of the members of the PTG, but it does allow me to be able to take some time off during the year to recuperate! If you feel this is useful for editorial reading I hope this will be helpful.

Ralph Long

And Now For A Few Puzzles:

Some of the mail I get includes questions I simply can't answer—maybe someone out there can. The first is really a comment on the procedure I use (and have written about) for measuring downbearing. The question really is — how am I getting away with doing it the way I do, which seems to be inaccurate or at least fraught with potential for misinformation? I know that once a piano is in the shop and unstrung I do numerous checks along the bridges with a length of fishing line, lowering it slowly and making sure that it contacts the front edge of the bridge top before it hits the back. I also check soundboard shape (crown) fairly carefully in my initial evaluation process: distortions here will usually be indicators of potential bridge roll or other problems. I'd welcome comments on use of the rocker vs. other bearing gauges (realizing that I may be opening up a can of worms for my successor), and thanks to Mr. Stein for writing.

Dear Susan:

I was very disappointed to read your method of measuring downbearing. This method has proven to be inadequate in that it measures only composite bearing — the angles of string offset at both the front and back of the bridge added together (or, as we shall see later, sometimes subtracted one from the other). This is fine if the top of the bridge is parallel to the soundboard. In some cases, though, it isn't. I've seen rebuilt pianos with poorly-recapped bridges or older pianos with rolled bridges where this is not so. In some cases the front bearing can be negative — the string comes down to the bridge — and the back bearing excessive, and your method still shows it as normal, adequate bearing.

It is important to be able to measure the two angles separately. This is most easily done with a bubble gauge. I realize that this is an expensive instrument and a time-consuming procedure, so there is a shortcut. Using your rocker gauge, you move it front to back on the bridge cap and take measurements at different positions. If your measurement varies with a change in gauge position on the bridgecap, this is an indication of a difference between the front and the back bearing. A more precise measurement is therefore needed.

Of course I'm sure you realize that incorrect bearing on only one side of the bridge has all the consequences of incorrect overall bearing. In fact, overall bearing is not a very useful measurement. The greatest danger with your method is that it can mask zero or negative bearing on one side of the bridge. If front bearing is .013 and back bearing is .018 on the bass bridge, your method will yield .005, which is no problem. But what really is happening is as follows: there's poor contact at the termination of the speaking length and also excessive pressure on the board at the back of the bridge.

I've seen this on poorly rebuilt pianos, where the "rebuilder" simply planed the bridgecap at an angle.

Thank you for a generally useful and informative column,

Israel Stein, RTT

And, while you're in a commenting mood, here are few more:

Dear Revered Member:

In the April 1969 Journal, *is a column called "Restoring The Voice," by Gaylord Wight. Under conditioning the hammers, he says: (about filing the hammers) "Such filing as this can efficiently be done with a coarse hand file. I have tried a number of various wood blocks and I like one 11" long by 1 1/4" wide and 1/8" thick. To one side of the block I glue garnet paper. Garnet paper is sharper and faster than sandpaper. I prefer #3 (not 3/0) size close coat. Be sure it's close coat and not open coat. Open coat tears felt whereas close coat cards felt and keeps the layers laid down. One doesn't file any rougher than he wants to with #3 close coat, yet he gets the shoulders and dead layers removed with dispatch..." The only garnet paper around St. Louis I can find is open coat. MMM catalog does not list close coat. Maybe they know something up in Canada that we don't know. I want to try close coat, but I am not going to Canada to find any. What have you heard from "out there?"*

Walt Thatcher

Dear Susan:

In an article several months ago you explained how holes in wood (balance rail holes, etc.) become larger when wood swells with humidity, after the entire piece of wood has reached equilibrium. I believe the truth of this. However, wouldn't that mean that tuning pins would be loose in the summer, and tight in the winter? If anything, they're more loose in the winter. Can someone explain this?

William Magnusson

Dear Susan:

Where can I get information about all of the different types of actions we read about in the Journal? *There's the Pratt-Win, Renner, Schwander, Herrburger-Brooks, Clemson, Langer 80, etc. Some manufacturers change from one make to another as though there is some advantage in that. It would be nice to have enough information on the different actions to make an analysis of their good and bad points as well as to better understand the equipment we are to service.*

T.J. Simmons

The Forum continues with two at-large articles. Larry Crabb has sent in a very detailed and useful checklist for restringing, which he created in preparation to give a talk to the Australian Piano Tuners and Technicians Association. He claims they hung on every word — Larry, are you sure they weren't just having a little trouble translating Georgian into Antipodean?

The second article is a very nicely-written piece on voicing. Submitted by Matt Grossman of the Louisville Chapter, it provides a good general explanation of procedures and techniques used in this work.

As a quick reminder, publication in the *Journal* does not necessarily imply endorsement of particular methods, techniques or opinions. We present information we believe to be helpful: it is up to individual technicians to evaluate the information and utilize it appropriately.

A Piano Restringing Procedure

Larry Crabb, RTT
Atlanta Chapter

This procedure begins *after* you have made a preliminary inspection of the piano, *after* you have made your estimate for the job, *after* you have the signed agreement from the customer, *after* a down payment has been received, *after* the piano has been moved to the shop and *after* all necessary tools (and most of the parts and supplies) have been obtained.

Definitions:

Rebuilding: "Overhauling" a piano, which includes such steps as: refinishing the case and the soundboard; replacing or repairing the soundboard, bridges and pinblock; refurbishing and restringing the plate; and, replacing or repairing major parts in the action and throughout the piano as needed.

Restringing: That portion of rebuilding which involves: removing the old strings and tuning pins, the plate, the pinblock and, sometimes, the soundboard; making the necessary repairs and replacements; stringing "to scale" with properly-gauged piano wire and tuning pins; and, bringing the wires "up to pitch."

Major Steps Included In Restringing:

1. analysis; 2. removal of case parts; 3. inspection; 4. measurements; 5. destringing; 6. repairs and preparation; 7. stringing; 8. chipping; 9. tuning; 10. remounting of case parts

1. Analysis

Before any disassembly of the piano, tune it, look at and listen to it and make notes (in the piano's job folder) of the piano's present physical appearance and condition — such as: dirty plate; cracked soundboard; dull and dead bass strings; etc. (Why not audiotape, or better yet, videotape?)

Make note and record such things as: its tone; its decay time; whether or not it has been restrung before; its strange sounds (buzzes and rattles); etc.

Note any obvious problems which will need repairs or corrections at the proper time. (If you can videotape, continue to record each phase of the restringing procedure. It's good PR for you and the customer may enjoy seeing it. Also, it could be used to help you get rebuilding jobs in the future, and it will make a good library tape for your chapter. Your members will find a videotape to be a great help in doing their restringing jobs.)

2. Removal Of Case Parts

Confirm that the piano case is mounted solidly on its legs *or* that it is placed on sturdy sawhorses with its legs and pedal lyre removed.

Remove lid, lid prop, music rack and music rack guides. (Before removing any other case parts, why not take some "before" measurements of the action in place — such as the relationship of the keys: a. to the fallboard; b. to the keyslip; and c. to the cheek blocks)

Then remove the keyslip, fallboard and cheekblocks and measure the present key height and key dip. (This information will come in very handy when re-regulating the action.)

Now, remove the dampers, numbering each one as you go and storing them properly on a damper storage rack or even on the edges of a cardboard box. (Always number anything on the piano from left to right, from bass to treble.)

3. Inspection

Check now for cracks in the soundboard, loose ribs, cracks in the bridges, loose soundboard at the edges, broken agraffes, cracked plate (Oh no! How did I miss that!), loose or unglued body joints, loose bridge apron, split treble bridge cap, rusty and/or broken bridge pins, loose bridge pins, and any hitch pin problems. Make appropriate notes and drawings in your job folder. (Some of these problems listed above will become more obvious after the destringing is completed, *but* begin looking for them now.)

Check the bass strings and record if there are any missing.

Check and record if there are any wound strings on the tenor section of the treble bridge — doubles and trichords.

Check and record if there are any plain wire doubles on the tenor section of the treble bridge. (Are there any plain wire doubles on the bass bridge? If so, note this also.)

Check the treble wire loops and record if there are any missing.

Check for any single wire ties and record the note number(s) where they appear and their left or right position in the unison.

Check the hitch pin stringing pattern and sketch anything unusual.

Check to see if the piano has been restrung before, and if it has any visible problems which will need special attention.

Check underneath the pinblock (wrestplank) with a mirror, for cracks and deterioration.

Check soundboard decal size, shape and style and make note to order a new one.

4. Measurements

If you haven't done so already, record (in your job folder) the name, size, model and serial number of the piano.

Measure and record the following: string heights from keybed to underside of strings (Be sure to measure and record the height of the first and last string in each section. You'll need these measurements in order to do action regulating on the bench.); downbearing readings at bass, tenor, treble and high treble; sidebearing at bridge pins; soundboard crown; tuning pin torque readings in bass, tenor, treble and high treble; tuning pins' diameter(s) and length(s) (Remove a pin from each of the sections and make note of the location of any that are a different size.); height of tuning pins (Make cardboard jigs.); location of aliquots (Scratch the plate at the corners of the aliquots.); location of stringing cloths, felts, and braids (You'll keep them as samples when you destring the piano. Photos and videotape really will help here.); location of plate (Measure its height above the soundboard at various places. Drill a small hole somewhere in the right front part of the plate — going through both the plate and the soundboard. Do the same at the back part of the plate. These holes should be just large enough to insert a piece of music wire through the plate and soundboard. Later on, after the plate has been removed, then reinstalled, the plate will be aligned as it was originally *if* the piece of music wire goes easily through the hole in the plate and on through the holes in the soundboard — at *both* the front and back holes.)

If you make a bass string pattern, make it now. (Two patterns are necessary if there any wound strings on the tenor bridge.)

Take the time now to protect the inner rim and the stretcher bar with pads, cardboard, etc.

Next, lower the string tension throughout the entire piano.

Remove the wound strings from the bridge and hitch pins in sequence, string them *in order* on a wire coat hanger and cut each string on the plain wire portion somewhere above the end of the upper winding near the tuning pin.

Set these wound strings aside to be sent off for duplication, or if you sent a paper pattern, keep these old strings until the new strings arrive and are checked. You just may need them!

Caution: Don't cut strings off at the tails! The stringmaker needs these!!

Caution: Don't forget to include the wound strings that may be on the tenor portion of the treble bridge!!

Caution: Don't remove the tuning pins at this time!!

Note: If you are restringing a vertical piano, now is the time to make a template of the pressure bar height.

Make a treble wire/note scale and record the wire size on each note. (Measure only one wire per note. If the resultant wire scale looks odd, go ahead and measure the other two wires of that unison. Be sure that any tied wires are recorded on the treble wire/note scale at the proper notes. Also, draw a heavy line on this scale between the notes where one section of the plate ends and the next one begins. For now, record what you find and not what you think it should be.)

Finally, review the stringing pattern which you've just recorded to see if it is logical, and to determine whether or nor you wish to improve it with half sizes or rescaling. Check the stringing scale in a book, such as Travis' "A Guide To Restringing."

5. Destringing

Bass section:

Reminder: Bass strings have already been removed!

Note: It is necessary that the bass section destringing portion be done in the order above so that the other needed measurements can be made and recorded.

If the piano has aliquots, mark the position of each aliquot with a scratch on the plate. (Even if the plate is repainted, the scratch marks will show through and the aliquots can be positioned properly.)

Treble section:

Now, cut one wire of each unison only, moving in sequence from the tenor section up through the treble (or viceversa). Come back the other way to cut the center wire, then reverse again to get the final wire of each unison. Cut as close to the tuning pin as practical to minimize the dangers and damages caused by "flying wiretails."

After all wires have been cut and removed from the piano, remove the tuning pins with a half-inch drive, heavy duty reversible drill (with that special tuning pin socket that you ordered from those pianos supply folks).

(Of course, if you have the time and need the exercise, you can use a tuning hammer, a T-hammer or a brace and tuning pin bit to do this job. Good luck if you do!)

Caution: Don't let that drill get hot!! You and the drill need to stay "cool" at all times!!

Measure and keep a sample pin from each section, watching for any that have a different diameter or length. If different diameter pins are discovered, a new pinblock probably will be needed.

If all the old pins are the same size and the pin torque is fairly even, the pin holes can be cleaned with a reamer or a gun cleaning brush. This will help to remove any rust, residue or dead wood fibers. Cleaning the holes is optional, but there are claims that doing this procedure minimizes loose or jumping pins. It's your choice.

If the old pins have different diameters and if the old pinblock is to be used, the pin holes will need to be drilled (and reamed?) to the diameter of the largest pin that you have measured.

6. Repairs And Preparation

If the pinblock is not going to be replaced, if there are no soundboard problems, and if the plate and soundboard are not to be refinished, clean the plate and soundboard, clean and brush or replace the stringing felts, make any needed repairs (see list below) and move on to the stringing procedure.

If the pinblock is to be replaced, remove the plate. (Use a large piece of cardboard to draw a picture of the plate, punch holes and store the plate screws in order in these holes. You can also store the pinblock screws on it.)

Make any needed repairs to correct the problems which were noted during our earlier inspection. Some of the most common problems which need repairs are: separations of the ribs from the soundboard; cracks in the soundboard; loose edges of the soundboard along the rim; glue faults at beams and other structure points; cracks in bridges; loose bridges; split bridge caps; separation of the bass bridge from its apron; rusty, broken and loose bridge pins; broken hitch pins; broken agraffes.

Install the new pinblock.

Refinish the soundboard.

Apply the new soundboard decal.

Prepare the bridges.

Gild the plate. (Repaint with Piano Gold.)

Install the plate. (Don't forget to fit for correct downbearing.)

Caution: Too much downbearing

will give a shorter-lived, stronger (louder) tone. Too little downbearing will give a longer-lived, weaker (softer) tone.

Each of the above repairs and preparation steps has its own method and procedure. The purpose of this outline is to remind you of an appropriate order to do these repairs and preparations and to provide some hints that may help when doing your next restringing operation.

Warning: Install a pinblock support jack! (This jack *must* be used!) Install it between the keybed and pinblock to prevent the plate or pinblock from cracking while driving in the new tuning pins! For additional safely, you can add support (a piece of two-by-four lumber on end with an auto jack) between the floor and the bottom on the keybed.

Apply the new understring felt (hold in place with just a touch of glue), install the new hitch pin punchings (if used) and drive new tuning pin bushings (if used) into pin holes.

Place the aliquots on the plate at the scratch marks made earlier.

7. Stringing

After confirming that your treble wire/note scale is correct or after making whatever changes or modifications to the scale, place a strip of masking tape across the top of the three holes of the unison where the wire size changes. Write the new wire size directly onto the tape. As an extra added precaution, do the same thing with the tape at the hitch pins. (Remember — it's easy to make mistakes in this part of the procedure, but it's very time-consuming and frustrating to correct them!) (Remember — the treble section is strung first! The overstrung bass strings are put on last!)

Decide on the new pin size to use. If using the old pinblock and if the torque of the old pins was fairly high (60+ maybe) you can go up one size. If the old pins were uniform but loose, go up two sizes. If using a new pinblock, start over with 2/0 pins. (Of course, some pianos start with 1/0 pins. You be the judge!)

Decide if you want to work from right to left or from left to right. Right handers like to start at the extreme right with the hammer in the right hand and work from right to left. Then, when setting the coil, the coil lifter tool will be used by the left hand while turning the tuning pin with the tuning lever in the right hand. Just reverse the above if you're a lefty.

Unwind enough wire for the entire string length plus a little more. Thread it through the plate properly (under the capo or through the agraffe), insert the wire through the new tuning pin with the end sticking out a distance that is the same as the diameter of the wire you are using. (If it sticks out too far, it looks bad. If it doesn't go all the way through, it just may slip out later.)

Hold the tuning pin in your left, gloved hand and turn your tuning pin crank three turns clockwise, keeping the coil wire above the hole (the small amount of protrusion of wire will keep it in place). Drive the pin into the pinblock with a hammer and a tuning pin punch. (Tape a hammershank to the side of the punch to guide you in getting proper pin height. One or two threads still showing above the plate bushing seems to work very well. About 3/16" space should result when the wire is brought up to pitch.)

Place this first portion of wire over the bridge and through its proper bridge pins. Pull the wire firmly and bend it around its hitch pin, then back up to its next tuning pin hole. Place this portion of wire over the bridge and through its proper bridgepins. Measure about a hand's width past its tuning pin hole (about three inches) and cut the wire from the coil. Now thread the wire end under the capo or through the agraffe, etc. Turn this wire end onto a new tuning pin and drive the pin into the pinblock (just like above).

Add enough even tension to both pins to keep the coils in place. (Use the coil lifter to hold up the coils.) Seat the becket well into the pin hole, using needle-nose pliers or a coil setter.

Use this same procedure for the rest of the treble wire section. (If the piano had tied wires, make each single hitch pin tie and proceed as above.)

Caution: Watch for any unusual stringing patterns at the hitch pins.

Caution: Don't bring any wires up to pitch yet — add just enough tension to keep coils tight and in place.

If you are restringing a vertical piano, install the pressure bar now, making sure the back has been smoothed by filing (keeping its curve in its original shape). Make sure the bar has been cleaned and polished well. Using your template for correct height, turn in the screws evenly to get a small (but noticeable) amount of downbearing on the wires as they go to the tuning pins. Alternate the tightening of the screws, a little at a time, until you get the wires deflecting about four or five degrees downward from the upper plate bridge. The wires will move around if the pressure bar isn't low enough, but the piano will be hard to tune if the pressure bar is too low.

String the bass section now, using the same techniques above.

8. Chipping

There are several philosophies regarding how to get the new wires up to their correct pitches. Just remember that you need a pitch source, another piano or an electronic tuner to assist you. Also, remember that the wire tensions must be brought up evenly throughout the piano. Any method you use with this in mind will probably work out fine.

Without the action and the dampers in the piano, you'll be plucking each wire as you add the initial tensions and pitch levels. (Use a pick, tapered shank, your fingernail, etc.) Bring the wires just up to pitch on this initial chipping.

Bring up the left wire of the unison as you tune up. Come down tuning the middle wire to the left string, then, finally, move back up to tune the right wire to complete the unison. This is just one method that works.

Install the action and move the wires left or right with a string spacer and a small hammer to align the strings to the hammers.

Remove the action.

Squeeze the wire loop at the hitch pin.

Tap each wire with a brass (or wooden) rod to seat the wire at: the hitch pin; the back side of the bridge at the bridge pin; the top of the bridge; and, the front side of the bridge at the bridge pin.

Roll or press each wire with a stretcher tool.

Do the second chipping procedure at 25 cents above pitch. It is not recommended to go above 25 cents.

Again, roll or press each wire with a stretcher tool.

Install dampers with new damper felt!

9. Tuning

Install the action again.

Make any final wire alignments, including leveling the wires of each unison.

Tune the piano to A440.

Measure the pitch level after this first tuning.

Perform a pitch correction procedure.

Fine tune. (Do several fine tunings during the period of time you have before all the other parts of your rebuilding process are completed and before the piano is returned to the customer.)

10. Remounting Of Case Parts

Complete all the repairs to the case, case parts, pedal lyre and action.

Fit all the case parts back onto the case, making certain new felts are used where needed, proper clearances and alignments are maintained and all the parts move freely.

There you have it!! You see, there is nothing to this piano tuner/technician work. Special thanks to: Arthur Reblitz's Piano Servicing, Tuning and Rebuilding; my special friend, John Travis, and his book "A Guide To Restringing"; my sons, Greg and Gary, who are in the business with me; and, my fellow technicians, my students and my word processor — all have helped me with words, content and order and have given me the needed encouragement while preparing this outline. ≡

At Large

Voicing Concepts

Matt Grossman, RTT
Louisville, KY, Chapter

What Is Voicing?

Simply stated, voicing is a term used to describe any process that is applied to a piano to develop or change its sound or tone quality. The "voice" of a piano begins in the mind of the piano designer. During a piano's research and development phase it's acoustical properties are analyzed for their effect on tone in order to determine if any changes are necessary before the instrument goes into production.

Piano technicians working in the field do not have the opportunity to influence the sound of a piano from its inception. A few rebuilders are able to modify pianos, but most rebuilding is concerned with restoring an instrument to original condition. Most voicing problems technicians encounter must be dealt with after the piano is built or rebuilt and is already in use on the showroom floor, home, professional studio or concert stage.

Since Cristofori invented the first piano early in the 18th century, his "gravicembalo col piano e forte," the parameters of piano tone have been in a state of flux. Manufacturers of quality instruments, in response to changing needs of pianists and seeking to gain an edge in the marketplace, continually strive to build pianos that possess greater spectrums of tonal character. When the sound of a particular brand of piano becomes successful it is recognized as a standard for the industry. At the present time, there are multiple standards of tone represented by several major piano manufacturers.

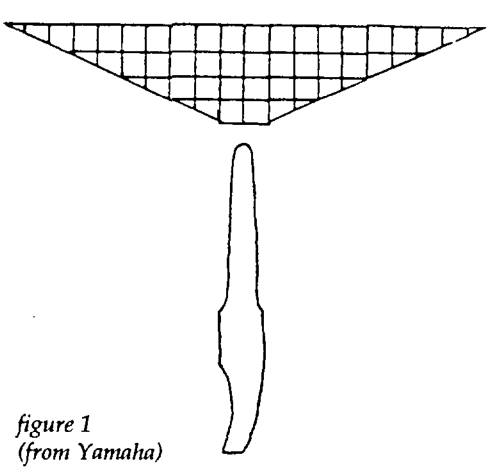

figure 1
(from Yamaha)

In developing one's own concept of piano tone, one should get to know the tone of the various brands of pianos and try to discover how each manufacturer creates the tone qualities of their instrument.

Some other things to do to increase one's awareness of piano tone are: 1. Listen to recordings of piano performance. 2. Attend piano recitals, especially those you have tuned for. 3. Listen openly (to) and analyze what pianists and musicians have to say about piano tone. 4. Read as much as possible on the subject of voicing. Use videotapes and attend classes on voicing. 5. Find out what tone piano manufacturers strive for in their new pianos and what procedures they use. 6. Install and voice new sets of hammers and try to achieve the "ideal" sound for that piano. 7. Discuss voicing techniques with other interested technicians. 8. Possess minimal keyboard facility: be able to play chromatic scales fast and confidently. 9. Develop a vocabulary for describing piano tone. For example: harsh, strident, tinny, metallic, dull, muted, covered, nasally, bright, brilliant, singing, sparkling, open, dark, rich, mellow.

Becoming a better listener, appreciative of different "standards" of piano tone and being open to input from pianists are essential skills in developing a concept of piano tone and becoming a competent voicer.

Hammer Making

Although the "voice" of a particular piano depends on a wide range of factors, after the instrument leaves the factory or shop, most of the voicing that is done to it will involve manipulation of the hammer felt.

It is common knowledge that the felt for piano hammers is made from sheep's wool. Characteristics of wool differ as to the type of sheep and the environment where the sheep live. Hammers are made-up of the "right" blend of the various types of wool. The piano manufacturer or hammer maker would normally specify the quality, thickness and density of the felt they need for making their hammers. The raw wool is cleaned, combed, layered, agitated, treated with acid, pressed and sanded to form a large dense sheet of felt tapering from thick at one edge to thin at the opposite edge. This sheet is cut into triangular shaped strips. Each strip is then glued over and around a set of hardwood mouldings under tremendous pressure giving birth to a matched set of hammers.

The process of pressing and gluing the hammer felt around the mouldings creates the forces of compression and tension within the felt of each individual hammer. These are the forces that must be manipulated by the voicing process. The degree to which these forces exist in a hammer determine its relative hardness as well as the type of sound it will produce.

The relative hardness of new hammers can vary too much to produce satisfactory tone in all sections of the piano scale at every dynamic level. Depending on the tonal characteristics of each individual piano's resonance apparatus, the compression and tension of the hammers must be adjusted to maximize the tone qualities and dynamic range of the instrument. This is done through the use of needles, sandpaper, heat and chemical solutions.

Theory

Compression and tension are the forces created in new hammers during their manufacturing process. Tension is formed as a result of the felt being stretched around the hammer moulding. Compression occurs due to several factors including the density of the felt used, the stretching of the outer layers of felt causing pressure upon the inner layers and the actual process of gluing the felt to the moulding where heat and pressure are applied to form the set of hammers.

In order to visualize the forces of compression and tension in a new hammer figures 1 and 2 may be helpful. In figure 1 cross-sections of the hammer felt and moulding are shown as they would go together in the hammer press. A grid is drawn on the felt so the effects of the pressing on the felt can be observed. Figure 2 shows the felt and moulding after being pressed and glued together. The grid, now distorted, shows the result of the pressing on the felt, specifically, a narrowing of the horizontal lines (compression) and a widening of the vertical lines around the outer perimeter of the hammer (tension).

Manufacturing a set of hammers that will produce acceptable tone throughout the scale of a particular piano at every dynamic level without any further adjustments to the felt of the hammer has yet to be accomplished. At the very least, it will be necessary to fit the hammers to the strings. In addition to this work, however, most sets of hammers will require a substantial amount of processing in the form of needling, ironing and/or treatment with a chemical solution in order to achieve the best tone possible from the piano.

New hammer sets differ in their degree of hardness (compression and tension forces) according to their manufacturer and design. For example, some sets are extremely hard from #1 to #88. Others may be hard in the bass and tenor sections, but softer in the treble. Some hammer makers produce a consistent degree of hardness from set to set and others vary.

Excessively hard hammer felt reduces hammer resilience. This condition can produce a sound that is very harsh and lacking in singing qualities. When a piano with over-hard hammers is played fortissimo, its sound can literally jar one's aural senses to the point of discomfort. Typically this sound tends to elicit unfavorable comments from a majority of piano soloists.

In order to produce the singing tone that is desired by more piano soloists, a hammer must have resilient shoulders. This is accomplished through needling. Recall figures 1 and 2 which show the forces of compression and tension that are created in the new hammer. Now look at figures 3 and 4 which provide a model for conceptualizing what takes place when a hammer is needled.

Figure 3 shows a new hammer before needling. An imaginary spring has been drawn in on each shoulder. The spring is shown compressed and the dots above the springs indicate a relative degree of hardness in that area.

Figure 4 shows the hammer after it has been needled. The imaginary springs have now been released creating the resiliency needed for the production of good piano tone. Also notice that the area in the crown of the hammer is darker, indicating that this area has become more compressed or harder. This helps to explain why the sound a hammer produces will often seem brighter after its shoulders are needled.

Sanding and filing are the methods used to remove felt from the hammers for the purpose of shaping them and/or developing the tone quality. The correct shape of hammers is shown in figure 5. The importance of which is to limit the area of hammer/string contact. Hammers that are shaped irregularly can be difficult to voice evenly across the keyboard and will cause the voicing job to be compromised.

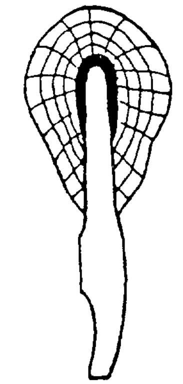

figure 2
(from Yamaha)

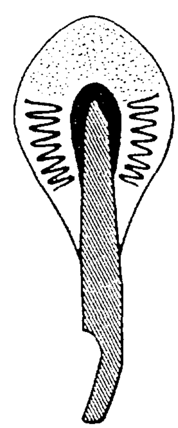

figure 3

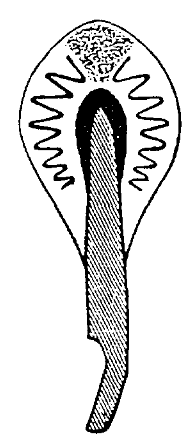

figure 4

Dull-sounding hammers can often be given new life or brilliance after having a layer or two of felt removed with a file and/or sandpaper strips. Fitting the hammer to the strings (making sure the hammer strikes each unison string simultaneously) can eliminate a multitude of tonal impurities and will result in a stronger, clearer sounding note.

Rough hammer shaping is done with a sandpaper file and/or sandpaper strips. Final shaping and polishing is done with various grits of sandpaper strips. Narrow 1/8" wide sandpaper strips are used to assist in fitting the hammers to individual strings.

The process of ironing hammers has two purposes: cosmetic and tonal. After filing and needling, the iron can be used to smooth the face of the hammer and to give definition to the hammer profile. Similarly, ironing is done to press the outer surface of the hammer in order to produce a brighter tone quality.

The effects of ironing can vary depending on the type of hammer, the design of the piano and the amount of heat used. With exception of the last few treble hammers, ironing over the crown is not recommended in most cases. Often, ironing over the crown will make an undesirable change in the tone quality. If this happens, it may be necessary to remove a thin layer of felt from the hammer with the sandpaper strips to restore the original tone and start the voicing process over again from that point. Also, any felt that becomes discolored or singed by the iron may be removed with sandpaper strips.

Lacquering hammers is a voicing technique that is generally misunderstood and is often met with disapproval by many in the industry. Without the use of chemical solutions such as lacquer, it would not be possible to produce acceptable tone from many sets of hammers.

One common misconception about lacquer and other similar solutions is that they are almost always thought of

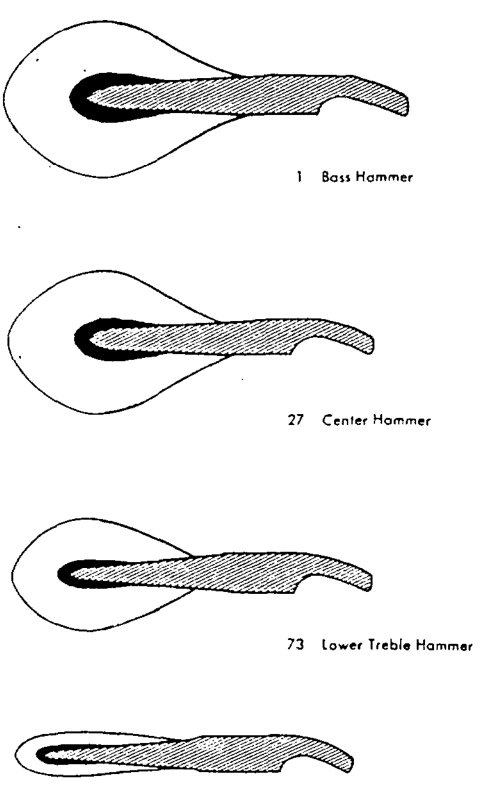

figure 5 (from Steinway)

strictly as hardeners. In many situations a more useful concept of lacquer is one of "fiber coating material." In other words, the lacquer need not be applied so thick that it interferes with the resiliency of the hammer. It can be mixed in very thin proportions so that it merely puts a coating on the felt fibers of the hammer in order to add a sparkling effect to the tone quality.

The recommended lacquer mixture to begin with is 15 parts acetone to one part clear gloss lacquer. The lacquer used for this mixture should already be of a consistency that would require an equal amount of thinner before it could be sprayed from a typical industrial cup-type spray gun. A way to check your 15:1 fiber coating solution is to rub some of it between your thumb and forefinger as it flashes off. A 15:1 solution will feel just barely tacky, almost imperceptibly so, as it evaporates and it will not feel as though any residue has been left on your fingers after it drys.

Lacquer applied in the proportions listed above is easy to control, that is once the lacquer has dried the tone can readily be adjusted using the techniques described herein. A double dose could be required for some hammers. If a 15:1 solution does not produce the desired result it is gradually strengthened until the hammers have enough tone to continue the voicing process. For some pianos, 15:1 lacquer solution applied to some or all hammers will provide the margin of tone needed. Another may require 15:1 to all 88 followed by 12:1 in the first treble section, 9:1 in the upper treble and 3:1 for the last four treble hammers. Each set of hammers will require a different treatment schedule. Figure 6 illustrates the technique for applying the lacquer solution. A small squeeze bottle known as a "hypo" is recommended.

A word of caution is in order here: 1. Lacquer is not a substance to be used capriciously. Indiscriminate use can ruin a set of hammers. 2. After the lacquer dries there remains a lot of work to be done to achieve acceptable piano tone.

Preparing The Piano For Voicing

The design, size and physical condition of a particular piano as well as its operational readiness has everything to do with how it will sound. Obviously a five-foot baby grand can never sound like a nine-foot concert grand. Analyzing piano tone is highly subjective. Within reasonable limits the pianist's needs should take precedence.

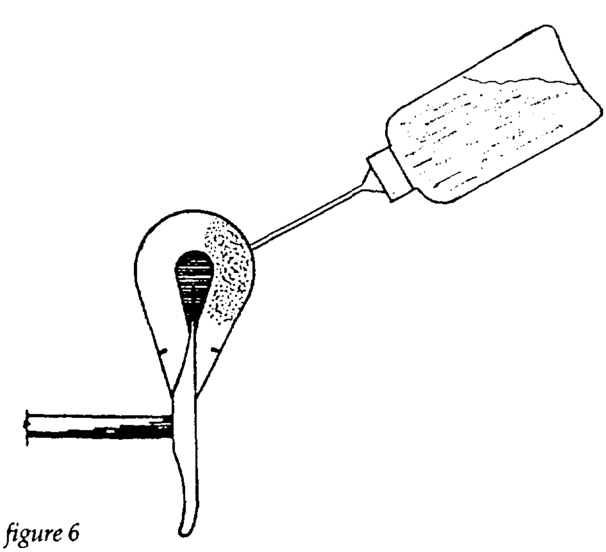
figure 6

For this discussion, the piano being considered is an instrument that is new or has been rebuilt to the highest industry standards. It is also assumed that the instrument is equipped with a new set of hammers and that the exact strike point has been accurately determined.

Before beginning the voicing process described here, it is imperative that the keys, hammer and damper actions are regulated as precisely as possible according to the manufacturer's specifications and PTG standards.

As one begins to understand the techniques used to voice a piano as described here, he or she will also gain the insight and experience needed to voice any piano.

Tools For Grand Voicing

Stringing hook, small brass punch for setting strings (make from brass music desk glide, about 3 1/2" long, wedge-shaped on one side), Yamaha style needling tool, supply of #6 sharp sewing needles, hammer file (make from nine-inch long piece of one by two, glue #50 grit garnet paper to the two-inch surfaces), 3/8" wide sandpaper strips backed with tape: grit numbers 50, 80, 150, 220, 1/8" wide sandpaper strips backed with tape: grit numbers 80, 150, three-inch wide sandpaper strip backed with tape: grit #150, hammer support board (min. size: 3" X 6 X 1/4"), chalk, chalk eraser (backrail cloth approximately 2 3/4" X 2"), stainless steel or brass bristle brush (toothbrush size), iron (electric burn-in knife with wide, flat tip from Mohawk), fiber coating solution (lacquer/acetone), three mixing bottles for solution (quart-size plastic, available from photo supply store), applicator for dispensing solution ("hypo" from Schaff).

Technique Of Needling New Hammers

The most common hammer needling technique is known as the radial needling method. The needles are driven into the hammer at angles about 30° to 40° starting in the low shoulders above the staple (A section), gradually increasing the angle of the needles for the high shoulders (B section). The area known as the crown of the hammer (C section) is never deep-needled. The wedged-shaped area under the crown surface should never be touched with needles as this will almost surely ruin the hammer. Only shallow needling (one to two millimeters deep) can be done on the crown surface.

Figure 7 shows a cross-section of a bass hammer, illustrating its sections, needling angles and the wedge-shaped area under the crown surface which is off-limits to needles.

The relative hardness of hammer felt can be determined by pushing a single needle (mounted in a voicing tool) deep into the shoulder of a hammer. The harder the felt the more difficult it will be to push the needle into the felt.

The recommended needling tool is the Yamaha style voicer equipped with three needles eight to 10 millimeters long.

The hammer support board serves as a bridge between the repetition levers and the backchecks. The hammer tails will rest solidly on the support board enabling the needles to be driven into the hammer felt with considerable force. (see photos 8, 9, and 10)

Grand Piano Voicing Procedure

Procedure

1. Keys, hammer and damper actions must be well-regulated. 2. The strings of each unison must be in the same plane (level) and firmly seated on the bridge. a) Unison strings are leveled by lifting up on them with a stringing hook. b) Strings are seated on the bridge by lightly tapping them down with a small brass punch. 3. Hammers must be shaped correctly. a) Use hammer file (50-grit) and/or 3/8" sandpaper strips (#50 and #80) to shape and remove cup-shape of new hammers. (see photos 11, 12, 13, 14, 15). b) Smooth surface with sandpaper strips (#150 and #220)

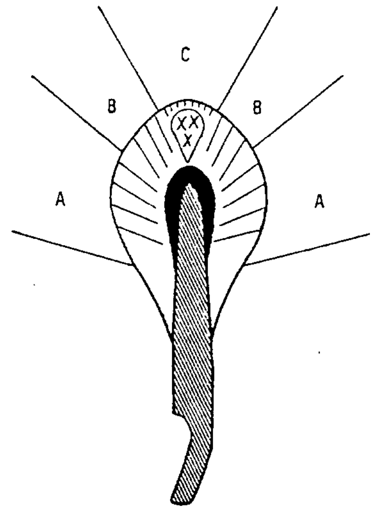

figure 7

Rough Needling (Increasing hammer resilience, eliminating harshness)

1. The tone of new (just installed) hammers can vary from section to section and note to note. a) Many hammers can be over-hard and it is rare when a new set of hammers does not require any needling. b) Play chromatically up and down the keyboard (no pedal) with strong even blows to determine which hammers will need deep needling (harshness in loud tones). c) Use chalk to mark keys where hammers require needling. d) Depending on the type of hammers, upper treble hammers do not always require deep needling.

2. Begin the needling process with several hammers on either side of the tenor/treble break. a) This is optional, but the first treble section is often the most difficult to voice. It is better to discover what the potential tone will be in this section early-on so that the rest of the piano can be matched to it.

3. Deep-needle sample hammers in the A section of the shoulders of each hammer until the first reduction in harshness is perceived. (see figure 7 and photos 9 and 10) a) Place hammer support board on top of the repetition levers and backchecks as a bridge between them and rest the hammer tails on to of it. (see photo #8) b) Use needles judiciously. c) Listen to the sound of the sample hammers. Do some test needling until it is determined how much needling must be done. d) Needle each hammer systematically, taking note of the number

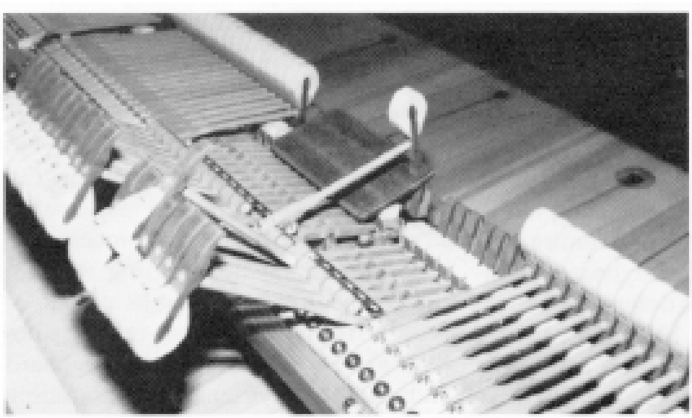
photo 8: hammer support board


photo 9: needling technique


photo 10: needling technique


photo 11: hammer filing

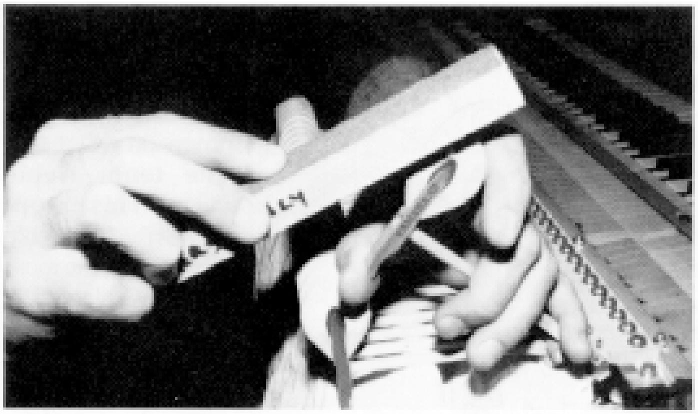
photo 12: hammer filing


photo 13: hammer sanding (sandpaper strip)


photo 14: hammer sanding (sandpaper strip)


photo 15: hammer sanding (sandpaper strip)

of stitches and the pattern of needling used on each hammer. e) Observe carefully the "feel" of the needles in the hammerfelt as each hammer is needled in order to correlate the "feel" of the hammerfelt with the tone produced by the hammer. f) Play each note often to determine what tonal changes are taking place.

4. When a hammer does not respond to needling in the A section of the shoulders, move into the B section.

5. After sample hammers are established, proceed to rough needle the rest of the hammers. a) Proceed up the scale from the tenor/treble break towards the treble. Move the hammer support board as needed. b) Next proceed down the scale from the tenor/treble break into the tenor and bass.

6. Do not over-needle. This procedure should produce gradual changes in the tone. a) Repeat the entire process from the beginning as many times necessary to achieve tonal goals. b) Play notes often to monitor progress.

7. After the rough needling operation let the hammers rest. Overnight if possible.

Maximizing Volume And Brilliance

Filing And Sanding

1. Check hammers for correct shape. a) Reshape hammers to obtain correct profile and square "face". (see figure 5 and step 3 under "Preparation") b) Chamfer edges of the hammers with the sandpaper file. c) Smooth hammers with #150 and/or #220 sandpaper strips.

2. Listen for dull-sounding hammers (individual hammers or entire sections). a) Play over the keyboard using strong, even strokes to determine which hammers sound dull. b) Remove an additional layer or two of felt using the sandpaper strips to develop a more brilliant, percussive sound from dull-sounding hammers.

Hardening

1. Ironing dull-sounding hammers. a) The ironing process is used to "erase" needle marks, improve hammer shape and brighten the tone. b) Use an electric burn-in knife with a wide, flat tip. (see tool list) c) Play over the keyboard using strong, even strokes to determine which hammers sound dull. d) Iron up the front of the hammer, skip over the crown, then down the back shoulder. (see photos 16 and 17) e) Ironing the crown (C section) can be effective in the upper treble, but in other sections of the piano it can produce an undesirable tone color. If this happens, restore the original tone by smoothing the hammer with the various 3/8" sandpaper strips. f) Keep the iron square to the shoulder (face) of the hammer. g) Any hammer discolored by ironing can be cleaned-up using the sandpaper strips. h) Repeat the ironing process until it is determined that ironing will not correct the dull-sounding hammers.

2. Applying the fiber-coating solution. a) Play over the entire keyboard and mark the keys where dull-sounding hammers will require the solution. b) Start with a solution of no less than 15 parts acetone or lacquer thinner to one part clear gloss lacquer. *A solution that is too heavy can ruin the hammers.* c) Apply the fiber-coating solution to the shoulders of the hammer approximately at the junction of the A and B sections on both sides of the hammer. (see figure 6) d) Stop the application when the solution begins to run down the hammer tail and spread into the C section. The entire hammer will be wetted. e) The solution must dry completely (preferably overnight) before continuing the voicing pro-

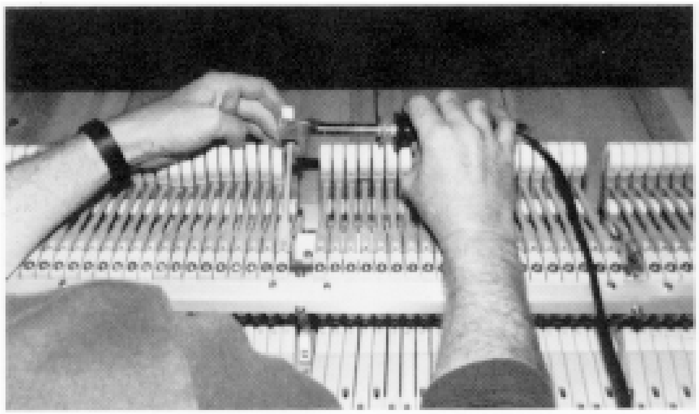
photo 16: hammer ironing


photo 17: hammer ironing

cess. f) Some individual hammers or sections of the piano may need a second or third application of the solution and particularly in the treble sections, the solution may need strengthening (see text).

Rough Voicing

1. Fit the hammers to the strings. a) Pluck the strings of each unison with the hammer blocked against them. b) When open strings are found, correct by leveling the strings with a stringing hook (pulling up on the low strings) and/or by sanding the hammer crown with the 1/8" sandpaper strips in the direction of the string mark so that the hammer strikes all strings simultaneously.

2. Needling. a) Rough needle the hammers using the procedure described above under "Rough Needling." b) Use chalk to mark the keys where hammers are too hard. (harshness in loud tones) c) Work systematically. d) Listen carefully. Use the needles judiciously. e) Some light needling in the C section may be necessary at this point in order to determine how much to needle in the shoulders.

3. Sanding, ironing and lacquering. a) Remove a thin layer of felt from dull-sounding hammers to brighten the tone. Next try the iron. If this does not solve the problem switch to the lacquer solution. Use the same procedures outlined above.

4. Leave a margin of tone in the instrument for final voicing. a) At this point the piano should be tonally brilliant, but without penetrating harshness. b) The tone should be even throughout the scale. c) There should be no dull, dead or muffled area in the scale.

5. Let the piano rest — preferably overnight — before continuing.

Fine Voicing

1. The voicing must be perfectly fine-tuned and regulated.

2. Repeat the steps listed above under "Rough Voicing." a) Use strong, even strokes to sound each note. b) The overall tone should be approaching its final form. c) Listen and work carefully.

3. Listen to each individual string for impurities in the sound and variations of the tone from note to note. a) Use a mute to stop the other strings of the unison. b) Compare the individual strings of the unison against each other. c) Strings that stand out are corrected by needling the shoulder in the direction of the string. d) The hammer must hit all strings simultaneously — correct with 1/8" sandpaper strips.

4. As tone quality approaches the desired result more needling must be done in the C section of the hammer. a) Only shallow needling is required in the C section (crown). b) Never needle the wedge-shaped area beneath the crown surface. c) Keep the outer surface of the hammer free from loose felt fibers by polishing the hammer lightly with #220 sandpaper strip.

5. The stainless steel or brass bristle brush can be used to unify the sound of the instrument. a) Brush over the B and C sections of the hammers from front to back. b) The value of this technique becomes evident with experience.

6. Play the piano at length — make necessary corrections using this guide.

Shift Position Voicing

1. Normal position voicing must be completed first.

2. Voicing in the shift position is possible only when the two striking points of the shifted hammer lie exactly in between the three striking points of normal hammer position.

3. Needling should only be done in the direction of the string and only where the hammer hits the string in shift position. a) Shallow needle (one to two millimeters) in the C section. b) Play the note after every stitch.

4. Normal position voicing always takes priority over shift position.

The position of voicing is to produce a piano whose tone and action qualities are appealing and satisfying to the pianist. The artistic expression of complex musical ideas demands an instrument of the highest degree.

The piano craftsperson who desires to pursue this elusive goal must possess a wealth of technical resources, an indefatigable spirit and an ultra-refined ear for piano tone. Working with the intangible parameters of piano tone makes each voicing situation unique with the potential for being a rewarding experience for both pianist and piano technician.

Author's Note

The intent of "Voicing Concepts" is not to restrict or define voicing procedures in absolute terms. Rather, it is hoped that this article will serve as a point of departure for those who have yet to embark on the journey into the realm of tone regulation and as a catalyst for discussion for those who already experienced in the art of voicing.

Tuning Up

The Stretch Calculator And The Exam

Rick Baldassin, RTT
Tuning Editor

This month we have a letter from Kent Swafford, RTT, from Lenexa, KS. Kent is the Tuning Exam Subcommittee Chair. He writes:

You might recall the letter which was published in the April 1989 issue of the Journal *from the tuning examinee who wrote of his experience using an electronic tuning device's built-in stretch calculator for the visual portion of his exam. Much to his dismay, the resulting stretch tuning lost so many points that he failed his exam. His conclusion was that he hadn't done enough aural verification of his tuning. While this conclusion was, of course, correct, I thought it might be interesting, even at this late date, to note that there is a relatively simple visual tuning check that a tuner can use to catch errors introduced by a stretch calculator.*

This particular test is available to those visual tuners who use the sixth partial above each note being tuned in the bass (that is, those tuners who would tune B2, for example, with the electronic tuning device set on F#5.)

First, here is a brief review of the bass-tuning technique using the sixth partial: In tuning the B2 of our example, the electronic tuning device is set on F#5, which is the note coincident with the sixth partial of B2, and the light patterns of the three notes above B2 are observed and compared. The notes to be compared are B3 (the octave above the bass note being tuned), F#4 (the perfect 12th above), and F#5 (two octaves plus a perfect fifth above), all of which have partials that are coincident with F#5. The cents reading of the electronic tuning device is adjusted until an appropriate compromise is reached between the readings of the three test notes, and then B2 is tuned until its sixth partial stops the lights. It is beyond the scope of this letter to discuss what an appropriate compromise might be, but I might mention that it is common for the compromised cents setting of the electronic tuning device to result in stopped or almost stopped lights on the perfect 12th above the note being tuned (F#4 in this example).

The "visual verification" of the stretch tuning is simple in that it does not require any extra settings be made or any extra readings to be taken, but rather involves just some additional analysis of readings already being used. The check is most valuable in detecting errors in the lowest half-octave of the stretch tuning area, which is most prone to mistakes by the stretch calculator and is the area where the examinee mentioned above was led astray.

The check is easier to perform than to describe.

Look at the relationship between the notes that are being used to tune the B2. The B3 and F#4 form a perfect fifth; the electronic tuning device is set to F#5 which corresponds to the third partial of B3 and the second partial of F#4. It takes just a second to get an impression of the width of this 3:2 fifth: if the lights are stopped when the F#4 is played, and if the fifth is appropriately contracted, then the lights would rotate slowly clockwise when the B3 is played.

As one tunes into the bass, then, one can check these descending chromatic fifths that were tuned just moments before. If a particular fifth is noticeably wider or narrower than the others for whatever reason, then one could investigate further to see if there is a mistake that could be corrected. It is not unheard of for the stretch calculator to tune too wide in the lower portion of the stretch tuning area, and this excess width would almost certainly show up as too-pure or even expanded fifths.

One could also check the width of descending chromatic 2:1 octaves through the mid-section using this technique. Again, using the tuning of B2 as the example, the 12th above (F#4) and the double octave-perfect fifth above (f#5) are read with the electronic tuning device set on F#5. The F#5 is being read on its first partial and the F#4 on its second partial, a 2:1 relationship.

Our thanks to Kent for his letter. For those of you who are unfamiliar with the letter to which Kent refers, it came from one of our apprentice members who stated that he had indeed failed his exam in the midrange section having used the stretch calculator. So that each of you can follow the saga without digging out the back issues, I have decided to reprint portions of letters and comments which were printed in three issues of the *Journal* in 1989. The first letter came from Patrick Poulson of the Sacramento Valley Chapter. This originally appeared in the April 1989 issue. Patrick wrote:

Recently two other Associate members and I took the tuning test from the Northern California Examination Committee at a local university. All three of us have been in PTG for two or more years, and involved professionally in piano service for even longer.

We all came out of the test with similar results, having passed with good scores on pitch, stability, unisons, bass, treble, and aural retesting. We all used electronic aids (two used Accu-Tuners, and one used a Sight-O-Tuner) and we all failed the temperament and midrange sections, by approximately the same amounts. We compared notes afterward, and agreed that we had all used the standard procedures we had learned, including measuring and storing the stretch number, and using the stretch calculator to tune the section from C3 to F6. The piano that was used for the exam was a nine-foot Steinway grand. The stretch tuning we had used produced excessively wide octaves from A3 down to C3, when compared to the master tuning, and as shown in subsequent aural verification. Some of the widest octaves were measured, and proved to be over two cents wide at the 6:3 level.

Obviously, we examinees had not done sufficient aural verification. We were under the assumption, however, that both the SAT *and SOT, when used in the correct fashion, would produce a tuning that would easily pass the PTG test. In fact, I heard Jim Coleman make this assertion in a convention class in 1987, where he used a stretch tuning as a master tuning to check his aural temperament during his "How to Pass the Tuning Test" class. Therefore, we examinees concentrated on the other sections of the test, particularly the stability, bass, and treble sections, which we all passed easily. We had assumed that the stretch calculator tuning would give us no problems. As the test results showed, this assumption was not correct. In fact, the results puzzled our testing committee so much that they re-checked the master tuning to see if it was at fault. They found a few small discrepancies, but not enough to change the test results to any great extent. They also tried out a stretch calculator tuning of their own on the same piano, and the same problem of excessively wide octaves in the lower midrange was apparent.*

The upshot of all of this to me is to point out the apparent limitations of the stretch calculator as it is presently incorporated in the SAT and SOT, and that this fact should be brought out, especially in regards to the tuning test, so that a person taking the exam using one of these instruments should be wary of relying on the stretch calculator to the degree that many of us have been led to believe. I should point out that all three of us had our tunings critiqued and approved by RTT members prior to undertaking the test. I would appreciate any comments you have on this matter.

Our thanks to Patrick for his letter. Patrick assumed that because points were missed in the lower midrange, that the stretch calculator was at fault. This, of course, may have been the case, but there could be other possible explanations. Since I was not at the test site at the time, and am not privy to the full details of the situation, I can only speculate as to the reasons for this problem, based on my own experience giving the tuning test, using the stretch calculator, and tuning Steinway D concert grand pianos.

It has been my experience giving tests over the past six years on a Baldwin concert grand piano (which very closely resembles the Steinway concert grand) that examinees who have taken the test using the stretch calculator have passed the temperament and midrange sections easily, usually in the high 80s to low 90s, some as high as 100%. I checked with Jim Coleman to see what his experience was, and he stated that he had experienced one case where the examinee failed because the stretch calculator procedure was not followed correctly. Beside this case, he has never examined anyone who failed to pass using the stretch calculator. He also stated that he was quoted correctly by Patrick from his class in the above.

My experience using the stretch calculator has shown me that it is the most accurate, simple electronic tuning system which I have ever seen or used. When this system is used, the notes are very close, and with slight and very minor adjustments, a very fine temperament can be tuned. Some have commented that the octaves which the stretch calculator creates are too wide for their tastes. This is usually in reference to very low inharmonicity pianos, such as Kawai, Walter, and some Yamahas. For this reason Jim Coleman created tables for stretch tunings with slightly narrower octaves which were published in the October 1988 issue, page 20. I have never heard this comment in reference to a Steinway. In fact, Dr. Sanderson told me that the stretch calculator was formulated with data taken from Steinway pianos, satisfying the tastes of faculty members for which he tuned at Harvard.

My experience tuning the Steinway D concert grand has shown me that the stretch calculator gives the right amount of stretch for the octaves in the midrange, with the M10ths beating faster than the M3rds, and such that the descending M3rds do not slow down too quickly. I have honestly never measured to see how wide the octaves are at the 6:3 level, but do know that tuning slightly wide 6:3 octaves into the section below C3 produces a nice progression of parallel intervals. If the stretch calculator were tuning excessively wide octaves from notes A3 down to C3, this would not be the case.

All of my experience points to the fact that Patrick's problem should not have happened. Yet it did, so why? A few possibilities come to mind. One is that Patrick made no mention of re-checking the notes in the midrange to see if they stayed where he originally tuned them. With the de-tuning which precedes the tuning test, chances are good they did not. My advice to anyone taking the tuning test is to go through the piano quickly to undo the de-tuning. The likelihood that the piano will stay in tune after this will be greatly enhanced. I wonder, with so many large errors in the low midrange (with 10 notes from A3 to C3, there would need to be a two-point error on each note to score below 80%) why there were no errors mentioned in the bass? The tolerance is greater in octave two, which may account for this lack of errors. Since I do not have the test score forms or master tuning records, I cannot comment as to whether the test was scored properly, or the master tuning read properly. I have to assume that they were; however, a miscalculation of the pitch correction number, or misreading of the master tuning in the third octave could cause these problems.

Since Patrick stated that these errors were verified aurally by the testing committee, it would seem a legitimate problem did exist. It could be that the committee which did the master tuning preferred narrower octaves than those set forth by the stretch calculator. If the committee tuned the temperament within an octave where the M3 beat at the same speed as the M10, and the octaves downward were tuned in like fashion, the resulting master tuning could be skewed sharp in the low midrange enough to create a discrepancy such as this. Perhaps the testing committee could provide further information which would help solve this mystery.

In any case, there are some important lessons to be learned here. First, go through the piano quickly to undo the de-tuning. This will help the piano to stay in tune better. Second, go back several times to re-check your work. This will insure that your tuning has not drifted. Finally, never turn your ears off! Since all three examinees passed the aural re-testing, these problems would have been detected if careful listening had taken place.

The next letter came from Ron Berry, who was at the time our president. This appeared originally in the July 1989 issue. Ron wrote:

In the April 1989 issue of the Journal there was a letter from Patrick Poulson recounting his experiences using the stretch calculator mode on the SAT during a tuning test. He had scored poorly because the stretch *calculator was producing overly wide octaves. This highlights a weakness of the stretch calculator which can only be assessed aurally. The stretch calculator will always produce a consistent tuning but it can be consistently wrong as well as consistently right. The problem occurs when the stretch number measured is not the best stretch number to use for that piano. If the piano has an inconsistency when the inharmonicity of the F4 is out of line with the other notes, the stretch numbers measured will not be the best one to use. I discovered this when I still used the SOT. The SOT did not have as much accuracy in its internal calibration, and my particular instrument always measured the stretch number at least .5 cents less than what worked well. I would tune through the temperament area and then listen to the temperament. The thirds will always progress smoothly but perhaps will increase too slowly or quickly. The fourths and fifths are the real test here. If you find that the fourths beat slower than the fifths then the stretch number is too low. If the fourths beat very fast and the fifths are pure, then your stretch number is too high. When the stretch number is too high the effects add up to octaves that are overly wide. This points up to the need to not depend totally on the instrument and the need to use your ears.*

The instrument is excellent at keeping consistent from one note to the next, but you need to determine aurally when it is running ahead or behind on beat speed increases. This is true when using the instrument for octave tuning. In the bass, for example, you determine aurally whether pure 6:3, wide 6:3, pure 3:1, etc is the best interval to use. You then use the instrument to consistently produce that type of octave. You must, of course, check every few notes to see that type of octave is still working well and adjust accordingly.

While Mr. Poulson's case may have some other cause, I know that this problem can exist. By measuring the stretch number on E4 and F#4 you can see if it matches that of F4. Above all, don't turn your ears off when using the instrument.

This is very good advice. Since I published this in the April 1989 issue, I have learned some interesting twists in regard to this story. First, as I speculated, the master tuning did favor narrower octaves. I have no problem with this. No one has ever claimed that every committee would produce the same master tuning. The next matter was that readings were hard to take on this instrument. This made it harder to measure the stretch number accurately, as well as record the master and test tunings. I also learned that at some point, this piano had been re-scaled. I have no problem with this. The piano could still be tuned smoothly, as evidenced by the passing of the aural portion. It does point out why this experience with the stretch calculator was different from my own experience using the stretch calculator on the same make and model. All of these factors led to the failure of our applicant. This, however, could have been avoided if our applicant had listened as much during the electronic section as he did during the aural section. Ron's suggestions for confirmation of the stretch number by measuring neighboring notes to see if the number measured on F4 was in line with these neighbors, is a good one. The aural tests which he mentions are also a good way to determine if the correct stretch number has been chosen.

There has been much said here about the weaknesses of the stretch calculator which showed up in this particular instance. In fairness, I must say that many pianos are quite successfully tuned each day using this system. The moral is, indeed, to listen and test constantly whether tuning aurally, or with a tuning aid.

The final letter on this issue came from Alan Cate, RTT, of the Los Angeles Chapter. This appeared originally in the October 1989 issue. Alan wrote:

The letter from Patrick Poulson in the March 1989 issue of the Journal *and Ron Berry's reply in the July 1989 issue bring up some important points for those of us who tune using Dr. Sanderson's stretch calculator with either the Sight-O-Tuner or Sanderson Accu-Tuner. According to Patrick, three applicants, each using the stretch calculator program, failed the tuning exam because of notes judged to be flat in the range of C3 to A3. The piano was a Steinway D, and aural verification confirmed that those notes were indeed flat.*

Ron Berry is entirely correct in pointing out the importance of determining the best stretch number, and perhaps that was part of the problem in this case. But I have a different point to make in regards to the stretch calculator. Because of the way the stretch calculator program is constructed, it is susceptible, for some pianos, to giving poor settings for the lowest notes of its range (C3 to F3), even when the correct stretch number is being used.

The stretch calculator covers a range of 3 1/2 octaves (C3 F6). It is usually the half octave that is problematic. Beginning at F#3 and moving upwards to F4, there is a series of twelve "octave-double octave" groups, that is F#3-F34-F#5 through F4-F5-F6. The stretch calculator relates the notes in each of these groups by using the same coincident partial with slightly different cents offsets for stretch. Take, for example, A3-A4-A5. The stretch calculator specifies that the partial A5 be used for each note, and gives settings of 0.7 for A3, 1.7 for A4, and 3.0 for A5. This means that we are tuning a 4:2 octave which is one cent wide from A3-A4, a 2:1 octave which is 2/3 cents wide from A3-A5. These octaves and double octaves are constructed with a precise amount of stretch, perhaps more than some people might prefer, but a precise amount nevertheless. As we move down the scale past F#3 to F3 through C3, on the other hand, this relationship no longer holds true. Whereas F#3 is related to F#4 and F#5 in that the same coincident partial is used to tune all three, F3 and the notes below it have no such relationship to their octaves and double octaves. F3 is tuned using partial F5, but F4 and F5 are tuned using partial F6. Because of this, there is no way to control the amount of stretch at the 4:2 octave and 4:1 double octave, we would have to control the fourth partial of F3 (F5), and the second partial of F4 (F5), but the stretch calculator won't allow us to do this because it uses the fourth partial to tune F4, not the second.

I can only assume that in creating the stretch calculator, Dr. Sanderson came up with the three octaves (F#3-F6) first, and then discovered that he could tack-on, as it were, an additional six notes by extrapolating the descending progression of cent values for the fourth partials, and, of course, verifying that these values would work on a number of pianos. And it works. The stretch calculator almost always gives very good results (except for wrapped strings which extend up into the range of the stretch calculator on smaller pianos).

Recently, however, I encountered a new Bösendorfer concert grand which behaved similarly to Patrick Poulson's exam piano, that is, when tuned with the stretch calculator, the lowest octaves in the stretch range were clearly too wide. In this case I found it necessary to raise the settings for C3 through E3. I have tuned other pianos where similar changes were necessary.

Another point touched upon in this discussion is the fact that pianos of the same make and model do not necessarily have the same tuning characteristics, particularly pianos which have been restrung or rescaled. The Bösendorfer mentioned above surprised me because it differed from what I had previously found tuning other Bösendorfers, including a concert grand on the same model, and only a few months later.

Our thanks to Alan for his letter. In order that we might more easily visualize what Alan was speaking about concerning the construction of the stretch calculator, I have printed the notes, partials, and cent settings for a 5.0 cent stretch number, in such a way as to illustrate the "octave-double octave" relationships to which Alan referredin table 1.

From table 1, the octave and double octave widths in cents and beats per second can be calculated. Table 2 lists the 4:2 octave width for octaves F#3-F#4 to F4-F5, 2:1 octave width for octaves F#3-F#5 to F4-F6.

Dr. Sanderson specified that the stretch calculator give 4:2 octaves that were 0.5 bps wide. From table 2, we can see that this is indeed the case. Notice that the progressions for the 2:1 octaves, and 4:1 double octaves are smooth progressions, as well. Alan's statements about the construction of the stretch calculator, with its octave and double octave relationships are correct. Although Alan does not mention it, the relationship for note F3 is valid as well. I will explain why this is so.

The stretch number in this case is 5.0. The stretch number is determined by measuring the difference between the second and fourth partials of F4. Therefore, if we know the cent setting for the fourth partial of F4, the cent setting for the second partial will be 5.0 cents below that. In this case, the fourth partial of F4 is at 5.3 cents, so the second partial would be at 0.3 cents. Knowing the location of the second partial of F4, we can now calculate the cent width and beat rate of the 4:2 octave from F3-F4. The fourth partial of F3 is -1.2, and the second partial of F4 is 0.3. This makes the 4:2 octave 1.5 cents wide, which translates to 0.6 bps. Note that this is in line with the F#3-F#4 octave, which also beats at 0.6. So far, we have shown the validity of the octave and double octave relationships for notes F3 to F6. Let us now examine notes C3 to E3.

It was Alan's feeling that Dr. Sanderson simply "tacked-on" notes C3 to E3, by extrapolating the downward progression of cents. If this was the case, what assumptions were made in the process? Let us take a closer look.

If we were to measure the stretch number of notes C4 to E4, we could calculate the width of the 4:2 octaves from C3-C4 to E3-E4, as was done for the F3-F4 octave. When measuring the stretch number, the distance between the second and fourth partials is measured. You may recall from our discussion of inharmonicity, that the inharmonicity constant for a note can be extracted by measuring the distance between two partials, then dividing by the difference of the squares of the two partial numbers. In this case, since the second and fourth partials were used, if we divide the stretch number by 12 (4^2-2^2), we have the inharmonicity constant. Conversely, if we multiply the inharmonicity constant of a note by 12, we have what would be the "stretch number" for that note. (Please remember that for use with the stretch calculator, the stretch number for note F4 must be entered.) If we assume that the inharmonicity constants progress

table 1

Note, Octave And Cent Settings For A 5.0 Cent Stretch Number

Note	*SAT*	*Cents*	*Note*	*SAT*	*Cents*	*Note*	*SAT*	*Cents*
C3	C5	-3.2						
C#3	C#5	-2.9						
D3	D5	-2.5						
D#3	D#5	-2.1						
E3	E5	-1.7						
F3	F5	-1.2						
F#3	F#5	-0.7	F#4	F#5	0.6	F#5	F#5	2.3
G3	G5	-0.2	G4	G5	1.0	G5	G5	2.5
G#3	G#5	0.3	G#3	G#5	1.4	G#3	G#5	2.8
A3	A5	0.7	A4	A5	1.7	A5	A5	3.0
A#3	A#5	1.2	A#4	A#5	2.1	A#5	A#5	3.2
B3	B5	1.7	B4	B5	2.5	B5	B5	3.5
C4	C6	2.2	C5	C6	3.0	C6	C6	3.9
C#4	C#6	2.7	C#5	C#6	3.5	C#6	C#6	4.3
D4	D6	3.3	D5	D6	4.0	D6	D6	4.7
D#4	D#6	3.9	D#5	D#6	4.4	D#6	D#6	5.0
E4	E6	4.6	E5	E6	5.0	E6	E6	5.5
F4	F6	5.3	F5	F5	5.5	F6	F6	6.0

table 2

Octave And Double Octave Width In Cents And Beats Per Second

4:2 Oct	*Cents*	*Beats*	*2:1 Oct*	*Cents*	*Beats*	*4:1 Dbl Oct.*	*Cents*	*Beats*
F#3-F#4	1.3	0.6	F#4-F#5	1.7	0.7	F#3-F#5	3.0	1.3
G3-G4	1.2	0.5	G4-G5	1.5	0.7	G3-G5	2.7	1.2
G#3-G#4	1.1	0.5	G#4-G#5	1.4	0.7	G#3-G#5	2.5	1.2
A3-A4	1.0	0.5	A4-A5	1.3	0.7	A3-A5	2.3	1.2
A#3-A#4	0.9	0.5	A#4-A#5	1.1	0.6	A#3-A#5	20.	1.1
B3-B4	0.8	0.5	B4-B5	1.0	0.6	B3-B5	1.8	1.0
C4-C5	0.8	0.5	C5-C6	0.9	0.5	C4-C6	1.7	1.0
C#4-C#5	0.8	0.5	C#5-C#6	0.8	0.5	C#4-C#6	1.6	1.0
D4-D5	0.7	0.5	D5-D6	0.7	0.5	D4-D6	1.4	0.9
D#4-D#5	0.5	0.4	D#5-D#6	0.6	0.4	D#4-D#6	1.1	0.8
E4-E5	0.4	0.3	E5-E6	0.5	0.4	E4-E6	0.9	0.7
F4-F5	0.2	0.2	F5-F6	0.5	0.4	F4-F6	0.7	0.6

table 3

Projected Cent Settings And Octave Width In Cents And Beats

Note	SAT	Cents	Note	SAT	Cents	4:2 Oct	Cents	Beats
C3	C5	-3.2	C4	C5	-1.2*	C3-C4	2.0	0.6
C#3	C#5	-2.9	C#4	C#5	-1.0*	C#3-C#4	1.9	0.6
D3	D5	-2.5	*D4	D5	-0.7*	D3-D4	1.8	0.6
D#3	D#5	-2.1	D#4	D#5	-0.4*	D#3-D#4	1.7	0.6
E3	E5	-1.7	E4	E5	0.0*	E3-E4	1.7	0.6
F3	F5	-1.2	F4	F5	0.3**	F3-F4	1.5	0.6
F#3	F#5	-0.7	F#4	F#5	0.6	F#3-F#4	1.3	0.6

*Calculated based on projected stretch numbers for notes C4-E4.
**Calculated based on actual stretch number for note F4.

smoothly, then the stretch numbers for notes C4 to E4 would progress smoothly, also. Let us assume that the stretch numbers for these notes were as follows:
C4 = 3.4, C#4 = 3.7, D4 = 4.0, D#4 = 4.3, E4 = 4.6, F4 = 5.0

Calculating for the second partial as before would result as follows:
C4 = -1.2, C#4 = -1.0, D4 = -0.7, D#4 = -0.4, E4 = 0.0, F4 = 0.3

Incorporating these projected second partial values into our stretch calculator tables, we can calculate the cent width and beat rates of the 4:2 octaves below note F#3 in table 3.

As we can see in table 3, the 4:2 octaves from notes C3 to E3 behave very nicely, providing the stretch numbers (inharmonicity constants) progress smoothly, and are in line with those of note F3 above. Problems arise when this progression is not smooth, or is not in line with those notes above. This is common in pianos which have wound strings which fall in the lower range of the stretch calculator, as Alan has pointed out. Here, the inharmonicity often does not follow the above rules. For this reason, it is my recommendation that wound strings not be tuned as part of the stretch calculator, but individually as octaves.

Dr. Sanderson confirmed that Alan was correct in his assumptions about lower notes of the stretch calculator. He stated that the values for these lower notes were based on inharmonicity constants which decreased by a prescribed amount. He stated that you could project these constants for an octave or more below note F3, but felt in many cases, problems could be encountered. He found that in most cases, however, the projection down to note C3 worked out satisfactorily. He agreed that if the inharmonicity constants for notes C3 to E3 decreased faster than the stretch calculator projects, the octaves might sound too wide. This is probably the case with the Bösendorfer which Alan mentioned, and the re-scaled Steinway D which Patrick took his exam on, although this is speculation on my part, because I have never actually measured these instruments.

In conclusion, when tuning with the stretch calculator, it is important to listen carefully to notes C3 to E3, to make sure that the interval progressions behave nicely, and that there is a smooth transition into the bass. In addition, it is recommended that the stretch calculator be used on plain wires only, and not on wound strings, where the inharmonicity constants are less likely to progress smoothly.

While we probably will never know exactly what happened in the case of these three exams, several possibilities were speculated. The most obvious was that aural verification had not taken place. This was evidenced by the fact that the examinee had passed the aural section of the exam. Another likely reason was that not enough time was spent undoing the detuning. It was suggested that because of this, several of the notes may have drifted after they had been tuned. The exam piano was a concert grand, therefore, there was no problem from the introduction of wound strings. The piano had, however, been rescaled when it was restrung. The possibility that this particular exam committee may have liked narrower octaves was also mentioned.

Each of the letters on this subject which followed Patrick Poulson's letter, including Kent Swafford's letter, pointed out what was felt to be a weakness of the stretch calculator, and suggested a method to deal with this said weakness. Remember, the stretch calculator makes two assumptions: 1. that the inharmonicity progresses smoothly from note to note, and 2. that the note used to measure the stretch number is representative of those notes around it. The letters from Alan Cate and Kent Swafford dealt with the situation which occurs when the inharmonicity does not progress smoothly, and their suggestions on this matter are excellent. The letter from Ron Berry dealt with the situation which occurs when F4 is not representative of the notes around it, and his suggestions are excellent, as well.

Each of the letters also hit home on the need to aurally test and verify the work, so as to be able to catch the instances when problems in the piano cause the stretch calculator tuning not to fit well on the instrument.

Those of you who desire to even further review the stretch calculator can find some very detailed information, including graphs and tables, printed in the September 1989 issue, pages 22-27. I apologize, but this material was simply too lengthy to reprint in this issue.

Hope to see you in Philadelphia. Until next month, please send your questions and comments to:

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The Ideal Aural Tuning, Part III

James Coleman, Sr., RTT
Phoenix, AZ, Chapter

table I

WALTERS 43"CONSOLE	STEINWAY D GRAND	
Ic CURVES		NOTE
.351	.119	==01:A.0==
.349	.114	02:A#0
.287	.092	03:B.0
.270	.076	04:C.1
.227	.074	05:C#1
.226	.076	06:D.1
.231	.077	07:D#1
.216	.079	08:E.1
.202	.052	09:F.1
.185	.053	10:F#1
.185	.049	11:G.1
.179	.045	12:G#1
.165	.039	==13:A.1==
.144	.039	14:A#1
.136	.046	15:B.1
.136	.042	16:C.2
.189	.049	17:C#2
.137	.052	18:D.2
.138	.061	19:D#2
.138	.056	20:E.2
.132	.056	21:F.2
.131	.060	22:F#2
.139	.066	23:G.2
.142	.071	24:G#2

WALTERS 43"CONSOLE	STEINWAY D GRAND	
Ic CURVES		NOTE
.131	.069	==25:A.2==
.140	.075	26:A#2
.141	.082	27:B.2
.149	.092	28:C.3
.142	.102	29:C#3
.139	.113	30:D.3
.145	.116	31:D#3
.146	.129	32:E.3
.145	.146	33:F.3
.152	.163	34:F#3
.159	.186	35:G.3
.164	.206	36:G#3
.173	.215	==37:A.3==
.179	.235	38:A#3
.187	.254	39:B.3
.194	.282	40:C.4
.202	.311	41:C#4
.212	.349	42:D.4
.224	.373	43:D#4
.235	.375	44:E.4
.247	.417	45:F.4
.263	.463	46:F#4
.285	.513	47:G.4
.313	.581	48:G#4

WALTERS 43"CONSOLE	STEINWAY D GRAND	
Ic CURVES		NOTE
.337	.642	==49:A.4==
.378	.711	50:A#4
.424	.771	51:B.4
.489	.817	52:C.5
.564	.896	53:C#5
.651	.975	54:D.5
.764	1.049	55:D#5
.858	1.139	56:E.5
.976	1.251	57:F.5
1.129	1.299	58:F#5
1.257	1.422	59:G.5
1.429	1.530	60:G#5
1.556	1.686	==61:A.5==
1.766	1.852	62:A#5
1.969	2.025	63:B.5
2.150	2.156	64:C.6
2.372	2.372	65:C#6
2.547	2.641	66:D.6
2.763	2.917	67:D#6
3.026	3.197	68:E.6
3.206	3.622	69:F.6
3.947	3.788	70:F#6
3.746	4.194	71:G.6
3.984	3.902	72:G#6
4.637	4.396	==73:A.6==
4.895	4.886	74:A#6
5.210	5.502	75:B.6
5.253	6.287	76:C.7
5.677	6.892	77:C#7
6.204	7.308	78:D.7
6.438	8.435	79:D#7
7.200	9.131	80:E.7
7.520	10.258	81:F.7
7.889	11.948	82:F#7
8.365	14.196	83:G.7
8.925	15.531	84:G#7
9.929	16.110	==85:A.7==
10.839	16.978	86:A#7
11.962	19.147	87:B.7
13.377	19.241	88:C.8

Last month we saw how evenly the various intervals (thirds, fourths, and fifths) were progressing in several of the common pianos which we face from day to day. These beat rates were computed after determining the inharmonicity constant for each note in the area with special attention being given to the M3rds, single and double octave balance. An inharmonicity constant is a value that characterizes the amount of sharpness of the partials of a particular piano string. In later articles it will be explained how to compute this value based on speaking length, diameter, frequency, unwrapped portions of bass strings, etc.

In this article we will see what happens to the resultant fourths, fifths and the 6-4 or second coincident partial relationships of the fifths. Most readers have learned from the excellent articles of Rick Baldassin how to locate the various partials which produce beats for the various tempered intervals, including octaves. The charts shown here will point up some of the vagaries of the fifths. We all learned in our early days of tuning that we could easily become confused while tuning fifths, because it was so easy to get sucked into listening to the second set of coinciding partials. e.g.: While tuning F3-C4 on some pianos, the sixth partial of F3 and the fourth partial of C4 would beat louder at the pitch of C6 than would the third partial of F3 and the second partial of C4 at the pitch of C5. If we were tuning with the William Braid White system, this would mess up our entire temperament at the very beginning.

table II

NOTE	WALTERS 43"CONSOLE CD CURVES	STEINWAY D GRAND CD CURVES
==01:A.0==	-31.0	-14.1
02:A#0	-29.3	-13.2
03:B.0	-24.5	-11.5
04:C.1	-22.5	-10.0
05:C#1	-20.0	-9.5
06:D.1	-18.6	-9.1
07:D#1	-18.0	-8.8
08:E.1	-16.6	-8.3
09:F.1	-15.3	-6.7
10:F#1	-13.9	-6.4
11:G.1	-13.3	-5.8
12:G#1	-12.5	-5.3
==13:A.1==	-11.4	-4.6
14:A#1	-10.1	-4.4
15:B.1	-9.4	-4.3
16:C.2	-9.0	-4.0
17:C#2	-9.9	-3.9
18:D.2	-8.2	-3.7
19:D#2	-7.8	-3.7
20:E.2	-7.4	-3.3
21:F.2	-7.0	-3.0
22:F#2	-6.6	-2.9
23:G.2	-6.3	-2.7
24:G#2	-6.0	-2.5
==25:A.2==	-5.5	-2.2
26:A#2	-5.1	-2.1
27:B.2	-4.8	-2.0
28:C.3	-4.6	-2.0
29:C#3	-4.3	-1.9
30:D.3	-3.9	-1.8
31:D#3	-3.7	-1.7
32:E.3	-3.4	-1.7
33:F.3	-3.2	-1.6
34:F#3	-3.0	-1.5
35:G.3	-2.8	-1.4
36:G#3	-2.5	-1.4
==37:A.3==	-2.3	-1.3
38:A#3	-2.1	-1.2
39:B.3	-1.9	-1.2
40:C.4	-1.7	-1.1
41:C#4	-1.5	-1.0
42:D.4	-1.3	-.9
43:D#4	-1.1	-.8
44:E.4	-.9	-.7
45:F.4	-.7	-.6
46:F#4	-.6	-.5
47:G.4	-.4	-.3
48:G#4	-.2	-.2
==49:A.4==	.0	.0
50:A#4	.2	.2
51:B.4	.4	.4
52:C.5	.6	.6
53:C#5	.8	.8
54:D.5	1.0	1.1
55:D#5	1.1	1.4
56:E.5	1.3	1.6
57:F.5	1.5	1.9
58:F#5	1.7	2.3
59:G.5	1.8	2.6
60:G#5	2.0	3.0
==61:A.5==	2.3	3.4
62:A#5	2.6	3.7
63:B.5	2.9	4.1
64:C.6	3.3	4.4
65:C#6	3.7	4.9
66:D.6	4.2	5.4
67:D#6	4.7	5.9
68:E.6	5.2	6.5
69:F.6	5.8	7.2
70:F#6	6.5	7.7
71:G.6	7.1	8.5
72:G#6	7.9	9.3
==73:A.6==	8.7	10.2
74:A#6	9.7	11.2
75:B.6	10.8	12.2
76:C.7	11.9	13.1
77:C#7	13.2	14.4
78:D.7	14.4	16.0
79:D#7	15.9	17.6
80:E.7	17.5	19.3
81:F.7	18.4	21.0
82:F#7	21.2	21.9
83:G.7	21.0	23.8
84:G#7	22.4	23.5
==85:A.7==	24.9	25.8
86:A#7	26.6	28.1
87:B.7	28.5	30.8
88:C.8	29.7	34.0

In the charts you will see that the graphs of the beat rates on the fourths and the fifths run rather parallel until you look at the 6-4 relationship of the fifths. In the past I have heard tuners say that the higher frequency beat of the fifth is about double that of the partial we usually listen for. This writer may be guilty of having said this. It all depends on where in the scale you look. One piano may have a much steeper inharmonicity slope in certain locations of the scale than does another piano. As you look at the tenor bridge curve, you get a pretty good idea of the inharmonicity curve of the scale. As you look down the scale from the middle of the bridge, if the curvature straightens out or has a reverse in the curve direction, this indicates a fore-shortening of the string lengths usually due to case limitations. Normally, going from note 88 downward, the strings increase in length in an exponential fashion. In most pianos the inharmonicity constant increases as you look from the lowest note on the treble bridge to note 88. Where you find the "hockey stick" configuration at the bottom of the long bridge, there is a flatter inharmonicity curve.

The main thing these two graphs show is that, when the M3rds and octaves are smoothly balanced, the fourths and fifths can also be smoothly balanced on a well-designed scale, even on a 43" console. This lends some credence to the aural tuning system which many of us used in the early days where we were super careful about our fourths and fifths and little else. It really takes great skill to set a good temperament using only fourths and fifths; however, on poorly scaled pianos, it is impossible as graphs of those pianos would show.

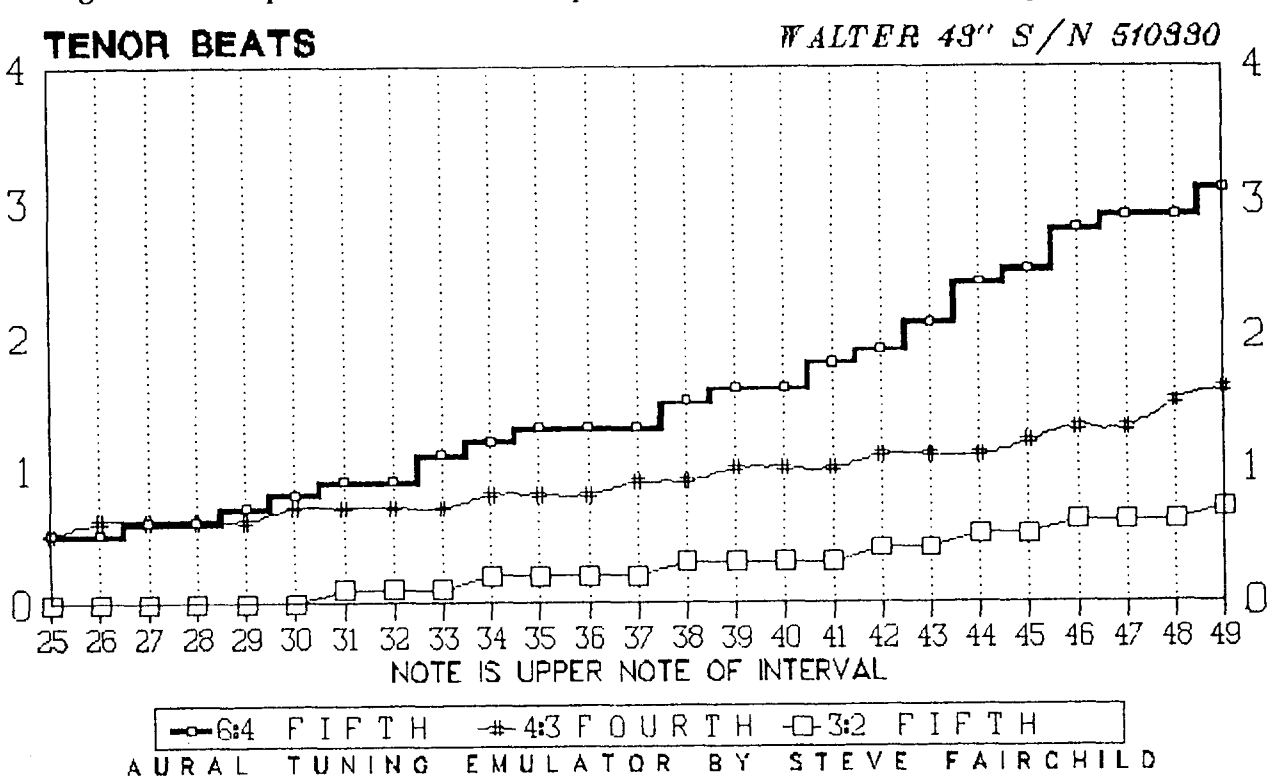
In table I, we see in columns one and two a complete list of the derived inharmonicity constants for the same two pianos. You will notice that even though the console piano has higher values in the bass section due to size limitations; from F3 upward, the values are near or lower than the nine-foot grand on up to note 88. You will also notice that both pianos have fairly good balances across the bass-tenor breaks. The nine-foot piano has its break between notes 20 and 21. The console has its break between notes 32 and 33.

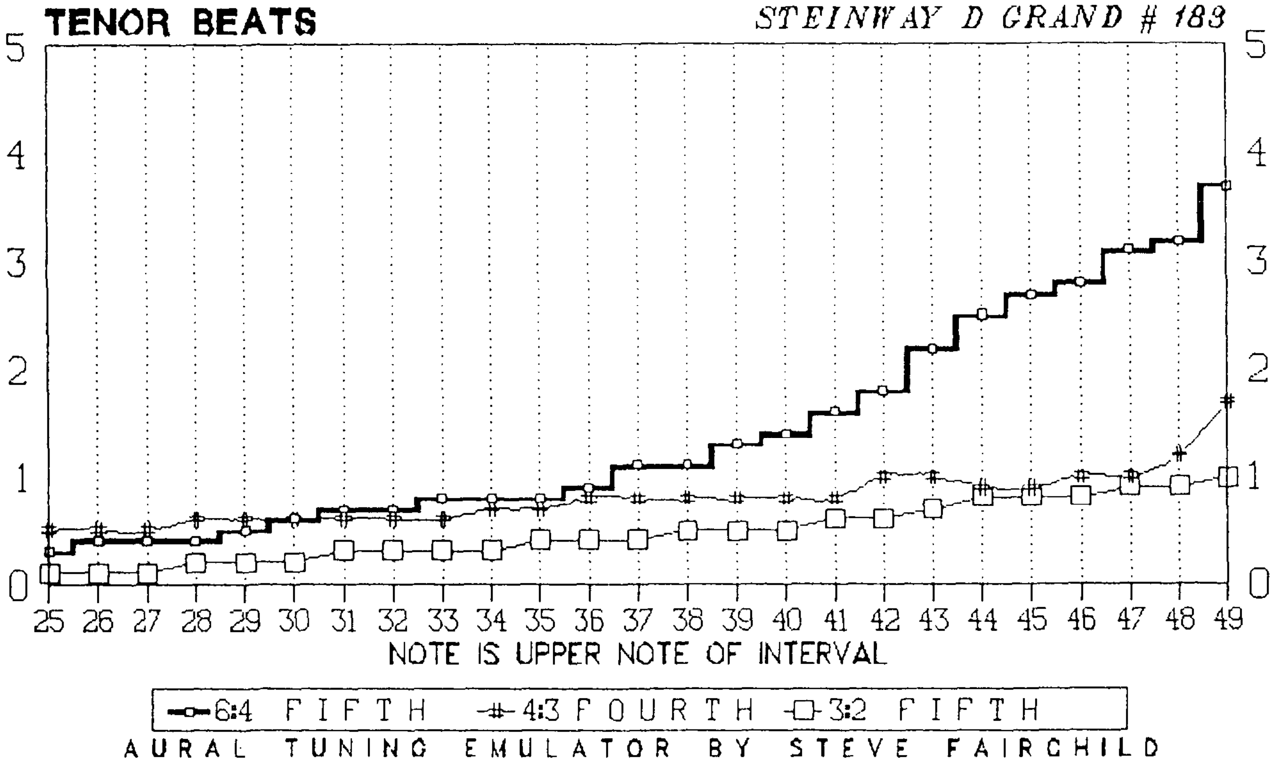
In table II, we see a comparison of the tuning curves of the two pianos after the computer has done its number crunching thing. These values represent the cents deviation or location of the fundamental pitch or first partial of each note. Now with the location of each note on the curve, and by again using the Ic values, the cents location of each partial can be derived. With this information, the difference in cents of the various coinciding partials of the various intervals can be calculated. This difference in cents can then be translated into beats per second.

Each value is the result of multiple recalculations of the formulas which balance out the M3rds, single and double octaves. This balancing is accomplished with certain pre-suppositions. The formulas give strong emphasis to keeping the single octave and double octave matching within approximately .5 bps of each other. Another guideline in the *table III*

NOTE	WALTERS 43"CONSOLE	STEINWAY D GRAND	NOTE	WALTERS 43"CONSOLE	STEINWAY D GRAND	NOTE	WALTERS 43"CONSOLE	STEINWAY D GRAND
	Ic OCTAVE FACTOR			Ic OCTAVE FACTOR			Ic OCTAVE FACTOR	
==13:A.1==	.5	.3	==37:A.3==	1.3	3.1	==61:A.5==	4.6	2.6
14:A#1	.4	.3	38:A#3	1.3	3.1	62:A#5	4.7	2.6
15:B.1	.5	.5	39:B.3	1.3	3.1	63:B.5	4.6	2.6
16:C.2	.5	.6	40:C.4	1.3	3.1	64:C.6	4.4	2.6
17:C#2	.8	.7	41:C#4	1.4	3.0	65:C#6	4.2	2.6
18:D.2	.6	.7	42:D.4	1.5	3.1	66:D.6	3.9	2.7
19:D#2	.6	.8	43:D#4	1.5	3.2	67:D#6	3.6	2.8
20:E.2	.6	.7	44:E.4	1.6	2.9	68:E.6	3.5	2.8
21:F.2	.7	1.1	45:F.4	1.7	2.9	69:F.6	3.3	2.9
22:F#2	.7	1.1	46:F#4	1.7	2.8	70:F#6	3.5	2.9
23:G.2	.8	1.3	47:G.4	1.8	2.8	71:G.6	3.0	2.9
24:G#2	.8	1.6	48:G#4	1.9	2.8	72:G#6	2.8	2.6
==25:A.2==	.8	1.8	==49:A.4==	1.9	3.0	==73:A.6==	3.0	2.6
26:A#2	1.0	1.9	50:A#4	2.1	3.0	74:A#6	2.8	2.6
27:B.2	1.0	1.8	51:B.4	2.3	3.0	75:B.6	2.6	2.7
28:C.3	1.1	2.2	52:C.5	2.5	2.9	76:C.7	2.4	2.9
29:C#3	.8	2.1	53:C#5	2.8	2.9	77:C#7	2.4	2.9
30:D.3	1.0	2.2	54:D.5	3.1	2.8	78:D.7	2.4	2.8
31:D#3	1.1	1.9	55:D#5	3.4	2.8	79:D#7	2.3	2.9
32:E.3	1.1	2.3	56:E.5	3.7	3.0	80:E.7	2.4	2.9
33:F.3	1.1	2.6	57:F.5	4.0	3.0	81:F.7	2.3	2.8
34:F#3	1.2	2.7	58:F#5	4.3	2.8	82:F#7	2.0	3.2
35:G.3	1.1	2.8	59:G.5	4.4	2.8	83:G.7	2.2	3.4
36:G#3	1.2	2.9	60:G#5	4.6	2.6	84:G#7	2.2	4.0
						==85:A.7==	2.1	3.7
						86:A#7	2.2	3.5
						87:B.7	2.3	3.5
						88:C.8	2.5	3.1

formulation is to graduate from a perfect 6-3 octave match from note 25 down to a perfect 8-4 match at note one. If one finds the match between A0 and A1 to be too much for his taste, there is an option to modify the formulas in the lowest notes of the bass to stay closer to the 6-3 matching or even to compromise toward 4-2 octave matching. 4-2 octave matching is where the fourth partial of C2 is in perfect unison with the second partial of C3. This is aurally proven by the third-10th test where G#1-C2 M3rd has the same beat rate as G#1-C3. 6-3 octave matching is where the sixth partial of C2 is in perfect unison with the third partial of C3. This is aurally proven by the m3rd-M6th test (C2-D#2 beat rate equals D#2-C3). 8-4 octave matching is where the eighth partial of C2 is in per-





fect unison with the fourth partial of C3. This can be aurally proven by the m6th-M3rd test (C2-G#2 beat rate equals G#2-C3).

In table III you will see the inharmonicity constant octave matching factor. If you take the Ic value from table I, console column, note 13 which is .165 and divide it by the Ic value from note one, which is .351, you will get an answer of .470085 which rounds off to .5 as shown in the Walter Column of table III, note 13. In both the Walter piano and the Steinway D you will see a relatively smooth progression of octave matching factors.

In next month's article, you will see tables of the beat rates of the important intervals throughout the entire scale. There will be graphs of the bass octave relationships such as the 4-2 matching beats, the 6-3 matching beats, and the 8-4 matching beats. After that, the octave matching relationships of the treble will be analyzed by following the thirds and 17ths. Then the remaining articles will deal with how the formulas work.

In the meantime, catch Steve Fairchild's class in Philadelphia. This writer will be there with his ears turned on, Good Buddy.

Book Review

Review: The Calculating Technician

Willis Snyder, RTT
Reading-Lancaster, PA, Chapter

This book illustrates a well-known but not always accepted fact of life: we never stop learning. Formulas and calculations are only a part of the text. Understanding of essential scale considerations and their relevance to the work of the average technician make this an essential text for everyone, not exclusively for the scale designer.

"The Calculating Technician" can best be summarized by its chapter headings:

Introduction: This excellent introduction encourages readers to partake of the knowledge involved in the subject matter, even if they do not intend to be actively engaged in piano scale work. David Roberts states that the work (calculating) is really not difficult at all.

Scaling Formula Algebra: For those of us who have been away from school for a long time (or even a short time) this chapter is a reintroduction to simple algebra designed to help you "think" your way through the mathematics necessary to calculate the essential scale factors. If you have reservations about your ability to understand the formulas, be assured that David Roberts makes it all seem simple. You will have a feeling of accomplishment after becoming familiar with the necessary formulas.

Essentials Of Good Scale Design: This chapter explains some conditions that may cause problems for Tuners (Aural and Visual).

The titles of the remaining chapters are self-explanatory: Hammer-String Contact Time; Unison Loudness Sustaining Factor; Inharmonicity Calculations; Improving Inharmonicity Patterns; Wound Strings (Design, Ordering, Installation); Typical Scale Designs, Modifications; Author's Update (May 1990); Appendix 1: Calculations For Scaling Computations; Appendix 2: Advantages Of Programmable Calculators; Appendix 3: Programming Scaling Formulas; References

Two items which are important to rebuilders and technicians are mentioned in this book: Notching of the bridges to effect a solid termination of the speaking length and chipping up methods which pay dividends in much better results.

Understanding the significance of the relevant factors in scale design provides valuable insight for the average technician. Such understanding can only help improve every facet of our work; tuning, voicing and regulating. David Roberts provides a useful and essential work for every piano technician. Another advantage of belonging to the Piano Technicians Guild.

Good Vibrations

Some Technical Wrap-Ups, And A Discussion With Chris Robinson

Nick Gravagne, RTT
New Mexico Chapter

By way of wrapping up loose ends, this month's article, in response to many pertinent questions, will include two mathematical formulas regarding soundboard crown, followed by a discussion on setting downbearing over new bridge caps (and usually a new soundboard) a la Chris Robinson.

As for the formulas: One is for figuring the amount of deflection given a radius and a length (such as a rib length), and another for figuring radius given a deflection. These will be useful for the technician interested in ascertaining soundboard crown, or in working out the dimensions for building presses and cauls, etc. Again, the usual caution is in order. Like the theoretical values assigned to temperaments and piano tuning in general, soundboard deflections, crown, etc., are likewise theoretical. Even the oft quoted 60-foot radiused crown is not an agreed upon industry value; probably it has survived all these years less due to its prevalence in use than by default in that no other radius seems to have been seriously forwarded as a standard. Indeed, even the idea of a radius exists only as a relatively simple way of discussing curvature. In actuality, either by happy accident, or by design, most ribs and presses end up with a parabolic or catenary curve form. It is more tangible, though, for most of us to talk about, and to visualize, let alone work through the mathematics of, curvature in the shape of circles and arcs.

I still receive calls and correspondence by computer-wielding techs who have rightly computed crown in existing soundboards, most of them wondering how to interpret the results. Worse, though, are those types who lean too heavily on the 60-foot standard and, after making the proper computations, insist on interpreting the results too strictly. For the working and experienced rebuilder what really matters is that crown exists — real crown, not simply upward, minimal deflections in the board imparted solely by the canted inner rim — and that positive downbearing can be measured, or, if it is negligible, can be made positive through intelligent rebuilding.

With these brief thoughts as a backdrop, the formulae can be found in the "computations" section following this article.

Setting Downbearing — Another Look

The following practice relating to setting bearing on the bridge/soundboard assembly is generally applicable to new soundboards with replaced, oversize (too-tall and unnotched) caps; but it also can be employed in setting the bearing on an old, reusable soundboard which is getting new bridge caps.

In past articles in this series, I have outlined setting downbearing solely by use of the "computed angle method." Without going into all that again, suffice it to say that the oversize caps were kerfed such that the rest string used in the process *would not*, after the kerf was introduced, touch the rear string rest (such as duplex bars in the Steinway). The idea was to kerf the bridge until the space found between the test string and the rear rest equalled a certain dimension (called the downbearing dimension, see figure 1) which related to a specified angle of one, or one and a half degrees, or whatever. For example, if a one and a half degree angle was decided upon, and the rear string length (i.e., measured from the *front* bridge pins to the rear string rest, figure 1) measured eight inches in the tenor part of the scale, the downbearing dimension sought in that part of the scale was found by multiplying the factor 0.026 by eight inches. Hence, the answer (0.208 inches) is the target dimension necessary between the test string and the top of the rest. This computed-angle method has worked quite well for me (and others). But notice that the soundboard is a passive participant in the process. It is not "pre-stressed" as an integral factor in order to determine downbearing.

Regarding such matters I recently had the experience of delving into the intricate and flamboyant mind of Chris Robinson. And with his permission a brief, but useful, outline of his downbearing theory and method, along with some of his definite feelings about related matters, follows.

The Pre-Stressed Soundboard Method

Although not Chris's term, this approach to setting bearing might be called the "pre-stressed soundboard method." In its broad scope the approach is not unique to Chris; other rebuilders use it, and Steinway employs a variation of it. The idea is to pre-stress the soundboard to an absolutely flat (or near so) condition. The raw bridges are then kerfed so that the test string touches the bottom of the kerf *and* the rear string

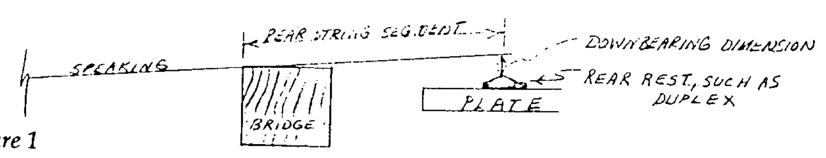


figure 1

rest simultaneously. When the pre-stressing apparatuses are removed, the board will rise and downbearing will be noticeably and measurably apparent and, as Chris affirms, the bearing will be custom-made to that particular soundboard given its size, shape, crown, and stiffness. Chris refers to the relationship of bearing-to-crown thus achieved as one-to-one. On a well-thought-out and constructed soundboard there will be no danger of either overloading the soundboard when strung, or of the board completely flattening out under actual downbearing loads.

Before going on to the working process, a couple of important factors enter in here, both of which Chris and I agreed must be accounted for. They have to do with the *amount* of crown present, and with how far one dares to pre-stress a crowned soundboard? Now, interestingly, and in light of this pre-stressing method, a 60-foot crowned soundboard must be considered a high-crowned board, and here's why.

In pre-stressing soundboards the one-to-one crown-to-bearing dimension will match and compliment the amount of crown in the board at any given section of the scale. So if, say, 1/4" of crown exists in the central region of the board, it will also exist as the downbearing dimension if the pre-stressing method is used. And in an area of the scale where the board deflects upward by only 1/8", say, in the mid-treble areas, the downbearing dimension will accordingly turn out to be 1/8", again if the pre-stressing method is used. But what happens on a 60-foot radiused board?

The upward deflection in the central regions of a 60-foot board can be as high as .0400". Now considering that the rear string lengths in this vicinity might only be 10" long, pre-stressing the soundboard to a flat condition — very questionable, if in fact possible — would yield a corresponding 0.400" bearing dimension, which, if we assume all upward deflections in the 60-foot board to be proportionately higher (as they would be) than a flatter board, would increase the downbearing load on the soundboard assembly by 400 to 500 pounds over that which would exist by using the straight computed-angle method. (The computed bearing dimension for a one and a half degree angle would be 0.026 times 10 = 0.260", or 1/4", which yields a four-pound pressure on the bridge per string. Compare the computed angle of 2.30 degrees for a 0.400" bearing dimension — the pressure computes at 6.4 pounds per string).

What all this means is that a pre-stressing, one-to-one approach to setting bearing on either a new or old soundboard works best when the crown deflections in the central areas of the board are 5/16" maximum. More than this and other limiting considerations, such as angular computations, must enter in. A 5/16" maximum deflection in the central regions of the soundboard, say where the rib lengths are 45" long in the average grand, relates to a crown radius of more than 60', which means the circle is larger hence the upward curvature flatter. For what it is worth, the radius of such a board works out to be 67.5' (see "computations"), and considering the opening comments of this article such a radius cannot be attacked as either too little or too much since it is only relative to other considerations.

Now does this mean that working with higher crowned soundboards (50- or 60-foot radii) precludes the use of the pre-stressing method? Although Chris and I did not discuss this, the answer is no. With a little imagination it can be grasped that all one has to do in pre-stressing a higher crowned board is avoid flattening it out completely. But how much? Simply select several points along the bridge, measure the rear string segment and compute the downbearing dimension per above instructions (factor 0.026 for one and one half degrees, or 0.018 for one degree). Now in pre-stressing, the board should be flattened out from its *relaxed* condition by the computed amounts. So, say the board in its relaxed condition deflects upward by 3/8", but the bearing dimension computes to be 1/4", then pre-stress the board by the 1/4", leaving 1/8" crown still apparent in that region of the board. Follow through with the same analysis at the various chosen points on the bridges. Remember, the bridges are kerfed such that the test string touches the bottom of the kerf and the top of the rear string rest simultaneously. This method of setting bearing is a hybrid of the "computed-angle" and the "pre-stressing" methods, and it circumvents the danger of possibly overloading the board when strung.

The question is asked: "After the board is strung, won't it then flatten out such that downbearing analysis might yield minimal readings?" There is no way to answer this since the amount of soundboard compression is a function of not only pressure applied but of soundboard flexibility and degree of starting crown. In general it can be said that for the usual soundboards being replaced these days, the load from actual downbearing will not flatten the board as much as the pre-stressing did, and that positive bearing can be measured in the strung piano.

The Method At Work

The soundboard, with new oversize caps, does not have to be glued to the rim for the pre-stressing method to work. For the moment we will assume that the soundboard is glued to the rim. The lag bolt holes have been spotted and drilled through the board so that temporary machine screw plate supports (adjusting screws) can pass through and thread into the lag bolt hole. The counter-sinking flared material of these machine screws will have been ground off such that the screw, to view it from the side, looks like the letter T, and not a golf tee. Failure to remove the counter-sinking material will necessitate on many Steinways counter-sinking the screw into the soundboard top as many Steinway plate bosses are nearly touching the wood. The screwdriver slot in the screw can be accessed through the plate lag hole making the screws dynamically adjustable. The adjusting screws are threaded into each lag hole and turned all the way down.

The plate, the height of which was measured relative to the top of the rim when the piano was torn down, is now temporarily installed on the pinblock and allowed to rest helter-skelter on the adjusting screws. (Nosebolts are not in at this time.) Four of the adjusting screws, those located at those lag holes where the plate bars terminate, are now turned up in order to raise the plate to its original horizontal location. In order to secure the plate so that it sits immovable on these four adjusting screws it must be clamped down on same. After this the remaining adjusting screws are turned up until they just make contact with the underside of the plate bosses. As insurance, a dial indicator set up accordingly in the vicinity of the lag hole will insure against turning the adjusting screws up too far causing the plate to lift. When all adjusting screws have been turned up it is time for pre-stringing the soundboard.

Again, the amount of imposed downward stressing depends on the amount of crown found in the relaxed soundboard. Let's assume 1/4". Drive the board down to a flat condition (i.e., wipe out the 1/4" natural deflection) by using wedges placed between the plate bars and the soundboard top, or even the bridge top where accessible. Along with the wedges Chris sometimes uses a screw press working off an overhead iron rail. Remember to check the pre-stressed board at several areas for flatness, and do not go beyond flat.

When satisfied, it is time for kerfing. With the test-string either passing through the agraffe hole, or under the capo bar, kerf the bridges at several places such that the string touches the bottom of the kerf and the rear string rest simultaneously. Remove the wedges (the board will pop up to assume its natural crown), remove clamps and plate, and all is ready to plane down the bridge caps until just a hint of the kerf marks show. Downbearing is set! But something else is set, too: The adjusted height of the adjusting screws also represents the required heights of the plate support dowels which will be installed later on. Remember not to monkey with those adjusting screws after the plate is pulled.

A derivative of this, and one which may save not only your back, but keep you from becoming a true vulgarian, is to follow all the above steps, but on a soundboard which is *not* yet glued to the rim. Simply wedging the board down in the prestressing process will also drive the perimeter of the board down onto the rim. The obvious advantage of this is that after kerfing the bridges, the soundboard assembly can be removed for bridge planing and finishing.

It can be added here that if the "computed-angle" method of setting bearing is used instead of pre-stressing, the process can also be accomplished on a board which has not been glued in. In order for this to work, however, the soundboard needs to be clamped down using clamps and blocks (such as used in gluing the board in) to temporarily secure the board to the rim. Use clamps/blocks along the long (left) side of the board, C-clamps along the belly rail, and screws along the curved side of the rim where the plate would be in the way obviating the use of clamps/blocks. Place counter-sunk screws through the soundboard and into the rim, and at a place where a plate support dowel will later exist. One screw near each lag hole is all that is necessary. With the soundboard thus secured the process continues as treated in the June 1989 *Journal*. After kerfing the bridges the board may be removed and the bridges finished without the hassle of having to deal with the obstructing piano rim.

Those Nosebolts Again

A recent article in this series suggested that flexing plates by turning nosebolts up or down is a legitimate practice if not overdone. Chris strongly believes — although we all concur that any proof is not forthcoming — that many years ago manufacturers such as Steinway purposely flexed the plate upwards at the hitch areas as either general practice, or in order to accommodate a higher than usual crowned soundboard. In any case, doing so allows the option of lowering the nosebolts if, in two or three years (or immediately after stringing and pitching), the bearing is found to be minimally measurable. But whether Steinway actually employed this practice, it is a reasonable one for rebuilders to consider. As also mentioned in the recent plate flexing article, I consider plate flexing at the hitch areas as a sort of fine tuning of an otherwise already well-thought-out and executed practice of setting the bearing. Chris's thoughts, although a different shade of the same light, corroborate this.

While on the subject of nosebolts, it is sometimes deduced that their very presence, design and placement insist that they were intended for adjustment by way of plate flexing. Possibly. But they do serve as necessary static supports at least. Since the pull of the strings on the hitch pins is situated on the top of the plate, the tendency of the force is to rotate the hitch plate down toward the soundboard. But where there is positive downbearing the rear string segments have a tendency to raise the hitch areas counteracting the downward plate rotation. Although this force and counterforce are probably of no consequence due to the strength of cast iron, the inclusion of nosebolts in the areas not only closes the subject, but prevents the plate from ever getting into serious flutter as a consequence of direct mechanical connection to 18 tons of pulling and vibrating strings.

Many, many thanks to Chris Robinson for sharing his methods with us. I understand that his class in Philadelphia during the upcoming PTG International Convention will deal more fully with this topic.

Computations

1. To find deflection (d) when given factors are radius (r) and length (l):

$d = r - \sqrt{r^2 - (l/2)^2}$

Example: find deflection when r = 60' and l = 3.75' (or 45")

$d = 60 - \sqrt{60^2 - (3.75/2)^2}$

$d = 60 - \sqrt{3600 - 3.52}$

$d = 60 - 59.971$

$d = 0.029'$

Now in order to convert 0.029' into inches, multiply by 12, hence

$d = 0.348"$

In the formula you can use any value for radius and length.

2. To find radius (r) when deflection (d) and length (l) are known:

$r = l^2 + 4d^2/8d$

Example: l = 45 and d = 5/16" or 0.3125

$r = 45^2 + 4 \times 0.3125^2 / 8 \times 0.3125$

$r = 2025 + 0.391/2.5$

$r = 810.16"$

$r = 67.5'$

To convert to feet, divide by 12 and again, any length and deflection can be used.

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Coming Events

July 13-17, 1991 — **34th Annual PTG Convention & Technical Institute**
Adam's Mark Hotel, Philadelphia, PA
Contact: PTG; 4510 Belleview, Suite 100; Kansas City, MO 64111 (816)753-7747

October 3-6, 1991 — **Ohio State Conference**
Truman Hotel, Columbus, OH
Contact: Don Gagliardo; 752 Macon Alley; Columbus, OH 43206 (614) 444-9630

October 11-13, 1991 — **Texas State Association 1991 Seminar**
The Crest Hotel, Austin, TX
Contact: Mary Smith; 2002 Oxford Avenue; Austin, TX 78704 (512) 462-0212

October 17-20, 1991 — **1991 New York State Conference**
Sheraton Inn, Buffalo Airport
Contact: Robert Tarbell; 358 Bedford Avenue; Buffalo, NY 14216 (716) 873-5465

November 8-10, 1991 — **North Carolina PTG Conference**
Adams Mark Hotel, Charlotte, NC
Contact: Eugenia Carter; 4317 Commonwealth Avenue; Charlotte, NC 28205 (704) 568-1231

AUXILIARY EXCHANGE

Questions And Answers

This month we will present some common questions about the Auxiliary along with answers to these questions. We hope that if you are preparing to attend your first annual convention as you read this you will decide to come join in the Auxiliary activities during convention week.

If you have more questions about the Auxiliary after you read this column please contact one of the officers listed in this column.

Q: What does the Piano Technicians Guild Auxiliary do?

A: The PTGA functions in several ways: as a group which plans and carries out spouse activities at annual and regional conventions, as a group which keeps in touch with its members and helps its members keep in touch with each other through semi-annual newsletters and through this column in the *Piano Technicians Journal*, as a group which maintains and promotes a scholarship fund for piano students, and as a group which has activities in conjunction with local chapter activities of the Piano Technicians Guild.

Q: Who can join the Auxiliary?

A: The Auxiliary is open for memberships from people who are married to piano technicians in the Guild, to people who are in the family of these technicians, or to people who are friends of Guild technicians. Even though most of our members are wives of technicians (this column even used to be called "Wives Lives" several years ago), we have husbands, mothers, children, and friends of technicians among our membership. The thing that brings us together is that we care about Guild technicians, and we want to show our support of their participation in the Guild.

Q: How many people are members of the Piano Technicians Guild Auxiliary?

A: Almost 400.

Q: How much does it cost to join?

A: Annual dues are $10. If you join the Auxiliary now your $10 will carry you through the end of 1991.

Q: Do you have to be in the Auxiliary to attend spouse activities at the convention?

A: No, although PTGA members can register at a lower fee than nonmembers.

Q: Who plans the Auxiliary activities at the convention?

A: From the time he/she attends the convention planning meeting in the fall until the closing banquet the following summer, the Auxiliary president works in conjunction with the PTGA executive board, the Home Office, and the local planners to bring together a program that will meet the needs and tastes of the Auxiliary membership.

Q: What do people get out of the Auxiliary besides a good feeling because they are showing support for Guild technicians?

A: Most people rate the friendships they make with other Auxiliary members and their families as the biggest benefit of belonging. Auxiliary activities and written communications give people a way to become better acquainted, and then the friendships blossom on their own.

Q: Does the Auxiliary undertake philanthropic projects?

A: Yes! Several times in the past the Auxiliary has used the proceeds from fund raisers to pay for special Guild projects or to help the Guild meet its goals. In recent years our fund raisers have supported a scholarship award to deserving young pianists.

Q: How are the scholarship recipients selected?

A: The scholarship winners are chosen annually by the Music Teachers National Association from outstanding high school and college age piano students in the state where our next annual convention will be held. Usually we get a chance to hear these winners perform at the convention.

Q: Does the Auxiliary currently have a fund raiser?

A: Yes! The Auxiliary is selling cookbooks compiled from recipes submitted by our members throughout the USA and Canada. Cookbooks will be available for $8 at the convention.

Q: How does the Auxiliary operate?

A: The Auxiliary council is its governing body. It convenes at each annual convention to conduct business and elect an executive board.

Q: How are delegates to the council selected?

A: Each chapter can send a del-

PTG Auxiliary Executive Board

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egate to represent it at council. People who do not live in an area served by a local chapter meet in regional caucuses at the convention to select one delegate from each region to represent the members-at-large in that region.

Q: Can interested parties attend the Auxiliary council meeting to see what it is all about?

A: Certainly. Auxiliary board and council meetings are open meetings unless they vote to move into executive session for discussions of particular items. These meetings are all to be conducted according to the rules of parliamentary procedure; many people find it very interesting to attend and listen.

Q: What do local Auxiliary chapters do?

A: Local chapters are often small groups of people, so their activities can vary quite a bit as they reflect the individuals involved. Many chapters meet three or four times a year to share the fun of holiday parties, summer picnics and banquets with members of the Guild chapter. Many local Auxiliary chapters work hand in hand with the Guild chapter to host regional seminars. Some chapters have monthly programs with speakers or special guests.

Q: What do I do if I want to join the Auxiliary right now while I am thinking about it?

A: Make your $10 check payable to the PTG Auxiliary and mail it with your name and address and the name of the Guild member with whom you are affiliated to Phyllis Tremper, 413 Skaggs Road, Morehead, KY 40351. Make the check for a higher amount if you want to include a contribution to the PTGA Scholarship Fund.

Q: How does the PTGA use the money it collects from dues?

A: The PTGA puts its dues money to good use. Each year the council appropriates a budget for activities for the coming year. Officers and committees need money for postage, photocopies, stationery, and occasional phone calls. Members receive a newsletter twice a year. The Auxiliary pays transportation expenses to send its president to the convention planning meeting each fall. Start-up funding is needed every time the Auxiliary undertakes a fund raiser. Actually, it's surprising how much the Auxiliary is able to do with membership fees it collects.

Q: Do I have to be a member of the Auxiliary in order to contribute to its scholarship fund?

A: Certainly not. Contributions of any amount may be sent at any time to the Auxiliary treasurer.

Q: When was the PTG Auxiliary formed?

A: The PTG Auxiliary got its start in 1958, at the same time the Guild itself was formed. Ruth Pollard served as its first president and has been serving the Auxiliary ever since.

Q: What does it take to form a new Auxiliary chapter?

A: Only three members are necessary to form a local chapter. As Auxiliary president, Arlene Paetow, wrote in the latest membership directory, "From a small nucleus of three, perhaps others could join along. Surely strength in numbers and unity of a group is as important today as ever." The vice president of the Auxiliary serves as its membership chairman; people interested in forming a local chapter should contact the vice president.

Q: Can members of the Auxiliary attend institute classes with technicians?

A: Anyone can attend institute classes with technicians by paying the institute registration fees. PTG member rates are usually extended as a courtesy to spouses or children of Guild members. Registering for the Auxiliary activities does not entitle a person to attend institute classes or enter the Exhibit Hall.

Q: Is the Auxiliary worth joining?

A: Most people who join the Auxiliary see ways their lives have been enriched by the associations they have made and the friendships they have cultivated. The Auxiliary is always looking for additional members. If you are not currently a member of the Auxiliary, we encourage you to come take a look for yourself.

Looking For Contributors

Do you have something to contribute to this column?
Most of us have experiences or ideas that would be interesting to share with other folks in the Auxiliary.
Don't hesitate. Jot your thoughts on paper and send them to:

Julie Berry, Editor; 6520 Parker Lane; Indianapolis, IN 46220-2259

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Write to: John Hunt; 940 S. 46th Street; Boulder, CO 80303

WANTED: Still looking for Steinway player grand in fancy case (prefer unrestored). Also need large Mason & Hamlin player grand with or without player parts, (prefer fancy case). Will also consider Knabe or Chickering. Reward for successful leads. **Bill Kavouras; 2740 Lighthouse Ct.; Lynwood, IL 60411 (708) 474-8787**

PAPER WANTED. Piano and organ catalogs, new or old. Technical information. Player piano catalogs. Roll catalogs, etc. **Richard Howe, 73 Saddlebrook Lane, Houston, Texas 77024 (713) 680-9945**

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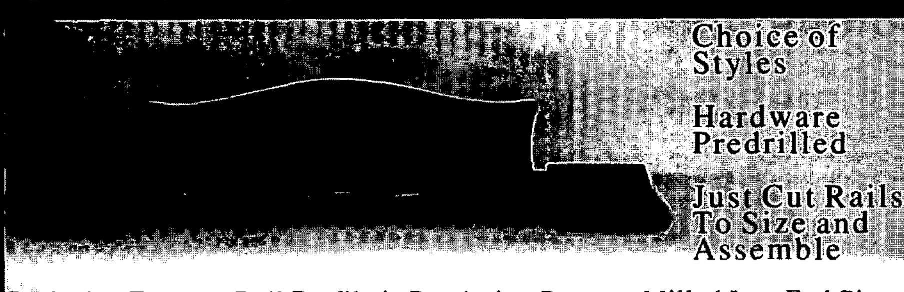

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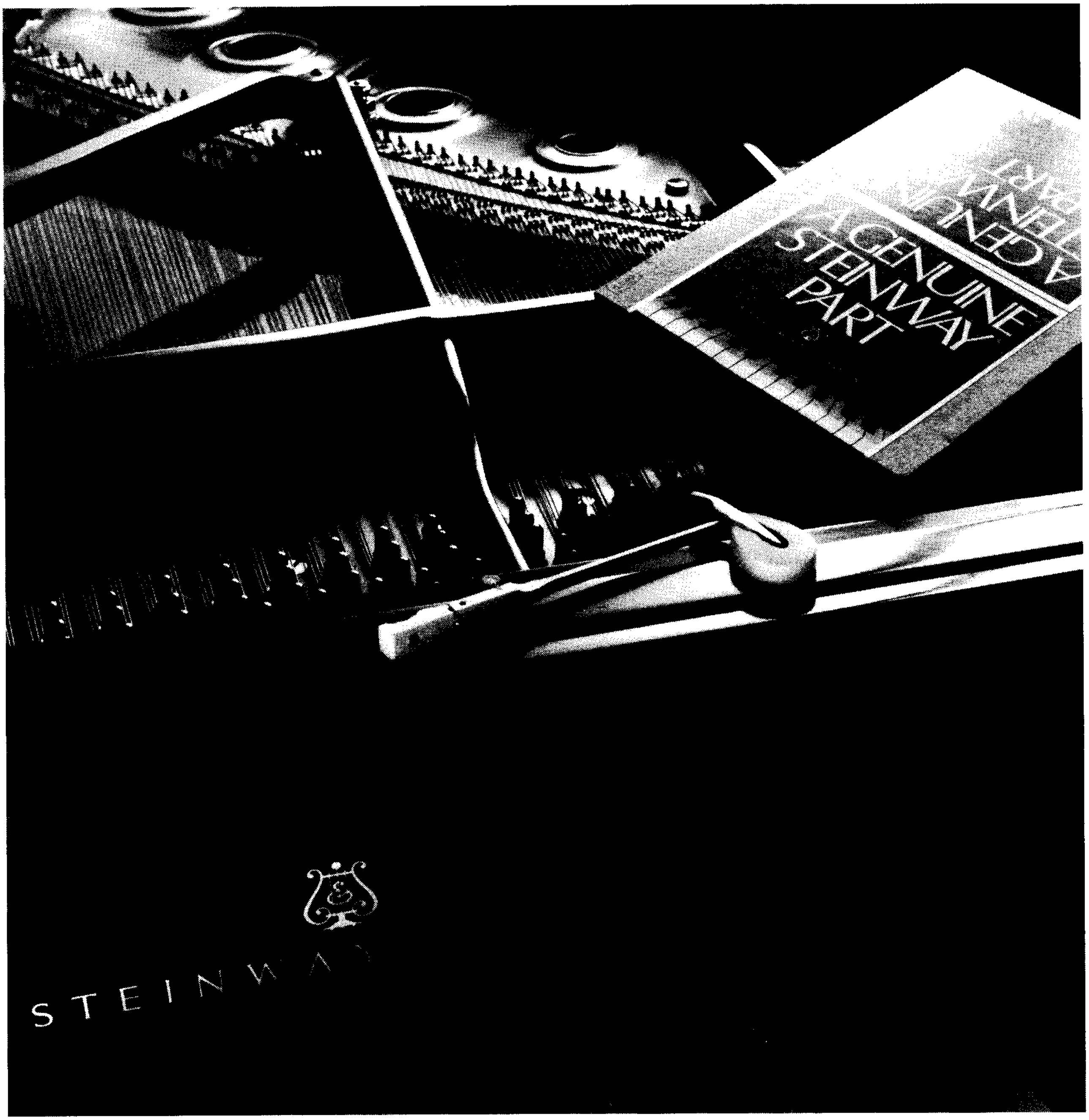
"I will pay from $100.00 to $5,000.00 finders fee for the following pianos and related items: A. Steinway Ex Duo-Art player, art carved case; B. Mason & Hamlin Ex Duo-Art player in any case; C. Art carved case of Mason & Hamlin, Chickering or Knabe, player or regular grands; D. Ampico or Duo-Art player mechanism or parts; E. Ampico or Duo-Art player rolls; **Please call Jim Brady COLLECT (317) 259-4307."**

PIANO TECHNICIAN OPENING — Full-time staff position at Ohio University, an equal opportunity/affirmative action employer. Minimum four years experience required. $22,000-$24,000 with generous benefits. Send letter of application, resume, transcripts, and three references to: **Bert Damron, School of Music, Ohio University, Athen, OH 45701 by July 20, 1991.**

PIANO TECHNICIAN WANTED: Major restorer of fine modern and antique pianos and New York dealer of Bösendorfer pianos needs person experienced in regulating, tuning and voicing for shop and concert work. **Call Sujatri Reisinger (212) 472-9799.**

Index Of Display Advertising

S T E I N W A Y



If it doesn't have 12,116 genuine Steinway parts, it isn't a Steinway.

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S T E I N W A Y & S O N S

One Steinway Place, Long Island City, New York 11105. (718) 721-2600.

Tech Gazette

Yamaha Piano Service July, 1991

Disklavier™ Service Tip

PERFORMING A RECORD/ PLAYBACK TEST

We recommend that before and after tuning or servicing a Disklavier piano, that you perform a simple Record/Playback test on the piano. This test takes about a minute to run and it is an easy way to check the major functions of the instrument.

To perform this test you will need to use a 3.5″ formatted floppy disk. (If you don't have one with you, ask the customer for one.)

The test procedure is as follows:

1. Turn on the power switch.
2. Insert a formatted floppy disk.
3. Press the RECORD button.
4. Press the PLAY/ PAUSE button to start recording. An audible "beep" will sound.
5. Play each key chromatically, followed by depressing and releasing the left pedal then depressing and releasing the right pedal.
6. Press the STOP button.
7. Press PLAY/ PAUSE button to begin song playback. Check to see that playback for each key and pedal is properly performed.*
8. Press the STOP button.
9. Press the disk eject button and remove the disk.

*MX80 ONLY–Because the right (damper) pedal does not move during playback, "listen" for the dampers to be lifted from the strings. (The left pedal is recorded but does not play back on the MX80).

Yamaha will Participate in

LITTLE RED SCHOOLHOUSE:
August 12 - 16
DISKLAVIER™ SERVICE SEMINARS:
August 26 - 30
September 16 - 20
October 28 - November 1
November 18 - 22

PTG CONVENTIONS:
Ohio State, Columbus, OH
October 3 - 6
New York State, Buffalo, NY
October 17 - 20
North Carolina State, Charlotte, NC
November 8–10

Personnel Profile

ROSE UVALLE

Although she is a recent addition to Piano Parts, Rose Uvalle has been with Yamaha since 1988. Having started as a temporary in Information Systems, Rose transferred to Electronic Parts for two years and then to SGD for one year.

Rose enjoys talking to people and making new friends, and has ample opportunity to do just that in her job as Dealer Service Representative. Rose brings to Piano Parts her knowledge and skill of handling orders and dealing with day-to-day problems.

Originally from Whittier, CA, Rose is in the process of moving to Chino Hills, CA. She enjoys cooking, reading and vacations in Mexico with her husband and two children.

JULY **UPDATE** 1991

Published Monthly For Members Of The Piano Technicians Guild, Inc.

Focus On Ethics:
Truth In Advertising

Francis Hollingsworth, RTT
Internal Code Of Ethics Committee Chair

The following appeared in a telephone directory as part of a piano dealer's ad:

Staff members of
The Piano Technicians Guild

Two members of the staff were Associate members of the Guild. The rest were not members at all. I have a little trouble trying to understand what it says. I point to this ad as an example of what can appear in advertising. Whether this was designed to confuse or whether it was a directory error, I don't know, but since it isn't in the current directory, it becomes a dead issue. This is a special problem with telephone directories. If an error appears, it can't be corrected until the next issue.

Another ad that was brought to my attention concerned an RTT who claimed 40 years' combined experience in piano technology. He was 39 years old at the time. His justification for such a claim was that his dad and brother were also piano tuner-technicians and that their experience was also his. Now, if

Continued on page 3

Piano Action Handbook Now Available

After a lengthy delay, the third edition of the "Piano Action Handbook" is now available. The 76-page book lists manufacturers' recommended specifications for key height, sharp height, hammer blow, hammer let off, key dip, back check distance and drop for pianos manufactured in the U.S., Canada, Asia and Europe. The listings include pianos regularly marketed or available in North America, as well as dimensions of instruments no longer manufactured. The book also lists names and addresses of companies currently manufacturing pianos, as well as sample regulating checklists.

The book was compiled by Randy Potter, RTT, from listings in the first or second edition of the book, manufacturers' technical publications, or extensive correspondence with technical representatives. The book is a project of a publications committee of the Piano Technicians Guild Foundation Press, chaired by Charles Huether, RTT, and proceeds from the sale of the book will go to the Foundation. The handbook joins "The Calculating Technician" on the Foundation's list of publications.

Cost of the book will be $10 for non-members or $8 to members of the Piano Technicians Guild. Those who ordered the book in advance at a higher list price will be issued refunds, with our apologies for the delay in bringing the book to print.

The PTG Survey:
Aural Vs. Electronic

Carl Root, RTT
Economic Affairs Committee Chair

One survey question which asked about visual aids and aural tuning techniques was little more than an afterthought. It turns out that several people have asked me to cover this subject in detail. I am somewhat reluctant, not because the subject isn't interesting, but because there are often overtones of mistrust expressed by one group towards the other. It seems to me that the quality of results, rather than procedures used, ought to be the basis for a judgement, but unfortunately, there is no way that a survey can measure quality of results.

Before giving you the raw data from the survey, it is necessary to discuss sampling errors. It plays an important role whenever a comparison is made between two subgroups who respond to the same question. The size of the error depends on the size of each subgroup and the percentage of respondents. The difference in the response rates between each subgroup must exceed the sample error value in order to be statistically significant.

All of the results listed here except one show that the differences between electronic and aural tuners are insignificant. The percentage of aural tuners who are RTTs is larger than the

Continued on next page

percentage of electronic tuners who are RTTs, but if we look at RTTs who have 20 years' experience or less, the difference becomes insignificant. This coincides with the increase in popularity of electronic tuning devices during the past 20 years.

Permit me a few personal observations. They are not backed up by statistics:

- The growing popularity and acceptability of electronic devices coincides with the invention of the Sanderson Sight-O-Tuner and later, the Accutuner.
- Although some tuners have bought this device because they are not able to achieve satisfactory results using aural techniques, many use it to supplement their aural skills.
- Although some electronic tuners who have never used aural techniques would be lost without "the box," other electronic tuners have a thorough understanding of the theory and techniques of aural tuning and could tune aurally if "the box" was not available to them.
- The advent of "the box" has coincided with a more thorough analysis of temperament sequences and greater understanding of the role of coincident partials and inharmonicity in fine aural tuning. Jokes about the umpteenth partial of the 32nd harmonic suggest that some tuners are intimidated by basic tuning theory. These fundamentals should be understood by all tuners.

The PTG Survey: Aural Vs. Electronic

Type	*Responses*	*Percent Of Aural Or Electronic Tuners*	*Difference*	*Sample Error*	*Statistically Significant?*
What percent of ...tuners tuned 500 or more pianos?					
Aural	375	40%	5.0%	10%	no
Electronic	169	35%			
What percent of ...tuners made $24,000 or more?					
Aural	341	36%	1.0%	10%	no
Electronic	169	35%			
What percent of ...tuners tuned more large grands than average?					
Aural	118	12.6%	3.5%	9%	no
Electronic	44	9.1%			
What percent of ...tuners take less than an hour to service a piano?					
Aural	163	17.4%	3.1%	9%	no
Electronic	69	14.3%			
What percent of ...tuners play the piano fairly well or very well?					
Aural	602	64.2%	6.0%	8%	no
Electronic	281	58.2%			
What percent of ...tuners have less than eleven years' experience?					
Aural	306	32.6%	5.1%	10%	no
Electronic	182	37.7%			
What percent of ...tuners spend nine hours or more in the shop per week?					
Aural	357	38.1%	2.3%	10%	no
Electronic	173	35.8%			
What percent of ...tuners are RTTs?					
Aural	711	75.8%	13.7%	6%	yes
Electronic	300	62.1%			
What percent of ...tuners are RTTs with 20 years' experience or less?					
Aural	400	42.6%	2.6%	10%	no
Electronic	193	40.0%			

Ethics...

we were to follow that thought further, what about those of us who have attended many seminars and conventions? Couldn't we advertise perhaps a few hundred years of experience? Think of all the instructors who have shared their experience with us. Can we ethically claim that as part of our own experience? I think not.

Another situation brought to my attention is along the lines of advertising, but instead of printed material, it concerns something a Guild member had said in presenting himself to a customer. The basis of this incident is Article III, section 3c in our Bylaws. When an Associate uses the Piano Technicians Guild name, he or she *must* accompany that with the word "Associate" in letters no smaller than those used for "Piano Technicians Guild." In our Bylaws, there is no reference made to the use of the word "Associate" when we are orally describing our qualifications to a prospective customer.

Does it follow that if we tell a customer that we are a member of the Piano Technicians Guild, we are obligated to tell them also that we are an "Associate" member? We have an RTT member who thinks this is implied. Do you agree? Perhaps it becomes a question of ethics when the "Associate" member tries to fraudulently use his/her association and membership in the Guild to misrepresent his/her services to a customer.

Although printers sometimes err, it is assumed that when advertising appears in print, it has been carefully written to say exactly what the writer wants to say, but in conversation, we may be guilty of saying things we don't mean or forgetting to say something that we should have said. That is one of the problems with being human.

Truth in advertising, whether written or spoken, should be a major concern of all PTG members.

Large Convention Attendance Expected

With the Guild's 34th Annual Convention and Technical Institute hard upon us, prospects are excellent for one of the largest and best conventions in our history.

More than 800 had registered before the June 10 early registration deadline. Registrations have been received from China, England, France Germany, Greece and Panama, in addition to the United States and Canada.

The convention exhibit hall, which was planned as the largest in recent years, has had to be expanded twice to fill demand for exhibit booths. Although hotel rooms are still available at the neighboring Holiday Inn City Line, the block of rooms reserved at the convention headquarters hotel, the Adam's Mark, has been filled.

Here are some last-minute convention notes:

- A pre-Council briefing for delegates will be a 6:30 p.m. Thursday, July 11. Delegates may pick up voting materials at that time. Delegate check-in will also begin at 8 a.m. Friday, July 12, and the meeting itself will begin at 9 a.m. Election of officers is scheduled for Friday afternoon.
- Larry Linkin, executive vice president of NAMM, will discuss the recent music industry initiatives and future plans during the convention opening session Saturday evening.
- Steinway artist Judy Carmichael will perform following the convention awards banquet Monday evening. Limited seating will be available for those who do not attend the banquet.

In Respectful Memory: *Owen C. Trimble*

Owen C. Trimble

Owen C. Trimble, RTT, 80, passed away in his sleep Thursday, May 30, 1991. Survivors include his wife, Laura, one son, four grandchildren, one great-granddaughter, two sisters and two brothers.

We all remember Owen as the person who was everywhere videotaping classes and assemblies at every PTG convention and seminar. He was the "spark plug" of our North Central Louisiana Chapter, the most faithful member, always on time and in attendance at every chapter meeting, regional seminar and national convention.

Owen helped organize the Shreveport Chapter of PTG and was instrumental in combining three weak chapters into one strong chapter in 1976 — the North Central Louisiana Chapter. He was tireless in his efforts to help PTG. He never met a stranger. Owen always had a joke to lighten the load and pick up our spirits. He was always willing to share his piano knowledge, a true technician who promoted PTG at every opportunity. We will miss you, dear friend.

Gary A. Neie, RTT

Dates & Deadlines

July 13-16, 1991
RTT Tuning and Technical Exams. 34th International PTG Convention and Technical Institute, Philadelphia, PA Contact: Michael Travis; P.O. Box 576, Greenbelt, MD 20768 (301) 441-3555

July 13-17, 1991
34th International PTG Convention and Technical Institute. Philadelphia, PA. Contact: Home Office, 4510 Belleview, St. 100, Kansas City, MO 64111. (816) 753-7747.

August 17, 1991
RTT Tuning and Technical Exams. Skyline College, San Bruno, CA. Application deadline: July 17th, 1991. Contact: Neil Panton, 5 Cedar Court, Menlo Park, CA 95025. (415) 854-8038

September 29, 1991
Associates Day. Reading-Lancaster, PA, Chapter, Reading, PA. Contact: Mike Carraher, 1502 Mill Road, Elizabethtown, PA 17022. (717) 367-8256.

October 11-13, 1991
RTT Tuning and Technical Exams. Texas State Seminar. Austin, TX, Chapter Test Center. Application deadline: Sept. 11, 1991. Contact: Bill Cory, 711 Landon Lane, Austin, TX 78705. (512) 472-9358.

November 7, 1991
RTT Tuning and Technical Exams. North Carolina PTG Conference, Charlotte, NC Chapter. Contact: Bill Clayton (Tuning) (704) 392-7836; Bill Alexander (Technical) (704) 455-2998.

Piano Technicians Guild Foundation

Dear Friends:

If we only could know about all of the wonderful things members of the Piano Technicians Guild are involved in and doing, I think those hanging back and not contributing to the whole experience would be encouraged to become more involved.

While this piece is about the PTG Foundation, the focus is Dave Stanwood. Although I've known Dave only for a few years, I have come to know that he is never stagnant. Those who attend his classes during this year's Institute will, I'm sure, come away really thinking. Those who visit his booth in the exhibit hall will also get to view and challenge their wits with a device which Dave engineered.

What I want you to know is that Dave has stated he will contribute all of the funds generated from your curiosity to the Foundation. The Foundation is very appreciative of Dave's generosity. With this in mind, I encourage everyone in attendance at the annual convention and institute to stop by Dave Stanwood's booth in the exhibit hall. While there, please help support our Foundation.

While in the exhibit hall, be sure to stop by the PTG Foundation Booth. Available for you there will be two publications from the PTG Foundation Press. They are "The Calculating Technician" by Dave Roberts and the updated edition of "The Piano Action Handbook" compiled by Randy Potter, RTT. Both of these books are a must for the serious professional technician, so be sure to get your copy.

The Foundation is tremendously proud of its accomplishments to date. We recognize that not much of anything would have been possible if it had not been for the contributions you have so generously donated. Allow me to encourage those who have not contributed to the Foundation to date, or do not contribute on some type of continuing basis, to join us in our efforts by giving something back to those who made a difference in your career — a teacher, friend or mentor. Your personal involvement can cause our 10th year of operation to be a banner year.

For the rest of the Foundation Board, let me thank you in advance for your support.

Sincerely & Fraternally,
Marshall B. Hawkins, RTT
President, PTG Foundation

The Piano Technicians Guild Membership Status May 31, 1991

Northeast Region	830
Northeast RTTs	530
Southeast Region	604
Southeast RTTs	388
South Central Region	317
South Central RTTs	210
Central East Region	635
Central East RTTs	394
Central West Region	375
Central West RTTs	248
Western Region	607
Western RTTs	392
Pacific NW Region	364
Pacific NW RTTs	231
Total Membership	3,732
Total RTTs	2,393