Piano Technicians Journal

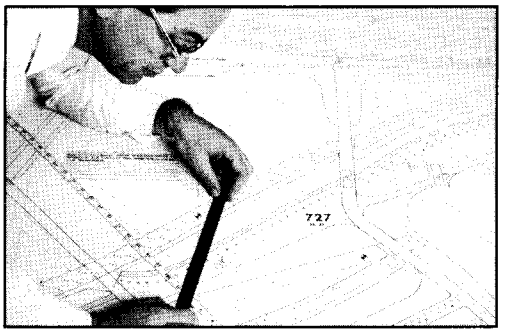
August 1988

The Baldwin Piano...
You can see why it sounds better

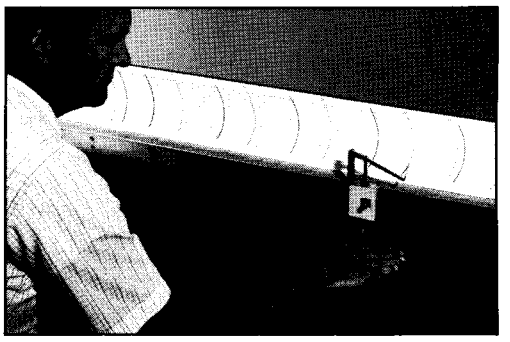
At Baldwin we believe that perfect piano tone is an ideal shared with all those who design, build, play and service pianos. That's why continuous research in piano tone has always been one of our major commitments. And that's why our piano engineering and research department is one of the largest in the industry. And that's why you'll often find in every Baldwin piano innovations to improve piano tone introduced in our SD-10 concert grand.

RESEARCH shows us why, as well as how, some things work better because we've taken a pioneering approach to piano improvement. We've substituted scientific testing and analysis for the unquestioning acceptance of traditional solutions. Some of the achievements that have resulted are treble termination bars (U.S. Pat. No. 3,477,331), the Acu-Just™ plate suspension system (U.S. Pat. Nos. 3,437,000 and 3,478,635), and vertically laminated bridges. Our patents are the most significant ones awarded for tonal improvements in grand piano tone in recent years.

ENGINEERING translates research into reality. To support our design innovations, we have produced our own testing and construction equipment and have expanded the use of precision tooling to insure that each Baldwin piano built will exactly match established standards of tone and performance. One example of this is a winding machine (U.S. Pat. No. 4,055,038) developed in connection with the SynchroTone™ Strings (U.S. Pat. No. 3,523,480).



MATERIAL STANDARDS insure continuing quality. For example, stringent standards for weight, dimension, taper, and hardness of hammer felt are established, and each sheet of felt is checked to be sure it meets those standards before it is accepted for production use.



First in a series of informative ads on piano tone published by Baldwin Piano & Organ Company exclusively for the benefit of piano technicians.

Baldwin® - *Leading the way through research*

The Piano Technicians Journal **August 1988**

Official Publication Of The Piano Technicians Guild, Inc.

Volume 31
Number 8

IN THIS ISSUE...

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President's Message

Ron Berry
President

An Introduction

It is my pleasure to introduce myself as your new President. While I feel I know many of you, there are also many of you that I have not yet had the chance to meet. I want to introduce myself and my background.

My professional history began shortly after I graduated from Northwestern University with a degree in philosophy. With a degree as marketable as philosophy, I ended up taking odd jobs while looking for a real job. Julie and I were married and with money we received as wedding gifts, we went to live in Dublin, Ireland. You must understand, there are more Irish in America than in Ireland which gives you some idea of the job market there. After three and a half months our money began to run out and my father offered to take us on a family vacation skiing in Colorado so we returned to the United States.

I got a job in the shipping department of a wire factory which didn't teach me much except Astral Projection to relieve the boredom. Finally, I happened on a correspondence course in piano technology which will remain unnamed, but I will say that this course lacked a great deal. (I have seen other courses since which cover the basic knowledge rather well.)

But this course was enough to get me started. When I completed this course I went to the Indianapolis Public Schools to see about tuning all their pianos. What I found was a major rebuilding shop with three full-time people and a school system with about 1,200 pianos. I hung around this shop working for free when I could and finally one of the technicians retired in August 1972. John Boukes, who ran the shop, told me that I knew enough that he could start to teach me, and I was hired. This was where my real education began.

Under John's guidance and with all those pianos which needed so much work we got into all phases of piano work. I remember John saying, "If you are going to be in this business, it's time to join the Guild." So, naturally, I joined the local chapter.

Afer six and half years at the school system I found that the work situation had changed and decided to become an independent businessman. I had been building my own business by doing tunings in the evenings. Many of my first customers were teachers who asked me to tune their home pianos.

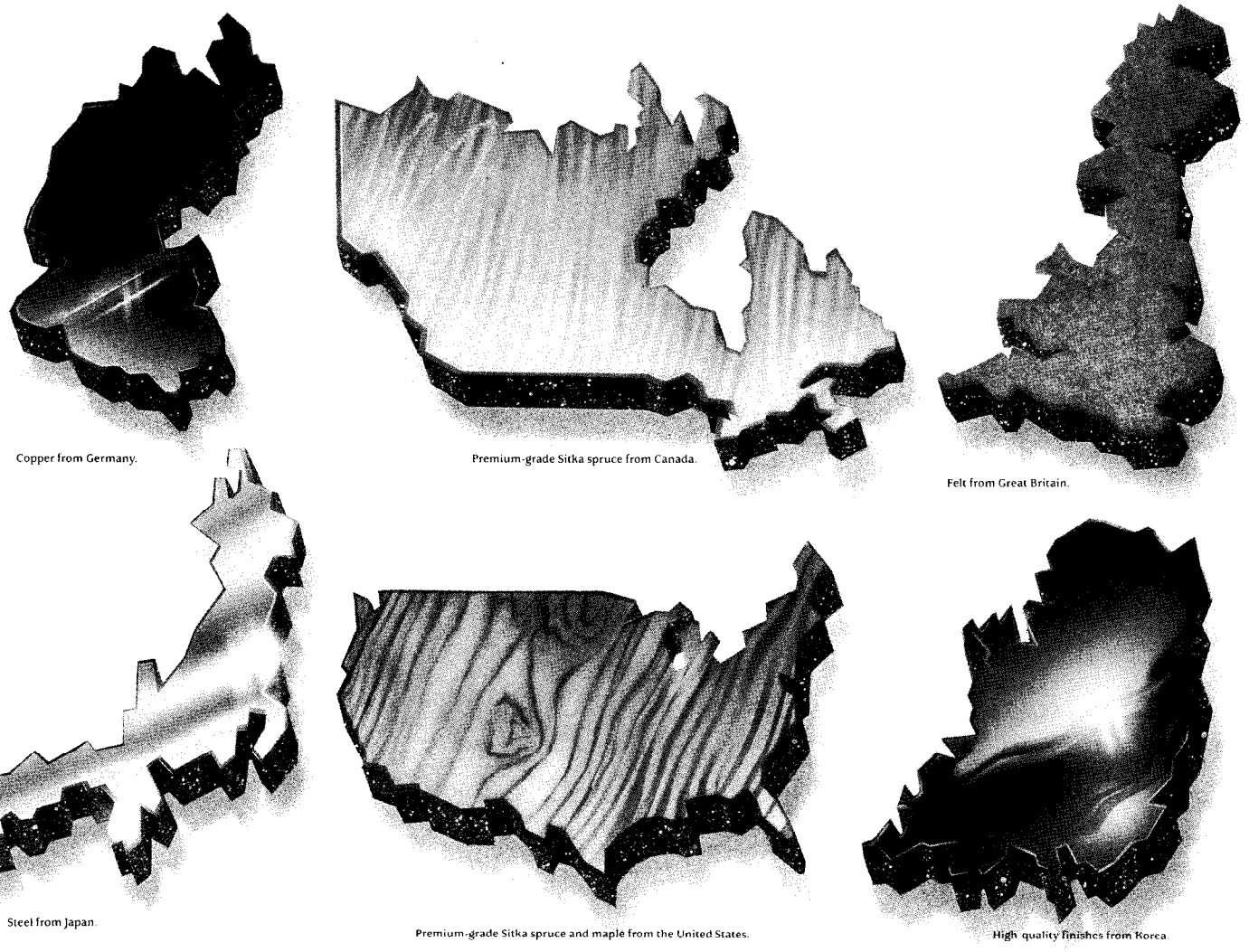
I have owned my own business since 1979 which has made it possible to devote some of my time to PTG. PTG is a wonderful organization and the willingness of people to share knowledge makes you want to repay the organization by giving it what you can.

My first job in PTG was in 1977 when I planned and organized a two-day seminar in Indianapolis. I guess the chapter members liked what I did because they insisted I become president of the chapter even though I had not been an officer before.

I have served on several PTG committees including Chapter Management. In 1980 I was appointed Chairman of the Examinations and Test Standards committee just as the new tuning exam became mandatory. Along with a committee of incredibly hard-working people we travelled the country certifying examiners and setting up the machinery to administer tuning tests.

After two years as ETS Chairman I was elected Secretary/Treasurer and served in that position for four years. During that period we changed management companies from Seattle to Kansas City. I was elected to a special committee to work out the details of a new memberhsip structure which was approved by Council in Las Vegas in 1986. Refer to my April 1988 *Journal* membership column and you will see that this work is not yet done.

Continued on page 47



Our parts come from these parts.

We all know instruments are only as good as the materials they're made of. That's why Young Chang soundboards, keys and backposts are crafted of Alaskan and Canadian premium-grade Sitka spruce. It's also why we insist on Japanese steel, German wire, and English Royal George felt.

We also recognize instruments are only as remarkable as the people who create them. And we believe our designers, engineers, craftsmen and artisans are among the most experienced and dedicated in the world.

That's why you're seeing more and more Young Chang instruments in homes, studios, schools and stages around the world. Because when you work with the best the world has to offer, you can offer the world the best.

For technical information, write or call Ed Whitting, Director of Technical Services, Young Chang America, 13336 Alondra Blvd., Cerritos, CA 90701, (213) 926-3200.

YOUNG CHANG

The best the world has to offer.™

From The Home Office

Larry Goldsmith
Executive Director

Our Proudest Moment

It's been said many times in many ways, but I've never seen it said better. Why should you join an organization like the Guild? Here's a quote from *Peachtimes*, a publication of the National Peach Council:

"You don't buy a newspaper, you buy news. You don't buy life insurance, you buy security. You don't buy glasses, you buy vision. You don't buy membership in an association, you buy cooperation of people in the profession with whom you can join hands to do the things you can't do alone."

Ain't that a peach?

During the 1985 convention in Kansas City, Stan Oliver was honored with the Golden Hammer Award. I will never forget his reaction: "How can I hope to be worthy of this award? What can I ever do to live up to this honor?"

Here was a man who, like every other recipient of the Golden Hammer, had devoted the best part of his life to serving his profession and the Guild. Literally hundreds of very professional technicians owe their careers to his teaching, support and help. And here he was, wondering what he could do to continue to be worthy of the award he held in his hands.

The late Bob Russell, who received the Golden Hammer the previous year, always said that that was the proudest moment of his life. The times when we are given the opportunity to honor such individuals as Stan, Bob and this year's recipient, George Defebaugh, should be among our proudest moments as well.

These people do what they do without any expectations of repayment, or even thanks. They recognize that an organization is not like a drive-in bank — you don't just pull up, slip an envelope in the slot and drive away, happy in the knowledge that you've done your bit to repay all the benefits you've received.

For an association, money is cheap — not that it's not frequently hard to come by. What's more important is time — the time volunteers make to keep the organization moving. And the most valuable time of all is not the time spent sitting around thinking high thoughts and talking about grand and glorious things. What really counts is the time spent tutoring a new member, the time on the phone arranging a chapter seminar, the time spent pounding out a chapter newsletter on a typewriter, or the Saturday spent administering exams, even though the fish were biting and the family wanted to go to the lake.

Without exception, the individuals honored at the St. Louis convention — the Golden Hammer recipient, the Hall of Fame inductees and the Members of Note — have put in their time unselfishly and without hope for reward.

By honoring them, we honor that which is best in ourselves, because they helped us become what we are today.■

Tech Gazette

Yamaha Piano Service August, 1988

Piano Technology The Yamaha Way

Every year when we return from the Annual PTG Convention, our desire to improve our technical and business skills somehow seems to reach a new level. However, this "spark" of renewed interest can be difficult to maintain through the coming months. Of the many tools available in today's technologically advanced world, the video medium has proven to be one of the most successful means of enhancing interest and continuing education.

After an overwhelming response to *Grand Action Regulation in 37 Steps*, Yamaha is pleased to announce our second "MASTER SERIES" videotape program: *Aftertouch - the Secret of Ultimate Piano Performance.*

Written and narrated by Yamaha consultant LaRoy Edwards, Aftertouch *- the Secret of Ultimate Piano Performance* is yet another program taken from the famous Yamaha "Little Red Schoolhouse" technical seminar. Each and every step of "Aftertouch" is thoroughly discussed and visually enhanced by close-up photography. An absolute must for your video library, "Aftertouch" contains one videotape (one and one-half hours of program material) and a printed copy of the entire text, handsomely packaged in a book-type binder.

To order *Aftertouch - the Secret of Ultimate Piano Performance,* call our Piano Parts Department toll-free at **(800) 521-9477.** For additional information, call Piano Service (toll-free of course), at **(800) 854-1569.** If you prefer to contact us by mail, our address is listed at the bottom of the page.

MIDI Corner

After a two-month break, let's reenter the world of MIDI by beginning a MIDI Dictionary:

ASSIGNABLE
Something that the user can set the function of. Master keyboards often have assignable control sliders and switches. You can set each one of these to send any desired type of control message, such as volume, etc.

EVENT
A "MIDI Message" is something called a "MIDI Event." In a sequence recorder, the "Event Edit" mode can be used to delete, insert and modify individual MIDI events.

MASTER
Any device (keyboard, rhythm machine, sequencer, etc.) that controls another device.

MASTER KEYBOARD
A keyboard whose main function is to transmit MIDI messages, and usually doesn't have sound producing circuitry. It usually has a wide variety of controllers which can be assigned to send any type of MIDI message, and the keyboard can be split so that notes played on different parts of the keyboard are transmitted on different channels.

SEQUENCE RECORDER
Also called a sequencer. A device that memorizes MIDI messages, stores them along with timing information, and can "playback" these messages, causing a synthesizer or tone generator to produce sound. Since only data (not the actual sound) is recorded, MIDI sequence recording offers virtually unlimited control and editing capabilities. Since playback actually "replays" the tone generator, there are no problems with tape noise or distortion.

Yamaha in the News

YAMAHA AT THE MET
On October 22, 1883, the Metropolitan Opera House opened its doors in New York City. Although the original opera house was financed by sixty-five wealthy patrons, the "Met" was plagued by financial troubles because of its lavish productions.

An NBC Broadcasting contract in 1932 insured financial success, and firmly established the Met as a national opera company. In 1966, the Metropolitan Opera was moved to its present home at the Lincoln Center.

In 1988, Yamaha was named the official and exclusive piano of the Metropolitan Opera beginning with the 1988-1989 season. Each Yamaha piano used by the Metropolitan Opera will bear a numbered brass medallion identifying it as having been a "piano in residence." From time to time, each resident piano will be replaced. These pianos will be available for sale after their service at the Met is complete.

Calendar of Coming Events:

1988:

Sept. 30–Oct. 2:	Florida State Jacksonville, FL
October 7-9:	Ohio State Seminar Columbus, OH
October 14-16:	Texas State Seminar San Antonio, TX
October 20-23:	New York State Seminar Syracuse, NY
October 28-30:	Central IL Seminar Normal, IL

1989:

January 20-22:	Winter NAMM Anaheim, CA
February 17-19:	California State Fresno, CA

YAMAHA

ECONOMIC AFFAIRS

Selling Piano Services Selling Pianos Selling Piano Playing

David Barr
Pittsburgh, PA, Chapter

I have heard a lot of conversation among technicians concerning the future of the piano, particularly the acoustic piano. Since the volume of pianos manufactured directly affects our service businesses, it is a serious point of concern for those of us who hope to depend on our hard-won skills to provide a solid living wage for the rest of our working careers.

It would seem that pianos are taking a nose dive on a broad scale. Even though sales figures were solidly up last year on a national basis, that may just be an adjustment after several very dismal years. My point in bringing all this up is not to wallow in negativity, but rather to look for solutions. There definitely is a problem. Even though I have felt for some time that too many of us have simply thrown in the towel and accepted defeat.

Has the piano really run out its usefulness? Will the electronic instruments take over? If any of you really believe either of these points to be true, you should begin redirecting your careers today. Don't wait for the long-drawn-out collapse. Your current attitudes certainly cannot be telling your customers that you really believe you are performing a function of real value for them, can it? More likely, you are sending signals to them that they are wasting their money on you.

If this is your attitude, you are quickening the demise of an industry that should be on an upswing. After doing a bit of research, I am more convinced than ever that the acoustic piano is of greater value today than ever before and that the electronic instruments of today and some time to come cannot take the place of pianos.

I spend a good deal of time with each of my customers every day talking about these very pianos. The key that I start from is something that every piano owner and every potential piano owner has in common.

It really is a very simple concept—value. How do I benefit by using (not just owning) a piano? What are the positive life values that I gain by playing a piano? Afterall, if there are no benefits, why should I own one, much less use one?

I think we have spent too much energy espousing the prestige of ownership. In the long run, this caters to a very negative life value; i.e., vanity. This approach of selling pianos, piano service or piano use has short range appeal. It lacks substance, therefore, it is directed in the opposite direction that active piano use will take you. Let's get back to promoting the positive benefits of playing the piano. I believe that this is the only realistic answer to reversing the downward spiral.

If you have ever spent much time talking with your customers, you have probably discovered that before you can easily sell them on any regular maintenance for their pianos, you must first sell them on actually using it. Sure, you can tell them truthfully, as I have, that even if they don't use the piano (and they are only getting it tuned this once because Uncle Bob who plays is coming to visit) in order to maintain its value, they must keep it well maintained. This approach may get you through once in a long while. More likely,

you will get a call in a few years when Uncle Bob is coming to visit again.

This same family has two or three children. They bought the piano for the oldest daughter who tried it for a few months, but decided she didn't like it and quit. After that, the parents decided not to waste their time trying with the other kids.

I like to get right to the point with parents like this. I just come right out and say, "Do you ask your children whether they would like to brush their teeth every night? Do you ask them whether they want to go to school, or take a bath, or learn to read or write? Do you want to do things for your children that will give them life skills that will help them get ahead when they are older?"

I explain that learning to play a piano gives people skills that they can use in all areas of their lives. These are not skills that just come out when they sit down at the piano. Discipline, persistance, goal orientation, math skills, reading skills, creativity, and a sense of accomplishment are just the beginning of life skills that learning to play a piano offers.

I tell parents that, to me, this is all part of our responsibilities as parents to nurture our children. We have to prepare them for life. It's our job. Kids don't know what's best for them. How could they? They don't have the benefit of hindsight.

Schools no longer teach values. They work to give them functional skills, but those skills are separated from value systems. It is more and more our jobs as parents to instill values in our children.

The piano offers a pleasant means of developing positive life skills that can pay off for a lifetime. I really believe that one of the greatest benefits for today's young person is the expanded ability to process information quickly. A young person who has learned to play reasonably well is using multiple physical skills, multiple intellectual skills, has explored many ranges of his or her emotions, and has, perhaps,

nally become spiritually
l, all in a given moment.
everyone has to deal with

more information in the workplace and in ordinary day-to-day living than ever before. The piano is one of the very best educational tools today. Taking about four or five minutes, eight to ten at the most, to explain what the real benefits are to the player is a wise move for a technician.

Now is the time to present proper maintenance schedules. Again, the point is, how does proper maintenance benefit the customer directly, not the piano itself. I spent too many years telling customers that it was bad for the piano not to be tuned regularly. That is true. But that does not tell the customer why they should part with their hard-earned money nor why it directly benefits them. Accenting positive benefits is the modern, proven method of selling either a product, service or even an idea.

What are the positive benefits of proper piano maintenance to the piano player? There is not a simple answer to this question. The answer most often heard in some form or another is that properly maintaining a piano is the only way to get the most out of it. The statement is perfectly true, but again it describes a benefit to the piano, not directly to the player.

This needs to be translated to something that speaks directly to the player. In essence, are we not saying that properly maintaining their piano is the only way to get the most out of themselves? A piano is meant to challenge the player, soothe them, organize a state of confusion. It can use more of the human capacities and refinements in one activity than is possible in almost any other civilized fashion. The piano is for the type of person who wants to get more out of life and give more to it. Skill levels have very little to do with this attitude. A modestly talented player derives the same sense of growth and pleasure in a new achievement as a beginner or a highly polished artist. There is always a certain sense of wonder attached to a newfound discovery—the discovery that we can become more, we can grow.

I believe that the person who learns to play the piano modestly well is in better touch with his or her surroundings. They are trained to listen, think and then act. They are disciplined to do these things in a very refined way. This has to spill over to other areas of their lives. The piano player is disciplined to hearing several things at once, thinking about interactions of music fundamentals (not just one note at a time), and taking action on what they hear and think almost instantly. It is an incredible process.

A person does not lose touch with these skills in the modern workplace. These very valuable skills could increase their productivity (one of the new catch phrases of the workplace today) tremendously. These people have been trained to listen, think, and act quickly and creatively for years. As I see it, the more complex life becomes, the more useful the act of playing the piano will become.

In your customers, you will see two basic types of people: those who are just coasting along for the ride, and those who want to garner the most that they can from this life we have been given.

Your best customers will always be the latter. Since likes attract, I hope you are part of the latter group as well.

Let me return to one point raised earlier. Are acoustic pianos on the way out, being replaced by the new digital machines? After a lot of thought and research, I have come to the conclusion that our chosen instrument (especially the finer ones) is going to be around for a long time to come.

I talked at length with a research scientist friend of mine who is also a very fine pianist. One of the most interesting points he made to me was about the rapid state of advancement in electronics today. The cost of research and development is extremely high, but at the same time, the industry cannot afford to sit still. The newest machine, the newest, most realistic sound, the most modern and miniature technology is what sells.

Take a close look at the formula. If R & D costs so much, only the machines that might pay back this up-front cost ever go to production. Mass appeal, right? Make your money quickly and move on. Competition is brutal for developing the newest technology and taking over the market. The manufacturers have to plan on short runs of production with high mark-ups, and then begin an all-new line for next year.

What does this say to us? How many technicians are going to be out there ten years from now to repair that $3,000 to $4,000 digital sound machine? Sure, it sounds incredible now. Will there actually be parts for it ten years from now? Digital will probably be a thing of the ancient past in ten years. I'm sure they will come up with some phenomenal electronic instruments in the future, but I'll still be able to get parts for and have the knowledge to service my client's fine grand piano ten or 20 years from now. If I don't get lazy, I actually will be a finer technician in my field rather than someone having to go back to school to learn the very basics of a new technology.

I have chosen to look upon the current popularity of electronic instruments as an expansion of musical interests rather than a replacement of a refined and time proven acoustic piano. A fine piano truly is a long-range investment. My own opinion is that I have yet to find an electronic keyboard that can come close to the almost infinite control and variety of a fine concert instrument that has been well maintained. It constantly challenges the player to discover more.

The electronics, on the other hand, quickly reach a plateau beyond which they, as of yet, cannot go. The attempt is made by adding different voices to compensate for their lack of subtlety. This generally fails on two counts. First, it requires an entirely different element of control directly removed from the keys themselves, therefore adding a major degree of difficulty. Secondly, it eliminates the subtle changes possible in a piano and, therefore, doesn't allow delicate changes of mood. I find a greater degree of difficulty and large gaps in expressiveness when compared to a fine piano.

Don't get me totally wrong, though. These instruments have a very valuable place in today's musical world. But, that place is not the replacement of the acoustic piano. My favorite instrument can stand up on its merits today and well into the future.

I love approaching a customer's home with this arsenal of information. I don't need a false sense of emotional enthusiasm in order to truthfully feel that I am going to enhance the value of their lives. I am clearly going to do something for them that will deeply benefit them if they take advantage of my service. Many of my customers comment that it is obvious to them that I really enjoy my work. I really do.

People, at least the vast majority of those I have met, are wonderful. It is truly enjoyable to work in a field that goes beneath the surface right to the core of our beings. Our outlooks on life are reflected in something as basic as a piano. I think that piano players are special, so my attitude reflects this outlook, and I project to my customers that I think they are special. Take the time to let your customer know how much they are benefitting by playing and maintaining their pianos. You and they will both be glad you did! ■

A studio piano designed with the technician in mind.

We listened and now we have a studio that meets your expectations.

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Awards:

Honoring Those Who Built Our Profession

Editor's Note: His service on the 1987-88 Awards Committee was one of Bob Russell's last contributions to the Piano Technicians Guild. Bob, who died in February, said several times that receiving the Golden Hammer Award during the 1984 convention was among the proudest moments of his life. As with everything Bob did, his closest companion, helper and friend was his wife Ginny, who helped complete the work of the committee and forwarded the names of these recipients after his death. As these awards were announced in St. Louis, it was easy to feel Bob's presence at the convention.

Hall of Fame

Allen Foote, Western North Carolina Chapter

The name of Allen Foote means many things to many people — a wonderful smile, a peck on the cheek, a beautiful red apple — but an unselfish, giving person is the best description. His nickname, "the beep-beep" man came to him through his company, Dampp-Chaser. "'With a tiny rod and a bucket of water you, too, can keep your piano in tune"...even though yours won't always go beep-beep.

Allen has worked hard over the years for the cause of PTG, always ready to display at conventions and seminars. His support for the Piano Technicians Guild is outstanding. Anytime a convention or seminar needed a list of non-members, Allen was always ready to assist, to bring sheep into the fold, and to do it with pleasure. At state conventions, he would help out by financing a coffee break, if needed; a class, if needed; he brought apples to help our nutrition. All in all Allen has been a tremendous asset to the public relations and forward progress of our organization. Allen is now retired but will always be active for us, always remembered by his peers. He and his wife, Edna, will always be a part of PTG!

Jack Sprinkle, Northern Virginia Chapter

Jack's many years of loyal, dedicated and ongoing service to the Guild constitute an outstanding testimony to his deeply committed and personal concern for the enhancement of the tuning profession, as well as for the individual and personal development and professionalism of his fellow technicians.

Jack is a charter member of the Guild. He was a prime mover and strong support in the early days of establishing the organization. He is a past president of the Washington, D.C., Chapter, as well as a charter member and first president of the Northern Virginia Chapter. His years of service and tireless effort on a national level included the office of Southeast Regional Vice President. He served more than 25 years on the Examining Committee. He was generous beyond measure in private tutoring and pre-testing.

Over the years, Jack has generously and consistently contributed as an instructor at the annual conventions, and his work, and efforts in his chapter continue to exemplify the personal dedication and zeal for which Jack is so highly respected and esteemed.

Golden Hammer

George Defebaugh, Los Angeles Chapter

An inductee into the Guild Hall of Fame and six-term member of the Guild Executive Board, George began his career in 1933 as an apprentice under Vern Woolsey in Fort Scott, KS. He was a full-time drummer and part-time tuner until he was drafted into the Air Force in 1943, where he played in bands and continued to tune pianos.

After leaving the Air Force, he moved to Los Angeles, where he worked as a floor tuner for Lindberg Piano in North Hollywood. He married his wife Betty in 1948, and continued to tune and perform with jazz groups. He also began rebuilding pianos.

Fred Lent introduced George to the American Society of Piano Technicians, where he met such other technicians as Charles Stein, Les Hoskins, Floyd Orr, Cecil Short, Warren Forgy and Herman Koford. In 1954, he took his exam from Don Morton and began working full time in the piano business. He became a full-time technician for the Los Angeles School System in 1958.

George was elected to the board of the newly-formed Guild's Los Angeles Chapter, where he also began his teaching career. In 1964,

he became Fred Odenheimer's assistant at the Los Angeles Trade Technical School of Piano Technology. He began teaching at Guild seminars and conventions with Norm Neblett in 1967, worked on the committee that produced the Guild film, "The Music of Sound" in 1968, served as chairman of the California State Conference and then, in 1969, became recording secretary of the Guild, a post he held for six years.

After retiring from the Los Angeles School System, he began a second career as a technical representative and consultant to piano manufacturers, serving first Kawai and then Steinway and Aeolian, forming his own company, Superior imports, in 1979.

In 1972, he became the official "*Journal* on Tape" reader, a position he holds today. He also continues to teach at Guild gatherings.

Crowl-Travis Member of Note

John Lillico, Toronto chapter

This gentleman was very instrumental in organizing the Toronto Chapter in 1979 and now holds the position of treasurer . . . for better or worse).... Who can ever forget the mounty from Toronto! Perhaps he was no Nelson Eddy but to PTG he was totally committed. John Lillico helped in setting up C.T.E. testing in Canada and also worked with testing crews in the United States. He is a friend to all who know him. His promotion in the *Journal* for the Toronto Convention helped make it one of the best; his help with home office and the institute helped make their job easier; as chaper chairman he put everything he had into making our time in Toronto exciting, coordinating everything to a 'T'! John will continue to give his all to PTG as he, along with so many others, believe in it! Congratulations John Lillico!

Lew Herwig, Phoenix Chapter

Many technicians teach and teach and teach....sharing all their talents willingly. This gentleman is no exception. For years he was always there, helping anyone who felt the need to get ahead. Originally from California he transferred to the south to increase and expand and share his knowledge on scale design with the world at Wurlitzer Co. His work was appreciated, and his knowledge will always be needed in the piano field. Following Wurlitzer he started his own shop in Phoenix, AZ. A few health problems have kept him from being just as active as he would like to be lately, but he remembers the great times, we remember the great times and we honor him for them.

Roger Weisensteiner, Spring Valley, IN, Chapter

The Spring Valley Chapter was started with a few technicians led by our fearless leader Roger Weisensteiner, also the first President. Of course with his knowledge and the knowledge he had of PTG this chapter had to succeed. Roger is employed by Kimball Corp., but he never let that conflict with his love for the Guild and its needs. Roger served on many national committees over the years; taught at many seminars, conventions, chapter programs, regional seminars, etc. At first we recognized Roger by the aroma from his pipe, but in more recent years we recognized him as a wonderful, outgoing, sharing, talented technician. ■

THE
TECHNICAL
FORUM

Questions, Tips And Responses

Susan Graham
Technical Editor

This month, contributions from various sources make this a forum in the truest sense of the word. Featured is the long-awaited article on key bushing by Fern Henry and Bill Spurlock. Preceeding that are questions, tips, and responses to previous articles. The diversity of thinking and writing is refreshing as well as informative (and it gives the technical editor time to attend and report on the NAMM show in Atlanta).

Cleaning keypins: The February 1988 Forum included a description of a device used in an electric drill to clean keypins. Designed by Bill Spurlock, it consists of 1/2-inch aluminum tubing with a cut-off 3/8-inch bolt epoxied into one end so it can be chucked into a drill. The open end of the tube is stuffed with hammer felt with a hole drilled in it so it can be run down over a keypin.

Don Peterson of Highland, UT, writes that he has trouble with the epoxied bolt coming loose. His theory is that the epoxy softens as the tube heats up in use. This is contrary to my understanding of epoxy, which is that it cures by heat and is then relatively impervious to it. I suspect the problem is due to the different expansion rates of the aluminum tubing and the steel bolt.

At any rate, Mr. Peterson has designed a brass tube with a spring-loaded plunger which holds felt in a similar fashion. From the pictures which accompany his letter, this looks to be an elegant and useful tool, particularly handy for those who don't care to machine their own. Pacific Piano Supply will be carrying it, or it can be obtained through Don Peterson, whose address is in our directory.

Action centers: As suspected, there is a lot of interest in the boring subject of action centers. Here are two contributions on the topic. The first is from Fred A. Koehler of Raleigh, NC:

"You mentioned using a roughened center pin to size bushings. I have had excellent results using decimal reamers from MSC Industries, 151 Sunnyside Blvd., Plainview, NY, 11803. (800) 255-5067. They are available in half-thousand increments and cover the range of center pin sizes. Because they are cutting tools they yield a much better surface. The little burrs on a roughened center pin pull out fibers rather than cut them.

"(An experiment: take two old flanges. Use a center pin in one and a reamer in the other. Punch the bushings out. Compare them under a high power magnifier. Amazing!)

"I also use a Dremel Moto-Tool when sizing bushings. But, I feel a drill press stand should be used, so that the hole is not 'wallowed out.' In my experience you cannot hold the tool in one hand and the bushing in the other and cut a true round hole. By the by, I think the speed should read 12,000 not 1,200. This is really too fast and the tool should be turned on and off as fast as possible to avoid heat buildup."

Editor's note: The point about the drill press stand is well-taken, and if I were using a power reaming system such as this I would definitely use one. However, my use of the Moto-Tool is with a smooth center pin. In that application, the intent is to "iron" the bushings, and size them around the pin. The heat buildup is desired. I have not had a noticeable problem with ovalling the hole. The speed, incidentally, is 30,000

(12,000 is the minimum acceptable speed for an orbital sander to be used on spruce — sorry).

Mr. Koehler continues with a question: *"I work on a lot of older actions. The bushings are worn to an elliptical shape. I ream them out to fit a larger size pin (yes, a 24 if need be). I then drill out the birdseye with a number drill — around 54 or 55 — and then reassemble the center with a new pin. This gives a bushing with a fresh round surface and a fresh-cut round hole to hold the pin. This procedure reduces the thickness of the bushing but all 88 centers are alike and the resistance is even from #1 to #8. It works for me when an instrument doesn't justify rebushing. Would you critique this procedure?"*

Editor's note: The concern, of course, is that there is very little of the bushing left lining the hole around the pin. It seems logical that the bushing acts as a shock absorber (as we know from slow-motion films, there is a lot of lateral movement and whipping of action parts). I suspect the very thin bushing remaining after this procedure would wear out quickly, and perhaps be noisy. The writer indicates that he uses this procedure as a last resort; it does seem to be a way to squeeze a few more years' use out of an action which might otherwise be scrapped. Having never done this job myself I can't comment on the time involved, but my question would be: is it really worth it? Can a price be determined which is not only fair to the technician who puts in the labor, but also fair to the customer in that the repair yields an extension and improvement of use commensurate with the charge?

Mr. Koehler adds, *"And finally, a tip on cleaning action centers. Buy a large syringe with a Luer-Lock tip. The opening (without a needle) is just slightly larger than a bushing. Press the tip of the syringe squarely against the piece and press the plunger. The solvent, under pressure, is forced through the bushing and does a much better job of removing 'gunk' than merely swishing the part in cleaner. Take the syringe apart and let it dry or it may freeze. Buy several — one for each solvent. I follow perchlorethylene with acetone. Acetone removes some residues dry cleaning fluid doesn't touch and it evaporates very quickly. Air-dry: acetone is very flammable!"*

Editor's note: Again, a good procedure, if the additional time spent removing and reinstalling parts yields an appreciably better result. You probably all know that my opinion regarding verdigris-affected bushing cloth is that it eventually must be replaced. However, this method of temporary treatment is certainly worth remembering. I have never used acetone on action centers, but would be very careful with it. It would certainly lead to a nasty shock on any plastic part, and may affect some types of glue. I also wonder if it might not remove too much of the natural lanolin from the cloth, inclining it to squeak. Other comments?

Finally, the writer remarks on the state of the industry and its tendency to remain conservative: *"Why not lightweight, low-density cast plastic keysticks? Why not carbon-fiber composite bridges? Why not honeycomb structure grand rims?...."*

Editor's Note: Well, why not? There might be a weight/mass/inertia problem with a lightweight key, there might be noise (I assume, given the proper material, that strength would not be a problem), and putting lead weights in such keys might present difficulties. As Mr. Koehler remarks, much of the resistance to use of new materials is among technicians (grown naturally cautious through years of painful experience).

Manufacturers are working to find substitutes for fast-disappearing traditional materials. Kawai, for instance, is using a carbon fiber jack in some of their grand actions; new plastic action parts are common. It isn't necessarily correct that this is "cheap" — these space-age materials can be more expensive and more difficult to work than wood. The failures have been more notorious than the successes because we are most likely to hear of problems, but we can expect more and more of this kind of change. Thanks to Mr. Koehler for his remarks.

Continuing on action centers, we

hear again from Randall Woltz of Tustin, CA, who did the research and photography for the 1981 PTG film on action centers.

"It is my feeling that chemical treatments speed up the deterioration of the bushing cloth. Water is the worst enemy and silicone permanently affects everything it comes into contact with. The only lubricants to be used in a piano are dry lubricants, with the exception of VJ lube which is best on trapwork (and sparingly!). This is only after all friction points are cleaned and smooth.

"A roughened center pin is not a good reamer for large amounts of reaming because it dulls quickly, making your work inaccurate. I use a tapered reamer in a Moto-Tool (after cutting it down to size). An unroughened center pin in a Moto-Tool is only a burnishing operation. The problem most of the time is too much cloth around the center pin so a little has to be removed. Otherwise humidity changes will swell up the cloth, making it too tight again.

"The problem with chemical treatments and heat on action centers is their unreliability. With reaming, burnishing and repinning, you don't have to wait 24 hours to see if it works.

"When researching my film, I found that action cloth as it comes from the supply house is untreated. Action cloth use by piano manufacturers is ironed, a shrinking solution applied, and sometimes a lubricating agent is added.

"My last thought is: why isn't this subject taught in depth at conventions? You can't regulate an action until the friction points and action centers are taken care of first."

Editor's note: To answer the last remark first, the subject will be covered in St. Louis by Sally Krefting. It promises to be an outstanding class. The remainder of the letter has some interesting ideas, and serves to emphasize the diversity of action center treatments. Clearly Mr. Woltz has the background and experience to develop methods which work well for him. Note the differences between his methods and those of the previous writer, as well as those which have been previously outlined in this column. I don't completely agree with not using chemical lubricants or water (and neither do a number of action manufacturers).

I do get good results with the unroughened center pin burnishing, in particular applications. There is differing advice on how and when bushing cloth should be treated. Whether it should be washed or ironed or lubricated before or after insertion is a matter for discussion.

This points out what we all know — piano work is pretty easy to do in your head, but you still have to get out into the real world and find out what really works for you. We can share the benefits of our experience, but there is no substitute for the real thing.

Speaking of modern technology, here's an interesting tip from Tauno Koski of Paradise, CA. When faced with the problem of removing an entire set of just-installed upright hammer heads, he found that placing the parts in a conventional 500-watt microwave oven for 45 seconds at full power softened the Titebond glue joint enough so the parts could be easily separated.

I found this works on hide glue as well, and on older joints as well as fresh ones. However, it also overfreed action centers, even with a shorter zap time. It does not appear to scorch the wood of the flange, which surprised me, but it took a grand shank assembly which had three swings and turned it into one with 20, and the change appears to be permanent.

This is a case of a tip to use with caution. If there is a glue joint with no action center involved (for instance, upright hammers shanked up but not yet inserted into butts) this is a fast way to soften that glue. It could also be useful in an emergency — such as getting caught in the field without a hammer head extractor — when the glue could be softened so a necessary repair can be made, and the action center repinned as well.

Somehow I think we're going to find more things to do with the microwave (anybody tried drying ivories yet?). Manufacturers have been using giant RF (radio frequency) cookers to cure glue for years, speeding up assembly time. We might as well use them to speed up disassembly time.

My thanks to these three contributors, and to all those who are taking the time to send in tips and comments. Space doesn't permit use of all material, and it may be a while before something appears in print, but a file of good material is like money in the bank to a technical journal (and a hardworking editor). The big thanks of the month goes to Bill and Fern, of course, for the excellent article which follows. ■

AT
LARGE

Key Rebushing

Fern Henry
Bill Spurlock
Sacramento Valley, CA, Chapter

Properly bushed keys are essential to good piano performance. The pianist will appreciate keys that move freely with minimal side play and mechanical noise; a smooth and solid feel to the keys lends the artist the security and control so necessary to musical expression. As technicians, we must realize that it is impossible to bring an action to full potential or even do a fine regulation if the key bushings are worn. Wobbly keys cannot be spaced and squared and thus key level and dip become inaccurate. Also, if there is excessive side play in key bushings, the capstans will travel sideways during playing, robbing power; and grand backchecks likewise cannot be accurately aligned to hammer tails if wobble exists. In short, proper key bushing lays the foundation for fine regulation and performance; since keys are the only action part the pianist touches, all key work, and especially bushing, should be a high priority in action service.

In spite of the importance of this job, many technicians find it so tedious and time-consuming that they avoid it, even on jobs where they may replace hammers and action parts. Naturally the full benefits of rebuilding cannot be realized if basic steps are omitted, and otherwise fine work can be overshadowed by keys that do not feel renewed. If key rebushing bores you and eats up hours of shop time, you may be surprised to know that many of your PTG colleagues routinely rebush keys in the time it takes to do an average tuning! In this article we will outline methods for developing such efficiency step by step.

A further complaint technicians make in critiquing their own bushing work is that the results are inconsistent: it is hard for some to get precise and neat bushings that look factory-perfect every time. This problem is understandable because it has only been recently that proper key bushing tools and materials have been available from our suppliers. The spring clamps and/or randomly sized wooden wedges sold for this work are not the best tools for the job. Their use, together with soft, loosely woven key bushing cloth virtually guarantees poor results. Here we will stress the importance of proper tools and materials and define a standard of quality for key bushing while showing how to achieve it.

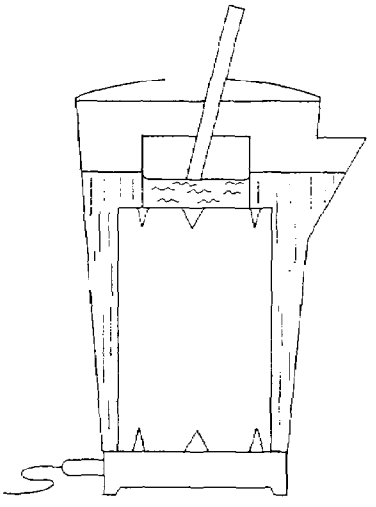
Before looking at the techniques for efficient bushing installation, we would like to analyze what specifically distinguishes a quality key bushing job. A professional job will pay attention to four important components: correct type and thickness of bushing cloth, proper depth of cloth in the key mortise, type and amount of glue, and the condition of the key pins.

First, the proper cloth must be used or the end result will suffer. Supply houses are now offering high quality bushing cloth; this cloth is usually listed as "special quality," "extra density," or "heavy" and is easily recognized by the white layer in the center of the fabric. This special quality cloth has a fine finish and few fuzzy fibers are visible on the surface; it is a densely woven cloth which is durable and stable. It is less spongy or compressible than lesser-quality cloth. Its density helps prevent glue from penetrating too far into the cloth when the bushings are clamped. Further, the firmness and smooth finish allow a free bushing fit with minimal side play. If a spongier cloth with a fuzzy surface is used, there is more drag on the pin unless the key is eased to the point of being almost wobbly.

Next, the technician must take care that the cloth penetrates each mortise to the correct depth. On average, the cloth should extend 3/16-inch into the key mortise. If the cloth is inserted too far, there will be excess drag. Too little cloth provides an inadequate bearing surface for the key pin.

Thirdly, an appropriate glue must be chosen: hot hide glue is ideal. Several properties of hot hide glue are especially useful. First, bushings are easily removed later; key rebushing is a job that might be done repeatedly on heavily played pianos. Therefore, we want a reversible glue so that old bushings can be removed without damage to the wood of the mortise. Hot hide glue also gels as soon as it begins to cool and so does not wick too deeply into the cloth

Sidebar — using hot hide glue



percolator top removed from lid provides access hole, wiped off glue drips back into container, lid contains steamy atmosphere inside, reducing skinning over of glue

small can or jar holds hide glue

spout makes handy spot for cleaning glue brushes

water bath, test w/thermometer for 140°-150°F

tin can w/hole to allow water circulation, supports glue container at convenient height and away from heating element in base

old electric coffee pot

Hot hide glue is the glue of choice for many piano jobs. It is easy to use once one becomes familiar with it; we include some basic tips here.

— add enough water to just cover dry glue crystals and plug in glue pot, stir occasionally.
— when glue is dissolved add warm water if necessary to achieve desired consistency.
— glue will gradually thicken as moisture evaporates during extended use so add more water as needed.
— glue can be reheated several times but since strength declines, it should be mixed fresh for critical jobs such as hammer hanging.
— for more on hide glue see Fine Woodworking magazine #57, March/April 1986

and harden it. Finally, this glue contains water, so it has sizing properties which we can use to our advantage. A firm grasp of this need to size bushings is the key to obtaining quality in this job, so we will clarify this point in some detail.

Uniform, correctly sized bushings are obtained by using precisely dimensioned cauls inserted into mortises lined with the correct thickness of cloth glued in with a water-soluble glue. The caul provides a mold around which the bushing forms as the glue hardens and the moisture leaves the wood and the cloth. If the cauls are manufactured to a precise width (viz. slightly larger than the key pin in the piano) the bushings will need little or no easing to correctly fit the key pins. The water in the glue will tend to swell the wood of the mortise, forcing the bushing cloth firmly against the caul. The cauls are left in place until all moisture leaves the glue joint (eight hours or more) at which time the glue will be hard and the bushing cloth will be locked into a stable shape.

Key mortises vary in size from piano to piano and also among keys of the same piano. Spring clamps or odd-size wooden wedges, while holding the cloth in place until the glue hardens, have no ability to accurately size the bushing. Thus some bushings may turn out far too loose and require redoing with a thicker cloth; others may be too tight, requiring considerable easing. While extensive easing of tight keys will achieve a correct fit, it should be viewed as a destructive operation since it crushes the wood of the mortise, often causing wood to splinter off when the bushings are removed next time. Thus a bushing method that sizes the bushings as the glue hardens preserves the keys, yields a higher quality job and minimizes the time spent fitting the newly bushed keys to the keyframe.

The fourth and final component of quality work is the key pin. In a previous article, Susan Graham has covered techniques for replacing and polishing key pins very well. Suffice it to say here that the pin must be free of rust, nicks, or scratches; lubricants such as teflon sprays may be used judiciously but no lubricant is a substitute for the preparatory work of cleaning nor can lubrication disguise old pins that need replacement. Again, the best bushing job in the world cannot function well on a substandard pin, and attention must be paid to the pins on which our bushings guide.

Preparation Of Keys For Rebushing

In preparing to rebush, we must first know what size key pins are in the piano. At the time you remove the keys from the instrument, use a micrometer to determine pin size on both the balance and front rail pins. Key pin sizes vary among manufacturers; often the balance pins are of different dimension than the front. Since our aim is to rebush in such a way that our bushings are accurately sized by a precisely made caul, it follows that we must choose the cauls that are made for the key pins in that particular piano. Thus we ensure precision and minimize the need to ease keys later.

Key pin sizes for some common pianos

	Front rail	Balance rail
Most American makes past and present	.146″	.146″
Yamaha, Schwander (Kimball), Young Chang, many Asian and European	.125″	.138″
Pre-1960 Steinway	.146″	.163″
All current Steinway, other grands using Kluge Keyboards	.131″	.131″
Some older Knabe Chickering, etc.	.146″	.087″
Kawai	.133″	.146″

Other sizes will be found, especially in pre-1900 and in some European makes. In some cases intermediate cauls for one pin size will serve as final cauls for another, and vice versa.

Next the keys should be placed in the key clamp shown in Figure 1 to hold them together in a convenient position for work. The benefits of this fixture cannot be over-

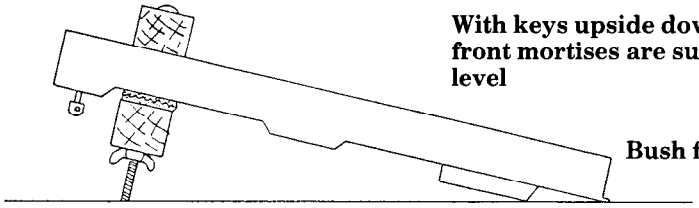
Figure 1

Key Clamping Fixture

Make two 28" long to hold 1/2 set of keys each

1-1/2" x 1-1/2" or saw 2x4 lengthwise backrail cloth glued to one piece

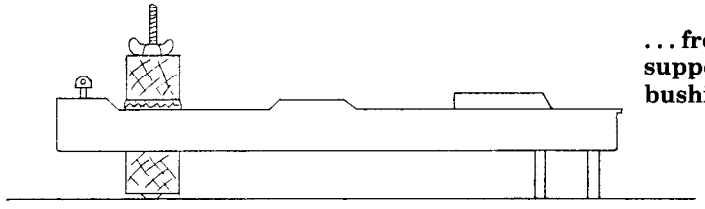
5"x1/4" carriage bolts w/wingnuts



With keys upside down on bench all front mortises are supported at one level

Bush front rail first . . .

then



. . . front rail cauls support all keys for bushing balance rail

emphasized. It allows handling of the keys as a unit rather than individually, thus eliminating much of the time spent positioning individual keys, standing them up after they flop over, etc. It is also a convenient and safe method of carrying keys from the customer's home; to the customer it looks more professional to see ivory keys carried out the front dooras a unit rather than stuffed into a borrowed shopping bag. Also note that when the clamped keys are placed upside down on the bench top, the five-inch carriage bolts allow the sharps and naturals to rest on the work surface in such a way that the undersides of all keys are supported at one level.

Prior to removal of old bushings it is a good idea to clean all dust out of the mortises and off the key wood with compressed air or a vacuum. This will allow better penetration of moisture into the old cloth and minimize staining of the wood. Usually the old bushings have been glued in with hide glue and will yield easily to steam. However, it is best to presoak the bushings by dabbing each with a small brush dipped in a wallpaper remover/ water solution. This soaking starts the glue softening so it will release quickly when steam is applied; excessive steaming should be avoided because it can loosen key button glue joints and ivory. Some more modern pianos will have their bushings glued in with a white glue. These can also be removed with steam, but require a much longer pre-soaking, best accomplished by cutting hammerfelt scraps into small wedges, soaking them in a pan of wallpaper remover/water and plugging one wedge into each mortise to soak for 1 to 2 hours prior to steaming. Adding ammonia to the soaking solution will help soften some modern glues.

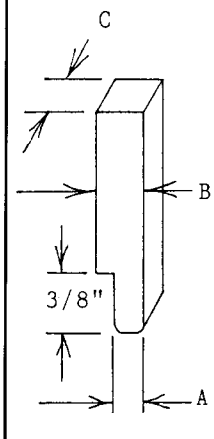
Our favorite method of applying steam to bushings is with a small travel steam iron. (Sears Catalog lists one, called a "World Traveler Steamer," #1186210, for around $15.) This is an all plastic "iron" that just produces steam and can be placed directly on the keys. Steam comes out of the bottom of the unit and, if the keys have been presoaked, the old bushings will loosen and the steamer can be moved along the keyboard about as fast as you can remove the bushings with tweezers. (This is also a great tool for steaming the wrinkles from your clothing when you unpack your suitcase at PTG conventions.) The keys should be allowed to dry at least 1 to 2 hours before proceeding.

Traditional methods of installing key bushings usually involve gluing the cloth into both sides of the key mortise at once. Each hand picks up one piece of cloth and then the two pieces are aligned and held in one hand; the free hand picks up a glue brush to apply glue to cloth or mortise and then sets down the brush to move back to help the other hand carefully position the cloth in the mortise. Then one hand must hold the two cloth pieces in place while the other inserts the bushing caul, then uses a knife to trim the cloth. After repeating this 175 more times the job is done; unfortunately such a tedious repetition of steps leaves many technicians dreading the next encounter with key bushings.

In the method presented here we bush only one side of the mortise at a time. While this may at first sound even more laborious it is actually much faster and easier. As can be seen from the description to follow, working with only one piece of cloth at a time eliminates much wasted hand motion and minimizes the redundant handling of tools.

This method requires that we have an intermediate bushing caul for the installation of the first piece of cloth, and a final caul for installing the second cloth and for clamping both until the glue is dry. Again, the sizes of these cauls relate to the key pin size as shown in Figure 2. Thus the dimension of the

Figure 2



Intermediate

A - Key pin size + .040"

B - "A" dimension + .10"

C - 3/8" for almost all, some balance rail mortises are smaller

Final

A - Key pin size + .003" to .005"

B - "A" + .10"

C - Same as intermediate

intermediate caul is the key pin size plus the slightly compressed thickness of an average piece of bushing cloth (key pin size + .040" is a good average). The dimension of the final caul should be .003- to .005-inch larger than the key pin to ensure that the bushing will have a slight clearance on the pin.

Having selected the proper sized bushing cauls, you must next choose an appropriate thickness of bushing cloth. Do this by placing two pieces of cloth into the mortise and testing the dry fit of a final caul. Here the fit should be snug enough that the shoulder of the caul clamps the top of the bushing adequately, without lifting back up when you let go of the caul. It should not be so tight that the caul is difficult to insert or shows a tendency to split key buttons or front rail mortises of sharps. Mortises vary, so test several and select a cloth for a good average fit. The same test should also be used with one piece of cloth and an intermediate caul. If the intermediate caul fits much tighter than did the final, then a slightly smaller intermediate caul (one intended for a smaller key pin) can be used. A second alternative is to use a thinner bushing cloth on the first side of the mortise than on the second. In almost all cases, however,an acceptable fit of both cauls can be achieved with one thickness of cloth.

After choosing your cauls and cloth you should make sure your hot hide glue is the proper consistency (see accompanying sidebar). For this job, the glue should be thin enough to spread evenly but not so thin that it soaks into the cloth immediately. A good test is to drizzle a little glue onto some bushing cloth; it should bead up slightly on the cloth surface. A thin stick about the proportions of a popsicle stick is most efficient for applying glue to the cloth. Your glue should be only about 1/2-inch deep in its container so only the end of the stick holds glue when withdrawn from the pot. Lastly, you will need a sharp knife with a comfortable handle (such as a chip carving knife from a woodworkers supply house or a hobby knife with replaceable blades) and a small hammer.

Installing The New Bushings

With the keys in the key clamp and resting upside down on the bench top, and your glue pot, knife, hammer, intermediate cauls and 12-inch strips of bushing cloth at hand, you are ready to begin. With a piece of bushing cloth held in one hand and extending along the index finger, apply glue to 1 1/2 to 2 inches of cloth (just one inch when trying this the first time). The correct amount of glue is applied by coating the cloth with one stroke of the stick, then wiping the cloth with a second stroke using the dry upper part of the stick. This technique spreads the glue evenly over the cloth while removing excess glue, rather like spreading honey on toast.

Lay the end of the cloth across the mortise to position it for proper depth (the mortise opening is usually about 3/16 inch wide, which corresponds to the depth of cloth we want), and with the other hand pick up the knife and intermediate caul. Insert the caul, holding some tension on the cloth so more is not

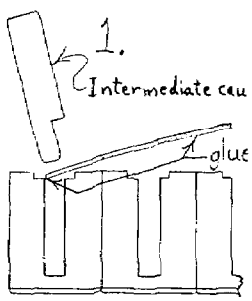
drawn into the mortise, transfer one finger from the cloth hand to apply downward pressure on the caul and cut with the knife. Proceed as in Figure 3 until you have used up the glued portion of the cloth (about five to seven keys). At this point tap each caul lightly with the hammer to make sure they are firmly seated, reapply glue to more cloth and continue. Work down the keyboard in one direction so that the cauls already inserted are not in the path of your work but are behind it. Note that one hand always holds the cloth while the other always holds the knife, except when applying glue.

If 88 intermediate cauls are on hand you can proceed in this fashion to the end of the rail. However it is possible to economize by using only 45 intermediates. After these 45 have been installed, remove the first 25 or so, giving those just installed a little more time for the glue to grab, and continue on with keys 46 to 70, remove another 18, and complete keys 71 to 88.

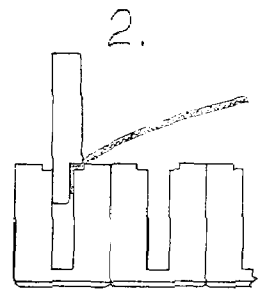
Now you are ready to immediately go back and bush the other side of the mortise. Remove all but the last 20 or so intermediates and, using the same procedure, install the final cauls. You can either work back down the rail in the opposite direction or turn the keys/clamp assembly around so you are still working in the same direction as before. (Some prefer to turn the keys around if they are more efficient working in a particular direction.) The only difference in technique required when inserting the final cauls is to position the cloth so it droops down slightly into the mortise. This gives the same cloth measurement as before in the now narrower mortise and also keeps the glued surface of the cloth away from the bushing already in place. Since the final cauls must be left in place for approximately eight hours, you will need 88 finals to rebush one rail at a time or 176 to do both rails at one sitting.

With the front rail now completed, leaving the final cauls in

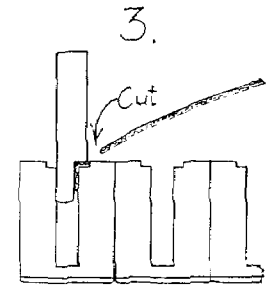
Figure 3



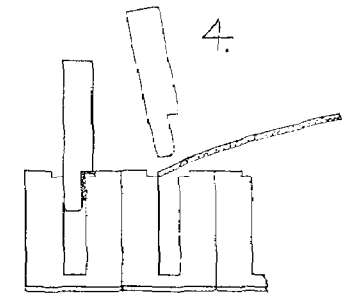
— apply glue to approx. 2" of cloth using glue applicator stick
— one hand holds cloth, other holds knife and caul
— place cloth across key mortise to measure for proper depth



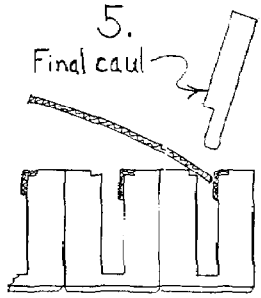
— insert intermediate caul while holding slight tension on cloth



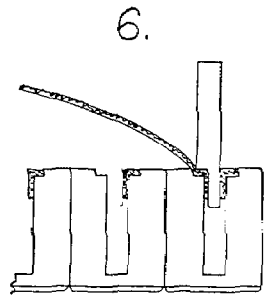
— cut cloth while holding caul down firmly
— keep knife in hand ready to cut next bushing



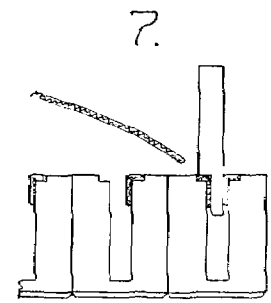
— proceed for 5-6 keys, tap lightly with small hammer to seat, then apply glue to more cloth
— continue bushing until whole rail has cloth in one side
— remove all intermediate cauls except last 20 or so installed (leave in for glue to set) and proceed bushing other side of mortise using final cauls as in steps 5-8 below



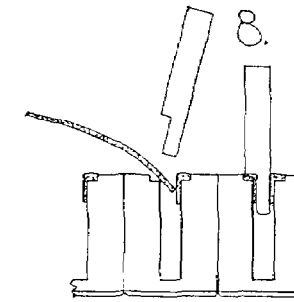
— place cloth across and slightly down into mortise to give equal length



— insert final caul while holding slight tension on the cloth



— cut cloth while holding caul down firmly



— when all front bushings are installed leave final cauls in place for eight hours until all moisture has left glue
— proceed to the other rail

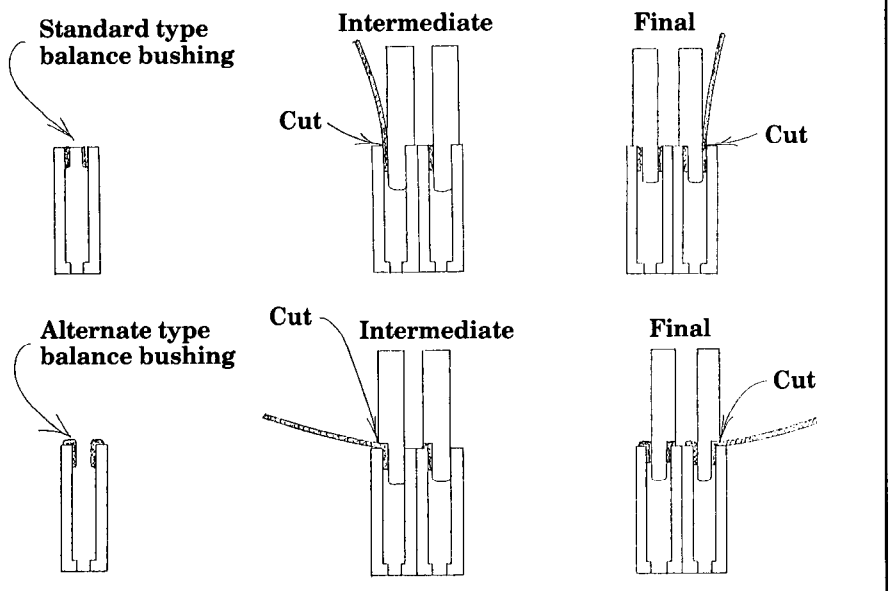
place, turn the keys/clamp assembly over to expose the balance rail. Now the reason for starting with the front rail is clear (see Figure 1): the clamp and the final cauls in the mortises support the keys in a flat position making work on the balance rail convenient. The procedure for insertion of the balance rail bushings is the same. However, should you desire to bush the balance rail with a cloth cut flush to the wood of the key (i.e. with no shoulder—as on the front mortise bushing), note that the cauls we use, having only a single shoulder,can serve for either style balance bushing (Figure 4). So while the shoulder cut uses the shoulder side of the caul, a flush cut can be done by reversing the caul and cutting against the caul itself.

tried it tell us that they were able to trim one to two hours off their average time on the first attempt. In our shop we average one hour to put bushings in both rails. So try it!

Bushing Cauls

Many of you have invested in the aluminum cauls sold by the supply houses. If so, you can use them as the final cauls in this system and you need only obtain 45 or more intermediate cauls for each size of finals used. You may question why we prefer the one-shouldered configuration of caul rather than the two-shouldered style so familiar in the aluminum cauls. One reason is that only one cut is required to make these cauls, so the accuracy of the critical dimension "A" in Figure 2 is more easily held to tolerance. Secondly, as noted above, this design

Figure 4 **Two Ways of Bushing Balance Rail**



Periodically it is wise to check your work in progress to ensure quality. From time to time pull out a caul just after you insert it but before you cut the cloth; look down into the mortise and see that you are consistently getting the cloth down 3/16 inch. If the depth looks good, reinsert the caul and move on. Also, notice if you are getting any glue squeeze-out along any of the cloth edges; if so, adjust your technique to spread a thinner layer of glue on the cloth. Too much glue will mess up your cauls and could be a source of noise if it contacts the key pin.

Most technicians will find it easy to develop proficiency in this method. In fact, many who have

allows us to use one caul to do either a flush cut or shoulder cut on the balance rail bushing. And we also note that, since the recesses on either side of the front rail mortise are often of unequal depth, a double shouldered caul may only clamp one shoulder of the bushing and not the other.

We make both intermediate and final cauls out of maple. Maple is easy to machine with ordinary shop tools, it allows us to cut against the caul for a flush cut without dulling the knife, and it is easily color coded with felt pens to identify intermediate and final cauls and to differentiate sizes. One possible disadvantage of wood is its change in dimension with humidity. However, with a 50 percent fluctuation in relative humidity, our largest caul sizes vary only .0015 inch in dimension. Considering that key mortise widths can vary as much as .020 inch in one keyboard, key cloth may vary by .005 inch in thickness along one strip, and our freshly bushed key should have at least .003 inch clearance on the pin, such humidity-caused variations in caul size are negligible.

Any technician with average wood working skills, some power tools, and the inclination can make his/her own cauls using the dimensions given in Figure 2. Those who want to purchase cauls can contact us for information on available sizes.

Conclusion

In writing so lengthy an article on key rebushing, we hope that we have not made a fundamentally simple procedure sound complex and intimidating. Our purpose in including so much detail is to enable you to adopt this system readily and to encourage those of you who are disenchanted with key bushing to try again. At a recent convention we taught this class as a hands-on class; each person who tried it for just 1/2 hour had immediate success. Turning out quality key bushing work can be enjoyable, satisfying and profitable.

Throughout the article we have emphasized speed as a feature of this bushing technique. We leave you with one final thought: quality and speed go hand in hand. In our opinion, excellent results require efficient methods. There is no inherent virtue in speed, and of course the "rush-to-finish" attitude that leads to sloppy results has no place in a craftsman's work. On the other hand, the technician who labors painstakingly over fastidious work may find his/her output too low to be financially viable. Fortunately a happy solution exists. If you commit to doing your best and develop efficient work habits as you learn, you will achieve greater productivity and have greater incentive to do even better next time.

We want to thank those who contributed to our learning: Mark Anderson for the key clamp idea, Del Fandrich for the two-caul technique, and Wally Brooks and Frank Stopa for some basic principles.■

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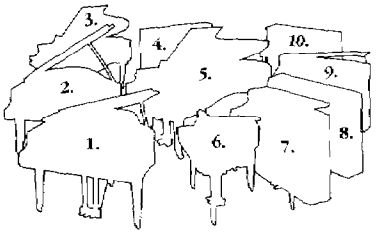

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SAMICK – Setting the New World Standard.

Comments: 'Setting The Temperament,' 'Direct Interval Tuning System,' Tempering Octaves

Rick Baldassin
Tuning Editor

There were a couple of letters this month in response to the June issue. The first was from Robert Bays, of Atlanta, GA. Robert writes:

"I enjoyed reading your article on "Setting the Temperament" in the June Journal. *I was interested to note that for many years now I have been following a procedure similar to (but at the same time very different from) yours and Don Foli's.*

"For all pianos except those which must have equal temperament for one reason or another, I use the Marpurg 'I' temperament, which I tune by setting up the chain of thirds F3-A3-C♯4-F4, then tuning perfect fifths and fourths from them. I am sure you are well acquainted with the Marpurg, which ends up with a series of lovely equal-tempered Major Thirds. Except for those based on F♯, A♯, and D, all minor triads have equal beating major and minor thirds. The only discordant fifths and fourths are F♯-C♯, F-A♯-F, and A-D. I have had excellent results with this temperament, having never had a complaint, and having had a number of special compliments.

"While I am writing, I am missing the 7th and 12th installments of your 1983-85 'On Pitch' series dealing with the integration and equation of aural and electronic tuning techniques. I do not know the exact dates, but #7 appeared between February and August 1984, and #12 after March 1985. If there was one after #12, I am missing it too. Can you tell me in which issues of the Journal *they appeared?"*

Thank you for your letter. I became acquainted with the Marpurg "I" temperament when I was a student in piano technology school. In school, we began by first learning to tune unisons, then various pure intervals, and finally various temperaments. Before we learned equal temperament, we were taught several other temperaments, such as mean-tone, Well Temperament, and the Marpurg "I" temperament. These were taught to us more as learning tools than for their historical significance, though this was not overlooked.

My teacher, Merrill Cox, felt that it would be easier for us at first to tune temperaments which

had several pure intervals. Once we had learned to tune unisons without beats, we could train ourselves to hear intervals without beats. The mean-tone temperaments served well for this.

Once we had mastered the mean-tone temperaments, we moved on to the Well Temperament, which was similar to the mean-tone temperaments, but introduced the concept of "tempering" intervals so that the instrument could be played in all of the keys, unlike the mean-tone temperaments.

The Marpurg "I" temperament was one which was studied as we neared our study of equal temperament, as it displayed the concept of tempering of Major Thirds.

Finally, we learned equal temperament which included tempering of all the intervals. In my daily practice, I have call only to tune in equal temperament, so I am not as familiar with several of the historical temperaments as others may be. I do recall that as unequal temperaments go, the Marpurg "I" is fairly close to equal temperament. We probably have all tuned it by accident while attempting equal temperament.

In regards to the back issues of the "On Pitch" series printed in the *Journal*, #1 appeared in June 1983. #2 in July 1983. #3 in September 1983, #4 in October 1983, #5 in January 1984, #6 in February 1984, #7 in May 1984, #8 in June 1984, #9 in December 1984, #10 in January 1985, and #11 in March 1985. Unfortunately, #12 was never finished. It has been so long ago now, that I do not remember what was coming up next. I am sure I have my notes around somewhere, and maybe someday I will write #12 so the set will be complete.

There has been talk at times of reprinting the entire series as a set, as some of the issues which were printed during the change in management have no extra copies. Perhaps if there is enough interest, this may happen in the future. I think your best bet for now is to find a fellow Guild member in your area who has these back issues, and copy them. Thank you very much for your interest.

Our next letter comes from Don Udell, of Morgantown, W.V. Don writes:

"Your column in the June issue of the Journal *on the Direct Interval tuning system was inspired writing! I have been somewhat dissatisfied with the temperaments I have been using, so I will give yours a try.*

"I suspect you have (or will have) trouble coming up with material on such a narrow topic as tuning, but you have done a great job! Your work is appreciated."

This is one of the nicest compliments which has been paid me since I have taken this position. I am pleased that the June issue met with such positive response. I must admit at the time I wrote it, I was not so sure. During the month of April, I was in Hawaii. I was scheduled to be home May 1, and had made arrangements to write and submit the June issue immediately upon arriving home.

Unfortunatelv (maybe I should say fortunately, I was having a great time), my stay was extended by one week. All of the material I had prepared to finalize and submit was in Provo, and I did not have any reference material with me, not even a single back issue of the *Journal*. I did find a friend who let me use his computer, but I was still faced with the problem of what to write, and how to do it with no reference material. I had received letters with questions about the temperament, and had been planning to pay tribute to my friend Don Foli for some time, and this appeared to be the logical time.

Recreating the entire subject matter from memory proved interesting, but not impossible. I had to live with the fact that while I was locked in my room writing, my colleagues were at the beach. My only consolation was that it was raining like crazy outside. Thanks again for your letter.

Our final letter this month comes from Bruce Grimes of the South Bay Chapter, currently residing in Indonesia. Bruce writes:

"This letter is based on comments taken from three sources and some of my own calculations. It advocates two things that seem to be too revolutionary for the Journal *to handle. Since I have not made arrangements to receive the* Journ *here in Indonesia, I do not know my previous letter or someone else letter on this subject received a published response.*

"The three sources are 1) The Piano Technicians Journal, *April 1988, p. 21; 2) Anita Sullivan, 'Th Seventh Dragon,' the riddle of equal temperament; and 3) a book in French referred to me by J. P. Martel of Townsville Australia, about the equal temperament in pure fifths. My own calculations ar for the Rational Equal Temperament having half-step size of 1.05959000.*

"The two things being advocated are: 1) Consistent use of the terms 'tempered interval' and 'stretched interval' specifically 'tempered octave' and 'stretched octave;' and 2) the use of a Rational Equal Temperament whenever theoretical figures are displayed for comparison with inharmonic and real piano figures.

"The term 'stretched octave' is used four times in close order on page 21 [of the April 1988 issue]: 1) 'Ben indicated that it was an 'equal temperament' set in a very stretched octave;' 2) '... a double octave tuning would sound 'radically stretched;' 3) 'The treble tuning in this data was based on single (2:1) octaves plus one cent stretch;' and 4) 'As to Frank's question about how this type of tuning could be out of the usual boundaries of octave stretching...'

"The third instance quoted here gives the definition of a stretched interval, that is, an interval at the outside ends of the keyboard that is larger than the corresponding interval in the middle two octave temperament setting section of the keyboard. Given this definition of 'stretch,' I vigorously object to the use of 'stretch' in the first quotation. The temperament is set in a 'tempered' octave, not a stretched one. The use of stretch in the first quote to mean one thing and in the second and third to mean quite another makes the use in the fourth quote ambiguous. Temperament tuning and treble tuning are two separate scores on the tuning exam.

"Anita Sullivan relates the historical background that gives the statement 'I temper my octaves' the

same negative emotional impact of the statement 'I am a sinner.'

"Once the keyboard industry accepts the confession 'I temper my octaves,' the door is open for the next step in the history of tuning: the Rational Equal Temperament, defined and derived as follows: The Rational Equal Temperament is a temperament system of twelve equal half-steps to the octave; the size of each half step is the rational number 1.05959. All of the harmonically defined intervals are tempered. The theoretical values in current use are for an irrational equal temperament in pure octaves; the size of each half-step is the irrational number $\sqrt[12]{2}$ *. At the other extreme of tolerance is the irrational equal temperament in pure fifths, half-step size* $\sqrt[7]{1.5}$*, described in J. P. Martel's book and elsewhere. The Rational Equal Temperament half-step size is an easily remembered, rational number close to the geometric mean between* $\sqrt[12]{2}$ *and* $\sqrt[7]{1.5}$*. The rational number 1.05957 might be more appropriate mathematically, but not so easily remembered.*

"If you have some computer time, you might run some 88-key tunings for the numbers 1.05957, 1.05959, and $\sqrt[7]{1.5}$ *with beat charts, inharmonicity, and stretch.*

"The third thing I was going to advocate is the use of the half-step size any time an equal temperament is mentioned. However, one person says that he has calculated the octave stretching all the way into the temperament octave. This would mean that every half-step on the piano has a different size. If every half-step is a different size, this is not an equal temperament. What might be an appropriate name for this tuning? How can it be specified? "

The meanings of words are often determined by their use in context. A stretch of freeway, standing to stretch, a stretch of the imagination, stretching our money until the end of the month, stretching a piece of wire between two points, elastic stretching, stretching your patience, stretching a canvas for painting, stretching the rules, and coming down the stretch all have very different meanings. It would be as improper to force one meaning on the word stretch as applied to tuning, as it would to force any one meaning on the above examples.

In tuning we deal with tempered intervals. By this we mean that they are altered from their pure state. Some of these intervals are altered by expansion, and some by contraction. In piano tuning, the octaves are always stretched, every single one of them, including the temperament octave. The amount the octave is stretched is dependent largely on the inharmonicity of the particular piano, and the taste or technique of the individual tuner. It would not be improper to say that the temperament is set in a tempered octave, but does the word tempered adequately describe a situation where one temperament octave is "more tempered" than another? I do not think so.

I would concede that in example 3 quoted above, it would have been more correct to say: "The treble tuning was based on single (2:1) octaves plus one cent additional stretch, as the octave was already being stretched to make it a 2:1 octave."

I do not feel that tempering or stretching octaves carries any negative connotation. The keyboard industry as a whole has been aware of the concept of octave stretching for years, so I do not understand your reference to "doors opening." Your system for Rational Equal Temperament might possibly work on some areas of some pianos. I entered the information for tunings based on half-step sizes of 1.05957 and 1.05959 into the computer, and compared them to the information which Dr. Sanderson provided me, and which has been used in several articles over the past year.

What I found was that neither 1.05957 nor 1.05959 worked well on the actual piano in the Sanderson data. The half-step size in the Sanderson data varied, but was approximately 1.05965 in the temperament region. The half-step size increased as the extremes of the keyboard were approached, being 1.05983 in the bass, and 1.0610 in the treble. There is no one ratio which will work on a given instrument, no less on pianos as a whole. Even if we confine ourselves to the temperament region, the ratio well suited to one make and model would differ from that of another.

With all this in mind, it seems the only logical choice for comparison of actual inharmonic piano data is the Theoretical Equal Temperament with half-step size of $\sqrt[12]{2}$. All electronic tuning devices currently manufactured employ this system, and cent deviation from this system. If we were to redefine our basis for equal temperament, then we would have to redefine what "cents" were as well.

The fact that the half-step size varies within a given piano, as well as from piano to piano, reinforces the argument that we are not tuning in equal temperament at all, even though that is what we call it. I am not sure it is worth renaming this temperament we tune every day, so long as we understand what it is we are and are not doing. What do you readers think?

Our thanks to Robert Bays, Don Udell, and Bruce Grimes for their letters.

Finding the answer to Dennis Gorgas' question last month took a lot of time and research. There were some side benefits, however. While I was looking through back issues of the *Journal* and through my files, I found two additional items of interest. The first was an article by Ron Berry entitled "Beats: What they are and where they come from." (*Journal*, March 1980). It is as relevant today as it was eight years ago, so I am reprinting it for the benefit of our newer members. The second was a class handout presented at the 1987 California State Convention by Jim Coleman entitled "Passing the Tuning Test." I felt that the information it contained would be useful to our Associate Members preparing to take the Tuning Test. Finally, please enjoy as well an article by Virgil Smith entitled "The Tuning Touch." Until next month, please send me your questions and comments.■

Rick Baldassin
2684 W. 220 North
Provo, UT 84601

AT
LARGE

The Tuning Touch

Virgil E. Smith, RTT
Chicago, IL, Chapter

Does the way the key is struck or depressed when tuning have any bearing on how the beats can be heard? Can a stroke be strong enough for tuning stability, and still be free from distortion so that the beats can be clearly heard?

My many years working with students as a piano teacher, and with musicians as a piano technician, have convinced me that the answer is yes. I write this article with the hope that it may benefit many tuners, helping them to develop a tuning touch that will both improve their tuning stability and their ability to hear the beats clearly.

I had practically all my piano training with a teacher who taught largely by imitation. It did not matter if my fingers were curved correctly or my wrist and arm properly relaxed, as long as I could produce the desired result. I made rapid progress because I was a good imitator. I could imitate my teacher, fellow students, and other pianists quite easily.

The result was that without a foundation of basic principles for playing the piano, my playing was very inconsistent. One day the tone would be lovely and the technique brilliant, the next day the sound poor and technique uncontrolled. With such a background, consistent performance with any confidence was impossible. I eventually turned to teaching.

I was considered a successful teacher, but had problems because I lacked a foundation of basic principles for playing the piano. On my good playing days, my teaching went well, but when I was off, it was a different story. I even found myself imitating the poor sound and bad performance techniques of my students on those days.

> "If such variety in tone quality and touch is possible in playing the piano, does it not follow that touch could be a strong factor in tuning?"

The situation soon drove me to research just what was happening physically and mentally in the technique and production at the piano. I wanted to know how pianists could produce such a huge sound that was completely free of distortion, or how they could play with such a controlled mellow sound on a piano that was voiced quite brightly.

I remember the first time I tuned for Eugene Istomin at Orchestra Hall. I found him practicing the day before the concert when I came to work on the piano. I introduced myself and mentioned that I was looking forward to his recital the next day. "I'm not," he replied in an unfriendly voice. It was apparent that he was unhappy with the piano.

I insisted that the piano sounded beautiful when he played it. "Yes," he said, "but I have to play like I am walking on eggs to make a good sound." He was not happy having to adjust his touch to make the desired sound on a piano that

was too brilliantly voiced.

Another experience several years ago with one of my own students was most revealing. This young lady loved the 7-foot Mason & Hamlin double B in my studio. Though it was voiced on the brilliant side, she had no trouble producing a lovely sound on it. When she began practicing her pieces on the 7-foot Yamaha in our auditorium in preparation for her senior recital, she was not able to produce a lovely sound. The touch that produced a desirable sound on the Mason & Hamlin produced a very undesirable sound on the Yamaha.

At first she complained bitterly about having to play her senior recital on such a terrible sounding instrument. I reminded her that other pianists were able to produce a lovely sound on the Yamaha, and that she could, too. Part of being a successful pianist was learning to adjust the touch to produce the desired sound on whatever piano was being played. Fortunately for her and me she accepted the challenge and played a lovely senior recital on the Yamaha. If such variety in tone quality and touch is possible in playing the piano, does it not follow that touch could be a strong positive or negative factor in tuning? There are two basic factors to be considered when determining the touch to be used for tuning: 1) the stability of the tuning, and 2) the ability to hear the beats clearly.

In addition to proper setting of the pin, stability is achieved when the note is struck hard enough to equalize the tension in the various segments of the string. If this equalization is not accomplished in the tuning, it certainly will be at the first hard blow of the performer, which will untune the string. Obviously, one must tune with a solid blow to achieve tuning stability. To tune with a softer blow in order to hear beats, and then test with a harder test blow does not seem logical. The soft blow will not equalize tension. Therefore the hard test blow, just like the performer's first hard blow, will put the string out of tune again. This cycle could be repeated several times without success. It would seem that stability can only be achieved by tuning with a hard, solid blow.

There cannot be two different tuning touches, one for stability, and one for hearing. Since the tuning stroke must be a hard blow for tuning stability, it is imperative that the tuner learn to control the touch so that the tone is free from distortion and the beats are clearly heard.

There are three points in the tuning process where it is helpful to listen to beats: 1) before the note is tuned in order to know where and how much to move it, 2) during the tuning in order to follow the string to its correct position, and 3) after it is tuned for a final check on the tuning accuracy. At points 1 and 3 where stability is not a factor, any stroke may be used, but point 2 is critical as both stability and hearing are involved. The loud sound from the solid blow must be clear and free from distortion so that the ear can readily follow the beat as it changes from the untuned to the tuned position.

In light of the above, it does not make sense to tell a student to strike the notes more softly so that the beats can be heard better. If the student's loud stroke is so harsh and distorted that it is difficult to hear the beats, it would be better to say, "Learn to strike the notes loudly without distorting the tone and you will hear the beats even better than when using the soft touch." The one touch will then be best for both tuning stability and hearing.

Much of the problem of hearing beats is not a problem of the ear, but rather a problem of touch. One way to improve the ability to hear beats is to develop a better tuning touch.

Artists spend years developing a controlled touch that will enable them to play loudly without banging or distorting the tone, play softly without losing tonal fullness and body, and play with a variety of tone colors on differently voiced instruments. It is foolish to assume that a technician can develop similar control in five minutes or even in five easy lessons. There are, however, basic principles that one can apply to the tuning touch that can greatly improve the sound and the ability to hear beats.

The physical movements involved in producing the ideal piano sound can be as complicated, or perhaps more so, than those in pitching or hitting a baseball, swinging a golf club, or the movements involved in any physical sport. The two physical factors affecting piano sound are speed and weight—how fast the key is depressed and how much weight is used to depress it. These two factors can occur in any number of combinations. Other considerations are the relaxation tension of the wrist, finger, elbow, shoulder and body.

The greater the weight and the slower the stroke, the more desirable the sound for tuning. A pencil must strike a key very rapidly to produce much sound, but a 100-pound weight dropped into a key very slowly will produce a huge sound. Since more weight is desirable, the stroke should be a whole arm stroke, not a finger, wrist, or forearm stroke.

The source of energy should be the back. Some say the seat or even the bottoms of the feet should be the source. The idea is to get the whole body involved. More body involvement means a greater amount of weight is involved. The effect of still greater weight can be achieved by increasing the amount of physical energy involved in the stroke. This can be done without necessarily increasing the speed of the stroke. Pianists produce huge, beautiful sounds using the whole body with tremendous physical energy in a very slow stroke.

> "Much of the problem of hearing beats is not a problem of the ear, but rather a problem of touch."

The finger as it strokes the key should be firm enough to transmit all the energy from the arm and body into the key, but should not be rigid or stiff. The finger need not be held stiff as it approaches the key, but held in a loose position so that the joints develop a natural firmness and resistance when contacting the key.

Greater accuracy and control are possible if the stroke begins with the finger quite close to the key. Some methods maintain that all strokes should begin at the top of the key. Two or three fingers held loosely together may be more effective when tuning unisons.

An important factor in eliminating harshness and rigidity in the sound is the ability to stop the downward force of the arm the exact instant the finger touches the bottom of the key. Any energy exerted beyond this point is superfluous, and can only cause a stiffness of the arm and hand. This instant stop is effected with a loose wrist, elbow and shoulder. They act as shock absorbers when all the energy comes in contact with the bottom of the key. The arm should remain very loose and relaxed after the stroke is completed.

An important part of the whole body involvement is providing a stable support from which the arm swings. Thebody should not be held stiff or tense, but should respond with natural resistance to movement as the arm descends. Do not let the body tighten more than the natural tension before, during, or after the stroke. To understand how this natural body tension should feel, sit up straight and slap your open palm hard on your knee or a table and observe the natural body response. I like to sit tall, assuming the position of a singer with proper breath support. The same principles can apply when standing to tune, although some modification may be necessary.

Another factor affecting tone color is the balancing of the volume of notes struck at the same time. Artists spend much time working on balance whenever two or more notes are struck together, as it greatly affects the overall sound. Notes struck at the same volume tend to lose their individual character. In tuning, greater emphasis on the top note can improve the sound and make the beats easier to hear. This is especially true when listening to 17ths.

A little experimenting with the principles set forth herein should lead to a vast improvement in the tuning touch. It should soon be possible to strike the note being tuned with a strong blow that will equalize the tension in its various segments, yet produce a tone so clear and free from distortion that one can easily follow the beat from the instant the note is struck until it reaches its correct position. This sound should also be less tiring on the ears. The final result should be that the piano will stay in tune longer and sound better as well.

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Ron Berry
Indianapolis Chapter

Mathematical calculations have always been the realm of computers because computers 'think" by using numbers. Using a computer to replace a desktop calculator to add up checks for a deposit is not all that practical or even easy unless you have a program which makes the computer function as a simple calculator.

However, a computer can easily handle some large-scale calculations that would be very difficult on a calculator. Piano-string scaling is one such example. This can be done with a programmable calculator such as the T1-59 as used for tuning tests, but the calculator prints out the information in a long tape. You have to transfer the data to a chart to make it easily readable. A computer easily handles input and output formats and gives you a report in most any form you want.

A spread sheet program works with a grid of "cells." Cells are places that hold information which can be defined. For example, a cell can hold the speaking length for one note or it can hold the formula for tension. In the case of a formula, the computer knows to look in the cells that have the length, diameter and note number to do the calculation. The spread sheet I have allows up to 64 columns and 256 rows. However, complicated formulas may reduce spread sheet size depending on the amount of RAM in the computer The spread sheet also allows linkage of sheets and therefore separation of data onto two sheets with the ability to transfer data between sheets if necessary.

Obviously a 64 x 256 spread sheet can't be viewed all at once on the screen unless there are awfully small letters. This problem is solved by scrolling. Picture looking at this large spread sheet through a window which allows you to see a part of the data. This window can be moved around to any part of the spread sheet thus giving access to the whole sheet.

You can even split the screen into several windows which allows different parts of the spread sheet to be viewed at the same time. There is also the ability to freeze titles along the top and sides so as you scroll to other parts of the spread sheet, the titles remain fixed. Sheets also can be linked so that information calculated on one sheet is transferred to a specific location on another sheet each time you call it up.

I use this feature on the spread sheets I set up for my business accounting. I have two income sheets and several expense sheets. The running totals were transferred from each sheet to the next and the totals from the last income and expense sheets were transferred to a summary sheet to give net profit.

Spread sheets can do some operations like sorting that a data base can. Information on a spread sheet can be arranged by date, for example. The program would keep each row of information together but will sort entire rows by date or alphabetically, for example.

Some spread sheets allow certain areas of data to be labeled. If column 5 has all your telephone expenses, you can define "PHONE" to be Column 5 from row 1 to row 250. To total all phone expenses at the bottom of Column 5, define a cell as "SUM (PHONE)." This technique provides easily remembered labels rather than entering a formula such as "SUM(R1:250C5)."

When you print a spread sheet that is 64 x 256 obviously it won't fit on one piece of paper. With many spread sheet programs you can define sections of the spread sheet to print. It will print strips of paper with as many columns as will fit on the paper from row 1 to 256. This takes several pages. To print all columns, it starts again with row 1 and prints the next group of columns. It repeats this process until finished.

At first, I used to use my spread sheet for my business accounting, but I wanted one system that would keep customer records as well as accounting. Using an integrated program such as Lotus 1,2,3 or Appleworks allows you to use a spread sheet approach but also provides some database functions.

I chose another route and found a data base that can handle calculations. The calculations involved in business accounting are not complicated so this approach works well. The calculations involved in piano scaling are quite complicated so the spread sheet is the best choice to do this job.

Next month I will discuss data bases. ■

AT

LARGE

Passing the Tuning Test

Jim Coleman
Phoenix Chapter

Your test piano will probably be a 6-foot or larger Grand. The piano will have been tuned by a committee of three, one of whom is a Certified Tuning Examiner. The top octave is tuned as simple 2-1 octaves to avoid human judgement as to personal stretching preferences. All other octaves follow normal tuning procedures. (There is enough tolerance in the scoring system to accommodate most individual stretching procedures). This Master Tuning is read by an approved electronic tuning device and the record is preserved in written form and stored in the computer (or on hand-scoring forms) for comparisons during exams.

The piano will have been detuned carefully so as not to upset the normal tension balance. The entire piano will be strip muted. You are not to remove the strip yourself (for fear of disqualification) until later for unison tuning only.

Those who tune entirely aurally will first tune all of the center strings of the piano by ear. A score of 80 percent is required in each of the eight sections of the test (Pitch, Temperament, Midrange, Treble, High Treble, Bass, Unisons, and Stability). Those who normally tune with an electronic aid will first tune all of the center strings of the piano using the electronic aid. The unison section must be tuned by ear alone. A score of 80 percent is required in each of the eight sections of the test. Then you will be required to retune octaves 3 and 4 (Mid-range) completely by ear as customer insurance against possible instrument failure. For this, a 70 percent score will be required instead of 80 percent.

In our daily work, the order of importance in tuning is probably reverse from the main sections of the test, (Temperament, Octaves, Stability and Unisons). Therefore, we will proceed in this fashion:

Unisons

The most important thing in tuning is unisons. It is imperative to have the tuning pin positioned in the right place and in equilibrium in conjunction with having the pitch of the string exactly where you want it after the key has been pounded

firmly. Normally a string is raised slightly above pitch (depending upon the hammer position and the hammer technique) and then settled back slightly as the key is pounded and the tuning pin is adjusted to equilibrium position.

Those who have electronic aids may test unisons themselves by muting off all but the left string, recording its cents value, then doing the same for each of the other two strings, and then writing down the differences between left and center then center and right strings.

When you can maintain all unisons in the mid-range within a tolerance of .3 cents that is good. It's not perfect, but you will pass this portion of the test. Of course, Unison tuning must be done strictly by ear.

Stability

Stability begins with setting the pitch and tuning the temperament. (Remember, your pitch will be scored after you finish all the octaves, so you better set things well at the start). String settling and "pin setting" as described above is especially important when tuning the first string of each note (center string).

Slightly more key pressure should be used here than in unison tuning later. Many people do it just the opposite and thereby destroy their beautiful temperament with excessive pounding. Your stability will be tested by dropping an eight-ounce weight from six inches above the key three times and then measuring the string to see if it has settled 1 cent or more.

Over zealous or excessively heavy pounding during tuning can cause the pitch to rise later. Consistency is what is needed here. Pressure which is only slightly more than will be used in the testing procedure is sufficient.

Pitch Setting

During the test an accurate A-440 tuning fork is essential. Anything else used will be to your disadvantage. There is only one officially recognized pitch and that is A-440. If you use a C fork, you do not know how much inharmonicity is involved in the strings of your note C or your note A when you are tuning by ear. Also there is a possibility your temperament will be slightly skewed increasing the error of the note A.

There is a 1 cent error tolerance at the fundamental or first partial of A-440. Any error beyond that will accumulate points which will lower your percentage score. Here is the best way to ensure that you will tune the A accurately.

Make sure that your A fork has recently been tuned to a good Quartz crystal frequency standard such as the Sanderson Accu-tuner. File the ends of the tines to raise pitch; file the inside surfaces near the base to lower the pitch. Remember that filing heats up the fork, so allow temperature to stabilize before final adjustments. I like to have my fork in tune at face temperature (armpits work fine too).

Tune A-49 to your fork making sure that the string and pin are well stabilized. Mute off all but one string of F2 or note 21. Play F2 and sound fork. Listen to beat rate of this 17th interval. (If necessary, tune F2 to where the beat rate is easily recognizable.) Then refine the tuning of the A until the beat rate of F2 and A4 is the same as F2 and the Fork. This procedure eliminates the usual confusion provided by other partials of the string or the Fork. If you keep these two 17th intervals within 1/4 beat per second of each other, and your stability remains good, you will get 100 percent on your pitch score. If you get within a 3/4 beat per second comparison, you will barely pass.

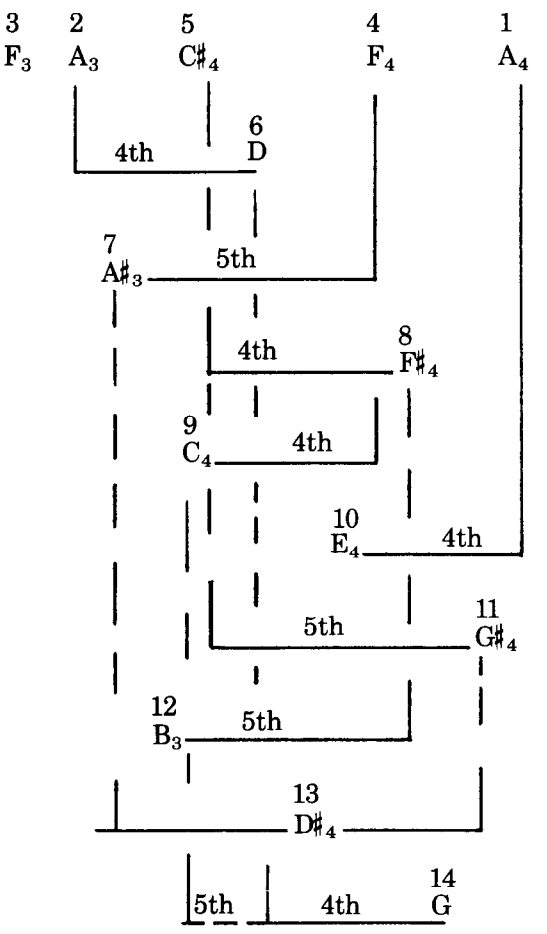
Temperament

1. Tune A4 440 using tuning fork and and F2; F2-fork = F2-A4.

2. Tune A3 to A4 octave such that F3-A3 3rd is .5 BPS slower than F3-A4 10th.

3. Tune F3 to A3 approximately 7 BPS wide. Metronome 104 X 4 beats.

Coleman A to A Temperament



Tests

Balance 3rds with 3rd-10 octaves F-A

F-A 3rd, F-D 6th

A♯-D, A-C♯
C♯-A♯ 6th, C♯-F 10th; A♯-C♯, C♯-F

A-C♯ 3rd, A-F♯ 6th; C♯-F, D-F♯

C-A 6th, F-A 3rd; (C-A = D-F♯)

C-E 3rd, C-A 6th

C♯-E, E-G♯
E-C♯ 6th, E-G♯ 10th; E-G♯, F-A

D-B 6th, D-F♯ 10th; B-D, D-F♯

B-D♯, C-E; A = F♯, B-D♯; Balance 4ths

Balance 4th, 5ths; //3rds, //6ths; 3rds, 6ths

4. Tune F4 to F3 octave such that C♯3-F4 10th is .5 BPS faster than C♯3-F3 3rd F4-A4 3rd should be approximately 14 BPS wide.

5. Tune C♯4-F4 3rd to balance with A3-C♯4 3rd; the ratio of each of the four 3rds should be 1:1.26 (4:5). If F3-A3 is too slow and A3-C♯4 is too fast, the F3 must be lowered along with F4 and the C♯ must be raised but not so much that C♯4-F4 is too close to the beat rate of F4-A4. Time spent at this point pays rich dividends later. Approximate beat rates are: F3-A3 = 6.93; A3-C♯4 = 8.73; C♯4-F4 = 11; F4-A4 = 13.86.

6. Tune D4 to A3-4th (approximately 1 BPS) on wide side of zero. Check to see that F-D 6th is 1 BPS faster than F-A 3rd.

7. Tune A♯3 to F4-5th (approximately .6 BPS) on narrow side of zero. A♯3-C♯4 should be almost 1 BPS faster than C♯4-F4 and C♯3-A♯3 6th should be approximately 1 BPS faster than C♯3-F4 10th. Then A♯3-D 3rd (9.25 BPS) should beat slightly faster than A3-C♯4 (8.73 BPS). This is the first check on steps 5 and 6. Correct if necessary now.

8. Tune F♯4 to C♯4-4th (approximately 1.26 BPS) on wide side of zero. See that A3-F♯4 6th is 1.26 beats faster than A3-C♯4-3rd. D4-F♯ should be 1.06 times faster than C♯4-F. This is an additional check on steps 5 and 6.

9. Tune C4 to F4-4th (approximately 1 1/3 BPS) on wide side. See that C4 to A4 6th is slower than F4-A and about the same as D4-F♯.

10. Tune E4 to A4-4th (approximately 1.6 BPS) on wide side. Also E4 to A3-5th should be about .6 BPS on narrow side. Test C4-E 3rd to be slower than C4-A 6th and C3-A 6th to be faster than C3-E4 10th. Compare parallel 5ths A3-E4 and A♯-F4.

11. Tune G♯4 to C♯4-5th less than 1 BPS on narrow side of zero. See that E4-G♯ 3rd is slower than F4-A and faster than D4-F♯. E3 to C♯4 6th should be faster than E3 to G♯ 10th and C♯4-E is faster than E4-G♯. This completes the tuning of the primary 4th and 5ths. Up to this point each 4th or 5th was tuned directly from one of the original balanced pivot tones A, C♯, F, A. This eliminates accumulation of minute errors. The three remaining secondary 4ths and 5ths with their corresponding checks will complete the temperament.

12. Tune B3 to F♯4-5th (approximately .83 BPS) on narrow side of zero. See that B3-D4 3rd is faster than D4-F♯ 3rd and D3-B 6th is faster than D3-F♯4 10th. B3-F♯4 should be faster than A3-E4 and slower than C♯4-G♯. The B3-E4 4th (approximately 1.1 BPS) should compare well with neighbors.

13. Tune D♯4 to A♯3 and balance D♯4 to G♯ such that B3-D♯ equals beat rate of A3-F♯4 and is faster than A♯3-D4 and is slower than C4-E.

14. Tune G4 to D4 such that C4-G fits between B3F♯4 and C♯4-G♯. A♯3-G4 should fit between A3-F♯4 and B-G♯ 6ths. D♯4-G should fit between D4-F♯ and E-G♯ 3rds. All major 3rds should now fit into a smooth ascending progression from A3-C♯4 to F4-A. The same with the 6ths A3-F♯ to C4-A. The 4ths and 5ths should not exhibit noticeable change in beat progression.

Octaves

Tune octaves down to the bass break using the M3rd-M6th test along with all other available test intervals and try to slow down the 5ths as much as the octave sound will permit.

Tune octaves above the Temperament using almost pure 5ths, busier 4ths, slightly stretched octaves and using the M3rd-M10th test such that the 10th is no more than a half beat per second faster than the 3rd. It is not desireable to maintain the 3rd-10th test up to octave 6 because it would force too much stretch.

By the time you get to E5 or F5 you should have completed your transition from using the 3rd-10th test to using the 3rd-17th which is the proof of good double octaves. At first, when using the 3rd-17th, you may allow up to 1 beat per second greater speed in the 17th, but you should gradually eliminate the difference by the time you reach E6. (Less difference in the 3rd-10th and the 3rd-17ths is required in low inharmonicity pianos such as Yamaha and Kawai.)

Before you reach C7 there should be a definite compromise between the A5-A6 single octave and the A4-A6 double octave. From C7 on up the single octaves should be kept pure (for purposes of the test requirement). A good test for this condition is to have equal beat rates between the G♯4-C6 and G♯5-C7 10th -17th test. In all of the treble octave tuning, the 5ths and 12ths (octave + 5th) will be rather quiet. In the top half of octave 7 another test which is easier to hear (slower beats) is that the octave-5th interval must always be slower that the double octave-5th (If you tune too sharp, the octave-5th may be on the wide side and the double octave 5th would be almost pure.) If you really get lost up there in the stratosphere, you can play diatonic scale portions or even whole tone scale patterns to get back to reality.

Bass Octaves

Going down into the upper part of the bass, the M3rd-M6th test is a safe guide (this is 6-3 tuning). Almost pure 5ths and rather quiet 4ths are some help in the upper bass, but carefully graduated 10ths and 17ths give a little more precise tuning. Listening to the ghost tones (George Defenbaugh's term—see Tuning Up, September 1987 *Journal*) is very useful in producing even graduations.

There will be some compromising necessary when the upper note of your test interval crosses over from the plain steel strings to the copper wrapped bass strings. In the lower part of octave 1 the 10ths and 17ths are rather slow and the double octave-minor 7th is of some use here on down to C1. 8-4 tuning works well from the highest single bass strings on down. The complimentary intervals M6th-M3rd of an octave especially when touching the note of the ghost tone two octaves above the upper note of the octave being tuned is also helpful. ■

AT
LARGE

Beats: What They Are And Where They Come From

Ron Berry
Indianapolis Chapter

Perhaps the most important thing to the proper tuning of a piano is the phenomenon of beats. Without them piano tuning would not be possible at all to the accuracy which we can achieve with their aid. However, it seems that beats are really little understood by most tuners and that it is worthwhile to discuss what beats are and where they come from. We are often fooled by beats when we think we hear the proper beat rate and find out later that what we heard was actually a different beat than we are used to listening to.

First we need a definition of a beat. I might venture the following: *the physical interference between two tones or harmonics of tones which have nearly the same frequency.* This interference is heard as a variation in loudness at a frequency which is equal to the difference between the frequencies of the two tones. For example, a tone of 440 Hz. and a tone of 441 Hz. would produce a sound whose loudness increases and decreases at a rate of 1 Hz. or 1 bps.

To begin our examination of beats, let's begin with the simplest interval used in tuning, the unison. (At least it appears to be the simplest at first glance, but we will see later that it is more complex than first appears.) The beat that occurs when tuning a unison is basically what we showed above in the definition. That is, a beat occurring between two fundamental tones which are slightly different in frequency.

Naturally, the goal in unison tuning is to eliminate the beat entirely. This is one of the few times that a tuner actually uses the fundamental tone of the string in tuning. The fundamental is used sometimes in octave tuning and the most notable time is in the use of an electronic tuning device. When using such a device with the method of setting the device for the appropriate key and then tuning to stop the pattern, the tuner sets the fundamental tones of the strings to the theoretically correct values which are set up in the device.

On the other hand, an aural tuner almost never tunes the fundamental, but rather the higher partials produced by the strings. Coupled with the effect of inharmonicity, this accounts for the difference in the two types of tuning. Newer mehtods of using electronic tuners are being developed which use them to tune the same partials used in aural tuning. These methods will lessen the difference between the two types of tuning, but they require a complete knowledge of aural tuning and of where beats heard in aural tuning occur. I hope the following discussion can help clarify these matters.

Before proceeding to other intervals, we need to clarify exactly what partials are and where they are. A vibrating string produces not only its fundamental tone, but also many higher tones called partials. These partials should occur at whole number multiples of the fundamental frequency. However, we have all seen many discussions of inharmonicity and the fact that they occur at slightly higher frequencies than where they should.

However, for this discussion we will ignore inharmonicity and locate these partials only in an approximate way. Please refer to the first entry in Figure 1 where I have shown in musical notation the approximate locations of the first eight partials of the tone F2. Keep in mind that these tones shown are only guides to help us find the partials and are not exactly the same as the partials themselves.

The human ear has a way of taking a series of partials and hearing them as one tone governed by the relative intensities of the partials. The ear also has the capability of separating out the individual partials if it knows where to listen first. Play F2 on a piano, hearing it as a single tone. Then play F3 an octave above and, remembering

that sound, play F2 and listen for the second partial of F2. Similarly, play C4 or middle C and remember its sound, then play F2 and hear the third partial of F2. Continuing this way, you should be able to locate the first eight partials shown here.

Let us now go on to the next larger interval used in tuning, which is the minor third. If we use the minor third composed of F3 and Ab3, we can find in tables of frequencies that the frequency of F3 is 174.61 Hz. and the frequency of Ab3 is 207.65 Hz. These two tones have a difference of 33.04 Hz. This is much too fast for us to hear as a beat so we must look elsewhere to explain the very distinct beat we hear when the tones are played together.

Now please refer to the second entry in Figure 2 which is labeled min 3. For ease in fitting the music notation within the staff I have chosen intervals in the lower

Figure 2

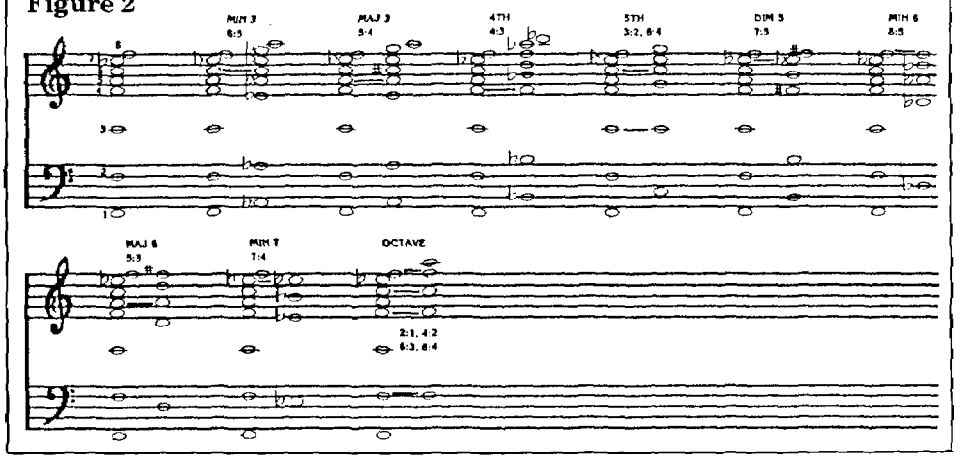


Figure 1

In general, we can say that the partials of a tone are the following:

1st partial	The fundamentals
2nd partial	One octave above the fundamental
3rd partial	One octave and a fifth above the fundamental
4th partial	Two octaves above the fundamental
5th partial	Two octaves and a major third above the fundamental
6th partial	Two octaves and a fifth above the fundamental
7th partial	Two octaves and a minor seventh above the fundamental
8th partial	Three octaves above the fundamental

There are many more partials above these but the first eight will be enough for this discussion.

part of the piano's range, but the principle applies throughout the entire range. Notice that above each tone the partials produced by that tone are shown. Of particular importance is the fact that both tones have the C above middle C in their series of partials.

Play a minor third and listen to the beat, then play the tone which is two octaves and a fifth above the lower tone; then, remembering that sound, listen again to the beat in the minor third and you can verify that this is where the beat occurs. This beat is happening between the sixth partial of the F and the fifth partial of Ab. We could therefore say that a minor third has a ratio of 6:5.

Again using calculations, the sixth partial of F3 would be 174.61 X 6 = 1047.66. And the fifth partial of Ab3 would be 207.65 X 5 = 1038.25. These two tones would then have a difference of 9.41 Hz. and would therefore produce a beat of that frequency.

Continuing on to the next larger interval, we find the major third, which is labeled maj 3 in Figure 2. Notice that the tones F and A have a common partial at the A above middle C. This is the fifth partial of F and the fourth partial of A, so a major third has a ratio of 5:4.

Here also we an calculate and find that the fifth partial of F has a frequency of 174.61 X 5 = 873.05, and the fourth partial of A has a frequency of 220 X 4 = 880, which produces a beat of 6.95 bps.

Proceeding, we come to the interval of a fourth and find by aligning the series partials that F and Bb have a coincident partial at the F above middle C. This is a match of the fourth partial of F and the third partial of Bb, so a fourth has a ratio of 4:3.

Next we come to the interval of a fifth and find an interesting situation. By aligning the partials we find that F and C have a coincident partial at middle C and another coincident partial at the C above middle C. So we have one beat where the third partial of F and the second partial of C coincide, thus a 3:2 fifth; and we have another beat where the sixth partial of F and the fourth partial of C coincide, thus a 6:4 fifth.

The big problem here is that the 6:4 beat beats twice as fast as the 3:2 beat so we must be certain which beat we are hearing when we set it at 3 beats in 5 seconds.

Using our previous type of calculations, we find the third partial of F to be 174.61 X 3 = 523.83, and the second partial of C is 261.63 X 2 = 523.26. This makes a difference of .57 bps. Now the sixth partial of F is 174.61 X 6 = 1047.66 Hz., and the fourth partial of C is 261.63 X 4 = 1046.52, making a difference of 1.14 bps.

If we add the fact that inharmonicity affects the higher partials more than the lower, we can see where we might run into problems unless we are very aware of which beat we are hearing. The beat rates which we find in books for the fifths in equal temperament are all based on the lower match of partials, or the 3:2 ratio, so this is the beat we need to listen to in setting fifths.

Between the fifth and the fourth is the tritone, augmented fourth or diminished fifth. Although this is not normally used in setting a temperament, it does have a distinct beat which is fast enough to make it usable in the bass portion of the piano, where the beats of other intervals are very slow. Referring to the chart and the interval labeled dim 5, we find a match between the seventh partial of the F and the fifth partial of the B.

Likewise, with the major and minor sixths and the minor sev-

enth, we find ratios of 5:3, 8:5 and 7:4, respectively. The chart shows the relative position of the beat for each of these intervals. The minor seventh has an extremely fast beat and is undiscernable in the middle and upper ranges of the piano. But it, like the tritone, can be helpful as a check test in the bass by making sure that the minor sevenths or octave minor sevenths have a decreasing beat rate when descending the scale.

One other interval which does not even occur in equal temperament can be found by referring to the minor third again in the chart. We discussed earlier that a beat can occur at the C above middle C, or a ratio of 6:5. Notice also that the two sets of partials also both include Eb above that C. This is where the fact that these notes are only approximations of the real partials comes into play. This beat, occurring between the seventh partial of the F and the sixth partial of the Ab is not audible until the minor third is narrower yet and the 6:5 beat becomes so fast that it becomes more of a buzz. Only then do we hear the next set of partials begin to beat, and we have an interval called a small minor third. This interval is used in many of the historical temperaments, but not in equal temperament.

One very important interval which we have neglected up to this point is the octave. This seems to be one of the simplest, and yet is one of the most complex intervals we will examine. Referring to the octave in the chart, we find that there are four different places where beats occur.

These are where the second partial of the lower tone meets the fundamental of the higher, or a ratio of 2:1, also where the fourth partial of the lower tone meets the second partial of the higher, or a 4:2 octave; likewise we have beats at the 6:3 and the 8:4 partial levels. The difficulty lies in the fact that inharmonicity affects the higher partials to a greater degree than the lower partials, which means that it is impossible to make an octave beatless at all these different partial levels simultaneously. How we go about solving this dilemma has been covered before in the *Journal* and is beyond the scope of this article. When we match the octave at the higher partial levels it is actually more stretched than it would be at a lower partial match.

But, by being aware of just where these beats are occurring, we can control exactly how much we stretch an octave. Also, by knowing the location of these partials, we can use an electronic instrument to measure the partials of the tones instead of the fundamentals, and ensure a beatless octave at any one of these levels.

Finally, we return to the first interval we looked at, which is the unison. We first discussed the beat between the fundamentals of the two tones, but on further inspection, we see that beats occur between all the partials of the tones. Even inharmonicity will affect both tones the same if they are well scaled and matched, ensuring a beatless unison.

However, we have all run into a note, particularly in the bass of cheap, poorly-designed pianos, where we found it impossible to achieve a beatless unison. This happens when, for some reason, the partials of the two tones are not alike, whether the strings be of different length or for some other reason. We then get a beat at some partial level and when we attempt to stop it we find that we have created a beat at another partial level.

Again, how to solve this problem is a matter for another article. We should notice, however, that an error of 1 bps at the fundamental level will cause a beat of 2 bps at the third partial level, and so on. This means that the upper partials are more sensitive, and if we use them in tuning unisons, we can achieve a greater level of accuracy.

Although all this discussion may seem to confuse the matter, the intent has been to point out and clarify a fairly complex situation with which we must live. As new methods are developing for the use of electronic tuning instruments, and we see more articles discussing 2:1 octaves as opposed to 4:2 octaves, these fundamentals of musical acoustics are absolutely necessary. ■

Restoring Antique Pianos: Part IV Making Looped Strings, Clamping and Woodworking Techniques

Edward Swenson
Ithaca College

In the past few months I have had many calls and letters from PTG members regarding their own work on antique instruments. Questions have been raised regarding early music wire, refinishing antique instruments and, inevitably, repair problems associated with square grands. Many questions have dealt with complicated issues such as determining the appropriate pitch for tuning antique instruments. Some of these questions will be considered in subsequent articles. I am grateful for the continuing interest in these articles and for the opportunity to exchange ideas.

In May I was in Germany and Austria for three weeks. My trip was funded by a Winnipeg foundation which is planning to bring an antique Viennese concert grand to North America. Because the piano needs some repair I was sent to appraise the instrument and evaluate its condition. The piano was built by the famous firm J. B. Streicher Co. in 1866 and has been in the same family since it was purchased at the factory. (Illustration 1)

The instrument was a wedding present for a talented Austrian pianist who went to the Streicher factory with her piano teacher, who helped her select the best instrument. Her piano teacher was Johannes Brahms. I will report more about this unusual

Illustration 1

instrument, which Brahms autographed, when it arrives in my shop in the fall. Fortunately, the instrument still retains most of its original parts, including the original strings and hammers. When restored, it should be an ideal instrument for the performance of Brahms' piano music.

During my stay in Europe I visited the Renner Co. in Stuttgart, Germany. The Renner catalogue of tools and parts contains some items which are not immediately available through suppliers in the United States. I was surprised, for example, to discover that Renner continues to make hammershanks and flanges for older Steinways in which the knuckle is located 14 mm. from the flange center pin. To the best of my knowledge, U.S. supply houses and Steinway in New York are currently only supplying Renner hammershanks for Steinway's newly modified grand action in which the knuckle is located 16 mm from the center pin. One has to go through all types of contortions to make these parts work in old Steinways.

Among the Renner tools which are particularly helpful to the restorer of early instruments, I recommend the string looping machine (senschlingmaschine) Nr. 1506a. Most early pianos had individually looped rather than wrapped-around stringing. Making perfect loops in soft brass and low-carbon steel music wire without the proper equipment, is a tedious and wasteful operation, as the soft wire tends to break.

The beauty of the Renner machine is that the looping hook is located in a geared shaft which eliminates the problem of overstressing the loop. It is possible to make an exact duplicate of an original looped string by counting the number of coils in the original loop and then counting the number of revolutions of the looping handle. The machine makes perfect, identical loops and won't break even the softest wire (Illustrations 2-4).

A few weeks ago a modern "historical" instrument came into my shop for repair. Constructed by Philip Belt, the piano is a replica of Mozart's 18th-century fortepiano built by Anton Walter in Vienna. This instrument was used by American pianist Malcolm Bilson

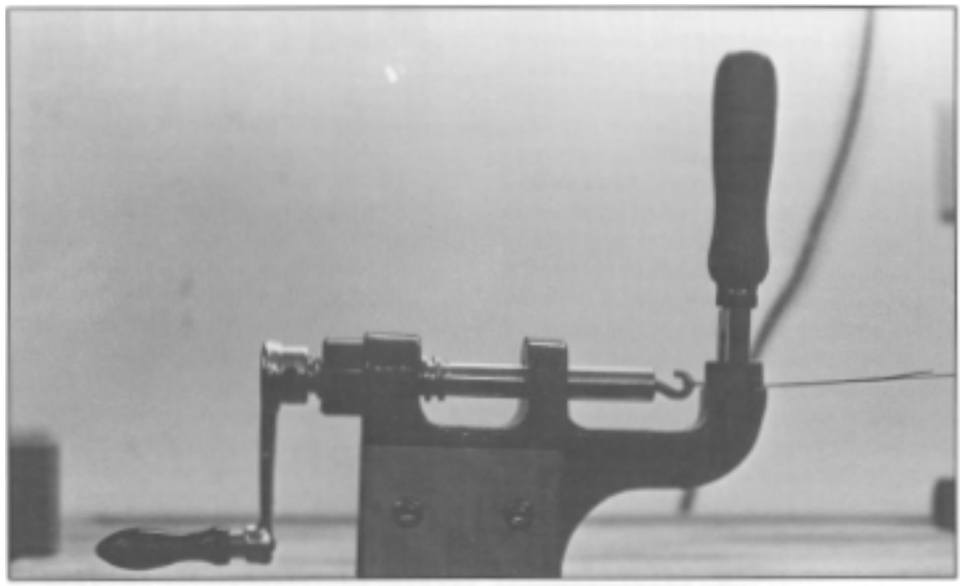


Illustration 2

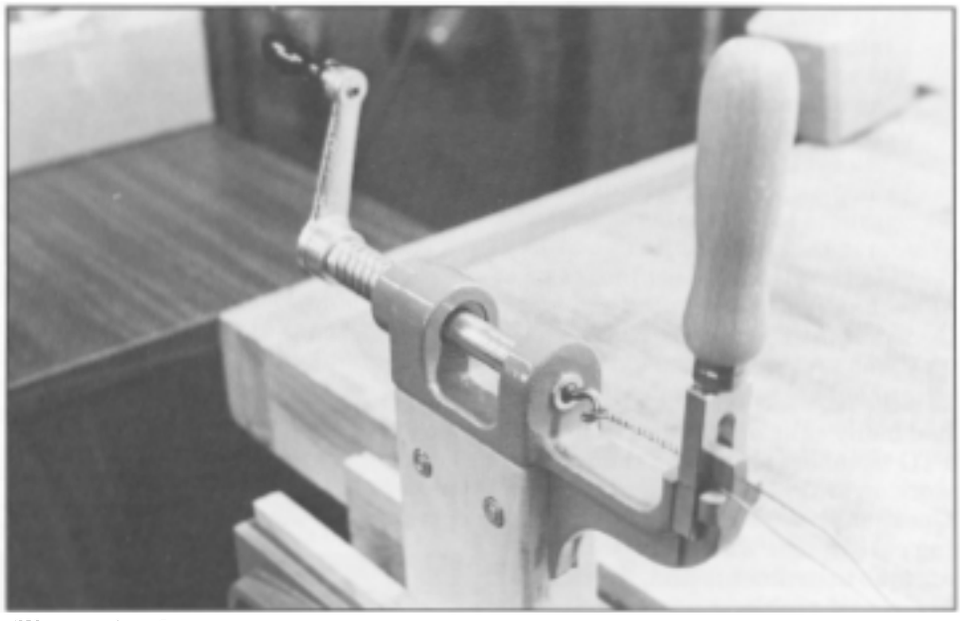


Illustration 3

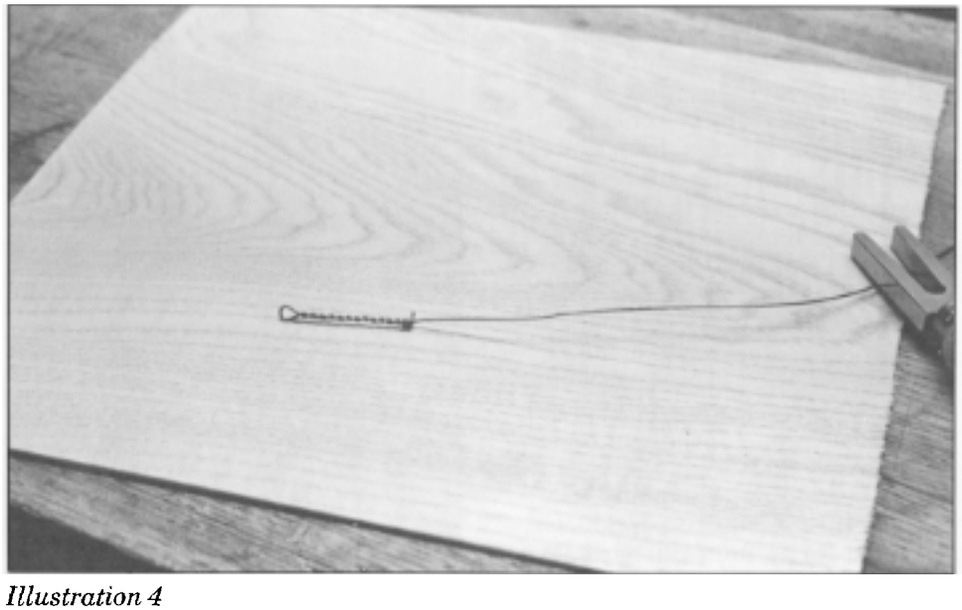


Illustration 4

in his recent recordings of the complete Mozart piano concertos on the Deutsche Grammaphon "Archiv" label. On its return journey to the United States from London, where the recordings were made, the piano was dropped, resulting in serious damage. Several deep cracks had opened in the spine, the top hinges had pulled out of the side and the soundboard had cracked at the end of the bridge.

The clamping system used in repairing the instrument is shown in Illustration 5. Working with an assistant, we gently worked the spine back and forth while feeding glue with a thin spatula into the deep cracks which ran the entire length of the spine. The bass cheek of the instrument had also separated from the keybed and had to be reglued. To provide protection from the clamps, soft strips of leather were positioned between the clamping blocks and the finish. In places where glue might squeeze out and bond the leather to the case, a layer of waxed paper was placed between the leather and the case wall as a precaution. The stripped hinge screw holes were drilled out using a brace and bit and 3/8-inch spruce plugs were glued into the holes.

At the end of the bridge the soundboard had cracked and the bridge side of the soundboard had lifted slightly. When the bridge was lightly depressed by hand, the crack in the soundboard closed completely. Illustration 5 also shows the clamping arrangement used to repair the crack and level the soundboard. A wooden strut was clamped horizontally across the instrument above the bridge. A vertical piece of wood, applying enough pressure against the end of the bridge to level the soundboard, was then clamped to the strut with a C clamp. After gluing, the crack, which did not require a shim, was completely invisible.

Work continues on the 1841 Bosendorfer concert grand. During my trip to Austria I bought several square meters of Austrian ash veneer from a veneer mill near Salzburg. My plan to save the original veneer along the spine of the instrument had to be abandoned because of the large number of broken and missing pieces.

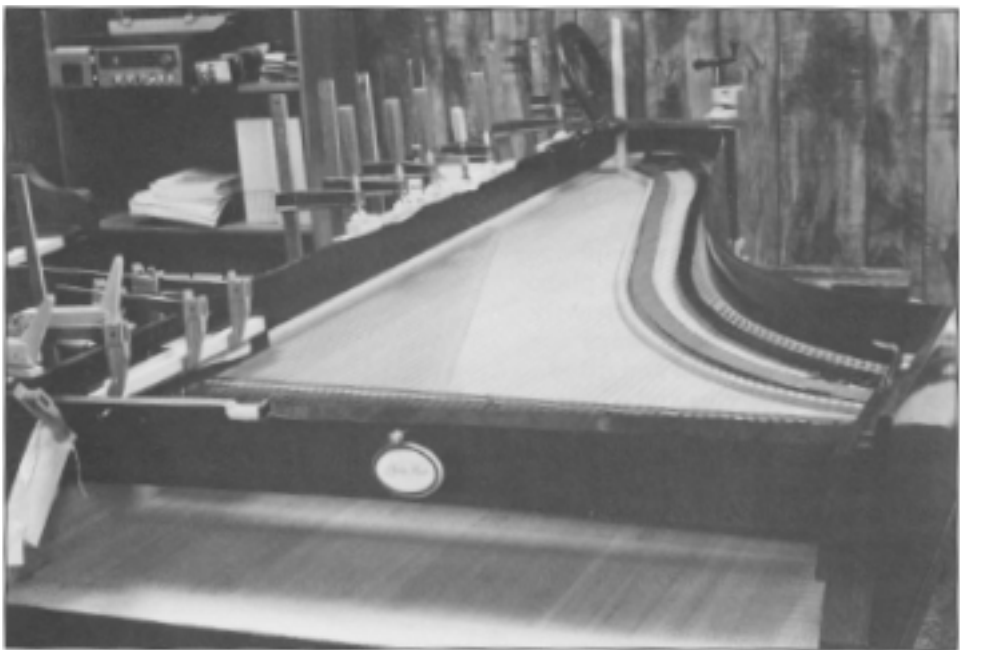


Illustration 5

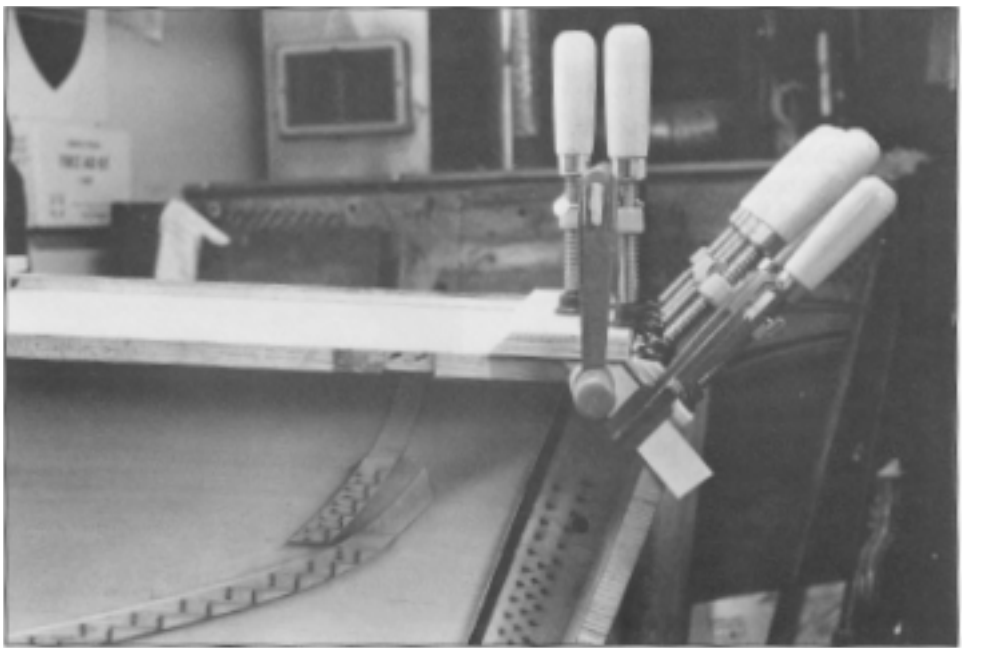


Illustration 6

Instead, all of the veneer on the spine will be replaced with new veneer. The old veneer panels have been removed, numbered and preserved. Before leaving for Austria, I traced the original veneer pattern on a piece of mylar. I was able to locate very similar ash veneer, which was cut to the same width and thickness as the original. The veneer mill cut the panels so they would fit in my suitcase. So far, four new panels have been glued to the spine.

Illustration 6 shows the clamping arrangement for joining the old veneer with the new at the corner of the spine. I will discuss matching the veneer panels, and fitting the joints after the veneering process is finished.

Several other important repairs have been made to the Bosendorfer since my last article. Several soundboard ribs were loose at the spine end of the rib. These ribs had probably been loose for decades, as it took considerable effort to press them back into their original position. I decided to wedge the ribs against the soundboard for a few months before

gluing them back in place. After removing the wedges three months later, the ribs were much more willing to return to their original position under the soundboard.

I have never encountered so many loose ribs in this area of the soundboard and it took some thought to find a way to clamp them back into position. The piano was turned upside down on heavily padded horses. Special clamps were cut out of plywood and fitted between the loose ribs and a brace which runs conveniently inside the instrument along the spine. (Illustration 7). The clamps and wedges were all carefully fitted before gluing.

After preparing a fresh batch of hide glue the night before, the temperature in my shop, which is controlled by a gas furnace, was raised to 85 degrees, giving renewed meaning to the term "sweat shop." The thin spatulas for applying the glue between the soundboard and the ribs were heated in the water liner of the glue pot. Each loose rib and the soundboard area around it were warmed with a heat gun, using a deflector tip to avoid overheating or burning the wood. My assistant and I rehearsed the gluing procedure several times before actually using glue.

Working together, we heated the area to be glued, applied the glue, snapped each clamp in place and cleaned up excess glue with a lightly moistened cloth. The preparation for this work took considerable time, while the actual clamping was done in about fifteen minutes.

While the instrument was turned upside down we also repaired and reglued the sockets for the legs. The legs on many early pianos are attached to the case by means of a large wooden screw, which turns into a threaded socket. On the Bosendorfer, these sockets had come loose and numerous past attempts to repair and reglue them had only resulted in more damage to both the socket and the underside of the instrument.

Illustration 8 shows a leg and its leg socket before repair. We scraped away many layers of old glue and the damaged areas on the underside of the case were gouged

Illustration 7

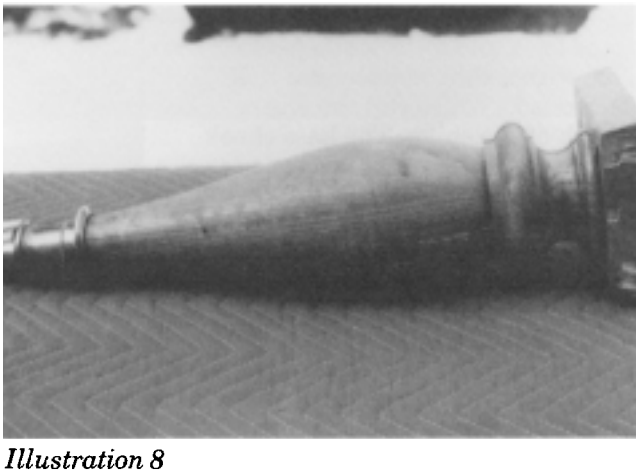


Illustration 8

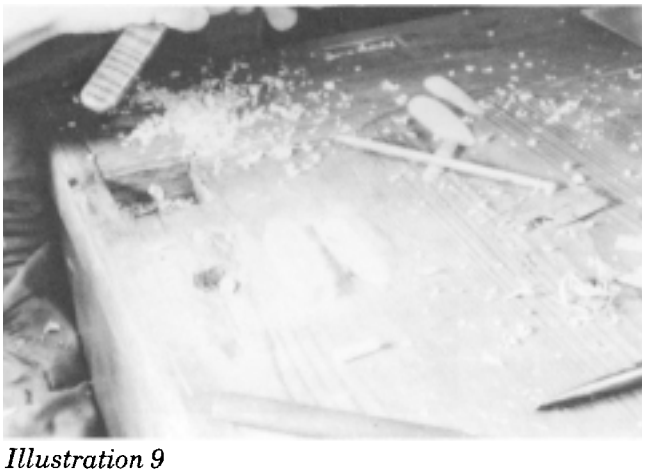


Illustration 9

out and fitted with new spruce (Illustration 9). These new pieces were fitted with great care to the underside of the instrument by first making a mylar template of the repair area and then chalk-fitting the new wood to the bottom of the case, much in the same manner that a pinblock is fitted to the plate flange.

After gluing and planing down the new pieces of spruce, the leg socket, which was slightly warped, was also planed flat and then reglued to the instrument. The damaged veneer on the leg socket was replaced before regluing it to the instrument. I may have been a bit overly painstaking in making this repair, but an instrument with loose and wobbly legs is dangerous, irritating to play and likely to sustain serious damage. Even though the legs have been repaired, we will keep the piano on horses until work is done to avoid unnecessary strain on the delicate legs.

Soon I will finally be able to start putting strings in the piano. I will continue with stringing techniques in my next article. ■

Bearing on the Bass Bridge

Nick Gravagne
New Mexico Chapter

Previous articles have shown that practical downbearing work begins by choosing angles of downbearing and/or their relative deflection dimensions in the *unstrung* piano. A standard (albeit somewhat arbitrary) model downbearing angle of 1.5 degrees has been discussed and shown to be a reasonable approach for an amply crowned soundboard.

Past articles have promised a closer inspection of a few related downbearing ideas: "ballpark" downbearing dimensions and "coin tests" compared; bearing on the bass bridge; formula for bass string tensions; bearing on the old, partially crowned soundboard.

There is more than one path open to the piano technician here. There are inevitable departures from theory and strictness in all life's endeavors; art in general and piano technology specifically are not immune—on the contrary, defensible departures are the very essence of individual expression.

Table 1 compares downbearing angles, dimensions (defined as test string over string rest), and pressure (force in pounds on the soundboard) for three approaches to setting downbearing. The left hand columns are for the 1.5 degree model, the middle columns for the usual quoted "ballpark" dimensions, and the right columns for the "coin test" (dimes, nickels and quarters).

The data assumes average string tension at 160 pounds in the steels and 220 pounds in the bass. The rear string lengths include the bridge top segment and are average. The piano is a 5-foot, 7-inch model. The formatting of the table

Table 1

		1.5° Model			Ballpark			Coins		
Location	Average rear string length	Downbearing angle	Dimension inches	Pressure in lbs.	Downbearing angle	Dimension	Pressure	Downbearing angle	Dimension	Pressure
High treble	2 inches	1.5	.052	4	1.5	1/32-1/16	4	1.3	dime .047	3.8
Mid treble	4 inches	1.5	.104	4	1.5	3/32-1/8	4	1	nickel .070	2.8
Low tenor	6 inches	1.5	.156	4	.60	1/16	1.7	.6	quarter .058	1.6
Bass (220 lbs ten)	5 inches	1.5	.130	5.8	.38	1/32	1.5	.6	dime .047	2.3

Table 2

Note #	Frequency f
1	27.50
2	29.14
3	30.87
4	32.70
5	34.65
6	36.71
7	38.89
8	41.20
9	43.65
10	46.25
11	49.00
12	51.91
13	55.00
14	58.27
15	61.74
16	65.41
17	69.30
18	73.42
19	77.78
20	82.41
21	87.31
22	92.50
23	98.00
24	103.83
25	110.00
26	116.54
27	123.47
28	130.81
29	138.59
30	146.83
31	155.56
32	164.81

and plugged in values are self explanatory and are meant for purposes of comparison.

But which approach is best under a certain set of conditions? What is meant by a fully crowned soundboard and under what conditions is the old crown suitable? These will be the subjects of the next few articles. But let's begin discussing downbearing on the bass bridge.

In a properly designed scale the tension in the wound strings is always higher than in the plain strings. For example, a sampling of five bass strings in the Steinway M reveals an average tension of 223 pounds per string. The reasons for higher bass tensions won't be discussed here but have to do with mass, flexibility and optimum segmentation of the vibrating copper and core. If these higher tensioned bass strings deflected downward over the bridge at 1.5 degrees, the pressure per string on the bridge would approach six pounds (220 sin 1.5 = 5.76) making for a total downbearing force on the bass bridge alone of around 230 pounds.

This is excessive, especially so considering that the bass bridge crosses three ribs which are already carrying downbearing forces from the treble bridge (in the tenor area). An inspection of older first- and second-class instruments (the kind that turn up in rebuilding shops) reveals that soundboard grading and thinning was once routine. Interestingly, the bass bridge, rather than sitting over the thickest portions of the board, finds itself placed over the thinner areas supported underneath by ribs of relatively shallow depth. This design clearly does not anticipate much downweight on the bass bridge.

Anyway, a heavy force here isn't necessary in either prompting full tone or in maintaining close contact of strings to bridge. Excessive force can easily distort or seriously compress the soundboard, thereby partially or completely choking the tone not only in the bass but everywhere. As long as there is front bearing and *some* downbearing the conditions are properly set for vibrant energy transferral of string to soundboard. All this is to say that the handling of downbearing anywhere in the scale is quantitative—we are asking "how much" not "how good."

The intelligent setting of downbearing allows for freedom of soundboard motion and, hence, the best tone quality possible, *subject to inherent design features.* Of course, this assumes other things are correct. As far as downbearing on the bass bridge is concerned, the oft quoted 1/32-inch to 1/16-inch (average angle is .5 degrees) dimension of test string over hitch plate works well— but let's qualify this.

From a practical standpoint, there are some factors here which, if overlooked, can wipe out *any* downbearing on the bass bridge. The tolerance is small and the dimension can easily get lost in the shuffle. What are these factors and how do they add up?

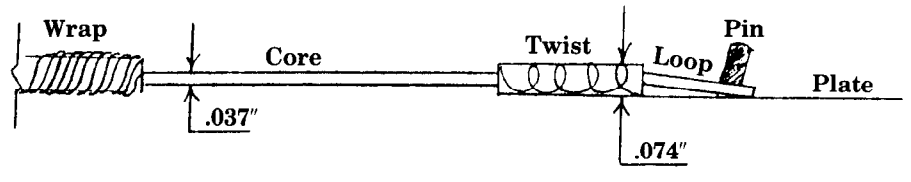
First, the hitch pin end of a bass string has a twisted core wire which in effect makes the core wire twice its plain diameter. For example, if the core wire diameter is .037 inch, the twist makes for an effective .074 inch diameter. Since this twist is the part of the rear string length which presses against the hitch plate (or undercloth), the bearing angle is going to be reduced from the anticipated amount. See Figure 1 for an exaggerated illustration.

This condition could be compensated for by allowing another 1/32 inch to the desired downbearing dimension thereby increasing it to 1/16 inch. What about stringing cloth? Yes it compresses, but it doesn't completely squash. We could mike the cloth and add one-half the measurement to downbearing. Say the cloth mikes at .040 inch, one-half this is .020 inch. Adding this to our previous sum of 1/16 inch equals .083 inch.

Soundboard compression is yet another variable. The high bass is more or less centrally located on a more flexible part of the soundboard. The bass is also strung after the long bridge has been strung. Even with string tension not up to pitch, compression on the long bridge will strain the soundboard downward by a significant amount. Thinner, more flexible soundboards yield more than bulkier ones, but figure on losing at least 1/32 inch at the high bass due to board compression.

Now if we add the initial desired downbearing dimension (.047 average) with that of the core wire diameter (.037 in the high bass), one-half the stringing cloth (.020), loss due to board compression (.031), we have a total of .135 inch to allow for—a little better than 1/8 inch. So in the high bass the test string should clear the iron hitch plate by *at least* this amount if a

Figure 1



final, or net 1/32 inch to 1/16 inch downbearing dimension is desired.

Surely it is understood that downbearing work, settings etc. should not be undertaken in humid conditions. Somewhere between 35 percent and 50 percent RH and 65 degrees to 80 degrees is safe for most work. Still, if minimal bearing is being set on an old soundboard, the shop and/or the soundboard and bridges better be drier than the worst-case ambient conditions that the piano is likely to live in.

Regarding our net 1/8 inch test dimension, please refer again to Table 1. Find the three left hand columns headed "Model 1.5 Bearing." The center column of this group is the dimension column. Follow it down to the bottom row and you will find that the theoretical downbearing dimension for a 1.5 degree angle of deflection is 1/8 inch plus .130 inch for bass strings at 220 pounds tension.

What I do in order to simplify things is to set the high bass to a 1.5 degree angle of deflection and the low bass to around 1 degree and the rest of it—twisted core wires, undercloth, and soundboard compression—pretty much takes care of itself.

If you prefer to work with dimensions instead of angles (i.e., test string over hitch plate) please refer to "Finding Dimension V" (*Journal*, May 1988). But, for the most part, the high bass will be set at a full 1/8 inch and the low bass at 1/16 inch in average-sized home grand pianos. Before actually stringing the bass, take another string test and make a final decision to either use thinner stringing cloth or to build up under the cloth with thin cardboard strips (posterboard) or hardwood strips. The final aim is to set an *actual* downbearing dimension of 1/32 inch to 1/16 inch.

When is it necessary to calculate bass string tensions? For the most part I don't bother in well-known makes and models except for personal edification. I am aware, however, that there are those who endeavor to rescale everything and have set out for themselves and their string makers special bass scales. For me, it is in the less well known, less sought after grand pianos of early 1900's vintage that I want to know bass tensions. What concerns me is the possibility of excess and unnecessary tension or the reverse.

Consider the following dialogue from 1916 between William Braid White and string maker E. Johnson:

WBW: When you have obtained this data, including the length, do you ever find it necessary to inquire at what tension the strings are to be stretched?

EJ: No, because I do not think the average piano manufacturer in the past has paid any attention to the tension of the strings. It was more or less a matter of hearing...Our method of evening up the scale was either to raise or lower the strings, finding at which point they seemed to vibrate the best and taking that as a basis.

WBW: Suppose some unusual manufacturer were to say to you: "I have decided my strings shall be at a certain tension and give you lengths and weights." Would you find it possible then to make up your strings accordingly?

EJ: Absolutely yes. In rare instances weights have been furnished to us. Unless the results are not satisfactory we use those weights— we would prefer it.

WBW: If you did it a certain number of times would you not have a mass of data to put your own scaling on a more scientific basis?

EJ: Certainly. If the tension was determined in drawing the scale that naturally would follow. A mathematical method of figuring weight would save us a lot of time and experimenting.[1]

It is no secret that many old pianos contained average or bad scales throughout. Since there is no good reason in duplicating mediocrity or error, I check the bass tensions, not so much for purposes of rescaling but to uncover anything suspicious—like tensions in the high 200's or high 100's. Should such conditions exist, I begin thinking of rescaling. (There is more to rescaling than just tensions).

But whatever the reasons, finding tensions in the bass requires individual calculation. The formula I use was derived by Domenick Venezia and published in the June 1984 *Journal*. Venezia's article explains his approach and includes the derivation of the formula, so please refer to it for more information. The formula (which is really Taylor's famous formula in disguise) boils down to this:

$T = .0002454(f\,L)(8.39D + d)$

The "Computations" section which follows provides an example calculation and comments. ■

[1] *Piano Tone Building, American Steel and Wire Co., 1916, 1917,1918, p. 43-44.*

Computations

$T = .0002454(f\,L)(8.39D + d)$
T = tension in pounds
L = speaking length. Measure in piano from agraffe or capo to front bridge pin.
f = frequency of the note. Table 2 lists notes 1 to 32 with respective frequencies for A440.
D = diameter of copper (or iron) winding in thousandths. Use a mike.
d = diameter of the steel core wire
Example: Note #26 Steinway M

L 35.75 inches
f 116.54 vps
D .080 inches
d .037 inches
$T = .0002454\ (116.54 \times 35.75)\ (8.39 \times .080 + .037)$
$= .0002454\ (13581.6 \times 1278.1)\ (8.39 \times .0064 + .0014)$
$= .0002454 \times 17{,}358{,}643 \times .055096$
T = 234.7 lbs.

Rounding decimals up or down will yield slightly different results. Rescaling accuracy requires more decimal places to the right.

Remember you must multiply 8.39 by I and then add this to d. This now becomes one factor which is multiplied with the other factors.

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Brookshire, Jerry	2	Gugala, Gary	2	McCoy, Alan	1	Stebbins, John	2
Brown, Larry M.	1	Gustafson, David	3	McKowen, Frank	2	Stevens, Bruce	2
Brown, Walter	1	Hammond, Gary	1	McVay, James	1	Steward, Brian	1
Bruce, Gary	1	Harmon, Clayton C.	5	Meade, Michael	1	Stone, Sid	7
Bryant, Ken	8	Hazzard, Nancy	1	Mehaffey, Francis	1	Stutters, H.E.	1
Buck, Edward	1	Hedrick, Ralph S.	1	Miles, Gary B.	1	Sullivan, Wycliffe	1
Buscio, J. R.	3	Heischober, Norm	2	Mishkin, Robert	1	Tasciotti, Lou	1
Cade, Leon Ray	1	Held, Jerry	1	Morgan, Doug	1	Teetsell, Kathy	1
Capp, Richard	1	Henry, Fern	1	Morris, Jere	1	Tew, Don	1
Cardwell, Harry	1	Hess, Marty	1	Morris, Robert	1	Thomason, David	1
Carey, Marcel	2	Hohf, Robert W.	1	Mott, Brian R.	2	Tomko, Tom	2
Catell, Brian	3	Hollingsworth, Francis	1	Mueller, Paul	1	Travis, Michael R	1
Champine, Calvin	1	Hornberger, Paul R.	1	Neal, Doug	1	Tremper, Fred W.	7
Chapman, John	1	Howard, Terald	1	Nelms, Gary	1	Urlacher, Lucy	1
Childs, Leonard	2	Hoy, Tom	1	Nicholson, Kerry P.	1	Valley, Donald S.	1
Churchill, Ken	1	Inman, Gene	1	Odenheimer, Fred	2	Vanderlip, Dave	2
Coleman, James Jr.	2	Jackson, Stephen	2	Onesti, Ralph	6	Wagner, Richard	1
Cobble, Tom	2	Johnson, Chris	3	Panton, Neil	1	West, Richard	1
Collis, Alastair	2	Johnson, Dennis	1	Perkins, Robert K.	2	Wicksell, Larry	1
Corbett, J. Sam	2	Johnson, Robert L.	1	Pettit, Thomas	1	Wigent, Don	2
Crabb, Larry B.	4	Johnston, Gerald	1	Phillips, John	1	Wilken, Candice	1
Crinage, Francis	2	Jones, Tom	1	Plumb, Norman	1	Wilson, Tommy	1
Dante, Richard	1	Jorgenson, Les	2	Pointer, Ferdinand	2	Wisenbaker, Martin	1
Davenport, Richard	1	Jorgensen, Owen H.	3	Porter, Aiko	1	Young, Donn	1
Dobrins, Lee	1	Joslyn, Eric	2	Porterfield, John	1	Zeringue, Nolan	2

Calendar Of Coming Events

Date	Event
September 10, 1988	**2nd Annual Maine Chapter Lobster Bake** Pemaquid Point Lighthouse Paul Rice; H.C. 31, Box 84; Bath, ME 04530; (207) 443-3372
Sept. 30-Oct. 2, 1988	**Florida State Seminar** The Jacksonville Hotel, Jacksonville, FL John Pelick Jr.; 1567 Townsend Blvd; Jacksonville, FL 32211-4944; **(904) 724-4795**
October 7-9, 1988	**Ohio State Conference** Rodeway Inn, Columbus Kim Fippin; 37 University St.; Westerville, OH 43081; (614) 890-2197
October 14-16, 1988	**Texas State Seminar** El Tropicana, San Antonio Leonard Childs; 7867 Lark Ridge; San Antonio, TX 78250; (512) 647-3648
October 20-23, 1988	**New York State Seminar** Quality Inn North, Syracuse Arthur Nick Smith; 730 Park Avenue; Syracuse, NY 13204; (315) 478-1669
October 28-30, 1988	**Central East Regional Conference** Sheraton Inn, Normal, IL Robert Morris; 1729 D Valley Road; Champaign, IL 61820; (217) 356-9781
November 4-6, 1988	**North Carolina State Seminar** Comfort Inn Sam Corbett; Rt. 3, Box 115; Grifton, NC 28530; (919) 254-5016
July 10-14, 1989	**32nd Annual Piano Technicians Guild Convention & Institute** Red Lion Lloyd Center, Portland, OR Home Office; 9140 Ward Parkway; Kansas City, MO 64114; (816) 444-3500

Continued from page 4

In 1986 I was elected Vice President and have put in a good deal of time at various regional seminars promoting membership and talking with members. During this term we negotiated a new five-year contract with Martin Fromm & Associates, our management company.

As far as my interests outside of PTG are concerned, I enjoy spending time with my two sons, Charlie, age 4, and Daniel, age 1 1/2. I am also an avid singer and sing with a small professional choir, have a regular church soloist job, and sing chorus and solo roles with the Indianapolis Opera Company. I enjoy working with my computer for business applications, writing my own programs, and, of course, playing video games.

The time I have given to the Guild over the years has been wonderful but I have gotten back far more than I have given. I have worked for many other organizations, but PTG is different because it has so many long-term members and so many members who really want to give to the organization. It will be my pleasure to serve you as President. ■

...In Appreciation
from Ginny Russell & family

The children and I would like to take this opportunity to write the final chapter for Bob. We would like to thank the people responsible for implementing the Bob Russell Trust Fund, without which we could not have existed financially. Thanks to the people who took the time to send the letters and the money to support the mailing. Many thanks to everyone who donated to this trust fund; to the many friends who sent letters of support to us; for all the prayers offered in our behalf; the many cards, letters, telephone calls, flowers, plants, etc. For all of this we are truly grateful.

In the beginning my plan was to thank everyone individually for this support. However I have found this to be impossible. I have written about 900 Thank-You notes and I must stop and put the final chapter together and continue with my life. If you did not receive a personal "Thank You," please accept this letter of appreciation written just to you. We appreciated all that everyone did for us.

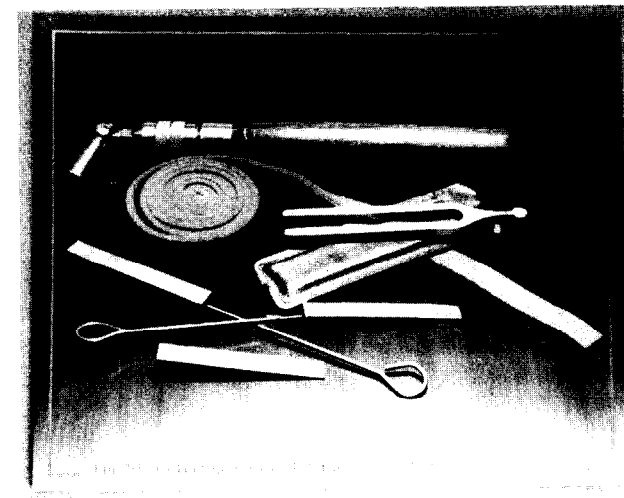
We have many happy memories of our friends in PTG. Before Bob passed away we talked many times about our wonderful friends and the great support they gave us when we needed it. You can be sure Bob appreciated it. Our photo album is filled with visual memories of conventions, seminars, and fun times. I will continue attending conventions and seminars as Bob had wanted me to do. I need the support of the friendships made over the years.

In closing I must add that in PTG, support is perhaps one of our best benefits. Think about it... when the going gets tough... fellow piano technicians are always there. Support at the chapter level; the technical level; the emotional level; financial level; but *support* is always there.

Thanks again for your support.

Tools Of The Trade

A fork. A hammer. A handful of mutes. The basis on which a piano technician builds his business. But there's one tool on which the most successful technicians have relied for years — their membership in the Piano Technicians Guild. Show your pride in your Guild membership by displaying this poster. It measures 16 by 20 inches, and is printed on heavy enamel stock, suitable for framing. To order yours, send check or money order for $9.95 U.S. plus $2.00 per poster shipping and handling to: **Piano Technicians Guild, 9140 Ward Parkway, Kansas City, MO 64114.**



The Auxiliary Exchange

Hear Ye! Hear Ye!

The Editorial Staff of the Auxiliary Exchange met recently and reviewed the content, focus and volume of articles written over the past 12 to 15 months. There was unanimous enthusiasm for the regularly received copy from **Ginger Bryant.** She did all in her power to inspire, to inform and to encourage vigorous participation in the Auxiliary.

Deanna Zeringue's accounts of customs and traditions in her state of Louisiana were very much appreciated. All recalled her articles on the "Mardi Gras" and "What Is a Cajun?"

With luck we might be able to persuade **Celia Bittinger** to research and submit an article about Portland, OR — the site of our next annual convention. Celia can always avail herself of the services of her husband Dick, who is quite knowledgeable about the "Rose City."

There were kudos also to **Helena Thomas** for her reportorial skills. Her comprehensive piece on the Auxiliary program in Toronto was very well received. Everyone could benefit from **Judy White's** column on stress and how to deal with it, as well as her corallary article on "Taking A Constitution."

The group felt that **Nita Kadwell** did her level best to persuade the membership, their spouses and friends to submit recipes for our forthcoming cook book. Everyone was in agreement that **Julie Berry** did an outstanding job with her article "Striking It Rich In Piano Tuning," in the April 1988 issue. Her clear and concise presentation should be read especially by those who feel it is an up-hill grind to make it in the world of piano technology.

As our Staff mulled over events of the past, they recalled having read items by a few of the above, in past issues of the Auxiliary Exchange and wondered why there were some members who seldom, if ever, submit articles. Every now and then Ginger had to use her gavel and call for silence: before our opening meeting, before our Council convened, before our installation luncheon, before and during Julie Berry's Discussion Group.

We can all talk; how about putting some of those words on paper and forwarding them to our Editor. For as long as we are able, we shall resist high tech with its emphasis on credit numbers and Social Security numbers for ID; the telephone, TV and Cable for advice; information and news data instead of the printed word! Nellie Bly, Brenda Starr and Jane Arden will be ecstatic if and when letters come in to **Agnes Huether,** our Editor.

The Staff

All Wool and a Yard Wide

In the hot humid days of August, would you wear a wool dress, blouse or slacks? Would you wear even fine sheer wool items given the promise of it being appropriate attire? Most likely one would opt for cotton or linen and perhaps raw silk since we limit our wearing of wool to times when the temperature drops.

Despite our Twentieth Century knowlege and know-how, it is wool that keeps the young Moroccan children cool in summer and warm in winter. Their homespun wool *djellabas* are worn year round, and as adults similar garments are worn whether crossing the hot desert or shepherding flocks in the chill of night.

In western China an underground cave used for storing ice had its heavy wooden door insulated with thick wool felt. Ice later transported to customers was placed on a cart lined with felt. Bedouin wear wool clothing in the desert as insulation against heat or cold.

Recall the expression, "What keeps out the cold, keeps out the heat!" Today scientists can explain why that adage came into being, through the use of electron micrographs that greatly magnify the fibers of wool. The secret of wool is discovered in the structure of wool fibers. These fibers consist of tiny scales rather like pine cones that rub against each other contracting, expanding, tangling, absorbing and pulling together in a manner unique to all fibers.

When compacted under heat and moisture, the wool shrinks into felt. The wool fiber's core is highly absorbent, taking in as much as 30 percent of its weight in moisture. In contrast, cotton absorbs eight percent while synthetics hold barely two percent. By drawing perspiration away from the body, wool clothing prevents the skin from feeling clammy during summer and helps to hold in heat during winter.

Unlike linen, silk, cotton or polyester, wool fibers absorb moisture, insulate against heat and cold, resist flame and maintain their resilience.

This writer enjoyed an absorbing and well written article on wool in the May 1988 issue of *National Geographic.* The author, Nina Hyde, gives an interesting account that sweeps across 12,000 years from the time

man discovered that in addition to a food source, sheep's wool could also protect his body from hot or freezing temperatures. Sheep then became worth more alive than dead. "Wool-Fabric of History" provides many insights and little-known facts about wool from biblical times, when wool was used to collect water, to the present.

Fashion expert Nina Hyde and her photographer-assistant Cary Wolinsky presented a comprehensive written and pictorial account of the history of wool, "gift of wandering animals." Here is just a sample of some of the items.

Merino sheep, prized for their fine white wool, represent the pinnacle of selective breeding. The merino supplies at least a third of the world's wool. Spain so valued its merino sheep that to export one was a capital offense.

The Soviet Union is the largest consumer of wool, using as much as the United States and Japan combined. Australia leads in world production.

The felt kepenek of the Turkish tribesman serves as his coat, tent and blanket. Wool and particularly felt was so much a part of the life of the Asian nomad that the Chinese in the Fourth Century BC referred to their territory as "the land of felt."

Because wool has such springiness and good elastic recovery, 150 yards of wool yarn are used in an official baseball. It is also the reason why wool felt covers are used in *piano hammers*.

We no longer need to be concerned with moth larvae consuming our wool products—mothproofing can be done in the dyeing stage with chemicals that kill larvae through their digestive systems.

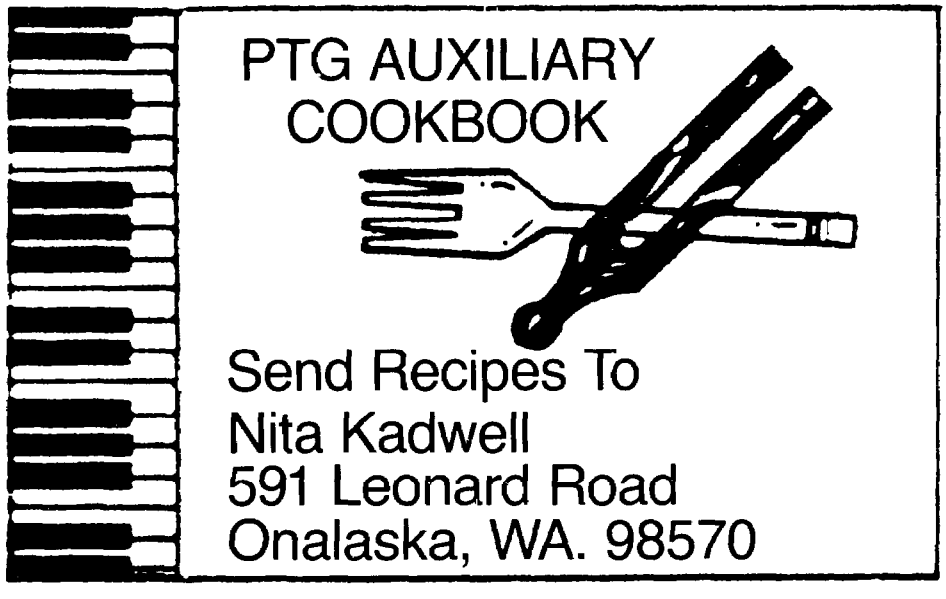
The finest "wools" do not come from sheep but from high altitude beasts — the goats of Kashmir, Tibet and the Pamir Mountains and the shy vicuna of the Andes in South America.

In eastern Oregon, the Pendleton Woolen Mills supply trade blankets to the Umatilla Indian Reservation. The blankets are given as gifts at birth and become the burial shroud at death.

In his zeal for wool, Edward III of England placed in Parliament symbolic red square sacks of wool. In the course of time these sacks were filled with hair, probably because wool was so valuable. In 1938 the sacks were once again filled with wool, and today the lord chancellor sits upon a royal wool sack to address the peers of the realm. The sack measures 36 inches.

Do you suppose this is the genesis of the expression, "All wool and a yard wide?"

Agnes Huether, Editor



Exchange Editor:
Agnes Huether
34 Jacklin Court
Clifton, NJ 07012

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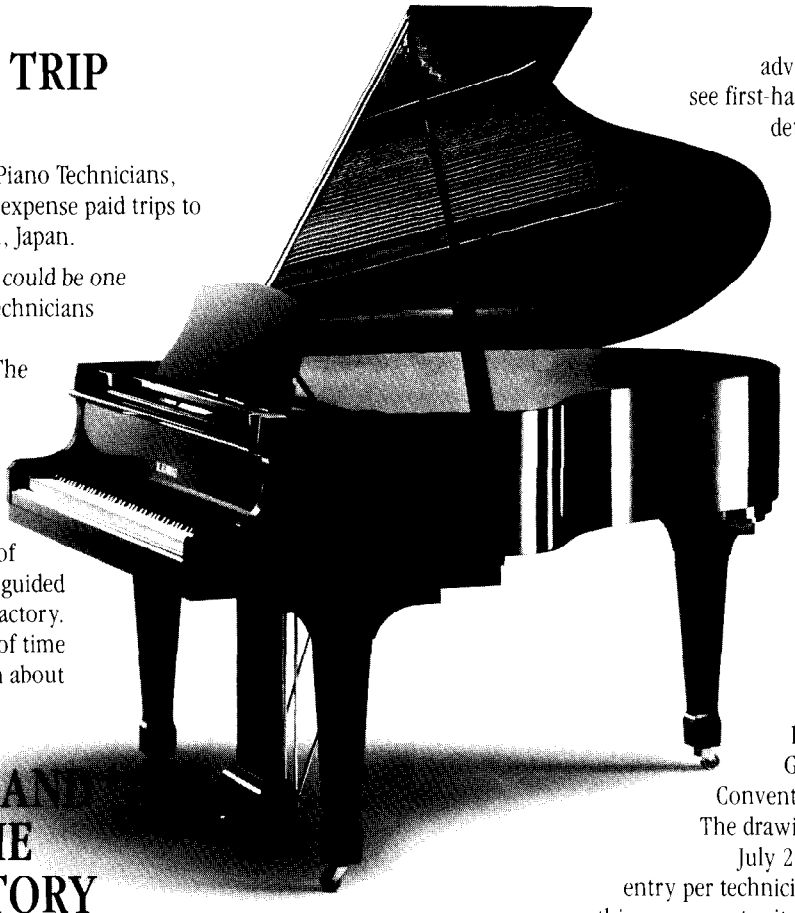


WIN A FREE TRIP TO JAPAN

As a special tribute to the Piano Technicians, Kawai is offering three all-expense paid trips to our factory in Hamamatsu, Japan.

In the Spring of 1989, you could be one of the three lucky piano technicians who will embark upon an unforgettable journey to The Land of the Rising Sun. As Kawai's special guest, you'll enjoy FREE roundtrip airfare, hotel accommodations and meals. The highlight of the trip will be a personal guided Grand Tour of the Kawai factory. You will also have plenty of time to shop, explore and learn about Japan and its culture.

GO ON A GRAND TOUR OF THE KAWAI FACTORY

On your Grand Tour, you'll discover how Kawai has blended old world craftsmanship with today's most advanced piano technology. You'll see first-hand the meticulous attention to detail and the careful selection of materials that go into making such extraordinary grand pianos.

TO ENTER IS EASY

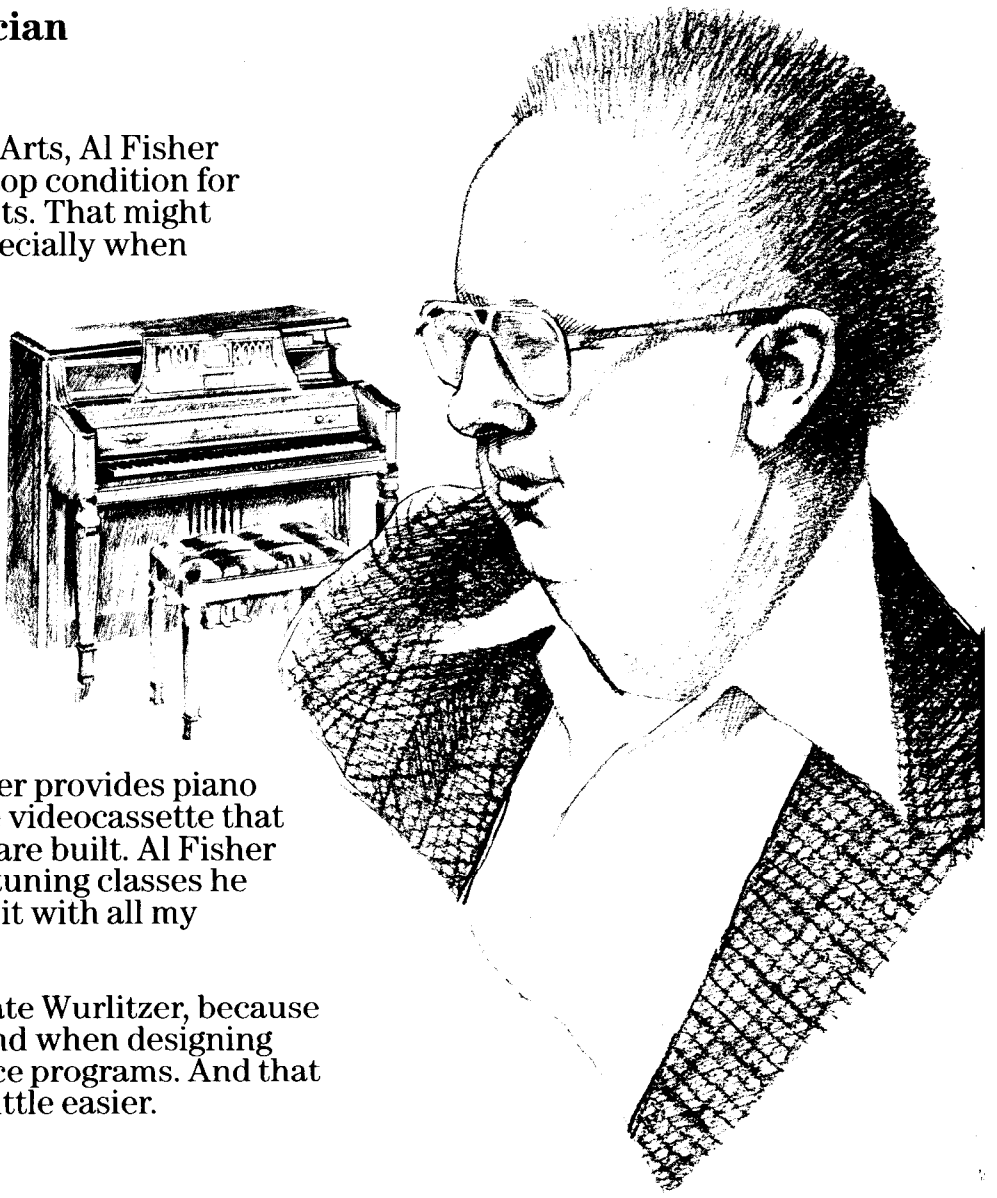
In order to qualify you must be a current member of the Piano Technicians Guild. You can register for the drawing at an authorized Kawai dealer. All entries must be received no later than July 15, 1988. You can also register at the Kawai Exhibit Booth at the Piano Technicians Guild 31st Annual International Convention in St. Louis on July 18-20. The drawing will be held on Wednesday, July 20 at the Convention. Only one entry per technician will be allowed. Don't miss this rare opportunity to win a trip to Japan and the Kawai Grand Tour of the most technologically-advanced piano factory in the world.

KAWAI
The Master Builder

KAWAI AMERICA CORPORATION, 2055 E. University Dr., P.O. Box 9045, Compton, CA 90224-9045 (213) 631-1771

"We don't have problems with sticking actions on Wurlitzer Pianos."

Al Fisher—piano technician and teacher.



At Interlochen Center for the Arts, Al Fisher makes sure the pianos are in top condition for students and performing artists. That might look like a formidable job, especially when you consider that most of the pianos used during the famous National Music Camp are in lakeside buildings where temperature and humidity change constantly. But Al Fisher will tell you that it's "easier than you might think" with Wurlitzer pianos...because Wurlitzer actions are manufactured with uncommon precision.

Naturally, he appreciates that. But he also appreciates the extra service that Wurlitzer provides piano technicians. For example, the videocassette that shows how Wurlizter pianos are built. Al Fisher uses it regularly in the piano tuning classes he teaches at Interlochen. "I use it with all my students. It's well done."

People like Al Fisher appreciate Wurlitzer, because we keep the technician in mind when designing pianos and establishing service programs. And that makes the technician's job a little easier.

WURLITZER®

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