PIANO TECHNICIANS Journal

September 1993

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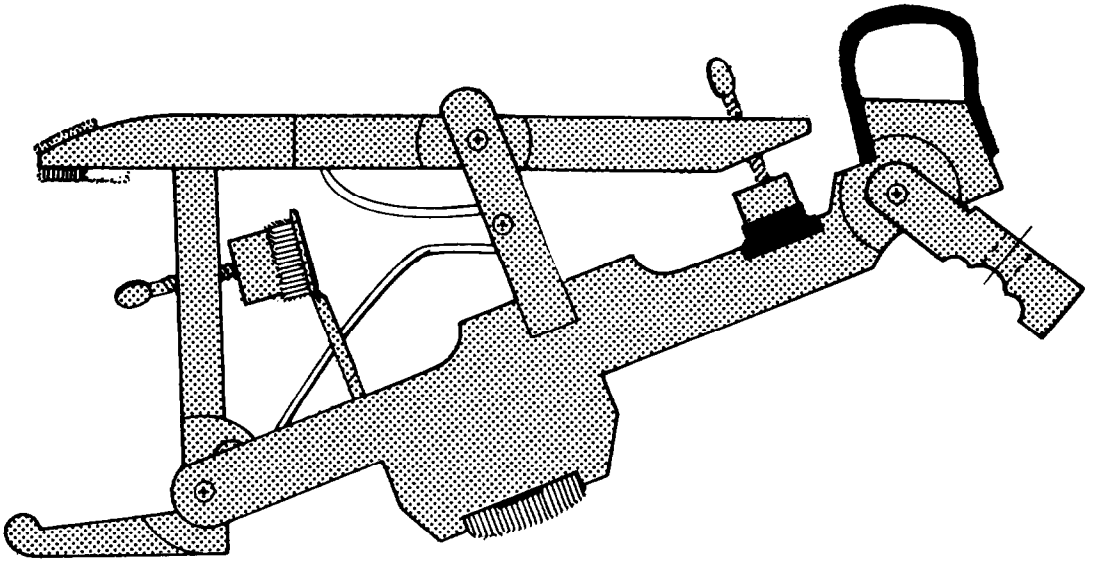

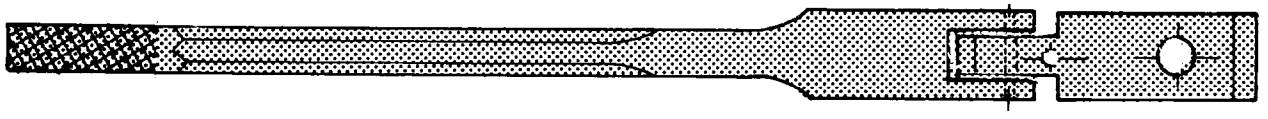

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PIANO TECHNICIANS JOURNAL

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SEPTEMBER 1993 • VOLUME 36 • NUMBER 9

ON THE COVER

There is a lot of discussion about hammers in this month's issue. Thanks to Dorothy Coleman, "Business Director, Wife, Mother, Cleaning Lady, Cook, Person to blame when all else fails...", (for Patrick Coleman) for these unsolicited before and after shots.

"Whether I'm on the road with the Range, the Grateful Dead or at home in my studio, the Baldwin is my constant companion.
Its keyboard action responds equally well when creating a subtle melodic line or a strong driving rhythm."

Bruce Hornsby

As a pianist and keyboard technician for Bruce Hornsby, I have learned that I can expect great things from the Baldwin piano. As touring instruments, the pianos are moved daily, submitted to changing temperatures — indoors and out, and even danced on by Bruce. It amazes me how they take the abuse, hold their pitch and always sound great. The Baldwin piano rocks!

John "J.T." Thomas

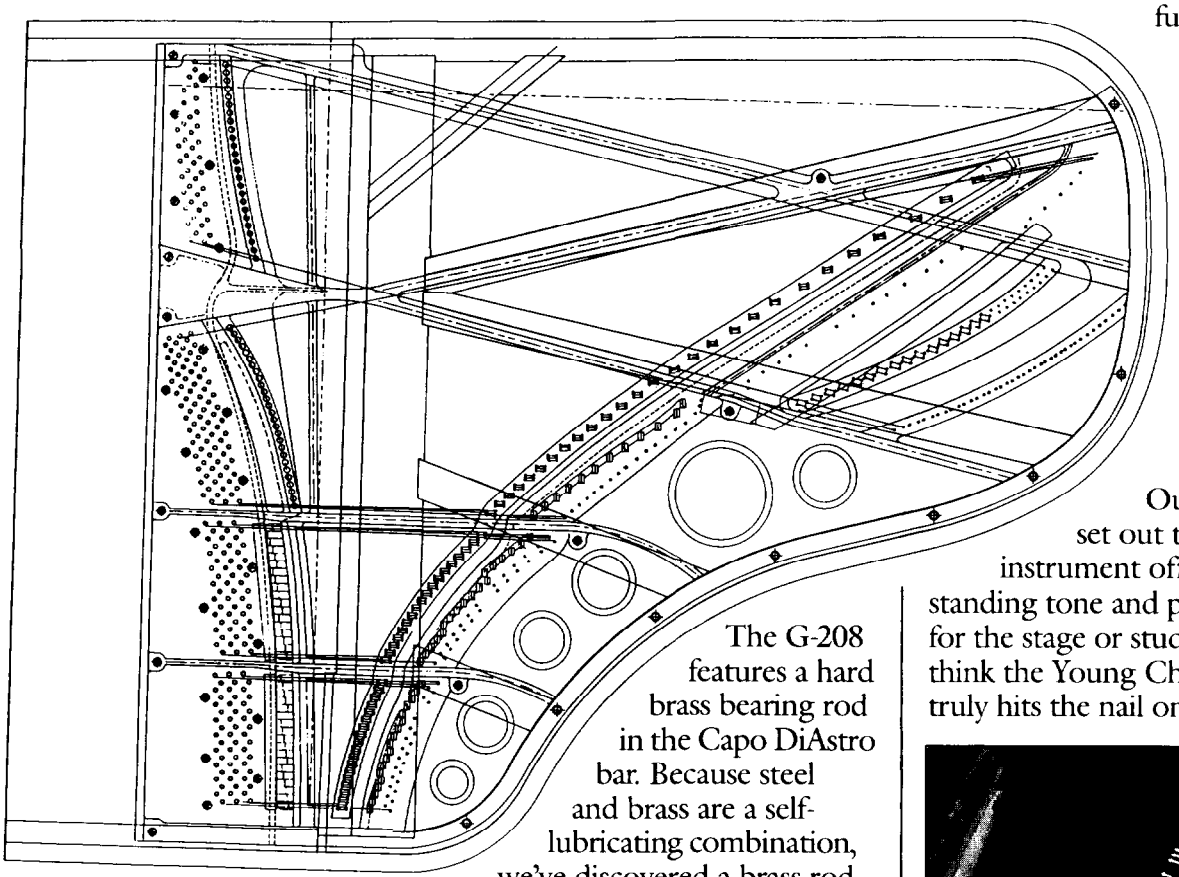
Baldwin

Baldwin . . . *Leading the way through research.*

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

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

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

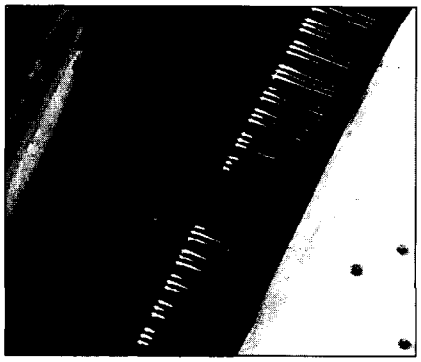


The G-208 features a hard brass bearing rod in the Capo DiAstro bar. Because steel and brass are a self-lubricating combination, we've discovered a brass rod offers better control of strings during tuning. In addition, the brass rod is easily replaced later in the life of the instrument eliminating the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

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

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

Together these innovations create an instrument with a rich, full sound, greatly improved response and a remarkable evenness of tone throughout the entire range of the keyboard. Our engineers set out to design an instrument offering outstanding tone and performance for the stage or studio. And we think the Young Chang G-208 truly hits the nail on the head.



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

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

YOUNG CHANG

The best the world has to offer.

President's Message

Lesson Plans: The PACE Curriculum

PTG provides many learning opportunities for its members, through chapter meetings, seminars and the Institute, special publications, and this Journal. While these offerings are many and varied, the subject matter available at a given time is often a piecemeal, rather than planned, curriculum. Thus a technician's learning may advance in a random fashion, skipping over some important basic concepts.

Another feature of our educational offerings is that they usually present information only, without hands-on practice of a skill.

Of course hands-on teaching is much more complicated to do, and is simply impractical for large groups. However, each of us must ultimately put our learning into practice if we are to translate knowledge into skill.

This lack of structure and practical experience is especially noticeable for those new to the trade, who may rely almost entirely on PTG for their learning. Those preparing for the RPT exams especially need a systematic, hands-on approach. Given the increasing percentage of Associate members, and the increasing desire to turn this trend around, many innovative educational programs are being planned.

PACE
Professionals Advance through Continuing Education
LESSON PLAN

Introducing:

PACE Professionals Advance through Continuing Education

The success of this new focus on planned educational programs requires visibility and awareness. To help identify the various elements of this program, we have chosen the acronym "PACE." This word implies motion and continuity, essential to continued learning. It also implies an expectation of progress, which must be conveyed to all members but especially to Associate members.

With the able help of Jami Henry, our talented Home Office Director of Communications and graphics designer, the PACE symbol will be used to designate special articles, convention classes, etc. that are of particular use to those pursuing a planned curriculum in essential skills.

Associates preparing to challenge the exams will finally have a clear path to follow. RPTs who are tutoring beginning technicians will find these programs helpful in structuring tutoring sessions. Examiners and potential examiners can use this review of core skills as preparation for the coaching and evaluation that is essential to the exam experience. And any technician can benefit from a periodic "refresher course" in essential skills!

This article will introduce one exciting new program designed to provide both a curriculum and hands-on practice for learning many of the essential skills of our craft.

Journal Lesson Plans

Beginning in this issue is a series of articles providing specific lesson plans for hands-on learning sessions covering technical and tuning topics. These lessons can be used in a variety of ways:

- Chapters can use them as special Associates meetings before each regular meeting.
- Chapter program planners can occasionally use them as ready-made technicals for their regular meetings.
- Several lessons can be combined into special one-day meetings or paid seminars.
- Individual members (especially those without an active chapter nearby) can use these lessons by themselves, then seek evaluation of their work by a mentor.
- An experienced member acting as a mentor can use these lessons to give structure to their tutoring.
- Associate members need not wait for RPTs to set up hands-on training meetings; enterprising Associates can combine efforts to organize their own study days, using the lesson plans and inviting more experienced members to assist.

Each article will feature a specific skill, such as splicing a string (technical) or how to set A-440 from your fork (tuning). Each will provide a complete program recipe including

how to run a hands-on session to teach the skill, prerequisite reading for the participants, a list of the tools each must bring, and a detail of the steps involved in doing the job. For chapters wanting to encourage their Associate members to upgrade but not knowing quite how to go about it, these Lesson Plans should be a dream come true.

Subject Matter

The Lesson Plans will mainly cover those skills required for the RPT exams, in order to encourage upgrading. On the technical side, these include various field repairs as well as grand and vertical regulation. Those preparing for the tuning exam express a specific need: according to the Member Needs Survey, one of the most important obstacles to challenging the tuning exam is lack of aural tuning skills. Thus the focus here, at least initially, will be on step-by-step lessons for learning basic tuning, including aural interval tests and temperament and mid-range tuning.

Is this program just for Associates ?

Although specifically designed to help those preparing for the exams, these lessons will cover the typical skills that make up the work of most technicians. Thus they should be equally useful to all, and hopefully can provide a common ground for both Associate and RPT members to work together toward PTG's mission of advancing our profession through education.

It is a fact that the development of the RPT exam worked to advance the state of our art for all members. Developing the exam required a serious study of piano tuning and technology, with the result that better methods and understanding became known throughout our organization. This process continues; every effort we make to teach Associate members can potentially and very often does, update the RPT's knowledge.

Thus we all stand to benefit from any educational program. Educational programs, therefore, serve to move us all—RPTs and Associates alike—toward a common goal of ever-increasing skills and ever improving customer service.

And isn't that what PTG is all about?

From The Home Office

Larry Goldsmith
Executive Director

"Piano Tuning Near the End Of Its Strings Unless Profession Can Recruit New Blood"

The article on which that headline appeared was printed almost 50 years ago in the Milwaukee Journal of July 19, 1944. Its topic was the fourth annual meeting of the American Society of Piano Tuner-Technicians at Milwaukee's Schroeder Hotel. A diligent reporter unearthed it from the newspaper's files in preparing an article on the 1993 PTG convention.

"Firms that before the war made the instrument with which the couple in the apartment upstairs used to keep you awake are now making gliders, bomb bays, escape hatches, pack boards and an untold quantity of GI equipment and no pianos other than ones for army camps all over the world," the article noted. And in that wartime situation lay the reason for concern about the end of the profession:

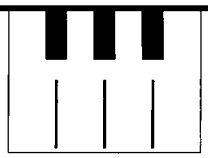
"It seems that theirs is a dying profession. The average age of the delegates at the convention, and of the profession in general, is near the 50 mark. Young men do not seem to be interested in piano tuning, and the few who were studying to become piano fixer-uppers were drained from what the government deemed as nonessential industry. Most of the members of the society are old cronies who can recall meeting almost everybody else some place from as far back as the turn of the century."

Things have changed in 50 years. As the country moved to a peacetime economy, returning veterans filled out the ranks of the profession. Manufacturing firms were able to go back to making pianos instead of wartime equipment. And the industry boomed — at least for a time.

We're not exactly confronting the end of the profession today, but there are some disturbing clouds on the horizon. Since new-piano sales peaked in the late 70s, they have declined to less than half of their former levels. This is not news. We've talked about it at length, and we know that literally millions of used pianos still change hands each year. PTG itself is strong, both in numbers of members and in financial reserves. But it doesn't bode well for any of us. By being in the service end of the industry, we're a bit insulated from the cutting edge, but we're not immune. That's why we have strongly supported the National Piano Foundation's SPELLS (Study of Piano Enhances Life's Learning and Success) program and why we've consistently participated in industry initiatives.

But fewer new pianos are not the only challenge we face. As noted by President Fern Henry in her address to this summer's Council, we have received a large influx of Associate members in recent years. As in 1944, however, the need is for education, for training. The educational opportunities outside of PTG are declining. Some schools have closed. Others report declining enrollments. For many, PTG offerings like chapter technical presentations, conferences, seminars and the Journal are the only opportunities available.

As that unknown writer said of the 1944 meeting, "That is why the 150 piano tuners who are meeting at the Schroeder hotel this week have more to talk about than the plinks and plunks of business, and why this convention is not, as it might easily have been, one of the final meetings of the delegates of a rapidly dying art."



Technical Forum

Clippings

Volumn 2

Jim Harvey, RPT
Editor

Reader response was positive to the previous "Clippings" article, so I'm happy to present another installment of selections from newsletters from around the country.

From the October 1992 Forum article: "It is my belief that the words and works of excellent local technicians, writers, and newsletter editors from various parts of the country are going unseen by most of us. For this reason, I have been wanting for some time to create a once or twice per year Forum article, consisting of short clips from some of these newsletters."

This type of presentation was never meant to be a contest, however it *has* seemed to serve as a morale booster to local chapters, their members, and especially to hard-working newsletter editors. Consider the following tongue-in-cheek reference from Gina Bonfietti, included in her own Connecticut chapter newsletter, and referencing the former group of "Clippings":

> *"The Keybed has made it to the big time! Selected articles from several newsletters were reprinted in the October* Technical Forum, *yours truly included. I will be having an autograph session soon. Look for dates and cities in your area in upcoming issues."*

In keeping with the spirit of things, this article will also provide examples of the *type* of material that catches my attention while perusing the newsletters. I should mention that there were newsletter items that were not included here, for one of the following reasons:

- too long for inclusion here. Work may be featured as a stand alone article;
- to be used later as support information for a specific *topical* discussion;
- has yet to be posted into my reference database;
- has yet to be seen — am I on your mailing list?

Help Me Help You, Part I

It is not my mission to alter the style or contents of newsletters. They are, and appropriately so, as varied as the chapters they represent. It is necessary that I read through meeting times and places, multi-generation cartoons, news of chapter picnics, and so on, in order to flesh out this type of column. A good deal of this information is required on a local level, and much of it is filler. Whatever the case, it is important that it remain at the discretion of the chapter and its newsletter editor. However, while reading, I noticed a few repeatable (if not global) "improvements" that I would like to suggest for your consideration:

- Editors, throw modesty or humility aside, and please list your name (as *editor*) in a prominent place somewhere on *every* newsletter! Many of you include all chapter officers, committee members, and those assigned kitchen patrol duty after chapter meetings; then fail to include your own name. I would like to have included the names of editors, but since editors change (often before material appears here), the research time required to find *who* was editor *when* was not worth the effort. Others can't decide who is really the editor, or will list a pseudonym or fictitious person. For this reason, *none* are mentioned.
- Wherever known (and appropriate), please give credit to the author of an article, regardless of how short the submitted material may be.
- Writers *and* editors please pay particular attention to the first three clippings. Each is in reality a class review. They are positioned ahead of the others to serve as examples. Far too often writers will state, in effect: "At our last meeting, Scut Farcus of the Broken Plate chapter provided a delightful and informative technical session on how to make your own hide glue, starting with the horse, and a good time was had by all, followed by cookies and punch."

Not much to go on, huh? Instead, the writers herein took time to include highlights or details of the event. Either approach would likely make you want to see the class for yourself, but the following examples make for more interesting reading. But first...

Disclaimers:

The contents herein are used with either specific or implied approval by the respective chapter newsletters and/or writers. If the author is not identified, no author credit is given (although we may assume that the information was generated by the newsletter editor).

This material has been merit-reviewed for subject interest. However, not all the procedures or suggestions have been *performance* reviewed. As always, I will disallow any responsibility should you destroy a piano, or become hurt or seriously killed while attempting anything written here.

Cleveland Chapter (Butts & Flanges) On the Road with Baldwin

The last meeting featured a technical session by Kent Webb, head of technical service at the Baldwin Piano and Organ Company. His class focused on concert

service of grand pianos, although much of the information offered applied to the everyday servicing of grands.

It seems that the finest instructors include many seemingly small details. I found the following to be of special interest. Check the lid hinges and music desk hardware for tightness as well as the fitting of the legs. Examine a random sampling of damper underlevers to be sure they are tight and moving freely. His favorite use for the Jaras key leveling tools is in bedding the keyframe. When it's time to finally bring the balance rail glide bolts down, instead of using a strip of newsprint for a feeler gauge, he watches for the Jaras tool to barely show movement at the front of a natural key.

Of course Baldwin is responsible for the Accu-just hitch pin and I won't go into the details of his discussion, but it was noted that a "dead" section of treble strings could be reset for only .005" to .010" of bearing to improve the singing quality.

Also interesting was his method of softening hammers by wetting them with 25% water and 75% methanol, then letting them dry at least 20 minutes. Some Baldwin grands have a special treble termination strip in place of the normal capo bar, and if a string is buzzing there, he suggests putting one drop of yellow glue on the offending string — closest to the keyboard, that is.

The individuals attending this technical session seemed to be very attentive of a fine instructor, and the Cleveland Chapter PTG certainly thanks Kent Webb for his class, and Graves Piano and Organ Co. for hosting the meeting.

Alan Nemeth

Eugene Chapter (Piano e Forte) The 20-Minute Hammer Filing

Brian DeTar favored us this month with the technical presentation. His topic was "The 20-minute hammer filing". As usual, it was a very entertaining and educational experience.

Brian explained that before you actually start filing there are several things you should do first. The very first thing you do is to play the piano and get a feel for the general overall sound. Usually, when hammers need filing they will sound harsh and brassy. Since you are filing hammers to improve the sound, obviously you need to consider voicing. Brian likes to do "gross" or "gorilla" voicing before filing to avoid having to refile, as massive needling causes the hammers to puff up. One quickly develops a feel for softening hammers. The idea of pre-voicing is to get all the hammers to feel the same when you plunge your voicing needles into the felt. Also, before filing, you need to look at the grooves in the hammers. You can easily see if any hammers aren't striking all three strings evenly and space and travel hammers accordingly. When needling hammers, Brian will needle into the shoulders on both sides. He needles up to the strike point on the back side of the hammer, while avoiding needling the area near the strike point on the front side. The reason for this is, as you strike a hard blow, the hammer shank flexes enough so that the hammer strikes the string on the area in front of the strike point; thus you don't want that area too soft.

To file the hammer, Brian uses a strip of sandpaper about 2" wide and 12" long with clear strapping tape on the back side for strength. He uses only 60 grit or coarser sandpaper for filing. You can remove lots of felt quickly yet obtain precise control by varying the pressure you use. To begin with, it is necessary to raise the hammers to the string height. This can be accomplished by setting them on a board roughly 1/4" x 4-8" x 4' (the length of the keyboard). Standing on the keyboard side, begin filing (gang style) the back side of the hammer starting with the bass hammers. Use 3 fingers of your left hand (if you're right handed) to put pressure on the sandpaper as you pull it upward with your right hand. Brian slides his left fingers downward as he pulls up on the sandpaper. Using this method, you can remove felt from the shoulders up to near the strike point. (To keep the hammers from flopping while you pull the sandpaper, put a metal bar, wooden stick or whatever on the shanks and press down on it with your left thumb as you pull on the sandpaper.) This all takes a bit of coordination, but it is easily learned with a

little practice.

After you've finished filing the back side of all the hammers, turn the action around and do the same on the other side of the hammer. Then, using a modified shoe shine technique, you take the felt off the top and end up with your final shape. By modified shoe shine, I mean that you only make contact on the hammer while pulling the sandpaper in one direction (from back to front).
With practice, this procedure goes very quickly. This procedure sounds complicated, but actually it is quite simple — it is much easier demonstrated than explained.

Bill Stratton

St. Louis Chapter (The Gateway Tuner) Brass Reactivating

[Excerpt]... *The class I attended that was a "new" subject was called Brass Reactivating, given by Bill Balamut, RPT, of the Twin Cities Chapter. Although this was presented as a mini class lasting only 30 minutes, the subject matter presented is going to forever change the way we think about brass.*

As all of you might know, brass crystallizes and breaks down over a long period of time, about 60-75 years. Anyone who has ever worked on brass rail actions can attest to this. It is bad enough to have a tab break in half, but to have the rail itself break is enough to consider throwing the piano away. Although new rails can be bought from supply houses, my experience has shown that the rail is not perfect, and compensations have to be made.

Bill is not only an excellent tuner, technician and rebuilder, he also has a lot of experience in welding and soldering. He has used this experience in a number of ways when working on pianos. When he came to the problems of brass flanges, action rails and agraffes, he put his experience and knowledge of metallurgy to good use.

Bill told us that when brass is heated to over 700 degrees, it rejuvenates itself, and makes it like new again. Kind of "Born Again Brass".

Old agraffes can be heated using a propane torch. He demonstrated using a small propane torch, to heat up one agraffe for about five minutes. Not only will the agraffe be like new again, but if it has a small hairline crack around the base, it can even be repaired, using silver solder. This would be extremely important to know when working on an older grand that uses an unusual thread size agraffe.

Brass rails can also be heated and become born again. To heat a brass rail, Bill recommends using an acetylene torch. To be on the safe side, unless you have schooling and experience in using one, Bill suggests we have this done professionally. He says if you tell a metal worker to heat the brass rail to 700 degrees, he will know what to do.

Cracked and broken off tabs can also be silver soldered on these. The trick is not to get solder in the threaded holes. If this should happen, then retapping is the only solution.

Bill had an acetylene torch in the class, and heated up a brass rail. After it cooled, he was able to bend it back and forth with ease, something one should not attempt to do with an untreated rail.

This new development with brass rails and old agraffes will definitely change the way we will do business. Now there is something you can offer the customer who has an antique upright that is an heirloom, and worth "thousands of dollars". Even if the brass rail is broken, it can not only be repaired, it will be born again and can be brought back to life.

Wim Blees

San Francisco Chapter (In Tune) Where, Oh Where To Pull?

For years I have pulled out grand actions (especially Steinways) by grabbing hold of the glide bolts at the bass and treble ends, which seemed to me to be sturdy and of a convenient height above the keys. Recently I went to service a Steinway D that I had rebuilt three years ago. The complaint was a squeaky shift pedal. After checking the usual sources for shift pedal squeaks, I determined (by easing up slightly on the

end glide bolts as I worked the pedal) that the squeak was the result of loose glide bolts. Now, it's true that this 1922 piano had many other technicians who preceded me, and that there was also a crack through the balance rail at the bass end that I had repaired during rebuilding, but I can't help concluding that using the glide bolts to pull an action out of the piano may not be a neat idea. On Steinways, at least, there is a convenient "notch" in the keyframe directly in front of the end glide bolts. Now I use this notch to pull the action instead of the glide bolts.

Anonymous

New Hampshire Chapter (The Granite Action) Database Tip

Okay, database cadets, here's an important one for you who wonder what a computer is good for. Have you ever needed to call a customer from the road or from someone's house? You're lucky if this pay phone or kitchen drawer has the right directory, and directory assistance is a nuisance (especially with a wind-chill of -20 degrees whipping around your ankles).

So take that database and make a phone book out of it. My preliminary one has five columns with last name and number in 9 point type. And by golly, 250 names fit on one letter-page, which folds up neatly and discretely next to the billing pad in my tool box!

Bill Ballard

Close Encounters Of The Salad-Master Kind

I knew something was wrong as soon as I started in on the tuning of this 5-year old Yamaha U1, and I could already feel condolences for its owners. The tone in the third and fourth octaves was anemic, washed out. Worse yet, a subtle flutter was showing up in the middle partials (3rd through 7th) on notes in this region, maybe one or two partials per note. The partial number affected changed from note to note, and this flutter was independent of the tuning's usual beat rates. Was this the reason I was called in on a piano not badly out of tune? Was I really going to have to report a collapsed board? I listened around the room for other sources of pitch that might be interfering with the piano sound. The loudest electrical appliance was the ceiling fan just eight feet away, which whispered innocently.

I could still tune, so I did, until halfway through the tuning when, on a hunch, I decided to shut off the fan. Like magic, the sound turned from a cold drizzle to warm sunshine. This was a case for Dr. Science, my neighbor who is a black belt, 12-star radio engineer with a labor rate twice my own when he services the area's electronic facilities. According to Ira, sound transmitted by or received from moving objects produce a Doppler effect in which frequency or phase is modulated. For all practical purposes, I, the listener was stationary, as was the plane that the turning fan blades moved. However, the blades themselves were attached to the hub with a pitch so as to push air. Consequently, sound from the piano was faced with a constantly changing distance to the blades that would reflect those sounds. Had the fan been unnecessarily fancy, the blades might have had a curved rather than flat cross-section. This would have made the Doppler modulation non-linear. Regardless, the phase modulations were a product of the distance from the piano to the blades (fluctuating periodically within a fixed range), the motor's rpm, and the number of blades (these two also being constant). All that was left was for these factors to combine in consonance with some partial on the note currently played. And I had noticed that as I moved from note to note in the temperament, the flutter would settle on a different partial (or partials). Shut off the fan, and my problem disappeared!

Bill Ballard

Oklahoma Chapter (Sooner Tuner) Close Encounters Of The Same Kind

[Excerpt]... By the way, I had someone call about her piano being out of tune right after I finished tuning it. I had her turn off her ceiling fan over the piano and try it again. She called back and apologized. I imagine we've all had an experience of trying to tune with such fans around us. Fun, huh?

David Bonham

Salt Lake Chapter (The Piano Wire) What Is Making That Noise?

Several years ago I was hired to take care of some pianos in an old church building in a rural Utah community. One of those, a venerable 1927 Steinway grand, seemed to be possessed by a ghost of the past.

This piano had sat in the chapel of another, abandoned meeting house for several years. When a sympathetic local church member had offered to buy the piano or even to "store" the neglected Steinway in his home and get it away from the pigeons and extremes of temperature in the abandoned building, the piano was moved to the stage in the cultural hall of the building where I saw it.

The music rack was falling apart and the bench in use was obviously adopted from another family. The piano seemed to have lost the stately grandeur it had once possessed and was thus relegated to use for recreational activities on the stage. Even the sound of the piano suggested that maybe it had seen better days and was filling the only service it could. Whenever anyone played the instrument, up from the depths would come a bizarre buzzing sound that increased in volume as playing volume increased. The buzzing was not present on all notes, was weaker on some than others, and was very noticeable through a section of notes in the tenor to mid-treble.

At first I thought there must be something rattling around on the soundboard. I cleaned out a bunch of tacks, paper clips, pencils, crayons, etc., from the soundboard and felt sure that I had solved the problem, but alas, the ghost remained.

I next looked at the soundboard from underneath to see if there was any evidence of cracks or rib separation. There wasn't. Needless to say, I was baffled and in the presence of the man who had hired me. I felt insecure and desperate for a solution.

By applying pressure (with my thumb on the underside of the soundboard at the end of one of the ribs), I was able to subdue the buzzing somewhat, but not get rid of it entirely. I even wedged a piece of wood between the end of the rib and a brace in the bottom frame to minimize the

buzzing — a temporary solution at best.

I consulted with other technicians and even looked into having the piano rebuilt. However, somehow I felt that the problem was not as complicated as I was making it.

Each time I came to tune the piano, I worked on the problem with fresh enthusiasm and each time I left baffled by the ghost in the piano. Then one day as I once more began to tune the piano, I noticed that the buzzing had become louder and more vigorous. The piano is mocking me, I thought. It is daring me to try again. Well, I won't be beaten that easily!

I began to look again for something on the soundboard. By this time I had acquired an inspection mirror (like those dentists use) and with the help of a small flashlight, I spotted something lying on the soundboard way back underneath the plate near the treble end of the piano. It was too far away for me to reach with my hand but I pulled it out with a magnetic pickup tool. The culprit was an old four-inch closet door deadbolt that had somehow found its way into the piano. One can only imagine how that may have happened. Apparently, when the piano was played, the vibrations had made the bolt move and it had finally worked its way into a position where I could see it. As soon as I had removed it, the ghost was gone, the buzzing had vanished, and the glorious tone of that beautiful (albeit battle-scarred) Steinway came through loud and clear.

I felt like rejoicing and couldn't wait to report to the building custodian that the piano was "fixed"! It didn't require rebuilding, and it didn't cost hundreds or thousands of dollars. It just took a little persistence, the right tools, and the patience of those who owned the piano. All of a sudden I felt a little more confident. Persistence had paid off.

Don Findlay

St. Louis Chapter
(The Gateway Tuner)
Replacing Strings
With A Ratchet Wrench

When replacing strings, use a 3/8" ratchet wrench with a ratchet star head tuning tip. The Sears Craftsman wrench is probably one of the better ones, and the tuning tip is available from most supply houses.

The wrench allows you to turn the tuning pin to wind the string around it, without having to take the tuning tip off the pin. You can make smaller motions to get a good coil on the string. Use needle nosed pliers to hold the string to guide it to make a nice coil.

Cleveland Chapter
(Butts & Flanges)
Titebond II

Franklin International has a new wood glue on the market — Titebond II Wood

Glue. This glue is advertised as being weather proof, and is suggested as an appropriate glue for exterior applications. It's advertised to include all the properties of the original Titebond, with the added feature of water resistance. Ken Sloane has been using this glue for piano work and recommends it.

Fine Woodworking, *September/October 1992 has an excellent article on* "Adhesives for Woodworking", by Chris Minick. *In the article, Titebond II is reviewed. He says that this glue is a cross-linking PVA glue that doesn't require the addition of a catalyst to activate the adhesive. Glues of this type were only available to large commercial users. During drying, chemical bonds form within the adhesive, thus improving the toughness and increasing water resistance. Chris says it handles like regular Titebond but has a higher tack and short drying time. Chris glued up maple panels with both types of Titebond and submerged them in water. Next morning the aliphatic resin glue bond came apart. Forty-eight hours later Titebond II, still under water, could not be broken apart by hand. As for gap-filling, Chris glued up boards with gaps ranging from 0 to 1/32". After one week of drying he used a tensile tester to check bond strength. All joints with gaps up to 1/64" split apart at 2,600 psi before the glue line failed. Gap size of 1/32" split at 1,700 psi. Technicians, please remember to use glues like this only where you do not foresee ever needing to separate the joint. In other words, don't use it for key bushing. Key buttons would be an excellent use.*

Janet Leary

Fluorescent Lights

Fluorescent lighting may be damaging to your eyes and to your physical well-being. "These lights generate a frequency that interferes with the normal pulsation of the aura causing a beat frequency to be set up in the field. The spectral range is also unhealthy." (Taken from "Hands of Light" by Barbara Brennan). *Fluorescent light has always irritated me and I never understood why — now I know. I even got to the point of stringing up moveable incandescent shop lights for my personal use while at work. If you're slaving away hours at your work bench under fluorescent light tubes getting tired and dragged out, the problem may very well be your lighting, not the action you're working on.*

Janet Leary

Central Florida (Action Central) The Thomas Piano

Just when you think you've seen it all in pianos...

A month ago I was called upon to tune a Thomas Piano, built by Thomas Organ Company. Until that time I wasn't aware that Thomas Organ built pianos. It was an interesting experience. The piano contained a lot of non-standard construction details. Very different. A lot of plastic was used throughout but the plastic was holding up okay. I did a little research and found some good information in an old Piano Technicians Journal. If you ever run into one of these pianos, here's what you can expect to find. The piano has a full "X" plate, no conventional frame or back posts, a reverse crown on a laminated soundboard, 2-1/2" x 1/0 reverse thread tuning pins with string coils flush with the plate and compensated to screw out as you tune to allow for wire "take-up". No screws in the action as all plastic parts clip in on hard extruded aluminum rails, including the keys. No key punchings are used for level or dip. Capstans, level and dip are adjusted from under the keybed.

The piano was not pleasant to tune. It was 20 cents flat so I had to give it a pitch raise. Tuning by ear was very difficult because the beats did not come through loudly. I guess this indicates that the upper harmonics were not strong, possibly because of the reverse crown on the soundboard. Can anyone tell me why they designed in a reverse crown? Fortunately, I had my Accu-Tuner with me. After the job was finished, the piano sounded lifeless. I have relegated this customer to my "dead" file, meaning that I'm not going to call him when his piano is due. I'll wait for him to call me. It had been 10 years or more since its last tuning, and I'm hoping it'll be another 10 years before he calls. By then I'll be retired to Hawaii or some other exotic paradise like Mims or Apopka.

Ted Simmons

[jh] The last two Thomas pianos I saw would not play. The keys were stuck to the back rail, preventing them from going down. The back rail key rest material was not cloth, rather a black foam that, over time, degenerated into foamagris, rubbergris, or whatever it is that California smog does to this type of material. Other than that, there is no particular reason to be suspicious of the plastic parts just because they are plastic. They will break, much like the plastic key on an organ, but if I recall, are not made of nitrocellulose based material that deteriorates over time. So, should you encounter one of these instruments, likely in a dealer's back room as a trade-in, caution should be exercised, but only because replacement parts are no longer available.

A rewarding occupation...?

Piano tuning can be a very rewarding occupation sometimes. I was preparing a piano for tuning when one of the owner's children came in to watch. As I started into the temperament octave, two more children arrived, then a fourth came just as I was into the 2nd octave. They were very well behaved and orderly, and seemed rapt with attention to what was going on with their piano. I was starting to feel like the star in a show. But as I finished the third octave the smallest one lost interest and left. With the treble finished, I started on the bass — lost one more of the children. Before I got too far into the bass a third one left, leaving only the oldest girl. She held on through the bass and I was sure she wouldn't stick around for the unisons. But she did, all the way to the end. I was really impressed with this girl's interest. She was obviously music oriented in a big way. I finally finished tuning and started to fill out the bill. The mother and the daughter were sitting on the sofa near the piano, huddled over some kind of typewritten form, mumbling softly. I overheard the mother say "Now you can cross off the piano tuner." Puzzled, I politely asked what that was all about. She said that her daughter's girl scout troop requires each member to complete a list of items for one of the [merit] badges. The item they were

crossing off read "Watch a piano tuner tune a piano."

Ted Simmons

Connecticut Chapter
(The Keybed)
Vegetarian Ivory

(The following is a summary of "The Good Fake, an Old Substitute for Animal Ivory is Making a Comeback", by Anne Underwood).

In the past ten years Africa's elephant population has been cut in half by poachers seeking ivory. Now, from the Rain Forests of South America, comes a natural product, taqua. Taqua, a vegetable ivory, is made from the dried and polished nuts of several South American palms. Taqua is durable and easily carved — it even mimics the porosity of animal ivory. An early botanist names the palm Genus Phylelephas, elephant plant. The idea of using taqua is not new. More than 100 years ago, a ship from South America to Germany used taqua for ballast. Taqua quickly became one of Ecuador's leading exports. In the early part of the century, Colombia and Ecuador were exporting some 40,000 tons of material annually to the United States and Europe. It was used for anything from chess pieces to umbrella handles.

After World War II, competition from the inexpensive new synthetic called plastic wiped out the taqua trade. In a single year, a female taqua tree can produce 20 pounds of nuts; that is the same amount of ivory on a female elephant. The elephant yields its ivory once; the tree continues to yield nuts year after year.

Reviving the taqua trade would help protect the endangered Rain Forests in Ecuador, Colombia, and Peru. Taqua grows in abundance in these countries. Vegetable ivory can generate up to five times the income of banana plantations and cattle ranches. The only drawback is the average size of the nut, which measures a little more than an inch. This size limits the amount of items that can be produced. The best part of taqua is that it saves elephants and saves Rain Forests.

Washington DC Chapter
(Alpha Bits)
Too Bad For Words

Mark Stivers, RPT, Sacramento Valley, writing in The Valley Technician, talks about using a "piano pounder" to strike the keys firmly while tuning with minimum wear and tear on body parts. The only drawback is that it's usually hard to hold while playing intervals. The piano pounder is among the simplest of tools, consisting of a handle with a cushioned impact surface attached. One of the best designs I've seen is a 2" diameter wooden ball with an upright bass hammer glued in. I have also used a 5-1/2" x 9/16" brass dowel with a front rail punching superglued on the end. This just so happens to weigh 8 ounces, and when dropped from 6" onto a key delivers the standard test blow for the PTG Tuning Exam, and puts a nice ding in the fallboard as a bonus.

As Mark says, just because it's called a piano pounder doesn't mean you can't deliver something short of a murder-

ous test blow. Those who break keys with a pounder (pianocidal maniacs?) would probably break keys without one too. Like all tools, it's only as good as the person using it. Its main purpose is to allow you to work with less pain. But it doesn't do intervals well.

That's where my approach comes in. I wear a snug-fitting driving glove on my left (keyboard) hand while tuning — an Isotoner, constructed of fine leather and Spandex. A bit pricey, but worth it. Intervals are no problem, and there's just the right amount of cushion at the fingertips. Wearing the glove while tuning also seems to stimulate the circulation in the hand and wrist. And most important for me, I have had no pain in the left elbow, forearm and wrist since I began using the glove.

However, I have had to tolerate the occasional wise-cracking customer, such as the one who took one look and said, "What's this, the Michael Jackson look for piano tuners?"

Michael Travis

Toronto Chapter
(In Tuner)
Pianos or Horses?
Original Title
They Shoot Horses, Why Not Pianos
Harvey Version

You can buy a new one or a used one. They are heavy and expensive to maintain. If you let them go wild, you have to train them all over again.

Miscellany

Help Me Help You, Part II

I've been trying to include more subject diversity into recent *Journals*, while still maintaining a reasonable semblance of order. This has certain consequences:

•Depleting my cache of contributed materials evokes the funnel effect: the more material I publish , the more required to refill the funnel. So, if you are waiting for a rainy day to record your thoughts — pretend it's raining. (No joke intended for our colleagues in the midwest — we're in a drought here, and my thoughts lean *toward* rain.)

•I believe acknowledgments of submitted material to be up to date. However, unsolicited materials are rarely published on a first-in, first-out basis. Please keep this in mind before calling me about the status of your documents.

While on this general subject, I'll mention the following request. I receive many statements similar to: "Jim, if you decide to publish this [document, letter, graphic, etc.], I can send [whatever item] on disk to [Larry, Jami, home office, etc.] to save you [time, energy, trouble, etc.]." The fact is, there should be nothing of a technical nature that does not get modified, however slightly, by me. And the edited version is what ultimately gets published. So, if you are capable of sending a disk, send it to me, along with your printed version, if you prefer. This is the *only* way it will help the process. Thanks!

Glitch

In the July 1993 issue, an end-of paragraph mark apparently became lost in the computer's bit bucket. At the bottom of page 10, last paragraph, note the following change:
The bulleted item "Speed curing of epoxy and polyester resins" should be a standalone item, with no additional comments. Add a *new* paragraph (the *lack* of italics is already there). This makes the words beginning with "Being too impatient..." mine, not those of Bill Spurlock. This slight change should make more sense for those who thought that Spurlock suddenly developed a sense of humor.

Next month, providing there are no unforeseen hitches in the get-along, we will be presenting class reviews from the Milwaukee convention.

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LESSON PLAN

Technical Lesson #1

Flange Rebushing

By Bill Spurlock, RPT

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

This lesson will present methods for doing a professional job of re-bushing a flange. While it is more common to replace, rather than to repair, a part with a bad bushing, this skill is still a valuable one. Sometimes a replacement part is not available.

Also, the skills involved in successfully rebushing a flange are applicable to many other piano bushing jobs, such as pedal pivot blocks, upright damper hanger brackets, damper guide rails, etc. Finally, one reason that some technicians never rebush flanges is that they are not able to get good results, but with the proper materials and methods, excellent results can be consistently achieved. Note: the methods presented here are specifically for the spot repair situation of rebushing only one or two parts. When rebushing a large number of parts, slightly different procedures may be used to speed up the process.

Getting started

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

Hands-on session set-up

This job is easily taught to a group in a hands-on format. Obtain the following parts and materials for the session:

- used grand hammer & shank assemblies, with flanges attached (avoid very old, brittle parts)
- extra Renner flange bushing cloth strips
- one set of all tools and materials shown in Photo 1, for the meeting leader
- meeting room with good lighting, tables

Estimated lesson time

45 minutes

Tools & materials participants must bring

Participants must obtain and bring all those items shown in Photo 1. Note that Renner flange bushing cloth strips are specified. This cloth is superior to ordinary supply house flange bushing cloth for several reasons: one end is rolled and glued into a pre-formed "needle" which will not tear off when it is pulled through the shank. It is also glue-sized on the outside and graphited on the pin side. Most important, it is extremely dense; this produces an action center that remains very firm after sizing to the correct friction. Renner flange bushing cloth is available from: Renner USA, (801)292-4441, and American Piano Supply, part #33897R (201)777-3600. Be sure to specify strips with the pre-formed "needle" end.

The double-ended pin vise is available from several supply houses. Although a regular pin vise will work well, the double-ended style is convenient because it holds both the smooth tapered burnisher and a knurled centerpin at once. When not in use, the smooth burnisher stores entirely inside the handle.

Assigned prior reading for participants

All articles in chapter IV; PTG Technical Exam Source Book (PTG Home Office, 816-753-7747)

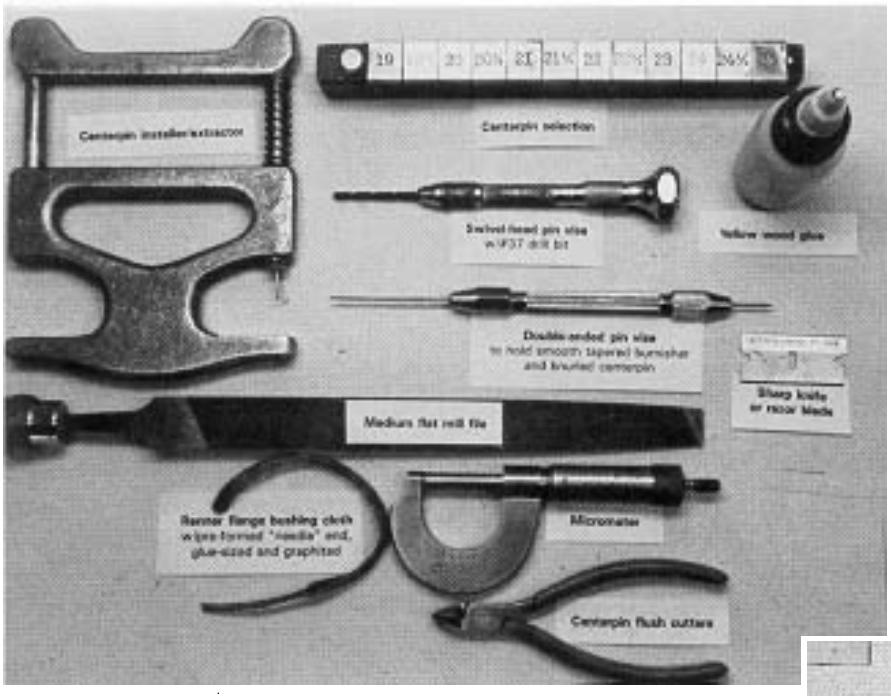
General instructions

The object of good flange rebushing is an action center with the correct friction level while still being very firm (free from wobble). This result requires a very dense, firm bushing which is sized to the centerpin using a minimum of reaming. I suggest the following procedure:

Technical Lesson #1 begins on the next page

Technical Lesson #1
Flange Rebushing

For this lesson:
The meeting leader as well as the participants should have or obtain one set of all the tools shown here.



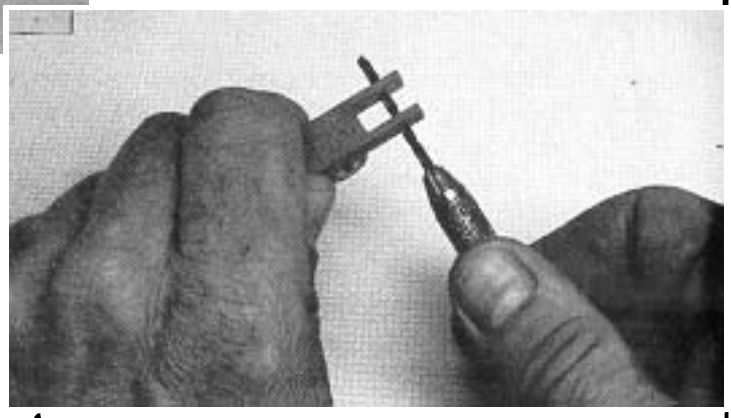


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Photo 4: Clean the shank holes with a #37 drill (.104") rather than the 7/64" (.109") that the supply houses sell for this purpose, since the larger drill makes the hole bigger than original. Turning the drill backwards while inserting, then forward to ream, will further prevent damaging the holes.

Photo 2: Un-pin the shank & flange, and note the size of the original centerpin.

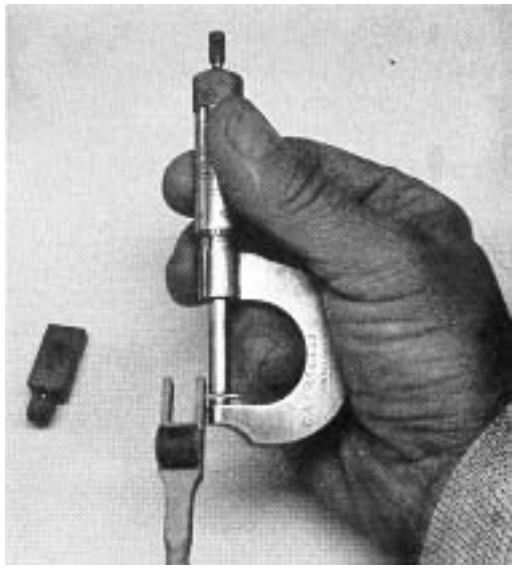

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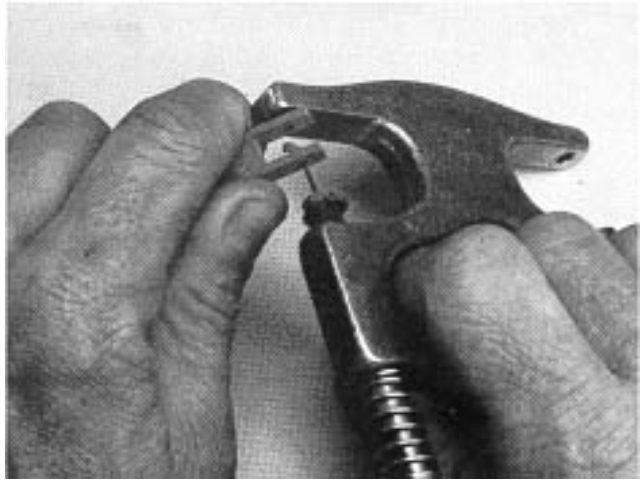
Photo 3: Push the old bushings out with your centerpin punch, rather than by drilling, so the hole in the shank is not accidently enlarged.



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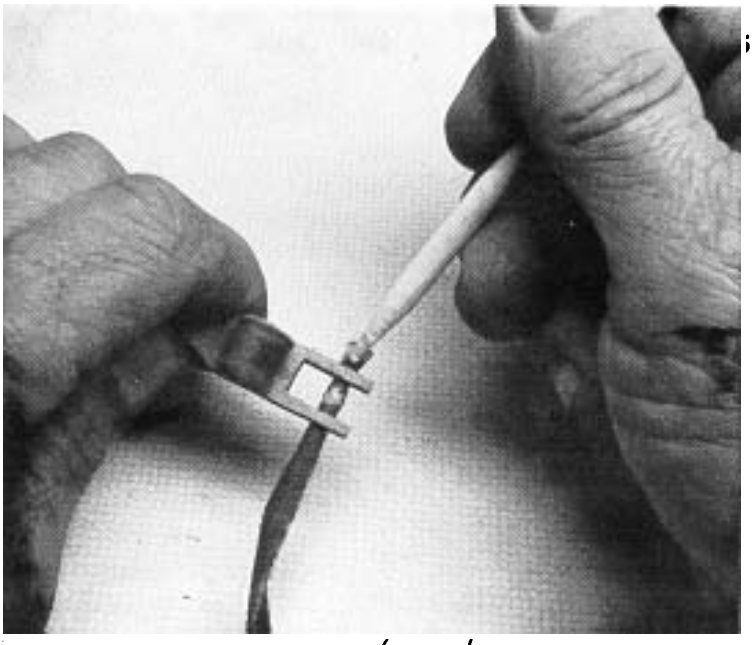
LESSON PLAN

Photo 5: Pull the bushing cloth through the shank, stopping about 1/4" from the end. Locate the seam as shown in Figure 1, avoiding the area of greatest stress. Apply a small amount of glue to the cloth adjacent to each fork of the shank (avoid gluing near the seam of the cloth).



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LESSON PLAN

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Figure 1

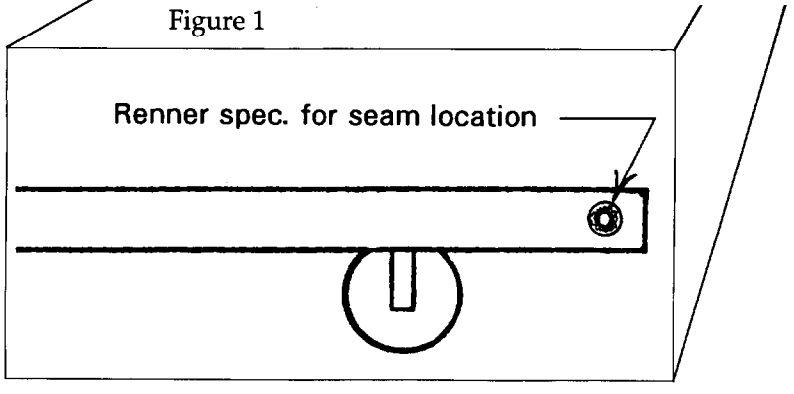
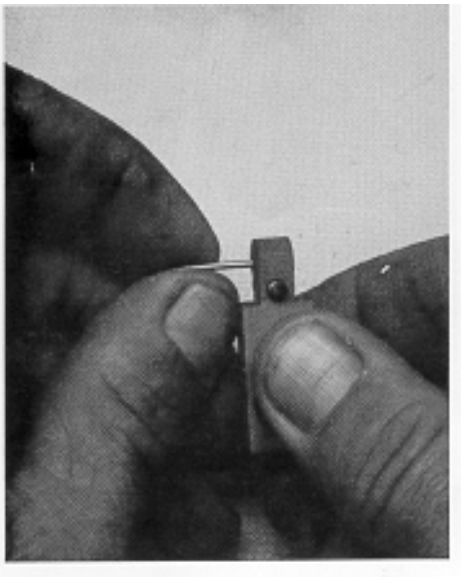


Photo 7: Select the size of centerpin to be used later in the re-bushed part. This will be the size pin that is tight in the flange birdseye (you should not be able to push it in by hand.) Normally this will be one half-size larger than the original.



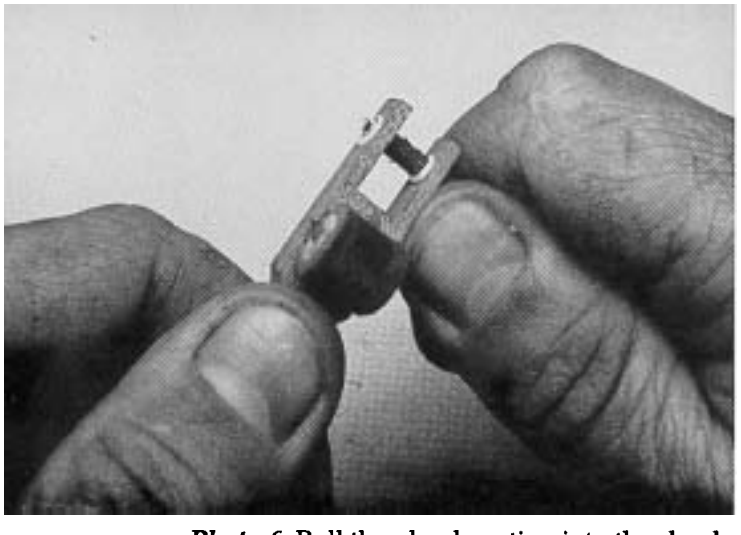


Photo 6: Pull the glued portion into the shank.

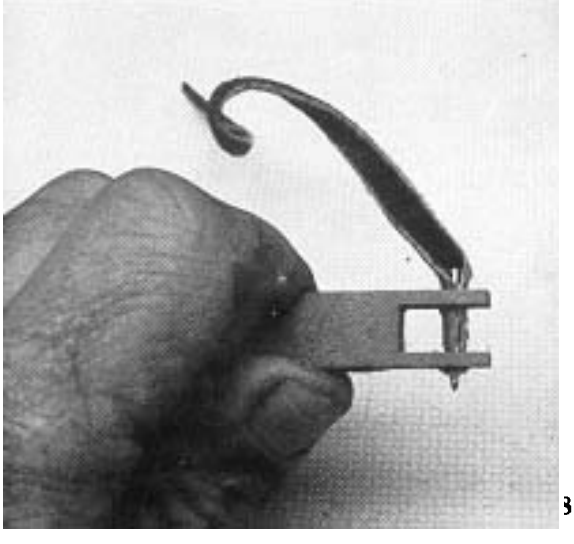
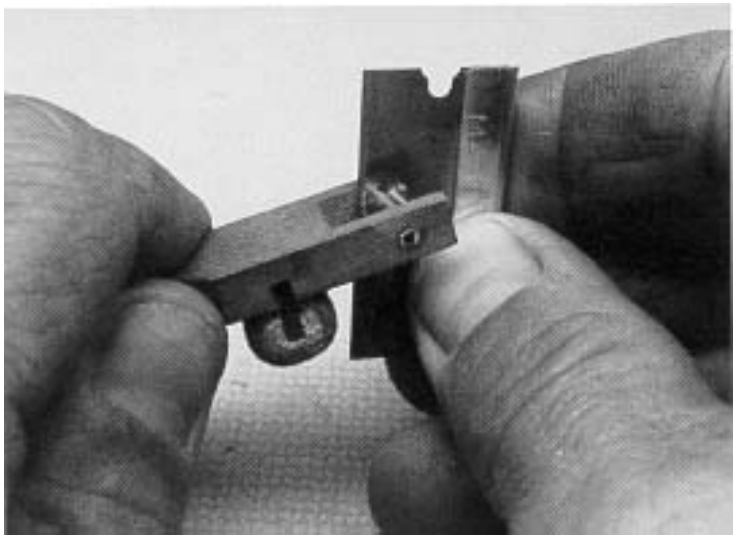


Photo 8: Insert the new centerpin to clamp the cloth, and set aside to dry, preferably in a warm place such as a sunny window sill or under a lamp. Allow to dry for at least 20 minutes.

Photo 9: After the drying period, remove the centerpin and trim the cloth flush with the wood. Be sure to trim flush so the birdseye fits freely within the fork of the shank.



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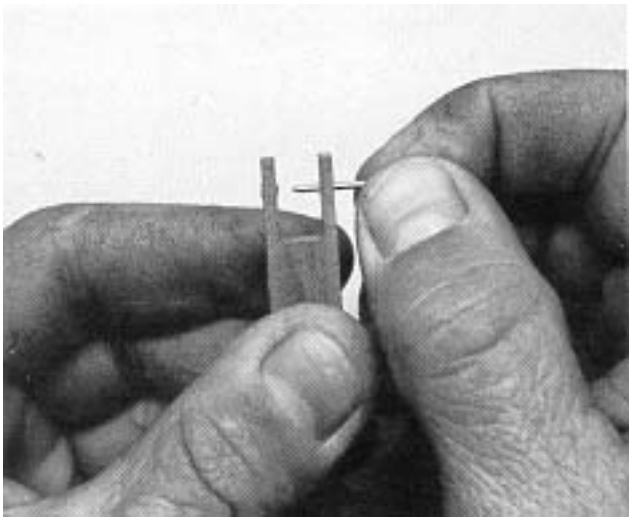

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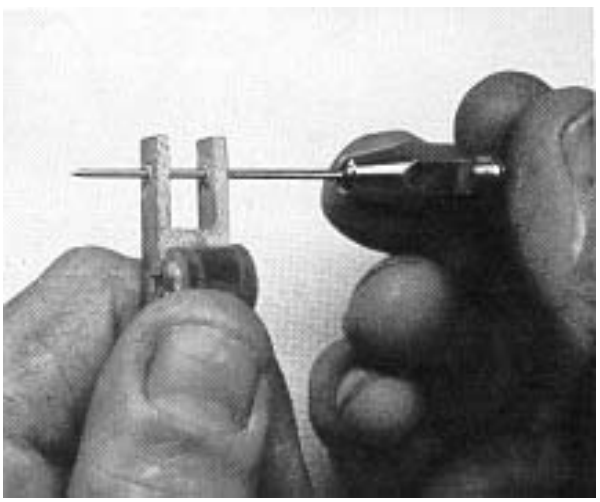
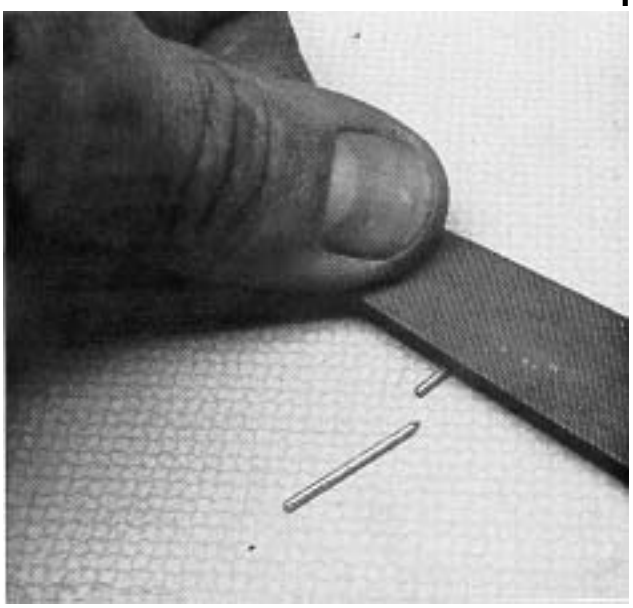


Photos 10 & 11: Test the fit of the pin in the bushing. Usually it will feel quite tight. Avoid reaming if possible; you will get a denser, more solid bushing if you compress the cloth with a smooth tapered burnisher since reamers tend to loosen up the cloth, sometimes resulting in a wobbly part. Burnish carefully, then test the fit of the pin in both sides of the shank.

12



Photos 12 & 13: If burnishing alone does not adequately ease the fit, ream sparingly with a knurled centerpin. (Choose a pin one half-size smaller than that to be used for assembling the part, and roll it firmly under a file to knurl.) Follow by re-compressing with the burnisher. When correct, the fit should be equal on both sides and should still feel a little too tight. At that point, assemble the part (but do not clip off the centerpin).

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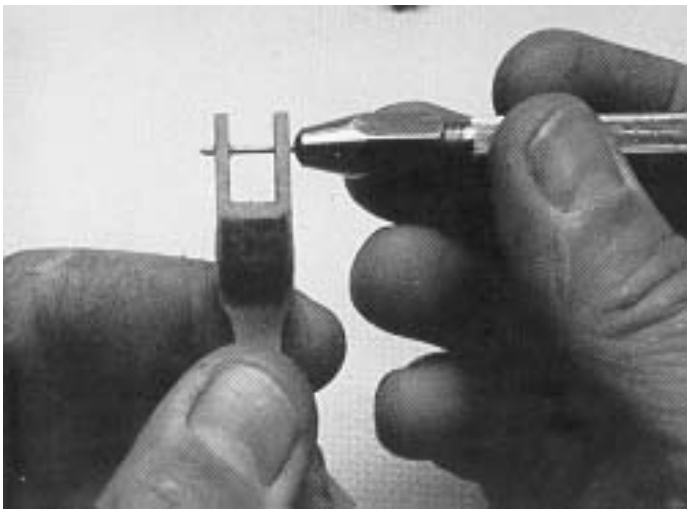
LESSON PLAN

continues on next page

13



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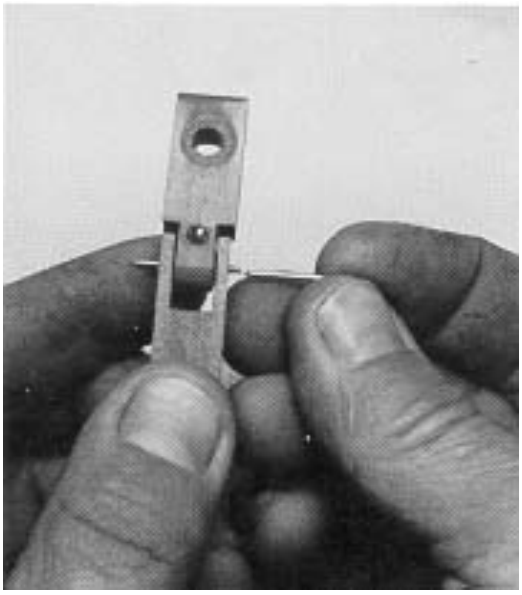

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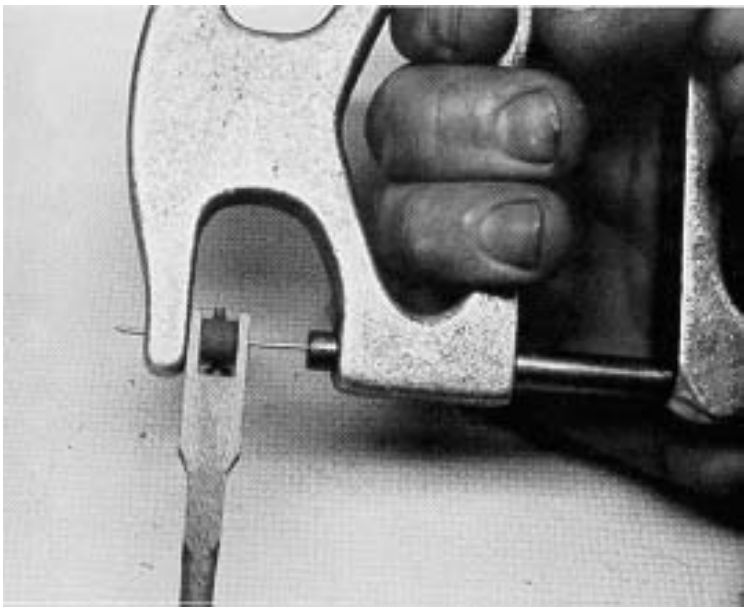
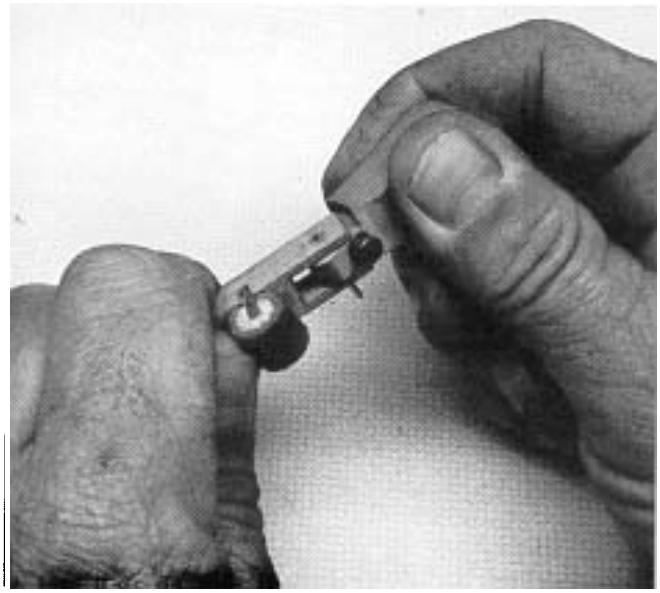


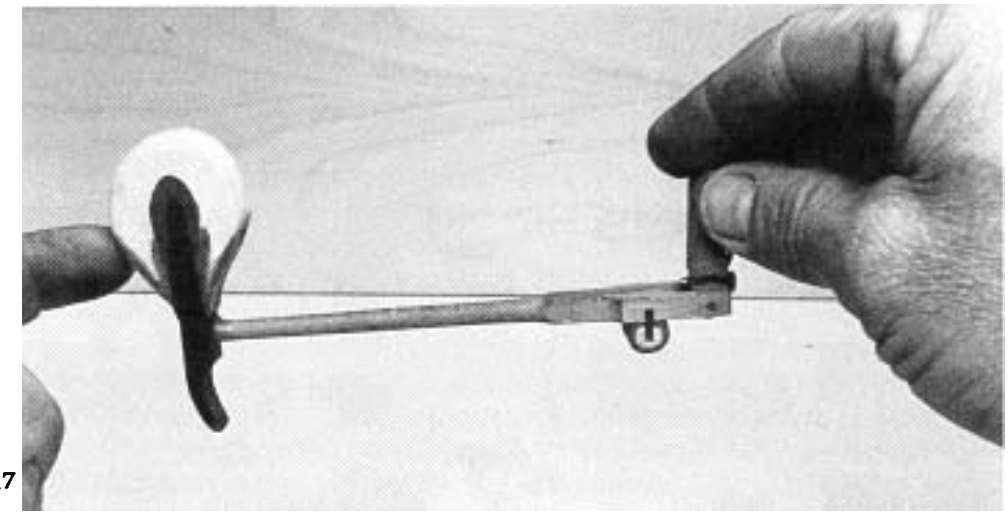
Photos 14 & 15: To avoid accidentally pushing out the new bushing when pressing the new pin into place (due to misalignment of the holes in flange and shank), insert a much smaller pin first. This will hold the parts in alignment as the regular pin is pressed in behind it.

16



Photos 16 & 17: Check for friction. In the case of a hammershank & flange with hammer, it might initially swing only 3-4 times. (One swing is movement in one direction. Thus 3 swings would be back, forth, and back again). However, holding the flange firmly between the fingers and swinging the hammershank back and forth vigorously 20-30 times should cause it to loosen up and settle at 5-7 swings. A common mistake is to ream or compact to the correct final fit of the pin in the bushings and then assemble the part; it may have the correct friction initially but after a few swings or other stress (hammer filing, voicing) will invariably become too loose. You should expect this initial loosening and therefore strive for a fit that seems a little too tight, breaking the part in by "exercising" it before judging it okay and clipping off the pin. If after exercising the part you have more than 7 swings, you will have to re-pin with the next larger centerpin.

NOTE: Photo 17 is on page 22.



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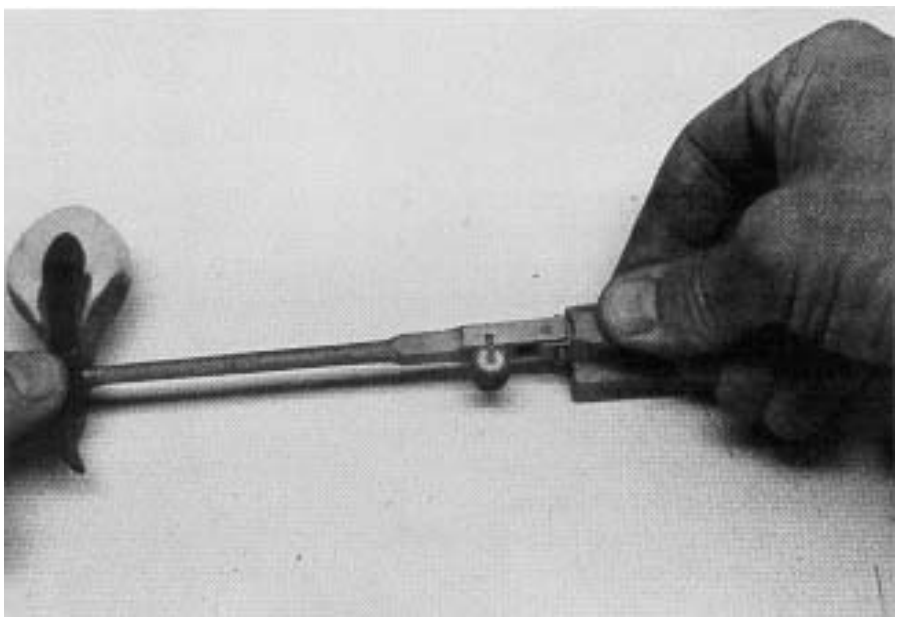

Photo 18: Double check for wobble before cutting off the pin. Often a part will pass the swing test but will wobble side-to-side because one bushing is looser than the other. Hold the flange down firmly on a solid surface while flexing the shank side-to-side to test.

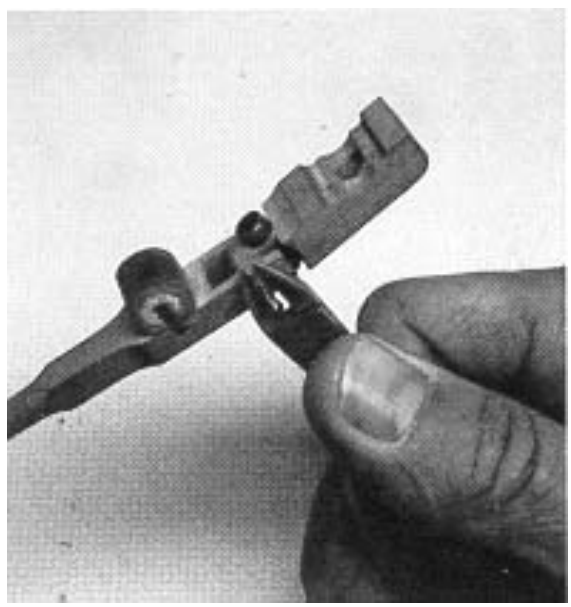

Photo 19: Cut the centerpin neatly with flush-cutters.

Follow up

As with any new information, participants should practice this procedure on their own until they can perform it easily with consistent results. Practice, along with obtaining the necessary tools, will reward the technician with the skill and not just the theory to do the job. Participants should also broaden their bushing skills by practicing on other parts as suggested in the PTG Technical Exam Source Book, page IV3.

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LESSON PLAN

Tuning Lesson #1

Unison Tuning

By Michael Travis, RPT

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

This lesson consists of listening to and tuning unisions. Each group participant will have an opportunity to tune several unisons and the group will then nitpick the results and test for stability with the instructor's guidance. After taking this lesson, participants will understand what a good unison is supposed to sound like, and also gain some insights into basic hammer technique and tuning for stability.

Chapter meeting set up

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

Estimated lesson time

60 minutes/4 participants

Tools & materials participants must bring

Tuning hammer and mutes.

NOTE: The "Coleman Beat Locator" (available from Superior Instruction Tapes) will be needed in upcoming units on interval tuning. Group orders are suggested.

Home study assignment for participants

Read articles on unisons, page 59, and stability, page 127 (PTG Tuning Exam Source Book); also, Piano Servicing, Tuning and Rebuilding, 2nd edition (1993), by A. Reblitz, pages 219-221 (through Tuning Exercise #2). Get a feel for small tuning pin movements and close listening by practicing unison tuning for at least 10 minutes daily.

General instructions

As an introduction, emphasize the importance of clean, stable unisons to the success of the tuning job and the reputation of the tuner. Briefly give the ground rules for this lesson: first, each participant will tune 4 midrange unisons, outside strings to the middle string, as cleanly as possible while everyone else listens. Then the instructor will play the unisons softly (to avoid disturbing unstable unisons for the moment), and participants will listen closely, noting where improvement is possible. Then the instructor will apply three firm test blows to each unison, and the group will listen again. Finally, the participant will have a second shot at tuning clean unisons, and the group will listen again. Each participant should have about 10 minutes actual tuning time.

Before an Associate takes the "hot seat", the instructor may wish to give a mini-lecture/demonstration of unison tuning by going first and talking briefly about listening, muting techniques, hammer technique, etc. Optionally, if a Sanderson Accu-Tuner or other measuring instrument is available, the instructor can also demonstrate the tolerances for unison tuning on the RPT Tuning Exam (+/- .9¢, or 1 penalty point per 1.0¢ deviation among any two of the three strings). Play through the midrange of the piano and point out unisons that are good and those that are not good. Measure a few of those everyone agrees are not good, and thus demonstrate what will pass and what won't.

The emphasis in this lesson should be on listening and doing, not on talking. Once everyone has had a chance to perform, participants will have had a good ear training session, in addition to an opportunity to observe various techniques and whether they result in stable unisons. The instructor should encourage participants to pay special attention to unisons in their daily work and to practice tuning clean and solid unisons. Finally, participants should be invited to ask questions about unison tuning or stability.

This lesson may be repeated periodically to gauge progress. Those who consistently demonstrate understanding and skill in unison tuning should check off "unisons" on the PACE Exam Skills Checklist.

Good Vibrations

The

Basics of Tone

Continued

Nick Gravagne, RPT
Contributing Editor
New Mexico Chapter

We left off last month having discussed Helmholtz's teaching on piano tone, both rich and poor tone. The great German physicist's emphasis in this regard has more to do with tonal spectrum analysis (fundamental, partials, etc.) than with certain additional tonal aspects of interest to the piano tuner-voicer, such as attack, swell, and decay. This is not to say, however, that the voicer's concerns exist independently of the physicist's. It is often the case that when (as argued last month) the tonal spectrum is "correct," having a strong fundamental and a pleasing array of partials, the attack, swell, and decay *automatically follow*! More on this later.

Incidentally, we haven't discarded Emma Schwartz and her grand piano that needs "bringing up." We are taking what I believe is a much needed excursion (as we said would happen) into the theory and practice of tone — what it is, and how we get it from our voicing efforts.

Now, by way of recap, last month's discussion defined rich and poor tone according to Helmholtz.[1] A rich tone contains a strong fundamental, while a poor tone emits a weak fundamental accompanied by a dizzying array of upper (usually screaming) partials. Hard hammers, whether hard initially, or hard through playing and packing in, do not encourage the presence of a strong prime tone. The tone may be louder (especially up close), but it will be thin and not carry as well as tones with strong primes. Helmholtz reasons that the poor tone contains "abrupt discontinuities" due to the presence of too many upper partials, while the rich tone contains "continuous velocities" due to the presence of a strong prime and many fewer upper partials. The significance of these scary terms is, I think, important to grasp, on both the theoretical and practical levels. At any rate, the concepts are not difficult.

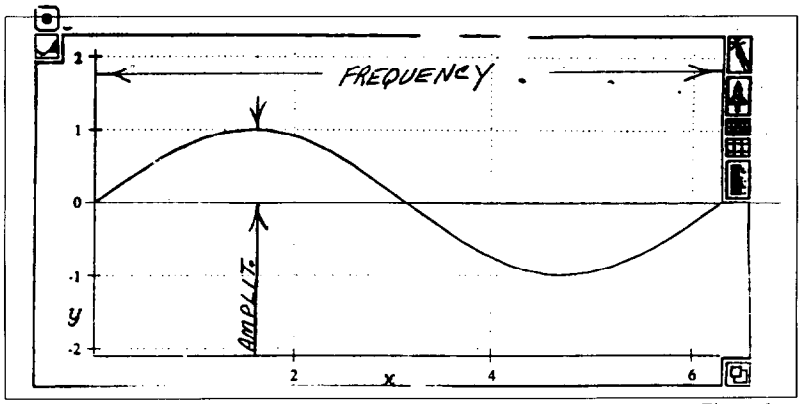


Figure 1

Wave Theory

In order to get a handle on what these terms mean we must first briefly consider "wave theory". **Figure 1** illustrates the typical method of using sine waves to represent musical sound waves. This wave, which completes one full cycle (cps or Hertz), unmistakably contains two components: amplitude and frequency. Amplitude means volume; that is, increase the "bumps" (crests and troughs) of the wave, and the volume will be increased. Frequency indicates how close together or far apart the bumps are; closer together means a higher frequency, and farther apart means a lower one. A third idea is implied in the wave — continuity. The wave is said to be "continuous" at the given amplitude and frequency unless some force interrupts it or changes it. A piano tone will eventually stop, due to friction and braking actions of the sound producing system. The frequency will not have changed, but the amplitude will have fallen off to nothing. But *while* the tone was sounding it was continuous.

In order to understand the meaning of a "discontinuous" wave

we must now consider what is meant by the "addition and subtraction" of waves (also referred to as the algebraic sum of the waves). This concept, too, is very easy to comprehend. **Drawing 2** shows the addition of two waves, i.e., waves *a* and *b*. Wave *c* is the sum of the two waves. Notice that its amplitude is twice what either wave *a* or *b* is. These waves are said to be "in phase." The actual sound coming from the sum wave (*c*) is twice as loud as that coming from either wave *a* or *b*.

The waves in **figure 3**, however, have canceled each other out. Notice that the "sum wave", or "resultant wave" is *no* wave at all, just a straight line. Here we have the subtraction of waves. Waves *a* and *b* are said to be completely "out of phase", and there would be *no* sound coming from wave *c*, even though there were sounds coming from *a* and *b*.

Figure 2

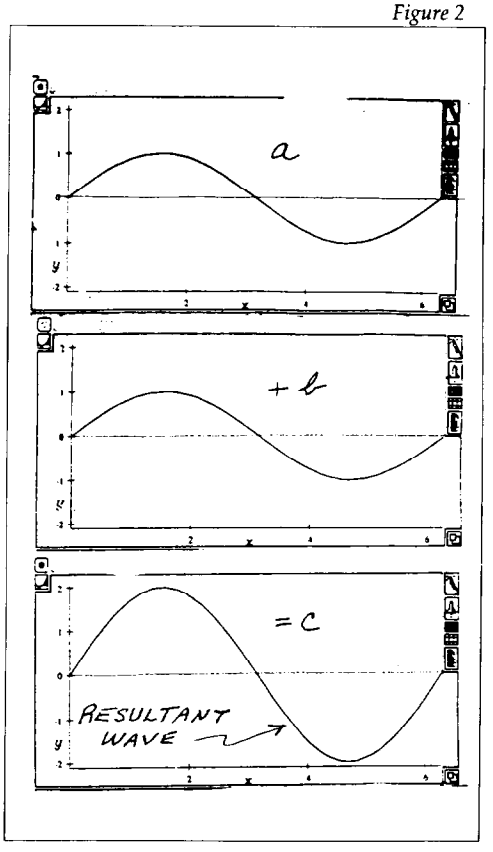
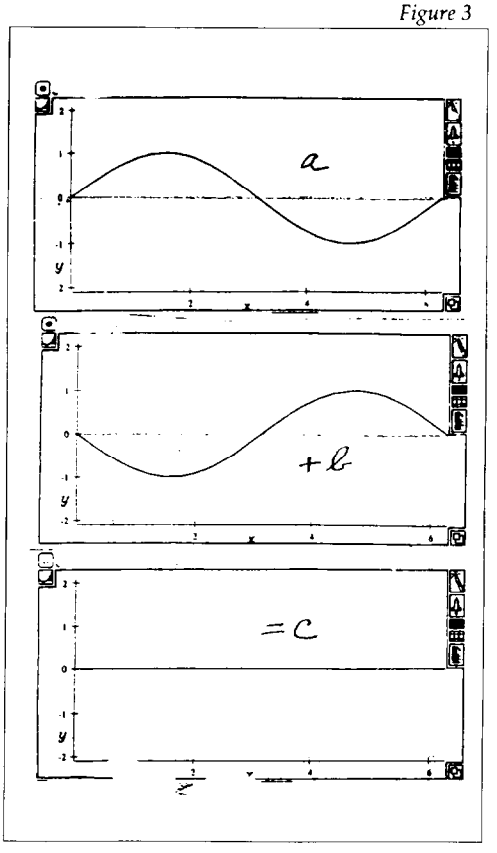


Figure 3



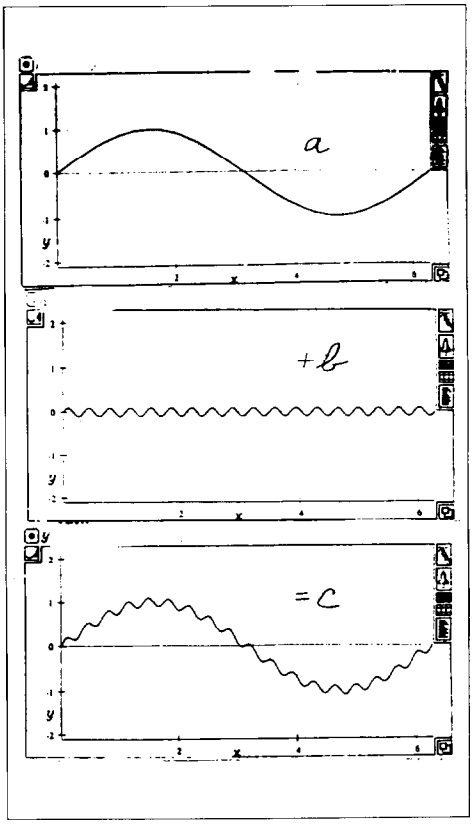


Figure 4

Waves of different frequencies can also be added and subtracted as shown in figures **4 and 5**. Again notice that the sum wave is the child of the mom and pop waves; it contains elements of its parents, but yet it's special in itself. Note that the resultant wave is *continuous*, that is, it is not breaking up into distortions, or *discontinuous* wave forms. A continuous wave form is dependable and repeating.

So, then, how do discontinuities come to be? Simply when too many high frequency waves are being added to and subtracted from each other. The sum, or resultant wave, becomes choppy, sharp-edged, square-edged, even flat in some places, then highly peaked in others (**figure 6**). The pattern of the wave does not neatly repeat itself as does a dependable, continuous wave. And what sort of tone do we hear from such a wave? Screaming, like the sound of glass breaking, thin, pingy, lacking in warmth, perhaps loud but with no carry to it — in short, like an awful lot of pianos sound.

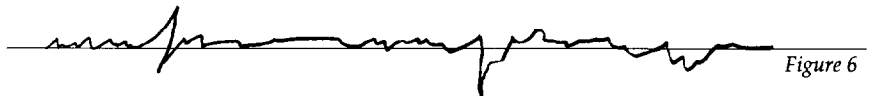
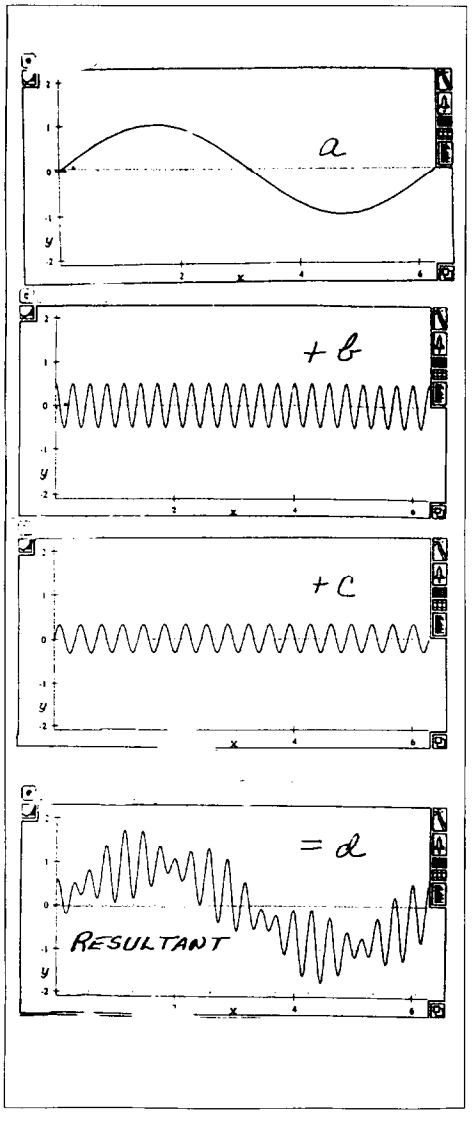


Figure 6

The Highs Lose Energy First

Another thing to know about thin tone is that energy in a string falls off and dies beginning with the highest partials, working down in order to the lowest partial, i.e., the fundamental. Said another way, the higher the frequency of an upper partial, the less energy it possesses. And the less energy, the more quickly it will die off. But suppose a very stiff (hard) hammer produces a tone of weak fundamental; a tone speaking in predominating overtones? Since the energy in the partials will die off quickly, we can expect the sustain or decay characteristics to be lacking. But given a strong fundamental, which will hang on to the energy longest, we can expect the sustain characteristics at all spectral levels in that string to improve. This is what we mean when we say that certain aspects of tone, such as swell and decay, are simply natural by-products of tone regulating — in this case a longer and more vibrant decay due to the presence of a strong fundamental.

Figure 5



Lesson

It is the hard hammer that delivers a uniquely direct pulse of energy to the string. The hammer then gets away from the string quickly. The tonal spectrum of the string is weak in fundamental, and lacks in fuller decay due to the predominance of high partials.

The solution always exists in properly understanding the problem. If a too-stiff hammer produces the above ills, then a less stiff, more springy hammer will produce a stronger fundamental, eliminate the unwanted screaming overtones, and encourage a fuller sustain/decay.

I believe this simple fact, coupled with practical application, can make better voicers of all of us. At the very least this knowledge, when translated into skill, can encourage many of us to be, if not the highest level voicer, an "everyday voicer" who can routinely improve a great many screaming pianos out there.

Now before we tread the open field of voicing procedures we must consider the vast array of booby traps. Given the different kinds of pianos (and in every sort of condition), the *many* kinds of hammers (factory or after-market replacements), the likes and dislikes of customers regarding piano tone along with the opinions of piano technicians as to methodology, suffice it to say that there exists no one way to voice a piano. What works well on factory Steinway hammers, would be a disaster on, say, a set of Japanese (Tokiwa) hammers. Piano technicians across the country have confided in me that, after having applied voicing techniques learned at a convention, they were disappointed at the outcome. After questioning them, however, I would usually discover that they were using the *right* techniques, but on the *wrong* set of hammers. Thus, given the booby traps, what we all need to learn better is how to "read the hammer." Regardless of the hammer in question, the tone will tell us what we need to know.

We now find ourselves right down to the practical level of discussing tone regulating. In order to do that we will have to cover the basic types of hammers available to us, either new replacement hammers, or already-in-the-piano hammers. We will also have to delve a bit into real-life scenarios regarding in-home tone regulating. A typical scenario would involve, say, a ten-year-old Kawai grand that is basically in good condition, but now has a hard, percussive and thin tone. The hammers are, of course, grooved and require shaping. But after shaping, what is going to happen to the tone? Why? And what will be the most straight forward technique for dealing with the tone in the least amount of time and with the least fatigue? Hint: the shoulders of the hammer do not play a significant role in the required techniques.

So, this and more will be found in upcoming issues. Also remember, we haven't finished with Emma Schwartz and her hated piano. She'll love it again as we go through the regulating and voicing steps to "bring it up."

Note: Special thanks to Ian Gravagne for mathematical formulas that gave rise to all computer generated wave drawings appearing in this article. Formulas are available upon request..

[1] *On The Sensations Of Tone*, Hermann Helmholtz; chapter 5, Dover Edition. Available from American Piano Supply.

Between You, Me & The Tuning Pin

The Circle Of Thirds

Bill Ballard, RPT
Contributing Editor
New Hampshire Chapter

This is the final article in my six-month tenure as the *Journal*'s Contributing Editor for Tuning, and I hope that you have found my ideas if not useful, at least intriguing. This month, we'll take another look at the 3rds and 6ths temperament. It shows up in the *Journal* nearly every year, but there are aspects of it that deserve highlighting. It's simply an elegant system.

But before that, I'd like to get to a letter that has been waiting patiently in the mail box, one from Associate member Chris Day of the Boston Chapter. His three pages begin modestly enough: *"Since tuning pin torque is the* Journal *'Subject of the Moment', I have some comments that might stimulate some further discussion in the pages of the* Journal."

He then describes his mastering the tuning of tight pinblocks at the "Piano Technicians' Boot Camp", run by the Concert Artist Division of the Baldwin Piano Company for the Boston Symphony Orchestra's Tanglewood Music Festival.

"At Tanglewood, Baldwin drops 140 'fresh-from-the-factory' pianos to be made ready for the Summer onslaught in two weeks. As Head Concert Technician for Baldwin, Andrei Svetlichny's task was the meticulous preparation of the concert instruments (regulating the action on top of the piano without fixtures, about which, more someday). The rest was up to two permanent and two temporary helpers, including myself."

"...Andrei...told us about Baldwin's initial pin torques and what they might be expected to settle down to. We were all, frankly, horrified! ...He suggested that a strong pair of shoulders would do an applicant no harm and that he himself worked out daily."

"With some trepidation I approached my first grand. I should perhaps mention that my only previous encounter with a tight Baldwin grand was one that had been badly redone, and all pins could be set only a quarter tone sharp or a quarter tone flat with no position in between. I still had that memory. After a few painful tugs, I lengthened my hammer 3 to 4 inches and re-started. I then discovered something I was quite unprepared for. If I leaned back on the hammer with a straight arm and pushed back on my back, I could slide the string gently and smoothly to pitch. Not quite right yet however, it ended up badly flat. After a few more tries, I learned the amount of over-pitch. With one steady over-pull, followed by an ease-back, I could be right on target and right in the middle of the 'slush' zone. I was quickly doing tuning, unisons as you go, hitting the target right nearly every time."

"The secret that Baldwin has managed to create, (and I am talking specifically about models, M, R, L, SD, and SF) is excellent uniformity and smoothness of their pin torque. It may start as monstrous in the factory and drop to merely very high early in the field but it is eminently tunable and I always look forward to tuning these pianos. So much for the fears of high pin torque."

Yet another tuner discovers that tight pins can be tuned. If you've been following the testimonies of Dan Bowman, Nick Gravagne, myself and others, you've noticed that while brawn is certainly called for, brains are best left out of it. That is to say that the more your brain wants to help in monitoring the flow of tension down the string's path from the tuning pin, the more it gets in the way of what is a no-brainer process. For me, however, the real monster is the piano whose string friction is higher than the tuning pin friction. Here neither brains nor brawn is of any use, as the basic correlation between how the wire is moving at the tuning pin and at the entrance to the speaking length is severed. These two situations compare to the two riddles of the Rubik's Cube. A prominent mathematician writing about the cube said that it took him a day to sort out the mathematics of returning all those squares to their proper side. But as for the mechanical trick of getting the squares to swivel around the cube, if he hadn't pried his cube apart, he never would have guessed the secret.

What must be said about such tight pinblock grips is that they are unnecessary. Once a pinblock has provided a minimum grip of, say, 90 to 100 inch pounds, during the driest season, any further torque adds nothing to what needs doing by the other equally important aspects of tuning stability — namely, solidity of the piano's construction, the balance of pin/string friction, the skill of the tuner, and the mercy of Mother Nature.

I can understand the nervousness of manufacturers, sending pianos off to different corners of the world, and to owners of unknown levels of responsibility. One factory will put in a rotary-sawn maple block and drill it with a .250" bit, and another uses the same size bit for their quarter-sawn maple block. Both blocks settle in at a lower torque, and twenty years hence that will have drooped further yet. Whether that grip is still in the safe zone depends on whether the maple was rotary or quarter cut. But the lion's share of that drop in torque comes from cramming a .281" tuning pin into a .250" hole. A .266" hole (or even a .262") will settle out initially at 120-140 inch/lbs., as opposed to the 160-200 of a .250" hole, and it'll do this with far less stressful pressure on the

pinblock. You can't convince me that once the torque gets above 100 inch/lbs, an extra 40-50 inch/lbs means anything as far as keeping the piano in tune. To the contrary, it adds to the tuner's work, if not confounding it.

Consider also what this unnecessary torque is doing to our hands. For every tuning we do, we must make several thousand motions with our hand on the hammer. Most of us consider four tunings as a good day's work. When we slam our hand on a tuning pin that doesn't turn, we might as well be applying that same force to a brick wall. Fortunately, pins do turn, some sooner and others later. The late ones, however, throw most of that force directly back into our hand. The fact that the twisting action of the pin may be creeping deeper down its length doesn't change the basic situation — that until the entire length of the pin has moved, that force ends up either compressing or distending our hands. The higher the torque, the more of beating our hands take. I have recently noticed a burning sensation in my right hand that arrives after the second piano of each day. Granted that I'm no longer 20-something (or even in my 30s), but I would have expected my left hand to get hit first! Face it. High torque has little to do with tuning stability, and certainly doesn't justify what it does to pinblocks and to your hands.

A Little Tap'll Do Ya!

Chris Day continues with the subject of driving loose tuning pins, and he marvels that such a small tap will make such a big improvement. *"...The only explanation I have ever seen in print is that the pin has claimed more tight wood to grip on at the bottom of the hole. Given the inch or so of tuning pin already in the wood and the small space sometimes available for driving, the excellent results often obtained do not seem to add up with the amount of incremental grip. Steadily becoming convinced that the classical explanation was far from the whole story, I performed some simple experiments while pin driving. I found that in some cases as little as 1/32 inch would produce substantial results and that these results did not measurably improve on driving another 1/8 inch."*

"In my discussion I will first eliminate tapered pins and those with unidirectional threading characteristics. Tuning pins have fine threads with six to eight simultaneous threads starting at once. When they are initially driven in, the threading is by-passed. ...The wood clearly fills in the threads in time to form matching a thread. Since this has allowed wood room to displace this will reduce pin friction a little. After many years, the friction of tuning wears away wood and the pins start to have poor holding power. Since the abraded wood has nowhere to go, I suspect that it remains in the area of the threads as a lubricating dust."

"Now comes the technician with his pounding. The pounding forces the pin threads to ride up onto the high parts of the previously formed wood threads. This may clear the wood dust film and will reduce the inner diameter of the wooden pin hole. Eureka! More friction. This is postulation at this time since I do not have the equipment to saw old pinblocks apart complete with pins and then do a fairly simple microscopic examination of the hole wall. It does suggest why so little pounding can produce such great results and why these results may be so transitory."

Frankly, in all the sets of loose pins I've driven, I've focused mainly on insuring that the string leaving the coil doesn't get pinched against the plate. After the initial tap has gotten me back up to 100 inch pounds, I have never looked to see what a second tap will do. The pinblock hole definitely forms thread around the pin's threads. Just saw into any chunk of used pinblock. If the pin's threads were cut, you can be sure the hole's wall is being cut too. (I like rolled threads.) Certainly if in the driving, a pin's threads end up riding on the threads of its hole, a little extra grip will result. The thread depth is all of 5 mils, and to double that (by aligning pin and hole threads) is to go up two sizes of tuning pin. And if you do manage to align these in a driving of 1/32", at 80 threads per inch, you'd have eighty-plus alignments in the old part of the hole, and two and a half in the new part. Conceivably, these thread-to-thread alignments would begin the same forming and relaxing process done the first time the hole ever received a pin. Thus, I'm not sure how much of the new torque can be laid to this thread realignment. It does have its uses, however. Chris asks, *"If one is a tuning a grand and perhaps only one or two pins need driving, does one pull the actions and set up supports just for this? Are there alternatives?"* You bet! A simple tap with the butt end of the tuning hammer will achieve this cross-threading without coming near cracking the block.

Where's the Lateral Support?

Chris next takes up supporting the pinblock which *"...will prevent the pinblock separating from the plate, particularly if the pinblock plate screws have not or cannot be tightened. It will also...prevent lamination separation. Unfortunately, if the pinblock is about to split sideways from the jamming forces of the pin, pinblock support will do little to prevent this since the supporting force is in the wrong direction. However, by giving the lamination glue only one job to do during the impact, it may keep the glue stresses down to a non-fracturing level."*

"Many have seen the experiment where an apple is put in the palm of the hand and a bullet forced through it with difficulty. An apple is then set on a post and a similar bullet fired straight through the apple by a high velocity rifle without even tipping the apple off the post. A builder's staple gun will drive a 1 inch staple full depth into wood without bending the staple or splitting the wood. Now try that with a hammer! The principle of air impact assembly on aircraft where the frail aircraft parts cannot risk damage is the same. Getting the parts in place is a matter of energy but there is a choice of how the energy is applied, with what force over what period of time."

"The usual 2 lb. hammer is used for driving pins not because it is the best

choice for the pins and the block, but because it is the most energy-efficient for the gorilla doing the task. The usual long hardened steel drift placed on top of the pin is several times heavier than the pin and adds substantially to the driven mass. The pin is able to transmit quite a substantial amount of energy to the pin block. Drive a pin with the dampers raised and note... the amount of noise from the piano. This represents energy transmitted directly into the piano body."

"Now repeat the experiment with a half pound hammer. Use instead a tuning pin setter with the handle held loose enough that only the pin in the setter's head is included in the driven mass. The hammer will have to be brought down with considerably more velocity to give as effective a blow and it becomes increasingly important to insure that the hammer lands on the right object. The undamped noise is considerably less, suggesting that far less energy has been transmitted to the piano. (Remember the apple.) In the shop, clearly some sort of small air impact hammer would be ideal."

"It is fortunate that nature is on our side. Energy is 1/2M (v^2). Thus if the mass has dropped four times, the velocity need only be doubled to obtain the same energy. The converse is that if one is driving only 41% faster when one hits a telephone pole, the energy that one's car has to dissipate is double!"*

I agree with Chris, that when driving pins 1-1/4 inches during a stringing, the 2-lb. hammer is the clear winner. For a 1/8" tapping later, the lighter hammer is called for, first to avoid driving the coils down below the plate's level and second to allow the looseness of each hole to determine how far a pin will go for a standard medium tap.

Torque Up or Down?

Finally, Chris brings up a very important point. *"In school I was told to measure pin torque clockwise. This didn't seem to be the best choice but I just jotted it down in my notebook and kept writing. Some time later I asked two outside technicians. Each said they did it both ways with no qualification as to which way was appropriate for when. Ignoring these strange ratchet threaded pins, the difference between the two directions should be the string tension times the tuning pin diameter or about 45 inch/pounds, (or pounds inches if you want to comply with the latest international thinking)."*

"Eventually I observed a technician taking a measurement counter clockwise (my own consistent practice at the time). When I asked 'How so?', he pointed out that it was the function of pin friction to stop the pin turning so the only thing he was interested in was how much margin was leftover. A man after my own heart, or am I missing a point here."

"I have no idea which side a rank and file survey would come down on. It really doesn't matter that much except that of torque numbers are bandied about by technicians without specifying the measuring direction two people may be engaging each other in quite meaningless conversation."

Thanks, Chris, for spotting this seemingly minor point. The 45 inch pound differential is there to be observed. In the clockwise direction, nobody but the tuner will ever be doing the winding. However, with an average 200 lbs of tension ready to unwind string from a tuning pin when the block lets go of it, counter-clockwise is the direction we worry about.

Once again Chris Day, thanks for a major contribution to the discussion.

The Circle of Thirds

For me, nothing beats the old 3rds and 6ths temperament. As Rick Baldassin points out in the December 1990 *Journal*, successful temperament systems are those which can determine, early on, a satisfactory interval width from the prevailing inharmonicity. This is no simple matter because in the real world the "stretch number" for any piano changes from note to note. Interval widths in a good temperament are literally being fine-tuned to the stretch numbers of the two notes involved, as well as those of the intervals being compared to. When the inharmonicity of pianos moves from the smooth, out through the bumpy, and on to the psychotic, a single width for such a building block interval that will work across the entire compass becomes a fond dream. But back in the land of the possible, the Circle of Thirds temperament, as I call it, is well designed not just for a happy choice of building block interval, but also for its grid-like structure.

I call contiguous thirds a "ladder," and spacing its rungs evenly for a straight-line slope of beat rates is grabbing inharmonicity by the horns. How quickly does the 3rds and 6ths temperament derive a building block interval from the prevailing inharmonicity? If you wanted to define the proper width of a temperament's building block interval from that piano's inharmonicity curve, the simplest way would be to divide the temperament's central octave by that interval. Is the 5th a good choice? Laying out the temperament by means of a consistently spaced series of 5ths and inverted 4ths, per William Braid White, you don't reach the octave note at the end to confirm your reckoning until you've been through all twelve fifths. (It's easy to see why the Circle of Fifths temperament has generated so many hybrids. On the best of scales, the proper width interval early in the pattern is a matter of memory, and on the worst, it is unobtainable.) Other intervals are available that will divide the octave in fewer steps, for instance, the seven M2nds, four m3rds, three M3rds, and two augmented 4ths. I'd pick the M3rd, since it's the shortest path from bottom to top of a temperament octave this side of the lunatic augmented 4th!

Of course, dividing the octave by 3rds will only get you three of the twelve notes. To break out of this circle and generate the other nine, you need a second, complementary building block interval. The 4th is often used to transpose between ladders, but there are several reasons why the 6th may be the best complement. First, as mentioned earlier, nothing divides the octave better than the 3rd, so why do it

a second time with a considerably less able interval? To divide the octave by 4ths, you need twelve of them. Well actually, the augmented 4th divides the octave best. But to take the Baldassin-Sanderson short-cut to the augmented 4th (a brilliant scheme, by the way), you still need four 4ths and two 3rds. All those extra intervals could be accepted in the name of good exercise, except that these six intervals (and the remaining that follow) are based on the octave found at one point on that scale's inharmonicity curve, namely F3. Which brings us to the second reason. Even on an ideal curve, I would still feel happier with a complementary interval just one step in from any point on that series, rather than arriving at the complement by committing to one point in the series and throwing myself six intervals in from there. In doing the latter, it limits its compass to one narrow octave.

The M6th is an excellent choice for a third reason. Its beat rate series is in the same neighborhood to the M3rd's series and, unlike the 4th, is easily related. If you wanted to hook the four ladders up with a narrow 4th beating at 3 beats per second, these ladders, being independent closed loops, would let you do it. That's right — a complete series of gold medal 3rds with the accompanying 4ths and 5ths off on lunch-break. It is the M6th that is going to convert the careful balancing of the 3rds widths to equally judiciously spaced 4ths and 5ths. Why? Because it is the sum of a M3rd and a perfect 4th. If both series of these intervals are even, then the M6th series will be as well (that is, if the piano's inharmonicity will allow you more than one smooth series)! But that's putting the cart before the horse. The inverse to this is that if we can generate a smooth 6th series from a smooth 3rds series, we'll also have a smooth series of 4ths and 5ths (remembering of course to base the inversions between 4ths and 5ths on consistent octaves). By the way, that "exchange rate" between the 3rds and 6ths beat rate series is not a M2, as tradition has maintained, but a m3rd. Accommodating this fact requires only a slight modification in the temperament pattern.

The best part about the 3rds and 6ths temperament, however, is its grid-like structure. Not only is it a readily expandable sample of the prevailing inharmonicity, but as the pattern generates new intervals, these appear in a very orderly fashion, across the entire width of the compass. This gives you prompt feedback as to how width judgments at one corner in the compass are fitting with the inharmonicity at another.

The nifty features don't stop there. Once the slope of the thirds in the first ladder and the first bridge 6th have been set, it's simply a matter of continuing the same pattern, and observing as more adjacent thirds and sixths appear to make sure that their beat rates fall on the same slope. The further into the temperament you get, the more adjacent intervals there are to confirm how things are going, and not just 3rds and 6ths. For instance, if your ladders can run from F through G# (and a m3rd exchange need not prevent this), after the second ladder you get a minimum of three pairs of adjacent 3rds and your first ladders of 4ths, 5ths, and 6ths. After the third ladder you get a ladder of thirds placed inside the first ladder, making a complete set on a whole-tone scale, plus three sets of three adjacent 3rds, and three pairs of adjacent 4ths, 5ths, and 6ths. By the time you hit the fourth ladder, the tempering of any of its steps is a matter of placing an interval's beat rate between two previously set beat rates, and the interval can be a 3rd, 4th, 5th or 6th — your choice. There are two big advantages to such a rapidly expanding selection of adjacent intervals to work with. One is that you again get to honor the first rule of good joinery. By proper choice of intervals, any of the later ladders can always be set directly from the first. The other advantage is that if the inharmonicity of a given piano won't allow you more than one smooth beat rate series, and if you know which series you'd like to favor, you can select that interval for the laying out of ladders. Now that's what I call a full-service temperament!

Thanks for reading along with me. Those who remember my opening statements in February will notice that there was plenty I wasn't able to fit in during these months. But that's for later. For now, I'll pass the torch on to the next runner in this relay. Send him lots of mail!

Everyday Voicing

Other Views of *The Truth*

Bob Davis, RPT, and Dale Erwin, RPT
Modesto Chapter

My high school physics teacher, a delightful and creative woman, was as much concerned with the way we approached problems as with the actual answers. One day we were discussing pulleys. She tied one end of a rope to an upright fixture on the desk, passed it down through a pulley and back up to her hand, and told us that a one-pound object attached to the bottom of the pulley would rise half as fast as her hand, but she would only have to lift with a force of half a pound. One bright student asked, "But Dr. Morgan, what about friction?" Dr. Morgan replied, "These are special frictionless pulleys."

We did a lot of problems with "frictionless" pulleys, "complete" vacuums, "absolute" zero, "rigid" materials, and the like. The concept of a useful fiction, or idealized construct, has been around for a long time as a tool for clarifying a concept by temporarily ignoring some of the real-world detail. Dr. Morgan knew that as the pulley systems became more complicated, we would find the principle of proportionality between force and distance clearer without the added variable of friction, which could be added in any time without changing the basic concept.

One of these useful fictions was used in the description of the traveling wave. A slow-motion film of a vibrating bass string shows a very complex motion. The traveling wave is apparent, but one can also see evidence of standing waves as well. The point remains intact and is easier to understand at first, though, if we ignore the complications and consider the ideal case.

Hammers are much the same way. For instance, we have been talking about the outer tension layer maintaining the inner compression area. This is a partial truth which demonstrates one aspect of hammer construction and function, and could be considered true with respect to the way the elasticity inside the hammer is set initially and maintained. It is the exceptions and refinements to this model, though, and even models quite different from this one, which give us even more control over tone than the simplified description would suggest.

A traditional model of voicing suggests that in order to have gradations of tone color through the dynamic range, the tip of the hammer must be soft, the middle or perhaps shoulders harder, and the part around the tip of the molding quite hard. According to what we have seen so far, however, it is the natural tendency of good wool felt to act as a spring which gets stiffer as it is compressed. A hammer which is absolutely uniform in density from tip to molding should automatically exhibit this property, behaving as a stiffer and stiffer spring (and therefore producing a spectrum with more and more high partials) as it is compressed with increasingly harder blows.

So which model is true? Both are, depending on what aspect we want to see most clearly. If the hammer is of optimum mass and uniformly of ideal density all the way through, it should exhibit both of the criteria we are probably seeking: good sustain and a change in spectrum over the dynamic range.

With the pure tension/compression model, needling on the circumference of the hammer should cause the band of tension to relax, allowing the compressed areas to expand, lowering the stiffness, and darkening the spectrum. A color change curve would remain, with the tone brightening up on increasingly harder blows, but all dynamic levels would have a darker tone color than before the needling. According to this premise, we could needle anywhere on the circumference of the hammer, releasing tension, and achieve the same results. Anyone who has done any voicing knows that this is not the case.

The discrepancy is accounted for by the fact that the pure tension/compression model, while instructive, is not complete. Remember the little scales linking the felt fibers together? They are keeping the felt from ex-

panding perfectly. During actual voicing, this works for us rather than against us. Here the soft/medium/hard model is of some use, *as long as we understand the tension/compression model as well.* The linking inside the felt allows us to vary to some degree the stiffness in different parts of the same hammer. This can be used to compensate for changes in tone due to filing, which will brighten the spectrum by reducing mass. It is also helpful when tonal preferences dictate different tonal color change curves and limits. If the understanding is imperfect, though, unintended things may result. For instance, in many recent pianos from fine makers, notes in the octave five-ish area exhibit a much longer sustain when plucked than when struck. This is very common; you can check it for yourself tomorrow. It is possible that the manufacturers desire this quick decay. It is also possible that they don't.

More Fictional Cases

Back to the practical: we would like to propose five extreme cases which will cover various conditions commonly found in the hammer. These conditions can certainly combine and vary in proportion, but we hope that these five will serve for maximum clarification of the concepts. We will explain what sound each is making, what condition causes the sound, and what will cause a change. The reader can then extrapolate from these extreme cases to the more subtle ones. Just for uniformity, we will speak of the hammer as if it were in a vertical position, with the striking point up.

Case #1 - About right

This hammer exhibits a sustain curve very similar to that of the plucked string, and a spectrum that goes in a straight diagonal line from mellow at a soft blow to brilliant at a heavy blow. Relax and enjoy this one. Some might even think of this as the ideal case, but it is important to remember that this series is about control, rather than preference. This is a good place to start if the client has no opinion, but we need to be able to go in other directions if we or the client so desire.

Case #2 - Weak all over

The hammer produces a dark sound at all levels. The pianissimo will be "puffy" (this comes from the hammer damping the string) and the forte will lack "power" (also from damping and from too weak a spring). The sustain might be somewhat decent if the hammer is elastic, but will not be ideal. We said earlier that a dark spectrum can be caused either by too weak a spring or too great a mass. Since mass is changed all the time by hammer replacement and filing, it is fortunate that mass and stiffness are in some measure interchangeable. That is, in this case we could brighten the spectrum by stiffening the hammer with hardening solutions, or we could reduce the mass by removal of felt or molding material. The choice depends on the technician's judgment of whether juicing or removal of mass will result in reduced hammer longevity, difficulty in voicing maintenance, or perhaps even in undesirable reduction in inertia at the pianist's fingers. A light hammer with little lead in the front of the key may have the same static downweight as a heavier hammer with more lead counterbalancing it, but will have considerably less inertia. This is good only to a point. Too much inertia is bad, of course, because it is tiring, especially in loud rapid passage work; but some pianists will find that too little inertia makes the action feel "squirrelly" to them, and too different from other pianos they play. As you can imagine, there are also tonal reasons for having enough mass in the lower end of the piano. Descriptions of filing and juicing will follow in separate articles.

Case #3 - Weak tip, rigid core

This is the case we described earlier as typical of many new pianos. The most obvious symptom is a rapid decay, but the sound will be puffy on a soft blow, and shrill but empty on a hard one while still not developing enough high partials. How does this happen? It is possible that the voicer is following the soft/medium/hard plan without sufficient regard to elasticity. In many cases the hammers are pressed quite firm or hardened chemically in search of a powerful tone, then the shoulders and tip are needled to get rid of the harsh attack and produce a more "mellow" tone.

As in our second example of last month, sustain can be improved by a good-sized needle (perhaps #3, #4, or #5) passed clear through the hammer, from side to side rather than through the shoulders. This might need to be done more than once, but listen after each pass until you get the feel. The stiffest places can be felt with the needle, but will be in the area right above the molding. This has the effect of redistributing the stiffness, making the felt less stiff above the molding and actually more stiff right below the hammer top. The result will be a tone with more carrying power as well as more sustain, as the hammer gets away from the string more quickly and the lower partials are no longer damped out as the pulse wave returns from the bridge. One might think that since the hammer is the same height as before, and since it has exactly the same amount of felt between the tip and the molding, that the tone should be the same on a loud blow as before, but it obviously isn't. The curve of energy delivery to the string has changed.

Elasticity is necessary for good sustain, and needs to be considered as a separate attribute, in addition to the stiffness of the spring. An extremely tight core will act like a coil spring whose coils are touching. The hammer must compress between the tip and the molding, and return quickly to its original state, aided by the shoulders. Poor sustain, particularly easy to hear in the mid-treble, is caused by the damping effect of the hammer when it stays in contact with the string too long. In the case we are discussing, the hammer, instead of acting as a variable-rate spring, is acting more or less as a rigid, non-elastic mass (the core) with a shock absorber (the weak, low-elasticity tip) on top. The non-elastic core is trying to deliver its energy all at once, which should produce a bright spectrum, but nothing is stored in the hammer to help push it away, so it stays longer on the string. The shock-absorbent tip wastes energy as the hammer stays on the string, soaking up the fundamental as well as higher partials, leaving any clangy, mid-rangy sound, which you should experience rather than read about. A hammer which is too heavy produces this same sound, so if you haven't already tried it, this is the place for the experiment with seven or eight turns of solder around the shank. It is most obvious on adjacent treble hammers with good sustain and identical color. On verticals, you might want to take a turn around the heel of the hammer first to hold the solder in place. The weighted one will sound as if the bottom is dropping out, which it is.

Up to now, we have been treating the hammer either as an outside and an inside (circumference and core), or as a top, middle and bottom (in terms of distance from the strike point). Now we will integrate both ways of looking at it. It could be that, although the core is quite stiff in this case, the outside is not stiff at all, and actually wants to collapse because it is under tension. The core must be allowed to move, even if this makes the overall stiffness of the bottom on a top/middle/bottom basis too low. Now that the compressibility has been restored and the inside is acting as a spring instead of a lump, the shoulders may be stiffened to even up the

stiffness in a horizontal band across the hammer at about tip-of-molding level, which will support the upper part of the hammer and create more partial development if desired. The shoulders also now act as an "outer" to encourage the return of the "inner" as it distends outward.

Case #4 - Stiff tip, weak shoulders and core

Put the *Journal* down for a moment, and see if you can hear in your head what this hammer would have to sound like.

What did you hear? Wouldn't it have a brighter spectrum at a soft blow, and whether or not it had decent sustain, wouldn't it fail to develop a change in partial structure at a loud level? The same "ping" will be evident on soft and hard blows, but the sound will not "fill out" or develop power. This might be an instance where the voicer, wanting more brightness from a basically soft hammer but afraid of making it too hard, dripped a few drops of lacquer on the surface, but not enough to soak in very far.

Put the Journal down for a moment and see if you can hear in your head what this hammer would have to sound like.

The cure, as you can probably sense by now, requires stiffer shoulders (or perhaps less mass), and possibly a little needling or filing at the tip to break up the lacquer and allow the hammer to develop partials more naturally, by compression.

Case #5 - Too stiff all over

Lack of elasticity affects both the sustain and the spectrum change in this hammer. Because it is not compressing, its color, bright because of stiffness, also does not change much. Such a stiff spring delivers its energy to the string quickly, never developing much in the way of low partials, and the sound decays rapidly. This hammer has probably been densified by re-pressing with heat and perhaps moisture.

This is a more complex case, because we will be changing more than one aspect at a time. Should we, for instance, use the needle through the side of the hammer to increase sustain? No, because there is no differential in stiffness to even up. There is no place for the tighter felt to go. Since the hammer is too tight everywhere, it is more efficient to loosen it up from tip to molding by sending a #6 or #7 needle through the circumference clear into the core. This will give the felt compressibility, allowing color change as well as increasing sustain. Since we are hearing brightness at all dynamic levels, we can pass the needle through the hammer at all distances from the string, that is, through the top, middle and bottom. Since the sustain is bad, the needle ought to wind up in the core area. The angle of insertion depends upon the pattern of stiffness, evidenced by what you are hearing. The color at all dynamic levels will be affected by these deep strokes. However, the effect will be proportionately greater on the color of the lower dynamic levels if the stroke is close to straight up and down. Conversely, the effect will be proportionately greater on the higher dynamic levels the farther down the circumference the stroke is started. It is even possible that one to three strokes right down the center (through what used to be considered a sacred area) might be appropriate, although care must be taken. Usually, a fairly safe place to start is at about the eleven and one o'clock positions, pointed toward or just beside the tip of the molding. You may notice that we suggest starting higher up on the hammer than we did even last month. This is because we feel that in the traditional method there is some danger of weakening the shoulders excessively before the sustain becomes satisfactory. This would then cause us to be unable to get sufficient brightness at high volume. Moving around, continually trying to solve the worst problem next, will keep us from staying in the same place too long and overworking an area. As the sustain improves, the depth of the strokes can decrease and the position can be more determined by the desired color change.

Adjusting The Color Curve

Generally speaking, the color will change less with loudness if the top is stiffer than the bottom (for instance if the top is lacquered or tightly pressed and/or the shoulders are needled around the three o'clock position). It will change more if the bottom is stiffer than the top. It will brighten sooner, as well as develop more "clang" (middle partials) if the middle shoulders (around one-thirty) are left (or made) stiffer and later if they are needled.

Incidentally, as we mentioned in Case #1, the "ideal" case is not always "ideal." Here is an example of modifying the color change profile to meet changing needs: in voicing for a large venue, less color change might be built into the hammer. A piano which sounded great when voiced in a smaller room off the concert hall, might actually sound muffled on softer blows in the large hall, as the natural attenuation caused by distance and audience makes for too much of a drop-off. The voicer might allow a little more stiffness in the upper part of the shoulders in this circumstance.

Durability of Voicing

The most durable voicing is in a hammer with appropriate mass that depends as much as possible on elasticity to create its partial structure. The least durable is in one like Case #3, where the top is loosened up to compensate for a rigid core. This loose wool will re-felt itself and knit back together easily. There is some feeling that lacquered felt, at least on the surface of a hammer, is more brittle

and more easily broken or cut than non-lacquered felt.

There is some disagreement about whether or not voicing should be symmetrical from shoulder to shoulder, but it seems to us that smaller differentials in stiffness inside the hammer make for more stable voicing, as the compression will be less likely to redistribute itself with repeated impact. For example, it makes sense to us that rather than having one shoulder of stiffness "one" and the other shoulder of stiffness "three," the voicing will be more stable if both are of stiffness "two." Since there might be uneven stiffness from manufacture or from previous voicing, this would imply not an equal number of needle strokes, but an equal feel from shoulder to shoulder.

About Listening

While a voicer ultimately wants to be able to recognize certain sounds and conditions instantaneously, in the learning stages it is easiest to listen by immediate A-B comparison wherever possible. Fortunately, we can usually think of a way. For instance, if it is difficult to decide where a sound lies on the dark/bright continuum, pluck the middle of the string with the fleshy part of your finger, then strike the note, then pluck the end of the string with your fingernail. You will be able to sense where on the continuum the tone lies. When making changes in the voicing of a note, alternate with a neighbor note as an unchanging reference throughout the process. When deciding about sustain, pluck and strike the string alternately several times in succession. When listening to the change in color through the dynamic range, compare A-B with the neighbor note at pianissimo, then at piano, then at mezzo-forte, etc., as well as listening to the test note throughout its whole range.

The Tao of voicing

Are there other voicing models? Definitely. Are they also paths to "The Truth?" Absolutely, if I may use that word. Each of us ultimately develops a personal model of voicing difficult to put into words, which works.

How many needle strokes to use? What size needles? What kind of voicing tool? Stick to single needles at this point, pushed rather than stabbed, in order to train your ear, your head, and your hand. Once control is established, speed and efficiency will follow automatically. Remember that a particular sound is caused by a particular condition inside the hammer, and that if we can fully describe the sound in terms of sustain and spectrum/dynamic profile, we will know what the condition *has* to be. Once the condition is fully described, *the method of change will suggest itself.*

Tech Talk

Don Mannino, RPT
National Service Manager
Young Chang Pianos

Key Regulation

Fifth in a Series of Articles on

Grand Action Regulation

Now that we have located the action and bedded the keyframe, it is time to consider getting the keys themselves regulated. This has always been the part of regulation jobs that I look forward to the least, as it seems tedious and slow, with rather limited rewards. At least that's what I used to think.

Proper key condition and regulation is the next step in laying the foundation for good action performance once the keyframe is located and bedded well. Paying attention to details here will contribute greatly to action precision and consistency in the finished action, so don't get lazy! Although working within a budget is nearly always necessary when we recondition and regulate, ignoring the keys will be very detrimental. A little creativity in eliminating problems is sometimes needed in order to insure the best performance possible without running the bill up too far.

If the keys are slightly pulley (meaning the key balance holes are slightly elongated at the bottom, allowing the keys to move front to back), the keys will not only look bad from the poor alignment at the fronts, but the capstans will move front to back as the piano is played, changing the touch substantially. Movement of the capstan only 1/4 mm makes a substantial difference, because the change in hammer height regulation and the altered leverage from movement of the capstan to wippen contact point will combine to affect the touch.

If the key bushings are very loose, especially at the balance hole, the key will not work with the upper action correctly. The wobbling of the capstan side to side will affect the touch, and the movement of the backcheck, which is even more pronounced, will lead to poor checking, and may damage the hammer centers in a heavily used piano.

The front bushings can lead to similar problems, although perhaps not to the same degree. Fortunately, these bushings can be treated in one way or another to make them work well. Rebushing is always the best solution, so if you have space in your estimate for rebushing, by all means do not skip this task. Mastering one of the high speed rebushing techniques demonstrated at PTG conventions around the country will help to make this task less tedious as well as more profitable, so I recommend that everyone use these new tools and techniques.

As an alternative to rebushing, the least damaging and most successful method of reconditioning keys is to steam the bushings. This is a very cost effective and beneficial treatment for bushings that are only slightly worn, especially if you have sets of the precise key bushing cauls. Steaming the bushings and inserting the cauls will sometimes restore the bushings to almost new condition. As with steaming the old bushings out in a rebushing job, light steaming to restore old bushings can also eliminate problems with the key balance holes by swelling the wood fibers there, so consider steaming the bushings as a minimum treatment for looseness.

Most of us have heard diatribes on the importance of buffing capstans, so I don't need to grind on that subject here. Suffice it to say that there should be no burrs or roughness on the capstan tops or you will find yourself trying to eliminate friction problems later on, with uneven friction from one note to the next.

The condition of the backcheck buckskin is easy to see, but when evaluating what needs to be done to the keyboard prior to regulation, also consider the condition and age of the backcheck *wires*. If the wires have become flabby and soft, they will make the regulation difficult and will lead to uneven checking, especially during hard playing. Also, the springiness of the wire contributes to the repetition by helping to push the key and hammer apart when the note is released. This is a very slight effect, but the difference in performance in

the action when the wires are changed can be substantial (although I don't think any of my customers have ever told me "My backcheck wires are flabby!") If the backcheck buckskin is worn, think about the condition of the wires before you decide whether to replace the backchecks or just recover them.

Finally, consider the key end felts before going on to the regulation of the keys. Although worn key end (or damper lift) felts may not seem like a serious fault, this will affect the regulation of the dampers, which *can* be a source of complaints, especially with accomplished pianists. There is a friction dividend from having these felts in good condition also, so bolstering or replacing the key end felts will contribute to the finest level of performance in a fine regulation job. In general keep in mind that, in most actions, the lower the damper lift point becomes on the key (such as when the felt is worn), the higher the friction becomes.

Step 3: Square and Space the Keys

Before leveling and doing more regulation, square the keys up so that the tops of the keys are level. I use a front key pin tool to do this. Place the tool on the balance rail key pin, using the slot in the tool, because the bottom of the slot will prevent any marring of the key pin. Hold the tool with the handle almost laid down on the key buttons, and bump the handle to slightly bend the pin over and square the key.

To space the keys at the front, use the same tool. This is its intended use — don't turn key pins to tighten keys, as this will increase the drag tremendously, and wear the bushings even faster. Insert the tool on the key pin *underneath the punchings* to insure that the tool doesn't mar the key pin on its working surfaces, and twist the tool to bend the pin over and space the key. A modification of this tool will help: grind the tip of the tool slightly on the top and bottom surfaces at the tip. This creates a slight bevel on the tool to allow you to slip it under the punchings more easily. The bevel in this tool also makes it easier to use for squaring the keys, as mentioned above.

Step 4: Level the Keys

To establish the correct key height, look at the piano case and keyframe first. Consider the relationship of key height to the cheekblocks, keyslip, key upstop rail, and the tops of the key pins. If you have a key height specification for the piano brand you are regulating, set the height of the end keys to that specification, put the action in the piano and assemble the case to see how everything fits together. Not all actions will work at their best when regulated exactly to the manufacturer's specs, so consider making small adjustments to correct for both appearance (i.e., excess space between the keys and keyslip), and performance (keys too close to the tops of the key pins at the balance *or* front rail, sharps knocking against the fallboard, etc.). Don't make large changes away from specifications — if the keys seem too high, lower them by removing a thin punching and recheck. Keep in mind that you should try to eliminate all problems of interference between the keyboard and the case, but don't be so extreme that you run into problems later and have to redo the key level. Be sure to also set a sample sharp at each end of the keyboard, or at least allow for the sharps when considering the fallboard and key rail (upstop) positions. The keysticks of the sharps in most pianos are slightly higher than the naturals where they pass under the key rail, so keep this in mind as you work.

Another consideration in establishing the key height is the meeting of the capstan and the wippen. I have had the unfortunate experience of following up on a piano in which the keys had been raised too high (probably by a succession of technicians), so much so that the capstan was moved slightly back. Once corrected, the performance of this action was noticeably lighter and quicker. It doesn't take much of a change here to affect the geometry, so allow me to delve into this a little more.

When actions are designed, an imaginary line between the key balance point and the wippen center is considered in locating the parts and setting dimensions. There is some difference of opinion among manufacturers just exactly where the line should stop under the keys, and just where during the keystroke the capstan-to-wippen contact should meet the line, but the most common setting is as follows: A degree line is drawn from a point half way between the sharp and natural balance rail pins, extended to the wippen center. The origin of the line half way between the key pins should be at the bottom of the keys themselves — not on the balance rail, which is lower. The capstan to wippen contact point should meet the line half way through the key stroke.

The implication for us is that if we raise the keys too high at the balance rail, two points in this line are moved; the end of the line at the key balance is raised, and the point where the capstan and wippen cushion cross the line is moved back away from the player slightly. The combination of these changes will throw off the touch of the action.

All of this is not to say that you must attempt to measure these lines and intersecting points, as being precise with these kinds of measurements is quite difficult in an action. The point is that you should not allow yourself to stray too far away from the original settings. The case parts, key pins, and key upstop rail are usually good reference points. In addition, if you are evaluating an action for proper friction and geometry before rebuilding or reconditioning, you should look at the key balance punchings and back rail cloth as possible areas where someone else may have messed up, and which you now have the opportunity to correct.

Once you are satisfied that you have the correct measurement for

the height of the naturals, set the number 1 and number 88 keys to that height, measured from the keybed. If the keyslip or fallboard look uneven, I don't recommend changing the key height to match unless there is no other solution. If the key heights are measured from the keybed and are the same in the bass and treble, the case parts should match up. If not, try to readjust the case parts for evenness. Leveling the keyboard at a slant should be your *last* resort.

There are many different ways to level the keys, but my favorite way is to use a long straightedge, with weights on the backchecks to keep the keys up in the absence of the upper action. Another common factory method is to use a short straightedge to level in sections, usually with the action stack in place and with slit punchings inserted with tweezers by tilting the action up and lifting the keys a little. If I am spot leveling a few problem notes in a keyboard I will use this method, but for the initial leveling I prefer the former method.

An essential part of leveling with a long straight edge is to brace the end keys so that the straightedge doesn't depress them while you are working. I use jigs (which I read about in the *Journal* some years ago) made from upright damper blocks (the part with the screw and brass sleeve in it). You can place the block on the keyframe under the front of a key, then adjust the screw until it supports the key without raising it any. Since these blocks are sometimes too small, you can either make up some of your own that are thicker, or just drill another hole in the block in the tall dimension and move the brass insert and screw. I also use a set of tweezers about 12 cm long to remove punchings from the pin. To make the tweezers easier to use, grind down the tip of one or both tongs to a chisel like point. This makes it easier to get under the punchings to grab them.

My straightedge is just a piece of aluminum U-channel, about 10 by 13 mm, and a little longer than the keyboard. You can get these at some hardware stores, but be sure to sight down the length of it very carefully to get a straight one. You can also buy excellent straightedges for key leveling from the piano supply houses.

Be aware that Steinway (and perhaps others) recommends that the keys be "leveled" with a slight arch, so that the keys at the center of the keyboard are slightly higher than the ends. I asked at the factory some years ago how they make the curved "straightedge" for regulating the key height, and they told me they just planed them by hand. Needless to say, they were better wood workers than I! If you want to use this system, I will leave it to another article to describe in detail how to make the leveling bar accurately. It involves bending a long, thin piece of wood, and marking the straightedge with the resulting curve as a reference for planing.

Once you have set the end keys at the correct height, put weights (available from piano supply companies) on the backchecks, put the keyframe with keys back in the piano, and adjust your little key leveling blocks under the end keys. Now lay the straightedge across the keyboard, and check for high keys. Eliminate these high keys by removing punchings or changing the balance rail felt punching. Then start at the one end and add punchings to the balance pin under each key until it just meets the straightedge.

This job will go faster if you make two passes quickly at the keyboard. I find it is best to fully regulate a few keys at each end for practice to find out how much a given punching actually raises the keys. Since each piano has different length keys, it seems as if the lessons learned in one action cannot be transferred to the next. Piano factories have a big advantage over us here, since they always work on the same type of piano. In any case, do a few keys for practice, observing the change in the key height made by each punching, then go on down (or up) the keyboard, placing the appropriate punchings in front of each key. Try to err on the low side — it is much easier to add a thin punching than to spot the high keys and remove punchings. Once you have selected punchings for each key, put the straightedge aside and put all the punchings under their respective keys in one pass. Don't take the time to put the paper punchings under the felt — just lay them on top for now. Finally, put the straightedge back on the keyboard and make a second pass, fine leveling each key before moving on to the next.

As you go through the keyboard doing the leveling, have a tool handy for squaring the keys. This is the best time to do the fine squaring of the keytops, as the straightedge is a very unforgiving reference point with which to compare the keytop.

After the naturals are leveled, you have to decide how you are going to set the height of the sharps. There are two schools of thought here also. The first concept is that the front punchings for the sharps should be set so that the sharps depress to a set level above the naturals, and the sharp key height is set later to give the correct aftertouch. The second is more common, in which the sharp key height is set at a given elevation above the naturals. I have used both methods, and I found that the end result of either method is almost identical in the majority of actions.

The aim of the first method is to prevent buried sharps, where the sharps travel below the level of the naturals, in pianos that want more key dip and more hammer travel distance. If I were regulating such an action and I was sure that I really wanted the extra key dip, I would regulate the sharps in this way, making them end up higher than normal at the rest position.

I prefer regulating the height of the sharps to a standard, however, and you will find that this works well in most pianos. The reason I am explaining both methods here is so that you will be able to handle those pianos that don't fit the norm. If the action doesn't work well with one method, use the other.

Keeping the above options in mind, set the first and last sharps 12mm to 12.5mm above the naturals,

put your key leveling support blocks under the keys, and level the entire set in the same way as the naturals.

The key dip will not be set until later, as the method of regulation I am using requires that the key dip be set according to the needs of the upper action and the piano. In other words, I use an aftertouch based key dip rather than a standard measurement. Before you go on to other parts of the piano, though, you should quickly check all of the keys with a key dip block to insure that they have at least *enough* key dip. Remove punchings as needed to have at least 12mm of dip on every key.

After the keys are all leveled, take them all off the keyframe, and turn all the balance rail punchings over, putting the paper punchings underneath. Before replacing the keys you might consider applying a Teflon spray to the key pins to reduce the friction and also keep bushings from wearing out as quickly.

Regulation Check List To Date

Regulation Step	*Related Items*
1. Locate action contact	Replace stop block cloth
	Repair keyframe at unacorda lever
	Repair/tighten keyframe joints
	Clean & polish keyframe guide pins or springs
	If damper wires being replaced, locate damper action to keys
2. Bed Keyframe	Replace keyframe felts
	Replace key pins
3. Square and space keys	Key tops
	Cleaning of key wood
	Key bushings
	Key balance holes
	Backchecks
4. Level all keys	Check, reset case part alignment

Next month we will be looking more at alignment and traveling of the action parts as preparation for regulating the wippens and upper action.

Viewpoint

Effects of Hammer Bore on Escapement Friction

Sam Powell, RPT
Washington, DC Chapter

How many technicians have heard customers complain that, "Once my piano was rebuilt, it never played as nicely as before?" This is a devastating comment to hear when you are trying to sell a subsequent rebuilding job to a friend of customer number one, but one that unfortunately is probably true. It would be nice to blame the poor showing of the original rebuild on poor craftsmanship, but often the offending piano looks just great and still doesn't play well.

After considerable thought, discussion with other technicians, and experimenting with actual pianos, I have concluded that the relationship of the knuckle/jack contact surface to the hammer shank and wippen flange center pins is a most important one indeed. Even a slight change in this relationship can add or take away objectionable friction in the key stroke. Understanding why will require some thought, but stick with me for a few sentences. If you draw a line between the hammer shank flange pin and the wippen flange pin you have a line that is below the hammer shank nearly parallel to the repetition lever top at rest (**refer to drawing**). When the hammer is in the lowered position this line cuts right through the center of the knuckle. The line is stationary (since the action centers do not move) and as the shank rises on the way to the string, the knuckle rises in relationship to the line. At the point of let-off the shank's/wippen's center line is usually near the bottom of the knuckle. The closer the bottom of the knuckle gets to this line before let-off the less friction will be felt at escapement. The reason is simple. As long as the bottom of the knuckle is below the line, its surface is moving in a circle towards the wippen center pin while the hammer shank is rising. If the knuckle contact surface were to pass over this line, then it would be moving away from the wippen center as the hammer shank rises. This is important to us because at the point of escapement the jack is being dragged away from the wippen center pin. If escapement starts too early in the chain of events then the jack will be moving away from the wippen center while the knuckle contact surface is moving toward the wippen center. This condition of early escapement in the knuckle/flange centers relationship will more than triple the friction felt. Since the knuckle contact surface is traveling in a circle, the direction is actually continually changing. The closer it gets to the line, the less it moves towards the wippen center pin.

There is a point at its travel upwards at which the knuckle is moving at right angles to the line and moving neither away nor towards the wippen center pin. This makes the direction of the motion of the knuckle at escapement neutral, neither adding to nor taking away from the friction at letoff. Most grand piano actions today are designed with the escapement taking place in this neutral range. This means that if the knuckle contact surface ends up too low in the geometry of the parts, then escapement will begin to take place down in the high friction area of its travel. There are three principal variables in the set-up of a grand action that can affect the knuckle position relative to the flange center pins line: knuckle size, knuckle placement on the shank, and hammer length. All of these can get changed rather easily during a rebuild of a piano.

It would be very useful to point out that simply having the let-off set too low on an otherwise correctly set-up piano will produce the same effect of increased friction at let-off for exactly the same reasons. If you ever wondered why setting the let-off made such a dramatic difference in a piano's feel, now you have one more bit of information to add to your understanding.

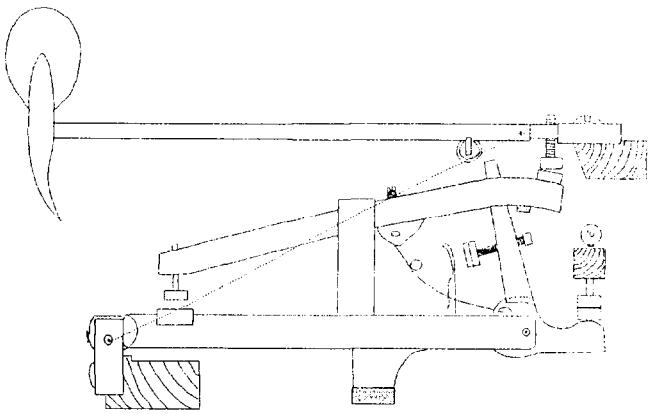
For years we have been taught that the correct length of the hammer for maximum power out of the action was a dimension which had the hammer perfectly perpendicular to the string at the point of contact. This is achieved by making the distance from the shank hole to the tip of the hammer the same as the distance from the shank flange center pin to the string when the action is in the keybed in playing position (we're obviously talking grand actions here). Furthermore, we were taught that we should bore our hammers slightly longer to account for wear in future filings on the hammers. While this arrangement has the potential of greater power, I am not sure that the difference in power available from slight changes in shank angle is as important to the pianist as the feeling of the key when it is being played.

If we put on longer hammers, then we have to lower the capstan screws to lower the hammers to the proper blow, and in doing so we lower the knuckle contact surface relative to the flange center pin's line. Of course we need to set the let-off lower, as the hammers will all block.

When we lower the let-off we are making the jack drag out from under the knuckle sooner and thus at a lower point in its travel up towards the flange center pin's line.

Larger knuckles will have the exact same effect. We will have to lower the capstan screw and set the let-off lower to regulate the action and in doing so have moved escapement to an earlier place in the knuckle contact point's travel towards the flange center pin's line.

Knuckles that are closer to the shank flange center pin place the contact point farther from the flange center pin's line, and thus increase friction (as well as down-weight with the gram gauge).



The dotted line demonstrates the relationhip between the action centers and knuckle size. A larger knuckle size will place the contact point farther below the line, thus increasing friction at let-off.

In studying production pianos in the field it is clear that manufacturers today are willing to over-center their hammers by 1/16", and an occasional 1/8" over-centering action can be found with many falling somewhere in between. This is clearly an attempt to get the jack/knuckle center closer to the line at the point of escapement. Is this wrong? I don't think so. The industry has settled in on original Steinway dimensions as a default standard, and if over-centering improves the way it works slightly, then it is probably a good idea to do so. I have worked on old German actions where the design was such that the knuckle contact surface was above the flange center pin's line at the point of escapement, and they felt very smooth; but we are not working with old German actions now, we are working with what is essentially the Steinway action in all cases.

Another area of impact is on the relationship of the repetition lever to the knuckle. Because the knuckle contact surface is below the center of rotation, the initial movement of the knuckle surface is away from the player while the repetition lever moves initially upward and not back. This produces a sliding motion between the knuckle and the balancier that is reduced as the lever moves upward. As the keystroke proceeds, the knuckle begins to travel more upward and the repetition balancier begins to move backward as it enters the top part of its arc. The lower the repetition lever sits at rest, the higher the friction is between the balancier and the knuckle at the initial movement of the key. The sooner the balancier moves into the top part of its arc and moves backward, the sooner the direction of its travel complements that of the knuckle, thus reducing friction. If the repetition slants downward towards the player when it sits at rest, then the repetition is actually moving slightly forward at the beginning of its movement, thus increasing the friction between it and the knuckle which is moving away from the player at that point in the key stroke. When a hammer is bored longer, the capstan must be lowered to achieve the 1 3/4" hammer blow, thus lowering the repetition. You can see, too, that the size of the knuckle on the shank has an effect on this. The larger knuckles on new hammer shanks force the repetition lower at rest, thus increasing this initial friction in the key stroke.

What does all of this mean to us as technicians? I would say this information is useful in several ways. When we are putting new hammers on a rebuild, don't trust factory hammer boring to be correct, especially if you lowered the plate to get increased bearing. The old formula of adding 1/8" to the bore makes the problem even worse. Hammers that are too long will often yield a piano that refuses to play nicely no matter how often you polish the capstan screws and balance rail pins.

My advice is to measure strings number 88 and number 1 and have your hammers bored, or better yet, bore them yourself to give you a level shank for numbers 1 and 88. The crown that is cast into the plate will produce hammers that over-center increasingly as you move towards the center of the piano, but probably not too much so. As the hammers are filed over the years they will over-center more, but should not leave the range of acceptability while there is still enough felt on the hammers to give a good tone.

The second area of usefulness would be that of diagnosing problems. If the customer is complaining of a lethargic feel in the action there are many causes for this; but one that should not be overlooked is the hammer bore. Fasten a small level to the hammer shank and pull it up with a hook to contact the string. You will see immediately if the hammer shank is under-centering or over-centering by the position of the bubble in the level. If the bubble is away from the player, then the shank is under-centering and vise-versa. If the action is under-centering, be forewarned that you have a limited chance of satisfying the customer with a simple action regulation. If, on the other hand, the hammers are over-centering, then the heavy feel is caused by something else, and that's a subject for another article at a later time.

AUXILIARY EXCHANGE

Dedicated To Piano Technicians Guild Auxiliary News and Interests

Since convention has taken up quite a bit of time and travel, I am taking the liberty of printing a column that I have read in other magazines and newsletters this year. It has been published by several of my publications and never have I seen an author's name assigned to this writing, so I will consider it ANON. However, I believe it is worth repeating and very apropos to our organization.

1. When geese fly in formation, each bird flaps its wings, creating an "uplift" for the bird following it. By flying in V formation, the whole flock adds 71 percent more flying range than if each bird flew alone.

Lesson. People who share common direction and sense of community can get where they are going quicker and easier when they are flying on the trust of one another.

2. Whenever a goose moves out of formation, it suddenly feels the drag and resistance of trying to fly alone and quickly gets back into formation to take advantage of the "lifting" power of the bird immediately in front.

Lesson. If we have as much common sense as a goose, we will stay in formation with those who are headed where we want to go.

3. When the lead goose gets tired, it rotates back into formation and another goose flies to the point position.

Lesson. We need to take turns doing the hard tasks and sharing the leadership. Tired leaders need to know it is OK to take a rest, and that someone is ready to take the lead.

4. The geese in formation honk from behind to encourage those up front to keep up their speed and strength.

Lesson. When we are leading, we need encouragement. When we aren't leading, we need to encourage those who are.

5. When a goose gets sick or wounded, two other geese drop out of formation and follow the sick one down to the ground to help protect him/her. They stay with their fellow goose until he/she is either able to fly again or dies. Then they launch out to find another formation or to catch up with their own flock.

Lesson. We need to be part of a community, and should be able to expect no less concern and support from our fellow man than a goose gets from his/her fellow geese. We are on earth to stand by each other no less than are geese.

Phyllis Tremper
Auxiliary President

Participation, Please?

A Special Message From The Editor Of The Auxiliary Exchange

Now that another convention has come and gone and we start in on the busy season for piano technicians and their families, it might be the best time to sit and assess the situation as it pertains to the PTG Auxiliary and especially these Auxiliary Exchange pages in the *Journal* each month.

As you no doubt noticed in the July issue, the usual two pages was down to one page with that consisting of only Phyllis Tremper's column and the usual listing of officers and pertinent addresses, etc.

In talking with Phyllis and Jami Henry of the home office, I have tried to indicate that I would be interested in continuing as *Editor* of these pages, but I am not interested in being the *writer* of the "Exchange". As *Editor* I will pull together the items submitted to me and get them into the Home Office and ready to print. But, if there are no articles and tidbits submitted to me I am forced into the *writer* mode.

Frankly, there are only so many words that you the members want to read about our move to the country and our new lifestyle. I am very involved in our County 4-H program with my daughter as well as my own involvement with showing Draft Horses on our regional circuit. Combine that with my sewing business and it seems as if I have a smaller and smaller pool of information to draw these pages from.

Don't get me wrong—I *love* the activities I am involved with but it doesn't make very interesting fodder for these pages month after month.

If the PTGA wishes to keep these pages in the *Journal* each month, then it is imperative that either another *writer* is assigned these duties or articles and bits and pieces start to come to me to use as *Editor.*

If the Auxiliary Exchange is to remain in the PTG *Journal,* it will take a concerted effort from the members to make sure that there is information to fill the pages.

Deadlines For Submitting Copy To PTG Journal

Copy for the Auxiliary Exchange pages must be submitted through Jennifer Reiter, our AE Editor. All articles must arrive at the PTG Home Office from Jennifer on or before the deadline dates listed below. In order to submit a story, photograph, or other information for publication, make sure it reaches Jennifer by the dates listed in the middle column. This will allow plenty of time for the editing process, mail delivery and any unforseen hold-ups. Submissions may be of any length, on any topic. They may be about activities and upcoming events or they may be coverage of an event which has already taken place. Go ahead—send them in!

ISSUE-1993	EDITOR'S DEADLINE	JOURNAL DEADLINE
November	September 3	September 17
December	October 1	October 8
ISSUE-1994		
January	November 5, 1993	November 19, 1993
February	December 3	December 17
March	January 7	January 21
April	February 4	February 18
May	March 4	March 18
June	April 1	April 15

Recipes

Cream Cheese Pound Cake

2- sticks of margarine, soft
2-c. sugar
1/2 lb. cream cheese, soft
6-eggs
2-c. self-rising flour
1 tsp. vanilla

Cream margarine, sugar and cream cheese. Beat in eggs, two at a time. Add flour and vanilla.

Pour into greased Bundt or springform pan and bake at 375 degrees for 45 minutes.

Cream Cheese Rolls

10-medium sized flour tortillas
2-8 oz. blocks cream cheese, soft
1-small can chopped hot peppers
1-small jar mild-medium or hot picante sauce

Cream together in bowl: cream cheese, chilles and picante sauce.

Place tortilla on plate and spread mixture over entire surface.

Roll tortilla up and slice into small 1 1/2 inch pieces.

Serve cold as an appitizer or as a side dish for a mexican fiesta.

If you have favorite recipes that are not already included in the Auxiliary Cookbook, send them in! New additions are always welcome. Remember, cookbooks are available through your Auxiliary President

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SEATTLE, WA 98136

1993 EVENTS CALENDAR

SEPT	25	**Pomona Valley Chapter Annual Seminar** Contact: John Voss, 2616 Mill Creek Road, Mentone, CA 92359
SEPT-OCT	30-3	**Ohio State Conference** Holiday Inn-Dayton Mall Contact: Kathy Shaw, 1066 W. Sparrow Road Springfield, OH 45502, 513-323-2555
OCT	15-17	**Texas State Seminar** Ramada Kings Inn—NASA Road One Contact: Ray Whitmire, 7126 Sonnet Glen, Houston, TX 77095, 713-859-7535
NOV	4-7	**New York State Convention** Westchester Marriott Contact: Michael Meade, 27 Perch Drive, Mahopac, NY 10541, 914-528-3365
NOV	6	**Orange County Chapter Seminar** 1st Presbyterian Church Contact: Peg Browne, 11511 Wasco Road, Garden Grove, CA 92641, 714-530-4768
NOV	11-14	**North Carolina State Conference** Omni Hotel-Richmond, VA Contact: Lewis Spivey, 15 Rachel Drive, Nashville, NC 27856, 919-937-4777
FEB-'94	10-14	**California State Convention** Cathedral Hill Hotel-San Francisco, CA Contact: John Schaecher, 1052 Oak Street, San Francisco, CA 94117, 415-431-1187

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- PTG Tie - gray with white and red trim
- Tie Bar* - -with blue & white RPT logo and gold clip
- Coffee Mug - blue print on white ceramic
- Pedestal Mug - 10 oz clear glass

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- Auto Sunshade
- PTG Portfolio
- Video (The Unseen Artist)
- Journal Binders
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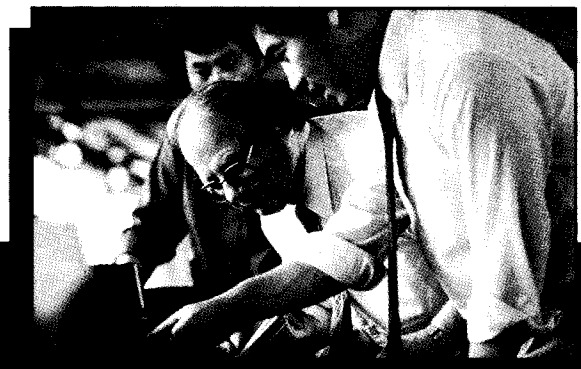

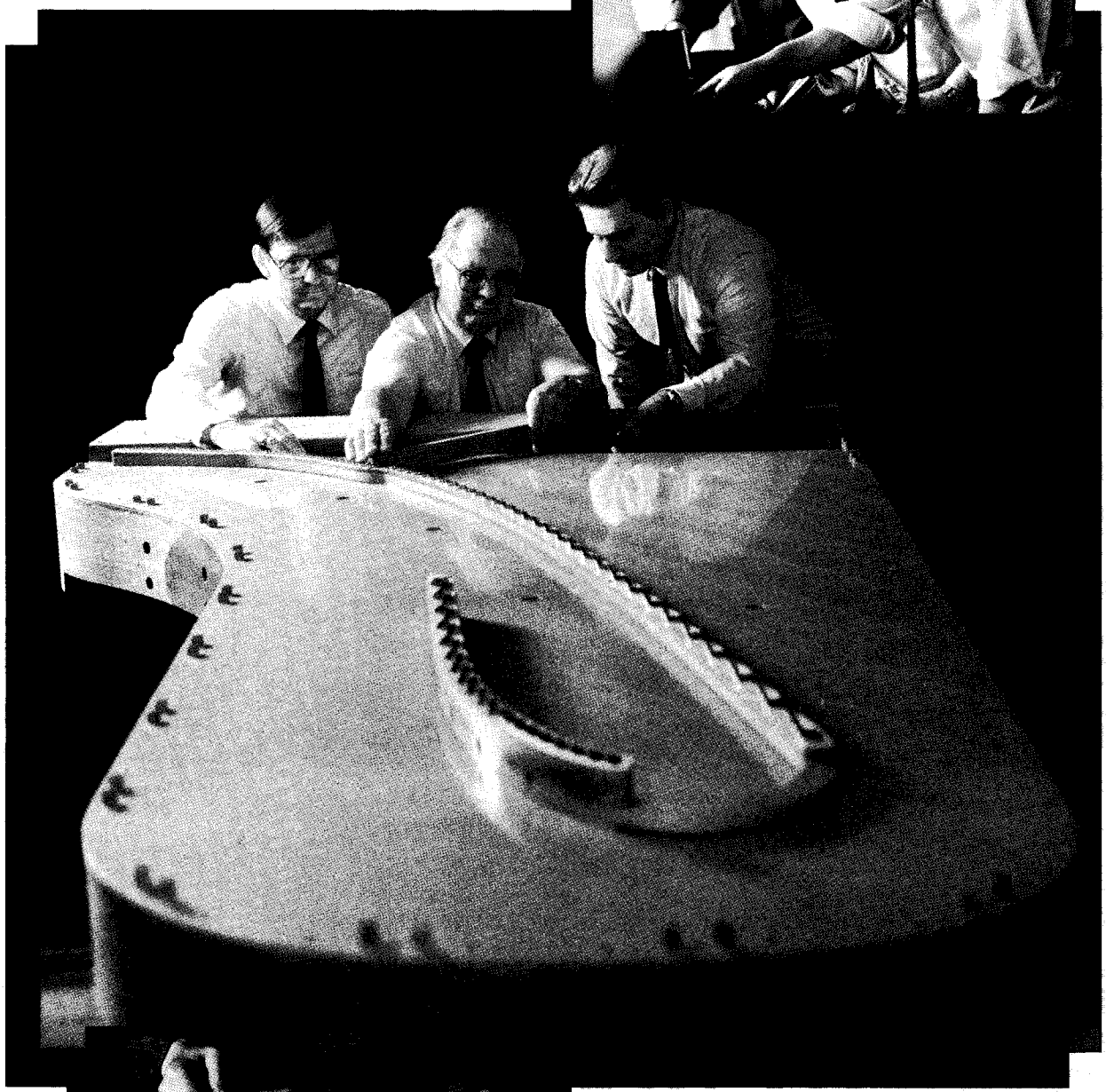

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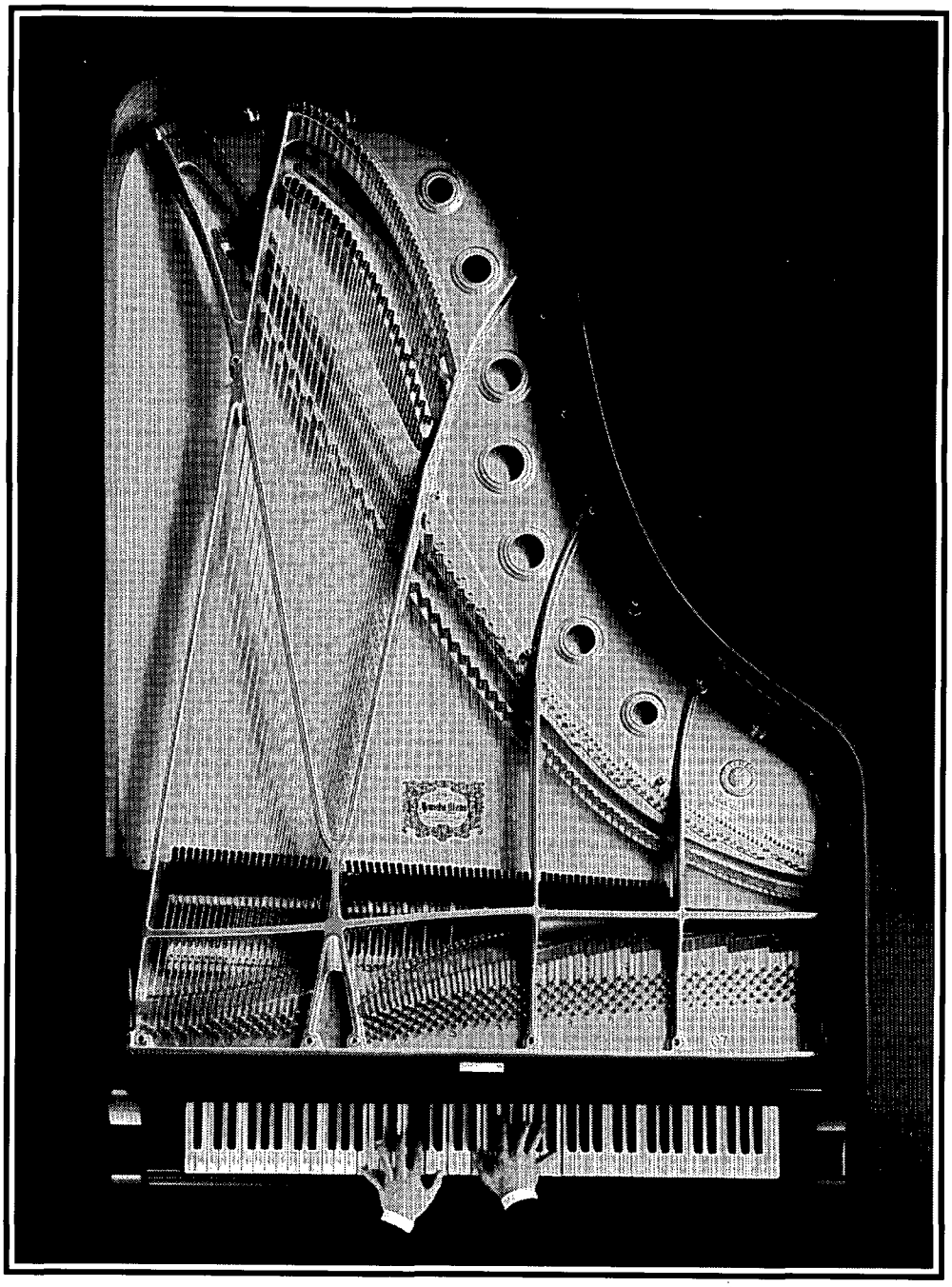

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