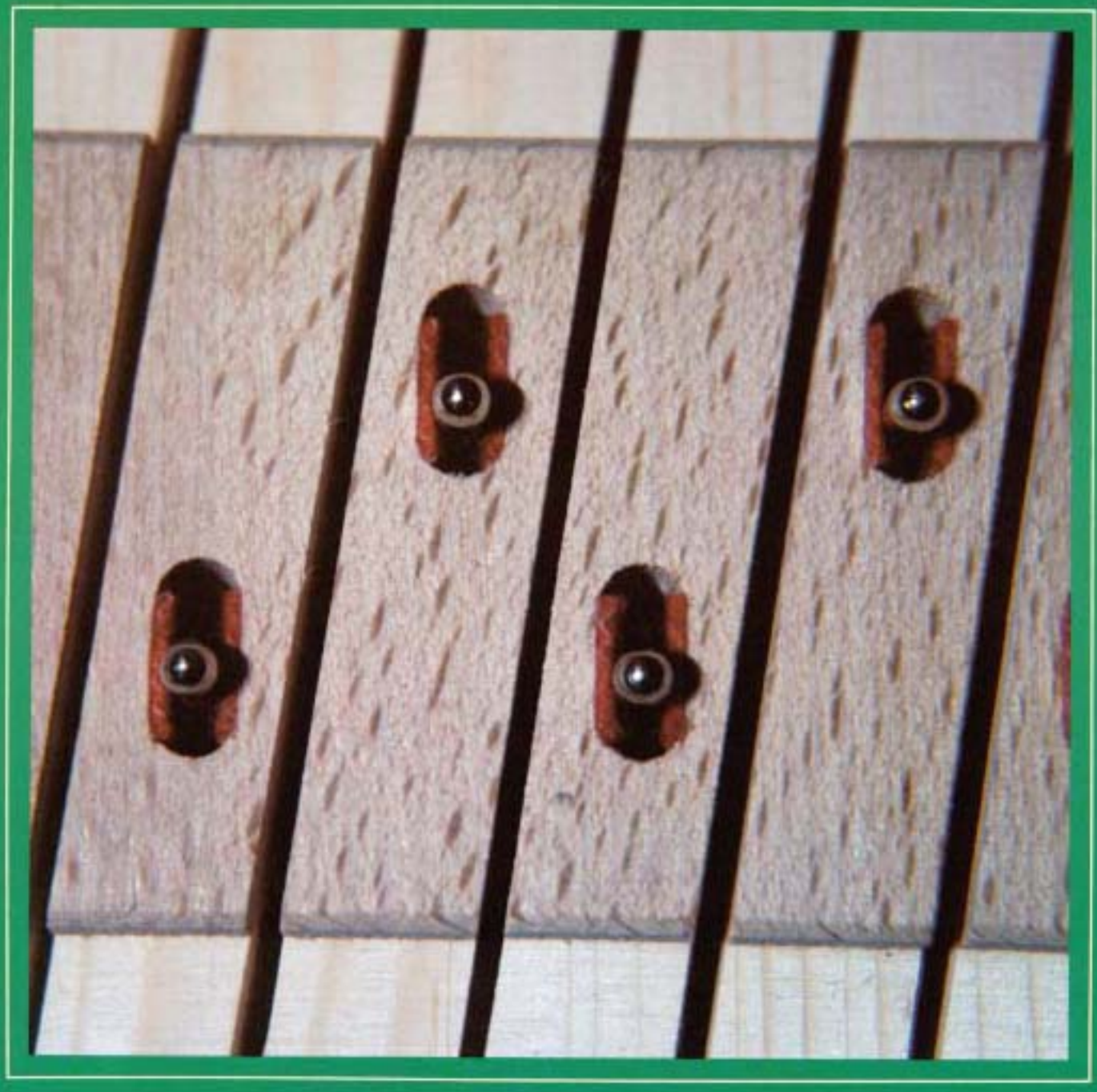
Piano Technicians Journal

April 1986



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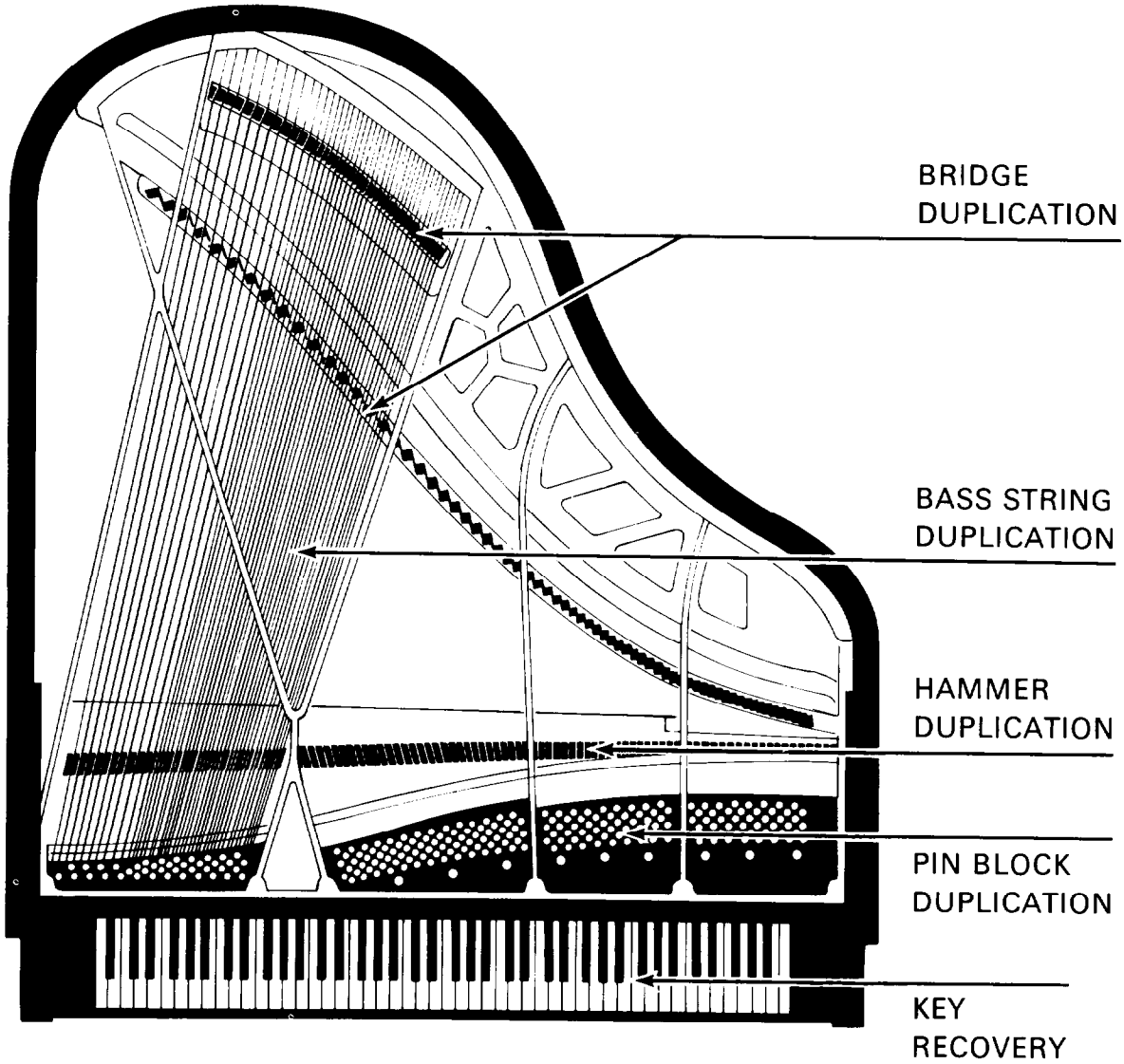

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Piano Technicians Journal **April 1986**

Official Publication Of The Piano Technicians Guild, Inc.

Volume 29 Number 4

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The Cover...

Detail from Yamaha M1AR

The *Piano Technicians Journal* (ISSN 0031 9562) is the official publication of The Piano Technicians Guild, Inc., 9140 Ward Parkway, Kansas City, MO 64114. The *Journal* is published monthly, with two issues in December. Second class postage paid at Kansas City, MO., US ISSN 0031 9562 foreign and domestic. POSTMASTER: send address changes to: *Piano Technicians Journal*, 9140 Ward Parkway, Kansas City, MO 64114.

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The President's Perspective

Charles P. Huether
President

Here's How Everyone Wins In Las Vegas

You ought to be getting ready for the annual convention and institute by this time. You have been reading articles about the wonderful classes which will be presented. You may also have been reading about the important items which will come up before Council for discussion and vote. All of this should have whetted your appetite to go to Las Vegas in July. If all of the above is not enough to whet your appetite, here is another good reason for going.

This year we are working hard at arranging meetings to specifically help chapters. Every year we bring large numbers of members together and saturate them with technical information and instruction. The potential for developing improved chapter operations, to assist chapter officers to function better, is there but not always utilized. This year we hope to be different.

There will be specially planned meetings for chapter management and for chapter officers. We anticipate having a new chapter management manual available. But doing this is not enough. What we need is to have the right people in attendance.

The Piano Technicians Guild runs because of its active chapters. They are the foundation of the organization. They are the basis upon which all activity and all authority rest. We have designed our organization that way. Members have indicated over and over again that that is the way they wanted it. Believe me when I say it would be a lot easier to have this organization run like so many others do, from the top down with general membership hardly aware or able to participate in important decisions. We don't do that and because we don't, our success is tied directly to how well chapters function.

If you have any love for the Piano Technicians Guild, if you recognize the importance of this organization to the way you make your living, if you hope to see the benefits of there being a Piano Technicians Guild increase, make sure that there are as many of your chapter members in attendance as possible so they can take advantage of the special meetings dealing with chapter management and activities.

For the last two years we have sent special invitations to chapter presidents encouraging them to attend the convention and institute. I believe we have achieved some success in increasing their attendance. We are continuing to do this, but now are appealing to membership in general to do a little arm-twisting back on the home front. Make sure your officers go. And when they get back home, make sure that they report on what they learned, not only in piano technology but in improved chapter management.

I have participated in such meetings many times. I am sure that anyone who has ever participated will agree when I say that they are as interesting, as valuable and as informative as the technical programs. This year it will be the chance of a lifetime to participate in an exchange of problems, solutions and ideas with others who are facing the same difficulties you are.

Sometimes it is helpful just to know that you are not alone with your problems. Hearing a sympathetic voice who has or is enduring the same difficulties is as good as finding a solution. To know that your problems are not unique, to find out that you may have answers to someone else's problems, serves to reinforce your feelings of competence.

So make it a point to speak up at the next chapter meeting and ask who is going to the convention and institute. Make a motion that the chapter officers be encouraged to attend and, while doing so, attend the extra meetings designed to improve chapter management and operations.

The Piano Technicians Guild will grow in size, vigor, influence and value in the same propor-

Continued on next page

Las Vegas . . .

tion as its chapters develop in the same direction. Do your part to make this happen. We will always need leaders in chapters and on the board of directors. Learning how the chapter works and how to make it work efficiently is the basis for developing leadership. Take advantage of the programs being offered in Las Vegas. This is a sure-win situation for all.

From The Executive Director

Barbara Parks
Executive Director

Letters From Friends

One of the benefits of the Executive Director's job is the opportunity to meet and stay in touch with some very nice people. I think a big reason for this is the Guild's spirit of being a single large family. I'm sure that some members are closer to other people in the Guild than they are to members of their own families, and I know that Guild conventions often take on many of the aspects of a large, boisterous, family reunion.

In that spirit, I'd like to share two letters we in the Home Office received lately. The first is from Jack L. Worth, of St. Croix in the Virgin Islands:

"Greetings from the Virgin Islands. Some of you may remember me as I formerly resided in Ohio, where I was a member of the Cleveland Chapter and later the Youngstown Chapter.

"Some years back, I had a medical problem and therefore a good excuse to retire to the island of St. Croix. It is always summer here and I like that.

"My interest in the Guild was renewed a few days ago when my phone rang. It was Stanley Oliver, of the Detroit Chapter. He was in the Virgin Islands to visit his son on St. Thomas and his daughter, who lives on St. Croix. He also made time to visit me and bring me up to date on PTG matters and personnel. Stan and I first met at the national convention in Detroit in the late '60s. I always enjoy our talks.

"The purpose of this letter is simply to say that Mr. Oliver is the epitome or embodiment of PTG spirit and a credit to the organization. Further, he spotted an obscure "drag" in my new G-2 Yamaha piano action which had annoyed me for months. Thanks to Stan, my piano feels good again.

"If any of you are down this way, please call."

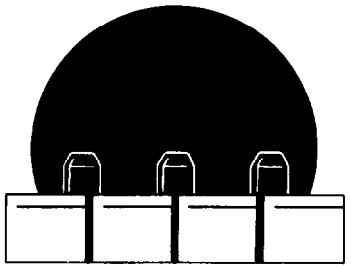
I couldn't have said it better myself. Stanley, last year's Golden Hammer winner and chairman of the Guild's Visually Impaired Committee, is a whirlwind of activity and a constant ambassador for the Guild.

The second letter, however, is not nearly so cheerful, if no less heartfelt. It comes from John Travis, who served with Erroll Crowl as founding co-presidents of the Guild in 1957 and 1958.

"Dear *Journal* Readers:

"I need your prayers. I have had three operations for a detached retina in the right eye within six weeks. Sure hope to be in Las Vegas to greet you in July. Please remember me in your thoughts and prayers."

I'm sure we all will remember John in our prayers and look forward to seeing him in Las Vegas.



Realize Your POTENTIAL

Ben McKlveen
1986 Institute Director

Notes On The 1986 Institute In Las Vegas

If you have been following these articles in the February and March issues of the *Journal,* you realize that the Piano Technicians Guild is having a convention at Caesar's Palace in Las Vegas, NV, July 21-25, 1986. The primary attraction at that convention will be the Institute, 3 1/2 days of unparalleled continuing education for piano technicians. Soon you will be receiving a packet of information about the convention, and a registration form. Fill it out and send it in. Make your plans and then, in July, make tracks for Las Vegas. We will be there waiting to help you "live a little and learn a lot" at the 1986 Piano Technicians Guild Institute of Piano Technology.

Last month I wrote about the classes concerned with tuning and the classes being taught by representatives of the various manufacturers. This month I am writing to appeal to the serious action regulators and piano rebuilders among our readers.

If you are interested in how the architecture of an action is designed and how it works then, by all means, see the class called "Action Analysis, Practice and Theory" taught by Gary Green and sponsored by Sohmer/Pratt-Read.

Move on over to the class, "Grand Action Rebuilding," taught by Willis and Dave Snyder and see the theory of action design put into practice. These talented craftsmen will present the action rebuilding process completely and clearly.

Norman Neblett returns this year to teach about grand dampers in a class called "From the Middle Up." He will take you through all phases of grand damper work from the damper tray to damper levers and top flanges, wires, heads and felt. Thoroughness and authenticity are the earmarks of any Neblett presentation and this class is no exception.

If you have regulated the action and it doesn't suit your customer, perhaps you have overlooked the key weighting or you have missed a friction problem. Stop in and see David Betts and his class on "Touch and Key Weights" and learn about this important aspect of keyboard control.

Soundboard repairs and pinblock installation will be taught by Cliff and Tony Geers. No one does it better than they do. Cliff has been teaching in our Institute for more than 30 years. He brings a world of experience to his classes. Tony, now responsible for the day-to-day operation of their shop, adds his insights to the effective repair of soundboards and replacement of pinblocks.

Is refinishing troubling you? Relax! We have Webb Phillips, whose class in refinishing last year drew a basketful of favorable mail. I have seen his work. It is beautiful. So, if you want to learn refinishing, here is your opportunity.

One of the reasons that Webb Phillips is a good refinisher is that he understands wood behavior. He teams with another talented craftsman, George Wheeler, to present a class called "Wood Behavior." They explore the characteristics of various woods and why these woods are chosen for piano parts, how they respond to moisture and dryness, their strengths and weaknesses.

After you have seen the class on wood behavior, move on over to the class called "Woodworking for Technicians," taught by our esteemed Technical Editor, Jack Krefting. His class will give you an overview of repair techniques with tips and hints about glues, wood joint preparation, various shop and home repairs, and help with veneer problems, key frames, structural problems and bridge caps. He will discuss the tools for these jobs and touch on the use of abrasives and their characteristics.

One of the new classes being offered this year is called "Shop Efficiency," taught by Clair Davies. Whether you are a novice just starting to organize a shop or a seasoned veteran whose shop "just growed" (like Topsy)

Continued on next page

Institute . . .

you will find something informative and instructive in this class. Clair discusses space organization, lights, tool storage, and cabinets with the idea of producing an efficient, clean, well-lighted, worry-free shop space. While the principles of his discussion apply to shops of any size, the class is especially applicable to a one-man operation.

Wally Brooks is returning to run a rebuilding clinic. Last year, this clinic was offered as an extra-charge option. This year it is free! If you so desire, you can follow the entire series of classes designed to acquaint you with all aspects of rebuilding, or you can stop in and take only the classes that you feel you need. This series will be outlined in a later issue of the *Journal*.

Have we forgotten vertical pianos? Not at all! Next month I will write about a new class on upright rebuilding and a repeat class that was a smash last year in Kansas City. But that's not all! There are many more classes about which I want to write.

In the meantime, it's your turn! Fill out that registration card and send it in! Don't miss this Institute. It is designed for you. A lot of people are giving a lot of time and effort so that you can come to Las Vegas, live a little, learn a lot, and, ultimately, realize your potential. It is all here from July 21 to 25, 1986.

Las Vegas: Getting Past The Glitter

Preconceptions and first impressions don't come close to telling Las Vegas' story. True, the first thing you see when you get off the airplane at McCarran International Airport will be a bank of slot machines. True, there will be big-name entertainers, chorus girls, acres of gaming tables and enough neon lights for a dozen normal cities.

But there's much more, enough to make Las Vegas one of America's favorite convention sites. A combination of great facilities (like those at Caesars Palace), lots of reasonably priced hotel rooms and easy access by air make it an excellent place for a convention. Las Vegas has more than 150 tennis courts, 11 golf courses, nine racquetball facilities and six bowling establishments. It has a 34-acre mall near Caesars that includes Saks Fifth Avenue, Neiman-Marcus and more than 130 other department and specialty stores.

And, if that's not enough, some of the most striking scenery in the U.S. is within easy driving distance. Red Rock Canyon includes 62,000 acres of federally owned land. Spring Mountain Ranch, in the Red Rock Mountains, once was owned by Howard Hughes. Hoover Dam and Lake Mead, about a half-hour drive from the city, offer 500 miles of coastline. Petroglyphs — pictures cut into the sandstone by prehistoric Indians — can be seen at Valley of Fire, a colorful sandstone formation northeast of Las Vegas. And, of course, there's the Grand Canyon.

Piano Foundation Releases Video

To help support retailers and music instructors, the National Piano Foundation has produced "Don't Miss the Magic," an informative and entertaining eight-minute videotape designed to be shown in music stores, and/or by teachers, to parents, children and adults wanting to learn to play or purchase a musical instrument.

In the tape's various sequences, a salesperson is asked several questions about learning to play by two young boys, an older adult, and a mother and her daughter.

Backing up the salesperson's responses are comments by Dr. Frank Wilson, a California neurologist and author of the soon-to- be-published book, "Tone Deaf and All Thumbs?: An Invitation to Music Making for Late Bloomers and Non-Prodigies." Dr. Wilson, a spokesperson for the music industry, became interested in music and its advantages to the human body and mind when his daughter started taking lessons.

"This videotape can be used as sales support in a music retailer's store, as a training tool for sales staffs, presented to individuals or families, or shown to civic groups, parents and older adults," says NPF President Lloyd Meyer. "There is no limit to its audience or its use."

Cost of "Don't Miss the Magic" in half-inch VHS format and accompanied by a printed study guide and suggested script for presentors, is $19.95, plus $3 postage and handling. To order the complete package, write the National Piano Foundation, 15080 Beltwood Parkway East, Suite 108, Dallas, TX 75381. or call (214) 241-8957.

The International Scene

Fred Odenheimer
Chairman, International

The Winter Market

The NAMM Winter Market at the convention center in Anaheim has come and gone. There was a PTG booth which, I am told, was quite busy with inquiries. It was also in comparatively quiet surroundings.

Mostly the exhibit was a noisy one, with electronic keyboards, amplified instruments and drums vying with each other to see which exhibit or which group could turn out the highest decibels. Coming to a piano booth to try out an instrument was a futile effort because the pianos were drowned out in the general noise level and even when coming to a section where only pianos were exhibited, the ears were so "tired" one could not concentrate on sound anymore, unless one started in that particular section.

Exhibits of pianos, especially American makes, were down. As we all know, a number of factories have closed down and we shall not see a good number of well known makes, except in used form. However, one could see the Chickering label in the Wurlitzer booth and one professional Mason & Hamlin upright made by Sohmer. The manufacture of American pianos is in a rather steep decline and one can only hope that the demise of a number of factories will help to strengthen the few that are left now.

As for foreign makes, we missed some exhibitors from Germany that were there last year. However, for the first time there was a nice Hohner piano exhibit (Hellas, Finland) and again some Fazers (also Finland) at Coast Wholesale. There were pianos from Japan: Kawai, Yamaha, Tadashi and Tokai; and exhibitors from Korea: Young Chang, Samick and Daewoo. Pianos labeled Schafer & Sons are, as far as we know, all made in Korea.

Tucked away in a corner close to the restaurant was a small exhibit from China. The Pearl River piano was introduced by two nice, rather timid ladies who were trying to interest American dealers and the public. I do not know how successful they were, but I certainly wish them and their company the best of luck.

The tour to Europe is well on its way to a success. At this time, I do not know if any empty places remain, but if you make up your mind at this late date, get in touch at once with Cartan Tours, Custom Tour Dept., 12755 State Highway 55 #101, Minneapolis, MN 55441, phone (800) 323-7888.

The tour will leave May 17 from airports in the U.S. and will extend over three weeks through Germany, East Germany, Czechoslovakia and Austria. There is an extensive program of factory visits and sightseeing, also attendance of various musical events. For those traveling, it may possibly be the trip of a lifetime.

Design Magazine Honors Accu-Tuner

The Sanderson Accu-Tuner, an electronic tuning device invented by Dr. Al Sanderson and marketed by Inventronics, Inc., placed second in an "Excellence in Design" competition conducted by *Design News* magazine.

The publication for design engineers named one grand prize winner, an automotive engine diagnostic device, and eight secondary winners ranging from Sanderson's device to a valve used in natural gas pipelines to an energy-saving circuit for dishwashers. The magazine awarded Inventronics a personal computer and devoted two pages to the tuner.

"Piano sounds . . . have very complex waveforms. Professional tuners, through years of training, pick these sounds apart and hear only those portions of the sound spectrum they are interested in. The signal shaping/filtering circuit duplicates this skill," wrote David J. Bak, the magazine's east coast editor, in the article.

THE
TECHNICAL
FORUM

Grand Leg Repairs And Preparing For The Tuning Test

Jack Krefting
Technical Editor

One of the more troubling problems that can occur with the casework on a grand is a tendency for the instrument to wobble while it is being played, or even when touched with light to moderate pressure. It doesn't take a vivid imagination to realize what could happen if a leg should break while a child is crawling around under the piano, for example, and as technicians we should try to notice such problems and notify the piano owner of them.

Having done that, the technician is likely to be asked just how the repair will be made and how much it will cost, so it is wise to analyze the problem first. Squat or kneel so the keybed is about at eye level, and push the rim with one hand while observing the leg, especially the upper part, called the "leg bracket." The movement will almost always be either between the bracket and the keybed, or between the bracket and the column (see *Figure 1* for nomenclature). If the movement is so slight that its source is not obvious, place a fingertip on each of the above joints while pushing on the piano; movement is more easily felt than seen.

If the leg bracket is loose from the keybed or console, check the eccentric cam or leg bolts, whichever is applicable, for tightness. If everything is tight, but the movement persists, it is likely that a leg plate is loose, or that it was never properly recessed in place, or the top of the bracket is rounded so as not to be parallel with the underside of the keybed or console. Let's look at each problem in turn.

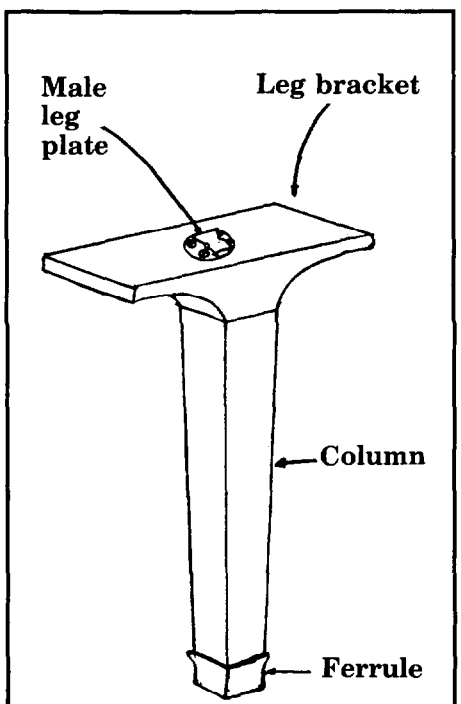


Figure 1

With the leg off the piano, check the leg plate screws for tightness. If they can be turned clockwise at all, turn them hard because they are probably stripped and this will make it obvious. Stripped screw holes should be drilled out to 3/8 or 1/2 inch, plugged with maple or beech plugs — not dowels, because the grain is wrong and the screws won't hold as well in end grain — and redrilled for the screws when the glue is cured. *Figure 2* illustrates this procedure.

If the screws are tight, use a straightedge to determine the elevation of each mating plate. The male plate, usually installed in the leg bracket, is generally installed so that its larger flat

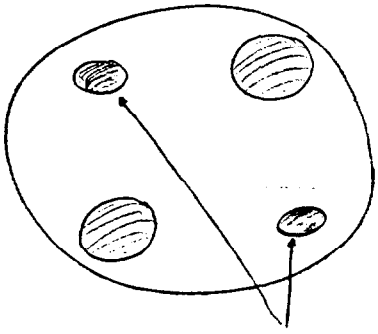
surface is just flush with the top of the leg bracket, or possibly just slightly recessed. The only part actually projecting above the bracket surface is the wedge-shaped part, as shown in *Figure 3*.

The female plate is usually installed in the keybed or console, and recessed into that surface by 1/32 to 1/16 inch. If this is correct and the male plate is not projecting, the binding effect of the plates causes the wood of the leg bracket to come into forced contact with the wood of the keybed as in *Figure 4*. If the horizontal surfaces of the plates are allowed to touch one another, the above-

Step 1: Drill out two holes, plug with pinblock plugs.

Step 2: Trim off excess, replace plate, redrill plugs using plate as a guide.

Step 3: Remove plate, drill and plug remaining holes. Replace plate and redrill as above.



Maintain alignment by leaving two holes as is until two plugs are redrilled.

Figure 2

Cross-section of leg #2, viewed from treble side.

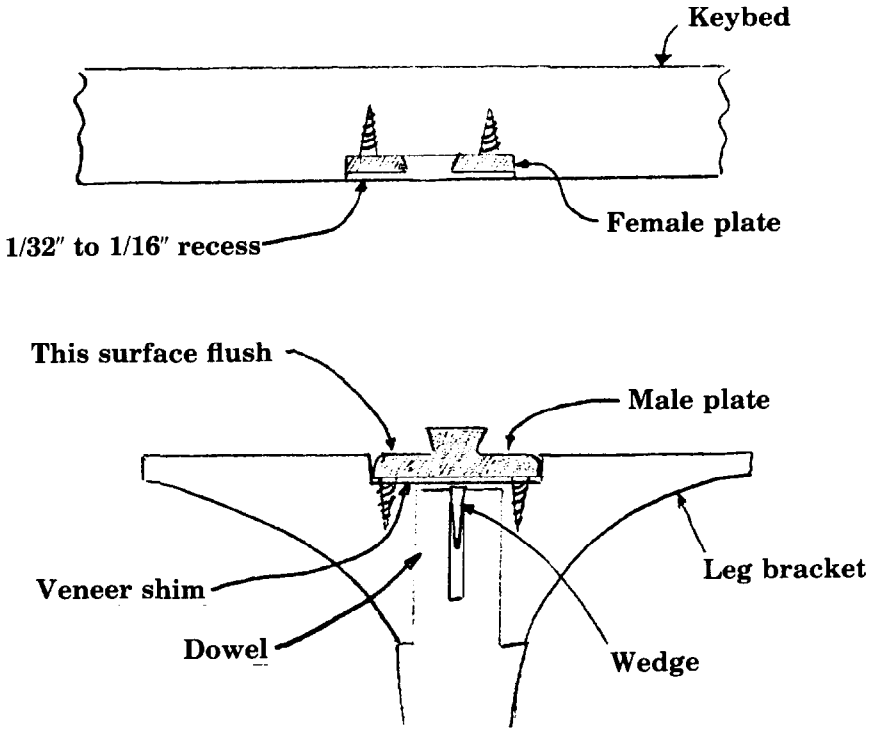


Figure 3

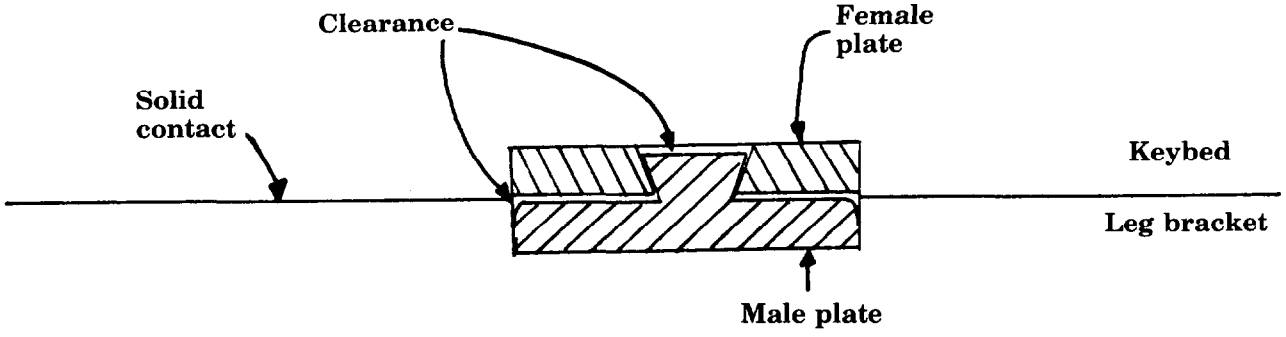
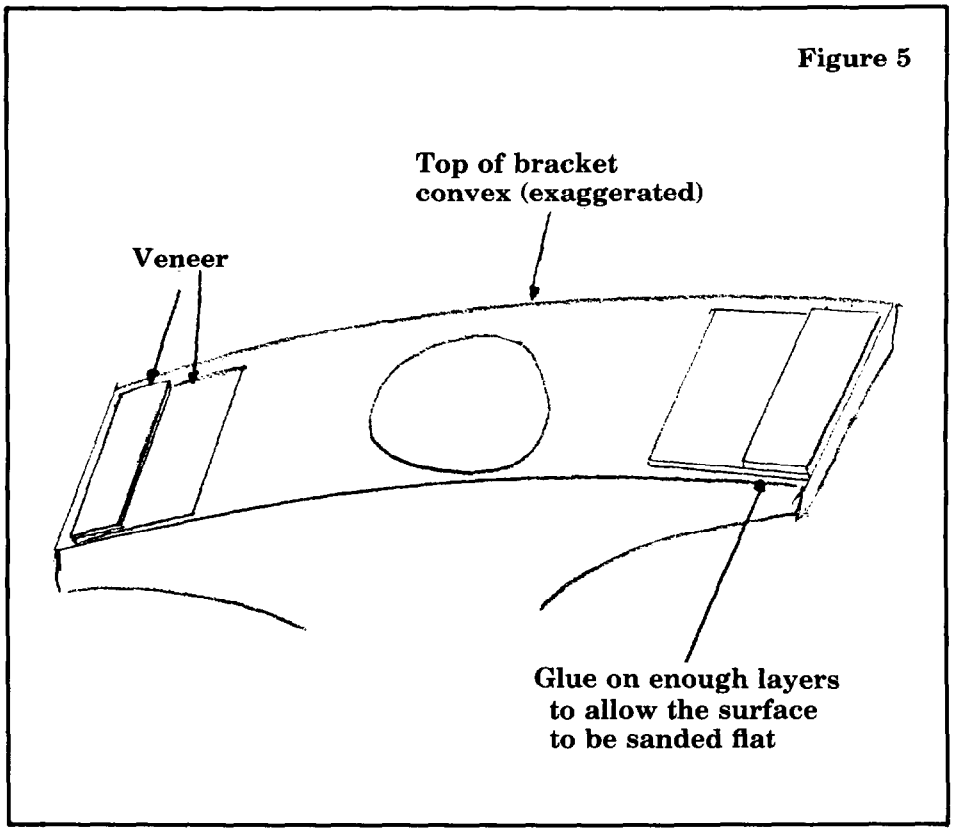
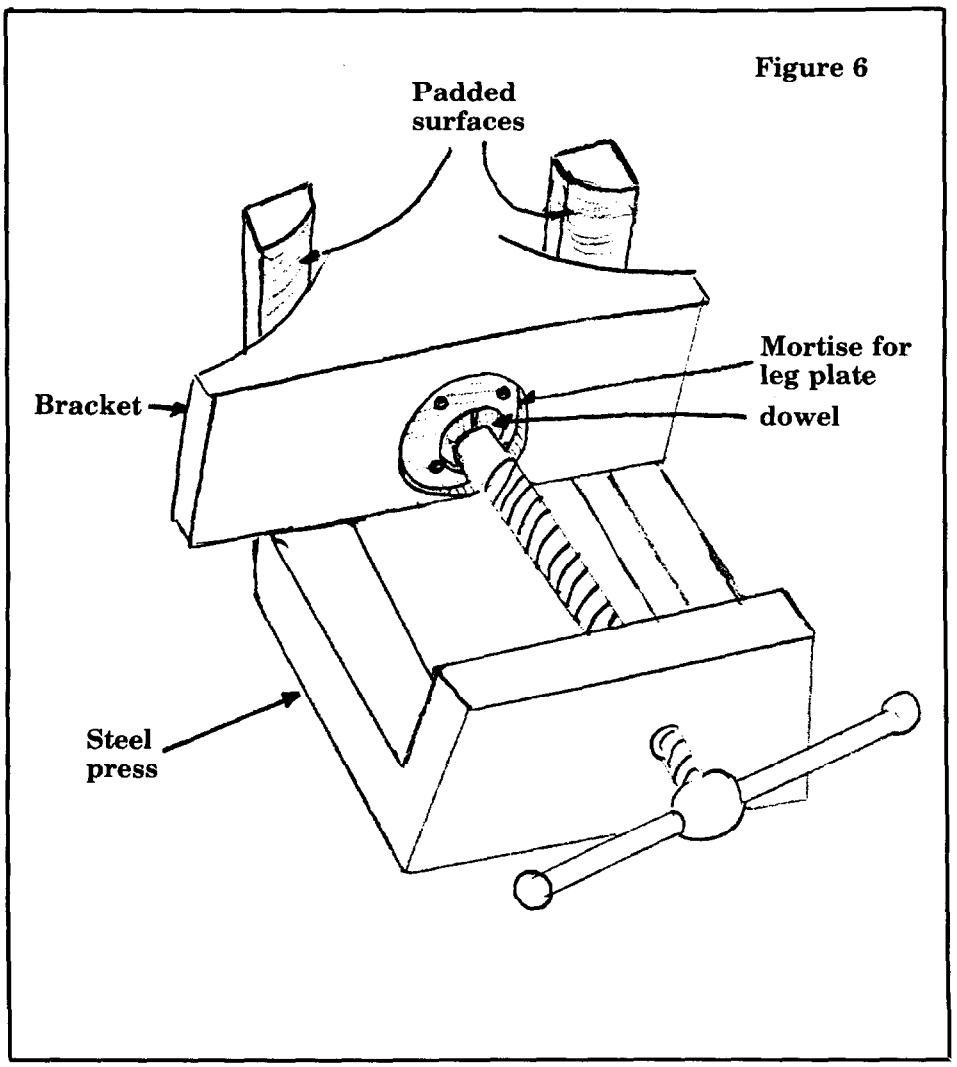


Figure 4





mentioned wooden parts cannot be tightly joined, and the piano will wobble even though everything is tight. To correct for this, remove the male plate and one of the veneer shims on which it rests, and replace the plate without the veneer. If no shim is present, deepen the mortise with a router and then reassemble the parts.

If the top of the leg bracket is not flat, as observed with a straightedge, it will have to be planed and then the mortise depth increased accordingly, or else the ends of the leg bracket must be shimmed with veneer as in *Figure 5*.

Now let's suppose the looseness is detected at the joint between the leg bracket and the column. The top of the leg column is usually turned on a lathe to a dowel shape to add gluing surface, and the dowel portion is cut vertically with a saw so it may be wedged in place after the glue is applied and parts are assembled. This wedge also makes it difficult to get the leg apart for repair, unfortunately, but it must be disassembled or it cannot be properly repaired.

Using a leg press (*Figure 6*) or some kind of fixture which would allow the column to be driven out of the bracket, get them apart. If any part of the wedge extends beyond the end of the dowel, be sure the pressing or driving tip is modified so as not to put pressure on it, as this would only wedge it tighter.

If it is so tight that it requires special techniques and equipment to get these pieces apart, one quite logically wonders, "why do they need to be separated at all?" Surely it would seem that such resistance must indicate a tight bond, and that therefore the leg should stay together in service as well, would it not?

No, it won't, and here's why: correctly made, the bracket and column joint will fit together easily only when both pieces are dried to a low moisture content. Any additional moisture, from ambient humidity later and from the glue, will cause both to swell together, tightening the joint so that every part of the bracket that touches the column is help-

ing to reinforce it. The wedge, driven in place after the joint is made, simply represents insurance that, in case the leg is dried below the original moisture content and the glue fails for any reason, the piano won't collapse. The wedge helps, but it cannot make up for the lack of solid contact and thus the leg is seriously weakened once the glue joint has failed.

When the column has been separated from the bracket, clean off the old glue without removing any wood and then saw out the old wedge. Make a new wedge from maple or something similar, and dry-fit the parts to check clearances. If they are a fairly tight press-fit, fine. If they are loose, that is probably the reason the glue failed in the first place. Excessive clearance meant a thick glue line, which is just as bad as a starved joint. If it is put back together this way, it will fail again sooner or later. Glue a piece of maple veneer to the outside of the dowel or the inside of the bracket hole, allow to dry thoroughly for maximum shrinkage and sand to fit.

When satisfied with the dry fit, add glue and reassemble quickly so the sudden swelling will not prevent full insertion of the dowel. Be sure the column is facing the right way and is straight with the bracket, and *clamp the two together before driving the wedge.* Otherwise the driving may separate the two somewhat and it will then be virtually impossible to fix. Be sure also that the slit in the top of the dowel is perpendicular to the length of the bracket, otherwise the bracket will split when the wedge is driven.

Finally, add glue to the new wedge and drive it as far as it will go. If any part of the wedge protrudes into the cavity mortised out for the leg plate, this protrusion will have to be trimmed off before the plate is reinstalled.

Preparing For The Tuning Test

Last year the Golden Gate Chapter sponsored a two-day seminar on preparation for the tuning test, which was undoubtedly much appreciated by those in attendance who had not yet been examined. Sidney O. Stone, a recent Piano Technicians Guild national president and member of the above chapter, subsequently wrote a letter to an apprentice member from another state who had been unable to attend that seminar. For the benefit of those of our readers in similar circumstances, here is part of Stone's letter.

Prepare yourself technically . . .

If you use a machine in your tuning, that is a tremendous help in all parts of the test. Part one is *pitch.* Assuming you have an A fork, practice tuning A49 on the piano to your fork. Check the 17th below (F21) to A49 and to your fork. The beat should be the same. You may want to raise F21 on the piano for a slower, more distinguishable beat. Then check your tuned A49 and also your fork to your machine. Practice this procedure until there is less than one cent between the fork reading and the A49 reading. Occasionally the 10th below A49 (F33) will give you a better reading than the 17th below.

For tuning the temperament and the two middle octaves, your machine again can assist you. Tune those two octaves (C28/C52) by ear and check with your machine. Get each note as close to the machine as possible. When taking the test, you may be informed that certain notes of your tuning are off enough to subtract from your score. Be prepared to tell the examiner whether these notes are sharp or flat and how you came to that determination. I am enclosing a two-octave tuning routine written for the aural part of the test — this was used in our seminar.

In the *unison* part of the test, you will tune all three strings in the two middle octaves. Practice by checking each string with your machine. On the examiner's instrument, if there is more than one cent difference in the three strings of a unison you will be penalized. You can't afford many of these penalties.

In the *stability* part of the test, practice using your machine to record the pitch, and then pound the note several times to see if it stays at that pitch. Again the tolerance is one cent and it doesn't take many penalties to fail the test.

The other three parts of the test are *bass, treble* and *high treble.* Tune these accurately with your machine and you have a good chance of passing the test.

Prepare yourself mentally...

As for the test results, this is as important as your ability to tune. Stress and fear are sometimes the downfall of an otherwise good tuner. The fear of the unknown has always given us problems in whatever field of activity we engage. The more you know about the tuning test, the easier it is for you to pass it. The piano on which you will be tested will be a six-foot or longer grand piano of good quality. It was tuned by a committee of Craftsman members of the Piano Technicians Guild who worked until all were satisfied that it was the best possible tuning for that piano. That "master tuning" was then recorded and put in the computer. Your tuning will be compared to the master tuning. You will be asked to keep your tuning fork on the plate when not in use to maintain temperature stability. The piano will be mute- stripped and you will have up to two hours to tune all non-muted strings (except 1, 2, 3 and 88).

The brief summary of the test I have given here in this letter should help you overcome whatever fear you might have. Another fear, perhaps even more important than the fear of the unknown, is the fear of failure. This is so common among examinees who have been tuning for a number of years and feel they are good tuners. To be examined by one's own peers — and the prospects of perhaps not meeting the standards of the Guild — is enough to give anyone butterflies in the stomach. Even then the test should be approached as a learning experience, and failing the test is much better than refusing for one reason or another to take the test.

— Sid Stone

Please send all technical articles, tips, comments questions and Dumb Sales Claims to me at this address:

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ABOUT THE
CRAFT

Abrasives, Part II: Sandpaper

Del Fandrich
Sacramento Valley Chapter

My last article dealt with the materials that go into making the various abrasive products that we use. Obviously, the raw abrasives by themselves are not going to be of much use to us. So this month, let's get some of these abrasives onto some paper and see if we come up with any usable products.

The traditional "piano finish" (and I'm not referring to the shiny polyester finishes which have become so popular — at least they've been popular up until fairly recently. Their desirability seems to be fading somewhat as the "shiny look" becomes more and more synonymous with "cheap." But that's another story.) would be impossible to get today without the wide variety of coated abrasives — or sandpapers — that are now available. Remember, though, that the abrasive papers that we now depend on weren't even developed until the very late 1800s and early 1900s, so many of the piano finishes applied to instruments made prior to that were finished without the benefit of what we now know as sandpaper. The early piano builders did outstanding finish work, especially considering the materials and tools they had available.

Sandpaper is now available in a bewildering array of types, textures, sizes, colors and grades. I'll get into some of those which are the most useful to us in a later article but this month I want to write about just what sandpaper is and how it is made.

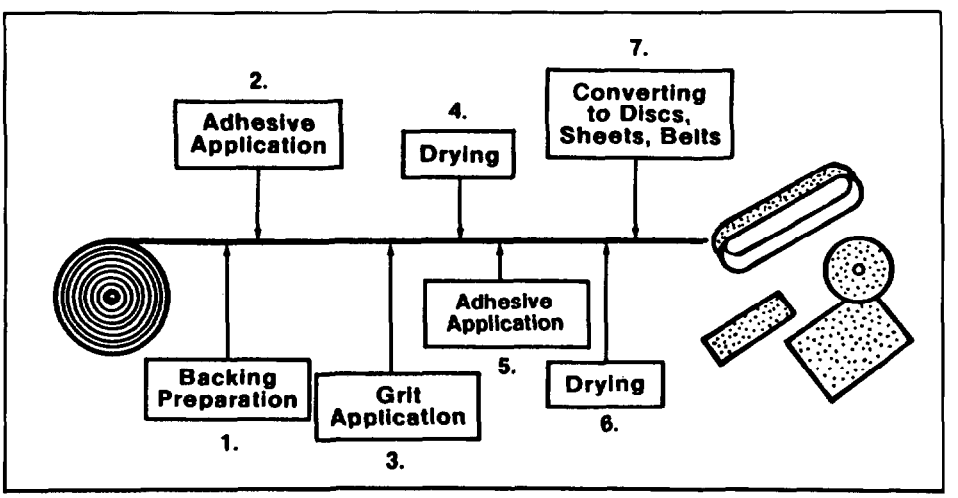


Figure 1: *The basic manufacturing process is similar for all coated abrasives.*

The Manufacturing Process

All sandpapers, or coated abrasives, are made by essentially the same process (See *Figure 1*):

1. The backing, which can be either paper or one of a variety of cloth materials, is unrolled from a very large roll and prepared — mostly this consists of imprinting the back with the identifying trademarks, adhesive type codes, grit size, etc.

2. It then goes through a machine where an adhesive is applied to one side. This first coat of adhesive is called the "make" coat, or the "bond" coat, and can either be natural hide glue (the coated abrasives industry is one of the largest users of animal hide glue) or a synthetic resin. This is the adhesive layer that bonds the mineral grains to the backing.

3. While the adhesive is still wet, the abrasive grit is applied. The abrasive is applied in one of two basic techniques. These are "gravity coating" in which the abrasive is dropped onto the wet adhesive, and "electrocoating," in which the abrasive is attracted to the backing as a result of an electrostatically charged field (See *Figure 2*).

4. The backing with the adhesive and abrasive grit next passes through a dryer.

5. Once the bond coat has fixed the abrasive grit in place, another

coat of adhesive, the "size" coat is applied. This coating fixes the abrasive grit in place and makes the finished product much more durable than it otherwise would be.

6. The now nearly finished coated abrasive goes through another dryer where the size coat is dried, or cured. The coated abrasive is now finished except for cutting and packaging.

7. The entire process, up to this point, has been accomplished in a continuous motion. The backing has been unrolled in a single long strip. It would be a little awkward for us to use in that form, so the final step is to cut it up into standard sizes and package it for distribution and sale.

There are many variables in this process which will greatly affect the characteristics of the end product. A few of these are:

— the type and quality of the backing material;

— the type of adhesives used (for both the make, or bond, coat and the size coat);

— the type, amount, and size of abrasive used.

Starting with the backing, let's take a look at some of these variables.

Backing Materials

The backing can be made of paper, cloth, fiber or a combination of these. As piano technicians and/or rebuilders, most of the coated abrasives we use are made with either paper or cloth backings. It is not a matter of which material is "better," since each of the backings used will perform well when used as it was intended to be used. Rather, which is the most suitable material for a given application?

Paper — The paper used is of particularly high quality. It has to be very tough to take the kind of heavy strains it receives during normal use. The paper backings come in four different weights, or grades. "A," which is the lightest, is primarily used for light-duty applications using finer grits, and for applications where flexibility is important. This is a 40-pound paper stock. (The grading system used for paper is somewhat like the one used for grading hammer felt. It is an indicator of both thickness and density, but it doesn't tell someone who is unfamiliar with the system much about either. "Forty-pound paper" means that a pile of 480 sheets of 24- by 36-inch paper will weigh 40 pounds, but we don't know how tall that pile will be.)

The intermediate papers, "C" and "D" (I don't know what happened to "B"), are quite a bit stronger and stiffer than the "A" grade and are often referred to as "cabinet grade," or simply "cabinet papers." These papers are usually used with coarser grit sizes and can be expected to stand up to harder use. "E" is a very strong and stiff paper used primarily for sanding belts and drums.

Cloth — Cloth backing material is usually cotton, although some rayon, polyester and various combi-

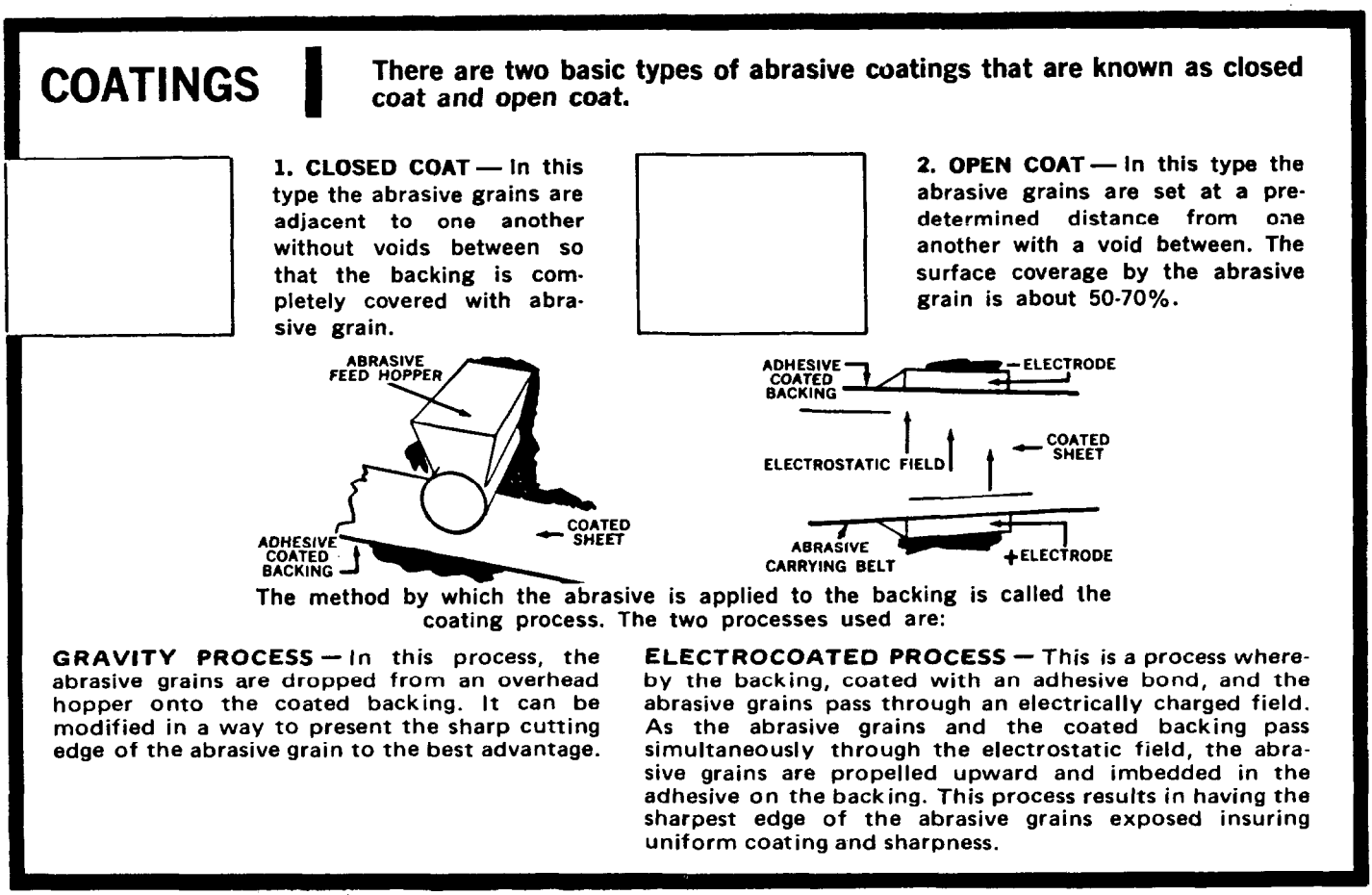


Figure 2: The coating techniques. The gravity process is normally used with larger grit sizes and the electrocoat process is used with smaller grits.

nations are used. It comes in two weights, "J," called "jeans," which is lightweight and fairly flexible, and "X," called "drills," which is heavier and stiffer, making it more suitable for flatwork. In our trade, we don't use much cloth-backed sandpaper (talk about a contradiction in terms...this is getting out of hand!), other than on sanding belts and on emery cloth. For years I had assumed that the backing on "Wetordry" sandpaper was cloth — after all, the stuff is completely waterproof, right? But it's not. It is really a specially treated "A" weight paper.

Fiber and combinations — Fiber backings are made from a very strong, specially treated rag stock paper. The combination backings are usually laminates of paper and cloth. Both of these are used mainly for high-speed disk and drum sanders.

Bonding

The types of adhesives used for both the bond coat and the size coats ("sizing" will be discussed later) will have an effect on the performance of the finished product. The adhesive bond must be strong enough to held the abrasive grain firmly in place without "shelling" (see *Figure 3c*) and yet it needs to be flexible enough to let the sandpaper conform to the surface being sanded. For some applications, it must also be heat and moisture resistant. Both animal hide glues and synthetic resins are used.

Animal hide glue — When animal hide glue is used, the paper is said to have a "glue bond." Animal hide glue is the most common bond coat adhesive found on typical "hardware store" sandpaper. It is almost always used on garnet-covered sandpaper.

Hide glue has several advantages over other adhesives when used as a bond coat.

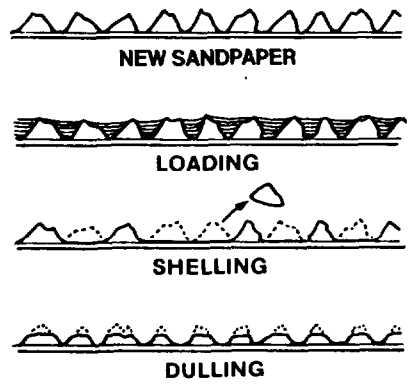
— It is fairly flexible, and yet forms a very strong bond.

— It is relatively inexpensive.

— It has good flowing characteristics. In other words, it does not cover the sharp ends of the abrasive with a thick coating of glue.

Resin adhesives — When synthetic adhesives are used, the product will be called a "resin bond" paper. The adhesives commonly used are phenolic and urea resins.

Figure 3



Resin bonding has some advantages also:

— The bond it makes is very strong.

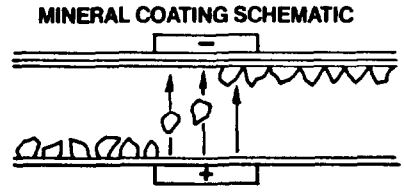
— It usually is waterproof, or at least water resistant.

— It will tolerate higher temperatures than will hide glue.

There are some distinct disadvantages, though. The major disadvantage (when used as a size coat) is that the resin bond tends to cover the sharp cutting edges of the abrasive grains, dulling the cutting action until it has worn away. It also is stiff and brittle, tending to break, rather than flex. Resin bond sandpaper is made more flexible by a process of controlled bending, or "flexing." The particular way that this flexing is done is determined by the type of product being made and by the requirements of its intended use.

Combinations —It also is possible to have a resin bond paper with a glue size, or a glue bond paper with a resin bond size, depending on the particular characteristics that the manufacturer is after. In general, coated abrasives that will be subjected to the hardest use and the highest temperatures will use a resin bond, and those that will not be subjected to moisture and require flexibility will use a glue bond.

Figure 4



Coating

The process used to apply the abrasive grains will affect the performance of the finished product. There are two basic processes used — gravity feed and electrocoating (See *Figure 2* again).

Gravity feed — The gravity feed process (or "drop coating") uses a hopper containing the mineral grains above the moving backing strip. The mineral grains are dropped onto the coated sheet in a fairly precise manner. Although it is possible to control the process somewhat so that the grains are laid out with their sharpest cutting edges outward, this is more easily accomplished using the electrocoating process. In general the gravity feed process is used with larger grits where grain orientation is not critical and electrocoating becomes impractical.

If the grains are not oriented with the sharper cutting edges outward, the most obvious effect will show up in the cutting action. Sandpaper made this way will not cut as well. There is a positive side effect to this, though. The grains will generally have more durability. Where the sandpaper will be used more for polishing (as with emery cloth, which is frequently used for polishing metal, for example) this would be considered an advantage. If you needed to rapidly cut down some soft wood, however, it would be a distinct disadvantage, so for these products, the grains are applied using the electrocoat process.

Electrocoating — Since the grains are actually picked up by one surface, a moving belt, by electrostatic attraction (see *Figure 4*), they naturally tend to stick to the adhesive a little more "on end" than they do when they are dropped onto the backing as they are with the gravity process. The larger, blunt end of the mineral

grain is attracted more strongly to the negative (upper) electrode. Remember picking up small bits of paper with an electrostatically charged comb in your high school physics class? The same concept is in operation here. (See? Static electricity really is good for something other than making your socks stick to your towels or zapping computers.)

Coating density — As the abrasive grains are applied to the backing surface, the amount of the surface covered is carefully controlled. Depending on the amount of surface covered, the finished product is said to have either "open coat" or "closed coat." (See *Figure 5*) The open coat papers have only 50 to 70 percent of the surface covered with abrasive grains, while the closed coat papers will have all, or nearly all, of the surface covered.

The open coat papers are not the result of the manufacturer's attempting to save a little money by not having to use quite as much abrasive. Rather, for certain applications (such as rough machining or finish removal) the open coat papers work much better than do the closed-coat varieties. They do not clog or fill as much. Closed coat papers generally work best for semi-finish and finish sanding.

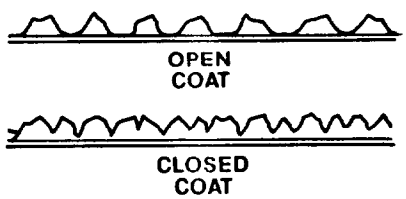
Abrasive Grains

Sandpapers are available with a variety of different types and sizes of abrasive grains. There are currently three primary abrasive materials being used to make sandpaper — at least those sandpapers that are readily available. These three are garnet, silicon carbide and aluminum oxide. (See the last article in this series for a description of these abrasives minerals.)

I suppose I should mention a fourth — flint — as well. I mostly disregard flint because it is no longer a viable product. It lacks durability, it is not cheap enough and it does not have anything else going for it to make up for that lack. It will probably be around for awhile just because it's traditional. That is not a good enough reason for us to waste any of our money on it, though.

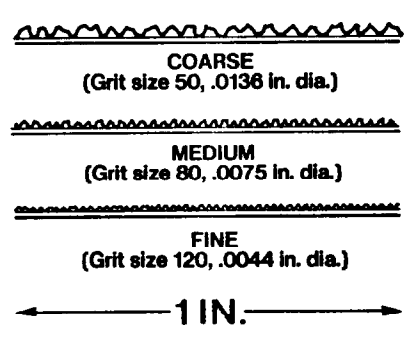
Garnet — Garnet paper is available in open coat and with several different backing weights. The narrow, wedge-shaped grains cause it to cut very well. Since the grains fracture and break away rather than wear, fresh new edges are exposed so that the paper remains useful right up to the end. Garnet paper is primarily used for sanding wood. Because the grain shape is so sharp, garnet paper tends to actually cut the wood fiber rather than just kind of plow through. It's a lot like using a nice sharp chisel as opposed to a dull one. Garnet paper is one of the best for sanding endgrain for this reason.

Figure 5



Aluminum oxide — Aluminum oxide is much harder and its grain shape is somewhat wider than that of garnet. These characteristics make it more durable than garnet. It is one of the best papers to use with power sanders because of this toughness. For these reasons aluminum oxide paper is frequently referred to as "production paper." Because of the more blunt grain shape it doesn't cut quite as well as garnet. It is best suited to production sanding as noted above and for sanding hardwoods where garnet paper tends to break down more quickly and the toughness of aluminum oxide is more of an advantage. Aluminum oxide tends to wear down rather than fracture, so it is not continuously "resharpening" itself. (See *Figure 3d*).

Figure 6



Silicon carbide — Silicon carbide papers are kind of an all-purpose product. The grains are not only extremely hard, but they are the sharpest of all the synthetic abrasives. Silicon carbide papers are made for just about all woodworking applications.

One type of silicon carbide paper that is particularly useful for the refinishers is 3M's "Tri-M-Ite Fre-Cut." This paper has an additional coating of zinc stearate that is quite slippery and helps the sandpaper slide over finished surfaces easier and helps to keep the sandpaper from clogging, or loading (See *Figure 3b*). Norton makes a similar product called "No-Fil Adlox." The Norton paper uses aluminum oxide and is therefore a little tougher, so it works a little better with power sanders. I use 3M's Fre-Cut for two reasons. First, I prefer the sharper cutting characteristics of the silicon carbide material, and second, because that is the brand my industrial supplier carries.

Speaking of suppliers, this is probably as good a place as any to talk about buying sandpaper. Unless you use a very small amount of sandpaper, it will probably be well worth your time to locate a good industrial supplier and buy it in quantity. Sandpaper comes in sleeves which contain either 50 or 100 sheets, depending on the grit and type of paper. The cost savings per sheet over the standard hardware store prices can be dramatic. True, you may have to buy more than you think you will need for awhile, but it doesn't go bad or wear out during storage, and you can probably sell some of it to other technicians if you don't think you'll use it all in a reasonable length of time.

A good industrial supplier can be one of a piano rebuilder's most valuable resources. Aside from saving you money, a good one can be quite a lot of help in many different ways. He can supply you with a wide variety of products and infor-

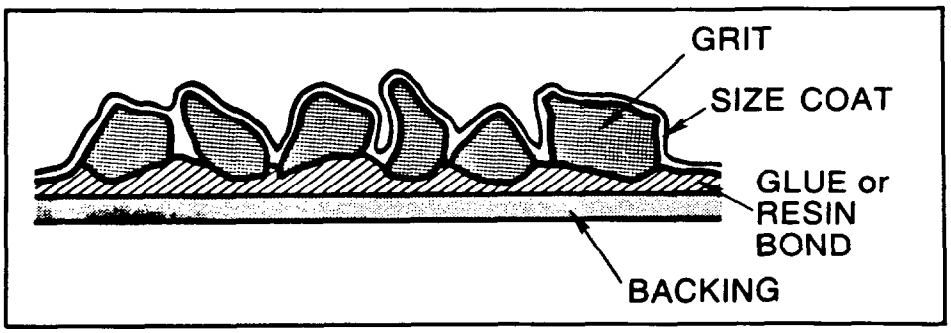


Figure 7: A cross-section of the finished product.

mation, as well as put you in touch with craftsmen of different types who can bail you out of all kinds of tough spots. (Just remember to scratch his back from time to time.)

Grain sizes — In addition to different types of minerals, abrasive papers also use many different sizes of grains (see *Figure 6*). Larger, coarser-grained paper is used for coarse sanding and grinding, while the finer, smaller grains are used for final smoothing and finish sanding.

The coarse grits are graded by passing them through a sieve screen with a certain number of holes, or openings, in it. The grit designation number (such as 50, 80, 120, etc.) refers to the number of openings per inch in the grid that finally stops the particle. A #80 grit particle will have had to pass through a grid with, say, 60 openings per inch, or 3600 openings per square inch, but be stopped by a grid with 80 openings per inch (or 6,400 per square inch).

This system works pretty well for the coarser grades, but not for the finer grit sizes. For these (roughly from 240 grit and finer — those called the flour grains) a system has been devised to grade them by passing them over a column of rising air and measuring how high they rise above the air inlet. The higher they go, the finer the grade.

Ultra-fine grades (600 grit and finer) are separated by a similar process, except that a column of rising water is used instead of air.

Impurities — There will almost always be some impurities mixed in among the desired minerals. Since these impurities will have been graded along with the desired grains, they will be approximately the same size, and since they will almost always be softer than the desired mineral, they really don't amount to anything. It would cost far too much (which we would have to pay for, of course) to remove them all, so they are left alone.

Sizing

After the abrasive grain is firmly glued to the paper or cloth backing and the adhesive is dry, one more coating of adhesive is applied. This is called the "size coat," or the "sizing." This sizing gives the abrasive grains much greater stability and strength than they otherwise would have, which makes the sandpaper more durable (see *Figure 7*). As mentioned before, this size coat can be either a glue size or a resin size.

Final Processing

Except for cutting the continuous strip of the finished "sandpaper" into usable sizes and packaging it, the manufacturing process is now pretty much complete. The finished sandpaper looks like what you see in *Figure 7*: seemingly quite simple, yet in reality, a very complex product.

Coming up later — Traditionally, sandpaper has been supplied in nine- by 11-inch sheets. In the last few years, there has been a tendency to package sandpaper in a wide variety of sizes and types to meet the specific needs of specific industries. In some cases, sandpaper is packaged to fit a particular sanding machine. I'll describe some of these in a later article about power sanders.

I wish to thank Douglas E. Wachs of the 3M Company, who kindly furnished the artwork that is used in this article.

TOOLS OF THE

TRADE

A Question Of Attitude

Richard Hassig, RTT
Tri-City, IL, Chapter

The sightless technician must in one way or another solve the problem of how to transport body and tools from one place to another. If the work is to be in homes and a wide variety of other situations, a good training in traveling is certainly useful if one wishes to maintain a degree of independence. When I went to school this travel training was called "orientation." The gentleman who taught orientation attempted to give us not only techniques but to instill in us an attitude. This attitude was expressed in this sentence: "It would be better to fall over the edge of a 40-foot precipice than to approach the edge dragging your feet." At first glance that sounds stupid, but as I have thought of it since, there is good philosophy there, and a philosophy which has stood me in good stead more than a couple of times.

Good traveling techniques, however, unless you are fortunate enough to live in an area with extremely good public transportation, do not help much in covering considerable distances in a short time. Neither does it serve much to help one find a specific house. I have solved the situation in a combination of ways. I use buses when practical, taxicabs quite a bit and my wife does quite a lot of driving for me. I feel rather fortunate in this, for I genuinely like the company of my wife, and this gives me the chance to be with her more than if I got into my car in the morning and drove myself.

"

It would be better to fall over the edge of a 40-foot precipice than to approach the edge dragging your feet. At first, that sounds stupid, but as I have thought of it since, there is good philosophy there.

"

The instances when I am traveling by myself present some interesting times. The story of being helped across the street which I did not wish to cross is an old one but still amusing. Drunks can present an amusing and sometimes sad diversion. This will give an example of the amusing. I was downtown one day, having disembarked from one city bus, and was waiting for the bus to get me home. There are benches for sitting but I chose not to sit on the bench because it is a hard, cold, concrete bench. I would prefer to stand.

A man asked if I wouldn't like to sit on the bench. I explained that my bus would be along soon and I would rather stand. He persisted, and so did I. His assuredness that I should occupy the bench continued until his voice reached nearly the shouting stage. "Why don't you come over here and sit on the bench!" Finally, he walked off and grumbled, "Well, don't say I never tried to help you!"

Sometimes the experiences are far from funny, however. I have had cab drivers drop me off at the wrong house a few times. Perhapse the worst time was in the winter, one of the really bad winters, I might add. I was dropped off at the wrong house and the driver drove away before I realized my predicament. Now this was a quiet, winding out-of-the-way street, it was icy-cold, there was no one home there, and I had absolutely no idea where I was.

I was able to find another house which was occupied at the time, called the cab and got to my original destination. I guess it is a good thing that the same cab driver had not gone far away or quit, because only he knew where I was.

I believe it was during the same winter that I was asked to come to a house which is set a little ways back from a very busy street. The gentleman suggested that because of the ice and snow on the front steps, I should come to the side entrance. Due to the conditions of the street and the traffic, it was necessary for my wife to park the car some distance from the house and we walked in. We went to the side door, the gentleman admitted me, and my wife went back to the car and back home.

I began preparing the small grand to be tuned, leaning over to insert my tuning strips and making conversation with the man of the house. Suddenly a new voice asked, "Are either of you the owner of this house?" Need I say that I was somewhat surprised?

It developed that a neighbor had seen me go into the house and called the police department. Perhaps my cane was mistaken for a weapon. The new voice belonged to one of five policemen, each of whom had a revolver in hand! I have since spoken with a neighbor of ours who is a member of the police force, and he tells me that this is the standard procedure in such cases.

Fortunately, the owner of the house was present, so there was no particular problem other than the initial, considerable, alarm. However, this might not always be the case. I have, and I am sure many technicians have, gone into a house where there was no one home. I have a regular customer whose piano I have tuned for nearly 20 years. Both of the people are now retired, but I took care of their piano for them for more than five years before we ever met. It has occurred to me that had I been in such a situa-

"It developed that a neighbor had seen me go into the house and called the police department. Perhaps my cane was mistaken for a weapon. The new voice belonged to one of five policemen, each of whom had a revolver in hand!"

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tion alone and heard that unexpected question while intent on my work, I might have jumped in alarm and been shot.

I believe that the blind technician must try to attain and maintain as much independence as possible, both for personal pride and for the impression of others. Many people, though, are willing to help when they are aware of the particular problem and know what is best. When I was to begin servicing the pianos for a private college here, I was concerned about learning the music building with as little trouble to the staff as possible. The people who worked there made for me not only a map which my wife could explain to me, but a word description of the corridors and what rooms lined them. I think that this was probably less trouble than showing me something over several times, and it worked extremely well.

Going into a strange house with no one else present and learning a new building if you will be working there frequently are some of the possible things with which a sightless technician must deal. It is up to each individual whether the approach is to "drag the feet" or be prepared to "drop over the edge." Of course, it is very easy to be brave while sitting at the keyboard of my computer, but personally, I much prefer to look at the situation as a challenge rather than with alarm. So far it has served me well.

Cristofori's Pianos: Case Design And Scaling

Jack Greenfield
Chicago Chapter

Modification Of Harpsichord Case

The typical Italian harpsichord was a long, light box of thin wood with one curved side. It was usually transported in a stout outer box from which it was removed and then placed on a table in order to be played. The instrument and the box were decorated independently. During the 17th century, legs were added to the outer box so that it could be used to hold the instrument for playing. Since this would hide any decorations on the sides of the inner case of the instrument itself, decorations were frequently left off the inner surfaces, which would be oiled or unfinished cypress while the outer case was decorated with elaborate ornamentation.

Later in the 17th century, some builders used a type of case construction Hubbard designates as "false inner-outer," with the outer case actually part of the instrument. It was made thicker, of a type of pine known as "deal" that was softer than cypress. The top of the inner edge was decorated with molding to give the appearance of an inner case.

Cristofori's first known piano was of separate inner-outer case construction. His inventory of 1700 (*Piano Techicians Journal*, July 1985, page 30) described the inner case as "covered with a sheet of cypress inlaid with ebony...with a desk of cypress and an outer case of white poplar, and a covering of red leather lined with green taffeta and edged with gold ribbon." Maffei gave no details of case construction of the pianos he reported in his 1711 article (*Journal*, August 1985, page 26). In Hipkins' 1896 book (*Journal*, February 1986, page 17), Hipkins stated that the 1720 Cristofori piano was set in a simple paneled outer case; however, the 1726 piano was held in a highly decorated outer case "red, with Chinese figures and landscapes in gold...The inner side of the top or cover is light blue." A black and white print of the 1726 piano included with Hipkins' description shows the case supported on three massive downward-tapered square legs completely covered with ornamental carving.

> "... the 1726 piano was held in a highly decorated outer case 'red, with Chinese figures and landscapes in gold... The inner side of the top or cover is light blue.'"

Recent references do not discuss the ornamental outer cases but show the instruments in the plain inner cases. Some pictures show the pianos supported on legs similar to table legs and with a lid. Except for differences in the legs, in photographs taken from similar positions, the 1720 and 1726 pianos are very much alike in external appearance. Pollens gives the case dimensions shown in the accompanying table.

The Leipzig museum contains a harpsichord spinet dated 1726 with Cristofori's signature, and a pedal spinet from about 1725 also attributed to Cristofori, which came from the Kraus Collection, Florence, the source of the 1726 piano. The harpsichord is similar in size and external appearance according to the details in Harding's 1933 book, but the article, "Cristofori, Bartolomeo" in the *1980 Grove Dictionary of Music* considers the harpsichord and pedal spinet of doubtful authenticity. The harpsichord has three sets of strings instead of the two typical of authentic Italian instruments and its case is of false inner-outer construction.

Cristofori 1720 piano after restoration at Metropolitan Museum of Art. The Crosby Brown Collection of Musical Instruments 1889 (89.4.1219).

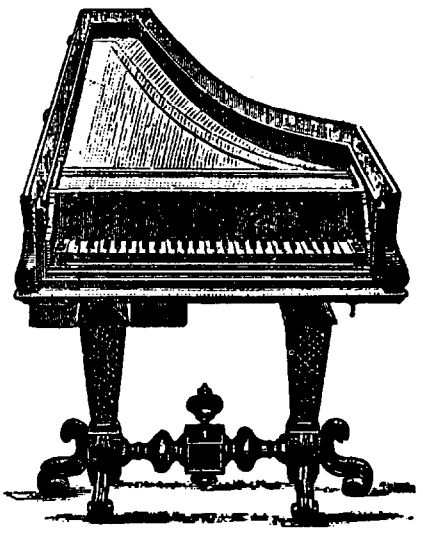
Case Outline Based On Scaling

The outline of the harpsichord case usually was derived from the lengths and lateral spacing of the strings. The first step in planning a new instrument was the determination of the string lengths of the Cs. Italians usually followed a 2:1 octave ratio across most of the range but bass strings were made shorter and thicker to curtail overall length. After the lengths of the Cs were laid out, the curve of the bentside was drawn and the lengths of the other notes were filled in.

Italians began construction by cutting the bottom to shape. Building up from the bottom, the sides were attached around the edge of the bottom with nails and glue. The woods used were usually 1/2-inch deal for the bottom and 3/8 inch cypress for the sides. The sides were reinforced with internal struts and bracing. Blocks were glued to the sides for support of the pinblock and the belly rail and liner strips around the inner case were attached for support of the soundboard.

Support Of Soundboard To Allow Free Vibration

Cristofori did not build the piano cases in the traditional harpsichord manner but designed a method of construction which strengthened the case and allowed the soundboard to vibrate more freely, supported on a separate inner wall. In all three pianos examined by Pollens, the case walls are of double-layer laminated construction — 1/4-inch cypress on the outside, 3/4-inch poplar from the bottom to the hitch pin rail and



Cristofori 1726 piano in ornamental outer case described by Hipkins in 1896

Case Dimensions of Cristofori Pianos

Piano	Length	Width	Height of Case Sides
1720	90.0 in.	37.6 in.	9.3 in.
1722	88.9 in.	32.0 in.	8.4 in.
1726	94.1 in.	31.5 in.	8.0 in.

1/4-inch cypress above on the inside. The soundboards are supported on the bentside by a separate inside wall about 5/32-inch thick held away from the inner case surface by a narrow spacing strip resting on the bottom between the support wall and the case side. The internal braces that run from the left side or spine to the bentside are shaped so that they can pass through openings in the soundboard support wall located where needed to avoid contact. The shelf-like hitchpin rail extends from the case side above the soundboard without touching it. The front of the soundboard rests on the belly rail as usual.

The piano built in 1720 was restored at the Metropolitan Museum in 1938. The original soundboard, ribs, pinblock and bottom were replaced with accurately copied new parts. A section of the original soundboard was identified as cypress by an analysis at the Forest Products Laboratory, Madison, WI. The placement and number of ribs differs in the three pianos and the underside of the 1726 soundboard shows signs of replacement and relocation of some sections of ribbing. However, these variations appear to be of little or no significance. All three pianos have soundholes in the belly rail as described by Maffei. It is Pollens' opinion that Cristofori's design for the case structure was established before 1711 and the only major change in later pianos was in design of the hammer action.

Traditional Harpsichord Scaling

Thin wire for musical instruments became available in Europe after the invention of the drawplate in the 10th century. The wiremaking process consisted of drawing the wire through a series of constantly decreasing diameters. The die plates, of steel, had holes made by piercing with punches. As the dies were used, the holes became slightly enlarged, consequently wire sizes were not very uniform. In continental Europe, most wire was gauged to the same system. In England, wires were sized by different standards.

It was customary to use steel wire for the treble and brass for the bass. The steel wire, much softer and easily bent, had low carbon content and was closer to pure iron than modern music wire. The brass wire had more impurities which gave it greater tensile strength but not enough to allow its use for the higher pitch of the treble notes.

From study of samples of old wire, markings on instruments, documents and other sources, investigators have concluded that the practice in scaling was to stress the music wire to two or three semitones below breaking point. Instrument makers had learned by trial and error that highest tension would give the best tone, but it was necessary to leave a safety margin to allow for changes in the wood part dimensions caused by fluctuations in humidity. With the string length and other wire data obtained, some researchers of the present have estimated pitch levels of which instruments were tuned. In *Keyboard Instruments* (E.M. Ripin, Editor, Dover Publications, New York, 1977, page 7) John Barnes states that evidence indicates Italian harpsichords of the 18th century were tuned to about present-day pitch.

Scaling Of Cristofori Pianos

In Maffei's description of Cristofori's pianos, he stated, "The strings are thicker than usual" (*Journal*, September 1985, page 24). Cristofori's reinforced case structure, thought to be needed for the higher tension of thicker strings, appears to be confirmation of an increase in string diameter. However, while many piano strings in the Cristofori pianos are larger than in comparable Italian harpsichords, the difference is quite small and some of the lower piano strings are even thinner. The accompanying table shows the present wire sizes in the Cristofori pianos and also includes Hubbard's figures for typical Italian harpsichords and the Klepac figures for a modern piano (*The Piano — Its Acoustics* by McFerrin, page 29). If the Cristofori piano strings were appreciably larger as indicated by Maffei's statement and the strengthened case, evidently at some time in the past, the pianos were restrung with the thinner size strings now in the instruments. Pollens mentions a report on the possibility that Ponsicchi may have changed string sizes when he restored the 1720 piano in 1875. The modern piano strings in the table generally have about three times the diameter of the corresponding strings now in the Cristofori pianos and in Italian harpsichords.

The second table compares present string lengths in the Cristofori piano with theoretical "just" scaling usually closely followed in Italian harpsichords. The figures show octave ratios close to 2:1 and fourth ratios 4:3 except for the shortening of the strings in the low bass. Also included is an example of string lengths in modern (Klepac) piano scaling. Modern octave treble scaling ratios are usually around 17:9. Most of the Cristofori strings are about 80-90 percent of the length of the modern strings for the same note.

Using the relationship "string tension is proportional to (diameter)^2," string tension of the Cristofori piano strings can be easily estimated if figures for the modern tension and ratio of both string diameters are known. All other factors being equal, taking the figures 165 points for the modern average tension and 3:1 as the average ratio of string diameters gives 165/9 = 18.3 pounds for the thinner

Comparison of Music String Diameters (Inches)

Octave	Italian Harpsichords 1666[2]	Italian Harpsichords 1694[3]	Cristofori Pianos 1720	Cristofori Pianos 1722	Cristofori Pianos 1726	Modern Piano
C5-C6	.008-.009	.010	.010	.012	.011	.036-.038
C4-B4	.009-.010	.010-.012	.013	.012-.014	.013	.038-.041
C3-B3	.010-.014	.016	.018	.014	.013-.016	.041-.044
C2-B2	.014*B* .016*B* .022*B*	.018 .020*B*	.020*B*	.020*B* .022*B*	.016-.017 .018*B* .020*B*	.045-.047

Notes: [1] Brass strings indicated by letter *B*.
[2] Wire sizes in 1666 harpsichord used by Hubbard for restoration of instrument.
[3] Wire sizes in 1694 harpsichord Hubbard obtained by measurement of old strings in instrument.

strings. However, since a factor must be applied for their .8-.9 shorter length, the figure for Cristofori string tension is reduced. Since tension is proportional to (length)^2 also, the length reduction factor is .64 - .81, giving roughly 12-15 pounds as the estimated Cristofori individual string tension. Each Cristofori piano has a total of 54 or 49 double strung notes.

Comparison Of Inharmonicity

Using the relationship derived from the Young formula for inharmonicity (*The Piano — Its Acoustics* by McFerrin, page 29), if the only variables are string diameters (d) and lengths (L), inharmonicity = (d^2/L^4) x (a constant). Comparing Cristofori's with modern piano strings, the reduction of inharmonicity resulting from reduced diameters is canceled out to some extent by the reduction in lengths. The bridge soundboard and other conditions which contribute to harpsichord inharmonicity mentioned by Benade (*Fundamentals of Musical Acoustics*, page 357) probably also act to bring the aggregate inharmonicity in the Cristofori pianos up into the range found in modern pianos.

Comparison Of Cristofori Piano Scaling With Theoretical Italian 'Just' Harpsichord Scaling And Modern Scaling

String Lengths in Inches

Key	'Just' Harpsichord	Cristofori Pianos 1720	Cristofori Pianos 1722	Cristofori Pianos 1726	Modern Piano
F6	4.1	4.8	-	-	5.5
C6	5.5	5.9	5.6	5.6	7.2
F5	8.3	8.4	8.4	8.4	10.4
C5	11.0	11.3	11.1	11.0	13.5
F4	16.5	16.9	16.6	16.6	19.5
C4	22.0	22.3	22.3	22.4	25.3
F3	33.0	33.0	33.6	33.1	36.5
C3	44.0	43.3	44.2	44.3	48.7
F2	66.0	74.0	62.4	63.3	66.9

The Auxiliary Exchange

From The President

First let me take this opportunity to say "thank you" to everyone for the many lovely cards, prayers and kindly thoughts during my recent crisis with meningitis. My prognosis is excellent and I am getting stronger every day.

I'm looking forward to seeing everyone in Las Vegas in July and hope my excitement for the convention is contagious. Caesars Palace is an extremely large and lovely hotel and our program will be made all the more exciting because of its gracious appointments.

Just think, 1,720 elegant guest rooms, beautiful twin swimming pools, four gourmet restaurants, unparalleled entertainment with Cleopatra's Barge, the spectacular Circus Maximus Showroom and the unique Omnimax, the theater of the future.

See you in Las Vegas!

Louise Strong
President

Greetings From Los Angeles

First of all, this was my first visit to Kansas City, dubbed "Hallmark Town." Personally, I feel the Auxiliary Convention was very well planned for our pleasure and enjoyment. I was unable to attend all of the activities, but I heard glowing reports about the cooking class and the jazzercise session.

The president's tea was one to be remembered. We all liked the voice of the "opera singer" whom Louise had engaged to entertain us and enjoyed Louise's able accompaniment!

The installation luncheon was enjoyed by all this year. **Ginny Russell's** brilliant performance with her accompanist . . . so original, so inspiring.

Maybe this item might be of interest to some. At the banquet I was placed next to a well-known gentleman, a **Mr. Mc . . .** Now, at last, I had the opportunity to ask a qualified **Mc** or **Mac** what I have always wanted to know about "Micks" and "Macks" but didn't dare to ask! — the reason for the differences and the meaning of "Mc" and "Mac." Of course, I had long surmised that "Mc" and "Mac" meant "the son of . . ." Mr. Mc . . . in question told about this with gusto, going into interesting historical detail and explaining about regions and clans. His bits of history and his illuminating remarks were appreciated. It seems the numbers of "Mcs" and "Macs" are boundless and staggering.

I think now of our president who has come through three illnesses since our July convention. I am (we are) very thankful! I have been told that she is doing fine and expects to see us in Las Vegas. Thank God! Meditating now on the various scenes at the convention, please allow each one to be a "Hallmark Card" preserved for memory's lane and posterity.

Look! Here is a past president, **Dessie Cheatham,** attending again after years of illness, following a tragic accident. How we welcomed her! How lovely and colorful this Hallmark card...framed for Auxiliary history.

Here is **Ruth Pollard** . . . receiving her placard for distinguished service. What delineation! What memories it brings. See Ruth's smiling face. She was our very first Auxiliary president. What a card of Hallmark quality to be preserved in the Auxiliary Hall of Fame! To be shared again and again!

From time to time, we will take out these precious "memory cards" to share with others, recollecting with joy and pleasure our delightful convention in Kansas City, Hallmark Town, in 1985.

How well our president had planned! Blessings on her!

Norma Lamb

Meet Your Officers

There have been several inquiries as to the reason no article has appeared introducing the Vice President, elected July 1985. Since the Vice President and Editor are one and the same, the following will from necessity be an autobiography, rather than a biography. This is difficult to do.

Ginger Bryant — Vice President

I graduated from the Heald's School of Business and began employment on the staff of California Republican Headquarters. It was fascinating, fun and frantic! However, after three years and reviewing my budget, I found I could no longer afford the luxury of a "fun" job and I accepted a position with a large insurance firm.

Then came that almost-fatal day in July of 1973 when an unhappy claimant entered the office and shot four employees. I was the only one who survived. I'm certain God didn't know what to do with me and the Devil didn't want me, so I was left here to slow down, smell the flowers, meet new and dear friends, know the joy of nine grandchildren and savor the wonderment of life.

My hobbies are skating, dancing and bicycling, but to preserve my dignity and a broken leg as a result of any of the above, I now pursue what were my secondary hobbies, reading, sewing and cake decorating!

I have been a member of PTGA for nine years, serving as parliamentarian, historian, chairman of the Bylaw Committee and now have the honor to serve as your vice president.

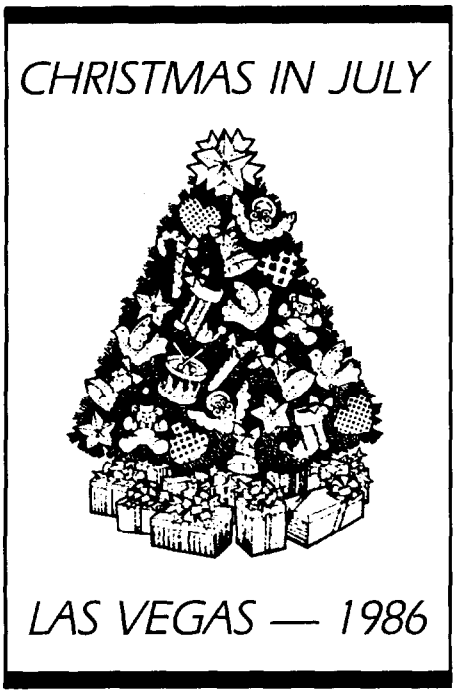
Combined Computer Class Scheduled For Las Vegas

As one who has successfully resisted the computer revolution, your editor is woefully unqualified to preview what promises to be both an exciting and valuable class at this year's convention. I asked my eldest daughter, who returned to college two years ago after a 15-year hiatus, for some input on the subject since her brother now refers to her as being on a "techno-high." She submitted the following:

Computer Mania

Little did I realize that the mumbled promise made last Christmas Eve would transform a semi-sane, mild-mannered mom into a computer maniac. When on opening a new Commodore 64, my eight-year-old daughter squealed, "Mommy, will you take a class at school next semester so we can learn how to use this thing?"

I should have been suspicious! When I saw my mother raise an eyebrow upon hearing my "sure, honey," I should have known! As I reviewed the spring schedule there was still time to turn back. Even after registering, I thought, "I still have time." But after only two weeks into computer science V, I now realize it was inevitable. This new and exciting journey into "hardware," "software," PCU's, microchips and MIPS was preordained.



Christmas In July

From the weather reports, now is the time to light the fireplace, get out all of the "goodies" you purchased in December and relive Christmas...in July. Reports are still coming in from all over the country of ideas, suggestions and details of completed articles that will adorn the tree and be on display for sale. There was a question from Texas, "How will the items be priced?" I would like to answer that in the form of a request. It would be most helpful if each of you priced your own items. A small sticker on the back will save the committee many hours of work. Only you know the cost of materials and time that went into each item, not to mention the dedication and love.

At this point it is necessary — no, obligatory — to stress I am several steps below novice. At best I am a beginning beginner. I can't even decipher computer jargon, let alone the instrument itself. But I do not remember when I have sought new information on anything with such fervor.

By no means are we on the ground floor of computer science, or even in the first generation. That was in the late 40s and early 50s when the Univac was introduced. Speed was expressed in milliseconds (1/1,000ths). In the early 60s we entered the second generation with the IBM 1620 and the microsecond (1/1,000,000). In 1964, the third generation arrived, along with the integrated circuit. Twenty transistors could be placed in about 1/2 inch square. Within only 10 years, 10,000 transistors could be placed on a small dot (.). By 1983, 600,000 on a similar microdot and today, one million. The nanosecond, one billionth of a second, and the pico, one trillionth of a second, became commonly used measurements of the speeds at which today's computers can operate, with a capacity to accept millions of instructions per second (MIPS).

Certainly we can all relate to the concept of a second, tenth of a second or even the hundredth of a second by which skiers are timed. But a trillionth? Why not a zillionth or the quadzillion we used as children to create the unimaginable number. My mind spins, not only from trying to grasp this idea, but from the realization of how swiftly we are escalating.

Keith Carver, in his text, "Computer and Data Processing," put it in perspective when he wrote, "The rate of change in computer technology is so fast that it dwarfs one's imagination. Consider this point: if the same proportional increase in speed and decrease in price had taken place in the transportation industry over the same period (1950-1980), a coast-to-coast flight would cost about two cents and take less than one second."

Amazing? Exciting? Awesome? Or all of the above. Of one thing we can be certain — it is here and here to stay. There are few people who are not affected by computers in their everyday lives. They handle our money, tune our cars, process our groceries through the checkout counter, tell us to fasten our seat belts and play games with us. Voice-activated appliances are now available in our local stores.

What was once to many a looming monster, computers are now an omnipresent evidence of mankind's potential. Far from being a wave of the future, they are already claiming a past and are solidly planted in the present with a certain, ever-advancing future.

Judy Beck

Getting The Organizational Spirit!

M.B. Hawkins
Vice President

For this month, perhaps we should rename the article "Got The Organizational Spirit." While reviewing newsletters from various chapters around the country, the following interview from the Detroit-Windsor Chapter newsletter stood out so vividly I thought it should be shared more widely. So without further ado, let's proceed with this interview and how it was developed.

DWN Interviews Dean Thomas

Although Dean Thomas (Guild Central East Regional Vice President) lives in the Keystone State, part of his heart is here in Michigan. You see, Dean was born in the Port Huron area and every so often (about PTG picnic time) he yearns for the homestead and comes back to visit.

Dean and his father assembled a harpsichord after he got out of the service, and thus began his career in keyboard maintenance. He "evolved" into piano work after his wife Helena's junior recital at college, where he prepared the harpsichord. The technician who worked at the school encouraged Dean to pursue piano technology.

He joined the PTG in 1976, became active in the chapter, became the chapter VP and then delegate to the national convention. He is now serving his second term as Central East Regional Vice President.

Dean is one of those "I-call-'em-like-I-see-'em" type of guys. He is truthful, honest and sincere, almost to a fault. But, you know when you speak with him you are getting the straight talk. He has been an active RVP, attending as many different chapter meetings and seminars in the region as possible.

The Thomas family frolicked with the Detroit-Windsor Chapter at our annual picnic back when it was in the middle seventies (and those are degrees). Dean and family spent some time with the Doerflers the day before the picnic and on Sunday, the day of the picnic, Dean and Anne Doerfler rode together from Toledo, OH, to Troy, MI, taping what turned out to be this interview. (Ed. note: We think it's a dandy.)

DWN: As RVP, you've probably seen a whole new side of the Guild.

DEAN: Yes, a frustrating side. The ability to stand in one place and watch the world go by and not be able to do much about it. The neatest thing about being RVP is, "Congratulations, you've been elected RVP. Can you please explain this bylaw to me?" It's a question of being able to know things instantly, which I didn't, and having to learn things very quickly.

DWN: Does the Guild have some sort of handbook for their officers?

DEAN: It's being written right now. It's being compiled by Charlie Huether and Barbara Parks, our executive director. There's going to be, we hope, a rather extensive portion on the history of the organization up to the present.

DWN: So at least the officers are well informed.

DEAN: Yes, and so we can, hopefully, spread a little of the history as well as the good news of PTG.

DWN: How do you approach the piano technician with several degrees behind his name, who doesn't feel he needs the Guild?

DEAN: The primary thing is to try and get people like that to a meeting or a function where they can see the fellowship, where they can find out that maybe they don't know what they think they know.

DWN: What if that person is one of ill-repute.

DEAN: Those are difficult situations. People with poor business reputations are especially hard to deal with. We're fighting a battle right now with one of the chapters that had a prospective member whose advertising is one of the worst cases of dark gray areas that I've ever seen. The name of his store implies the people who work there are exceptionally gifted craftsmen and that they have come together to form a cooperative and if you want a piano that's been well prepared by the finest technical people available, you come to this store and you get it. But he goes around and advertises the wholesale prices of competitors' pianos and that he'll sell you a piano of equal or better quality for 10 percent over his cost, which will be 40 percent below the other guy. So it's a difficult situation.

He has been pressured rather strongly. He needs to join the Guild, go through the testing procedures and find out how inadequate he really is, plus the fact that he really is not qualified to be saying all these wonderful things about himself.

DWN: That can be sticky wicket, because what you indeed are saying is, "Say, we want you to come join our Guild. But, in order to join us, you must take a test and what we really want you to find out is that you can't join because you can't pass the mark."

DEAN: Kind of. The idea of going in and doing something like that is very much akin to taking a shower on public television. It's very difficult to lower yourself to be examined by the people who are your peers. Especially in a situation where there are two or three people examining a third or fourth person from the same town. These are his economic peers, as well as his competition. No matter how you disguise it, the feelings of anxiety are still there.

When I joined the organization, a man came to me very quietly and said, "Now understand, you are going to undergo something that is called an examination, a test. But what you need to know and understand is that this is an evaluation of how you measure up to a standard; how good you really are versus how good you really need to be. You may pass at exceptional levels and be every bit as good as you think you are and every bit as good as you need to be. But you may not. What this evaluation will do is show you the weak areas and we will help you to overcome those if you are willing."

DWN: "If you are willing..." That's a very important point. That's the part that would save the integrity of the Guild's trying to evangelize, as it were, the non-Guild members if they say to them, "If you do not pass the test, or if your evaluation shows you need to brush-up in some areas, we can help."

DEAN: Part of the point of membership is that we don't want to encourage membership for the sake of numbers.

DWN: That's what's frightening about going after an unethical business person or the slipshod technician.

DEAN: Part of it is not going after them and saying "We want you to join the Guild." What we need to say is, "You need to join the Guild. You need to find out what the current technology is. The only means of finding that out, on a regular basis, is being a member of an organization that encourages that technology, displays that technology and incorporates it. We are the only organization in the country doing that for piano technicians and providing legitimate educational experiences on a regular basis.

DWN: To say nothing of the fellowship, where you gain

immeasurable amounts of insight by just the conversations you have with your peers.

DEAN: You may get a technical session during a meeting, but you may get the information you need over coffee after the meeting is over.

The word you used earlier is good — evangelism. The main reason it is such a good word is because evangel means good news. And, insofar as piano technology is concerned, we have it.

DWN: That seems to be one of the great features of the Guild. In the past, there were a lot of the "old guard" techs who were not too eager to share their knowledge. They were more reserved and had the attitude of, "This is the way to do it and don't talk about any other approach in this classroom."

DEAN: A lot of that deals with professional jealousy and it deals with communication. I found that the man who preceeded me in my town was a very wonderful technician. However, he was a lousy communicator. He did not tell his customers, "You need to tune your piano twice a year." Or, "These hammers need reshaping." He was a very shy man. He was content to walk in, tune the piano, collect his check and go on to the next job.

DWN: It appears he was not providing much of a service to his customers.

DEAN: That's right. He had self-centered motives. "I'm getting what I need to get by and I'm giving enough service so they are getting their money's worth." Today's technicians are learning that tuning isn't enough. We're learning that we need to be able to do the full service at least on a competent level. We need to be able to make a piano regulatable and then be able to make it do the things it is capable of doing. That's why these new exams are so good. It's real technical work, but we are still measuring for entry level. We are not asking people to regulate a piano like Fred Drasche or Virgil Smith. We're not asking them to come in and do a Cliff Geers rebuilding job. We're asking them to show us, in measurable increments, how they regulate an action.

DWN: So you are definitely not one who says, "Let's get out there and increase our numbers."

DEAN: Absolutely not! We should increase the quality of our existing people and encourage members to come because we are quality people and can share quality information. There are nonmembers out there who have been doing their thing for many, many years and think they're the best in the city, and they may well be, but don't want to come to learn, teach and share with us. We're sorry they feel that way, but it is their choice and privilege, God bless them and keep them...and we'll go on about our business. But, we also find those who say, "Oh, yeah, I'd really like to be involved with something like that." These are people who will help the Guild to grow and prosper.

Many, many thanks to the staff of the Detroit-Windsor Newsletter for allowing our readership to share this interview.

Monthly Membership Report

REGION 1

Boston — 021
Collier, John R.
71 Goss Ave.
Melrose, MA 02176
(student)

Newfoundland — 040
Williams, Walter D.
PO Box 379
Mt. Pearl, NF, Can. A1N 2C4
(Allied Tradesman)

L.I. Cristofori — 118
Linton, Robert W.
164 23rd St.
Brooklyn, NY 11232
(Student)

Philadelphia, PA — 191
Stambach, Floria E.
27 South Kershaw St.
York, PA 17402
(Student)

REGION 2

Charlotte, NC — 282
Barefoot, Paul J.
3035 Dunlavin Way
Charlotte, NC 28205
(Student)

Joyner, Joseph D.
6691 Ridge Rd.
Tobaccoville, NC 27050
(Student)

Starbuck, Karl M.
2128 Greenway Ave.
Charlotte, NC 28204
(Student)

Atlanta, GA — 301
Zeches, Clarence E.
141 Harris St.
Tocca, GA 30577
(Student)

South Florida — 331
Warfel, Thomas R.
3930 S.W. 60 Ave.
Miami, FL 33155
(Allied Tradesman)

REGION 3

N.C. Louisiana — 713
Hill, James M.
1008 N. Texas St.
DeRidder, LA 70634
(Apprentice)

Reed, Leslie S.
15 Pecanway Drive
Natchez, MS 39120
(Apprentice)

Zenter, John C.
9023 Watchwood Drive
Haughton, LA 71037
(Apprentice)

Houston, TX — 771
McPherson, Charles W.
2322 W. Shannon
Deer Park, TX 77536
(Student)

Walker, Sandra K.
7235 Log Hollow
Houston, TX 77040
(Student)

REGION 4

Cleveland, OH — 441
Paluck, Gerald M.
8958 Petter Ridge Dr.
Brooklyn, OH 44144-1228
(Student)

Dayton, OH — 454
Barbe, Allan M.
3700 Maxton Rd.
Dayton, OH 45414
(Associate)

McPherson, Archie L.
408 E. 2nd St.
Xenia, OH 45385
(Student)

N. Michigan — 496
Minor, Theodore E.
9643 Londolyn Bluff
Traverse City, MI 49684
(Student)

Tri-City, IL — 612
Foster, James E.
53 Southpark Mall
Moline, IL 61265
(Associate)

Central IL — 625
Campbell, Michael L.
Rural Route One
Riverton, IL 62561
(Student)

Denzer, Dwight Davie
RR 2, Box 66
Dawson, IL 62520
(Student)

REGION 6

Monterey Bay, CA — 950
Weinstein, Fredricka J.
1630 Merrill St., Apt. 305
Santa Cruz, CA 95062
(Student)

Utah Valley — 846
Honey, Leon V.
767E. 400 So.
Orem, UT 84058
(Apprentice)

Reclassifications

REGION 1

Connecticut — 064
Ellinthorpe, John F.
376 Shore Rd.
Old Lyme, CT 06371
(Student to RTT)

Lynn, Paul D.
Bradford Corner Rd.
Woodstock Valley, CT 06282
(Apprentice to RTT)

REGION 4

Milwaukee, WI — 532
Fulleylove-Karuse, Wayne
W. 2643 St. Charles Rd.
Chilton, WI 53014
(Apprentice to RTT)

Young, Tim J.
1572 S. 60th St.
West Allis, WI 53214
(Student to RTT)

REGION 5

Boulder, CO — 803
Westermeyer, Daniel J.
850 W. Baseline
Lafayette, CO 80026
(Apprentice to Associate)

REGION 6

Central Washington — 993
Troncoso, Jose A.
907 G Ave.
La Grande, OR 97850
(Student to Apprentice)

Coming Events

Date	Event	Site	Contact
April 4-6 1986	Pennsylvania State Convention	Harrisburg, PA	James N. Hess 511 Miller Ave. Mechanicsburg, PA 17055 (717) 790-9670
April 18-20, 1986	New England Regional Seminar	The Lowell Hilton, Lowell, MA	Nancy Walker Parry 125 Hartford Street W. Natick, MA 01760 (617) 653-2747
April 19, 1986	Los Angeles Seminar	Los Angeles, CA	Claudia Ellison 3137 Voltaire Dr. Topanga, CA 90290 (818) 348-4735
May 10, 1986	Northern California Seminar	Davis, CA	Yvonne Ashmore 12700 LaBarr Meadows Grass Valley, CA 95949 (916) 273-8800
May 16-June 6, 1986	Study Tour of Europe	East & West Germany, Austria Czeckoslovakia	Dan Evans 4100 Beck Ave. Studio City, CA 91604 (818) 762-7544
July 21-25 1986	Piano Techicians Guild Annual Convention and Institute	Caesars Palace Las Vegas, NV	Home Office 9140 Ward Parkway Kansas City, MO 64114 (816)444-3500
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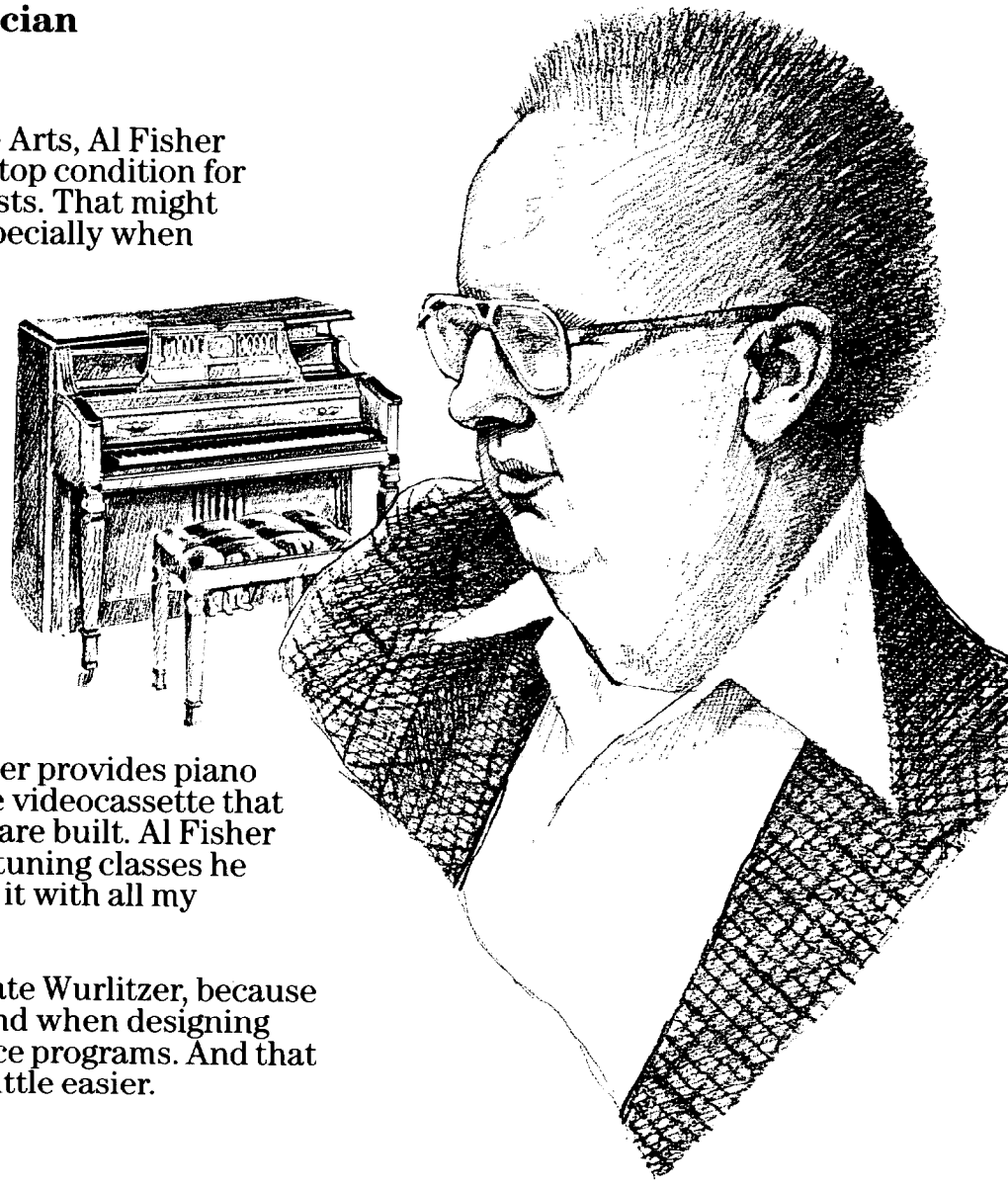

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