Action Touch Design

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The overall performance character of the piano, sometimes called "spielart," is a complex big thing we do with our hands to make pleasant sounds for our ears. There are certain things that we work on frequently, in contrast to the settings that are fairly well constant in a piano. We must translate what certain piano builders, like Steinway, want in their pianos to what other brands require. Some of the built-in components that we don't normally change are things like whippens, the shanks, the keys and their angles, and more. In terms of the overall picture, the big things that we service in the field and the shop to affect the player's experience are tuning, regulation, voicing, friction, mass, leverage, and arc geometry . This is pretty much the order that we are likely to follow. Tuning is first.

Tuning

Of all these activities, if you can't get a good solid tuning on the piano, nothing else matters. Tuning is the foundation that gets people to ask us about doing other work.

Regulation

Regulation has been written about in many formats. Steinways has a large window of flexibility on each step. After working with the world premier artists over the last 160 years, they encourage a piano into the middle of the window and stop and let the piano be the way it is. People and tastes are all different, so Steinway stays quite flexible and variable in their adjustment settings.

Some windows are very small, like let-off. Close let-off is about 1/16" for on stage if the weather doesn't change, and 1/8th of an inch is about as much as it should be. More than 220 thousands will create complaints. Doug regulates by after-touch and then sets the dip afterward. If the manufacturing is consistent you will get both dip and after-touch. If the manufacturing is inconsistent, sometimes after setting a perfectly even after-touch the dip might be inconsistent. Given the choice between the two, lean towards a perfect after-touch. All would agree that a well-regulated piano is more fun to play than a piano that is out of regulation. For most people, well-regulated pianos make people happy enough.

Voicing

Where do we start working on tone in contrast to working on touch? One client thought the touch was too easy to play, but a little loud. Simply by needling the hammers the piano was quieter and the client thought the touch was better because it could tolerate the level of playing and still sound softer. Figure out why the customer wants the piano a certain way. Steinway pianos are designed to try to please a wide variety of tastes. Don't limit the piano to what you like unless it's your piano.

Friction

There are a lot of points where one thing rubs on another in a piano. Some technicians believe that there are points where there is too little friction in the piano. Steinway believes that it is hard to get the friction too low. Doug is constantly trying to reduce friction. Wobbling centers can be a problem. Pinning the centers firm might jam if the weather changes. If the pin is too free there will be no problem. Key bushings are one of the biggest issues.

While the traditional way is to lubricate or polish the pin, replacing pins sometimes is the best option. Push the keys sideways and watch them slide. Where the knuckle slides on the jack the friction can be felt and sometimes heard. The capstans are also a noticeable friction point.

Verdigree in Steinway bushings occurred from what they dipped the flanges in. To fix green bushings it is best to replace parts: it is cheaper to replace than to re-bush a set of parts. Since the stuff is in the wood, the problem will probably still come back. The Asian pianos have a glue problem. They work great for a long time, and then all of a sudden the hammers won't swing. Renner used graphite. Lubricants will keep the piano serviceable for a long time.

In a frictionless system, down-weight and up-weight would be the same. The reason we have 50 grams down and 25 up is that there is friction in the system. Add and divide by 2 for the balance, subtract and divide by two for the friction. Ideally we want 12-15 grams of friction. If the bushings are tight there will be a huge amount of friction. In practice, 5 swings is getting to be too much, especially if the weather changes. To measure side-play, turn the action with the hammers toward you, lift a hammer up and place a finger on each side of the hammer and give it a wobble. All Steinway pianos will have a very slight sideways wobble. To test for tightness, lift them all and watch them fall. If the last hammer that falls is about five swings, you're there.

ProFelt from Pianotek will straighten out and lubricate key bushing felts. If hammer bushings are wobbly you can feel and hear the looseness. If the wobble is consistent, a good pianist can control the use of it by hitting it softly for a pure note or hard for a growl sound.

Mass

There is a lot of talk about mass in how pianos work. In the 60's and 70's there were a lot of problems with friction and mass in the Steinway pianos. Doug saw an 1870 piano that had the parts replaced with new parts. The problem was that the hammers back then were quite small, and to provide power in the hammers they created tremendous leverage. The balance rail was moved up in the 70s to lower the ratio. In the early 80's they changed the knuckle placement and made the action ratio lower.

There are three kinds of mass that influence the piano's playing ability:

- Mass of the *hammer*
- Mass of the *key*
- *Balance*. A big hammer with lots of lead will be balanced. This piano is balanced right but it will take a lot of strength to play it.

David Steinway has spent a lot of time studying mass and what works well. They made four 9' Steinways with different key sets (different locations of lead in the keys), and then covered the pianos so no one could see which was which. The results of this expensive project produced a lot of lack of clarity whether one was better than the other. Artists tended to lean toward the half-round balance points. When they took the rocker capstans out, the stack was higher. They put a nice wooden riser on the top of the key with a capstan on it (the woodwork was gorgeous.)

The action ratio affects the weight. Adding one gram to the hammer adds seven grams to the key. A ratio of 5.4 makes the piano touch easy and deep, a ratio of 6 makes the touch athletic with a shallow powerful action. Modern hammers are 7 – when you get used to how much work it is to play it, you will find that it plays amazingly well, even though the dip is shallow. There is a line between the center of rotation between the whippen and the capstan. Doug changed a piano down to 5.6 which made the piano almost a little too easy to play, but the owner loved it; he had to remove wood from the capstan rocker.

Even with more lead in the key, it is easier to accelerate. The downside is when the player wants to play so softly no one can hear; however, when on stage it feels good to have the action resist more when the adrenaline is going. Accelerated leading with the leads towards the balance rail makes the piano feel faster, whereas the standard balance with the leads more toward the front makes it feel fuller. It makes the difference between feel and loud playing bigger because there is more inertia in standard leading.

The stiffness of the key is in the outer edges, so drilling holes in the key does not make much difference. Powerful players can break keys. The only way we have of changing the flexibility of a key is to change all the keys – buy a new set of keys.

Leverage

The mass of the hammer directly relates to the leverage of the hammer. The combination of the hammer mass and the lead in the action changes the leverage, which in turn profoundly affects the tone. There is now an adjustable component that can be added to any piano so that the touch can be changed back and forth according to the player's favorite touch. Different pianos have different measurements. The leverage might be high because the stack got pushed out, or because the lead positions vary. The range ideally should be around 5.5 to 6.

Arc Geometry

The whippen cushion is not flat. What should happen in the factory is to locate the stack according to the strike point. Then they transfer the correct hammer position through the center of the whippen cushion down through the key to determine the capstan location. The cushion must be in the right place so there is not wiping. If new shanks are put on old whippens, the new shanks will have knuckles that are farther from the center. Now the jack has to lean away from the player, so the force transfer is trying to push the center pin out. This is wasted energy. When you first start the touch doesn't quite feel right because the jack is not quite perpendicular to the hammer shank. If the hammer elevations are off and the capstan is too short or tall it won't feel right and efficiency is lost.

Moving capstans is not difficult but requires a lot of precision. Doug now offers design services for precision touch. The half-round balance rail bearing can be changed. If you cut the cloth off the bearing, the key will move forward. The leverage can be changed noticeably by cutting this felt. On regular balance rails snip a round punching and glue it on the rail in front of the balance rail pin to move the fulcrum farther away and to lower the action ratio. The leverage can also be adjusted at the capstan or at the knuckle. Very small changes in the knuckle placement make very large changes in the action.

If the ratio is too low, the action might not be able to be regulated. Putting in new parts enables the ratio to be changed. Use the parts as they are if the overall leverage doesn't have to be changed. File new hammers because the trend is that new hammers are a little heavier. To determine whether to use new or old parts, look at the number of leads in the keys and the hammers. If the key is already full of lead, that's a problem. If there is not enough lead it is easy to put in more.

If you raise the stack, if you move the capstan too far, or if you move the knuckles, you will change the arc geometry. Work with how the piano is before changing things. If you have the time you can change the feel, voicing and tuning of a piano to come close to nearly any sound.

Steinway had put different pianos on stage in London to let the performers select one. There was such contrast between each of the three pianos, yet within a few minutes this pianist could make all three to sound exactly the same. Dance performers have the same dance partner wherever they go because they have worked out a symbiotic rapport. Piano players have a different partner on each new stage where they perform, and they need to make each piano work the same to get what they want. Our goal is to make the piano as close to the desires of the pianist as we can.