Carbon-Fiber Hammer Shanks and Flanges

Ed McMorrow
6/17/2013

Carbon Fiber

Wessell Nickel Gross shanks are made of carbon-reinforced nylon.
They won't tell us what their hard bushing is. The bushings are pinned very freely.
The stiffness of the shank is exquisite. The shanks are thinner than a standard hole, so they require a special drill bit.
The knuckles are ecsain, which has been proven to work better than buckskin.
The precision of the parts is pretty high so they do not require the adjustments that wood parts do.
The bushing in the fork flange has a little side play, so Ed pushes the bushing in with a poking tool to eliminate this side-play.
The center pins are needle bearings. We are supposed to use their special reamers; their process is very slow. Ed found a way to size them without taking them apart. Ed pushed a bushing in and the flange was too tight. He heated it with a heat gun and it loosened. He thinks that by heating it a little bit it allows the fork to adjust to the changes. Now he has a snug flange with zero side-play.
Nylon-reinforced plastic is heavier than wood, so there will be more mass and less friction.

Traveling

Lick-stick tape will not stay. Ed found that aluminum duct tape works well because it is non-hydroscopic: it does not compress and does not react with humidity.
Three pieces of travel paper will creep, so find the right size and the right placement with a single piece.

Cutting

Cutting the shanks is not easy. Ed uses a small circular cutter on a pneumatic drill.
Ed made a 4' shank clamp to hold all his shanks together at once. It is made with two lengths of 1" square aluminum tubing bolted together with about six bolts with wing nuts. The two sides of tubing that contact the shanks each have a thick strip of red felt glued to it. This clamp holds the shanks still for cutting off the excess shanks. The advantage of this smaller shank is that you can reduce the amount of time in the treble drilling and spacing. The smaller diameter of the shanks allows more room for narrowing and shaping the hammers. Drill/cut the shanks outdoors. Carbon dust is so fine it will get into everything, and is bad for your lungs.
Once the excess shanks are cut, Ed unscrews each shank to shape the tails and the side taper of each hammer. He uses aluminum oxide abrasive.

Gluing

Ed does not use the gel glue because it remains moveable.
Because the bits and shanks are so uniform, reaming is almost unnecessary.
Ed wicks in superglue. He puts all the hammers on the shanks exactly the way he wants them and then goes along with liquid superglue (acrylic – liquid plastic) and

Laquering

Acetone and thin superglue at 15:1 is an effective way to "lacquer" the hammers. If the hammers are too hard, more acetone can be added. This method eliminates the need to lacquer the shoulders.

Re-pinning
Reaming with WNG tools is slow. You can re-pin by heat-sizing. This process is stress-related. One side will be tighter than the other, so you heat the tighter side. The fitting won't creep back and will stay. The pins are made of needle stainless. They are very hard and can't be cut. They come with both ends rounded and color-coded, and they are all cut to the correct lengths.
WNG provides a re-pinning kit consisting of numbered smooth reamers and sorted pins in a container. The problem with using the reamers is that it is very difficult to move the material because the holes are so tight. These reamers have no abrasive areas on them as do some other reamers.

Burn-In
Use a heat gun guide to heat a single shank and to avoid heating any adjacent parts. You will feel the shank becoming plastic and rubbery. Wood stays rubbery longer, but changes over time, whereas the carbon shanks will not change once cooled. Heat the shank, then put it down, hold it slightly farther than where you want, and then let go. With wood you can put a curve in the shank left or right. With carbon fiber you cannot compress the fibers; they will bubble out. Carbon shanks will twist but they will not bend.

Shank Wall Thicknesses
The carbon shanks come in thin (white), medium (blue) and thick (red) thicknesses. Ed prefers medium. The most flexible part of the unit is the fork.
You can specify the diameters and positions of the ecsain knuckles. Ecsain is an expanded polyeurethane. Steinway started using these in Hamburg before they started using them in New York.

Dynamics
Stiffer shanks oscillate less than wooden shanks. This would distribute the energy and frequency differently from wood shanks. Pianists like quick, controlled response, and reducing the flex of a hammer shank definitely provides a more solid, definite tone. Playing softly is when we can notice the evenness of the tone with carbon shanks. Hard playing compresses the hammer felt more, thus clouding the response. With soft-playing there is less felt compression and it is more obvious whether or not the shank is flexing. The weight of the shank determines the point of oscillation. If the ball doesn't hit the bat at the right spot, the ball will oscillate the bat. The center of oscillation with a carbon shank shifts the center of oscillation closer to the hammer. The center of oscillation is calculated by the entire weight. The inner part of a bat rotates slowly while the outer edge of the bat rotates quickly and produces more inertia. The ratio of inertia of the bat is 1/3 of the outside of the bat and 2/3 of the inside of the bat. In bunting, if the bat were moving in a straight line, then the center of oscillation would be along the line of the center of gravity because the entire bat is moving at the same speed. When we hit the baseball on the bat too closely to our hands, our hands sting because the energy is traveling down the bat into our hands and then back. When the hammer hits the string, the energy is traveling down the hammer down the shank to the flange and then back up. The center of oscillation is also called the center of percussion.

The Zzzt Sound
Ed thinks the zzt sound when the hammer contacts the string is the number of times that the string is vibrating against the hammer before it has time to leave the string. Because of the odd shape of the hammer and shank, the hammer can never hit the string at the center of oscillation. We would get the same energy from the flange even if the hammer would be a steel hammer against a steel plate.

Hammers
When you get about middle C it is important to work on the voicing on the melody treble to get a big gain. Ed gets hammers from Ronson. The hammers with the silver maple or light maple moldings are very even. Mounted on carbon shanks they are quite consistent. The only problem is that Ed thinks the black parts look ugly.

String Scaling
Ed talked about hybrid string scaling. Stainless steel core wires are too brittle and he wouldn't trust them. He has considered replacing some of the upper bass bi-chords with tri-chords with thinner windings. He played different pianos so we could hear the tonal differences.