Comparison of the Ampico A and B in Concert Grands

By Craig Brougher

Is it really true that the Ampico model B is superior to the model A in its *performance?* The answer to that is, yes, and (also), no. And the reason for this answer is totally dependent upon the piano it resides in!

Yes, you read that right! The Ampico A was the "generic Ampico" and was designed for anything, whereas the Ampico B was the "home model." That means, the model B Ampico was specifically designed to play the baby grand or parlor grands.

Now I understand that this is not common knowledge, and there are a variety of opinions about it, so let me take this completely out of the realm of opinion variety and put it into the realm of acoustics and mechanics. I have never cared for opinions, and that began with my own. We all start with them but my dad used to ask me, "What makes you think so?" That started to sink in and pretty soon, I began to dislike my insufficient answers. So I started challenging my own "facts." Now that's kinda tough for a little kid at first, because friends questioned whether I would stand up for what I believed, when all the time I was just questioning the sources and degree of fact which I had. What degree was I also wrong? So I have studied out this particular question about Ampicos for decades, resorting to actual tests and measurements, and I think I can more definitively answer this question.

Once I explain the difference between Ampico B's and Ampico A's you are going to see the clearly defined difference, and why I have the greatest respect for each one. At the same time you are also going to see why an Ampico B is still great in any piano over 7 ft. too, as long as the piano is for home use, but it cannot reach that piano's full power.

Now that being said, there are Ampico B's in pianos 9 feet long! In the usual home environment you'll sense the full power! But put on a stage, that player would have to be miked and amplified to fill the auditorium, whereas, the original 9'6" Ampico A Knabe built for theater operation was more than adequate for any hall in the world without a mike, all by itself. It was the Knabe concert grands which were shipped in pairs around the world to all the great halls, accompanied by two world-renown artists, to give the "comparison performances" so popular with audiences in the 20's, worldwide. I knew someone once who assisted behind stage during those shows.

The difference between the two mechanisms was profound to begin with. The expression mechanisms in no way resembled each other, but the most basic difference of all was in the pump expression itself. The model A had individual crescendos, bass and treble, which in turn increased pump pressure according to the dynamic called for, while the model B's spill valve and long spring replaced the model A dual crescendo for modulating overall pump pressure.

The model A didn't need two crescendos anyway. They were separate from the actual spill spring itself so they weren't dependent upon the spring's reserve. Now understand a little about spring tension RATE. When a spring is stretched within its rated range (as determined by Hooke's law), the increase in force is proportional to the increase in its extension times a constant. All this means is, a spring has a linear rate until it's stretched too far and then the rate escalates non-linearly. That's when Young's modulus is exceeded for torsion, or you might say roughly when you could insert a couple more spring within the coils of the extended one. All you need to remember is this—pull a spring too far and the rate of force increases exponentially.

Now of course that applies to ALL springs, so how do you get more extension distance and linear force from a spring? Well, the finer the wire is *relative to the spring's own diameter*, and of course the larger number of coils (which equates to a lower deflection angle λ for each turn of wire), then the more LINEAR that rate remains. In other words, it can stretch further without exceeding its elastic constant. The Ampico B relies on the approximate linearity for the first stage of crescendo and then the exponential rate for the second stage. Problem is, that single spring is required to stretch a very long way, which means it too isn't going to last as long as it would otherwise.

I've never run into an Ampico B with a duplex spring. I will admit to having changed the design of ONE piano, a concert grand with an Ampico **B**, and gave it a duplex spring (with one other mechanical consideration). Trouble is, that requires a redesign and most guys aren't into that. So let's stick to the stuff that Ampico actually did, and shame on me!

This all boils down to either meeting the full capabilities of the instrument in which the player resides, or meeting it to a degree. Each grand, even baby grands, are not exactly the same in dynamic capability. That is why, if a rebuilder has plenty of time in grade plus curiosity, may have measured different spring rates in model B's.

I've run into a number of different spring coils in model B's and know that they selected them for the particular piano they were designed to go into. I've never seen any

noticeable difference of spring rate in model A's (that's not to say they didn't exist), I have always replaced the model A crescendo springs with new ones because of their original design, a heavy wire spring having a smaller overall diameter which permits overstretch.

You can tell an overstretched spring easily. If you can squeeze the spring and shorten it even slightly it has been overstretched. I've never run into an Ampico A whose crescendo spring coils were still tight together. An overstretched spring loses its initial unsprung force but then as it is pulled out it's rate of force escalates quickly and unpredictably, depending on how much further it can go.

The way in which the factory adjusted spill valve springs for the model A was by using a crescendo spring purposely overstretched to a certain length, then inserted and the excess clipped off. That's the way the spill spring was designed to work, but not the crescendo, which really requires a new spring. The design of my replacement is such that it should not require repeated replacements because it doesn't get nearly as overstretched.

Piano Characteristics

Dynamic capability has more to do with "volume" than "loudness." In speaker design, loudness is basically sound pressure measured in db. Volume is much more practical, but is not really as "measureable" a characteristic. Let me explain it this way—volume in piano music is the ability of a piano to fill a large auditorium. For example, you could measure the db of middle C struck with a given impulse and it might register approximately the same on a db meter from a baby grand as it would on a concert grand. But place both pianos on stage in an auditorium and play them exactly the same way with the same roll. Their difference becomes easily recognized, especially in the balcony. The difference comes from the length (mass) of the string and soundboard, the latitude which that extra power gives the artist to express himself. Even the softest-played notes are easily heard in the balcony from a concert grand, whereas they are barely audible from baby grands, particularly when the hall is packed full of people.

Even during loud playing, the same artist on the baby grand finds that his piano's power disappears on stage and is only able to carry so far and no further, while the concert grand is able to greatly exceed that level and bring everybody right up out of their seat! So while db's are necessary but are just one factor, the carrying power is the desired result.

It's like comparing power to voltage. The voltage is just one factor of the power equation. (We could talk about an area under a curve too, but that's going too far.)

There are at least two things going on, here. First, the concert grand responds to the harder strike and doesn't limit nearly as quickly (meaning "louder"), whereas the baby grand's db range flattens after a certain maximum key force (impulse). That's a "given." The second thing is that the power is responded to by the much larger resonating soundboard which vibrates a larger "volume" of air per note in comparison. Suffice it to say then that even though both pianos, when played in a small room sound identical in "measurable db loudness," the larger piano has far and away greater volume. It just cannot develop in the smaller room so you aren't aware of it.

Now one might say it still doesn't compute because the soundboard isn't that much larger, but oh, contrare'—it isn't simply the board alone but also the massive bass strings resonating sympathetically with even the higher treble strings. For example, Press down the damper pedal on a grand and strike the key of a high treble note, immediately dampening those three strings with your thumb. The tone didn't vanish instantly, did it? It's still heard. Now then, lay a heavy towel or pillow over the bass strings and perform the same test again. The note vanishes just as soon as you thumb the strings. So it's not just a soundboard reaction but the total combination, and since a piano is an acoustic instrument it relies on either the room or the hall it's in for carrying power and reverberation, not to mention tonal quality and other characteristics. It becomes part of an acoustic "circuit." Meaning, energy is also fed back to the piano and it's strings then respond to that feedback, which changes tonal color but also power.

So speaking db-wise, you aren't compelled to cover your ears and run out of the room if the piano is too large for the room it's in, simply because the db's never reach a painful level, but when that large piano is placed in a very large room or hall, it fills the hall with sound. This I know personally from years of direct experience in setting up stage sound systems, including a music hall performing reproducer grand on occasion.

Besides much greater volume at the same db level, a concert grand is also capable of somewhat greater db loudness range, besides. Ampico had laboratory test equipment which measured the power of a key strike to the corresponding db level it created. This device could also measure when the increasing key force was no longer directly related to the piano's db output, or in other words, shorter strings top out quicker under increasing key force than longer strings do, so the concert grand keeps responding directly to harder and harder key force, requiring double the pressure a baby grand would require. There are a few professional concert artists who can strike a note equivalent to the pressure exerted at about 90 in. H_2O. That requires an Ampico to top

that pressure by a small amount. The description of impulse is F*dt* but this is what the key strike machine is already calibrated to measure automatically in terms of force times impulse time. It was very accurate, and Dr. Hickman was particularly good at it.

Why the Difference Between Ampico Systems

But there is still a lot more to tell about this comparison between Ampico A and B in a concert grand. The Knabe concert grands needed two motors sheaved together and then one of the two motors (ac and dc pairs were provided) was given a 2-1/2" dia. pulley. This greatly increased the pump rpm's (which is about tripling it from the usual 1.75"dia.) without putting undue strain on the motor. But if the spill was always set to 20" nominally, then how was one to achieve the desired 90-95" H_2O vacuum level at "crash" loudness, simply by closing the amplifier pneumatic? Simple—they altered spill spring prestretch, readjusted the nominal spill deflection at 20" and gave themselves more reserve above that point. That provided a wider latitude with full power and about triple the cu. ft air/minute. So even though this is all spilled until it's needed, you have it in reserve.

That being said, I have also heard of Chickering concert Grands with the same system but according to one rebuilder, a maximum of 55 in. H_2O was attained. I don't doubt it, and I don't doubt that these pianos may have toured also. I cannot answer to that figure. It may have been correct for that piano or may have been discontinued when Clarence Hickman came aboard and started measuring things more precisely, but there were 4 touring concert grands that I am aware of and Chickerings were not used in the latter years of comparison performances which were taken worldwide, according to the fellow I knew who toured with the show for awhile and set up the pianos, himself.

Now this trick to raise pump pressure with the existing machinery will only work as designed for the Ampico model A. The reason that running the pump at triple speed won't work very well for the model B is because of the limitations of the built-in crescendo spring and corresponding small spill curtain. It's physically too small. As simple as that, it's approximately 1/3rd the capacity to spill as the model A pump, and is also too slow reacting. In addition, its sleeve pneumatic which counters the crescendo spring is scaled to the strength of the crescendo spring and its rate is perfectly linear. In order to increase this system for stage operation, an entirely different pump regulator and grid would have to be designed, the width and the draft ratios of the spill system would have to be greatly increased, as well as the sleeve pneumatic diameter which in its present form is simply not large enough to pull the curtain back against the second stage of crescendo which cannot be linear. It has to be scaled up triple in size!

This same mechanism is able to reach a crash pressure of 45" H_2O. Now this may seem like a huge improvement over the model A, but because of the flattening dynamic curve of most home-size grands, the difference is only moderately realized, plus the fact that they varied due to factory selected crescendo springs which varied. All reproducers were purposely limited in power by scaling at the factory through intended belt slippage, motor power, and pulley speed.

It is also curious that in all the well-known factory instruction manuals from Ampico, no pump was to my knowledge ever illustrated and broken down in picture format. I have always wondered why they never illustrated their pump.

So as you can see, the Ampico was primarily designed for home operation, as were they all. A stage performing instrument was a specially scaled instrument and varied from the ones intended for home operation but only by "regulation." It was one of Ampico's strongest selling points. The model B Ampico later on did have wider dynamic range, but this difference was appreciated mainly in its ability to play softer with reliability and yet even that difference was enabled by extending quick note perforations to double length holes, just to give the slower valve (and note) time to actuate.

Most people have never inspected a B roll closely enough to see this. That means if a staccato note played at a sub-intensity were to strike exactly in time, then it has to start sooner on the roll and last longer. There were also other very small adjustments in the B rolls as well. So the rolls which were converted to B were seldom gone over to this great an extent. That means the large majority of B rolls were approximated very judiciously and thus the model B seldom got a roll that really taxed all of its capabilities.

The conclusion one must come to is that the model A Ampico would always be the one to use in the largest instruments designed for music hall performance at which time you need the full power of the instrument, simply because its pump design and crescendo were unlimited in their capacity to provide it. The model B Ampico was more of an integrated design with the intention of providing superior reproducing piano music in the home environment.