

Exploration of Tonal Stability of New Pianos

-- An Experiment on Essex Pianos in Steinway & Sons (Guangzhou) Boutique

Huicheng Huang

Cinematography Institute, Ulaanbaatar, 11000, Mongolia

Abstract: Accurate intonation is the first element of piano quality. A piano with good intonation can cultivate people's emotions and give listeners a good sense of music, and it is also a symbolic symbol for performers to express their musical emotions and playing standards. This will cause all the beauty of piano music to be distorted, and in serious cases, even affect the human ear hearing organs. As the structure and string tension of new pianos are extremely unstable, the factors affecting the stability of piano intonation are also multifaceted, so it is an inevitable requirement for the pursuit of musical beauty to change the string tension and adjust the structure of the piano in a stable state through the intonation debugging in a timely manner.

Keywords: Piano Tuning and Actual Sound Effect; Factors Affecting Tuning; New Piano Tuning Change and Stabilisation Experiments.

1. Introduction

Piano is a process of force change from product to commodity until the process of artwork. A piano from the combination of parts until the formation of the finished product, parts of the process are in a relatively stable state of pressure, friction. After the parts are combined into a piano, they will be fixed and squeezed by the metal screws, string nails and pegs inside the piano, which will drastically change the pressure of the parts and lead to the change of the sound rhythm. This article wants to Steinway & Sons (Guangzhou) shop Essex piano experiments as an example, through the professional testing instruments to test the pitch way, from which to explore the changes in the rhythm, through the pitch curve test table can clearly understand a certain period of time changes in the piano's rhythm, hope that the user of the new piano's rhythm to be able to pay attention to.

2. Piano Tuning and Actual Sound Effects

Piano tuning refers to the stable state of the pitch frequency of an intact piano in the whole region. Ideal state of the piano rhythm is based on: ① standard tone - piano 49 keys vibrate 440 times per second $a_1 = 440\text{Hz}$ (conventional state of the piano using 440Hz; symphony using 442Hz) for the starting point of the accurate height, ② benchmark group - in accordance with the requirements of the twelve law of averages using the four and a half cycle of twelve semitones of the piano for the division of the rhythm of the intervals of the semitones must be in line with the observance of the twelve law of averages standard, that is, four and five degrees of cycle of twelve semitones. The standard of the twelve equal temperament laws, i.e., equal interval intervals of 100 cents. (iii) The same degree and octave of the whole piano - based on the benchmark group, respectively to the treble and bass areas to the pure octave and the same degree of proofreading (all two strings or three strings of a single tone to one of the strings (octave debugging good) as the benchmark of the single tone of the other strings for the same degree of debugging (the requirement of a single tone of the same

degree of pure and no beat)). Intonation curve in accordance with the habit of the human ear - note: from the ascending c of the second group of small letters (52 keys) up to c5 should be gradually higher by 1-40 cents; from the bass (32 keys) E down to A2 should be gradually lower by 1-13 cents, which is a better range of the intonation curve. ⑤ The whole instrument is in 12 equal temperament. A piano that meets all of the above requirements is considered to have good intonation.

Accurate intonation is very important for music. Inaccurate piano tuning is like singing out of tune. Piano is a polyphonic, harmonic instrument, if the meter is inaccurate, not only the tune will be inaccurate, but also the harmony, polyphony, colour, hierarchy, logic, interest and all the beauty of piano music will be distorted. The degree of distortion is directly proportional to the inaccuracy of tuning. Chen said in the "piano tuning is not allowed to the noise is extremely harmful" that when the tuning is not allowed to the ffff intensity of the noise intensity of the piano is about 62 - 96db, close to the rolling mill, trucks, traffic avenue next to the noise intensity of the work produced by the same thing. And these noises will make people restless. In addition, the latest scientific research has confirmed that noise can seriously affect the hearing organs, and even make people lose their hearing. There is a subtle inner "connection" between the ear and the eye, when the noise acts on the auditory organ, it will also "involve" the visual organ through the action of the nervous system, so the noise will hurt the eye, cause visual fatigue and vision loss.

3. The Main Factors Affecting the Rhythm

There are many factors that affect the rhythm of a piano, but the most direct influence is the resonance disc. The stability of the new piano tuning in the rhythm compared to the use of a period of time in the old piano is more prominent, the string tension is not balanced, extremely easy to change the piano pitch changes, but also by the user in the process of using improper use or affected by other factors, tuning once the changes will directly affect the overall performance. The author summarises the common factors affecting the tuning

of the piano in the following parts:

3.1. The Relationship between the String Plate and the Tuning Rhythm

Essex new piano string axle plate is generally made of several layers of different grain emissions of hardwood superposition bonded together, its main role is to string axle nails in order to hold the ability to nail can be solid. The size of the nail and the axle plate is very important, the torsion force of the string axle planted into the axle plate should not be less than 1.3KN.CM. The increase of the torsion force of the string axle and the axle plate will lead to the destruction of the hole wall, and the bursting of the wood fibre; if the friction force is too small, the string axle will be loose, and the string tautly stretched on the string axle will be easy to change the tension and thus affecting the piano's intonation.

3.2. The Relationship between the Soundboard and the Melody

Soundboard is related to the piano sound quality, tone, volume of the important parts, the soundboard in the manufacture, must be curved surface bulge. The concave side of the device has wooden strips called "ribs", the purpose is to support the curved surface of the soundboard. When the soundboard is pressed, the ribs act as a support so that the soundboard does not concave in the opposite direction. Although the soundboard is dried, it is still subject to the effects of wetting and drying, but strict control allows the soundboard to perform normally in terms of sound quality, volume, and tone during use. Changes in the soundboard can also affect the tone of the piano.

3.3. The Relationship between the String System and the Melody

The string system has more than two hundred strings, with different diameters and thicknesses, respectively, in the high school and low three different sound areas, tightly taut in the cast iron plate, the tension of the piano string range of 18-22 tonnes or so (different models of the size of the upright piano and grand piano tension is not the same). Strings have tensile strength, when its rigidity is too large, the wire is easy to break, the wire is too soft is also not conducive to the vibration of the string, resulting in the enhancement of overtones and make the sound harsh and unpleasant. After the string is tensioned, there will be a certain degree of extension due to the action of tension, this phenomenon is called "tensioning", the string tension rate should not be more than 3%. The string tension system will be deformed under the action of tension, especially for new instruments, the adaptive deformation of the body structure has a greater impact on the intonation.

3.4. Relationship between Cast Iron Plate and Intonation

The cast iron plate is the most important part to support the string tension, and its support strength and resistance to bending are the basis for the maintenance of intonation. Modern cast iron plate is also divided into two kinds, one is sanding cast iron plate; the other is vacuum cast iron plate, when the string tension, the iron plate to withstand nearly 18-22 tonnes or so of tension, tension in the distribution of the iron plate is not uniform, the force situation is also very complex. In the part where the force is concentrated, if the iron plate is not strong enough, or the assembly precision with

the back frame is not enough, it will be tilted and deformed under the huge tension of the strings, and the bigger the deformation is, the more the pitch will drop, and the deformation of the iron plate is an important factor affecting the stability of the tuning.

Newly installed into the piano more than 200 strings, from the original state of a free tension state instantly become a state of about 18-22 tonnes of tension, string tension will be subjected to drastic changes. At the same time, the newly installed string axle plate, sound board and cast-iron plate will be subject to huge string tension and deformation, destroying the pressure of the original string axle plate, sound board, etc., which will directly affect the original adjusted string tension and make the strings lose the original tuning pitch. However, the internal structural materials of the piano are mainly wood, nylon felt and metal, which are easily affected by the climate, and once affected by the climate change will undergo a certain deformation, thus changing the tension accepted by the piano. Since the tensioning system is always in a state of imbalance, it is difficult to reach a state of tension equilibrium in a short period of time. Therefore, pianos need to be tuned several times during the production process, by adjusting the tension of the strings at the same time to make the internal parts of the piano as soon as possible to achieve a relatively balanced state of tension.

4. Experiment on Rhythmic Change and Stability of New Pianos

This new piano tuning stability topic may have been discussed in the literature before, but in order to present the tuning change and stability of new pianos in a more detailed and clearer way, we chose the Essex piano brand, and practiced and analysed by tuning it and observing its changes in different time periods. We hope that piano users will have a better understanding of the stability of the new piano tuning, and break the wrong maintenance concepts of new piano users.---- The new piano is in a good tuning state before it leaves the factory, and there is no need to tune it for a short period of time after it is purchased.

Test brand: Essex-Eup116

Test instrument: yamaha professional meter test instrument, Steinway professional temperature and humidity meter; Test cycle: 7 days (tuning before the tune, tuning after the tune at the time of the tune, the third day of the tune, the seventh day of the tune); Number of test pianos: 2; Number of tuning times: 6 times (three times for each piano); Number of pitch curve tests: 24 (2 pianos x 4 pitch curves x 3 per piano for a total of three debugs); Total time of experiment: 21 days; Test temperature and humidity: ambient temperature 22-23 degrees Celsius, ambient humidity 60-65%; standard pitch: a1 = 440hz; tuning time: two hours (rough law once, fine law once)

Select two Essex pianos were marked as A piano, B piano (A piano for the factory just transported to the shop did not go through the intonation debugging of the piano; B piano has been in the shop for regular intonation debugging idle for some time of the piano), each time the sound measurement is to test the same string, through the debugging of the two pianos on the piano not before the debugging, debugging, 3 days later and 7 days after the intonation curve for recording, analysis and statistics (a total of three times the tuning of the piano). and statistics (a total of three tunings)

From the two new pianos' comprehensive analysis table of

pitch changes, we can know that the piano's pitch changes after three times of tuning are as follows:

Before the first debugging, A piano was in a serious state of going out of tune, B piano was in a general state, after debugging, after debugging, the piano had a better intonation curve at that time, but after three days of debugging, the new piano's bass area was scattered by individual congruence, low octave; the mid-range was scattered by part of congruence, low octave; and the treble area was scattered by the overall low and congruence. After seven days, most of the congruence was scattered and the octave was low. However, the pianos that had been serviced had less variation in intonation after the commissioning, although there was some variation in intonation.

Before the second debugging, the new piano's overall rhythm is more stable than before the first debugging, after the debugging, the piano has a better rhythm at that time, but then after three days of debugging, the same degree in the bass area will be scattered individually, the octave is more stable; individual same degree in the mid-range area is scattered, and individual octaves are falling down; a small portion of the octave in the soprano area will be lower down, the same degree is scattered. After seven days, the overall tuning is more stable than the first tuning, with slightly less variation. However, pianos that have been serviced have better intonation stability after tuning.

The third debugging, before the debugging than the second debugging before the sound law state is relatively stable, after the debugging, after three days and seven days, although the piano sound law has a certain amount of change, but the magnitude of the change is not large, the stability of the piano; has been maintained piano after the debugging, the sound law has been in a better state.

After three times of tuning of Essex pianos, I found that although new pianos will have better tuning after each tuning, but after three days and seven days, the tuning of new pianos will still have a certain amount of change, but after each tuning will be more stable than the previous tuning in terms of tuning, and the magnitude of the change is gradually becoming smaller. After three times of tuning, the piano will gradually stabilise and change little, which is in line with the daily needs of the piano and can be used normally.

5. Conclusion

New pianos will be fine-tuned before they leave the factory, so that all the components can function properly and reach a stable state as soon as possible. At this time, the piano has the best sound and feel, however, after the product - artwork conversion, the actual use of the new piano will be affected by a number of factors, which will affect the actual use of new pianos and the factory before the difference in the sound state. I found through experiments, ① Essex new pianos after more

than three times of debugging, the piano intonation will be more stable, and only after one or two tuning of the piano, in the debugging of the piano will have a better state of intonation, but then after three days, seven days, the intonation curve or a certain amount of change. ② The main position of tuning is in the tenor and soprano regions of the piano. The amplitude of the change is measured in lost points, generally around 20-40 lost points in the middle register, and around 50-80 lost points in the treble register. It is hoped that by presenting my experiments on the tonal stability of new pianos, more users will be able to know the importance of the tonal stability of new pianos. Here, I have a few suggestions for the piano pitch stability: ① new piano in 21 days of testing will have a certain change, obviously, once a year pitch debugging is not enough, the piano is subjected to changes in tension after every day there will be a small change, especially the use of new pianos for the object of the child, and the piano is idle in the state of room temperature, the change of the pitch will be even greater. Children learn the piano before the concept of pitch is completely a blank sheet of paper, the rhythm of the piano is not allowed to seriously affect the learner's concept of pitch, which will seriously affect the future pursuit of the beauty of piano music. ② tuning need to ask a professional piano tuning lawyer, do not because the price is cheap also casually deal with. ③ Piano placed in the environment of the temperature 18-22 degrees; humidity 40% -60%. Don't move the piano at will. In addition to the large changes in the sound of the new piano, the mechanical part of the state of the piano is also poor: slow response of the keys, murmurs, parts are too loose and too tight, and so on. Due to the relationship of time, the mechanical part is not explored in depth, the author will continue to explore the state of the mechanical aspects of the new piano in the coming days, and hope that in the new piano rhythm and mechanical aspects can give more advice to the piano users.

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