Tuning Ancient Keyboard Instruments

- A Rough Guide for Amateur Owners.

Piano tuning is of course a specialized and noble art, requiring considerable skill and training. So it is presumptuous for me to offer any sort of Pocket Guide. However, it needs to be recognized that our old instruments (and replicas) are not as stable as modern iron-framed pianos, and few of us can afford to retain the services of a professional tuner on a frequent basis. Also, some of us may be restoring old instruments, or making new ones, and we need to do something. So, with apologies to the professionals, here is a short guide for amateurs.

If you know how to set a temperament by ear, and know what that means, please read no further. But if not, a short introductory background might be useful.

Some Theory

We have got used to music played in (or at least based around) the major and minor scales, which are in turn descended from the ancient modes. In these, there are simple mathematical ratios between the notes of the scale, which are the basis of our perception of harmony. For example, the frequency of the note we call G is 3/2 that of the C below. This interval is a pure, or perfect fifth.

When ratios are not exact, we hear 'beats', as the two notes come in and out of phase. For example, if we have one string tuned to A415 (cycles per second, or 'Hertz' and its neighbour a bit flat at A413, we will hear 'wow-wow-wow' beats at two per second. When two notes are further apart, e.g. C and G, let us consider the C. The second harmonic of C is the C above, twice the frequency. The next harmonic is the G an octave and a half above. This is an octave above the G first mentioned, so in 'pure' tuning, the third harmonic of our C will be the same as the second harmonic of the G. If they are not quite the same, we will hear those beats – and this is the basis of how a proper (human) tuner works. The snag comes, however, when we introduce ‘accidentals’ (sharps and flats) and then want to play in different keys – G major, D major, etc.

On a normal keyboard, there are twelve notes in each octave. But we find that if we tune in fifths, C – G, G – D, D – A, etc., the last note to be tuned will be F (a fifth above A#). Of course, we cannot just carry on going up in fifths – we have to break back an octave occasionally. Unfortunately, however, this last note to be tuned will be nowhere near where it should be, for the original C to be a fifth above it. It will be about a quarter of a semitone too high, and the interval A# - F will sound horrible. The ‘fifth’ would actually be B-flat - F, and the fact that A# and B-flat are not the same note is a manifestation of the problem. It’s just that the same key has to do service for both. This discrepancy of ¼-semitone is called the Comma of Pythagoras, although he did not discover it.

Something must be done; compromises must be made. One early solution was to make the most commonly used keys (say from two flats to two sharps) sound quite smooth. This approach throws up a terrible problem with the interval C# - G#, which became known as the ‘wolf’ (because it howled).


).

Some early instruments (e.g. Ruckers harpsichords) originally had alternative strings for the two notes – you could choose one or the other before starting to play.

But more usually, and continuing up until the present day, the compromise was to spread the comma in such a way that the result was acceptable. The aim in particular was to make the thirds (e.g. C – E) sound nice, without making the fifths too bad. And this for the most commonly used keys. The result is that all keys sound different, and the remote ones such as C# major do sound a bit odd. Without going into too much detail, different compromises give their name to numerous ‘historic’ temperaments, such as ¼-comma meantone, Vallotti, and Kirnberger III. Finally, we end up with ‘equal temperament’ where all the notes are out-of-tune, but all equally so.

I would just like to allow one of my hobby-horses a brief canter, and to assert that Bach’s ‘Wohltemperiertes Klavier’ was NOT written with equal temperament in mind. There is no point whatsoever in writing pieces in every key if they all sound the same.

A personal opinion: our ears have got used to equal temperament, where all keys sound equally bad, but I think this is only possible because modern pianos have soft fluffy hammers, which diminish the high harmonics. These might be too high for our ears to hear, but apart from the danger of annoying passing bats, we *can* hear the beats when high harmonics clash with each other – it shows up as a harshness. Harpsichords and early pianos with harder hammers have a tone richer in the high harmonics, and many of us prefer to use one of the more traditional temperaments. My favourites are Vallotti and Kirnberger III. Thanks to the wonder of modern affordable electronic tuning aids, we do not need to not need to understand this, we can just enjoy the results with more agreeable thirds and sixths.

On the subject of tuning-meters, some time ago I tuned my little 1704 Blunt spinet for its post-restoration début at Finchcocks. I was chatting to one of the country's leading professional tuners, and he said that 'it sounds as if it's been tuned by a machine.' Fair enough – better a good machine than an incompetent human.

I am so old that I can remember struggling before meters were invented. When they did appear, at first they were extremely expensive. But now we have the little Korg CA 2(left) for under £20 (Equal Temperament only) or the bigger Korg OT 120 for £60 or so, which offers a choice of temperaments. Both enable any pitch to be set; we normally use A=415.

Then we had 'apps' for mobile phones and iPads. My current favourite is Cleartune, available for the amazing price of about £3.99.

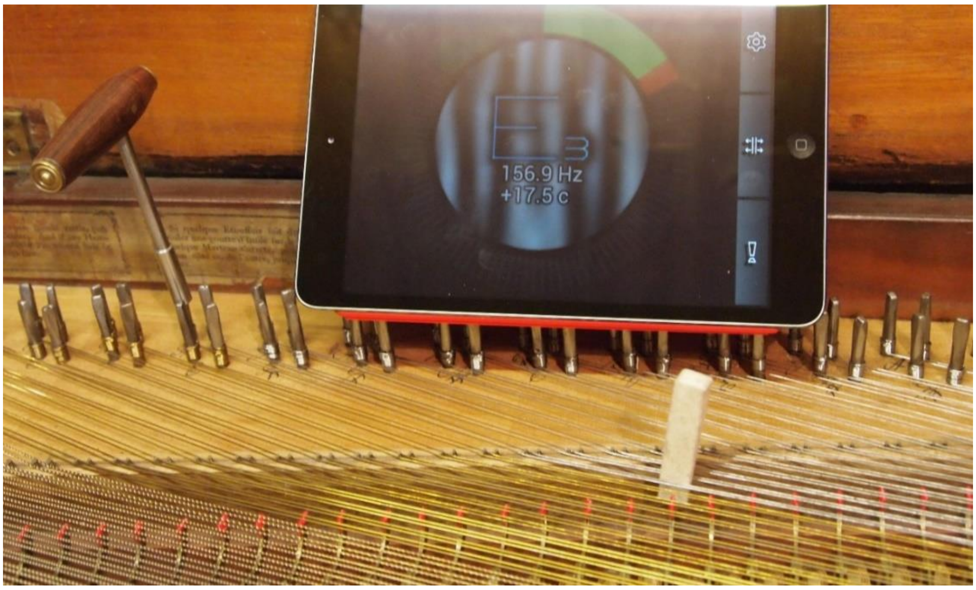
Tuning Hammers

Obviously, you need one, and it is important that it should be a good fit. Old instruments have hand-made flattened pins, and the hammer should grip the flats along the whole length (the ends do not matter). If the fit is sloppy, the corners of the pin will damage the socket, and be damaged themselves. There will also be backlash, which makes accurate tuning more difficult. On the other hand, if the socket is not big enough, it will grip only the tip of the pins, with damage as before. Some details of tuning hammers are on the Tuning and Tuning Hammers page of the Friends of Square Pianos website.

So What to Do?

If you've read this far, you are probably going to use an electronic tuning aid. The notes that follow use a 1787 Broadwood as the model, but the principles are the same for most instruments. If it is a spinet, you do not need to worry about having more than one string for each note. This is just one of the reasons why spinets are so nice. On a harpsichord, you can usually select just one of the 8' choirs and tune that, and then tune the rest of the strings to it.

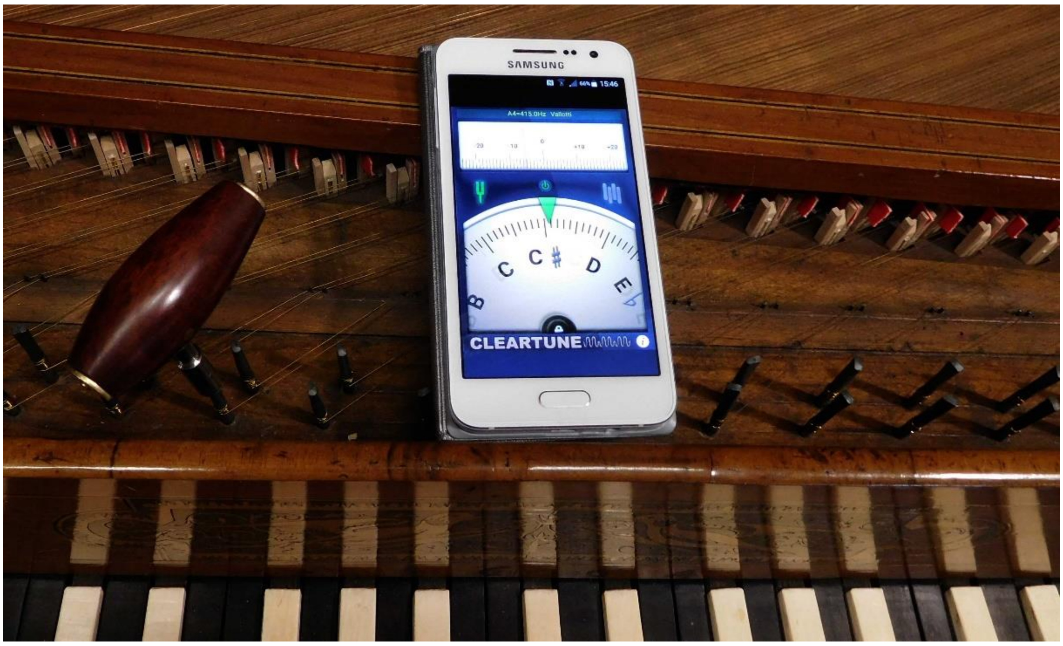
In the picture below, we see the iPad, set up with the older 'Pitchlab Pro' and ready to go. The tuning-hammer is the lopsided type favoured by some of the owners of pianos with the pins at the back, which includes all Broadwoods. They are not as pretty as the standard symmetrical type, but the lid does not get in the way so much.



As well as the tuning-hammer, you need a little felt wedge to mute one of the strings while you tune the other one. Here we see the wedge pushed between the upper string of **f** (below middle C) and **f#**. This leaves us able to tune the lower **f** string. You can start anywhere, but I prefer to get this octave in the middle of the piano done first, especially if you are tuning the top and bottom by ear. But even if you use the meter for the other octaves, you should still check octaves and chords.

Set the reference pitch. Most owners of early keyboard instruments choose A415, about a semitone below modern concert pitch. Play the note firmly. The meter will recognise what the note is, not what it should be.

In the example above, using Cleartune on an iPad, the note is C, but a bit sharp. (The green pointer stays fixed, and the circular scale rotates). The more sensitive horizontal scale above confirms that it is 20 cents sharp – a cent is a hundredth of a semitone. So we need to back off slightly with the tuning-hammer (anti-clockwise) until the red pointer is as near central as we can get it. Of course, if we are playing the C# key, then the note is well flat. As we advance the tuning-hammer gently, the red pointer will go off the scale to the right, and soon reappear on the left as the circular scale brings C# to top centre. The picture below shows Cleartune on a mobile phone, being used to tune a spinet.



Sometimes we can observe an interesting phenomenon, particularly noticeable with a harpsichord. When the string is struck (or plucked) it is displaced from its straight position, which momentarily increases the tension. This means that the initial pitch is unstable, and the display follows this, before settling down.

Now for Something Important: it sometimes happens that we have the hammer on the pin, and are turning to raise the pitch, but nothing happens, until BANG! The string mysteriously breaks. The answer, of course, is that we have the tuning hammer on the wrong pin. You would think that nobody could be that stupid, wouldn't you? Mmm… One insurance against this is to make the first tiny movement of the hammer anticlockwise, and listen for the pitch to drop. This also ensures that the pin is not sticking, and is moving smoothly. Against this must be set the point that we do not want to move the pins more than is necessary, because the holes will eventually wear.

But back to our piano: when the lower **f** string is as near to the desired pitch as we can get it, hop the mute up two spaces, to mute the upper string of **f#** and the lower one of **g**. Now tune the upper **f** string to a smooth unison (i.e. no beating) with the first one tuned. Then tune the lower string of **f#**, hop the mute again, tune the upper **f#** to unison with the first, and so on. You don't need to touch the meter – it will follow you. When you have tuned **a**, try the major third **f – a**. If you are using a traditional temperament, it should sound nicer than an equal-tempered one. Continue until you have tuned the first full octave, testing the thirds, and then chords.

At this point you have a choice. I find it easier to tune all the other notes in octaves from this first set, but it is possible to carry on using the meter (or app). However, this might be difficult for the lowest notes because the sound is made up mostly of harmonics rather than the fundamental, and this can confuse the meter. These notes really are best done by ear. It often helps to 'chip' the string (pluck with your finger-nail) to check. And also to be sure which of a pair is actually higher or lower. Try not to break any of these covered strings - they are a bit expensive. I usually continue to the top, and then go back to that first **f**, and go downwards. For this bit, it is simpler to tune the upper **e** string first, and hop the mute downwards in twos.

As we get nearer to the top, small movements of the tuning-pin have a bigger effect on pitch, because the strings are so short. We just have to learn the skill of making these tiny movements.

There are many other approaches to tuning, but I have tried to keep it simple to start with. However, we all develop our own little ways.

I hope that these notes will be of some help to amateur builders, players, and restorers. The results might not be perfect, but it will keep us going, and ensure that more of these lovely instruments can continue to make music.

David Hackett

May 2021