"The Big 3"
Better tuning, better regulating, better voicing

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Short cut:

1. **Learn the Fundamentals.** *(This is the easy part.)* Many people never truly understand the fundamentals. Eventually they settle and feel more comfortable with a lower standard.
2. **Practice the fundamentals over and over again until speed and quality increase.** The only short cut is not getting distracted by short cuts.
3. **Use judgment.** Know when to use something and when not to. Tuning, regulating and voicing overlap and are inter-related.

Tuning

Tuning requires physical strength and stamina. It takes energy to concentrate.
Ultimately tuning is a compromise.

Hierarchy of Intervals:
Unison
Octave
Fifth
Fourth
Third
Sixth
Minor Third

Mid-range, unisons and high treble are the most difficult part for most new technicians.
Our sequence of tuning is almost opposite of what's important; for example, we tune the unisons last.
The question is how accurate the rest of the tuning should or can be in order to allow time to make sure the unisons are accurate. Also, everyone has a different level of acceptance of accuracy. How bad was the piano at the beginning, and what is the final desired outcome?
What separates the average from the excellent tuner is stability, which is the true art of a good tuning.

Pitch Raising

The pitch will change if the piano is over approximately 6 cents.
Different sections of the piano will be off more than other sections.
For concert tunings, a three cent change can merit a second tuning.
In the treble Bob raises the pitch about a third high. For example, if it's 9 cents flat he will tune the treble 3 cents sharp. The bass will usually be closer to pitch, and the tenor will be somewhere between.
Bob's experience is that the notes that are tuned first go out the most and those tuned last go out least.
The treble changes in pitch the most because the string tension is more. The lowest plain wires are going to change in proportion to string tension and the breakage point. How much does the elongation go exponentially to the pitch? The bass strings are closest to the breaking point. Most piano designers stay around 60% of the breaking point. Around 70% is the elastic limit where the string will no longer elongate.
Bob starts his pitch raise on the lowest plain wire notes and tries to stretch each note about a third sharper. He mutes off the entire piano and tunes all the center strings. Then he tunes the unison by

ear, pulling out the strip along the way. Then he tunes the bass by ear by pure octave. This will come to about a cent or two of accuracy. The goal is to get the overall tension closer to where he wants it.
Ed's motto is that if the customer thinks the piano is out of tune, it needs a pitch raise.

Fine Tuning
With a tuning device, most people start at one point and work progressively up.
Hammer technique is the key to a fine tuning.
Tuning is ultimately done by feel. The tool itself can make a difference in hand movements and feel.
Pin setting is crucial. There is friction where the string goes over the bridge, through the agraffe, etc.
The vibrational difference between friction points must be equalized. Go above the pitch, then work your way down until the note stabilizes. The tuning lever handle should ideally point towards the hitch pins.

Dealing with Stability
Think of it as a five-step process.

1. Go up above pitch.
2. Turn the tool down to where it should be or slightly down.
3. Then zero in on it. This is a bracketing process.
4. Move the note slightly high but nearly perfect.
5. The final move is to go down: bend the pin towards the speaking length.

If the player plays the note hard and the note goes flat, it's the tuner's fault. To assure a stable tuning, tune using hard blows. Performers play exceptionally hard. Audrey glued a piano hammer into a racket ball for a comfortable hold on a hammer banging tool.

Seating Strings
The notch on the bridge pin hole is relatively delicate, and the steel string is very hard.
Sometimes for false beats seating the bridge pins with light taps using a pin punch can help.

Voicing
All things lead to voicing. Tuning and regulating are prerequisites.

String leveling
Shaping hammers
Fitting hammers to strings
Hammer hardening
Needling
Other

Regulating

Prior to regulation, piano action must have after-touch, some repetition lift and on a grand, the hammer shanks must not be resting on the whippen cushions. Fix these conditions before starting to regulate. The key to regulating is to follow the proper order. Friction must be within proper limits.

- Tighten screws
- Bed key frame
- Regulate
    - Keys (key height, key dip, and spacing)
    - Let-off
    - Drop
    - Repetition height
    - Jack position
- Back-checks: front and back, side to side
- Repetition springs
- Damper lift, with pedal and keys
- Pedals

Alignment is a critical goal. The hammers should be aligned to the strings, the butts and knuckles should be aligned to the jacks and whippens, the dampers should be aligned to the strings, etc. On grand pianos, make sure that the action shift still engages two of the three hammers.

Jacks. Wink the jacks. Before and after position of the jack: under the knuckle. Visually inspect the top of the repetition lever to the jack. Wink by feel, with the repetition lever at rest. With the action out, look at it. Press the jack tender and release it: see if there is friction as it goes into rest position. How does it relate to the regulating button. Some people say there should be some resistance as the jack goes back under the knuckle; Bob thinks there should be resistance all the time.

If there is little to no resistance, the repetition will be adjusted with less force to try to slow the repetition lever to bring the hammer up; yet at the same time at rest the repetition lever will have3 a tendency not to hold the hammer up. In this case there will be a winking.

Pins. It could be that the pinning could be incorrect. Sometimes a drop of protect on one of the two bushings can be all it takes to make a precise adjustment of the rise. Consequently one of the causes of the problem could be that there is not enough friction. You can't slow the rise down enough to hold the hammer at rest. When this adjustment is incorrect you will get double-striking or misfiring.

Repetition Springs. The repetition lever spring should rise about as fast as a person stands up out of a chair. Often in the bass and tenor the springs are often too strong. This makes control of soft-playing difficult. Bob leans towards low friction. Repetition is dynamic and cannot be judged by static measurements. Repetition is hard when trying to play softly. Trying to repeat at high volumes is also difficult to achieve.

There is a YouTube movie that shows the difference between regulating an action on a flat level bench and regulating with the action tilted back on someone's lap.

Bouncing hammers

Sometimes the shanks are very flexible and long.

Dip could be too shallow.

Back-checks are too far back.

Hammer springs could be too strong.