

Piano

How It Works
and
How to Keep It Working

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The Juilliard School

Overview

- How piano is constructed
- Producing sound
- Grand action
- Upright action
- Keeping it working
 - Humidity
 - Temperature
 - Tuning
 - Maintenance

How piano is constructed



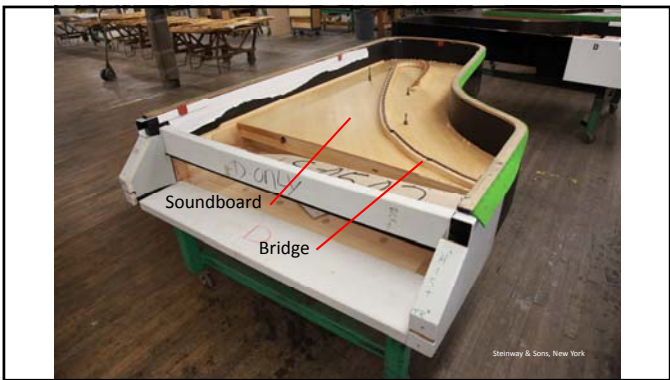
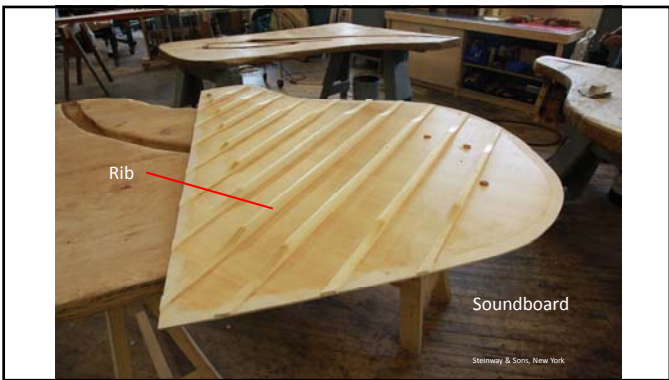
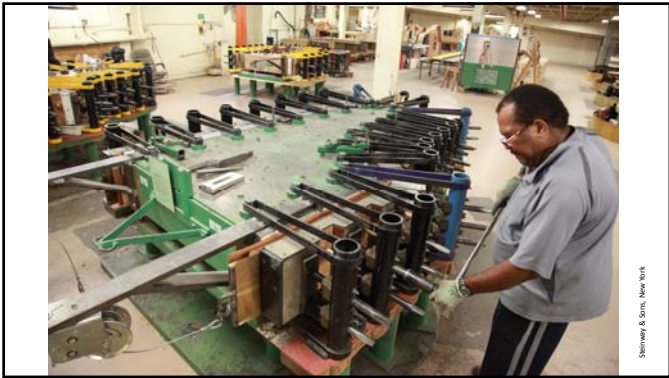
<https://www.pianobuyer.com/Articles/Detail/ArticleId/258/Piano-Buying-Basics-A-Little-Bit-of-the-Technical>

Case
Rim



Steinway & Sons, New York







Total tension:
40,000+ lbs.
(18-20 tons)

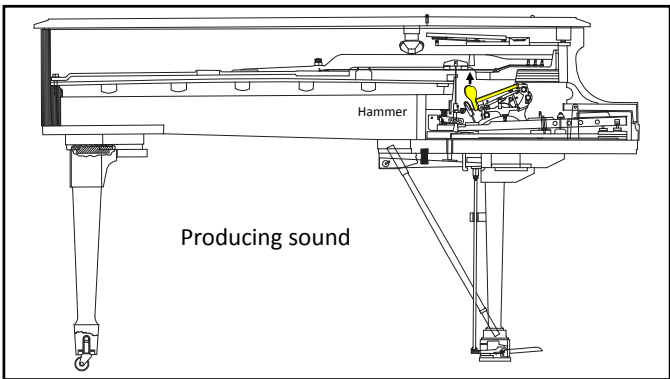
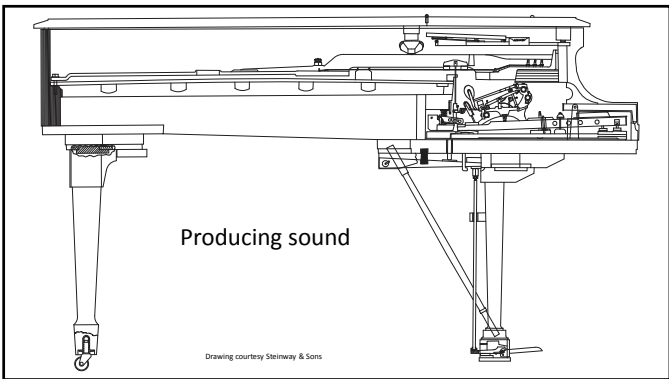
- Each string: 180 lbs (80 kg)
- 230+ strings

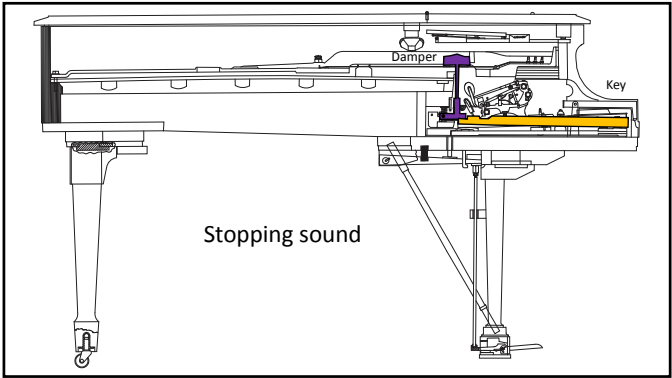
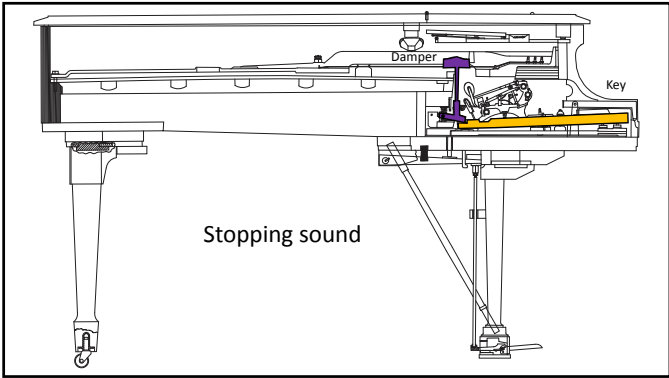
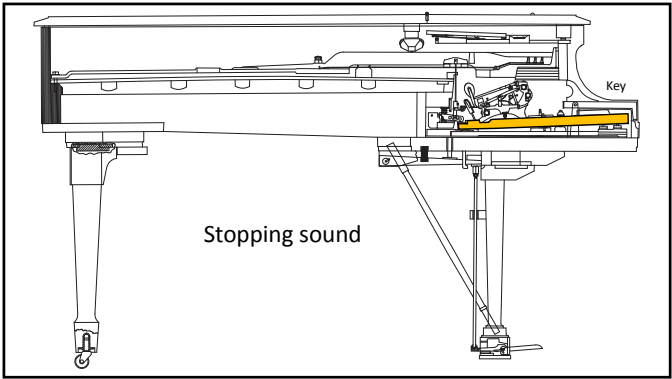
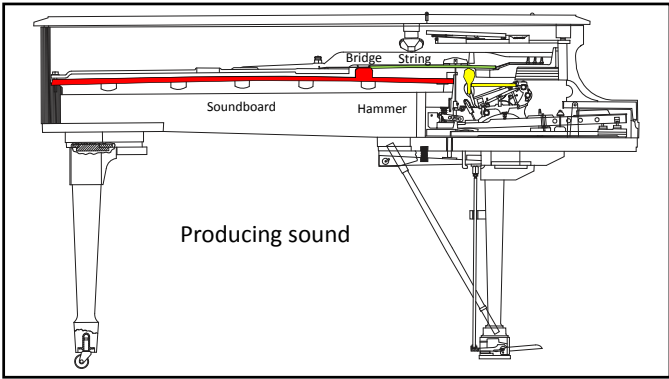
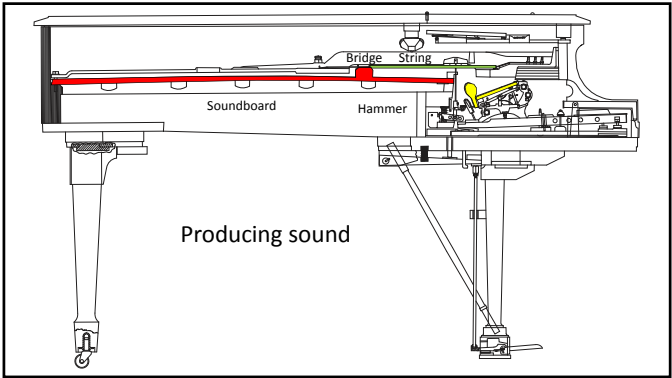
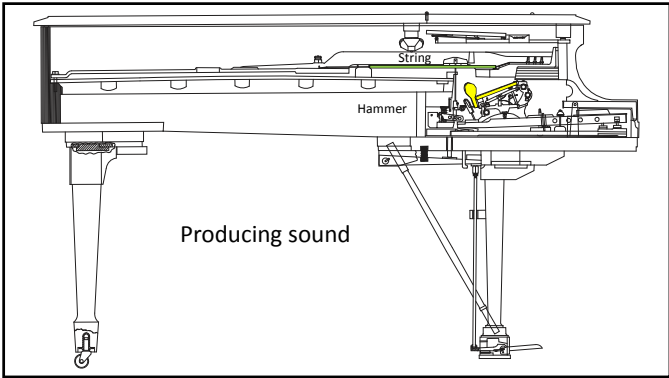
Photo by Steinway & Sons, New York

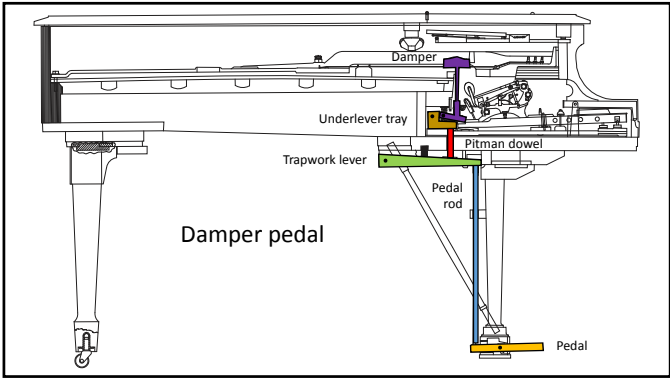
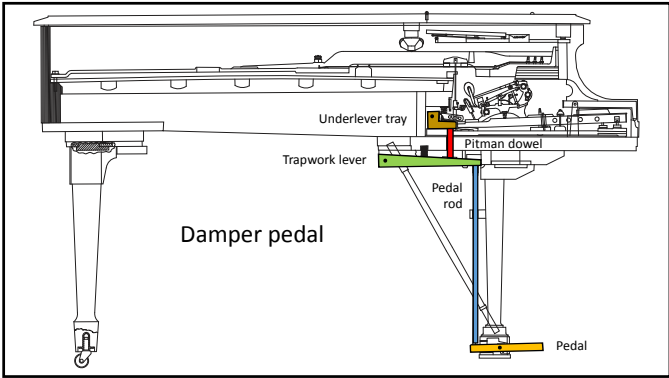
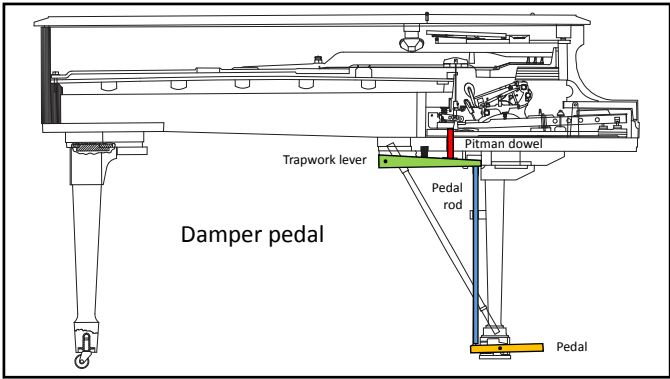
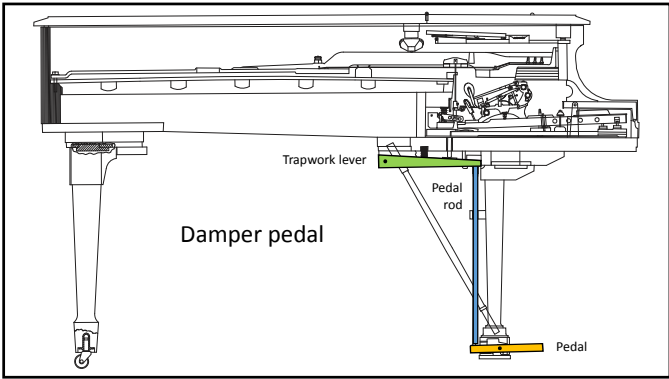
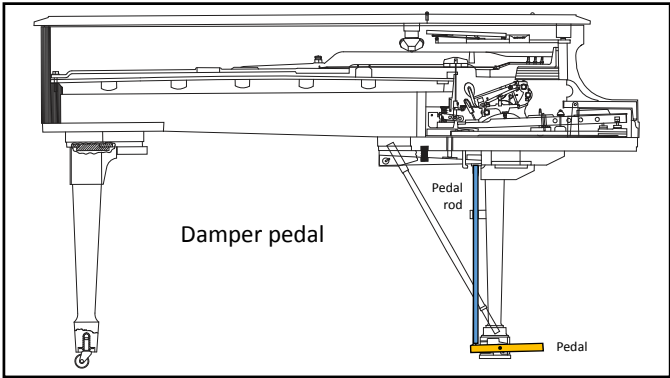
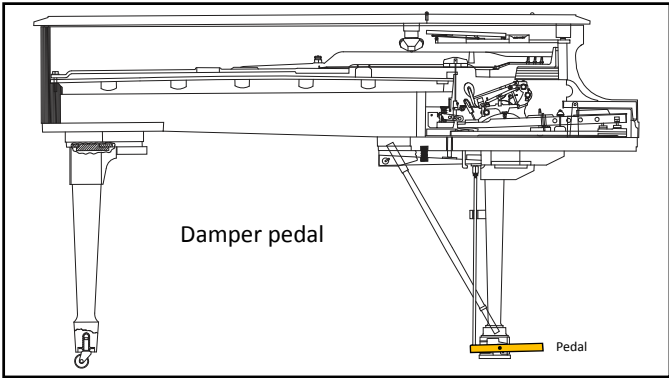
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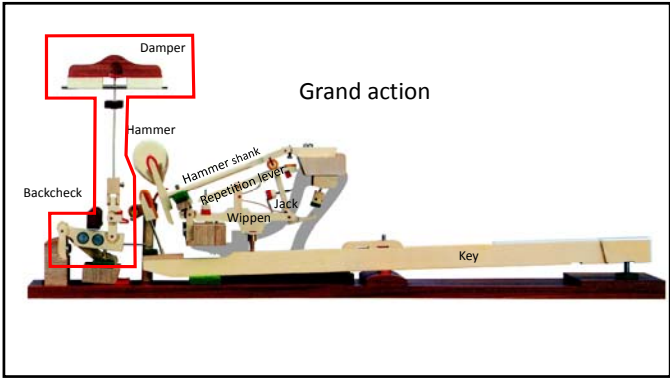
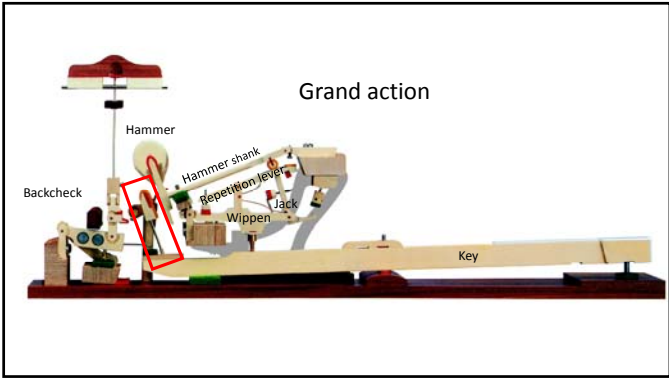
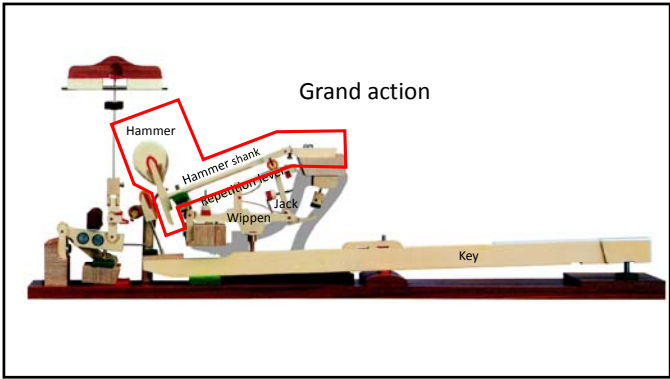
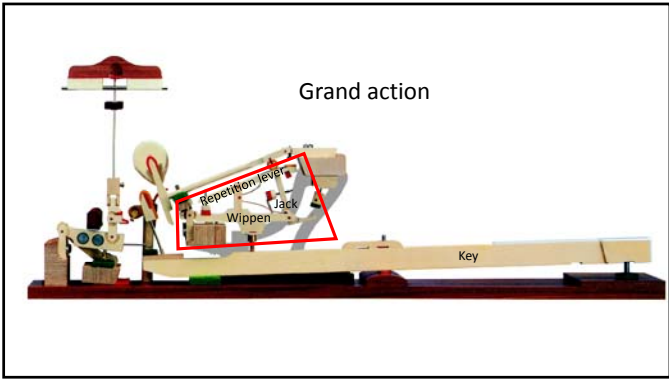
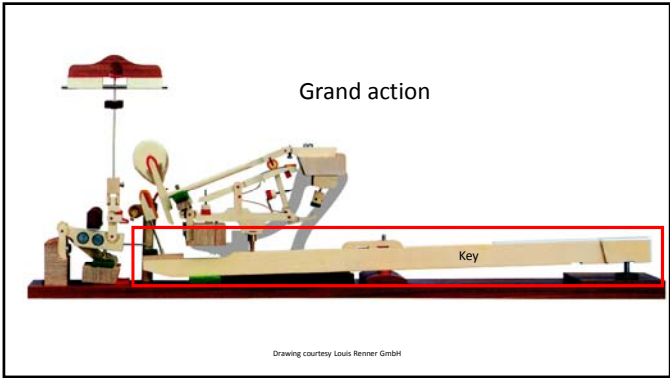
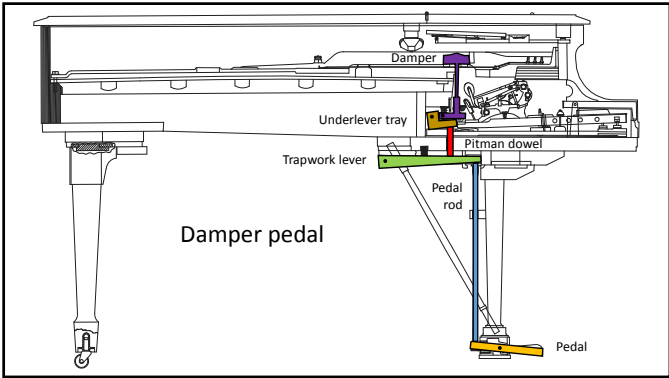
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Photo by Steinway & Sons, New York









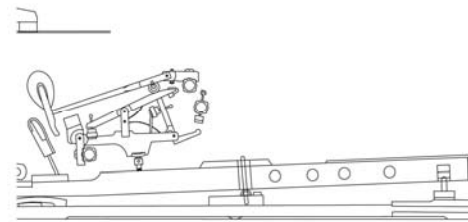
Grand action as levers



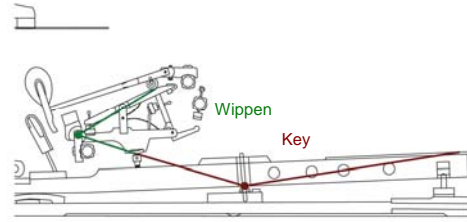
Grand action as levers



Grand action as levers



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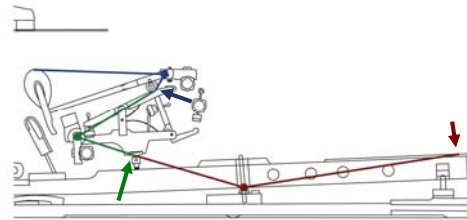


How do the levers work?

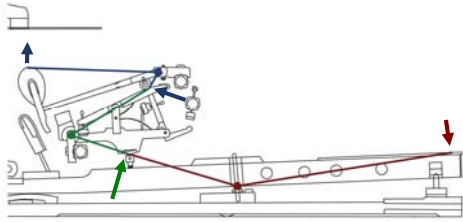
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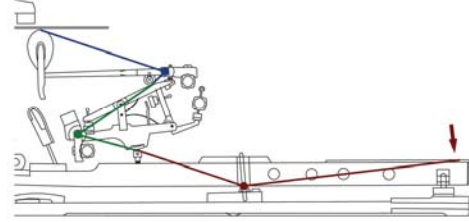
which pushes the shank up:



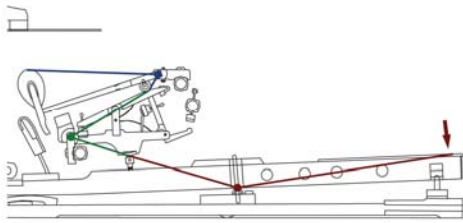
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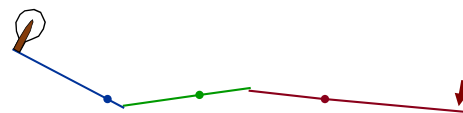
and lifts the hammer:



The angle of each lever doesn't matter.
The action could be laid out like this:

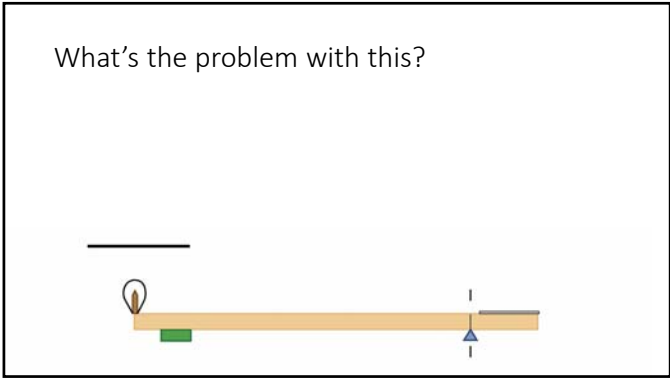
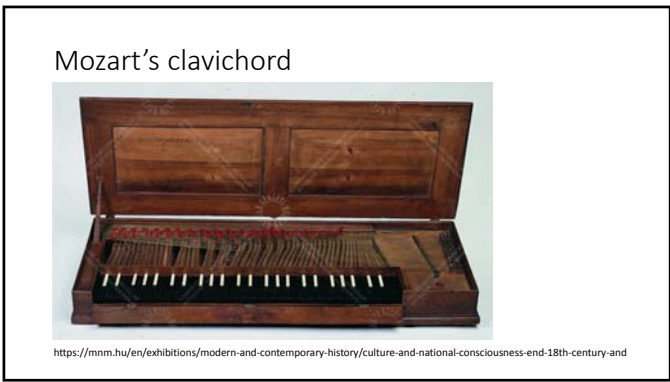
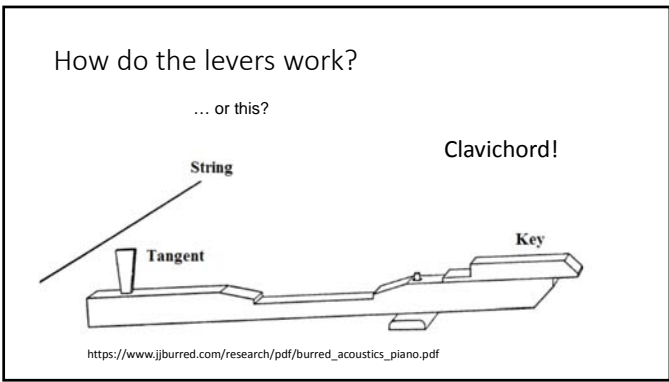
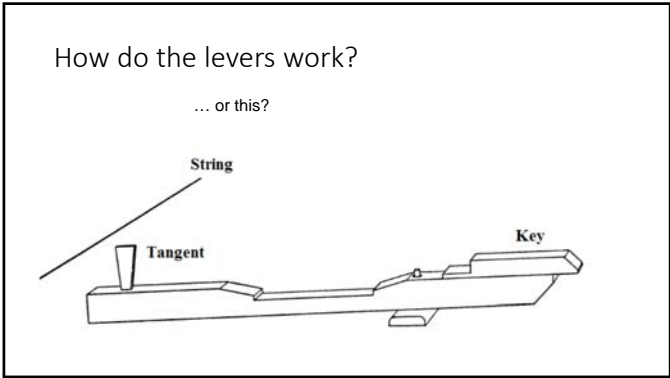
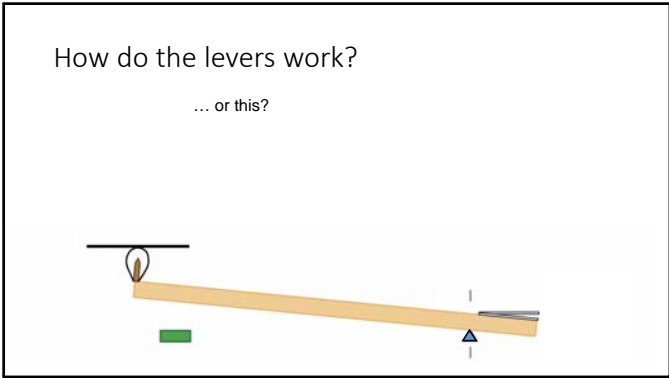


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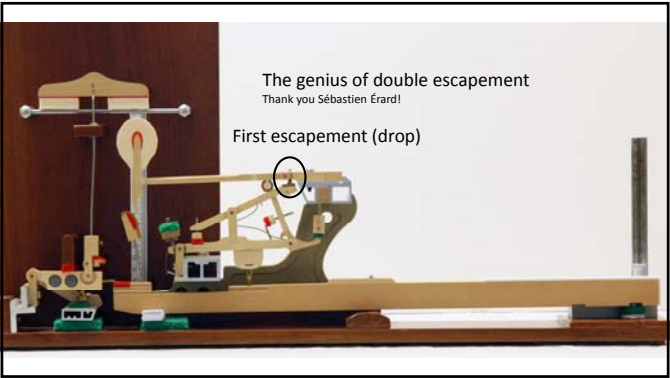
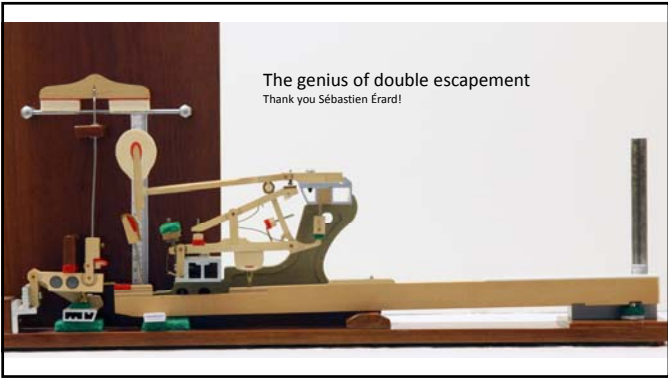
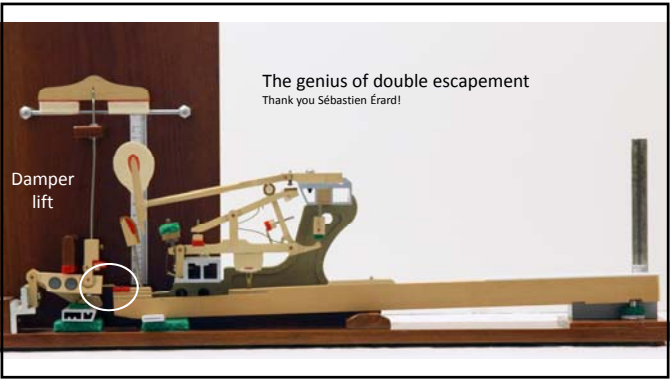
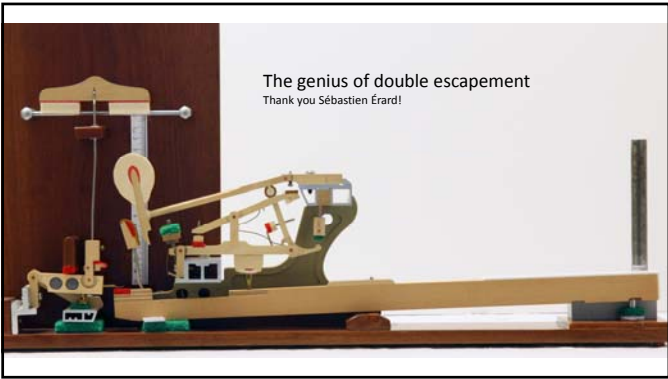
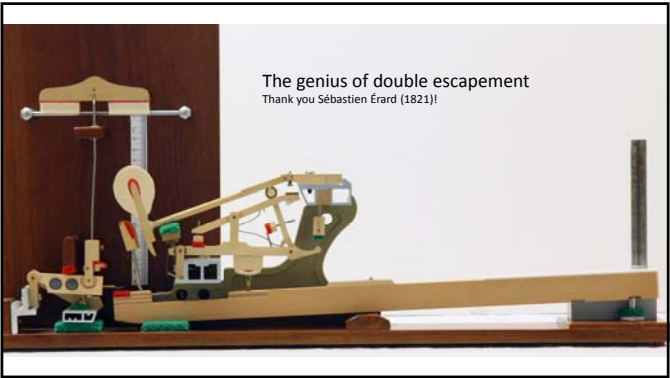


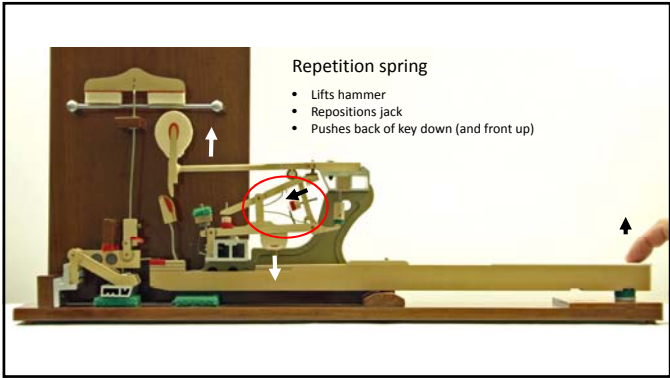
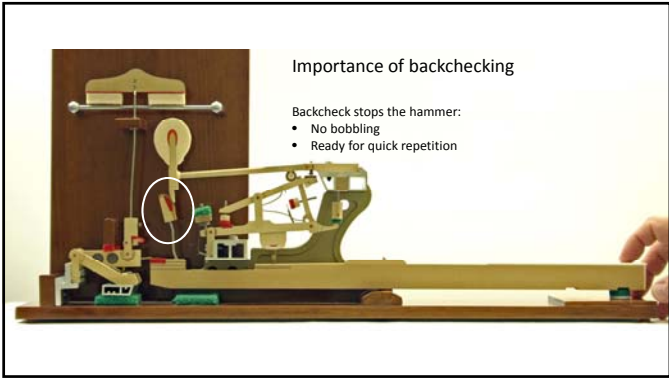
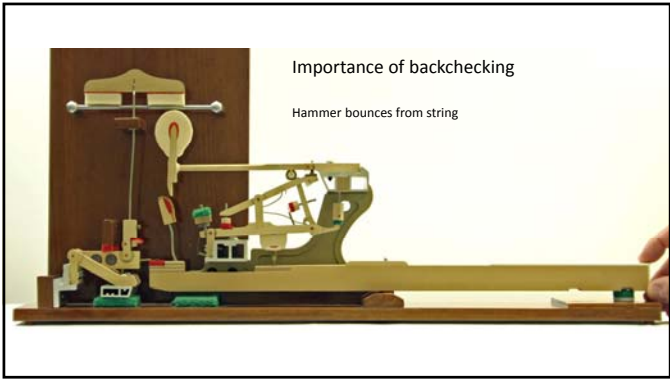
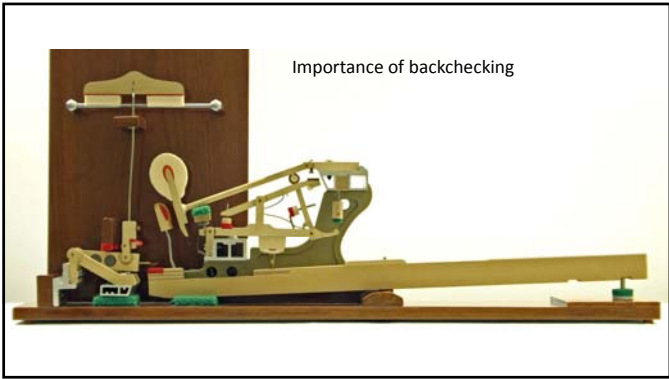
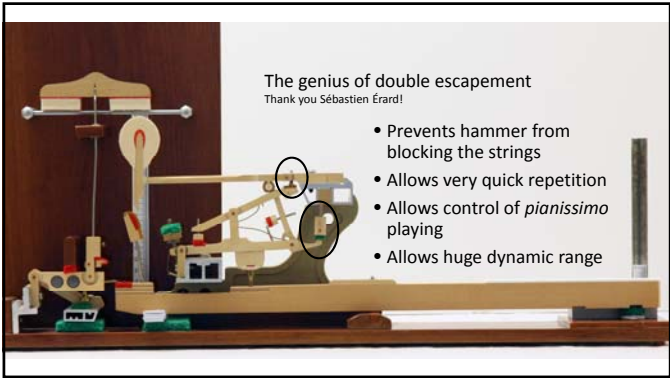
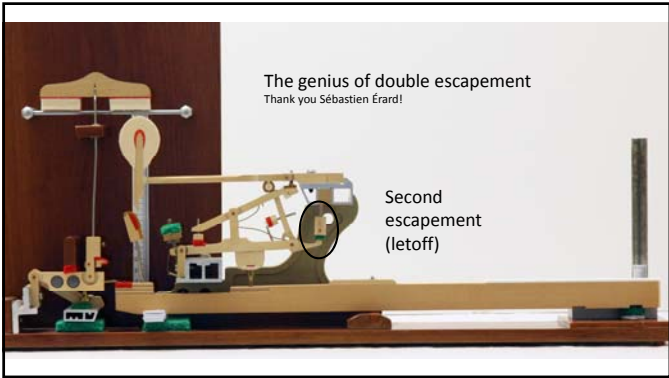
... or this?

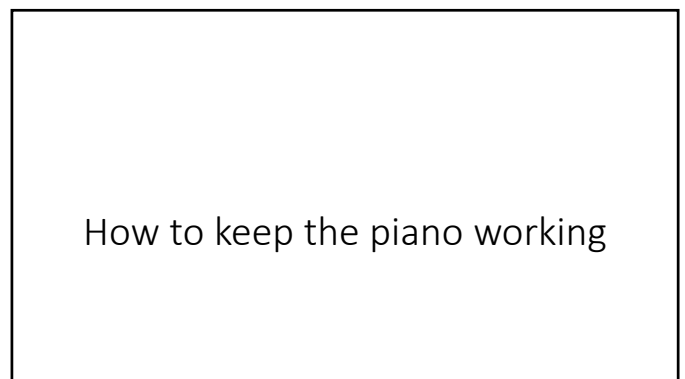
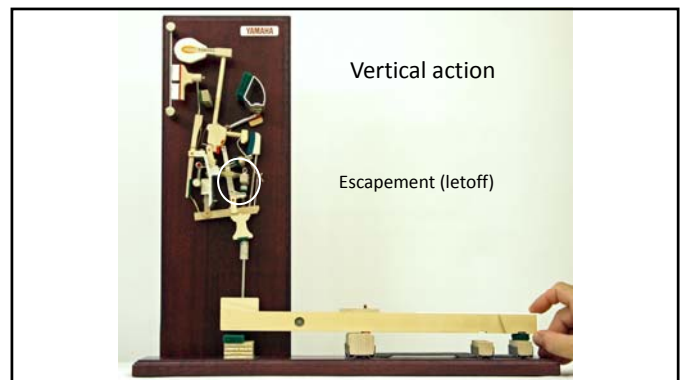
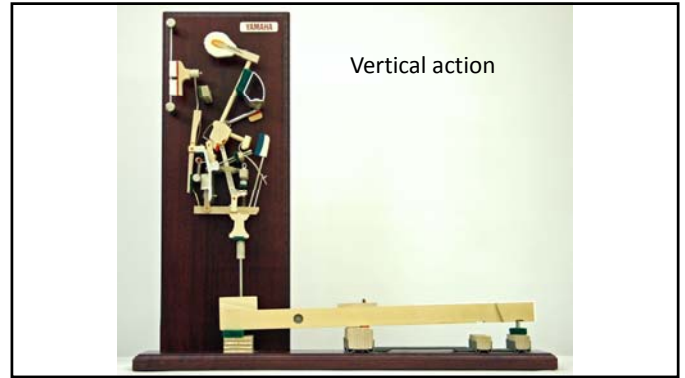




What's the problem with this?







Humidity

Keep steady (35-45%):

Tuning will hold

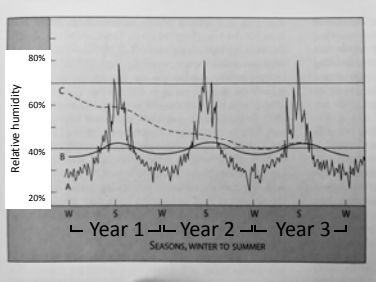
Tone will not deteriorate

Action will be trouble free

Soundboard and pinblock will last a 100 years

Humidity

Seasonal changes



Year 1 Year 2 Year 3

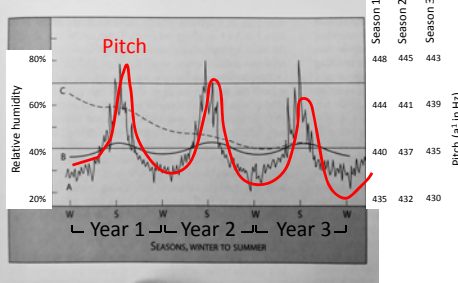
SEASONS, WINTER TO SUMMER

Bruce Hoadley, Understanding Wood, p. 135

Humidity

Seasonal changes

Pitch follows humidity



Year 1 Year 2 Year 3

SEASONS, WINTER TO SUMMER

Bruce Hoadley, Understanding Wood, p. 135

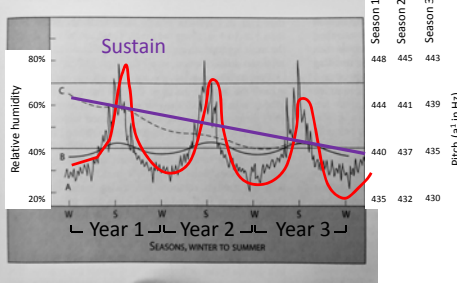
Humidity

Seasonal changes

Pitch follows humidity

Sustain gets shorter with time

The tone dies!




Year 1 Year 2 Year 3

SEASONS, WINTER TO SUMMER

Bruce Hoadley, Understanding Wood, p. 135

Humidity

Expansion, contraction (in piano soundboard: across the grain)



Humidity

Expansion, contraction (in piano soundboard: across the grain)


But wood is constrained:

Ribs



Humidity

- Expansion, contraction (in piano soundboard: across the grain)
- But wood is constrained:
 - Ribs
 - Glued to rim



Humidity

- Compression set

Original wood at 40% RH



After moistening, then drying to 40%



Bruce Hoadley, Understanding Wood, p. 129

Humidity

- Soundboard has nowhere to go



Humidity

- Soundboard has nowhere to go ... but up and down



Humidity


- Wood eventually cracks






Humidity

- Soundboard crown:
 - Breathes
 - Affects pitch, tuning



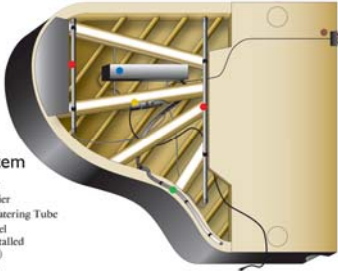
Humidity solutions


- Hygrometer (ideal: 35-45%)



Humidity solutions

- Hygrometer (ideal: 35-45%)
- Damp Chaser






The System

- Humidifier
- Dehumidifier
- Easy-Fill Watering Tube
- 3-Light Panel (Can be installed out of view)
- Humidistat


Humidity solutions

- Hygrometer (ideal: 35-45%)
- Damp Chaser
- Dehumidifier





Humidity solutions

- Hygrometer (ideal: 35-45%)
- Damp Chaser
- Dehumidifier
- Air conditioner



Humidity solutions

- Hygrometer (ideal: 35-45%)
- Damp Chaser
- Dehumidifier
- Air conditioner
- Humidifier
 - Whole-house evaporative type with automatic control



Humidity solutions

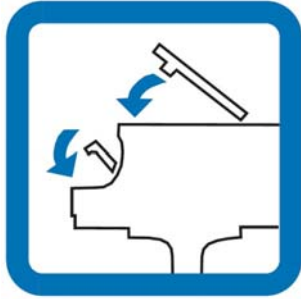
Humidifier:

- <https://www.amazon.com/HD1409-Whole-House-Console-Style-Evaporative-Humidifier/dp/B00KVN8CLA/>
- Additive:
<https://www.amazon.com/Chemical-Humidifier-PRODUCT-CANNOT-SHIPPED/dp/B01LX7ECBZ/>



Humidity solutions

- Keep the piano closed and covered (but air it occasionally)



Humidity solutions

- Piano cover protects against sudden humidity changes



Temperature

- Immediate change in pitch
- Keep away from:
 - Windows
 - Direct sunlight
 - Fireplace
 - Heaters
 - Radiators
 - Vents



<https://websterandsonsstud.cgsociety.org/9357/grand-piano-by-window>

Recommendations

- Damp Chaser (dehumidifier only)
- Whole-house humidifier
 - Fill daily in winter
 - Replace wicks and wash unit thoroughly every season
- Optional: room dehumidifier (run at night?)
- Piano cover
- Keep piano closed whenever not in use
- Monitor humidity!

Tuning

- Twice a year?
- Pitch: A 440-442 Hz

How to keep the piano working

- Key tops
 - Ivory
 - Brittle, yellow, falling off?
 - Plastic
 - Slippery?
 - Ebony sharps are wood
- Cleaning
 - Cory Key-Brite
 - Dish-soap & water
 - Alcohol (careful)



How to keep the piano working

- Cleaning lacquer finish
 - Cory Satin Sheen
 - Cory All Brite
 - Fantastik solution
- Cleaning polyester finish
 - Cory High Gloss Polish
 - Fantastik solution
 - Non-ammonia Windex
- Fantastik solution
 - 45% Fantastik
 - 45% water
 - 10% alcohol (91%)



How to keep the piano working

- Yearly service (every few years is fine)
 - Cleaning, lubrication
 - Dirt = grit = friction = noise = wear = shorter life span
 - Action regulation
 - Tighten
 - Brush, vacuum
 - Re-align
 - Adjust
 - Voicing
 - Even out
 - Reshape hammers?
 - Restore tonal gradient: mellow *ppp*, brassy *fff*



Resources

- Brand, pricing info: pianobuyer.com
- Forums, general info: forum.pianoworld.com
- Find a technician: Piano Technicians Guild (ptg.org)
- Piano tuning, repairing, rebuilding: pianosinsideout.com
- Benches:
 - Benchworld.com
 - Pianoworks.com (Hidrau model)
 - bondypiano.tumblr.com (Discacciati)
 - jansenpianobenches.com
- Piano covers:
 - howardpianoindustries.com/piano-covers/
 - americanpianocovers.com
 - jansenpianobenches.com/products/jansen-grand-piano-covers

Thank you!

Download the handout from:
<http://pianosinsideout.com/PianoHowItWorks.pdf>

Contact Mario:
pianotech@juilliard.edu