Physics of Musical Sound

Class 25
Read Chapter 14.10-14.16
Exam Friday!!

15th Century Positive Organ

Hydraulus
- Records back to 3rd Century BC.

Atlantic City Organ Console

Mediaeval Hydraulic Organ
- 9th Century AD

Halberstadt Organ
- Installed 1361
- First permanent organ
- Documented by Michael Praetorius

PLATE IV.
Old keyboard in Halberstadt Cathedral organ (Faber 1361). Part II in Praetorius's Syntagma Vol. III.
Wind Chest

Mechanical Stop Action

Tracker Action

Flue Pipe Sounds

- Open pipes have full harmonic series, stopped sound octave lower and lack even harmonics.
- Reflection at open end most effective when \( \lambda > > \text{diam} \) (diffraction!) so higher frequency harmonics fall off rapidly as \( \lambda \) approaches diameter and are absent above that frequency. Thus thin pipes have more high harmonics and sound brighter.
- Taller mouth opening means air jet is longer and cannot vibrate as rapidly so pipes with tall mouths (high cut-up) have fewer high harmonics and duller, more "flutey" sounds.
- Cones as well as cylinders have harmonic normal modes but the relative strengths of the harmonics are altered so the tone colour is altered.

Pneumatic Action

Baroque Flue Pipes
Reed Operation

- Reed is a metal bar clamped at one end and so has highly non-harmonic modes but it only acts to open and close air input valve in a repetitive fashion so the SOUND is harmonic.
- Metal reed has very high Q and so oscillates at only very narrow range of frequencies.
- Reed sets pitch of note and resonator only modifies relative strength (subtractive filtering).
- Note is tuned by altering reed length, pipe length is relatively unimportant.
- Some reeds use resonators that are shorter than you expect for a sound of that pitch. They enhance upper partials at expense of lower.
- Regals have resonators that are very small and only act to filter upper harmonics. The basic sound is a free reed sound with a filter. They can sound very distinctive (nasal, harsh, whiny, flutulent, etc.).