

Physics of Musical Sound

Class 25
 Read Chapter 14.10-14.16
 Exam Friday!!

8/30/01

Physics 120

15th Century Positive Organ



PLATE 7.
 A 15th century positive organ (Hulton-Stock photo). The organ is remarkably similar to that in use at present. (By general permission of the Society of Organists.)

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Hydraulus

- Records back to 3rd Century BC.

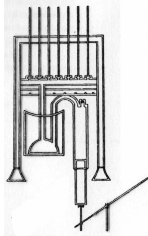


FIG. 3. The Hydraulus of Heron (Brit. Mus. MS. Harl. 5589). The seven pipes are of very small scale.

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Atlantic City Organ Console

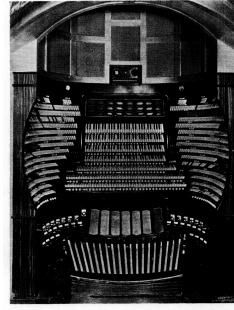


PLATE 17.
 The large console of the Atlantic City Organ, U.S.A. (the largest in the world), designed by Senior Organist Richards, (1927-31).

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Mediaeval Hydraulic Organ

- 9th Century AD

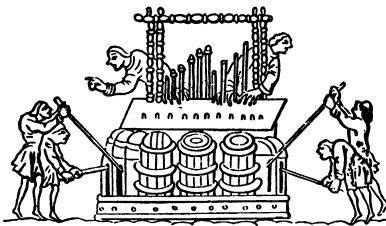


FIG. 7. The hydraulic organ of the Utrecht and Cambridge Psalters (Ps. 150).

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Halberstadt Organ

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

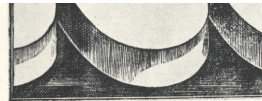


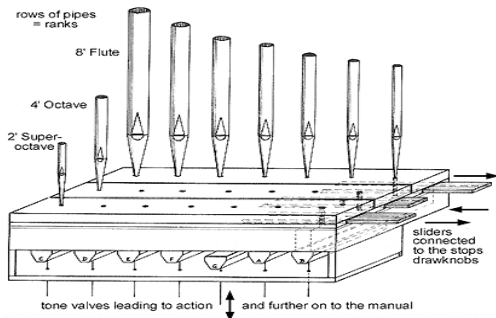
PLATE 4a.
 Old keyboard in Halberstadt Cathedral organ (Faber 1361). Plate 24 in Praetorius's Syntagma Vol. II



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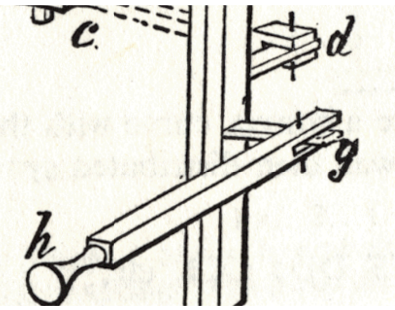
Wind Chest



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Mechanical Stop Action



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Tracker Action

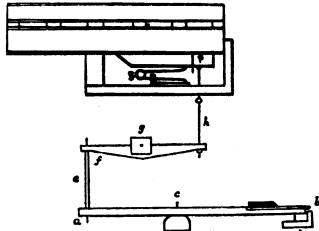


FIG. 22. Diagram of Simple Tracker Action.
a b key; *c* and *d* key pins; *e* sticker; *f* backfall; *g* backfall bridge; *h* tracker; *p* pallet; *s* spring. The pipes are supported in wooden rack-boards. (See p. 337.)

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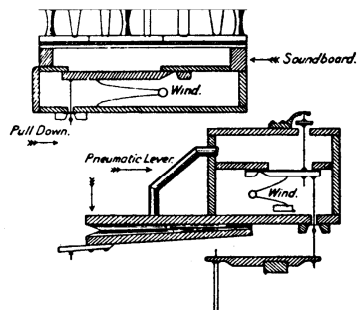
Flue Pipe Sounds

- Open pipes have full harmonic series, stopped sound octave lower and lack even harmonics.
- Reflection at open end most effective when $\lambda \gg \text{diam}$ (diffraction!) so higher frequency harmonics fall off rapidly as λ 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.

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Pneumatic Action



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Baroque Flue Pipes

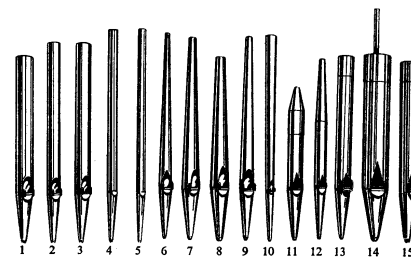


FIG. 19. Baroque Organ Pipes.
 From left to right : 1. Nachthorn. 2. Schwiegel. 3. Sifflöte. 4. Querflöte. 5. Schweizerpfeife. 6. Spitzflöte. 7. Blockflöte. 8. Gemshorn. 9. Flachflöte. 10. Dulcianflöte. 11. Koppelflöte. 12. Spillflöte. 13. Quintade. 14. Rohrflöte. 15. Gedackt-Pommer.

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Odder Flue Pipes

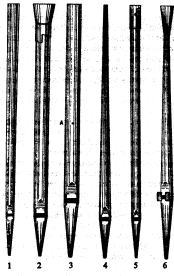


FIG. 20. Flue Pipes.
1. Dulcian. 2. Horn diapason. 3. Flûte Harmonique (flûte à aj.). 4. Gemshorn.
5. Kerasophon. 6. Bell Gamba.

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Older Reed Pipes

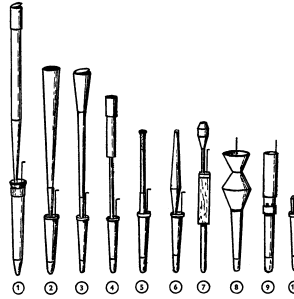


FIG. 21a. Old Reed Pipes.
1. Dulcian. 2. Trompette. 3. Oboe. 4. Rohr Schalmel. 5. Krummhorn.
6. Musette. 7. Finnish regal. 8. Bärpfife. 9. Rankett. 10. Regal.

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Organ Reed Construction

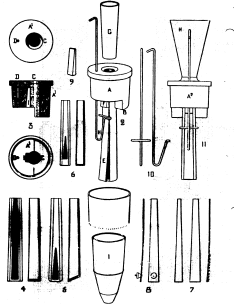


FIG. 16. A Reed Pipe and its Parts (after Audley).
1. Part of reed. 2. Block, holding reed, tongue and tuning screw. 3. Block. 4, 5, 6. Shakers. 7. Brass reed tongue. 8. Reed tongue with wedge (Wedge). 9. Wedge for raising tongue. 10. Tuning screw. 11. The parts put together. (The vertical tube is not shown.)

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Solo Reed Pipes

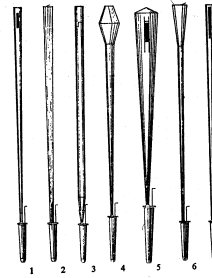


FIG. 21. Some Solo Reeds.
1. and 2. Bassoon. 3. Clarinet. 4. Cor Anglais. 5. Horn. 6. Oboe. 7. Orchestral Oboe.

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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, flatulent, etc.).

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