Introduction to Electrical Power

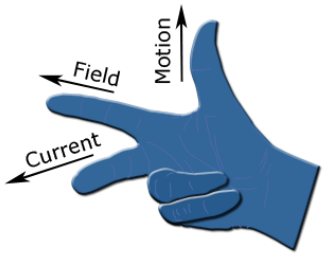
Rensselaer

Current and Voltage

- Current: http://en.wikipedia.org/wiki/Electric_current
  - Direct Current: http://en.wikipedia.org/wiki/Direct_current
  - Alternating Current: http://en.wikipedia.org/wiki/Alternating_current
- Voltage: http://en.wikipedia.org/wiki/Voltage
- Ohm's Law: http://en.wikipedia.org/wiki/Ohm%27s_Law
- AC vs. DC: http://www.pbs.org/wgbh/amex/edison/sfeature/acdc.html

Generation of Electricity

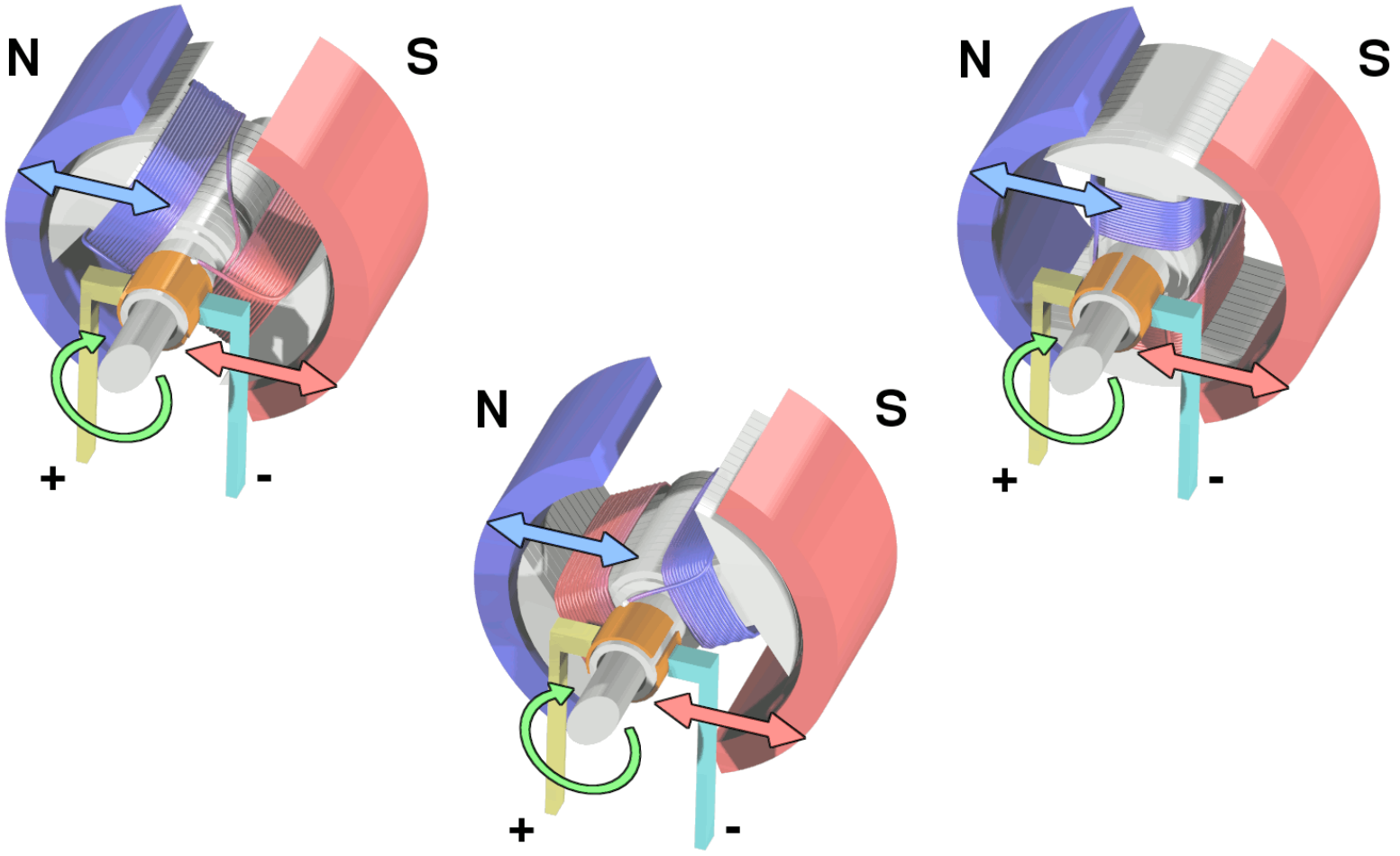
- By Electrochemical Reaction
  - http://www.pbs.org/wgbh/amex/edison/sfeature/acdc_insidebattery.html
- By Electromagnetic Induction
  - http://en.wikipedia.org/wiki/Electromagnetic_induction
  - Faraday's Law of Induction



Electrical Generator

- http://en.wikipedia.org/wiki/Electrical_generator
- AC Generator
  - http://www.pbs.org/wgbh/amex/edison/sfeature/acdc_insideacgenerator.html
- DC Generator
  - http://micro.magnet.fsu.edu/electromag/java/generator/dc.html

DC Generator



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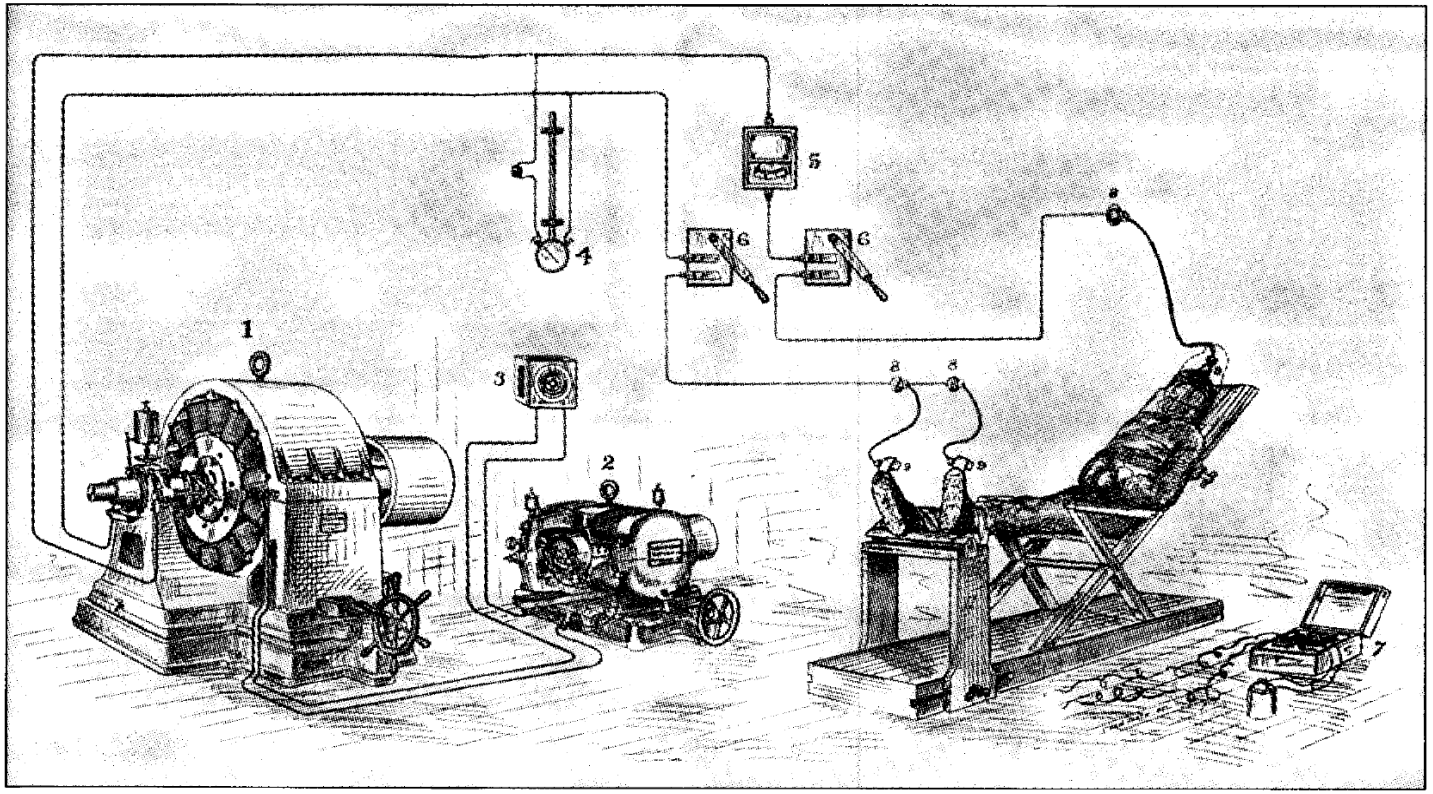
Early Use of Electricity

- Electroplating
  - http://en.wikipedia.org/wiki/Electroplating
- Lighting
  - Incandescent Light Bulb
  - http://en.wikipedia.org/wiki/Incandescent_light_bulb
- Measurement of Electric Power Usage
  - http://en.wikipedia.org/wiki/Electric_power

Transformer

- Electromagnetic Induction
  - http://en.wikipedia.org/wiki/Electromagnetic_induction
- Basic Principle of Transformer
  - http://en.wikipedia.org/wiki/Transformer
- Transformer Applications
- War of Currents: http://en.wikipedia.org/wiki/War_of_Currents

Electric Chair



Harold Brown submitted this plan for electrical execution as evidence during the hearings phase of Kemmler's appeal. On the generator he added a label reading "Westinghouse Electric, Pittsburgh."

Inductors and Capacitors

- Inductance and Inductors
  - http://en.wikipedia.org/wiki/Inductor
- Capacitance and Capacitors
  - http://en.wikipedia.org/wiki/Capacitor
- Impedance
- Reactive Power and Compensation
- Filtering

Electric Motor

- Lorentz Force
  - http://en.wikipedia.org/wiki/Lorentz_force_law
- Electric Motors
  - http://en.wikipedia.org/wiki/Electric_motor
- Variable-Frequency Drives
  - http://en.wikipedia.org/wiki/Variable-frequency_drive

Maxwell's Equations

Name	Differential form	Integral form
Gauss's law	$\nabla \cdot \mathbf{D} = \rho$	$\oint_S \mathbf{D} \cdot \mathrm{d}\mathbf{A} = q = \int_V \rho \, \mathrm{d}V$
Gauss' law for magnetism (absence of magnetic monopoles)	$\nabla \cdot \mathbf{B} = 0$	$\oint_S \mathbf{B} \cdot \mathrm{d}\mathbf{A} = 0$
Faraday's law of induction	$\nabla \times \mathbf{E} = -\frac{\partial \mathbf{B}}{\partial t}$	$\oint_C \mathbf{E} \cdot \mathrm{d}\mathbf{l} = -\int_S \frac{\partial \mathbf{B}}{\partial t} \cdot \mathrm{d}\mathbf{A}$
Ampère's Circuital Law (with Maxwell's extension)	$\nabla \times \mathbf{H} = \mathbf{J} + \frac{\partial \mathbf{D}}{\partial t}$	$\oint_C \mathbf{H} \cdot \mathrm{d}\mathbf{l} = \int_S \mathbf{J} \cdot \mathrm{d}\mathbf{A} + \int_S \frac{\partial \mathbf{D}}{\partial t} \cdot \mathrm{d}\mathbf{A}$

Summary

- Electricity
  - Voltage, Current, Power
- DC vs. AC
- DC and AC Power Generation
- Ohm's Law, Voltage Drop
- Transformer and Power Transmission
- Electric Motor

Lab Activities

- Construction and measurement of a dc-dc converter