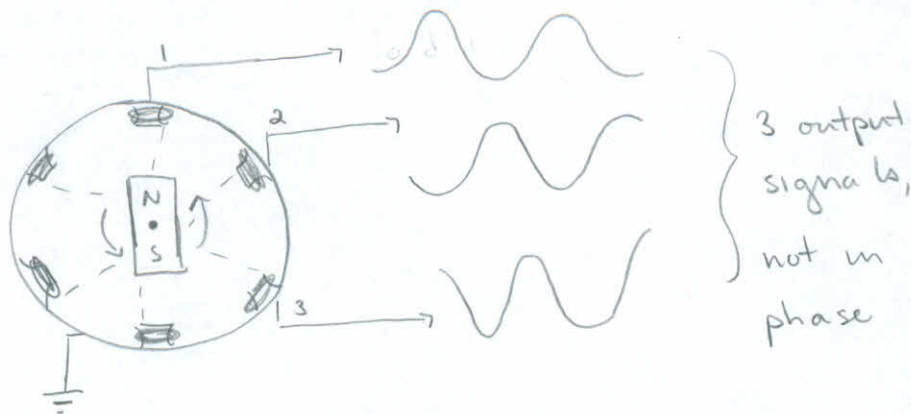


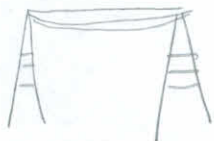
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3 phase AC generator:



$$\text{Signal 1} + \text{Signal 2} + \text{Signal 3} = 0!$$

↳ no "sloshing", don't have to pull current from ground



→ HV lines come in sets of 3

So, things we want:

- 3 phase AC → voltage transforms easily
→ voltage sums to zero
- big → heat dissipation, high voltage/power
- rotate magnet, not wires → no sliding connection between wire loops & output wires (which cause sparks)
- lots of coils → high voltage → less loss due to resistive heating
 - more coils → harder to turn magnet ∴ → frequency drops unless you put more power into the motor powering the generator
 - when power demand spikes (morning, evening), more generators must go online to meet the demand
- multiple poles → higher frequency (if necessary)

Turbines:

→ very important today

→ powered by steam, evaporated using (cheap!) coal

↳ external combustion

} $\epsilon \sim 33\%$

→ variant: gas turbine

↳ cleaner than coal

↳ recently became cheaper: competitive with coal

↳ environmental concerns

↳ internal combustion (more later...)

} $\epsilon \sim 40\%$

external



$T_{\text{combustion}}$

$T_{\text{hot}} < T_{\text{comb}}$

internal

T_{hot} is hotter

than for external

combustion

Carnot efficiency:

$$\epsilon = 1 - \frac{T_{\text{cold}}}{T_{\text{hot}}}$$

∴ internal turbines more efficient (theoretically)

→ rotational motion

→ lots of different designs

Features that matter in turbine design:

- speed
- density
- viscosity
- pressure change across turbine

↳ no: "free stream", "impulse" ex. wind turbine
power from change in speed of fluid particles

↳ yes: "confined", "reaction" ex. hydro turbine
power from change in pressure of fluid

↳ combination ex. steam + gas turbines (see slides)

(see slides for examples)