ELL 301

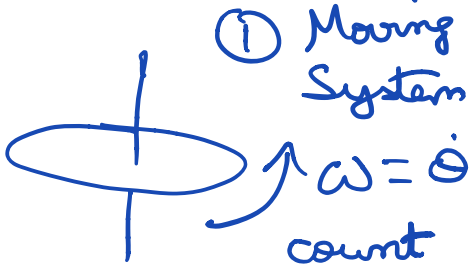
12.02.2019

voltage, current, power .... energy
(V) (A) (W) (kW-hr)

Energy Meters (≡ Watt-hour meters)
Instrument used to measure energy consumption.

↳ Digital / Electronic Meters

↳ Analog Meters



↳ Smart Meters

Analog Meters

- What do we want the angular velocity of the disc to be proportional to?
  ↳ at steady-state, ω ∝ power, VI cosφ

  - Why ω ∝ power? Because torque should be proportional to power?

    ↳ If we are counting total angle turned,

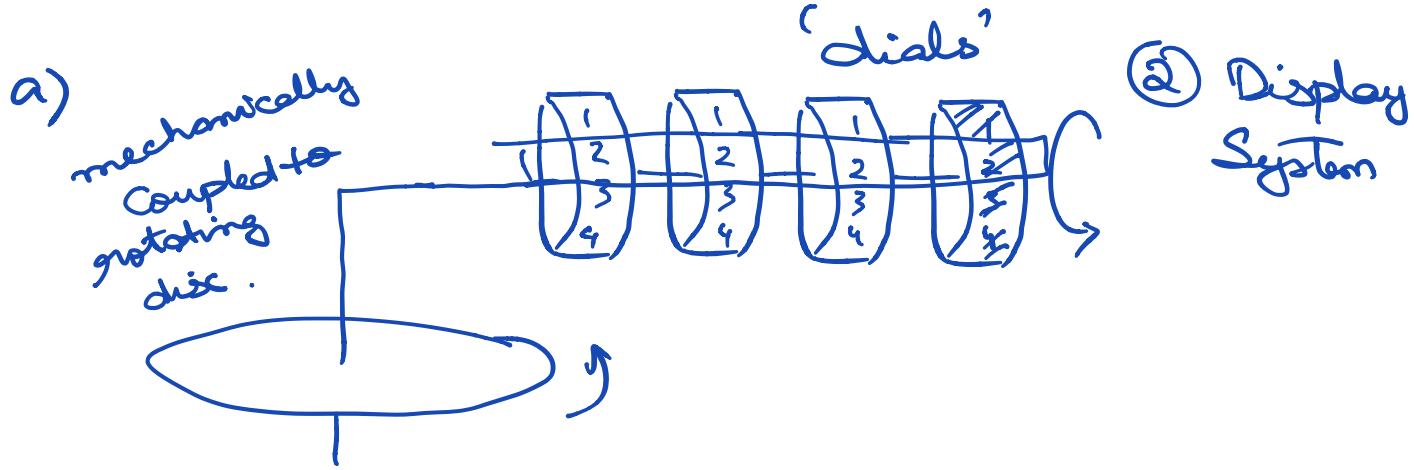
$$\theta = \int \omega \, dt \propto \int \underbrace{VI\cos\phi}_{\text{power}} \, dt$$

$\omega = \frac{d\theta}{dt}$

- How

a) to do the integral $\theta = \int \omega \, dt$?

b) to make $\omega \propto VI\cos\phi$?



b) How $\omega \propto VI\cos\phi$?

Actually, torque should be proportional to $VI\cos\phi$?

$$\dot{\omega} + b\omega = Z \propto VI\cos\phi$$

[as $\omega \equiv \dot{\theta}$,

$$\ddot{\theta} + b\dot{\theta} = Z$$

this is similar to previous second order equations we have seen, except there is no "spring constant" term, as there is no spring — we do not want 'θ' to be "restored" to initial position]

$$\dot{\omega} + b\omega = K\, VI\cos\phi$$

(K → constant)

Is this what we want?

Yes, as final value $\omega \propto VI\cos\phi$

Then, we need to design mechanism to make
- 'bω' term & → damping term, braking torque
- 'VIcosϕ' term → generating torque

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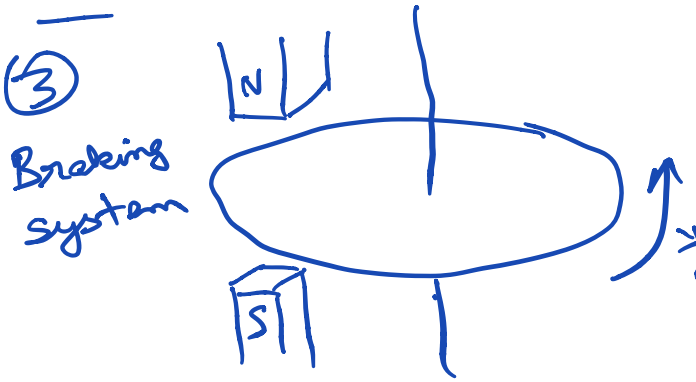
③



eddy-current brake

What is braking torque proportional to?

$\tau_b \propto \omega$

$= b\omega$

↑

a constant

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④ Generating System

$\tau \propto VI\cos\phi$