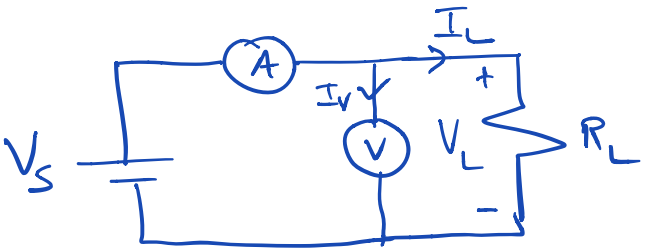
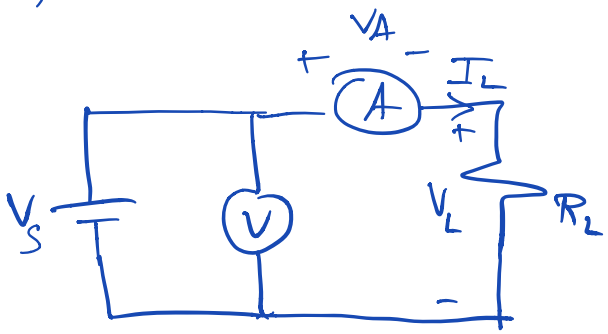
ELL 301

08.02.2019

Which of these is better at measuring load power (dc case) $= V_L I_L$?



or



$V = V_L$

$I = I_L + I_V$

$VI = V_L I_L + V_L I_V$

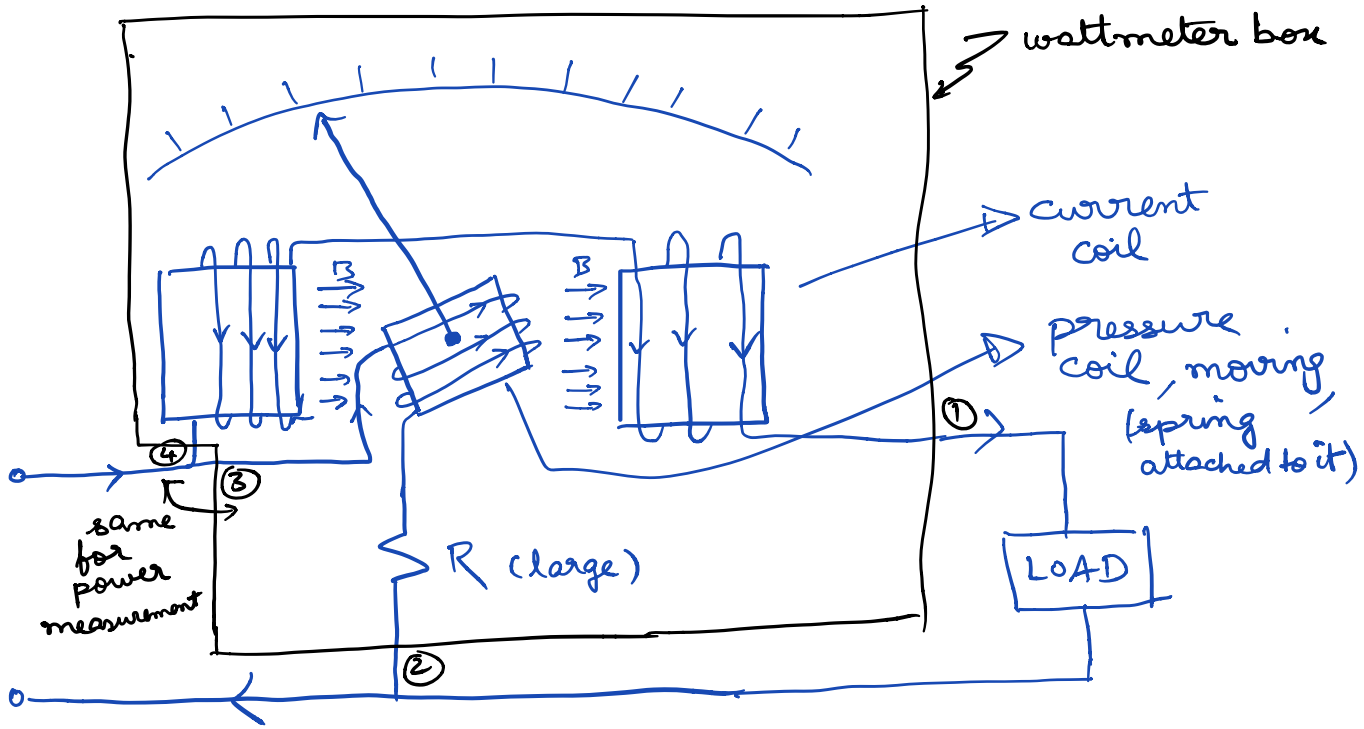
↑ we are measuring this ↑ want to measure ~ extra term

$V = V_A + V_L$

$I = I_L$

$VI = V_A I_L + V_L I_L$

↑ we are measuring this ~ extra term ↑ want to measure



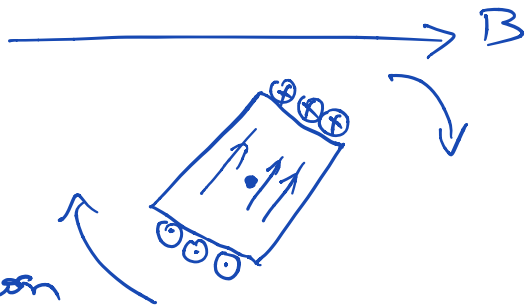
electrodynamometer - based wattmeter

Current flowing in pressure coil : $\frac{V_s \sin \omega t}{R}$

Current flowing in current coil : $I_L \sin(\omega t + \phi)$

$\Rightarrow$ Generates magnetic field, B

What is the force (or torque) generated on the pressure coil (moving part) due to this magnetic field?



force expression

$\sim \vec{i} \times \vec{B}$ $\quad i$

magnitude i $\frac{V_s \sin \omega t}{R}$ $\times I_L \sin(\omega t + \phi)$

directions $\sim$ clockwise rotation for the indicated arrows

currents on top and bottom cause no net motion, opposite forces + motion is constrained.

—

$$\ddot{\theta} + b\dot{\theta} + k\theta = \frac{K}{R} V_s I_L \sin \omega t \sin(\omega t + \phi)$$

$$\sin \omega t \sin(\omega t + \phi) = \cos \phi - \cos(2\omega t + \phi)$$

$\therefore$ steady-state response of θ = dc + ac

dc → $\frac{K}{R} \cdot (V_s I_L \cos\phi) \cdot \frac{1}{k}$ → power

ac → $-\frac{K}{R} V_s I_L \cdot A \cos(2\omega t + \phi + \psi)$

$$A = \left| \frac{1}{s^2 + bs + k} \right|_{s = j2\omega}$$

$$\psi = \angle \frac{1}{s^2 + bs + k} \Big|_{s = j2\omega}$$

Suppose same current is flowing through both coils, then what will happen to the angle of the needle?