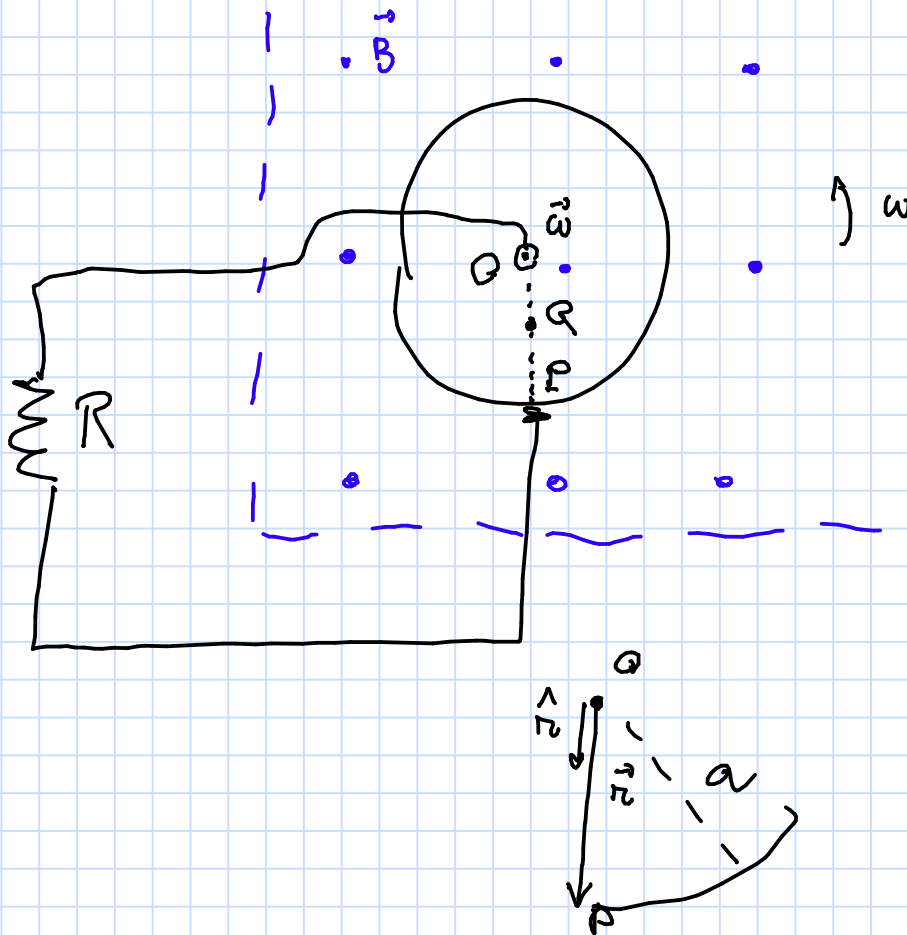


Disco di Barlow

(1) generatore di f.e.m.
potenza meccanica $\Rightarrow$ potenza elettrica



cariche (e^-)
trascinate dal
moto rotatorio

$$\vec{E}_i = \vec{v} \times \vec{B}$$

$$= r \omega B \hat{n}$$

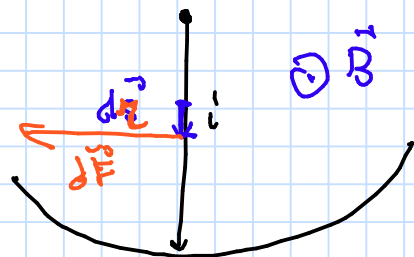
f.e.m. indotta nel circuito

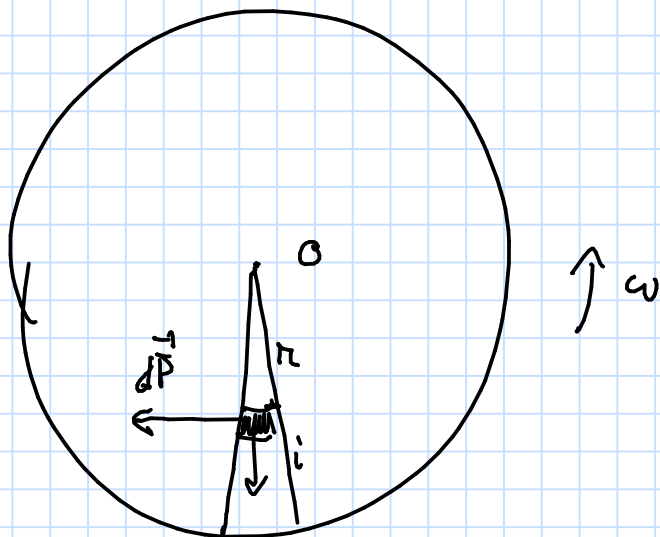
$$\mathcal{E}_i = \oint_{\text{cic. (chiuso)}} \vec{E}_i \cdot d\vec{s} = \int_0^a \mathcal{E} ds = \int_0^a \int_0^{2\pi} r \omega B \hat{n} \cdot d\vec{n}$$

$$= \omega B \int_0^a r dr = \omega B \frac{a^2}{2}$$

$\Rightarrow i = \frac{\mathcal{E}_i}{R}$ segue $\mathcal{E}_i$ da centro a bordo del disco
in senso orario

forza $d\vec{F}$: $d\vec{F} = i d\vec{r} \times \vec{B}$
opposta alla rotazione





momento delle forze

$$d\vec{M} = \vec{r} \times d\vec{F}$$

entrante $\otimes$
 $\vec{M}$

opposto a $\vec{\omega}$

$$d\vec{M} = -\frac{B^2 a^2}{2R} r dr \vec{\omega}$$

$$\vec{M} = \int_0^a d\vec{M} = -\frac{B^2 a^4}{4R} \vec{\omega}$$

frenante $\sim -\vec{\omega}$:
tipo viscoso

$\Rightarrow$ attrito elettromagnetico

potenza per mantenere rotazione : momento delle forze $\vec{M}'$

$$\vec{M}' + \vec{M} = 0$$

potenza $P = M' \omega = -M \omega = \frac{B^2 a^4}{4R} \omega^2$
fornita $\parallel$ p. dissipata elettrica

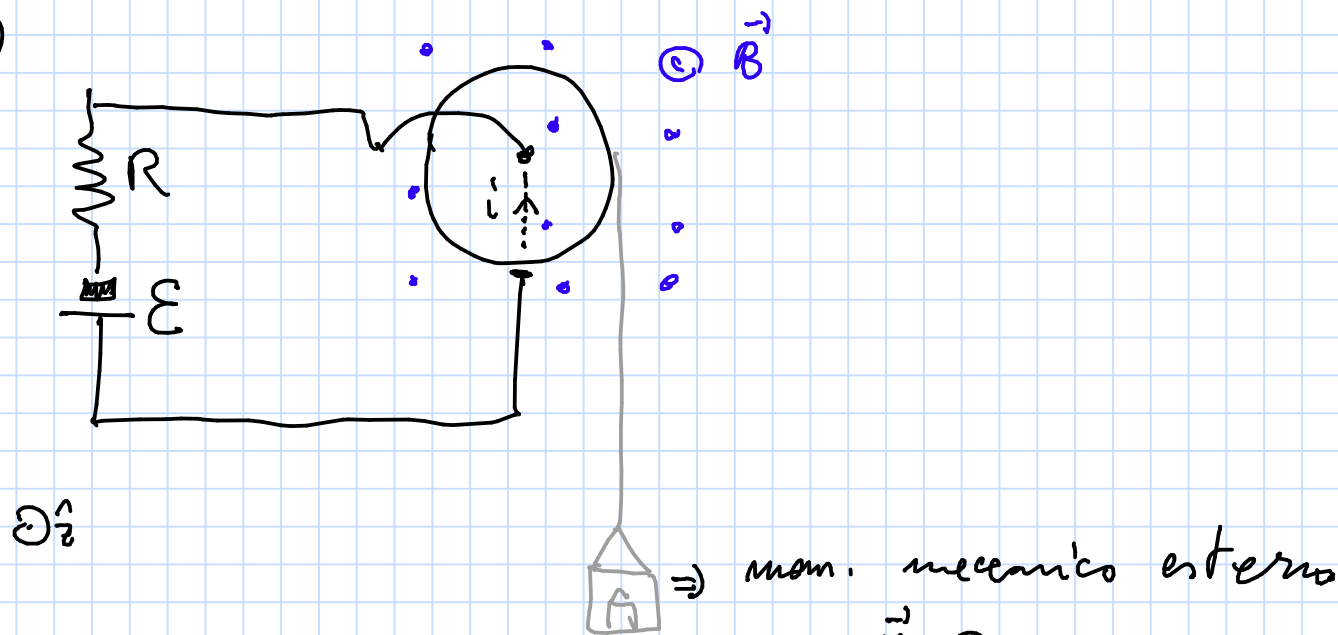
$$\frac{\varepsilon_i^2}{R} = \left(\frac{\omega B a^2}{2} \right)^2 \cdot \frac{1}{R}$$

se si toglie M' esterno $\Rightarrow$ moto frenato

$\Rightarrow$ Barlow come freno

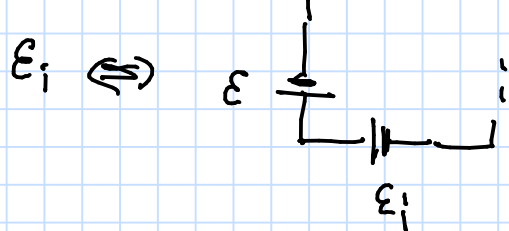
Disco di Barlow come motore

(b)



è opportuno a esempio di prima $\vec{M}_0 \otimes$

$$\vec{M}_1 = i B \frac{a^2}{2} \hat{z} \quad \otimes \vec{M}_1$$



$$\omega \Rightarrow E_i = -\frac{B a^2}{2} \omega$$

Ohm

$$E + E_i = R i \Rightarrow i = \frac{E - \frac{1}{2} B a^2 \omega}{R}$$

$$I \frac{d\omega}{dt} = M_1 - M_0 = \frac{1}{2} B a^2 i - M_0$$

$$= \left(\frac{E}{R} - \frac{1}{2} \frac{B a^2 \omega}{R} \right) \frac{B a^2}{2} - M_0$$

si può scrivere

$$\frac{d\omega}{dt} = \text{cost} - \frac{\omega}{\tau}, \quad \tau = \frac{4 I R}{B^2 a^4}$$

a regime: $\frac{d\omega}{dt} = 0$

$$\downarrow$$
$$\omega_{\infty} = \frac{z}{Ba^2} \left(\mathcal{E} - \frac{zRM_0}{Ba^2} \right) \neq 0$$

("∞": $t \gg \tau$) $\uparrow$ motore

$$i_{\infty} = \frac{zM_0}{Ba^2}$$

$$\mathcal{E}_{i,\infty} = - \left(\mathcal{E} - \frac{zRM_0}{Ba^2} \right)$$

$$P_{\infty} = Ri_{\infty}^2 + M_0 \omega_{\infty}$$

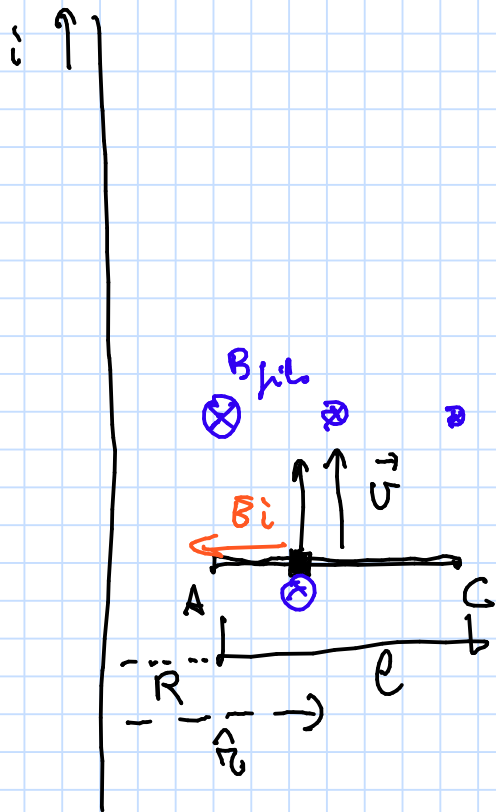
$\downarrow$ calore nella R $\downarrow$ lavoro

valore limite $R \rightarrow 0$

... termini...

$$P_{\text{gen}} = \mathcal{E} i_{\infty} = \mathcal{E} \frac{zM_0}{Ba^2} = \omega_{\infty} M_0 = P_{\text{diss. nella rotaz.}}$$

ω_{∞}



→ barretta conduttrice

$$\vec{E}_i = \vec{v} \times \vec{B}$$

$$= v B(r) \cdot (-\hat{r})$$

$$= v \frac{\mu_0 i}{2\pi r} (-\hat{r})$$

$$V_A - V_B = \int_A^B \vec{E} \cdot d\vec{r} = - \frac{v \mu_0 i}{2\pi} \int_{r=R}^{r=R+l} \frac{1}{r} dr$$

$$= - \frac{v \mu_0 i}{2\pi} \log\left(\frac{R+l}{R}\right)$$