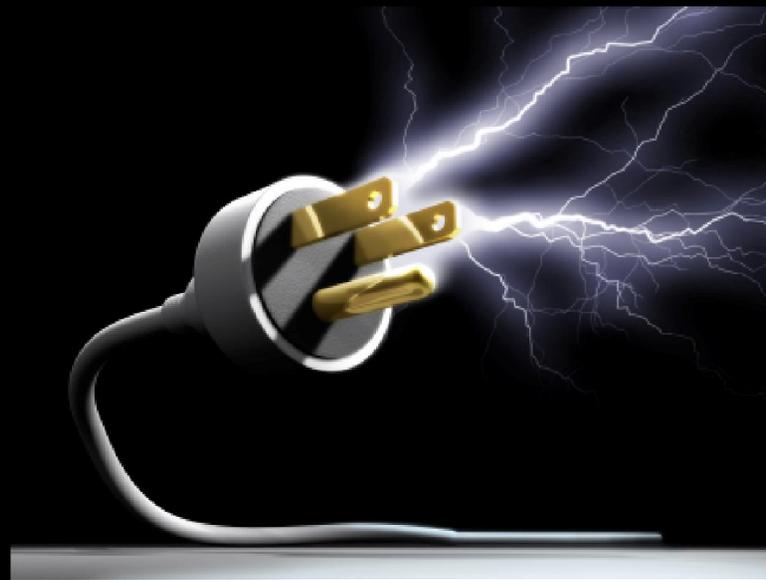


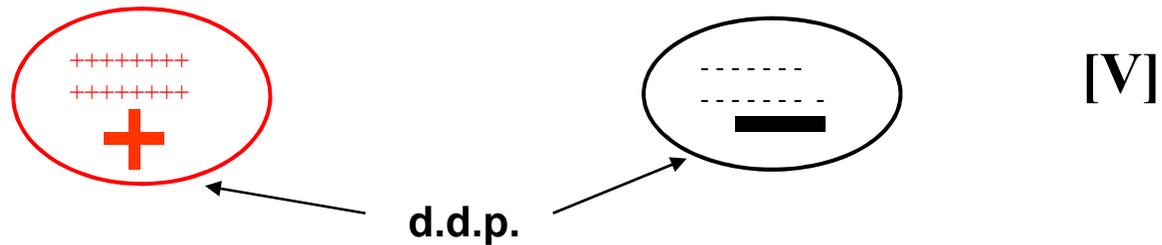
Eletricidade

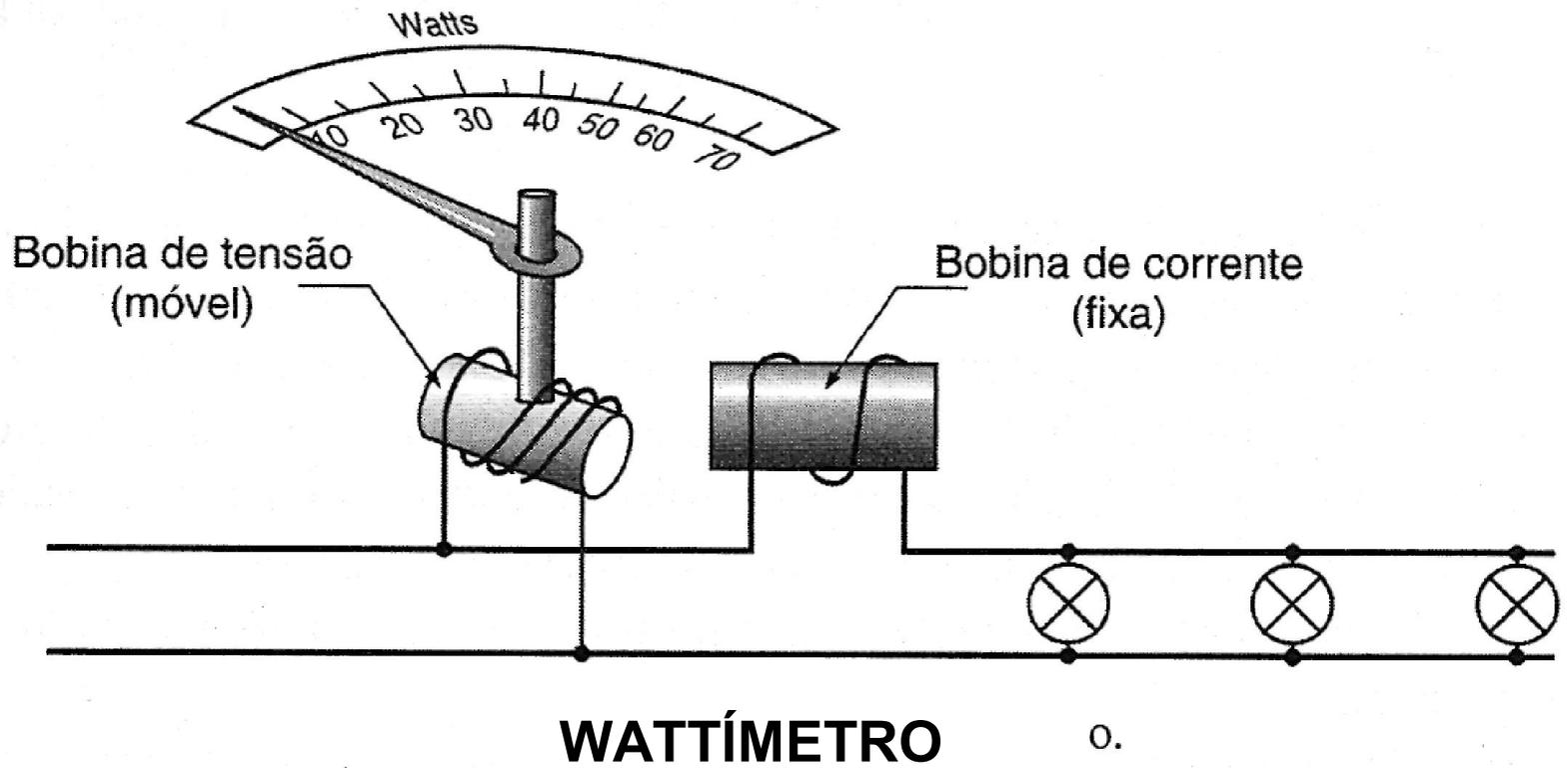


CONCEITOS BÁSICOS DE ELETRICIDADE

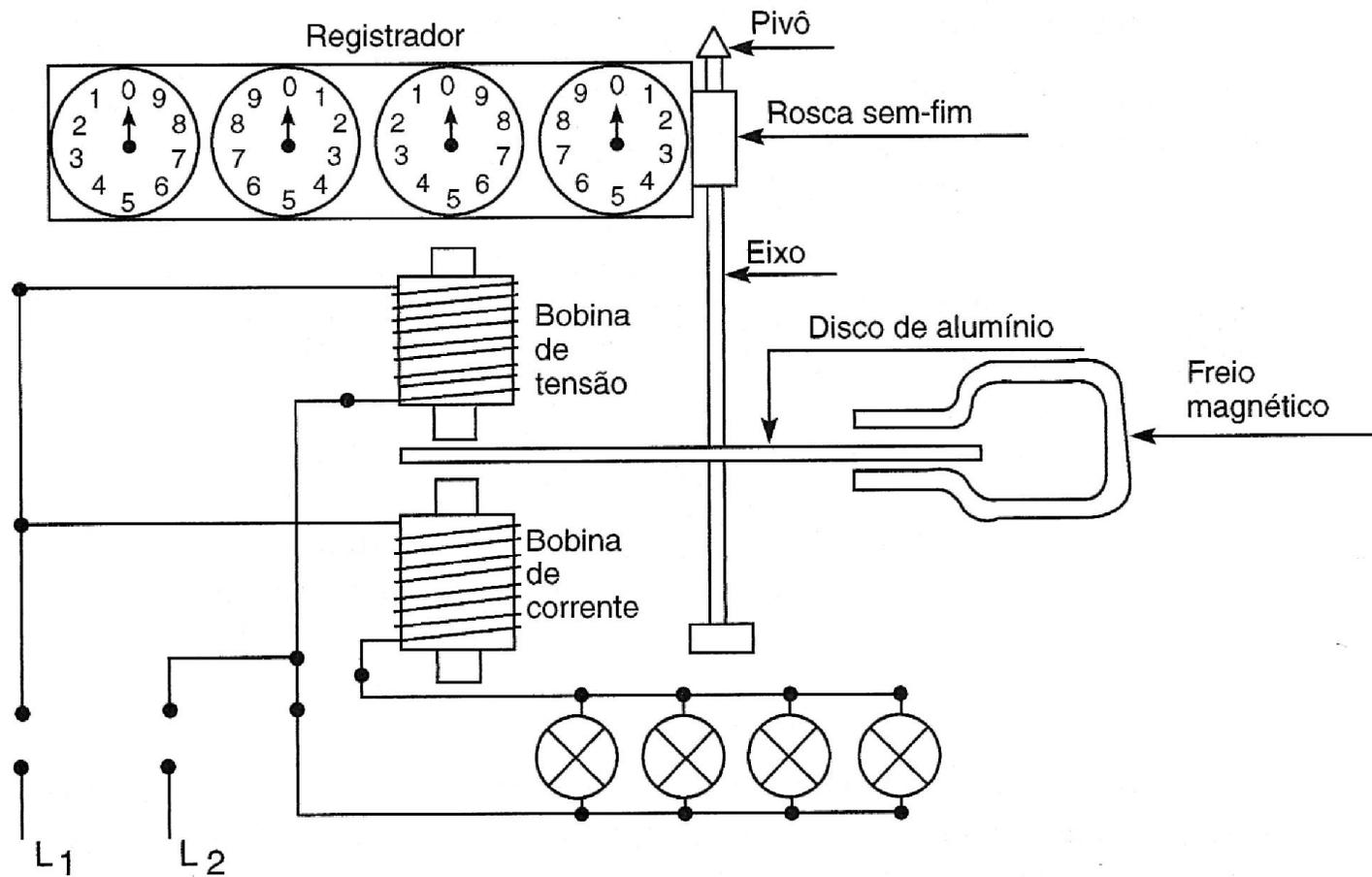
GRANDEZAS ELÉTRICAS

POTENCIAL ELÉTRICO





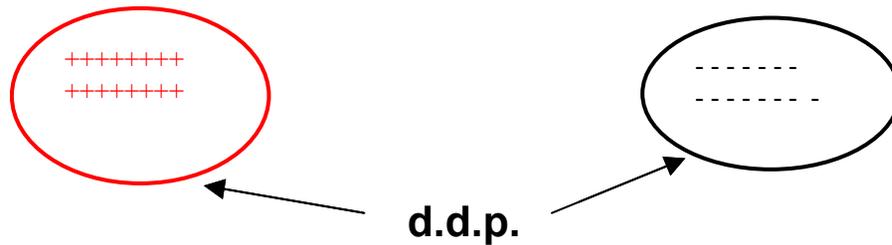
$$P = V \times I$$



quiloWATT-hora

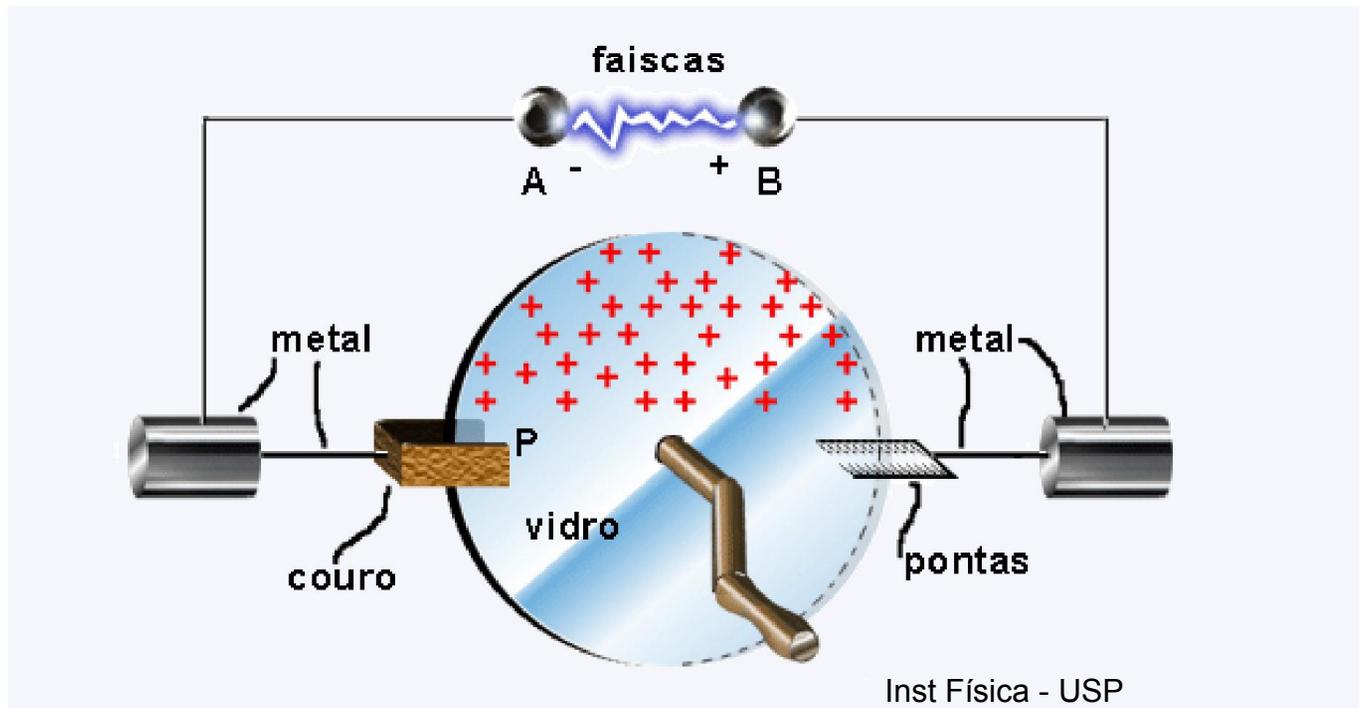
$$E = P \times t$$

PRODUÇÃO DE UMA FORÇA ELETROMOTRIZ (d.d.p.)

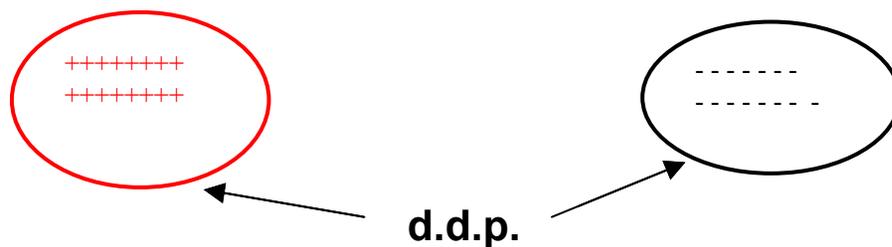


POR ATRITO

(ELETRICIDADE ESTÁTICA)



PRODUÇÃO DE UMA FORÇA ELETROMOTRIZ (d.d.p.)



PELA AÇÃO DA LUZ

(CÉLULAS FOTOVOLTAICAS)

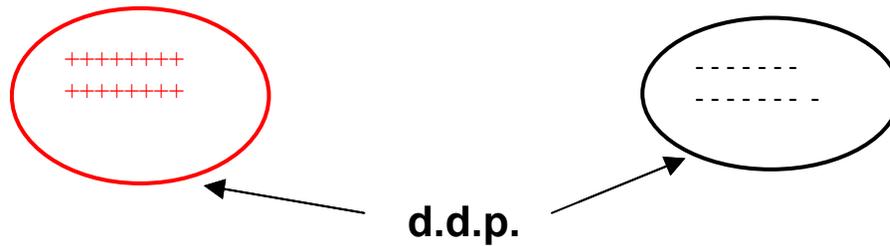
POR AÇÃO QUÍMICA

(PILHAS e BATERIAS)
(CÉLULA de HIDROGÊNIO)



Pesquisa sobre células acima

PRODUÇÃO DE UMA FORÇA ELETROMOTRIZ (d.d.p.)



PELA COMPRESSÃO

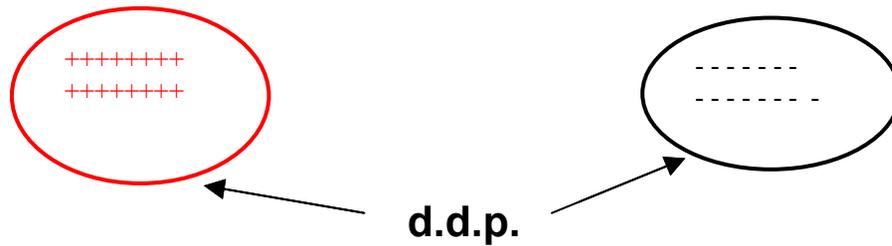
(EFEITO PIEZOELÉTRICO)



acupuntura.

Ref.: Dr Yamaguchi –bio-eletricidade

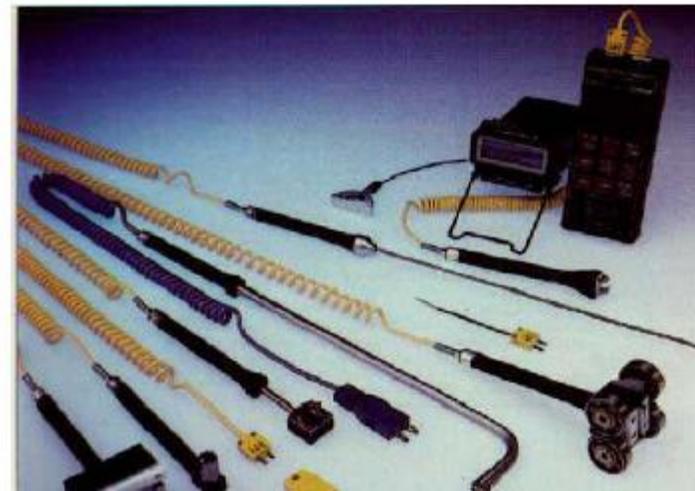
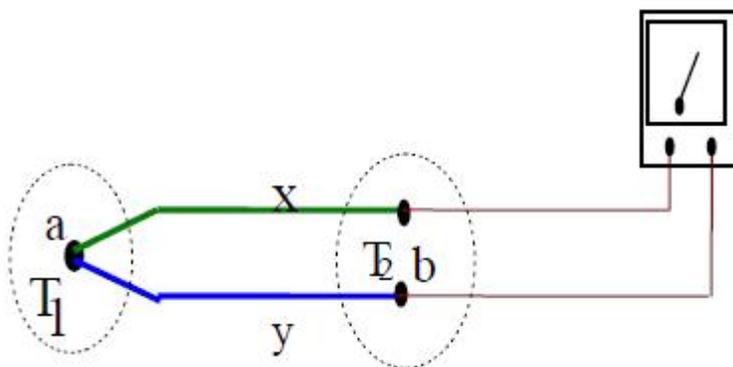
PRODUÇÃO DE UMA FORÇA ELETROMOTRIZ (d.d.p.)



POR AQUECIMENTO

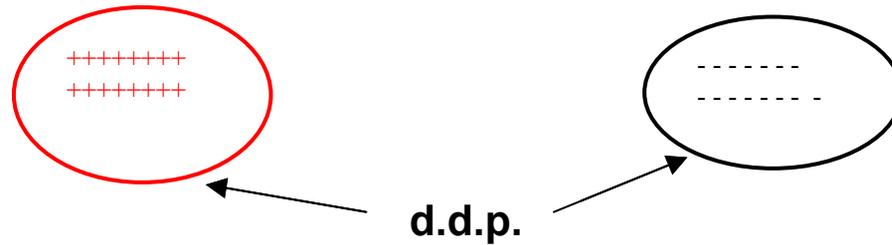
(EFEITO TERMELÉTRICO)

TERMOPAR



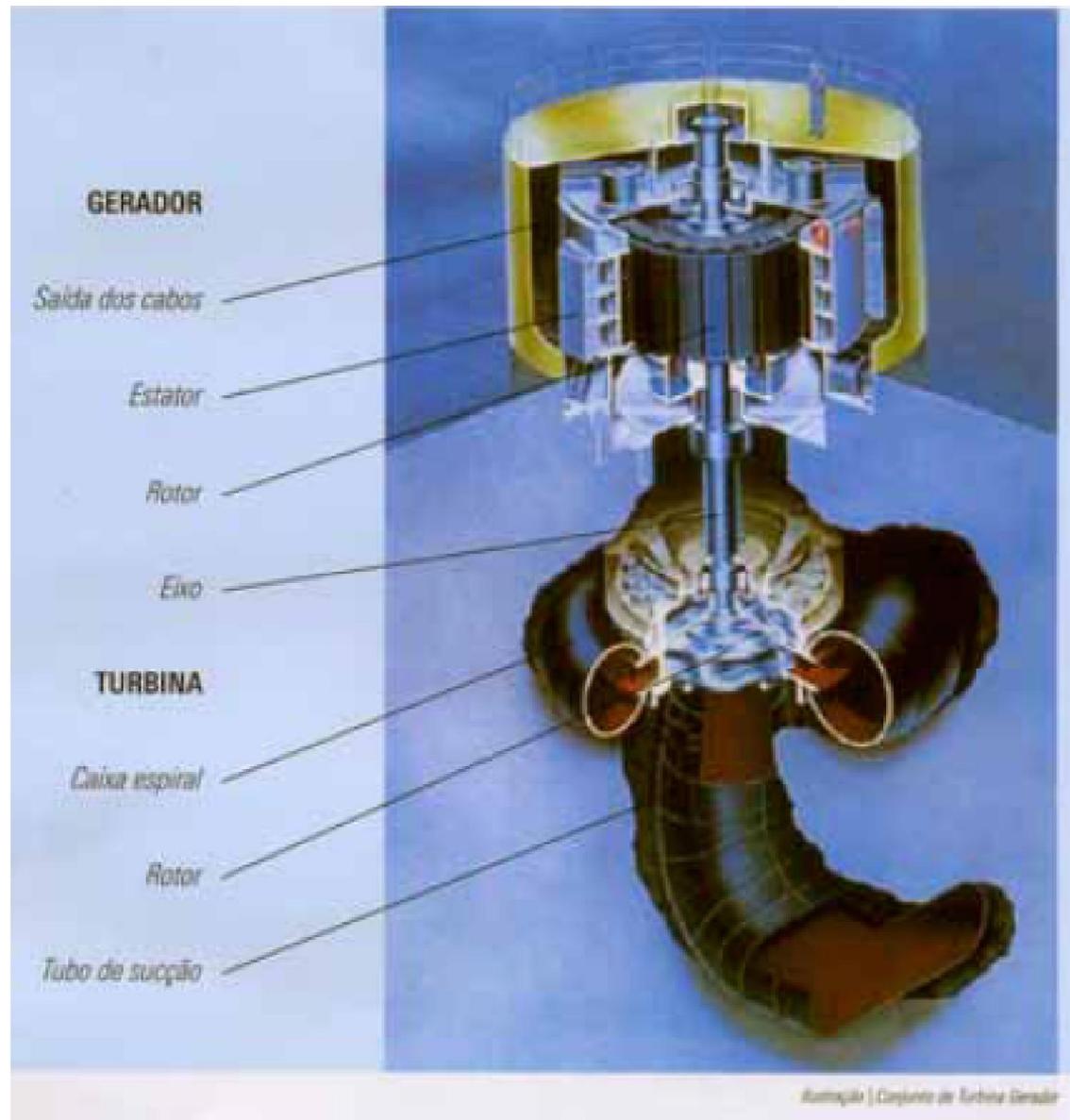
- Diversos termopares com finalidades aplicativas diferentes.

PRODUÇÃO DE UMA FORÇA ELETROMOTRIZ (d.d.p.)



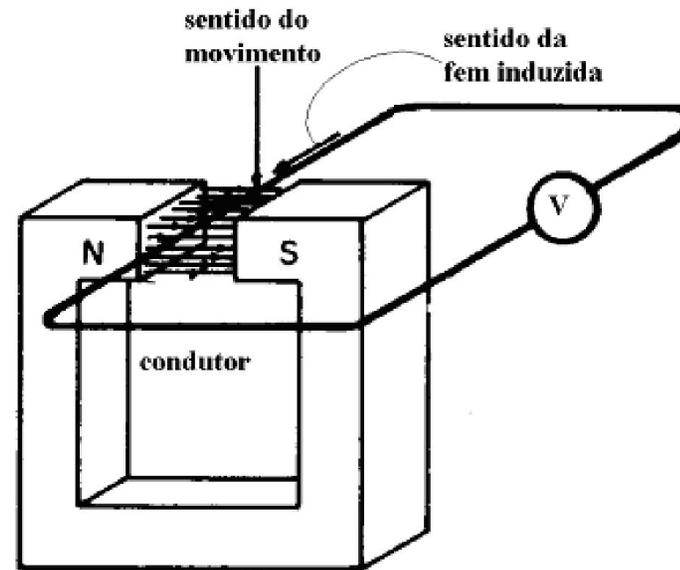
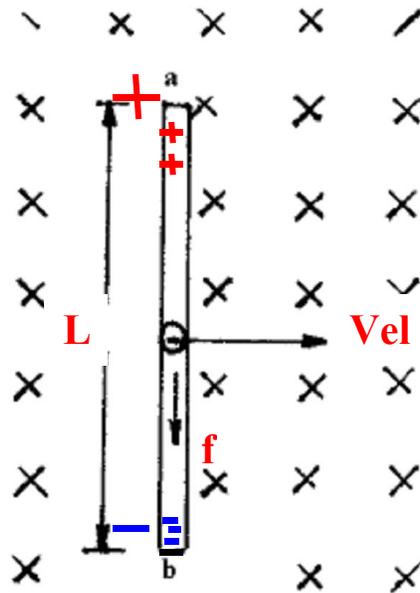
POR INDUÇÃO ELETROMAGNÉTICA





grupo TG turbo gerador, o “miolo” da usina hidrelétrica
desenho extraído de folder CPFL

PRINCÍPIO DA INDUÇÃO ELETROMAGNÉTICA



Lei de Faraday

$$V = f.e.m = B.L.v_{el}$$

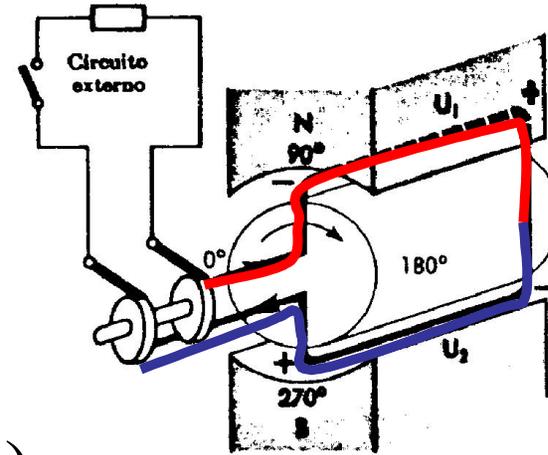
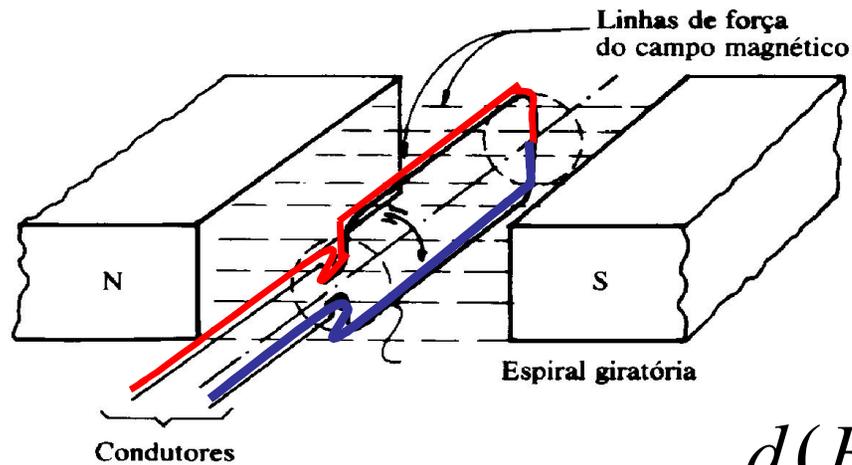
V = tensão gerada [V]

B = intensidade do campo magnético [Wb]

L = comprimento do condutor [m]

v_{el} = velocidade do condutor [m/s]

GERADOR MONOFÁSICO



$$v = N \frac{d(B \times A)}{dt}$$

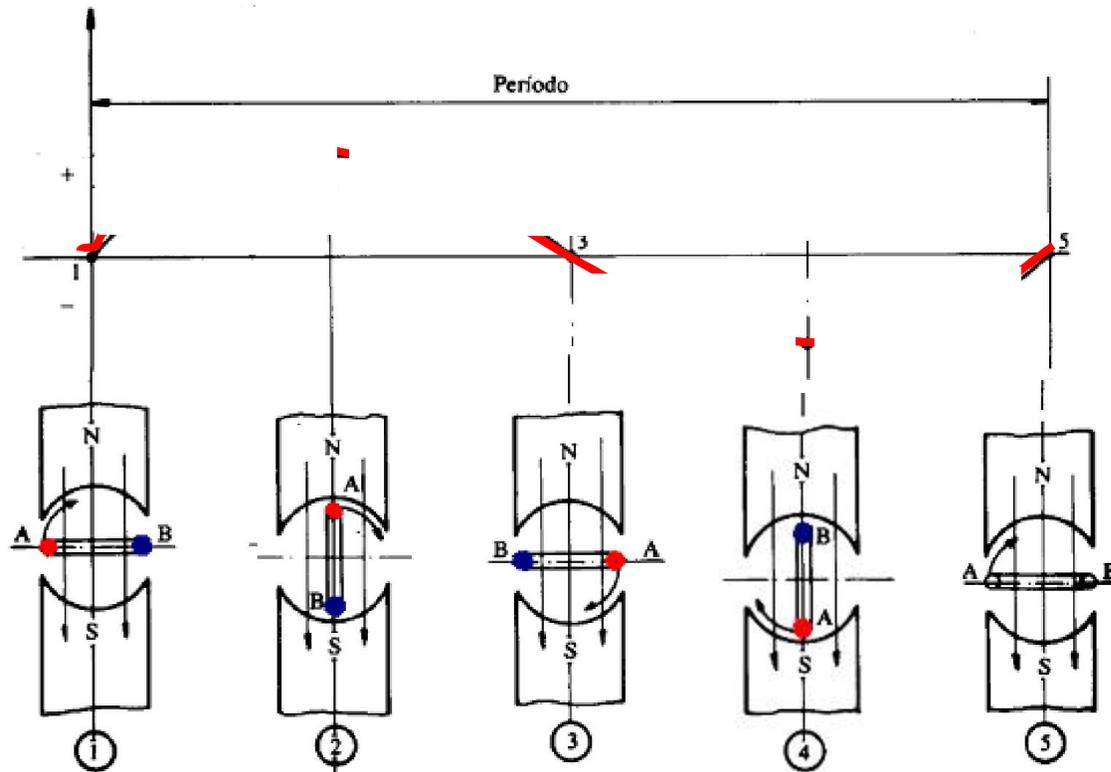
ou

$$v = V_{\max} \text{sen } \omega t \quad [\text{V}]$$

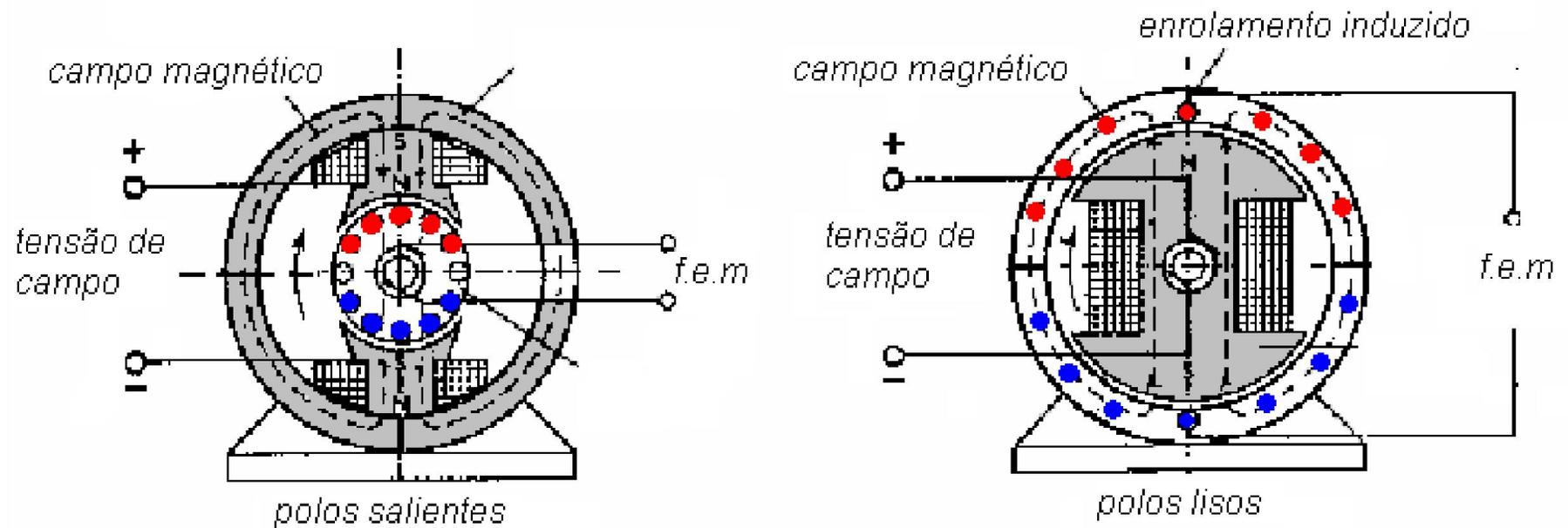
$\omega = 2 \pi f$ = velocidade angular

sendo f = frequência

GRÁFICO DA TENSÃO GERADA

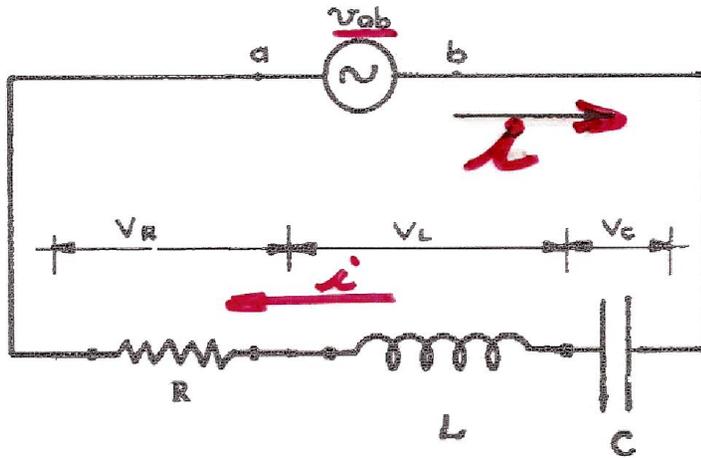


Tipos de Geradores



Gerador

CIRCUITOS DE CORRENTE ALTERNADA



$$v_{ab} = V_{\max} \text{sen} (\omega t) \text{ [v]} \quad (1)$$

$$v_{ab} = V_R + V_L + V_C \text{ [v]} \quad (2)$$

$$V_R = Ri$$

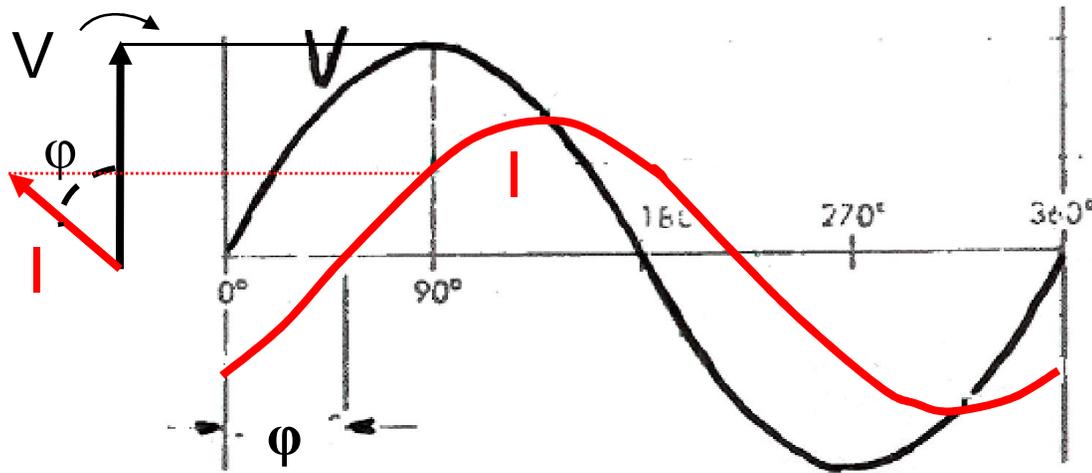
$$V_L = L \frac{di}{dt}$$

$$V_C = \frac{q}{C}$$

igualando (1) e (2) e substituindo V_R , V_L e V_C temos:

concluindo:

$$v = V_{m\acute{a}x} \text{sen}(\omega t) \quad e \quad I = I_{m\acute{a}x} \text{sen}(\omega t - \phi)$$



onde $\phi = \text{arc tg} \frac{X_L - X_C}{R}$

CASOS PARTICULARES

Circuito puramente resistivo

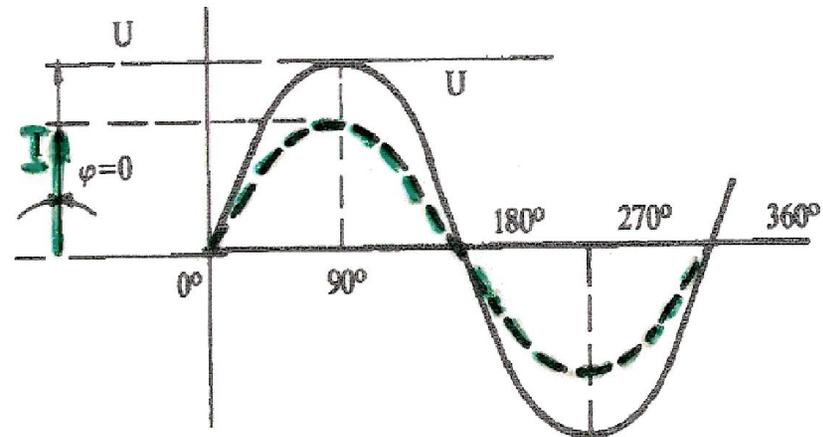
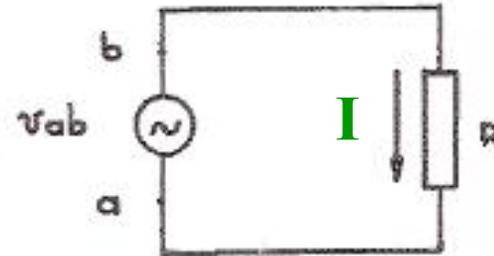
$$X_L = X_C = 0$$

como

$$\phi = \text{arc tg} \frac{X_L - X_C}{R} \quad \text{então:}$$

$$\phi = \text{arc tg} \frac{0}{R} \quad \therefore \phi = 0^\circ \quad \text{logo:}$$

$$I = I_{\text{máx}} \text{sen}(\omega t)$$



Circuito puramente indutivo

$$R = X_C = 0$$

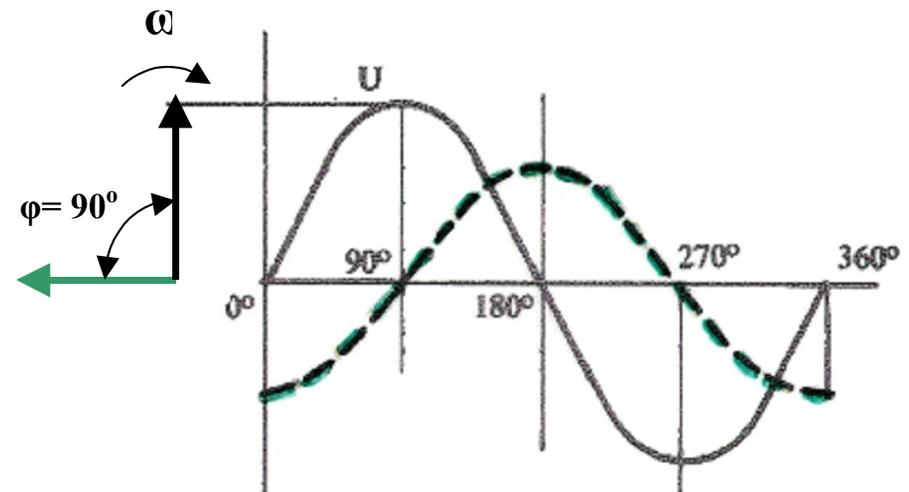
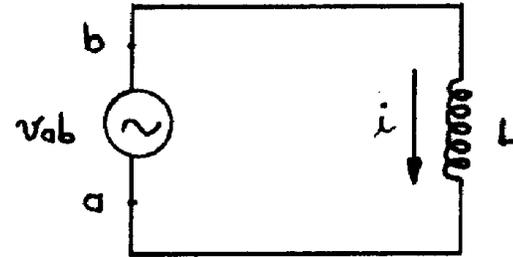
como

$$\phi = \text{arc tg} \frac{X_L - X_C}{R} \quad \text{então:}$$

$$\phi = \text{arc tg} \frac{X_L}{0} \quad \therefore \quad \phi = 90^\circ$$

logo:

$$I = I_{\text{máx}} \text{sen}(\omega t - 90)$$



Circuito puramente capacitivo

$$X_L = R = 0$$

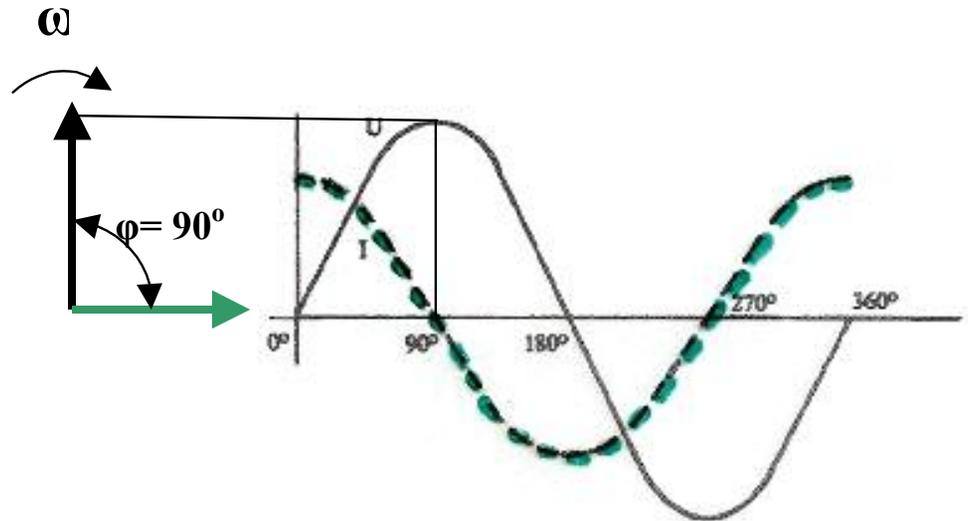
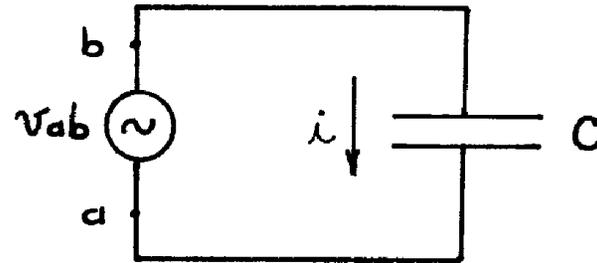
como

$$\phi = \text{arc tg} \frac{X_L - X_C}{R} \quad \text{então:}$$

$$\phi = \text{arc tg} \frac{-X_C}{0} \quad \therefore \quad \phi = -90^\circ$$

logo:

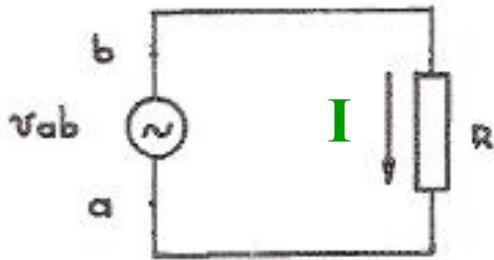
$$I = I_{\text{máx}} \text{sen}(\omega t + 90)$$



Potência em Corrente Alternada – Definição

$$p = v i \quad [VA] \quad \{ > [W] > [var] \}$$

Circuito resistivo

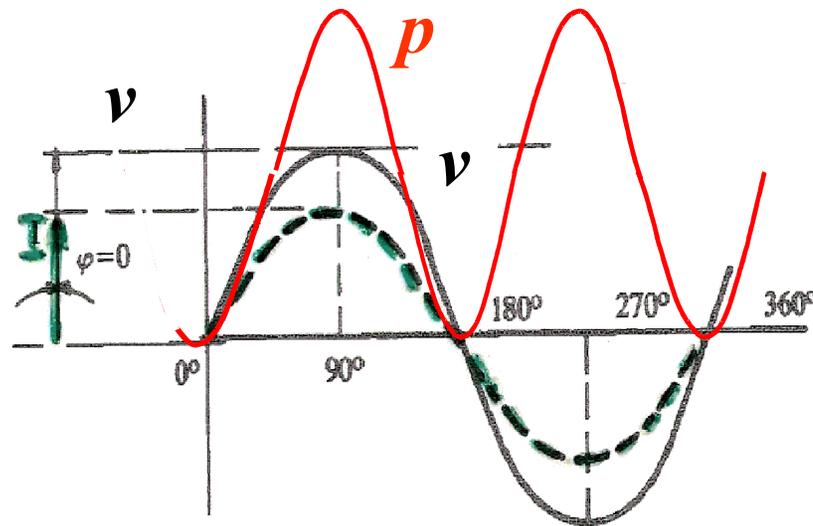
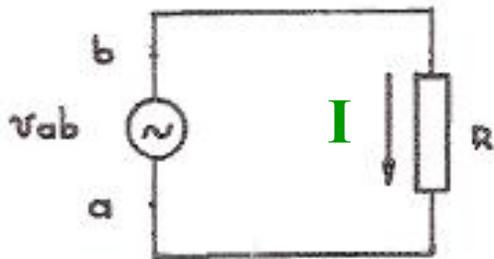


Potência em Corrente Alternada

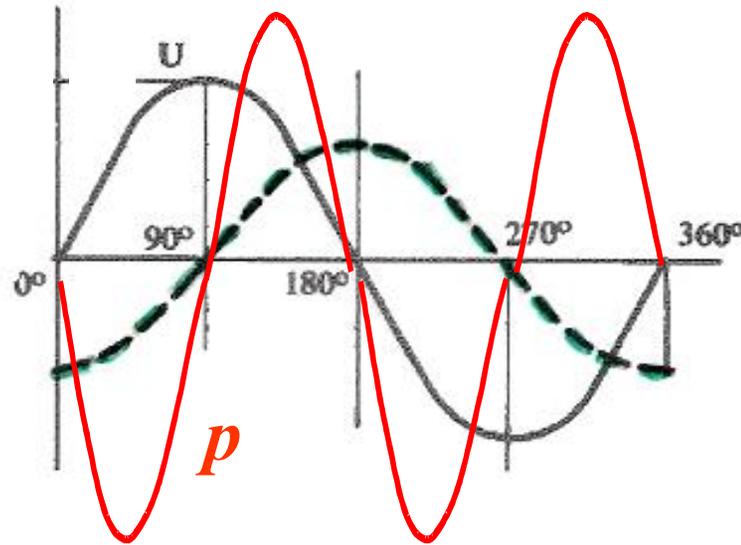
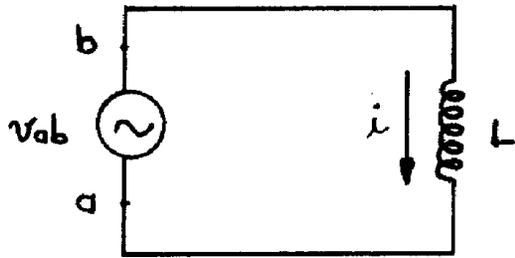
– Definição

$$p = v i \quad [VA] \quad \{ > [W] > [var] \}$$

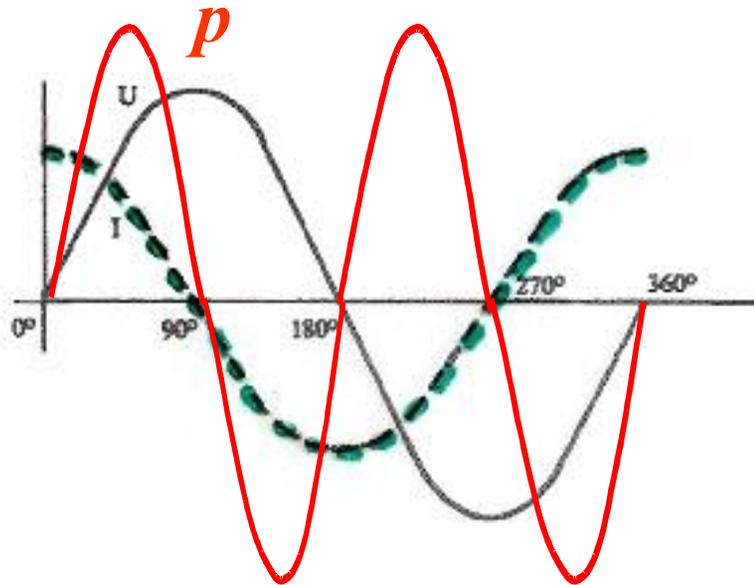
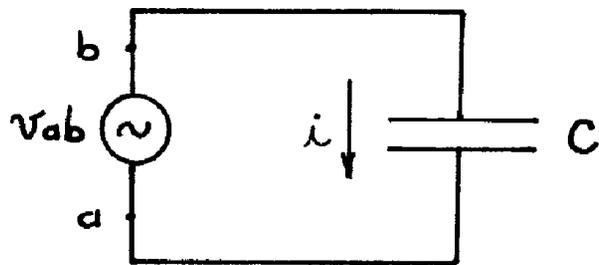
Circuito resistivo



Circuito indutivo

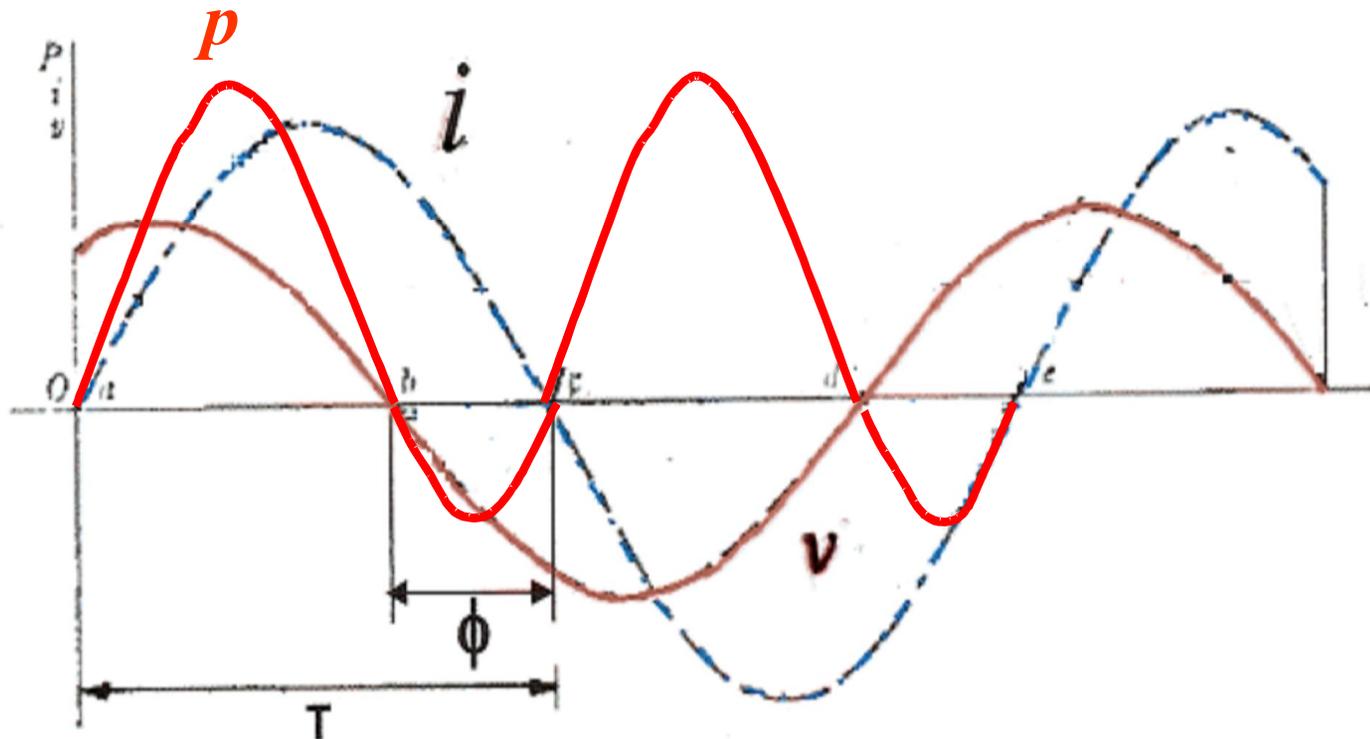


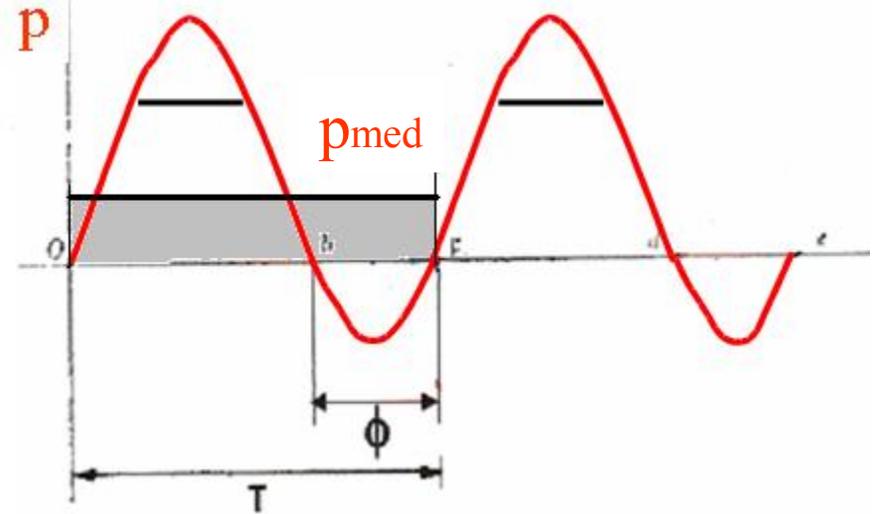
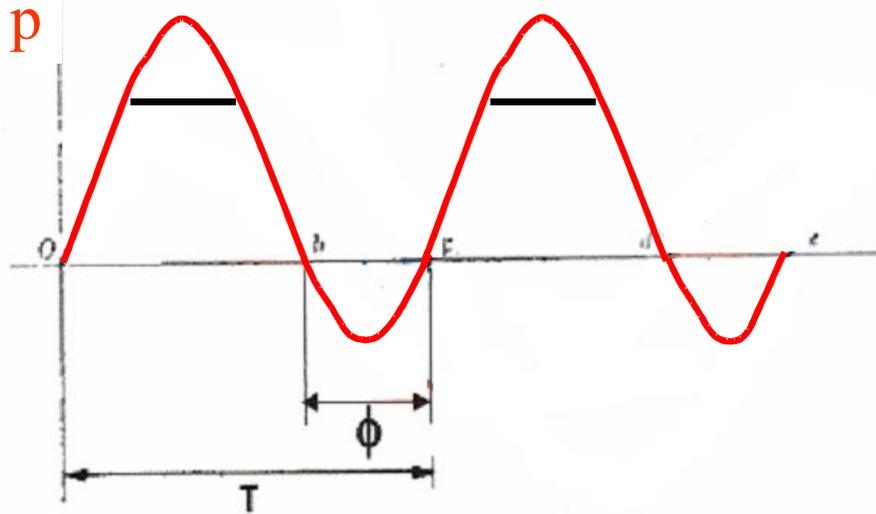
Circuito capacitivo



POTÊNCIA EM CIRCUITOS DE CORRENTE ALTERNADA

por definição: $p = v i$





$$E = \int_0^T p \, dt$$

$$P_{\text{méd}} = \frac{E}{T}$$

$$P_{\text{méd}} = \frac{1}{T} \int_0^T p \, dt$$

$$p = v \times i$$

$$P_{\text{méd}} = \frac{1}{T} \int_0^T v \, i \, dt$$

GERADOR TRIFÁSICO

Gerador Monofásico

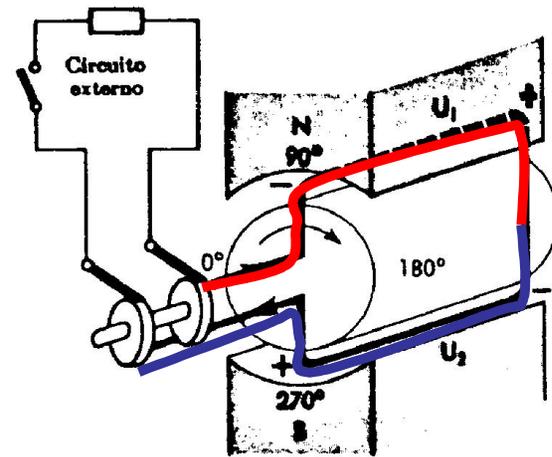
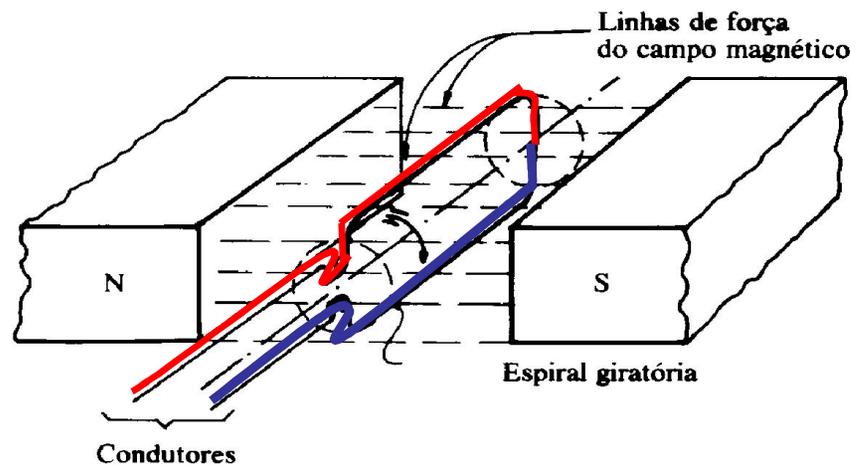
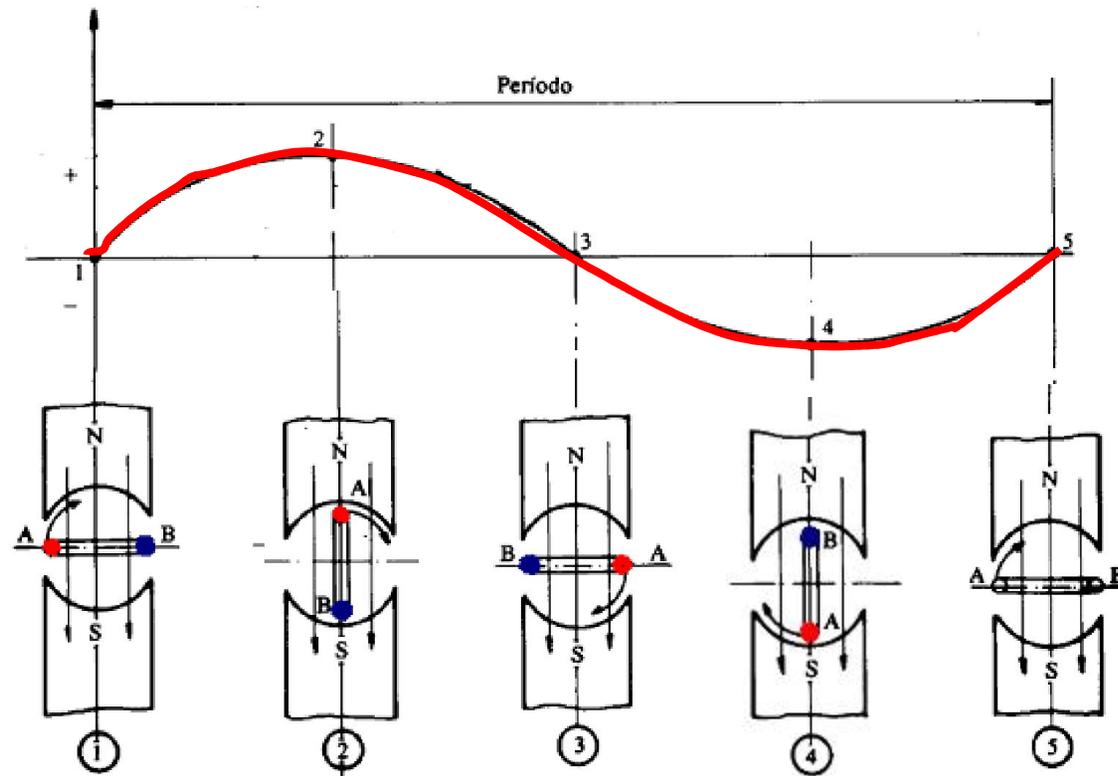
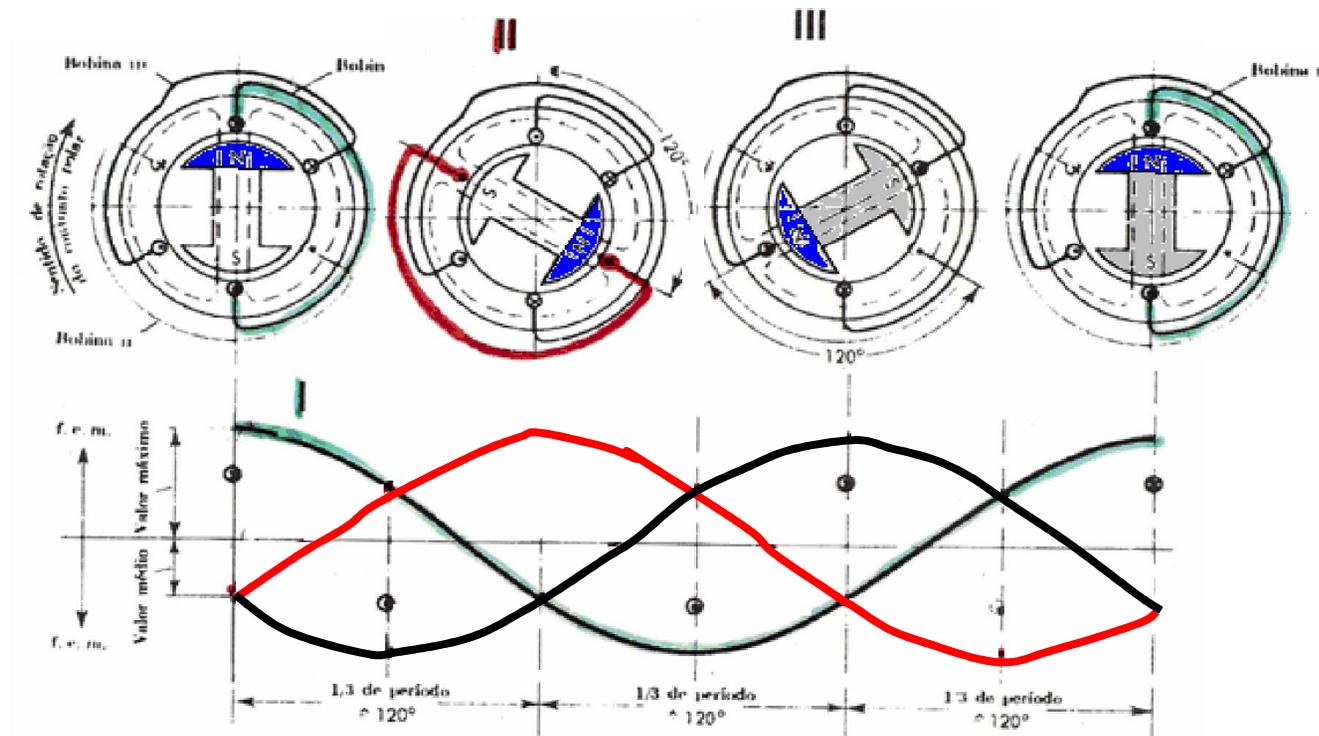


GRÁFICO DA TENSÃO GERADA



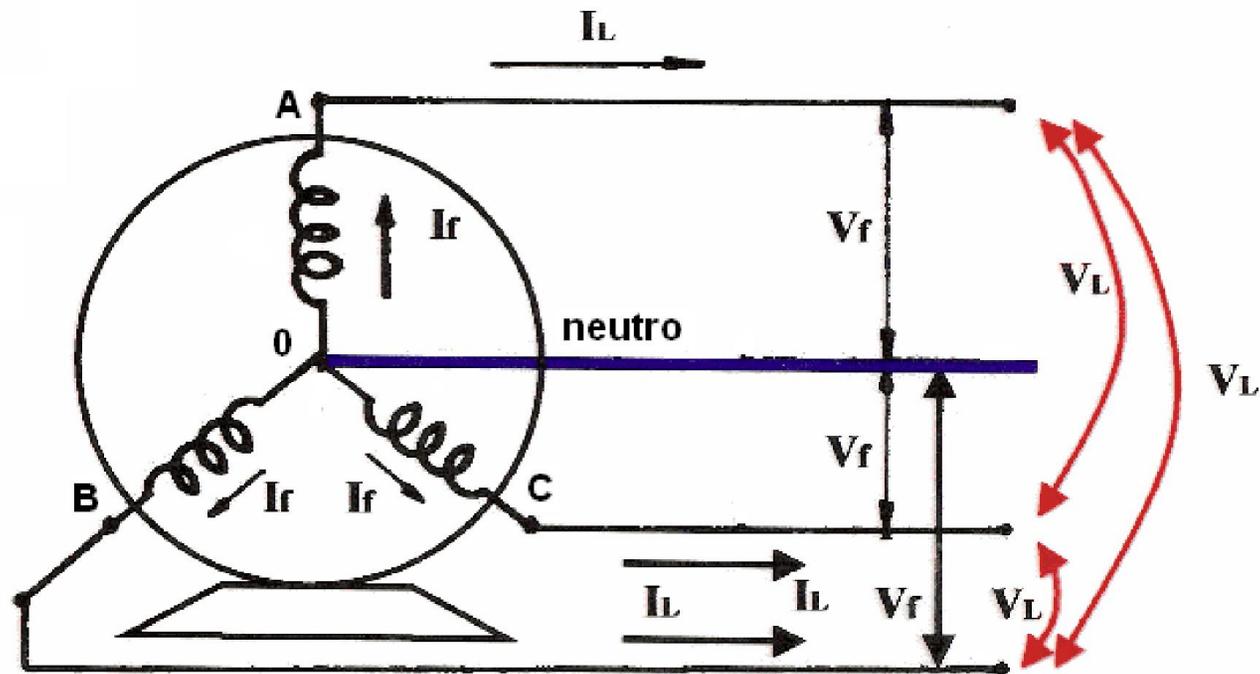
Gerador Trifásico

Conjunto de 3 Geradores monofásicos acoplados dentro de uma mesma carcaça, defasados de 120°



Formas de ligação do Gerador Trifásico

Ligação em ESTRELA ou Y

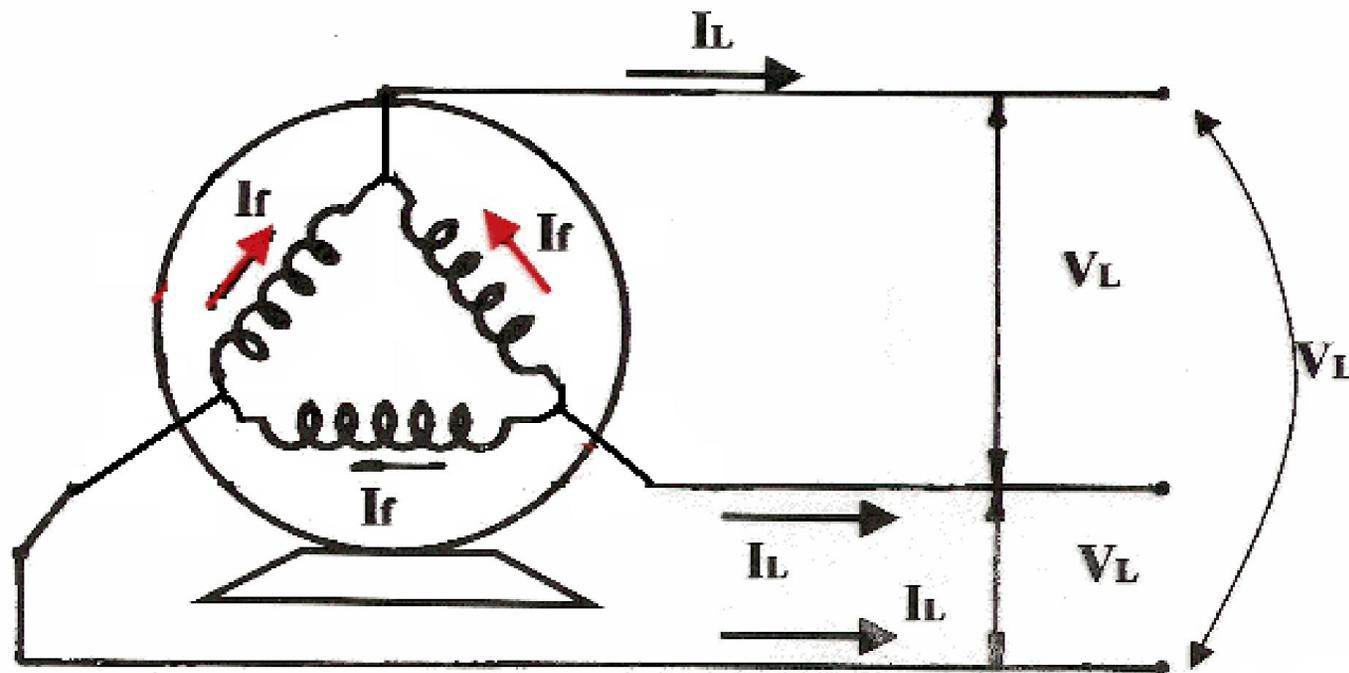


Provar que:

$$I_L = I_f$$

$$V_L = \sqrt{3} V_f$$

Ligação em TRIÂNGULO ou Delta



Provar que:

$$V_L = V_f$$

$$I_L = \sqrt{3} I_f$$