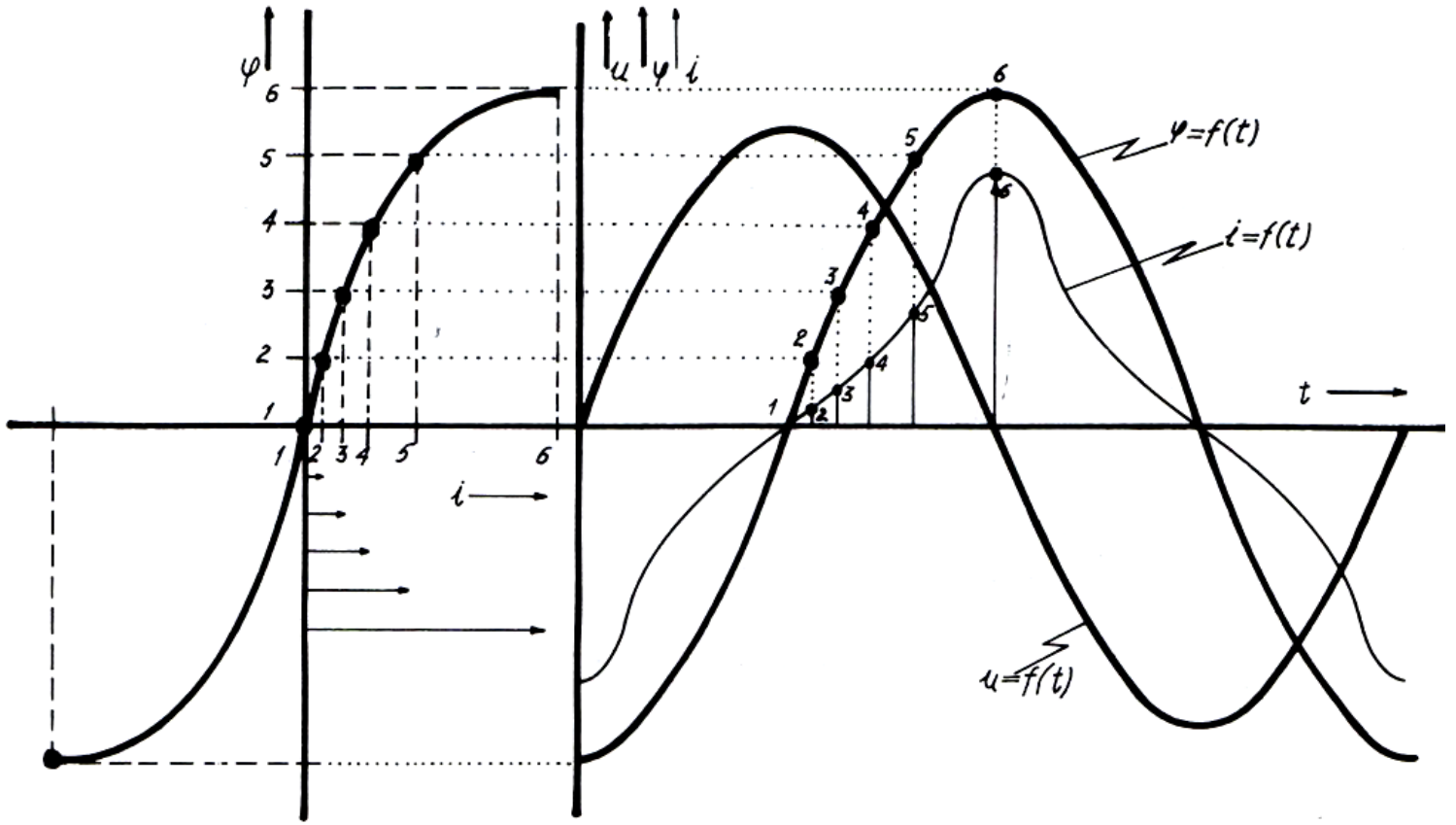
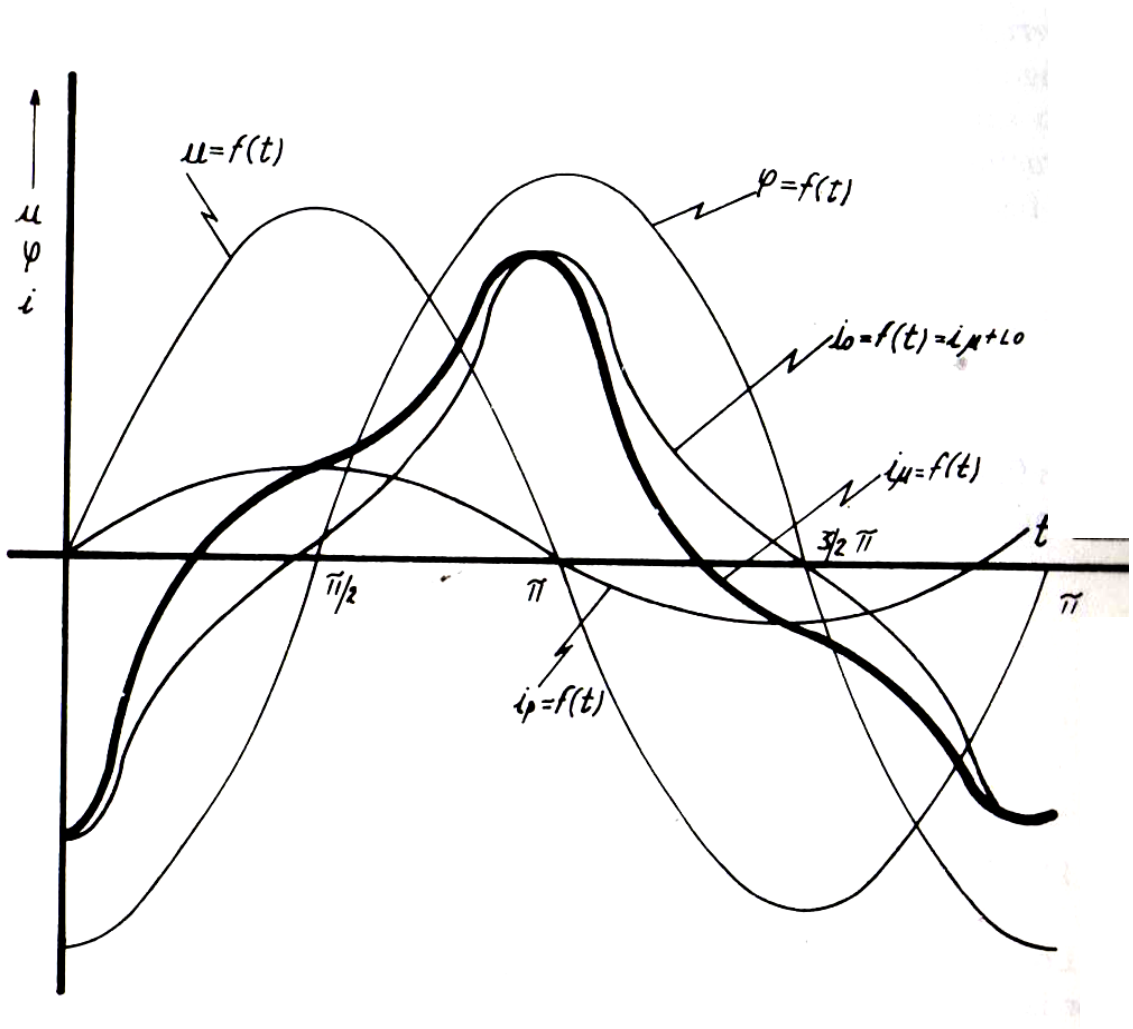

φ
u φ i
6
5
4
3
2
1
1 2 3 4 5 6
i
t
φ=f(t)
i=f(t)
u=f(t)


u φ i
u=f(t)
φ=f(t)
i0=f(t)=iμ+Lo
iμ=f(t)
ip=f(t)
t
π/2
π
3/2 π
π

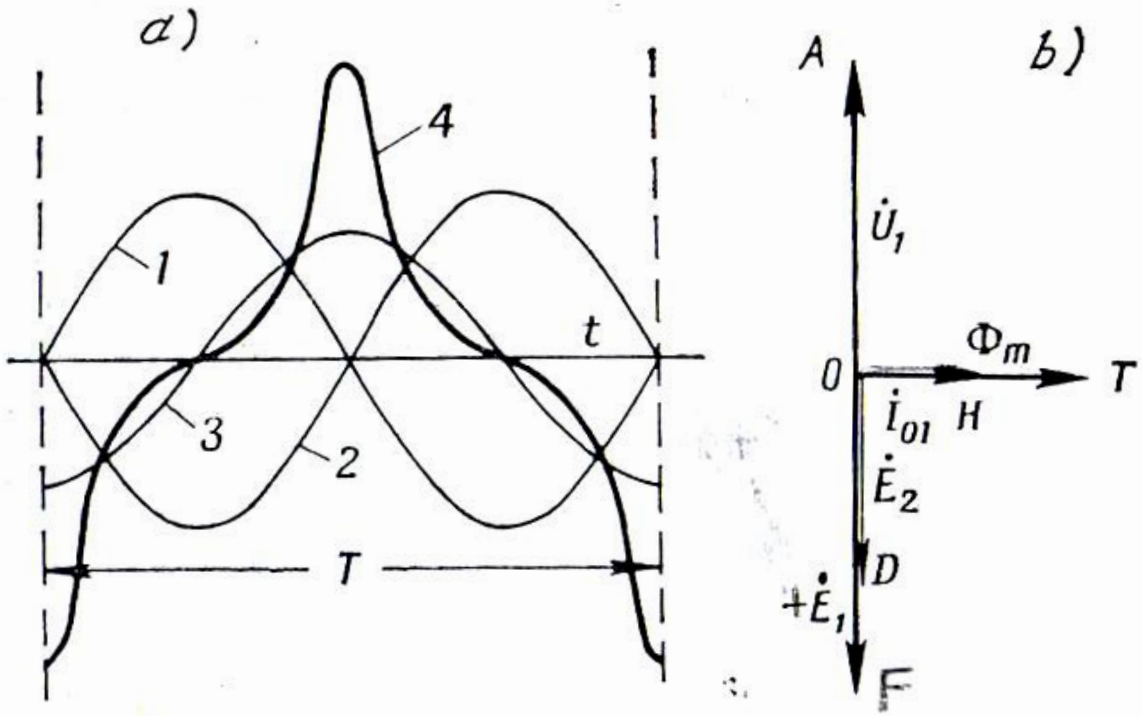


Fig. 14-2. Diagramas de la f.e.m. y corriente de un transformador monofásico elemental: *a* — en coordenadas rectangulares; *b* — vectorial

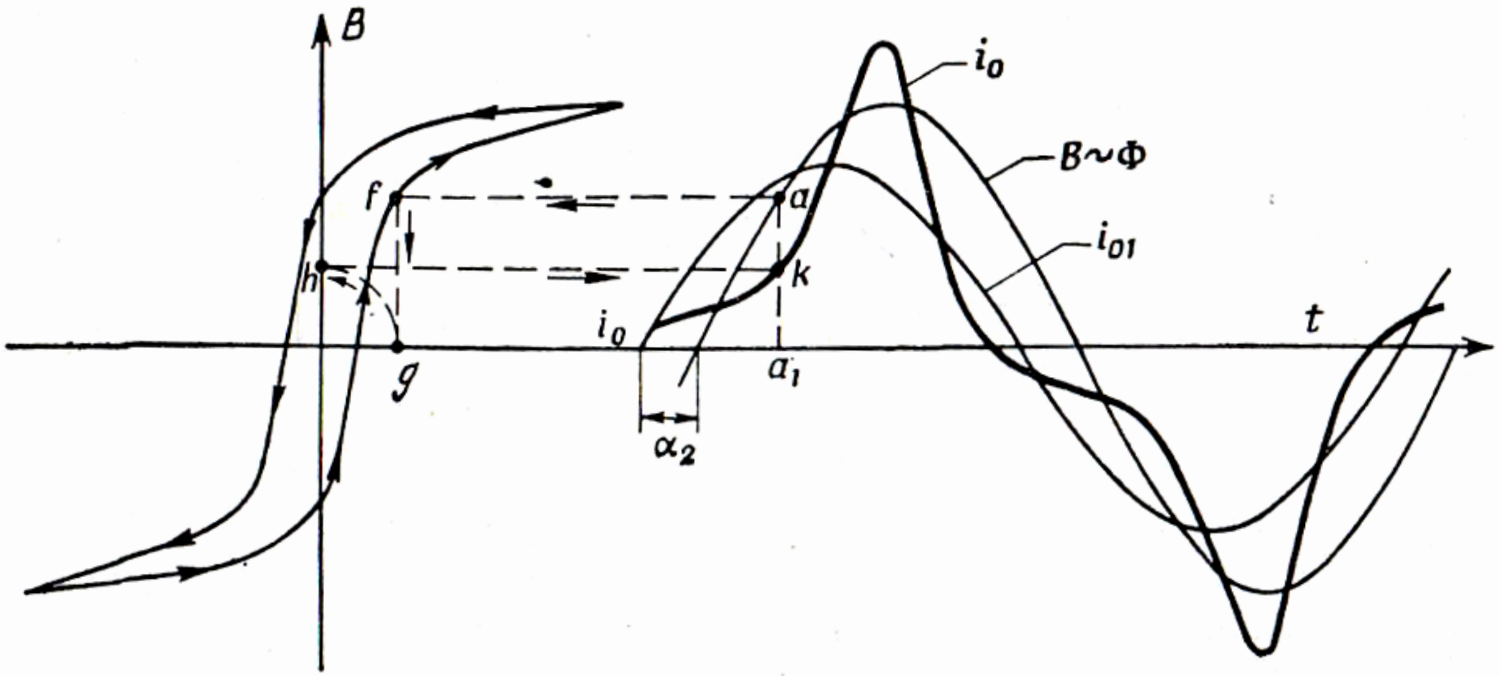
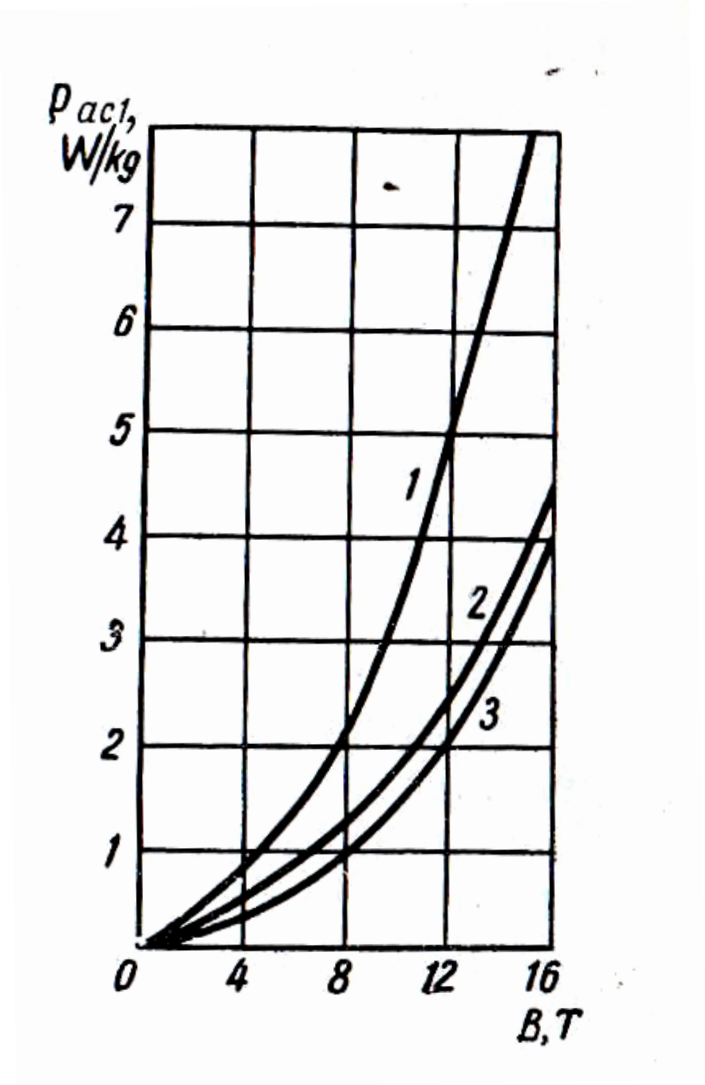
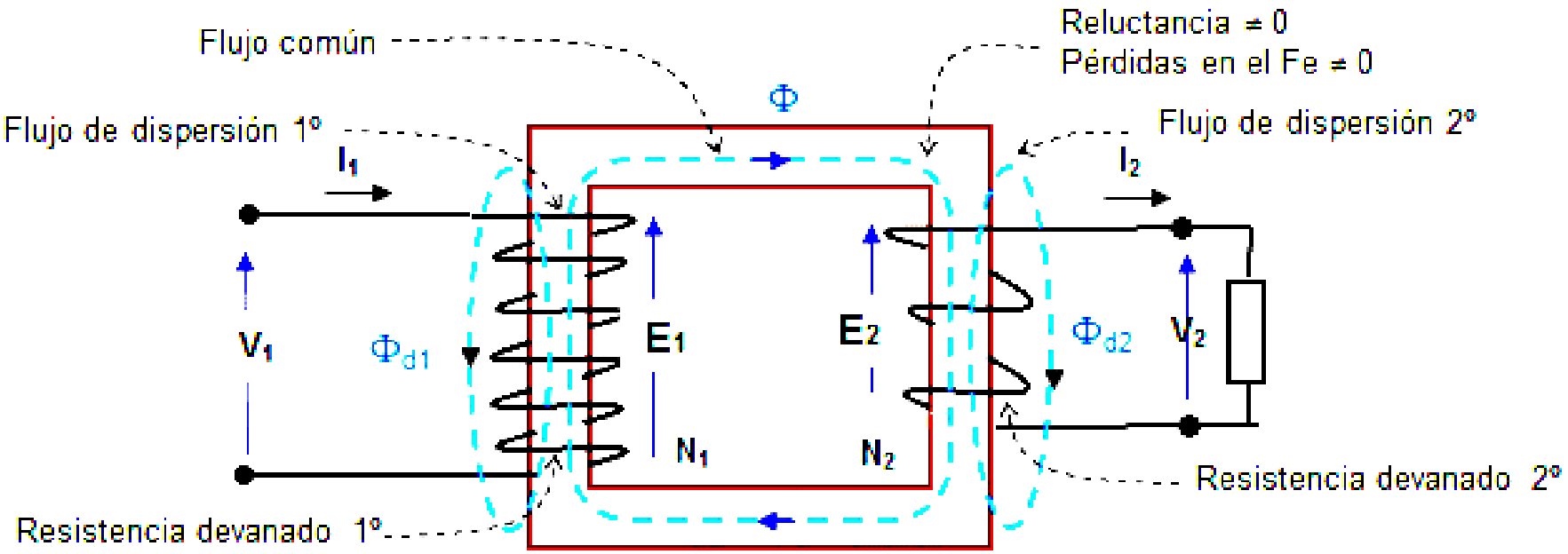


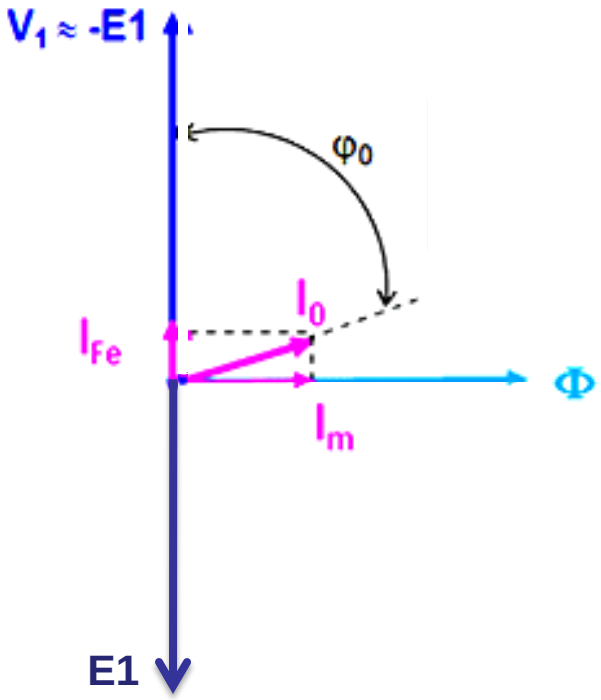
Fig. 14-6. Efecto de la histéresis sobre la curva de corriente en vacío


p ac1, W/kg
7
6
5
4
3
2
1
0
4
8
12
16
B, T
1
2
3

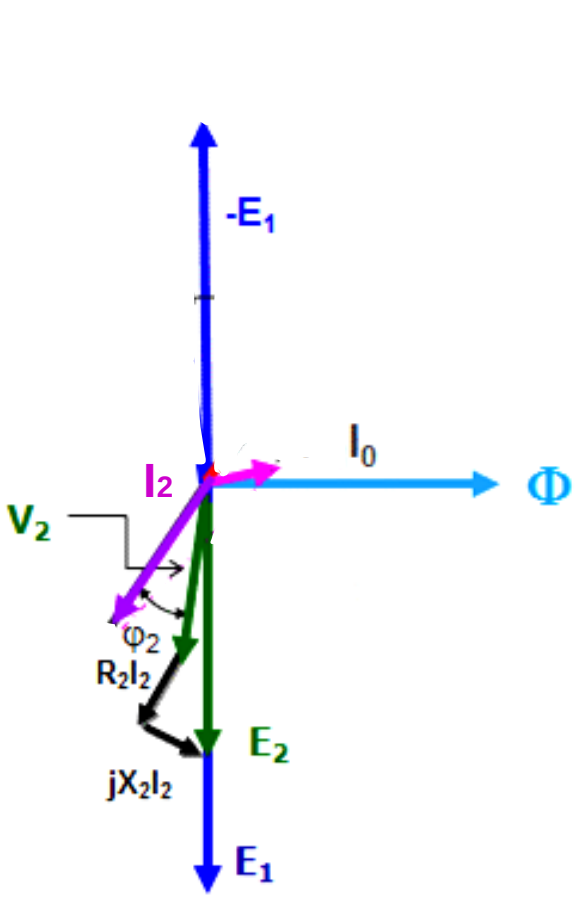
El transformador real

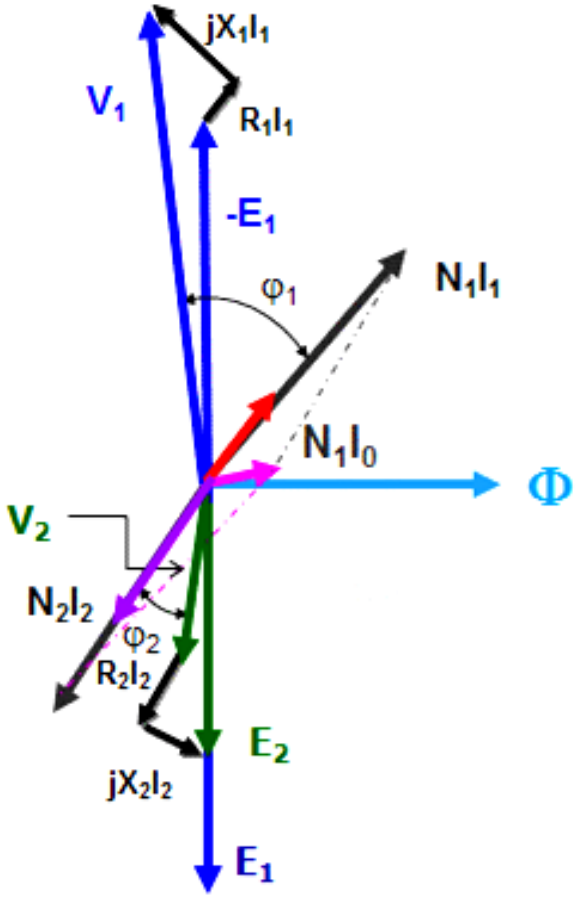


Vacío

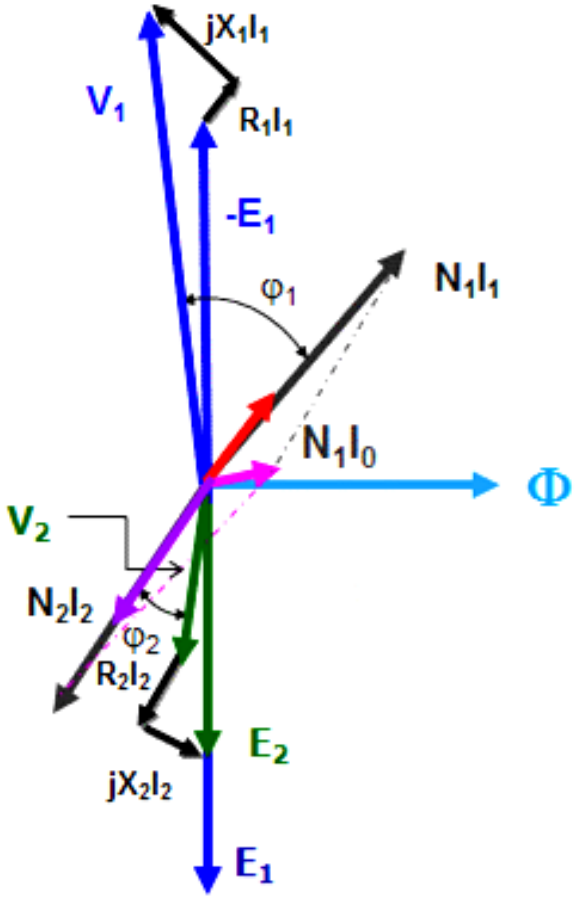


Carga

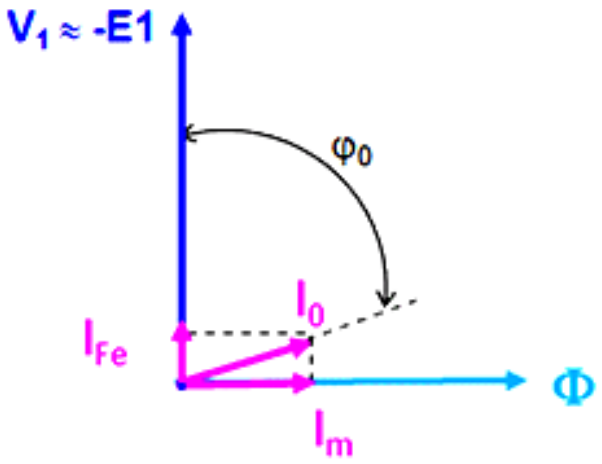

-E1
I0
I2
Φ
V2
φ2
R2I2
E2
jX2I2
E1


jX1I1
V1
R1I1
-E1
φ1
N1I1
N1I0
Φ
V2
N2I2
φ2
R2I2
E2
jX2I2
E1

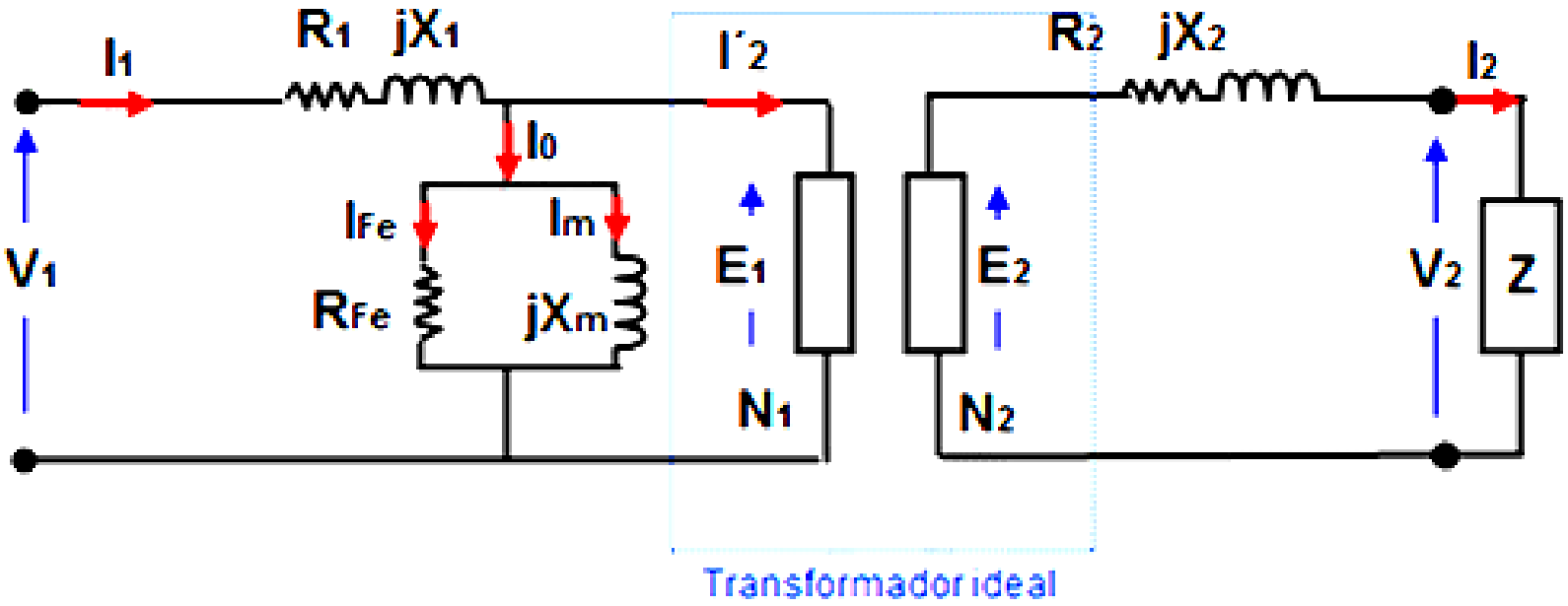
Carga


jX1I1
V1
R1I1
-E1
φ1
N1I1
N1I0
Φ
V2
N2I2
φ2
R2I2
E2
jX2I2
E1

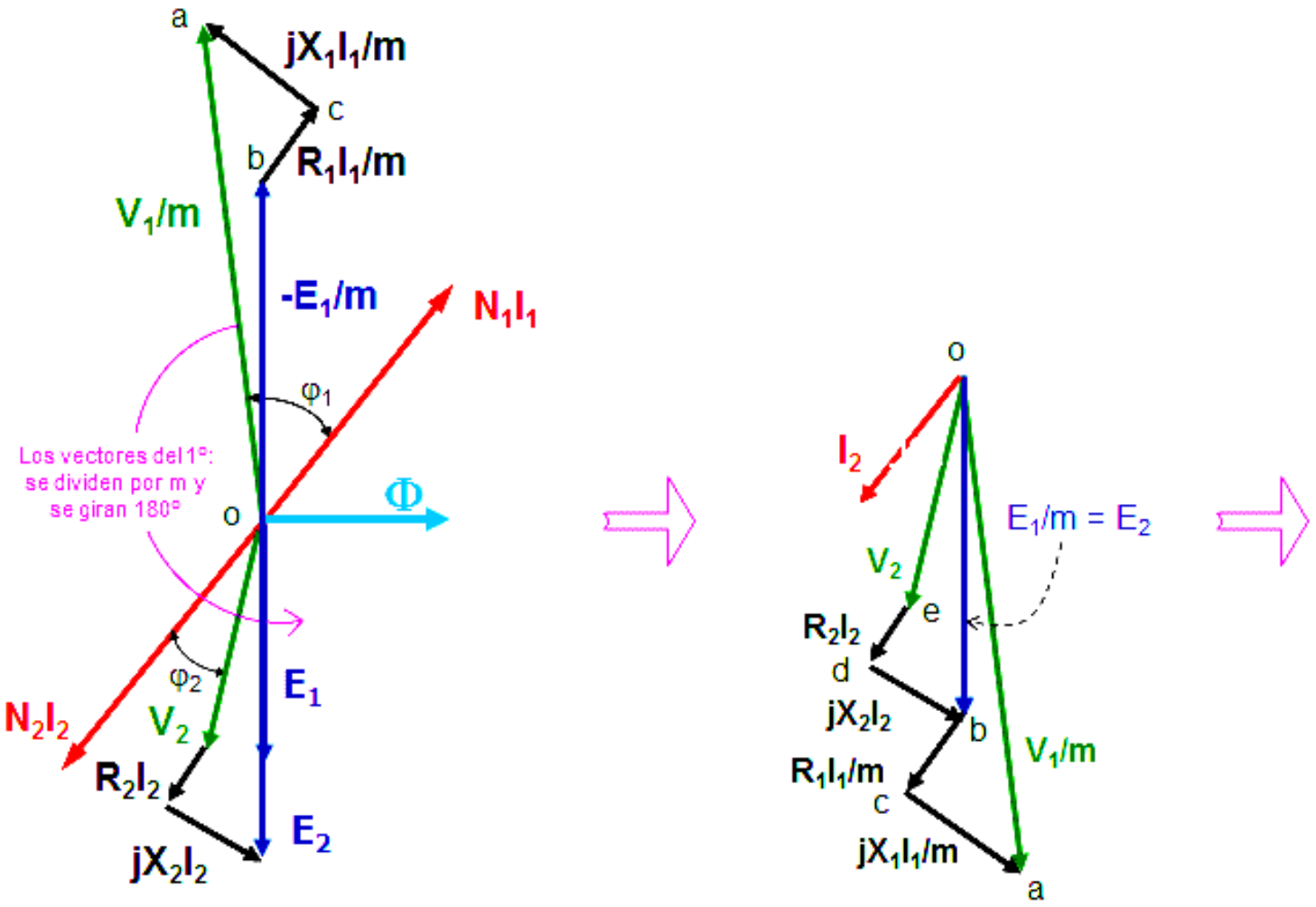
Vacío


V1 ≈ -E1
φ0
I0
IFe
Φ
Im

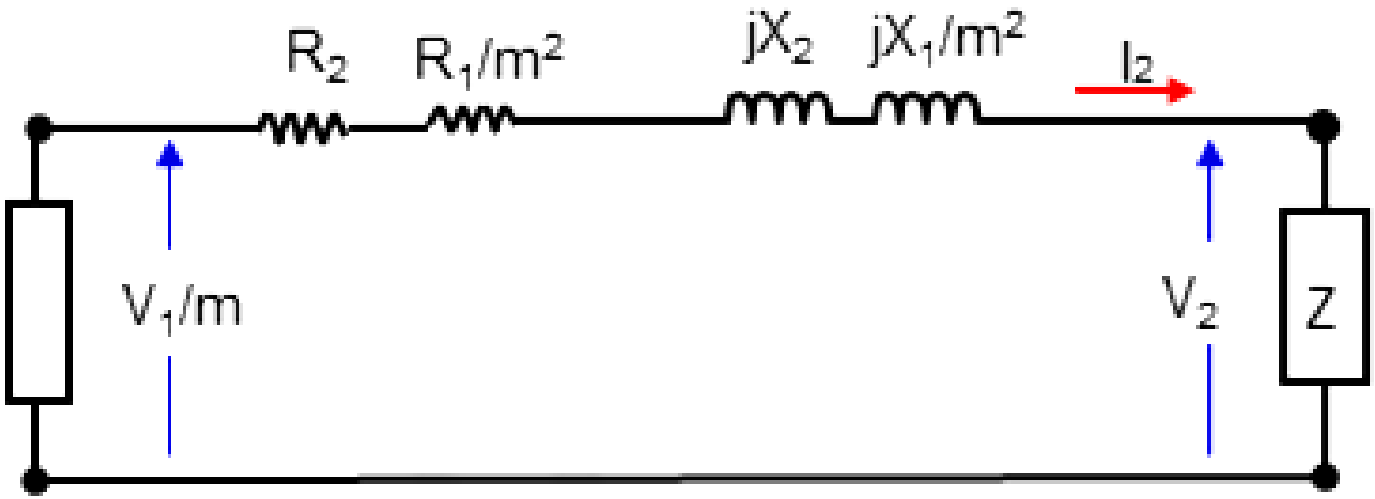
El Transformador Real. Circuito Equivalente



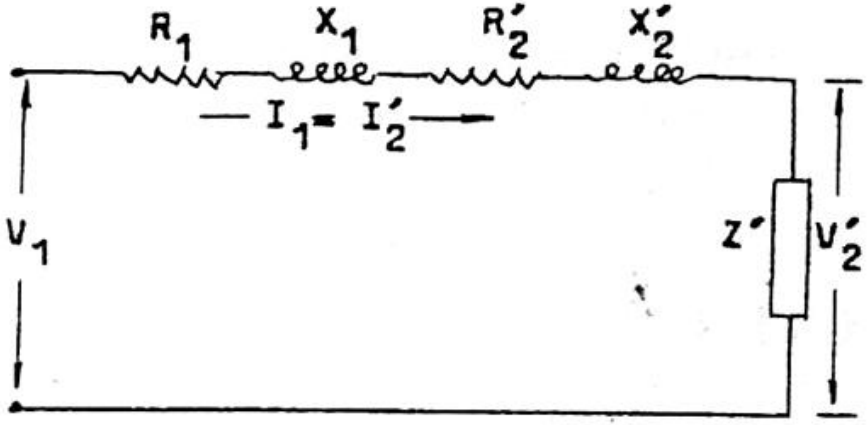
El Diagrama de Kapp

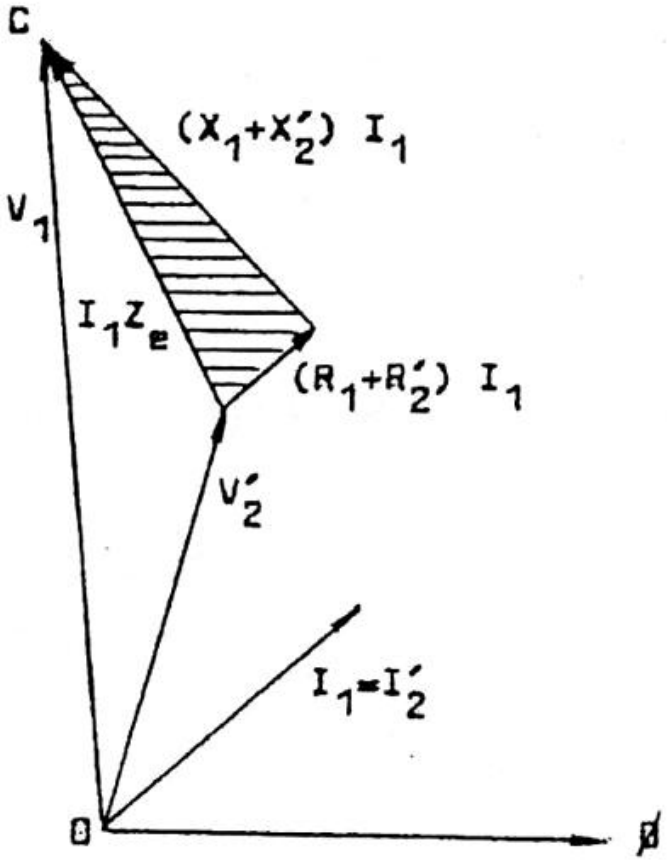


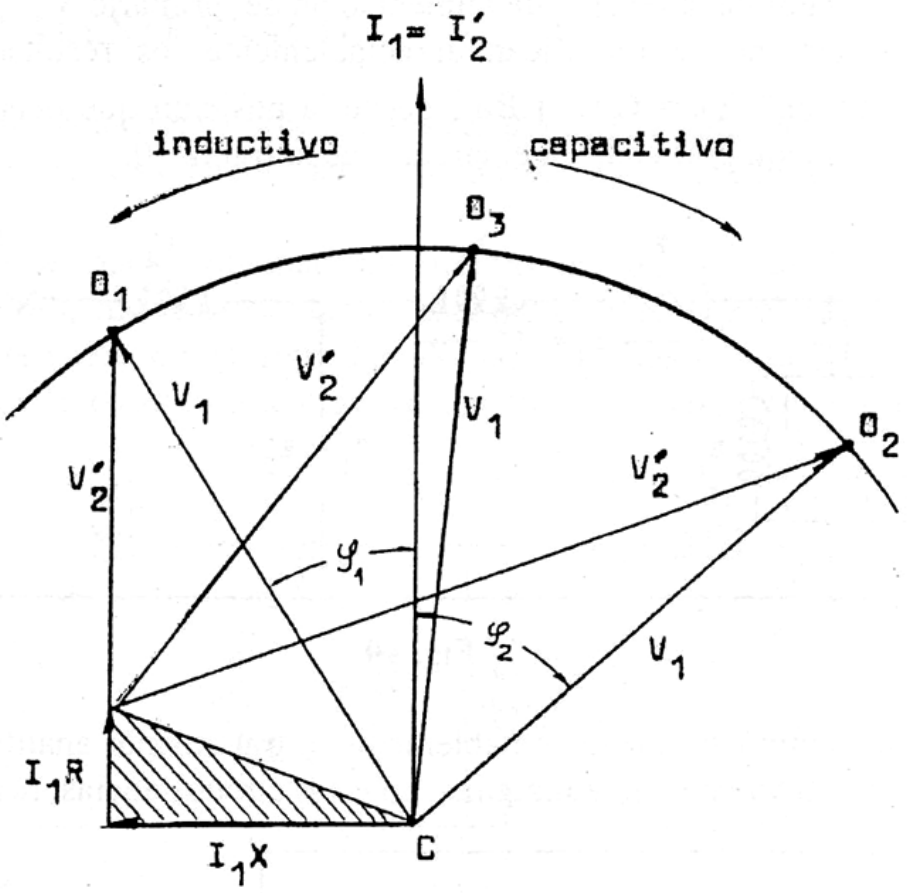
Esquema de Kapp

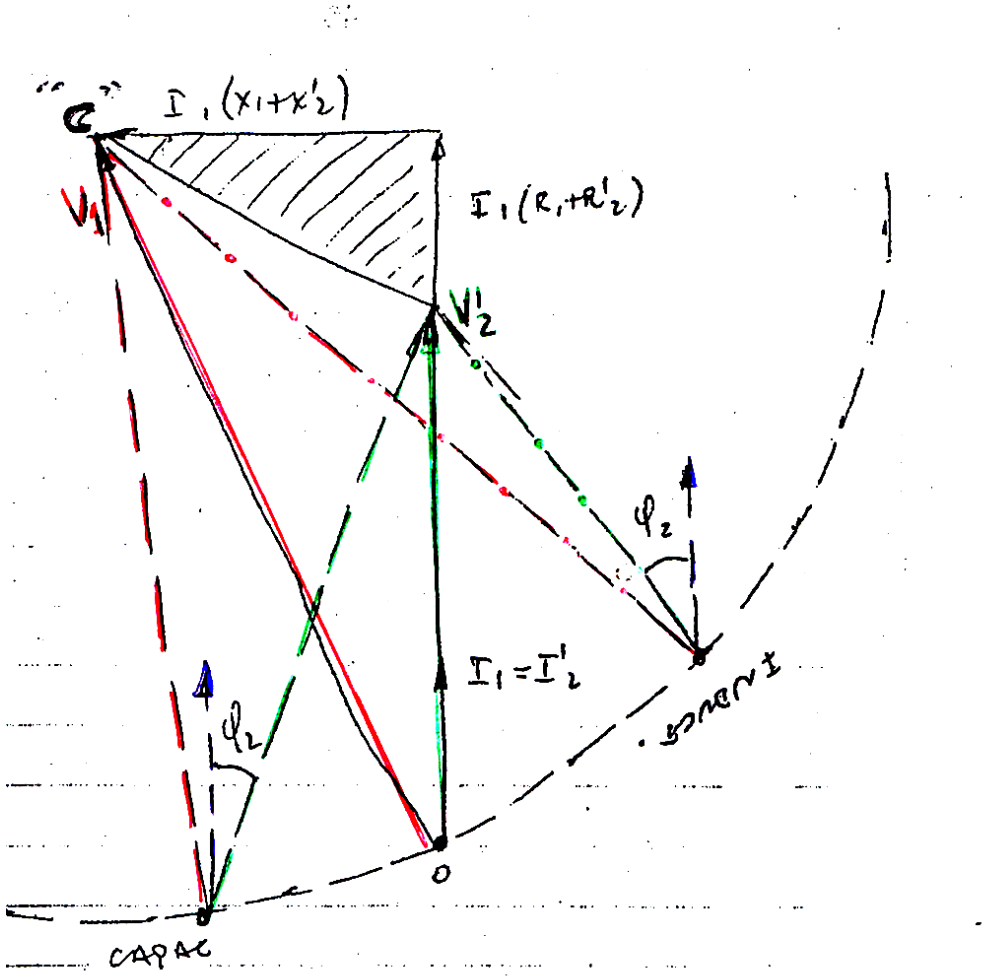


Esquema de Kapp

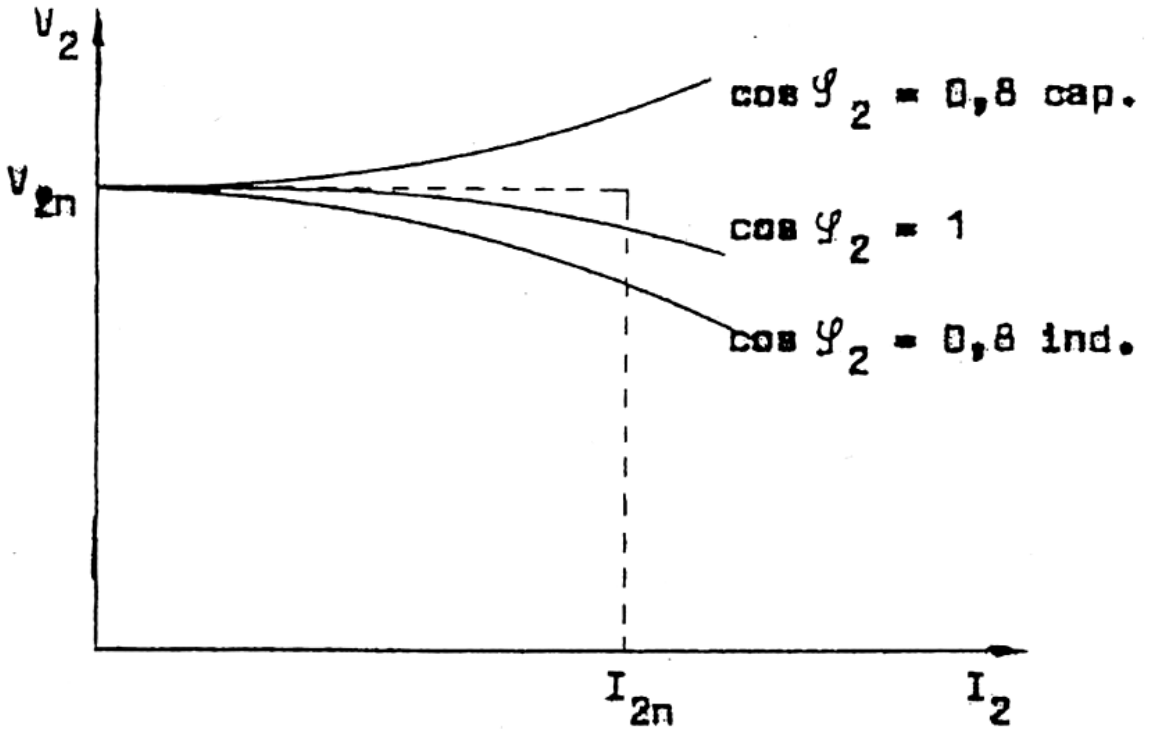




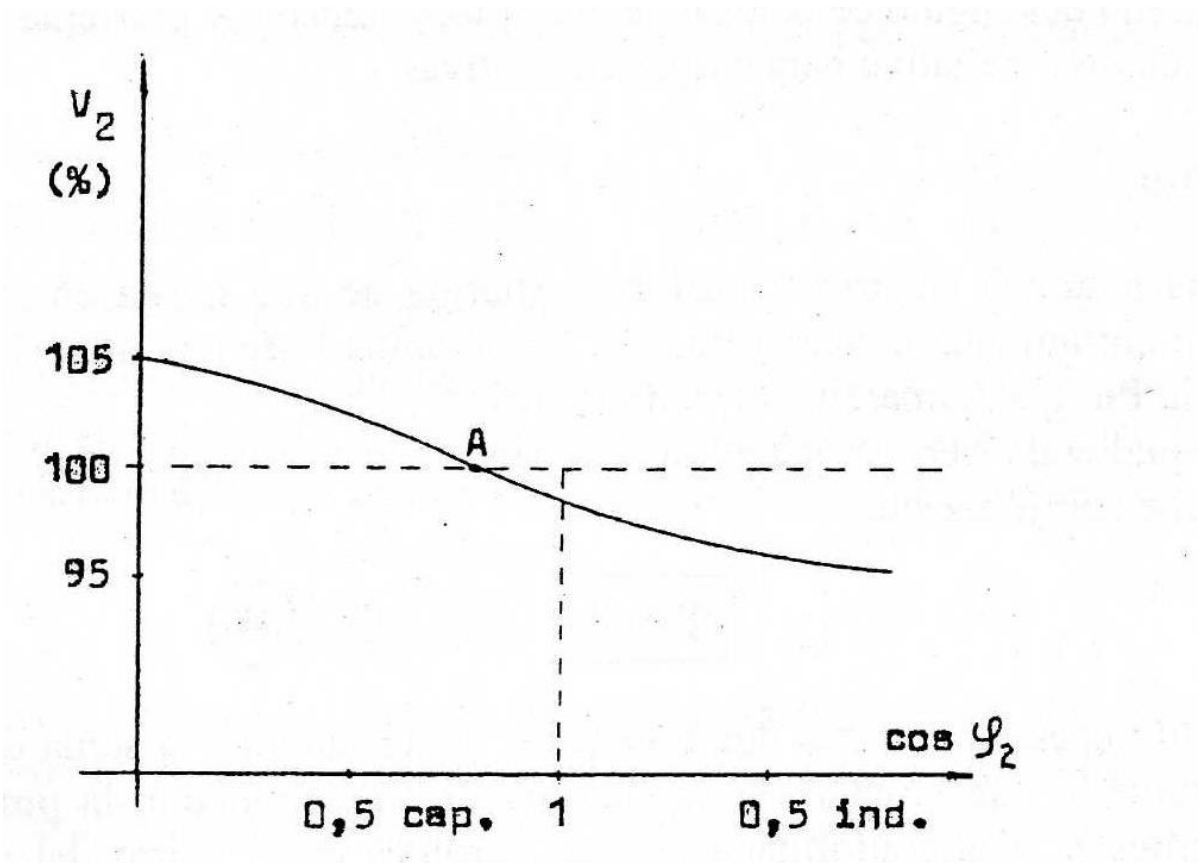

I1= I'2
inductivo
capacitivo
B3
B1
B2
V1
V'2
V1
V'2
V'2
φ1
φ2
V1
I1R
I1X
C


I1 (X1+X'2)
I1 (R1+R'2)
V1
V'2
φ2
I1 = I'2
φ2
O
CAPAC

Características de funcionamiento



Características de funcionamiento



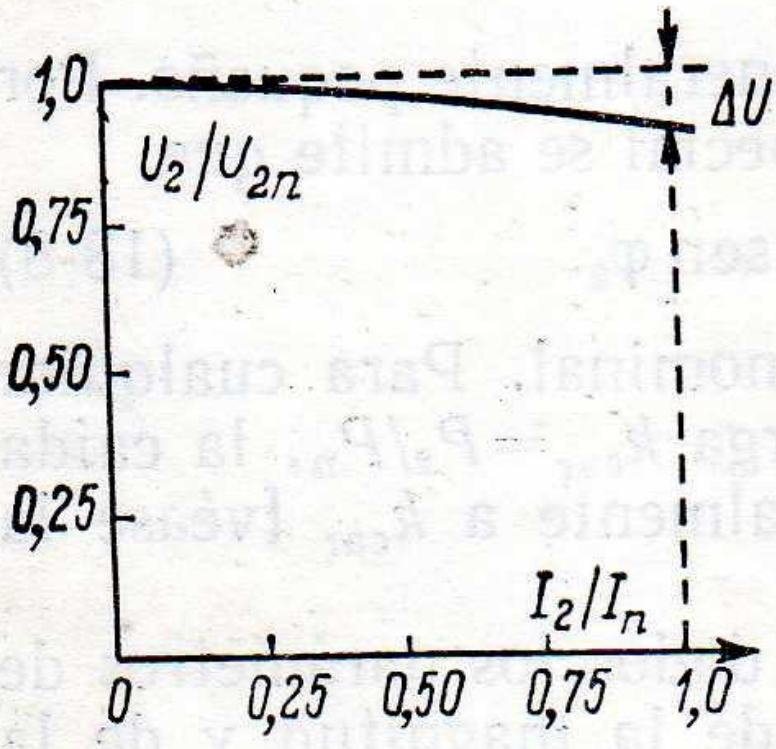
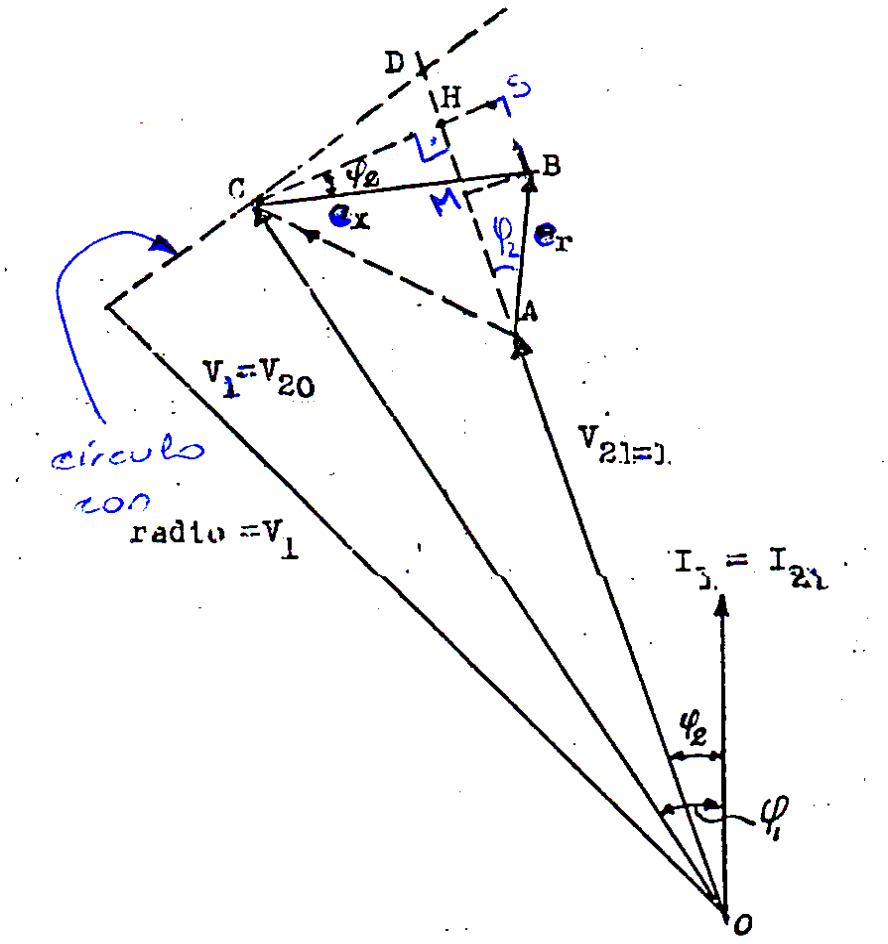


Fig. 18-10. Característica exterior del transformador

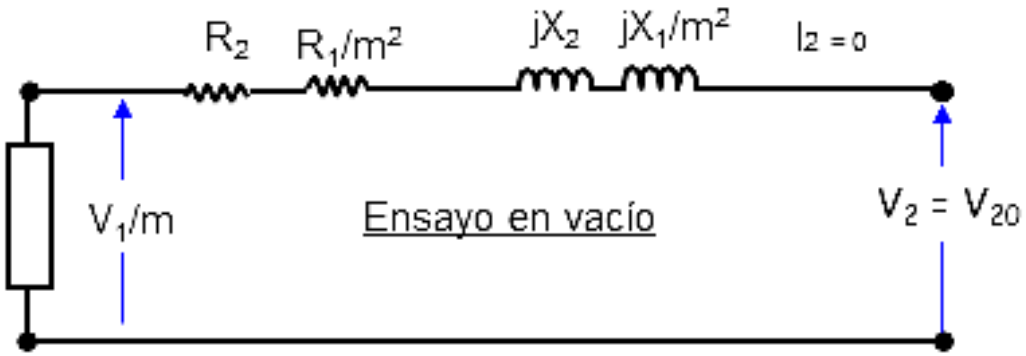
Características de Regulación



$$r = \frac{V_{20} - V_2}{V_2} \qquad (31)$$

$$r\,(\%) = \frac{V_{20} - V_2}{V_2}\,100 \qquad (32)$$

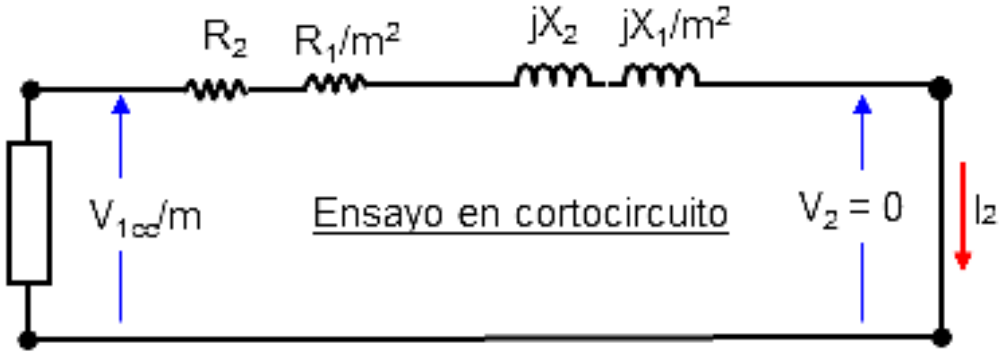
$$r\,(\%) = n\,(V_r \cos\varphi + V_x \operatorname{sen}\varphi) + \frac{n^2}{200}\,(V_x \cos\varphi - V_r \operatorname{sen}\varphi)^2 \qquad (33)$$



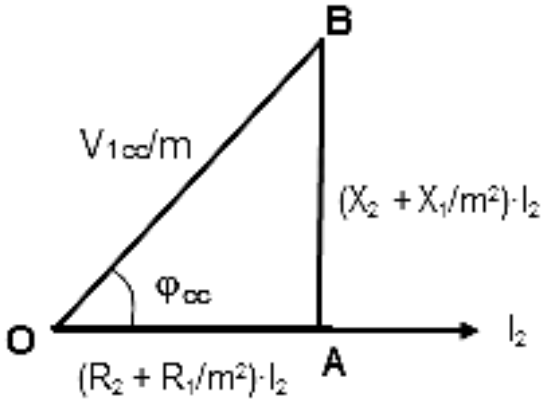
$\underline{V}_1/m = \underline{V}_2 = \underline{V}_{20}$

En vacío:

$I_2 = 0 \Rightarrow V_1/m = V_{20}$



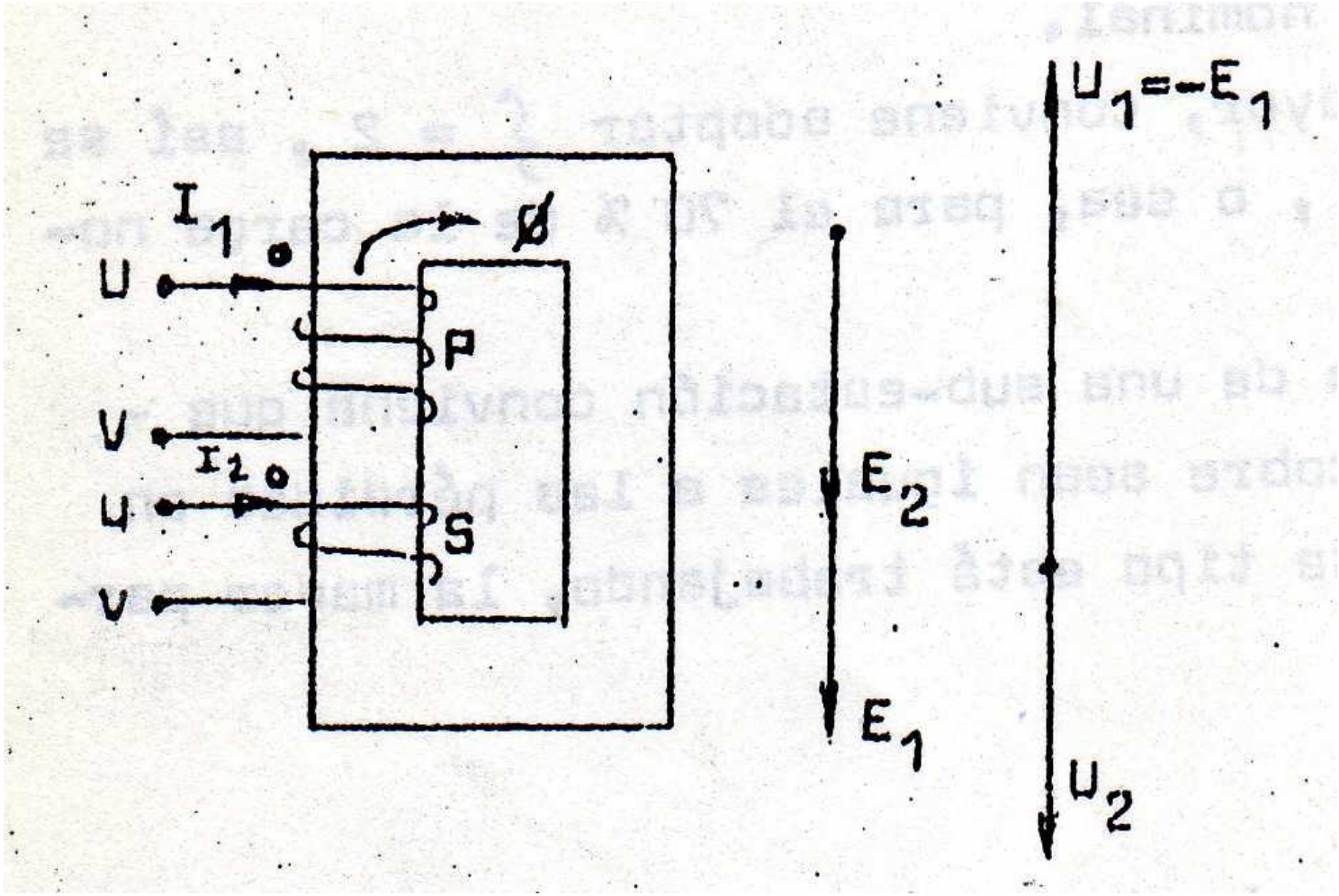
$\underline{V}_{1cc}/m = (R_2 + R_1/m^2)\cdot\underline{I}_2 + j\cdot(X_2 + X_1/m^2)\cdot\underline{I}_2$

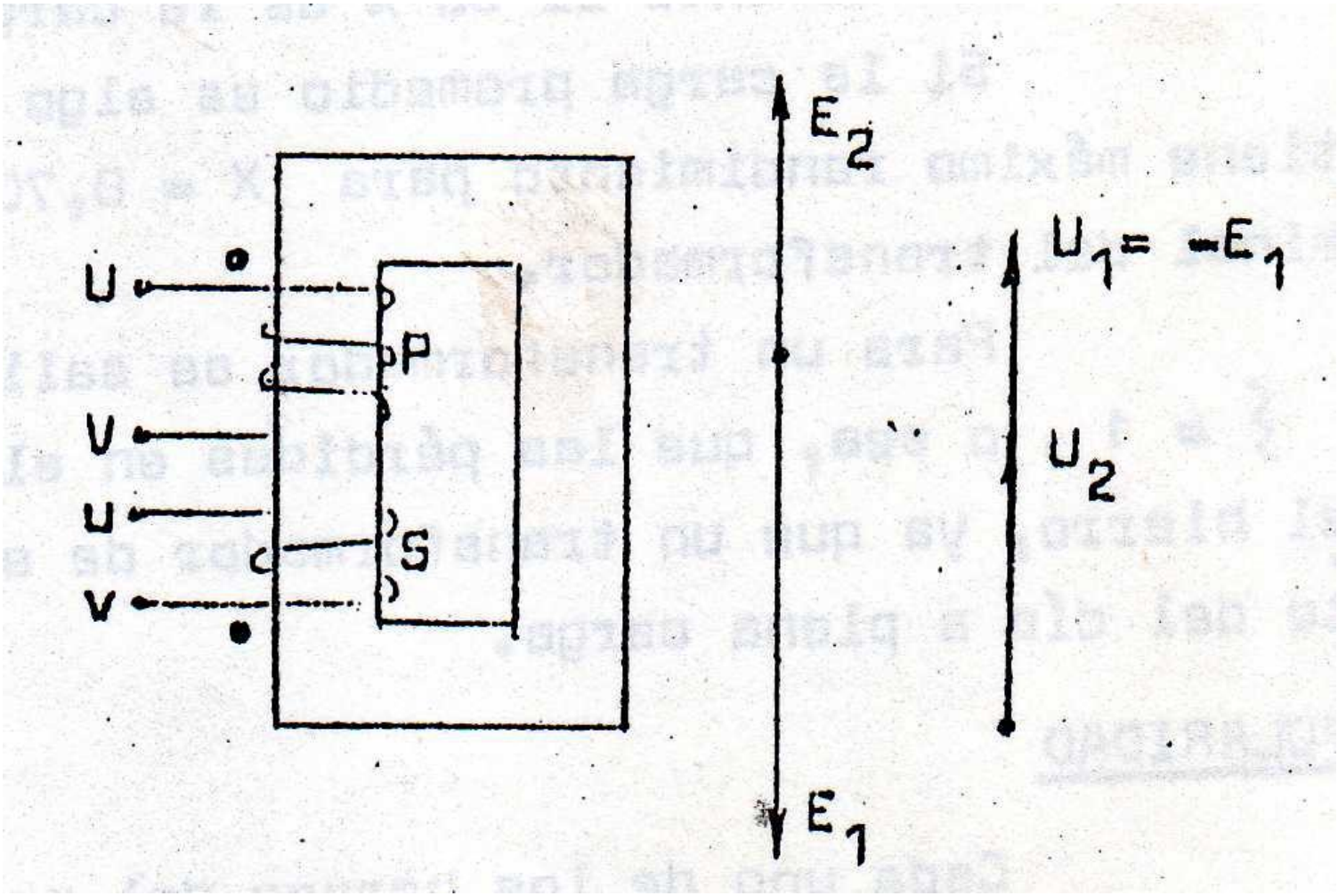


k_{car}	$P_2 = k_{car} P_n \cos\varphi_2$	P_0, kW	$k^2_{car} P_{c.c.}$, kW	$P_0 + k^2_{car} P_{c.c.}$, kW	$P_2 + P_0 + k^2_{car} P_{c.c.}$, kW	η, %
1/4	1120	18,5	3,56	22,06	1142,06	98,07
2/4	2240	18,5	14,25	32,75	2272,75	98,56
3/4	3360	18,5	32,1	50,6	3410,6	98,52
4/4	4480	18,5	57,0	75,5	4555,5	98,34

De esta tabla se ve que con una carga igual a 1/4 de la nominal el rendimiento del transformador ya es muy alto. Por la fórmula (18-15) hallamos que el rendimiento es máximo cuando

$$k_{car} = \sqrt{\frac{P_0}{P_{c.c.}}} = \sqrt{\frac{18,5}{57}} \approx 0,57.$$


I1
Ø
U
P
V
I2
u
S
v
U1=-E1
E2
E1
U2


U
P
V
U
S
V
E2
E1
U1 = -E1
U2