Fundamentos de Transformadores y Máquinas Eléctricas

Dr. Lionel R. Orama Exclusa, PE

Clase 19

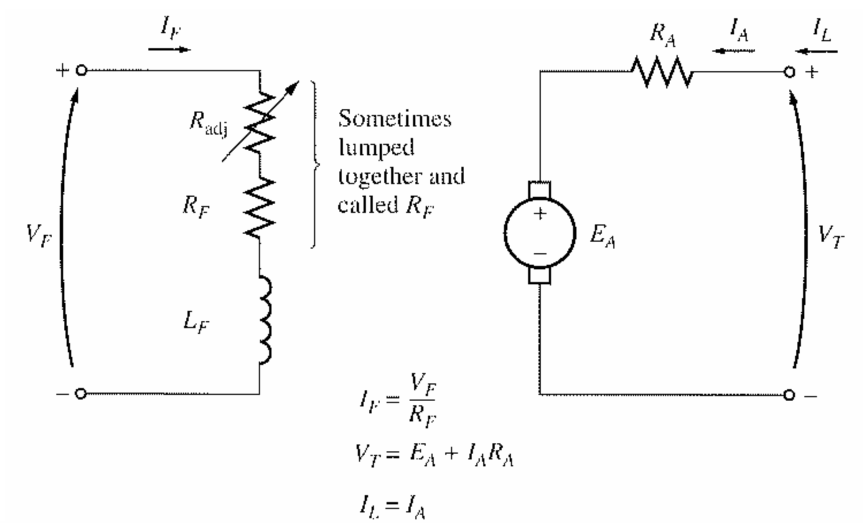
Motores DC

- Se comparan por % SR - regulación de velocidad

$$\% SR = \frac{\omega_{NL} - \omega_{FL}}{\omega_{FL}} \times 100 = \frac{n_{NL} - n_{FL}}{n_{FL}} \times 100$$

Voltaje de entrada (DC) se presume constante

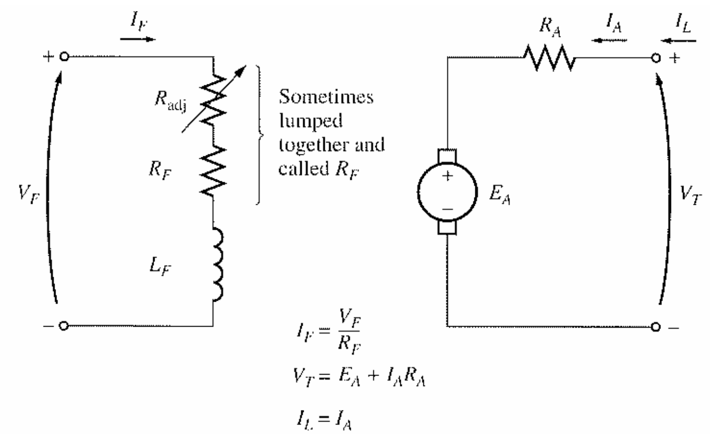
Circuito Equivalente



$E_A = K\phi\omega$, voltaje inducido ó interno

$T_{ind} = K\phi I_A$, torque inducido

Motor DC Exitado por Separado *Separately Exited*



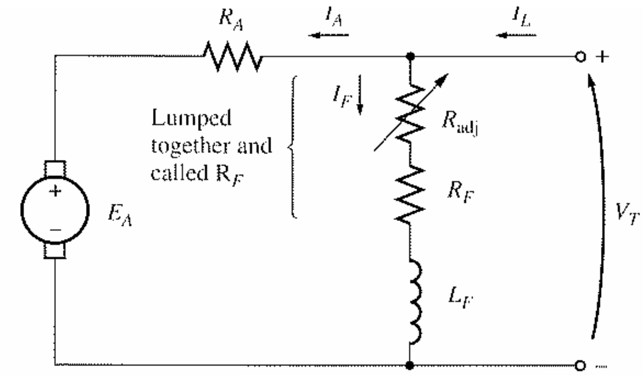
$$V_T = E_A + R_A I_A \qquad I_F = \frac{V_F}{R_{F_T}}$$

$$I_L = I_A$$

$E_A = K\phi\omega$, voltaje inducido ó interno

$\tau_{ind} = K\phi I_A$, torque inducido

Motor Exitado en Paralelo
Shunt DC Motor



$$I_F = \frac{V_T}{R_F}$$

$$V_T = E_A + I_A R_A$$

$$I_L = I_A + I_F$$

$$V_T = E_A + R_A I_A \qquad I_L = I_A + I_F \qquad I_F = \frac{V_T}{R_F}$$

* Si el voltaje que se suple al motor es constante no hay diferencia en el comportamiento de ambos.

Característica de Terminal

Aumento en Carga $\tau_{load} \uparrow >> \tau_{ind} \therefore \omega \downarrow$

$$E_A = K\phi\omega \downarrow$$

$$I_A = \frac{V_T - E_A}{R_A} \uparrow$$

$$\tau_{ind} = K\phi I_A \uparrow$$

$\tau_{ind} \cong \tau_{load}$ a una ω menor.

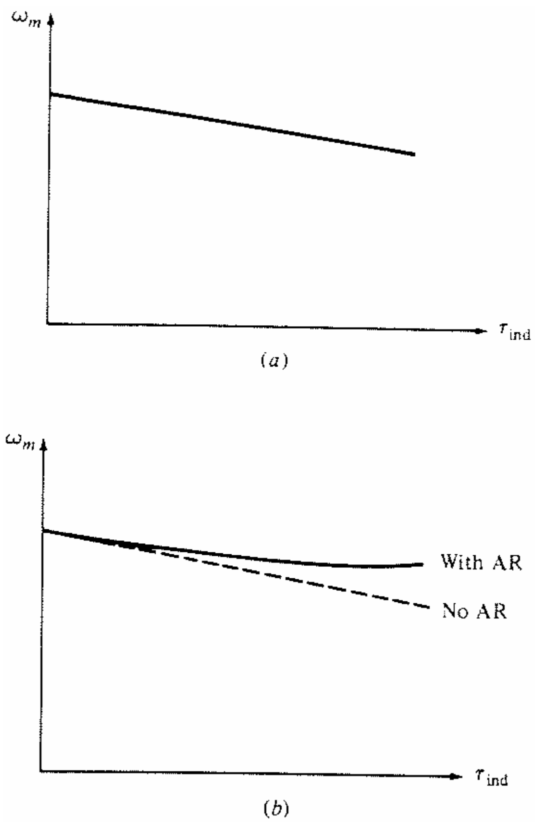
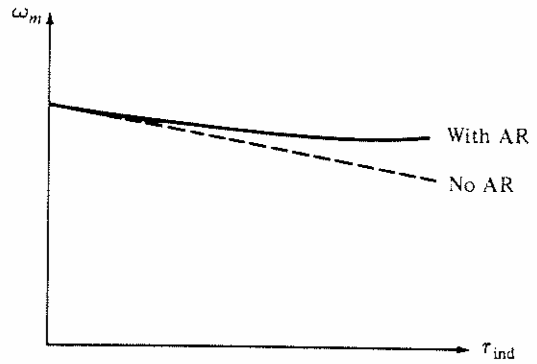


Figure 6-4 (*a*) Torque-speed characteristic of a shunt or separately excited dc motor with compensating windings to eliminate armature reaction. (*b*) Torque-speed characteristic of the motor with armature reaction present.

Control de Velocidad

$E_A = K\phi\omega$, voltaje inducido ó interno

$\tau_{ind} = K\phi I_A$, torque inducido



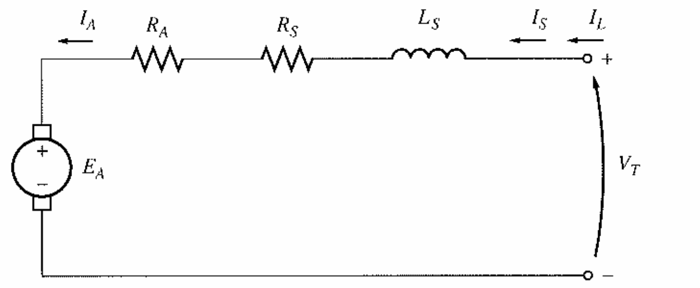
(b)

1) $E_A = K\phi\omega \rightarrow$ $R_F \downarrow$, $I_F \uparrow$ $\therefore$ $E_A \uparrow$

2) $V_T \uparrow$, $I_A \uparrow$ $\therefore$ $\tau_{ind} \uparrow$

Motor DC en Serie
Series DC Motor

Figure 8–40 | The equivalent circuit of a series DC motor.



$$V_T = E_A + I_A(R_A + R_s)$$

$$I_A = I_s = I_L$$

Característica de Terminal

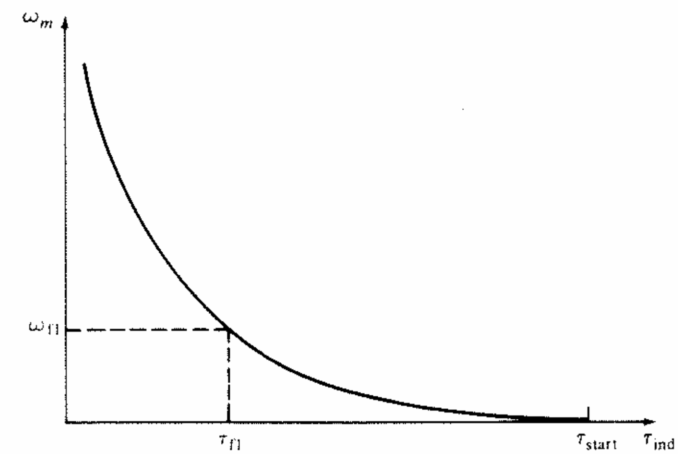


Figure 6-16 The torque-speed characteristic of a series dc motor.

- ω varía aproximadamente con la $\sqrt{\tau}$

* desventaja, $\tau = 0 \quad \omega \to \infty$

* ventaja, τ arranque alto

Control de Velocidad

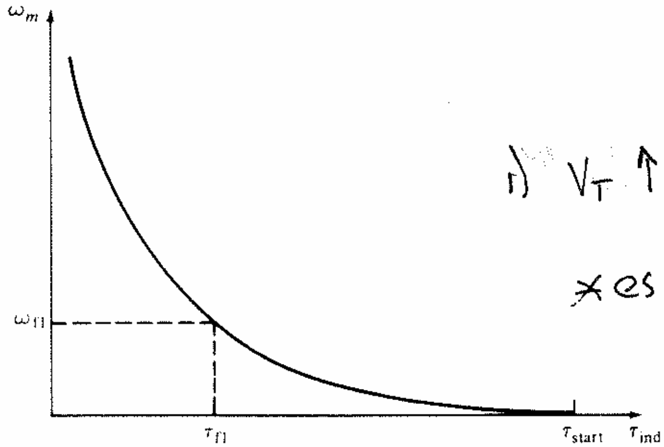
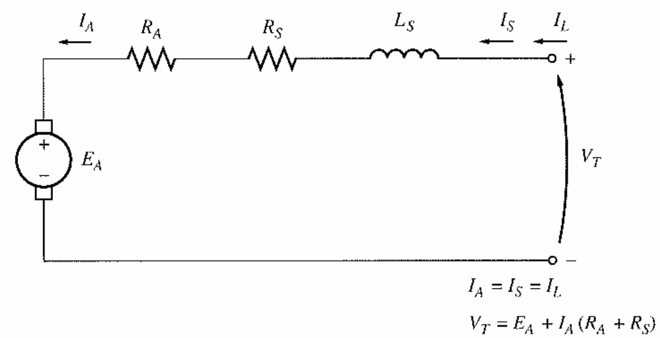


Figure 6-16 The torque-speed characteristic of a series dc motor.

1) $V_T \uparrow$; $E_A \uparrow \therefore \omega \uparrow$

* es la única forma efectiva de controlar velocidad

Figure 8–40 | The equivalent circuit of a series DC motor.



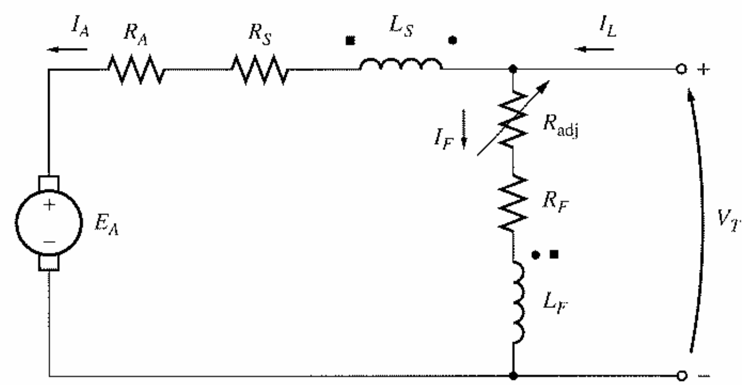
Motor DC Compuesto
Cumulative Compounded

$$V_T = E_A + I_A(R_A + R_S)$$

$$I_A = I_L - I_F$$

$$I_F = V_T / R_F$$

Figure 8–44 | The equivalent circuit of compounded DC motors: (a) connection; (b) short-shunt connection.



(a)

Característica de Terminal

Hay una $\mathcal{F}_F$ constante, $\mathcal{F}_S \propto I_A$; $\tau_S < \tau_{START} < \tau_{SE}$

∴ Tiene lo bueno de ambos (shunt y el series)

1) Series - τ start alto

2) shunt - $\tau \rightarrow$, ω es finita

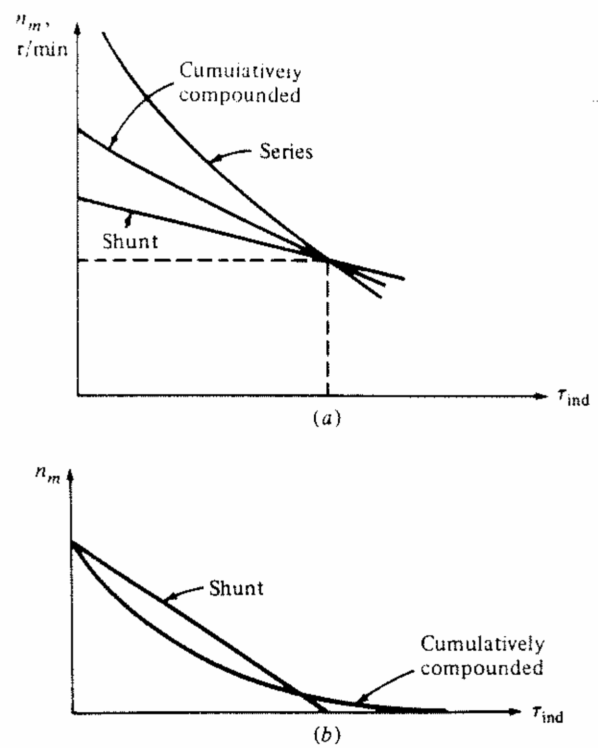


Figure 6-20 (*a*) The torque-speed characteristic of a cumulatively compounded motor compared to series and shunt motors with the same full-load rating. (*b*) The torque-speed characteristic of a cumulatively compounded dc motor compared to a shunt motor with the same no-load speed.