ROTATING DC MACHINES

Overview

- Basic principles of rotating dc machines are the same as those of the linear dc machine
- A rotating dc machine can be modeled by an equivalent circuit
- Magnetization curve

Structure of the Rotor and Stator

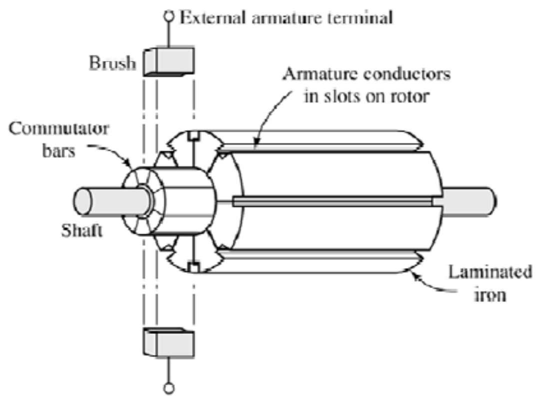

Figure 16.9 Rotor assembly of a dc machine.

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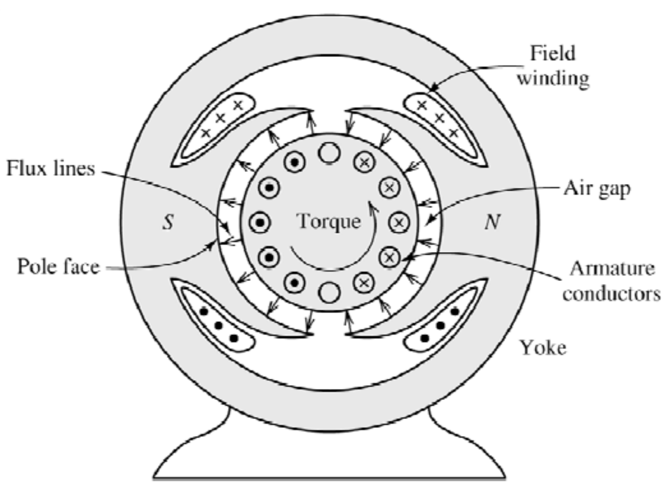
Cross section of a two-pole dc machine.



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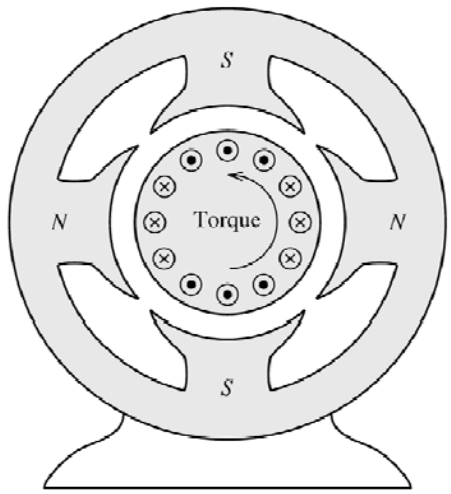
Cross section of a four-pole dc machine.



Induced EMF and Commutation

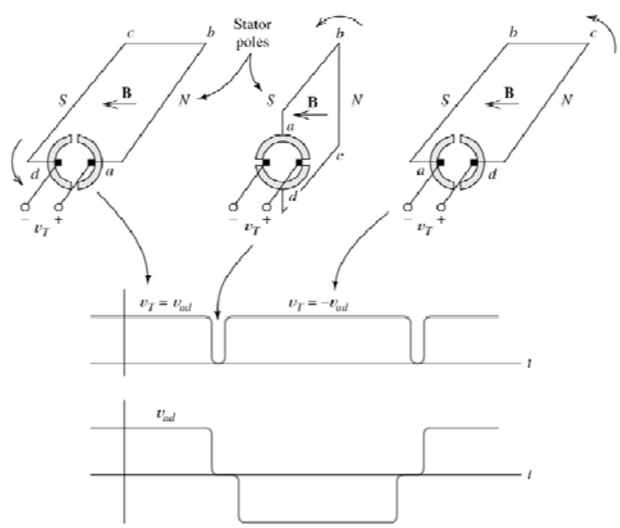
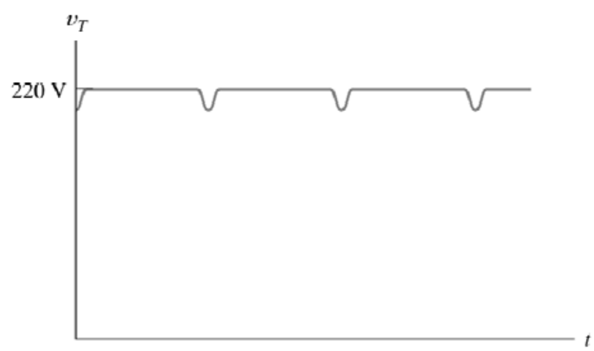


Figure 16.12 Commutation for a single armature winding.

Voltage Produced by a Practical Machine



- Only a few conductors commutated (switched) at a time, so voltage fluctuations are less pronounced.

Simple Model: Equivalent Circuit

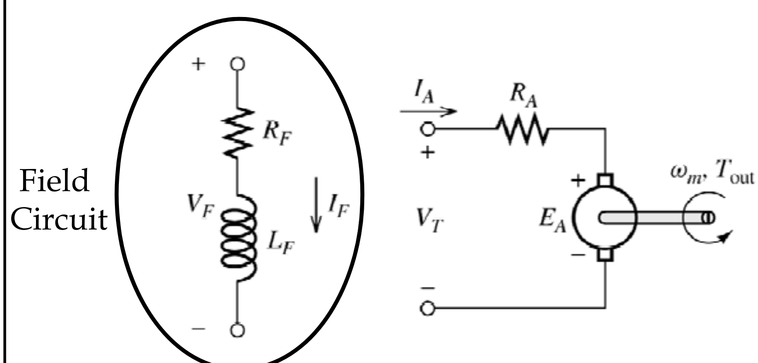
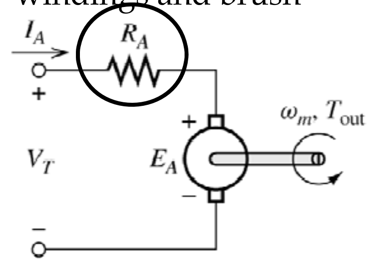


Figure 16.14 Equivalent circuit for the rotating dc machine.

$$V_F = R_F I_F$$

Equivalent Circuit: Steady State

Resistance of armature windings and brush



Induced armature voltage or back EMF: $E_A = K\phi\omega_m$

Torque: $T_{dev} = K\phi I_A$

Does not include losses

Developed power: $P_{dev} = \omega_m T_{dev} = E_A I_A$

Magnetization Curve

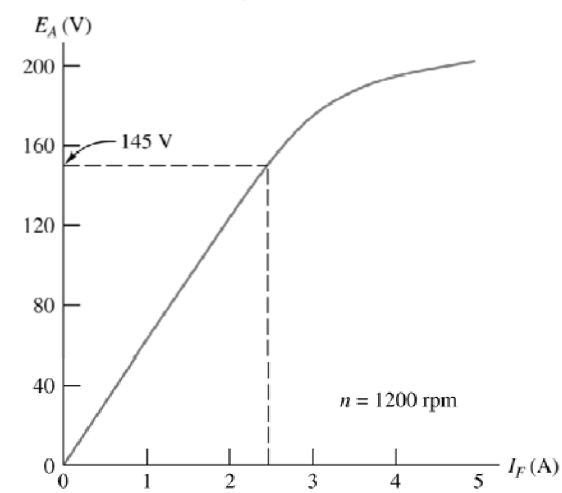


Figure 16.15 Magnetization curve for a 200-V 10-hp dc motor.

$$\frac{E_{A1}}{E_{A2}} = \frac{n_1}{n_2} = \frac{\omega_1}{\omega_2}$$

Summary

- A rotating dc machine can be modeled by an equivalent circuit
- Magnetization curve provides relationship between the armature voltage E_A and the field current I_F