

EEE 363

DC MACHINES

Class Schedule : MW 1:00 PM – 2:40 PM

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The University of Queensland, Australia

DC Machines- Construction

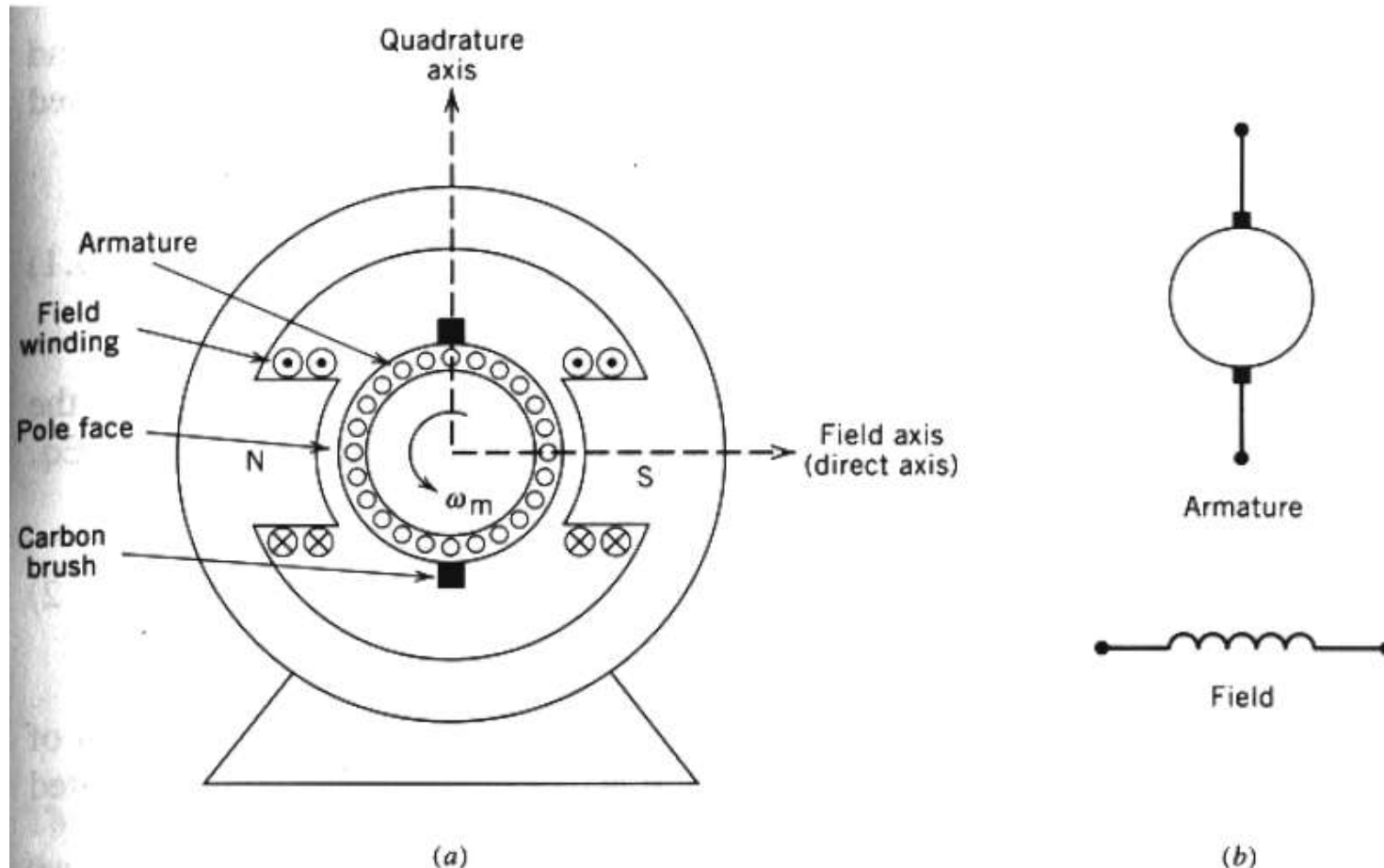


FIGURE 6.1 A two-pole DC machine: (a) schematic representation; (b) circuit representation.

Basic Principles of Operation

- DC machines consist of two sets of electrical windings
 - Field windings (or permanent magnets)
 - Located on stator
 - Armature windings
 - Located on rotor
 - Sinusoidal AC voltage induced in rotor as it turns in magnetic field of stator

Basic Principles of Operation

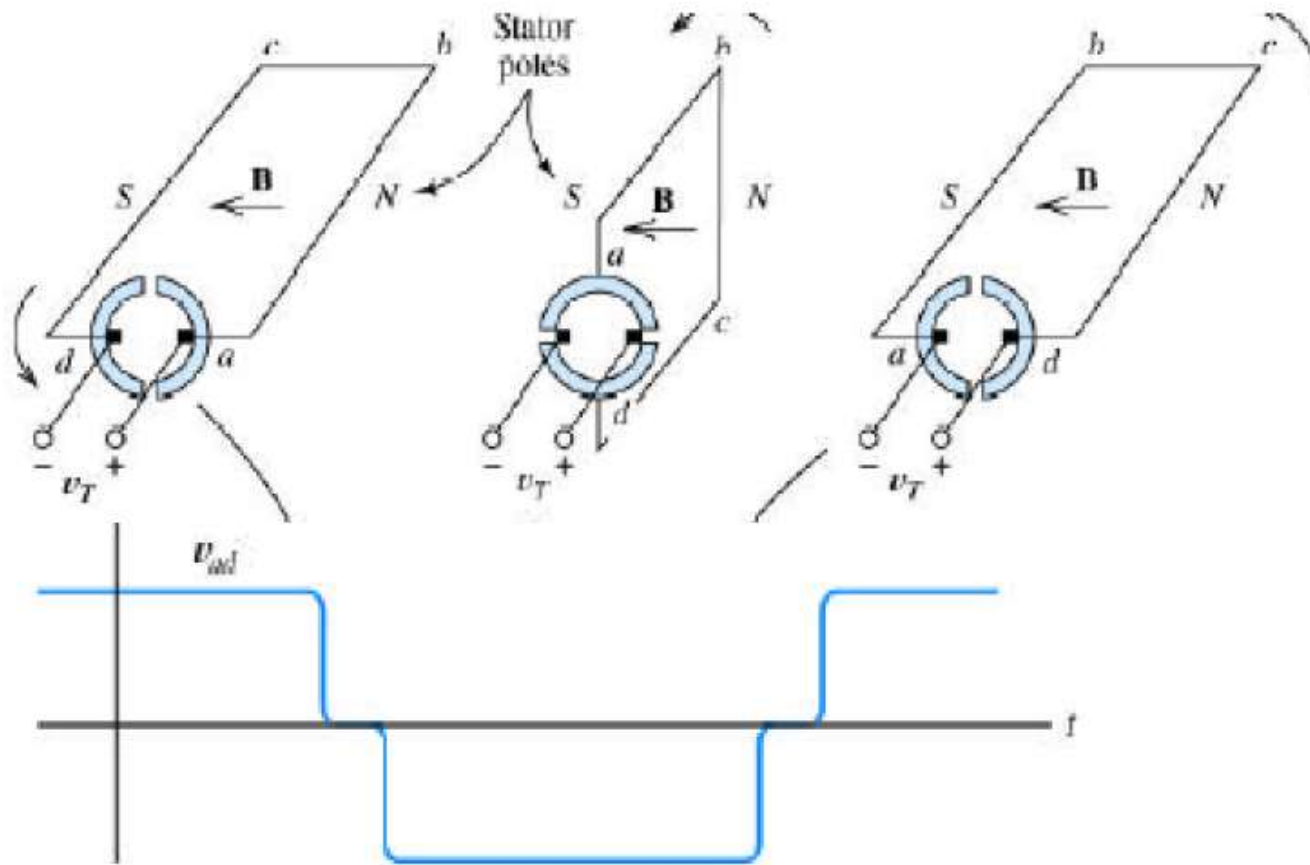
- AC generated voltage in armature converted to DC through action of commutator and brush combination
 - Commutator
 - Assembly of tapered copper segments insulated from each other and mounted on shaft of rotor
 - Allows change of direction of current in armature windings
 - Brushes
 - Make electrical connection between commutator and external circuit
 - Stationary and located so that minimum of voltage exists in coil segment undergoing commutation

DC Machines: Applications

- Versatile electromechanical energy conversion device
- More costly than comparable AC machine, with higher maintenance costs
 - Applications characterised by those requiring superior torque-speed characteristics and high efficiency across wide range of speeds

Generation of AC Voltage

(image from <http://www.eee.bham.ac.uk/robertc/ee1c2.htm>)



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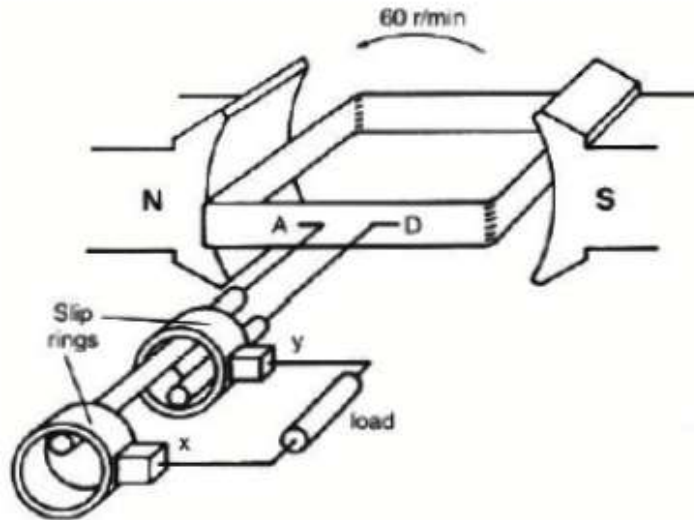


Figure 4.1

Schematic diagram of an elementary ac generator turning at 1 revolution per second.

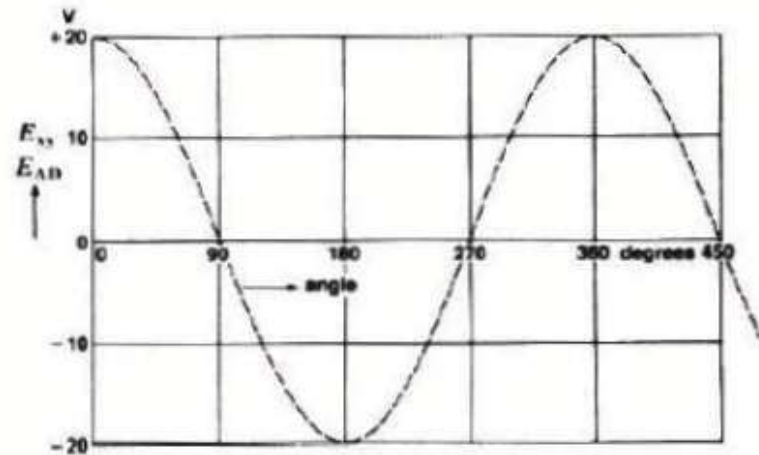


Figure 4.2

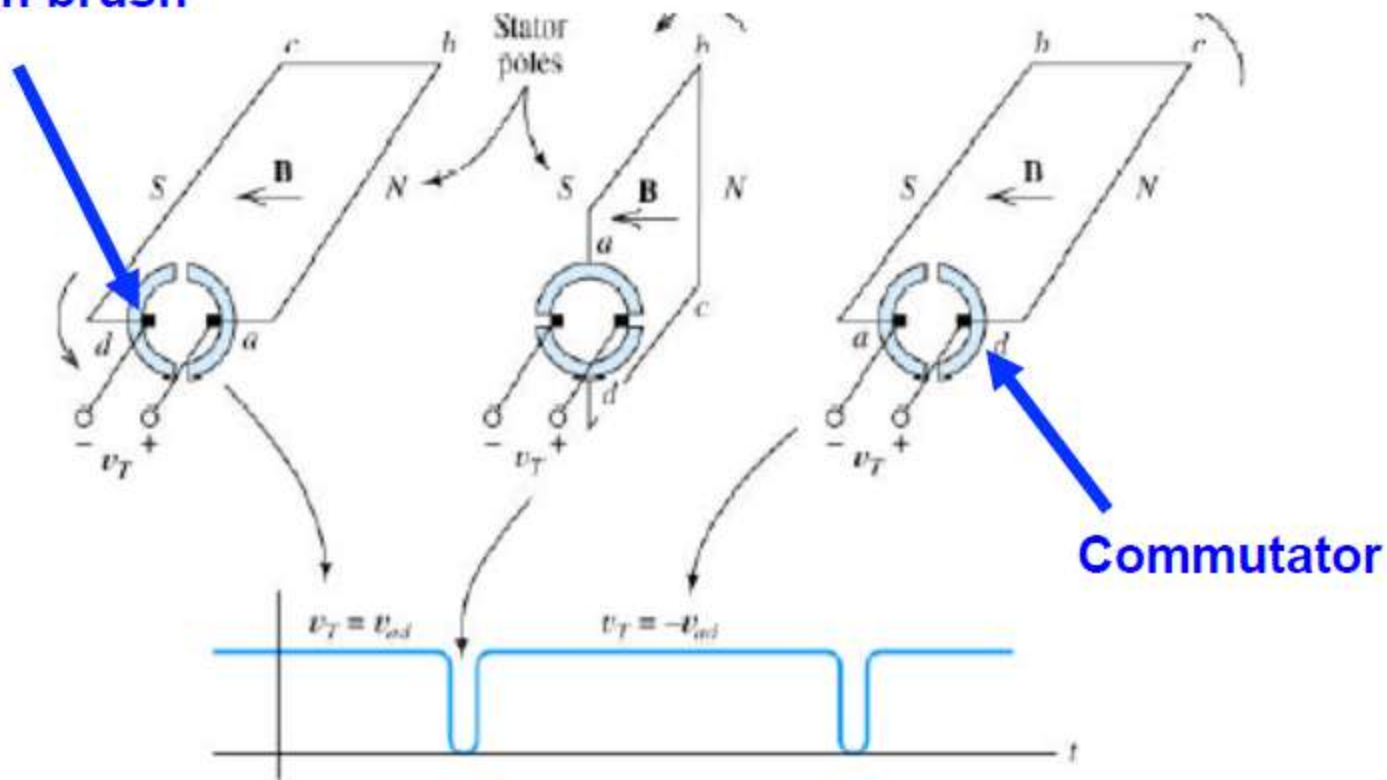
Voltage induced in the ac generator as a function of the angle of rotation.

Basic AC generator produces sinusoidal variation in voltage across load x-y as wire loop rotated in flux
 - connections to external circuit made through slip rings

Generation of Unidirectional Voltage

(image from <http://www.eee.bham.ac.uk/robertc/ee1c2.htm>)

Carbon brush



Generation of Unidirectional Voltage

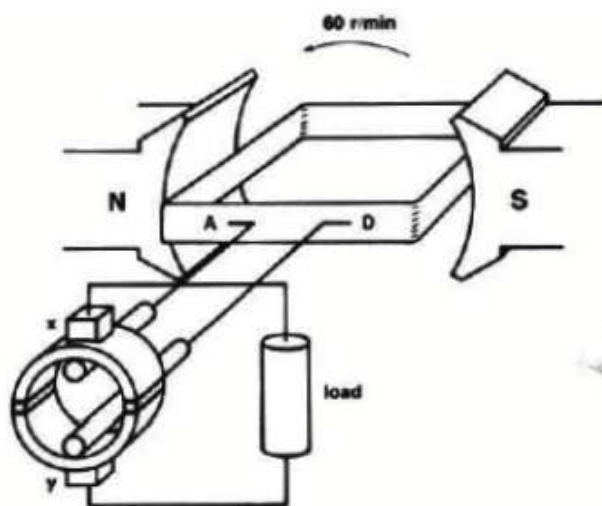


Figure 4.4
Elementary dc generator is simply an ac generator equipped with a mechanical rectifier called a *commutator*.

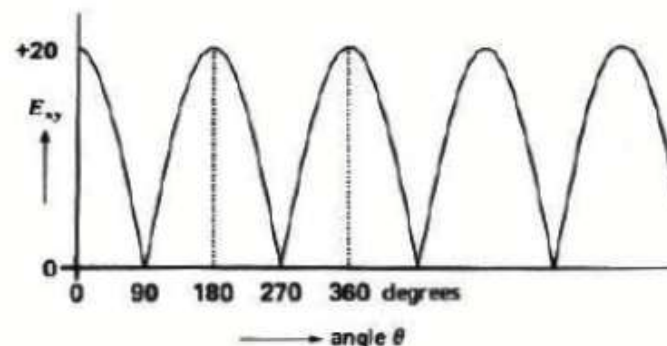


Figure 4.5
The elementary dc generator produces a pulsating dc voltage.

Basic DC generator very similar in construction to AC generator

- Unipolar voltage across load $x - y$ produced by connecting current loop to commutator that performs mechanical rectification of induced voltage (and currents)

Generation of Unidirectional Voltage

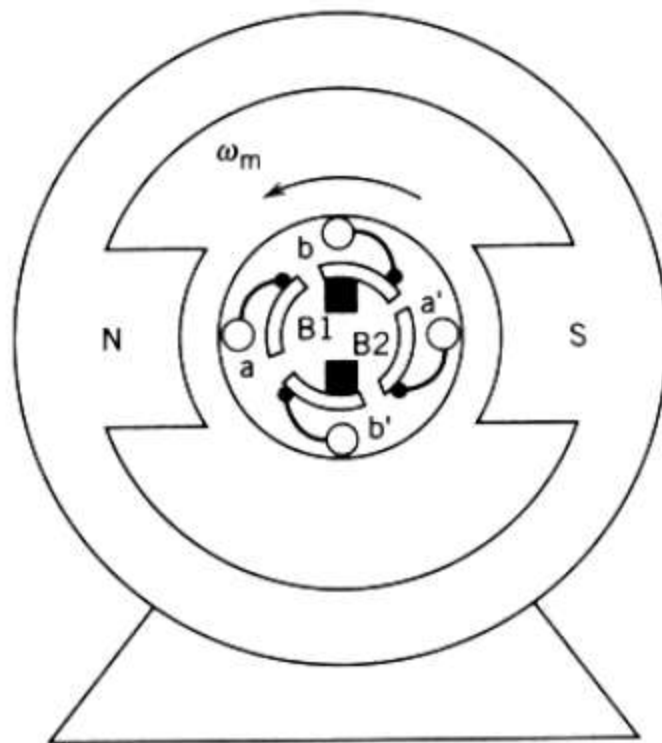
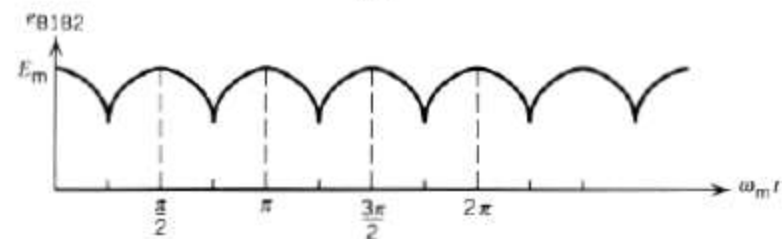
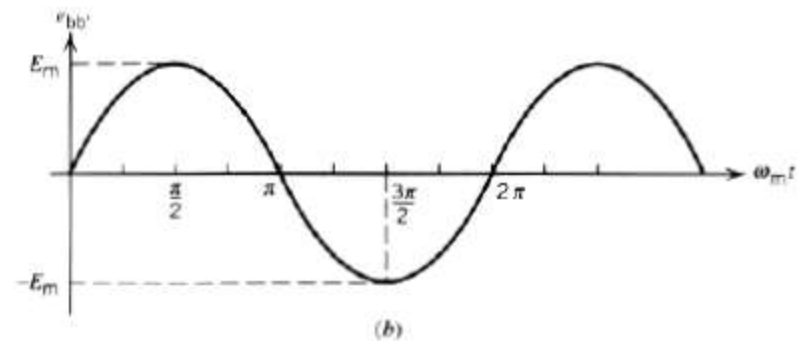
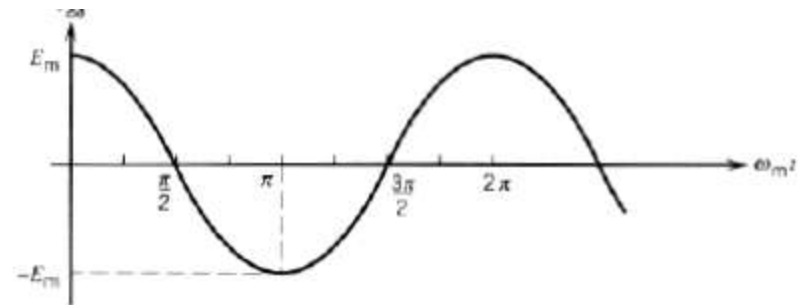
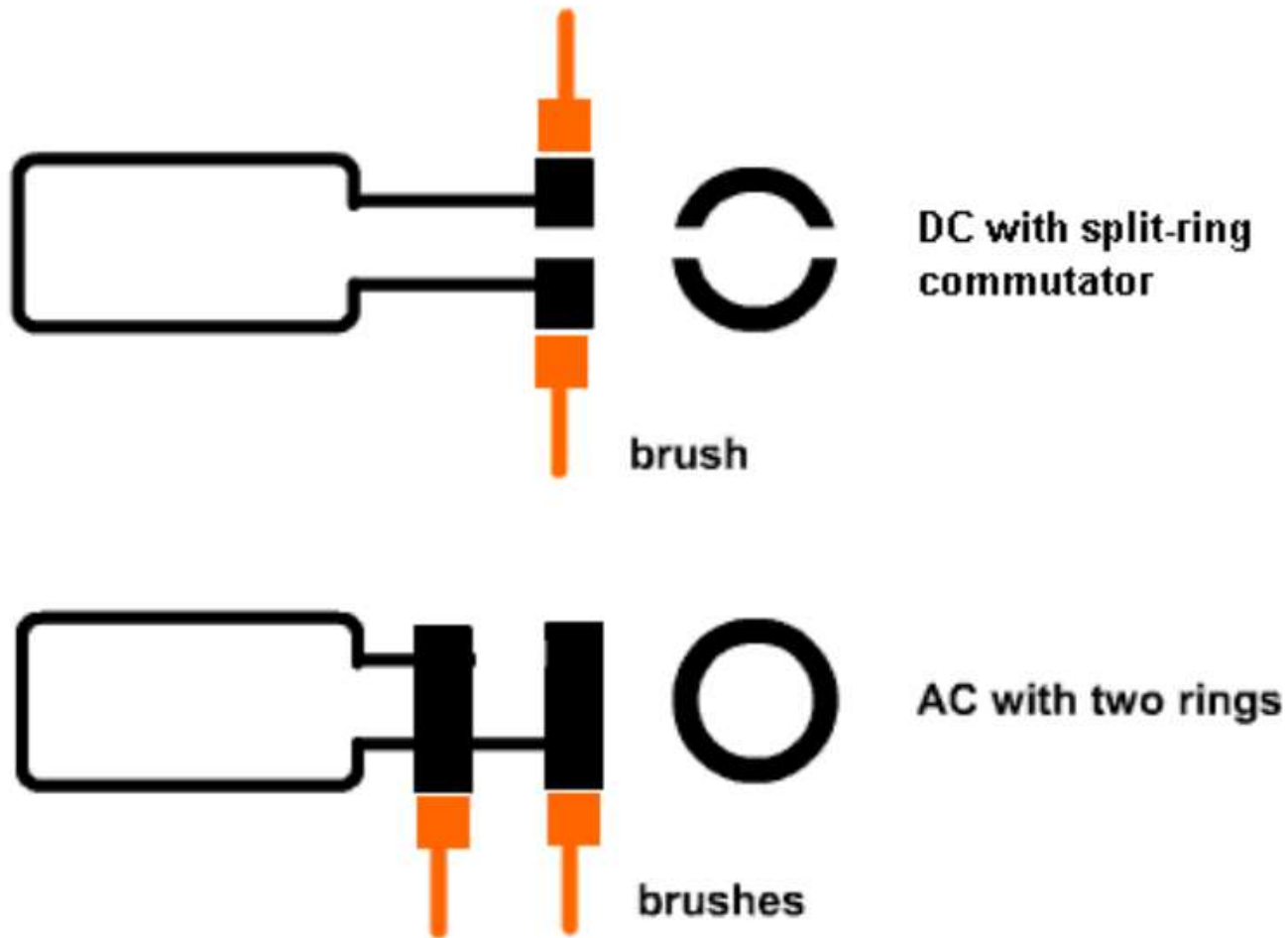


FIGURE 6.5 A two-pole, two-coil DC generator.



Slip Ring Arrangements



Slip Ring Arrangements

