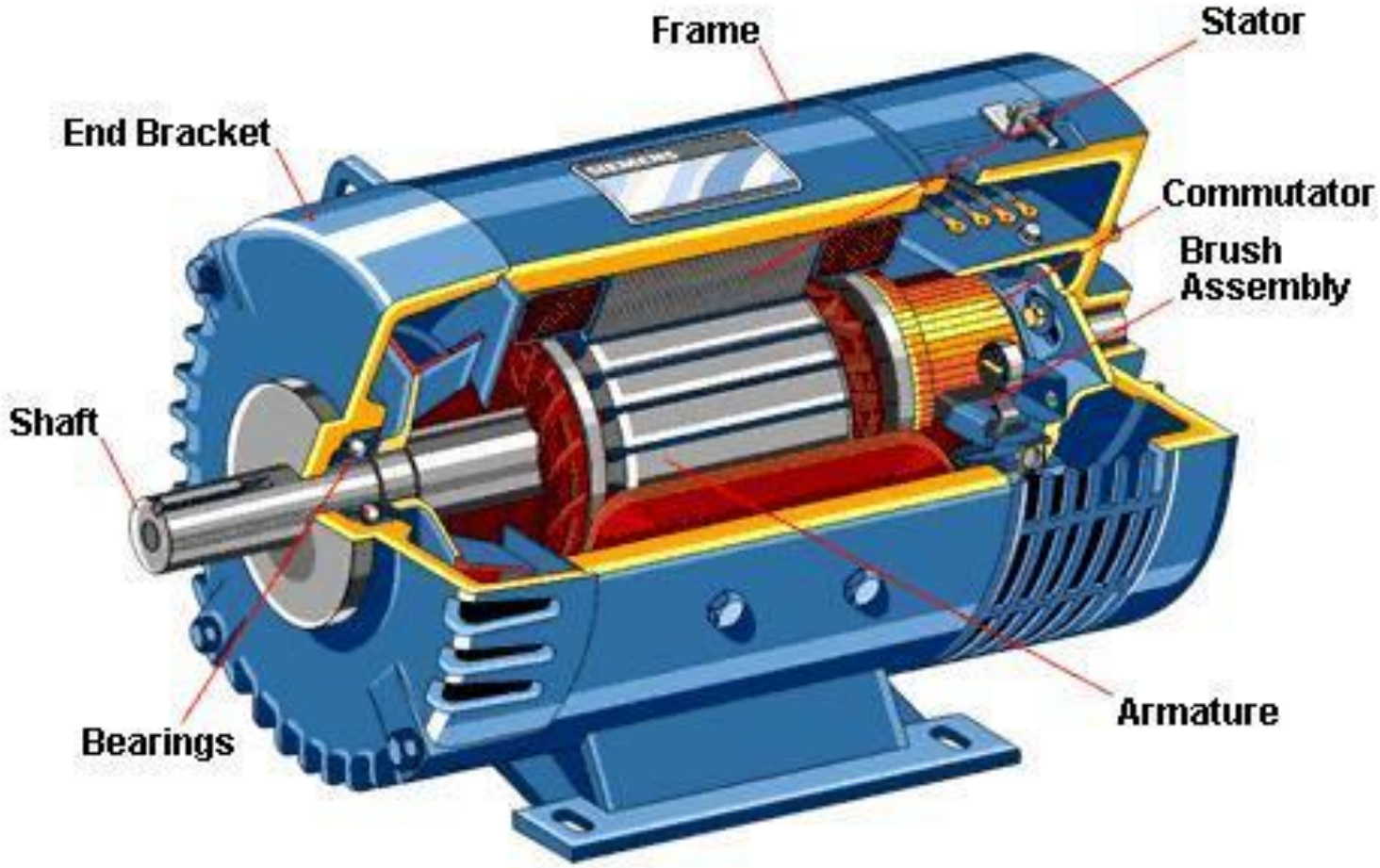
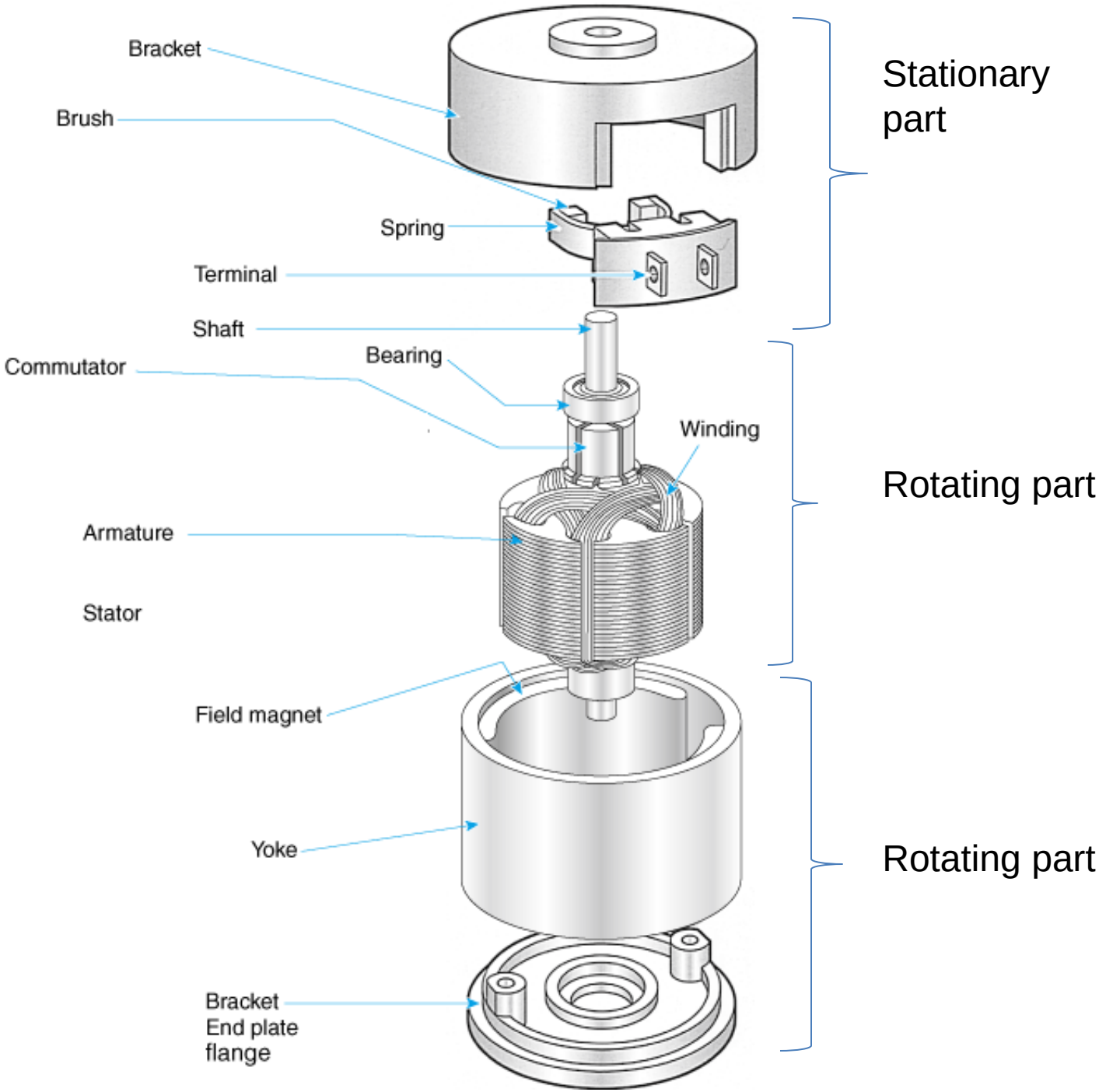
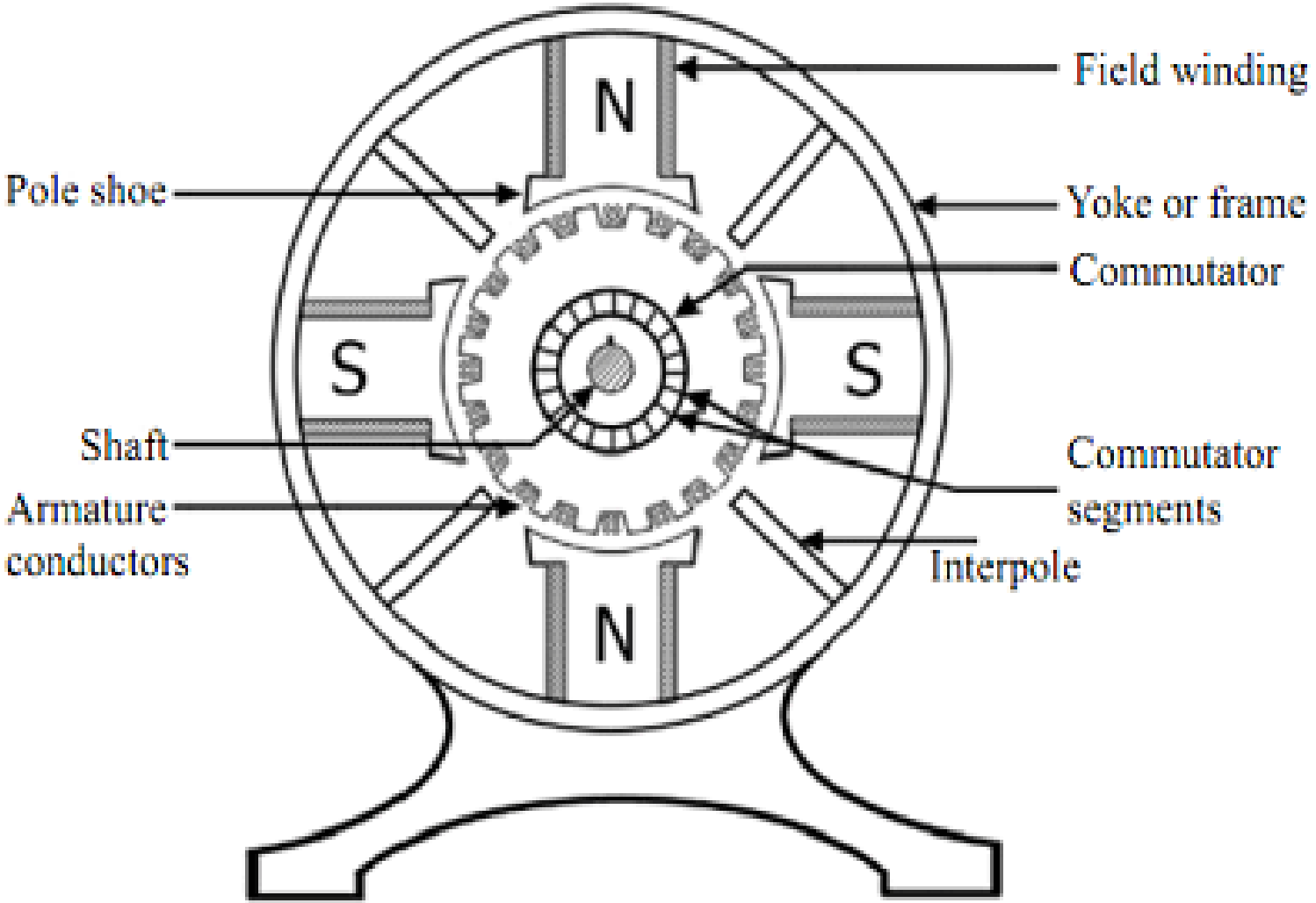
Fundamentals of DC Machines

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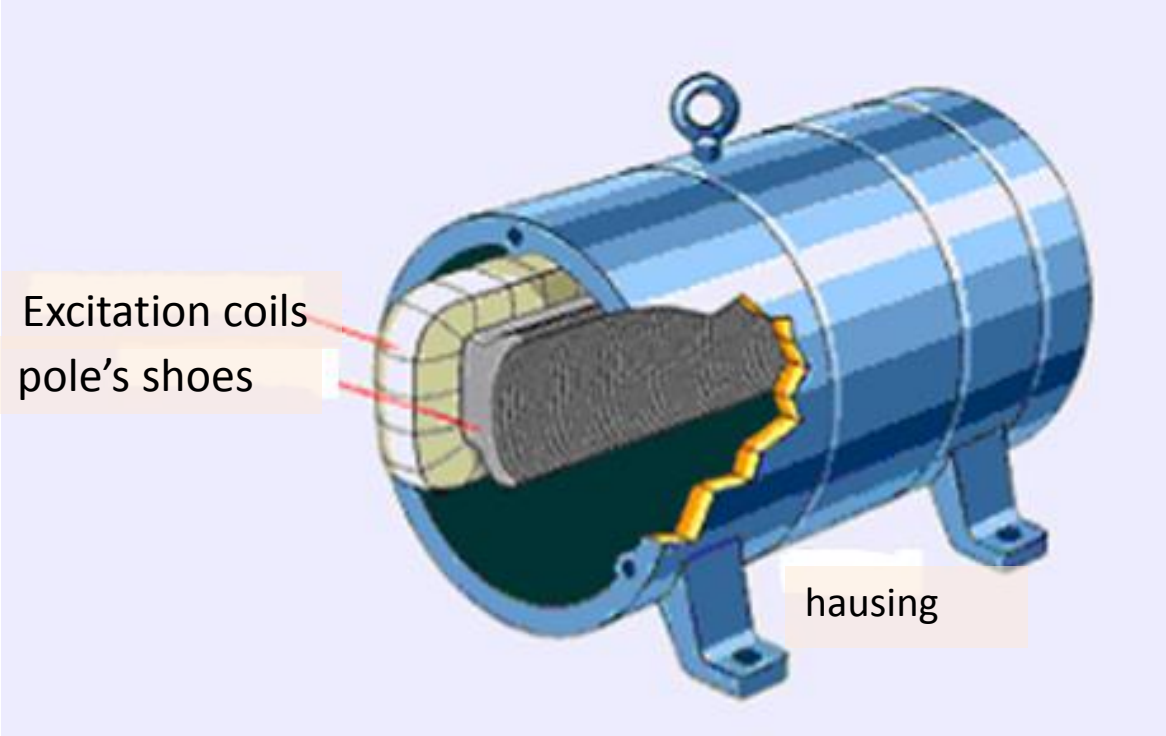

Frame
Stator
End Bracket
Commutator
Brush
Assembly
Shaft
Armature
Bearings


Bracket
Brush
Spring
Terminal
Shaft
Bearing
Commutator
Winding
Armature
Stator
Field magnet
Yoke
Bracket
End plate
flange
Stationary part
Rotating part
Rotating part

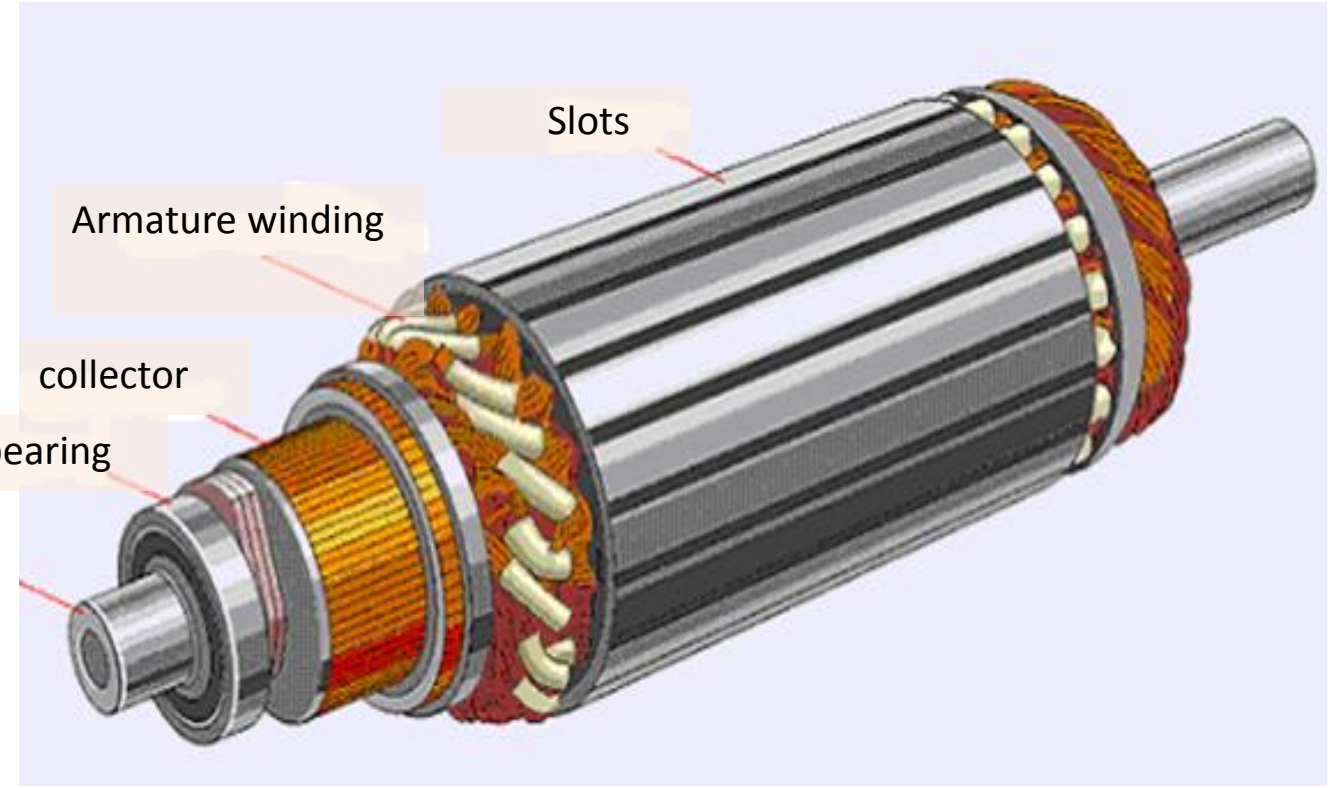


Construction of DC machine

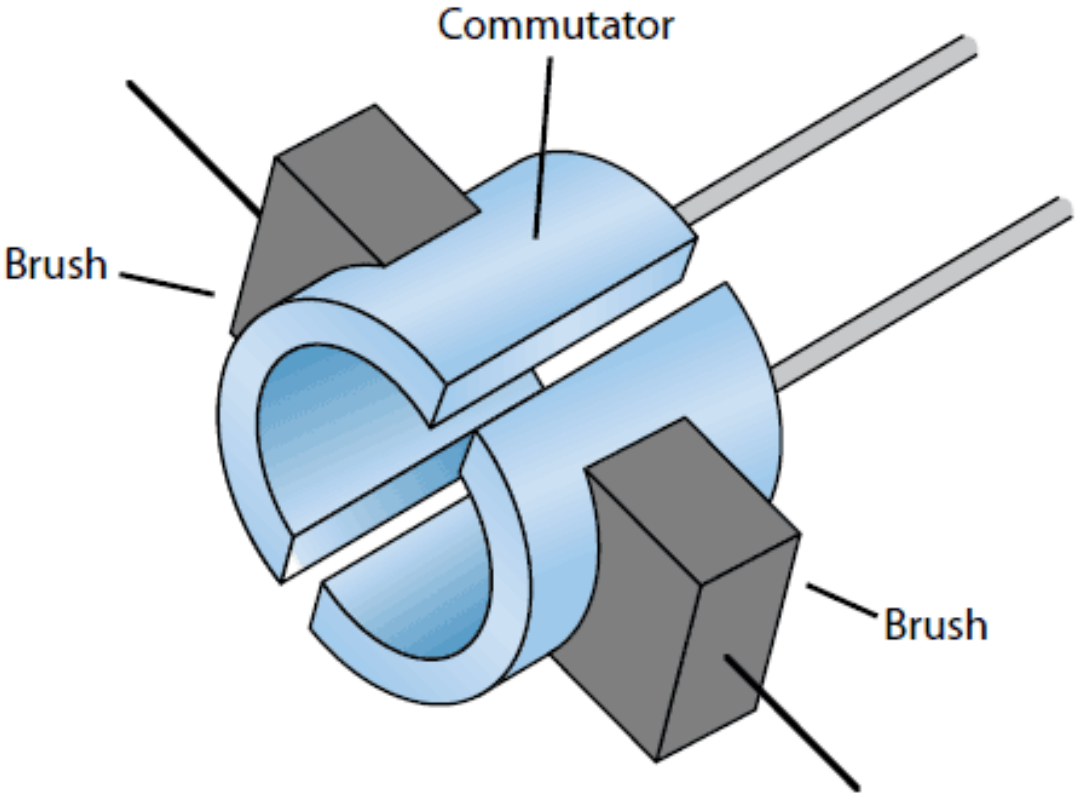
Yoke :



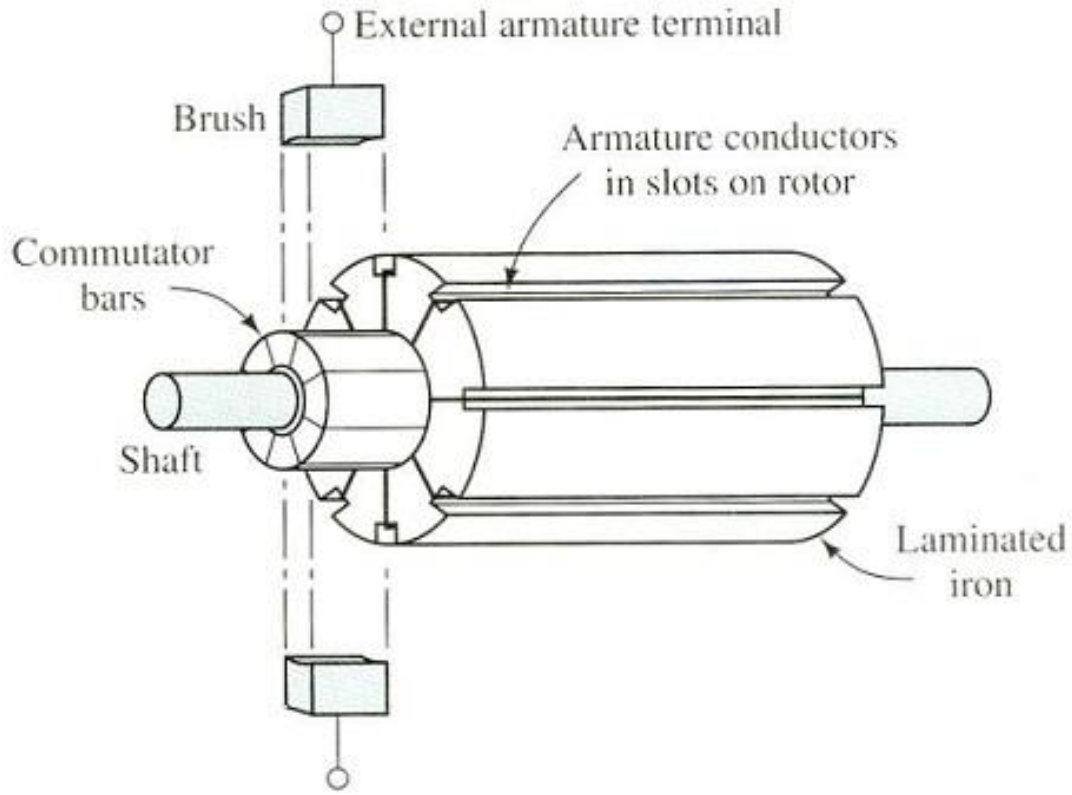
Rotor (Armature):



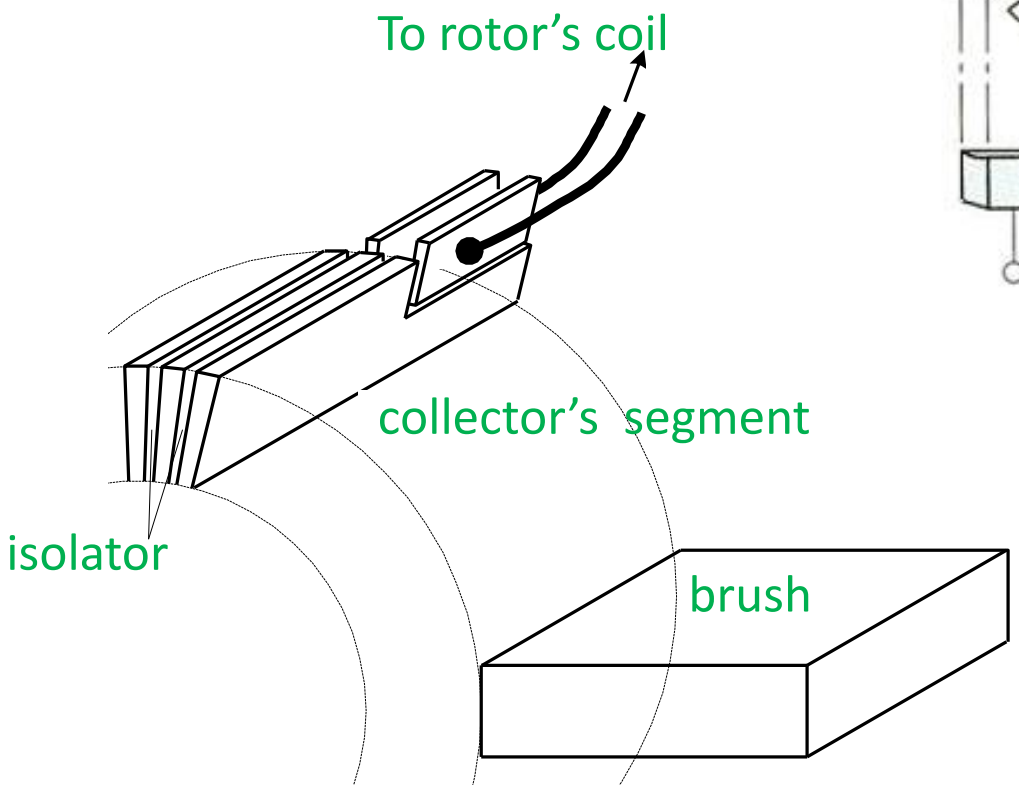
Commutator or Collector



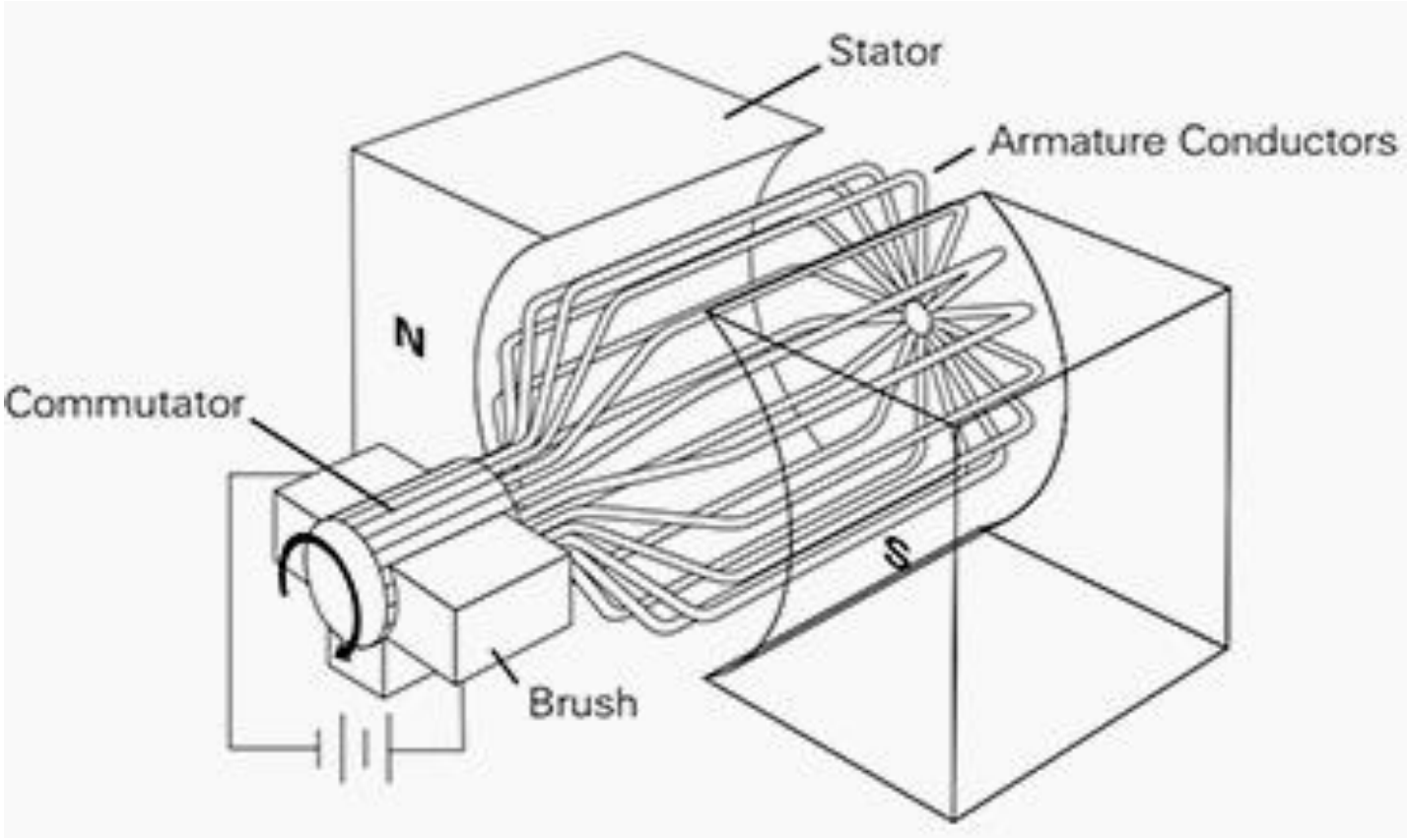
2. A split ring wrapping around the axle, the commutator makes physical contact with the brushes, which connect to opposite poles of a power source to deliver positive and negative charges to the commutator.

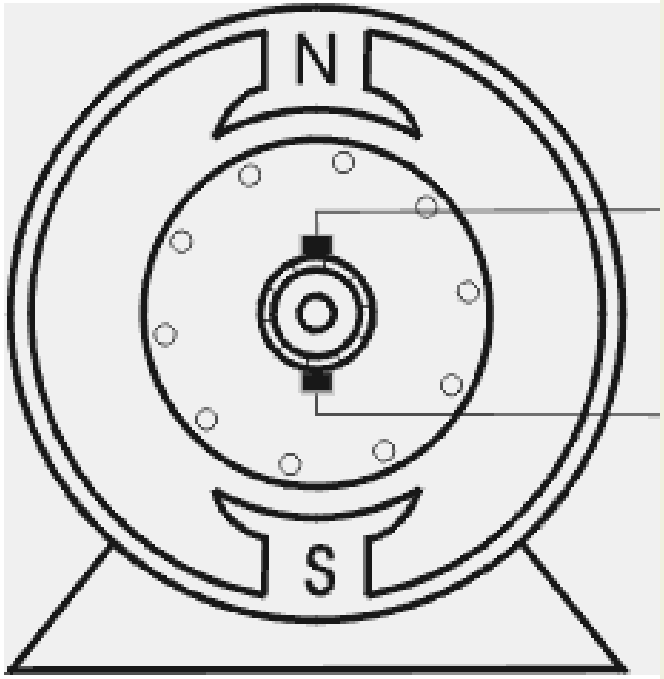


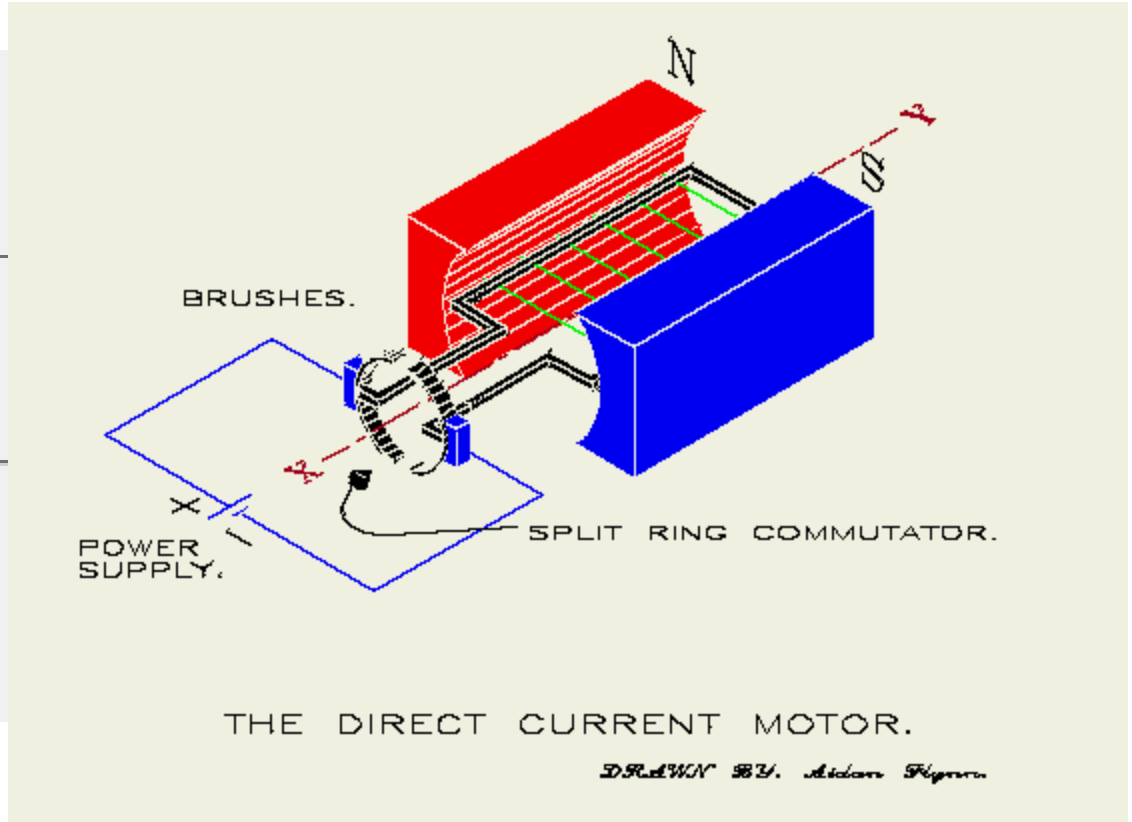
Overall Structure
of Rotating Part

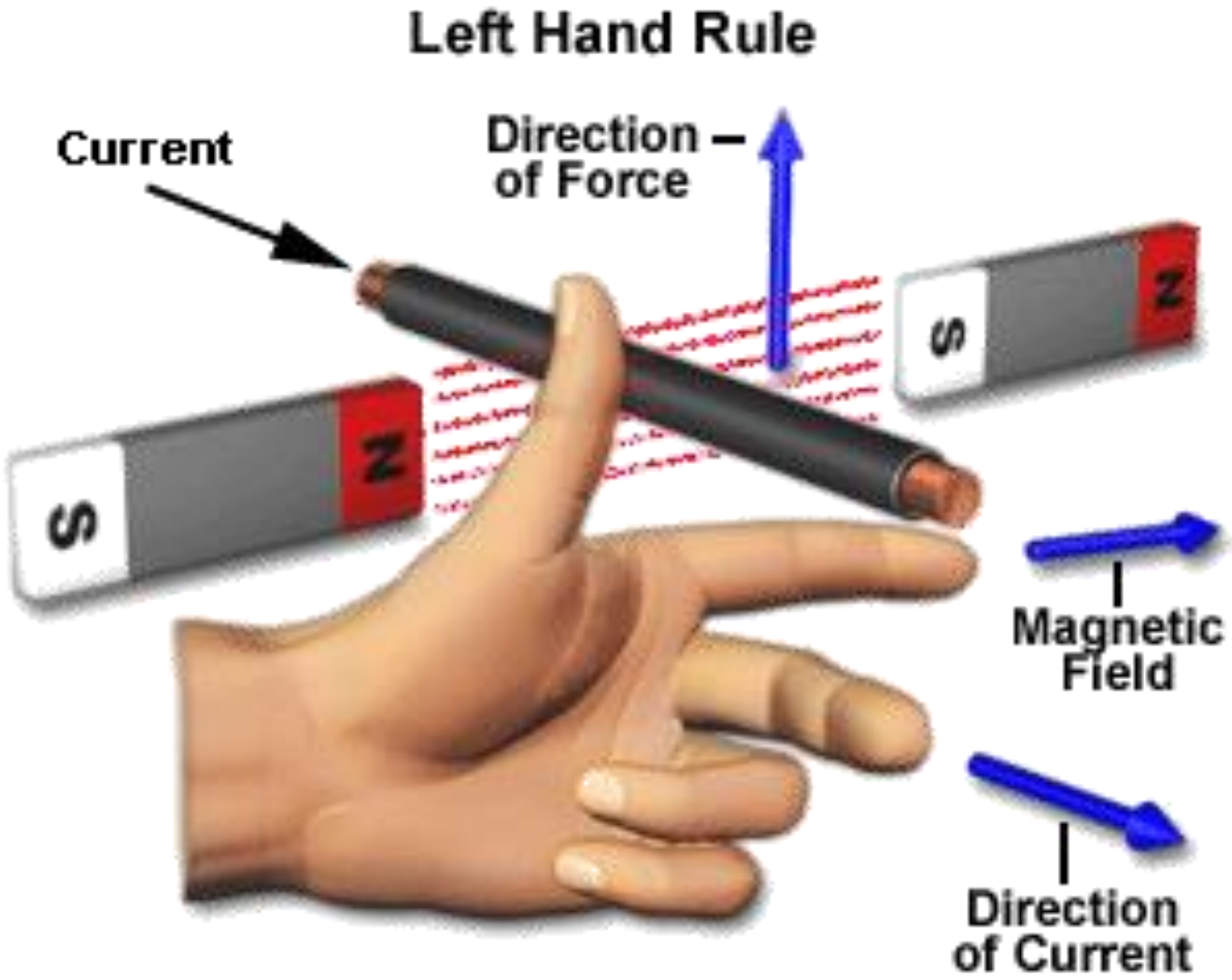


Working Principle



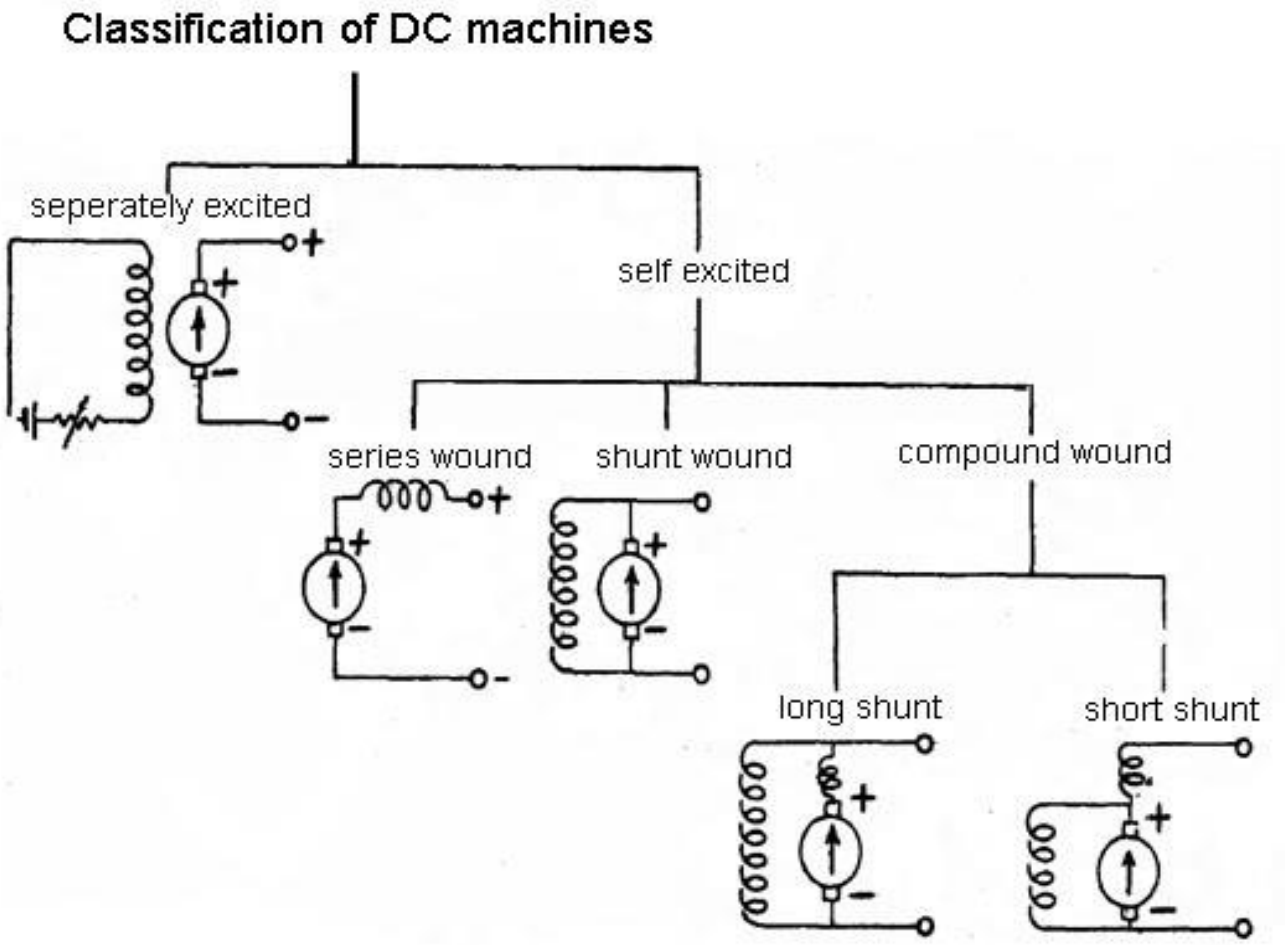

N
S


N
BRUSHES.
POWER SUPPLY.
SPLIT RING COMMUTATOR.
THE DIRECT CURRENT MOTOR.
DRAWN BY. Aidan Flynn.



When a current carrying Conductor is placed in magnetic field it experiences a force that acts tangential to the rotor.

Types of DC motors



© electricaleasy.com

EMF equation

Let ϕ = Flux per pole in webers

Z = Total number of armature conductors

N = Speed of the armature in revolutions per minute (rpm)

P = Number of poles

A = Number of parallel paths

When the armature completes one revolution, each conductor cuts the magnetic flux. Therefore, flux cut by one conductor in one revolution of the armature

= Flux per pole × Number of poles

= ϕP webers

Time taken to complete one revolution = $\frac{60}{N}$ seconds

Hence, average emf induced in one conductor

$$= \frac{\text{Flux cut}}{\text{Time taken}} = \frac{\phi P}{60/N}$$

$$= \frac{\phi PN}{60} \text{ volts}$$

Induced emf (E) = Resultant emf per parallel path

= Average emf per conductor × Number of conductors in series per parallel path

$$= \frac{\phi PN}{60} \times \frac{Z}{A}$$

$$= \frac{\phi ZN}{60} \frac{P}{A} \text{ volts}$$

In case of a dc generator, this emf is called generated emf (E_g). In the case of a dc motor, the induced emf opposes the applied emf and hence, it is called back emf (E_b).

Torque of DC motor

It will be proved that though torque of a motor is admittedly a function of flux and armature current, ***yet it is independent of speed***. In fact, it is the speed which depends on torque and not ***vice-versa***. It has been proved earlier that

$$N = K\frac{V - I_a R_a}{\phi} = \frac{KE_b}{\Phi} \quad \text{...Art. 27.9}$$

Also, $$T_a \propto \Phi I_a \quad \text{...Art. 27.7}$$

It is seen from above that increase in flux would decrease the speed but increase the armature torque. It cannot be so because torque always tends to produce rotation. If torque increases, motor speed must ***increase*** rather than ***decrease***. The apparent inconsistency between the above two equations can be reconciled in the following way :

Suppose that the flux of a motor is decreased by decreasing the field current. Then, following sequence of events take place :

1. Back e.m.f. E_b $(= N\Phi/K)$ drops instantly (the speed remains constant because of inertia of the heavy armature).
2. Due to decrease in E_b, I_a is increased because $I_a = (V - E_b)/R_a$. Moreover, a small reduction in flux produces a proportionately large increase in armature current.
3. Hence, the equation $T_a \propto \Phi I_a$, a small decrease in ϕ is more than counterbalanced by a *large* increase in I_a with the result that there is a net *increase* in T_a.
4. This increase in T_a produces an increase in motor speed.

DC generators

Generators are usually classified according to the way in which their fields are excited. Generators may be divided into (*a*) separately-excited generators and (*b*) self-excited generators.

(*a*) **Separately-excited** generators are those whose field magnets are energised from an independent external source of d.c. current. It is shown diagramatically in Fig. 26.41.

(*b*) **Self-excited generators** are those whose field magnets are energised by the current produced by the generators themselves. Due to residual magnetism, there is always present some flux in the poles. When the armature is rotated, some e.m.f. and hence some induced current is produced which is partly or fully passed through the field coils thereby strengthening the residual pole flux.

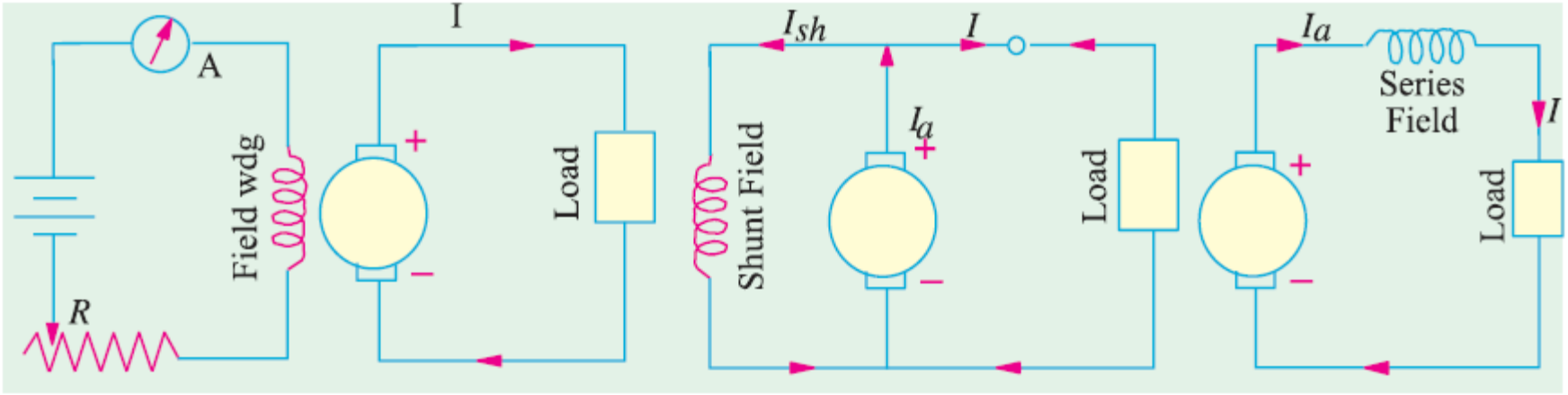
There are three types of self-excited generators named according to the manner in which their field coils (or windings) are connected to the armature.

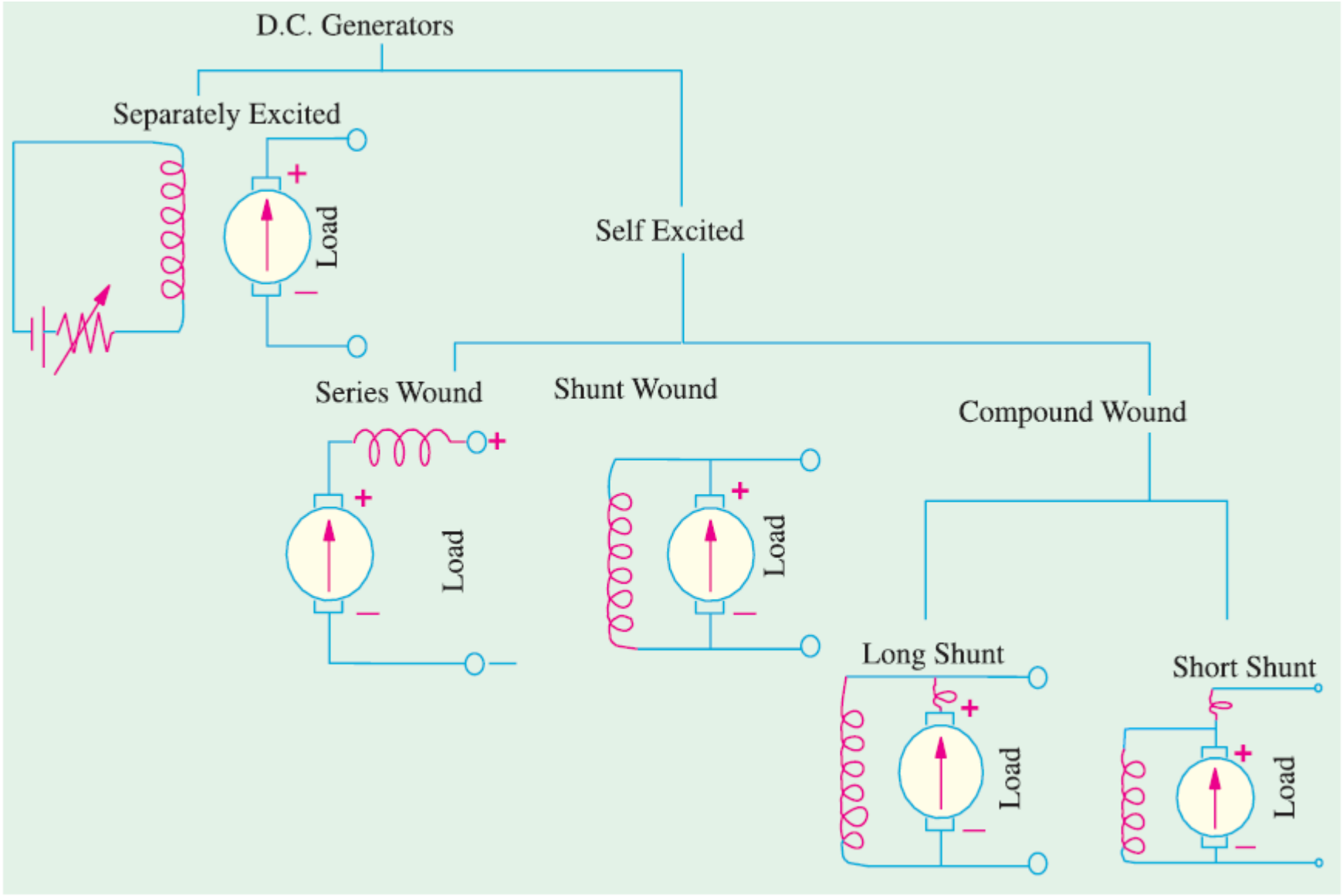
(*i*) Shunt wound

The field windings are connected across or in parallel with the armature conductors and have the full voltage of the generator applied across them (Fig. 26.42).

(*ii*) Series Wound

In this case, the field windings are joined in series with the armature conductors (Fig. 26.43). As they carry full load current, they consist of relatively few turns of thick wire or strips. Such generators are rarely used except for special purposes *i.e.* as boosters etc.


A
Field wdg
R
I
+
−
Load
I_{sh}
I
Shunt Field
I_a
+
−
Load
I_a
Series
Field
I
+
−
Load


D.C. Generators
Separately Excited
Load
Self Excited
Series Wound
Load
Shunt Wound
Load
Compound Wound
Long Shunt
Load
Short Shunt
Load

Thank You