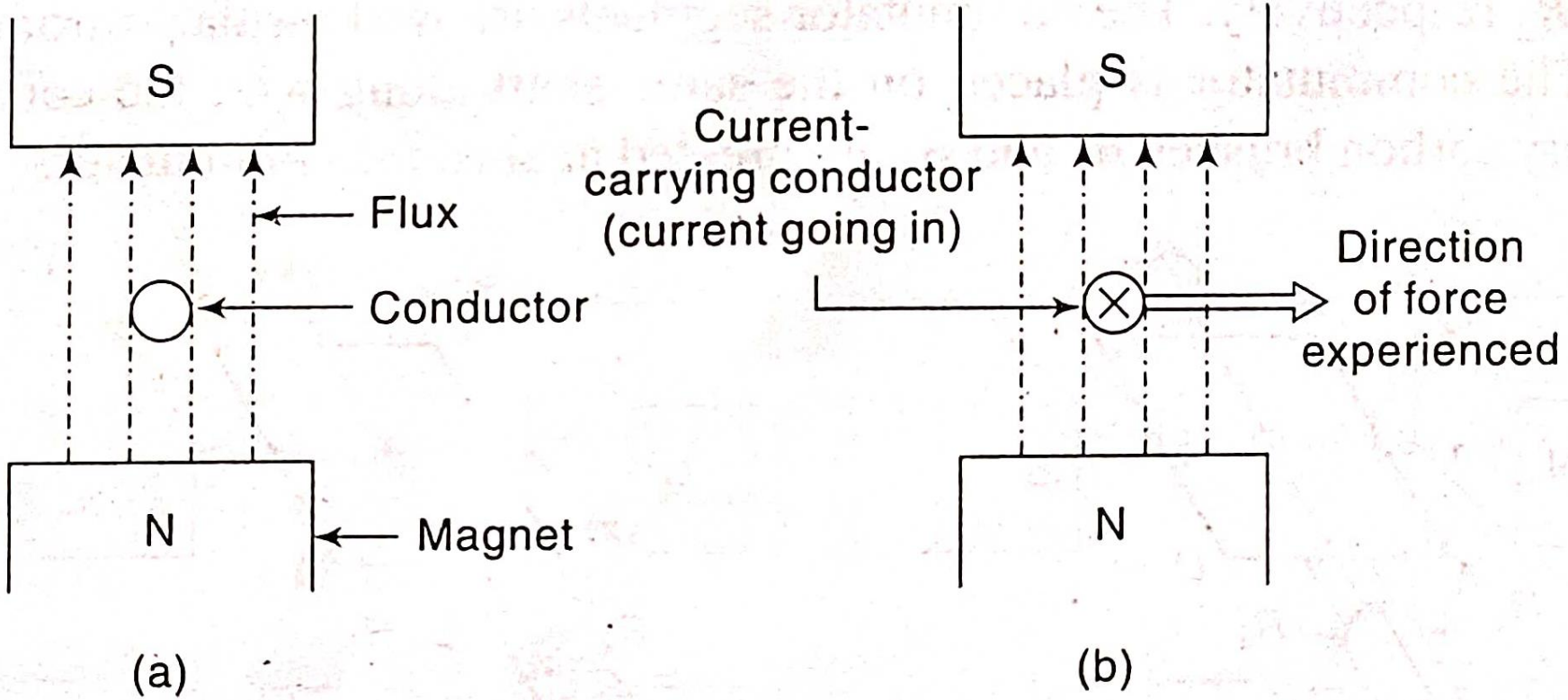
Electrical Motors

D.C. Motor



$$F = B\,I\,l\sin\theta \text{ newton}$$

where F = mechanical force experience by the conductor in N

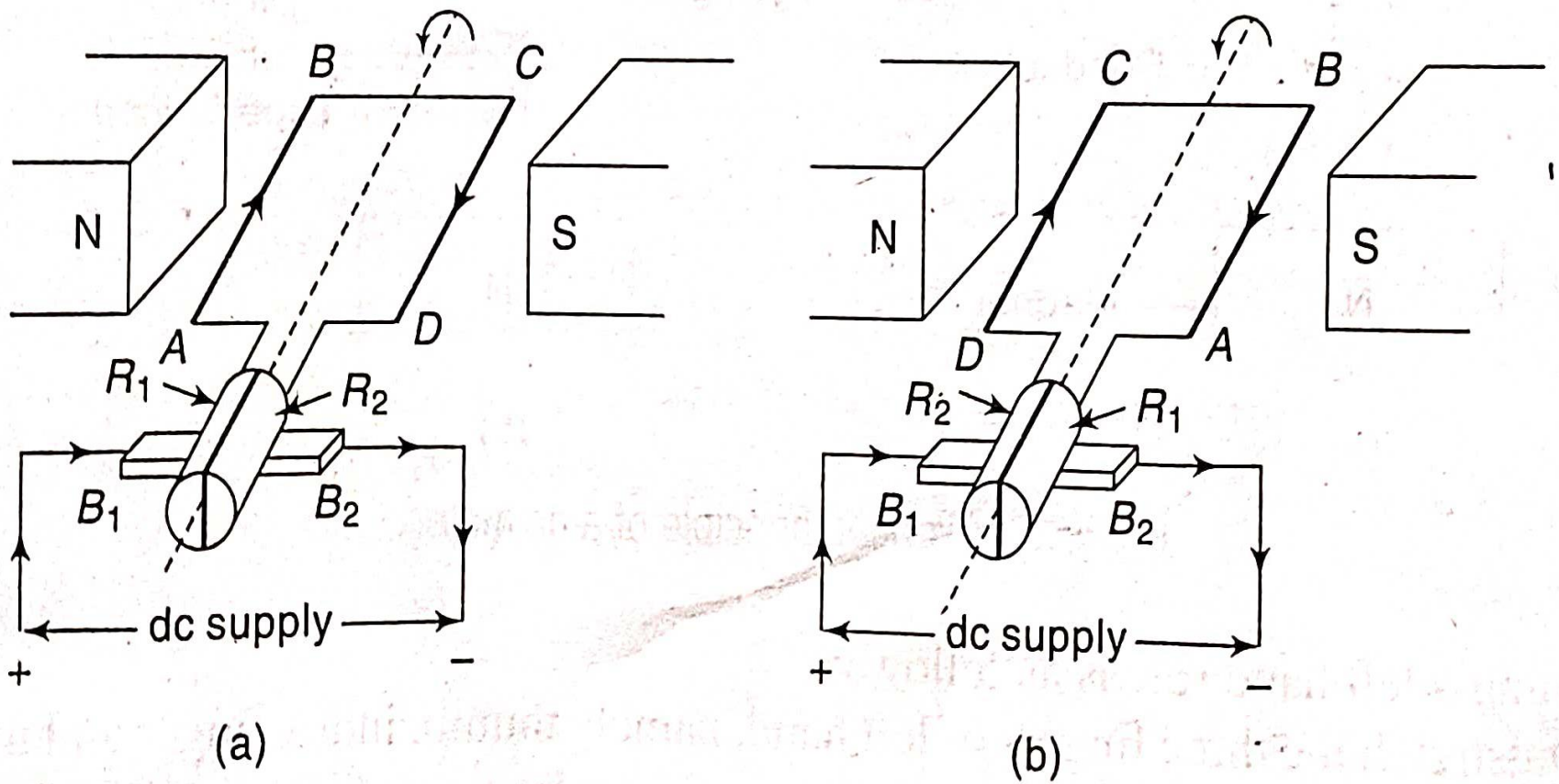
B = flux density in Wb/m^2

l = active length of the conductor in m

I = current through the conductor in A

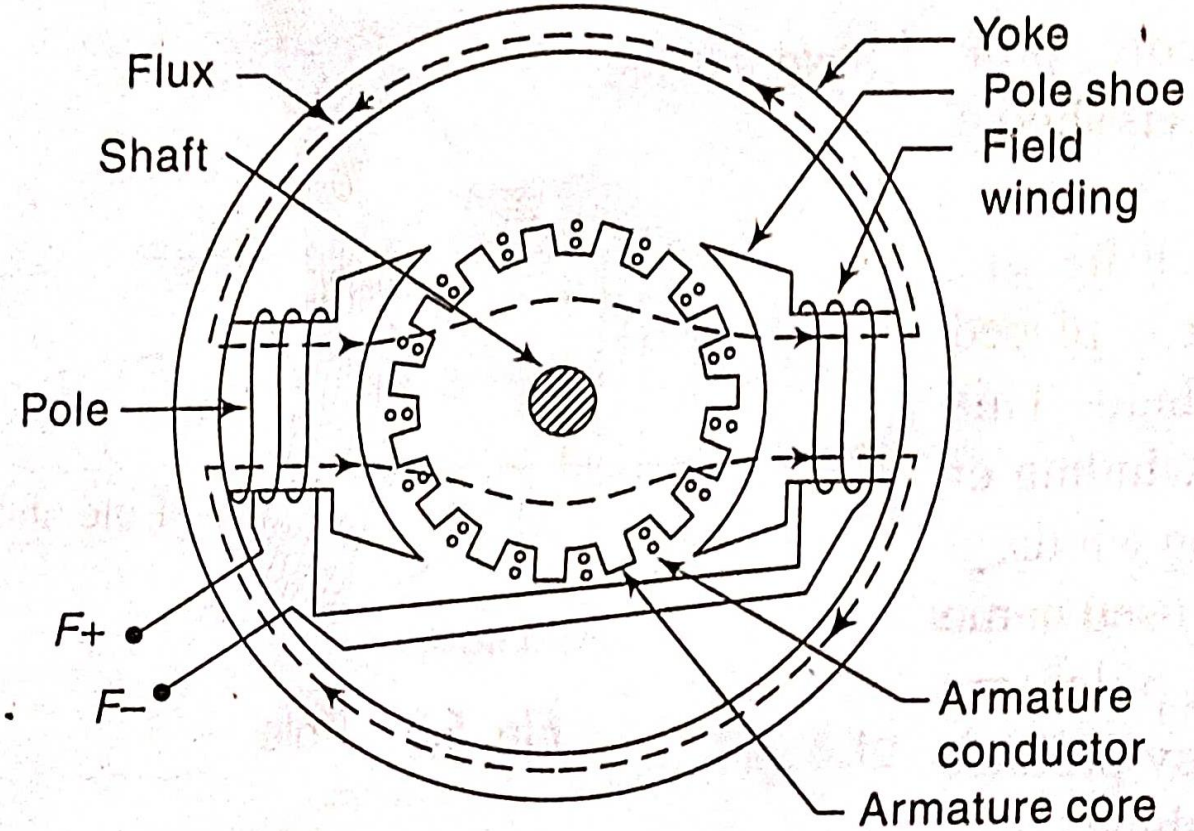
θ = angle between the direction of the current and the magnetic field

Working Principle

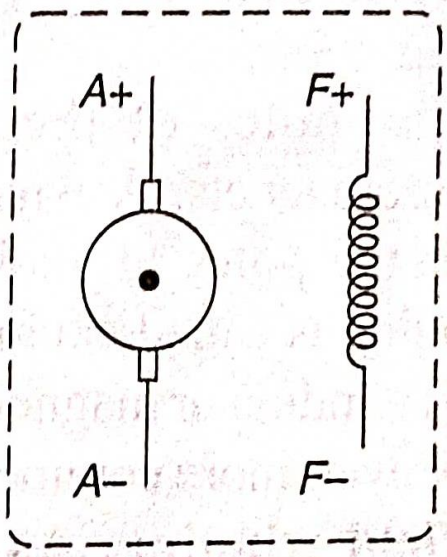


Reference: B.R. Patil, Basic Electrical and Electronics Engineering, Oxford Publication

Construction of DC Motor



(a) Cross-sectional view

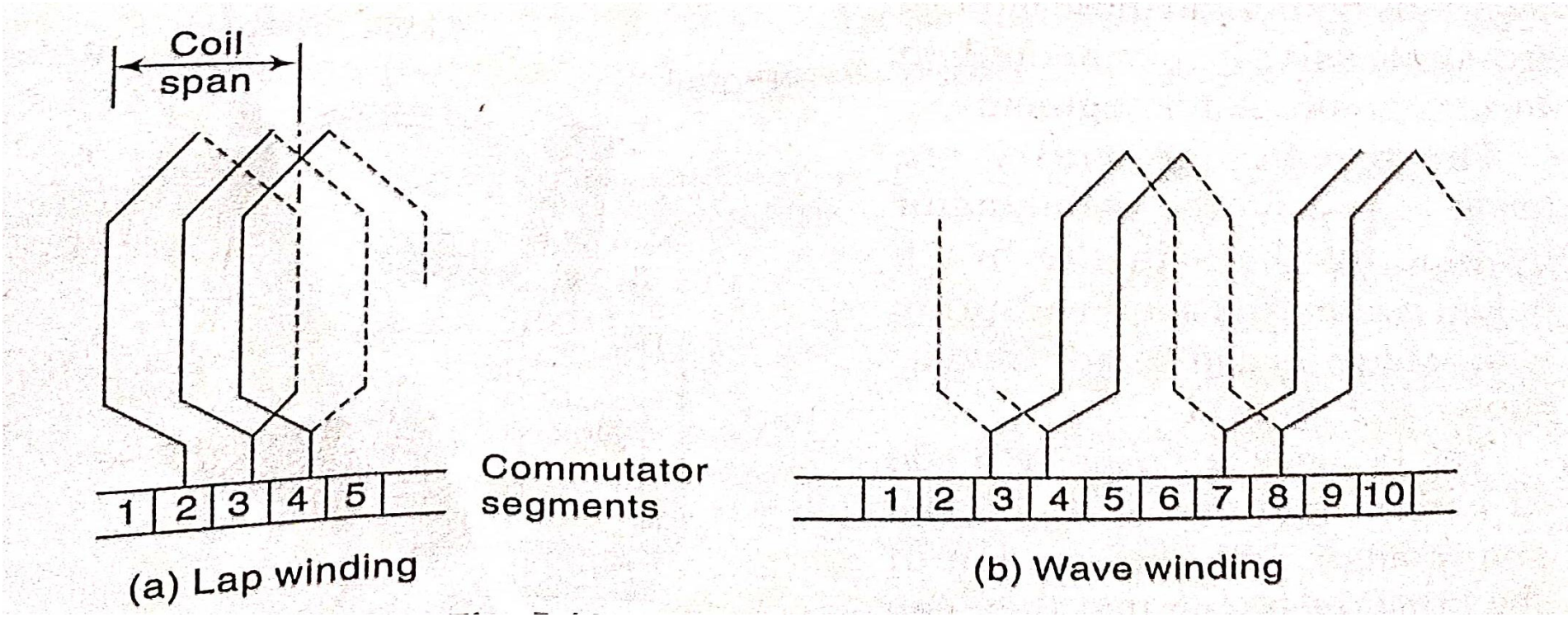


(b) Equivalent circuit

Types of Armature winding

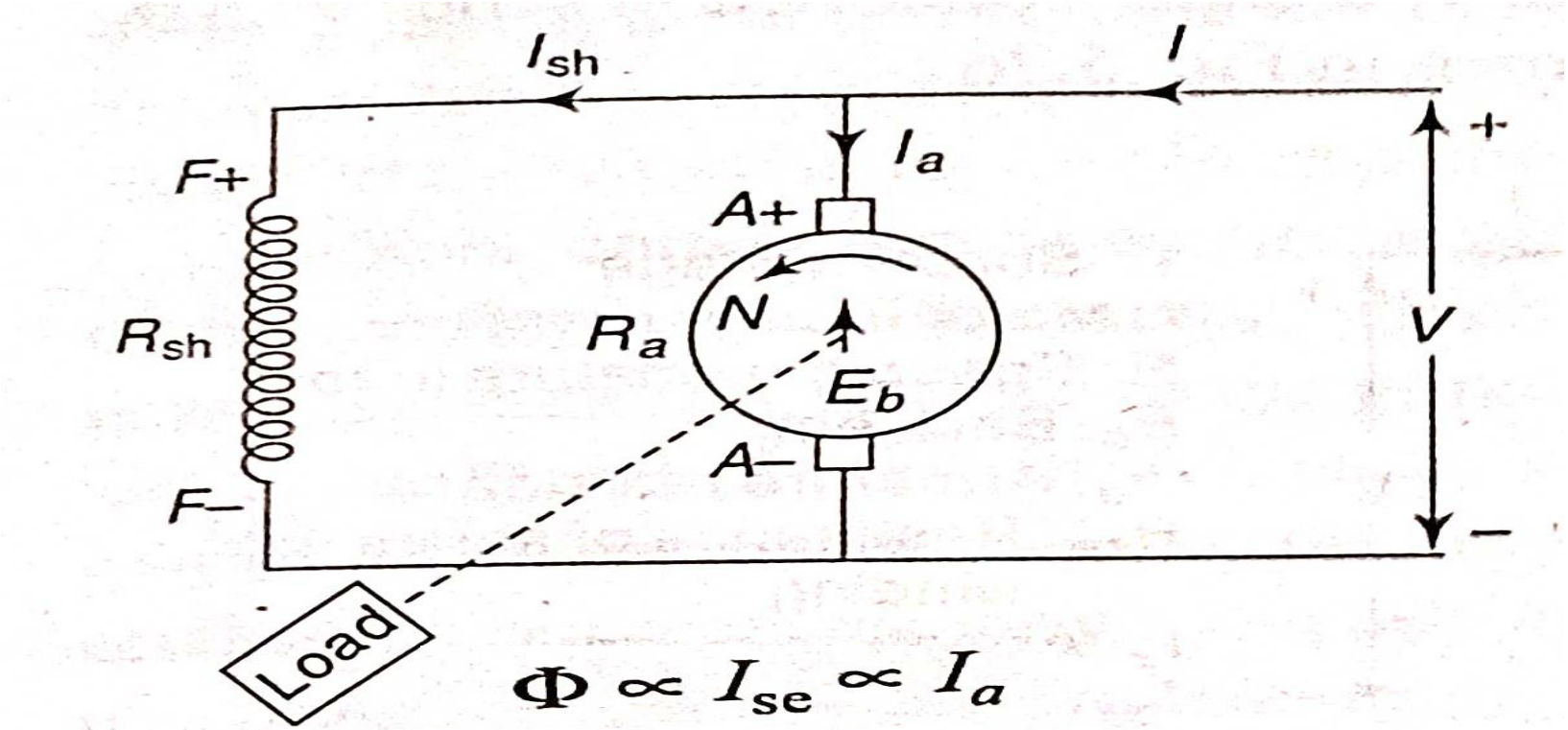
- Lap Winding

Wave Winding



Types of DC Motors

- Shunt Motor



$$\Phi \propto I_{se} \propto I_a$$

$$I = I_a + I_{sh}$$

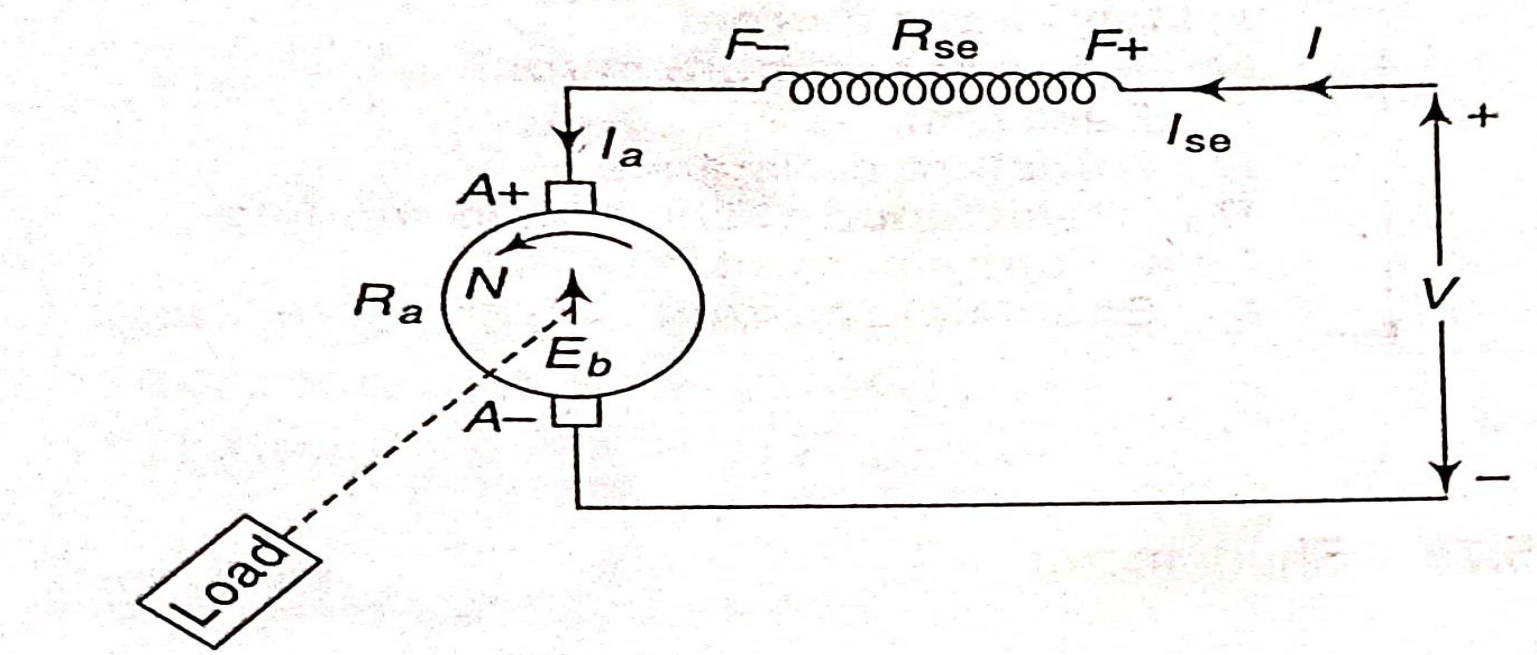
$$I_{sh} = \frac{V}{R_{sh}}$$

$$V = E_b + I_a R_a$$

$$\Phi \propto I_{sh}$$

Types of DC Motors

- Series Motor



$$I = I_{se} = I_a$$

$$V = E_b + I_a R_a + I_a R_{se}$$

$$V = E_b + I_a(R_a + R_{se})$$

$$\Phi \propto I_{se} \propto I_a$$

Applications

- D.C. Shunt Motor

1. Machine tools such as lathe machine, drilling machines, milling machines.
2. Centrifugal pumps.
3. Blowers and fans
4. Printing machinery and paper machines

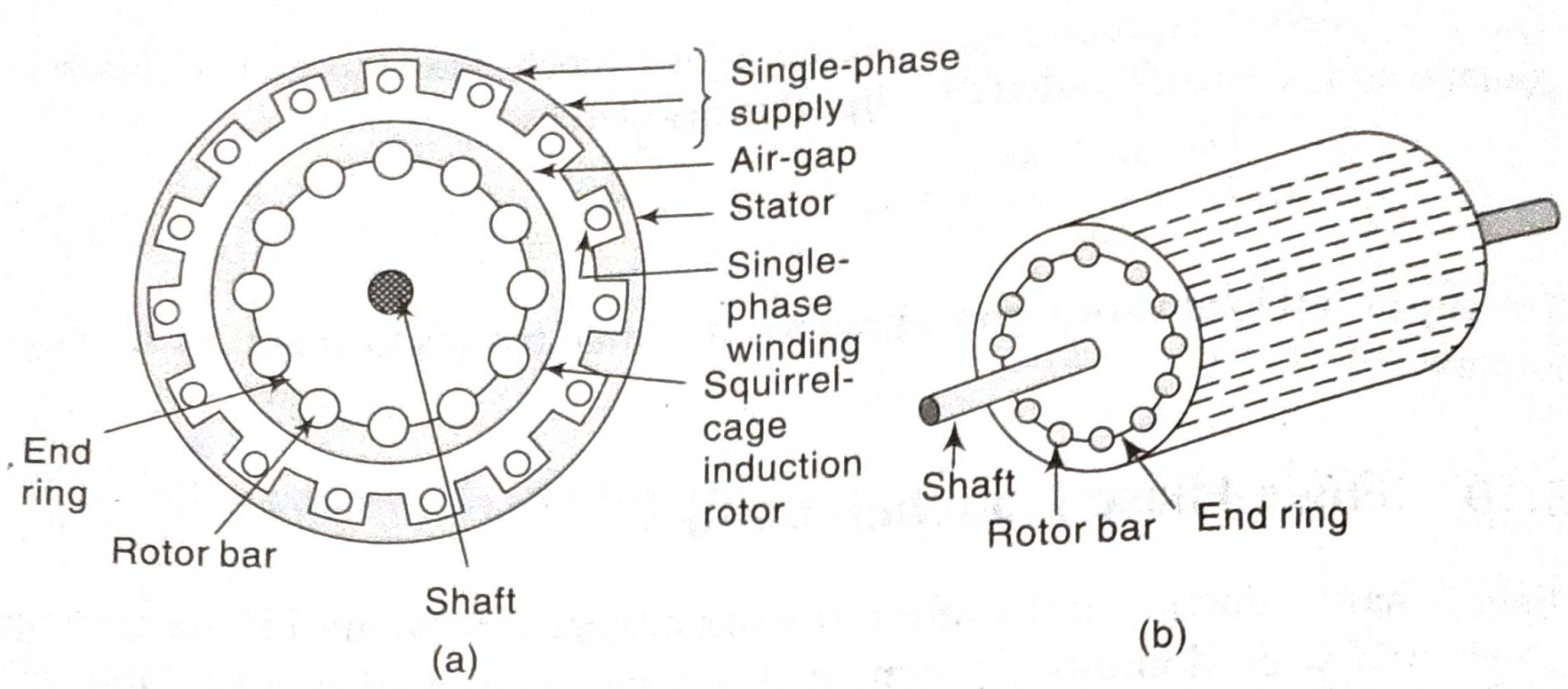
Applications

- D.C. Series Motor

1. Electric trains.
2. Trolley cars and buses.
3. Cranes
4. Conveyers

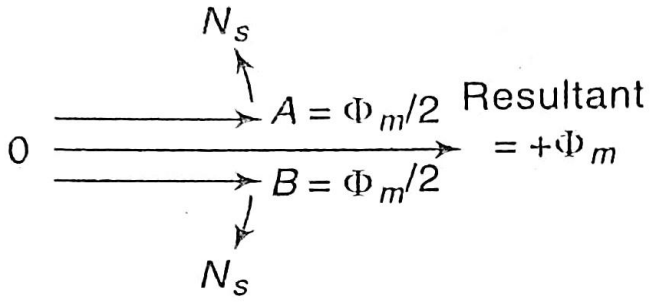
Single Phase Induction Motor

Construction

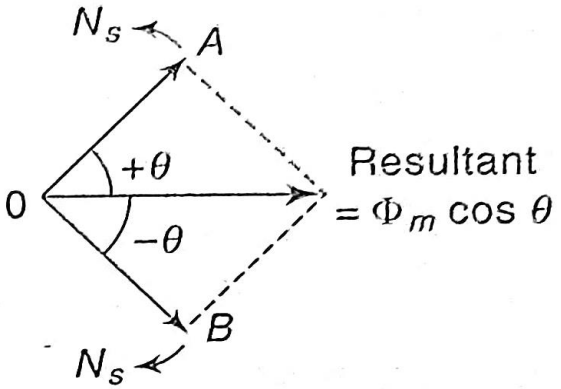


Double field revolving theory

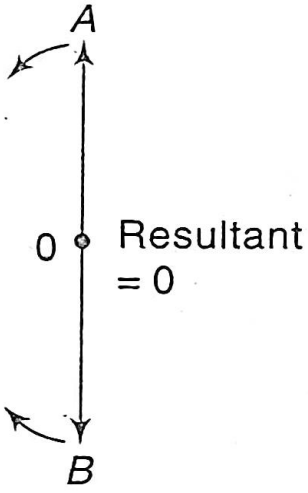
$$\Phi = \Phi_m \sin \omega t$$



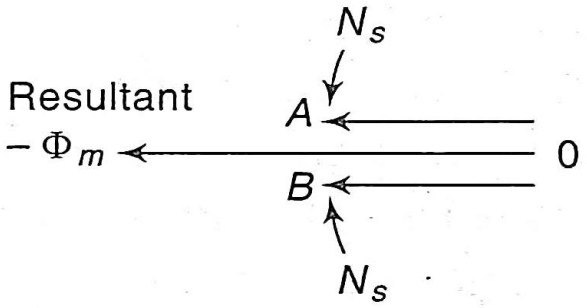
(a) When $\theta = 0°$



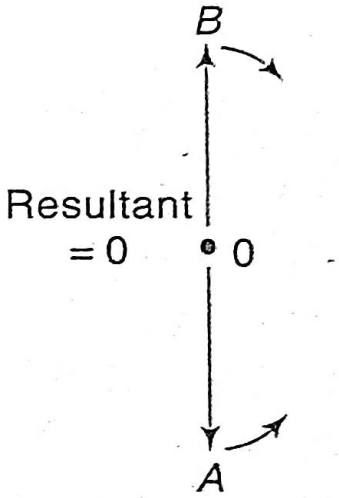
(b) When $\theta = 45°$



(c) When $\theta = 90°$

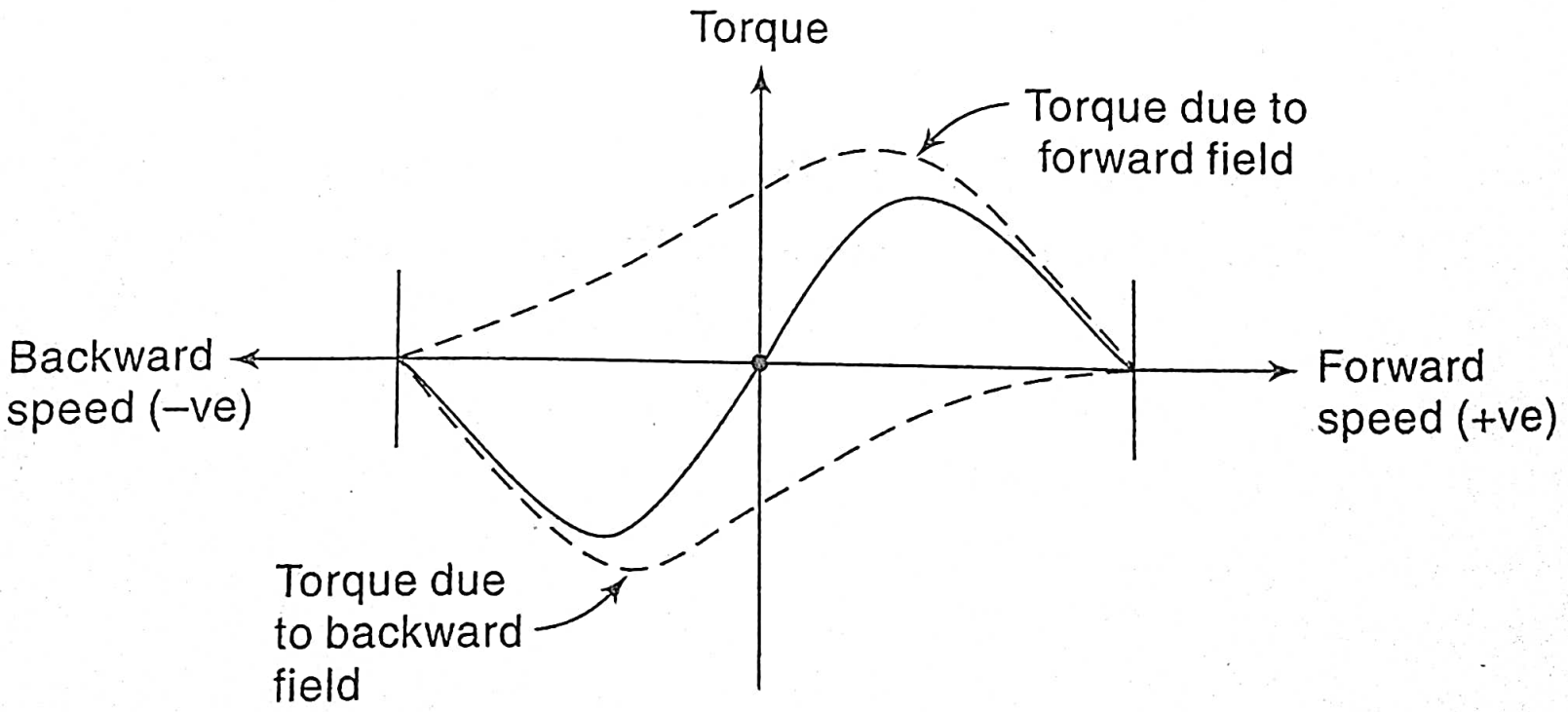


(d) When $\theta = 180°$

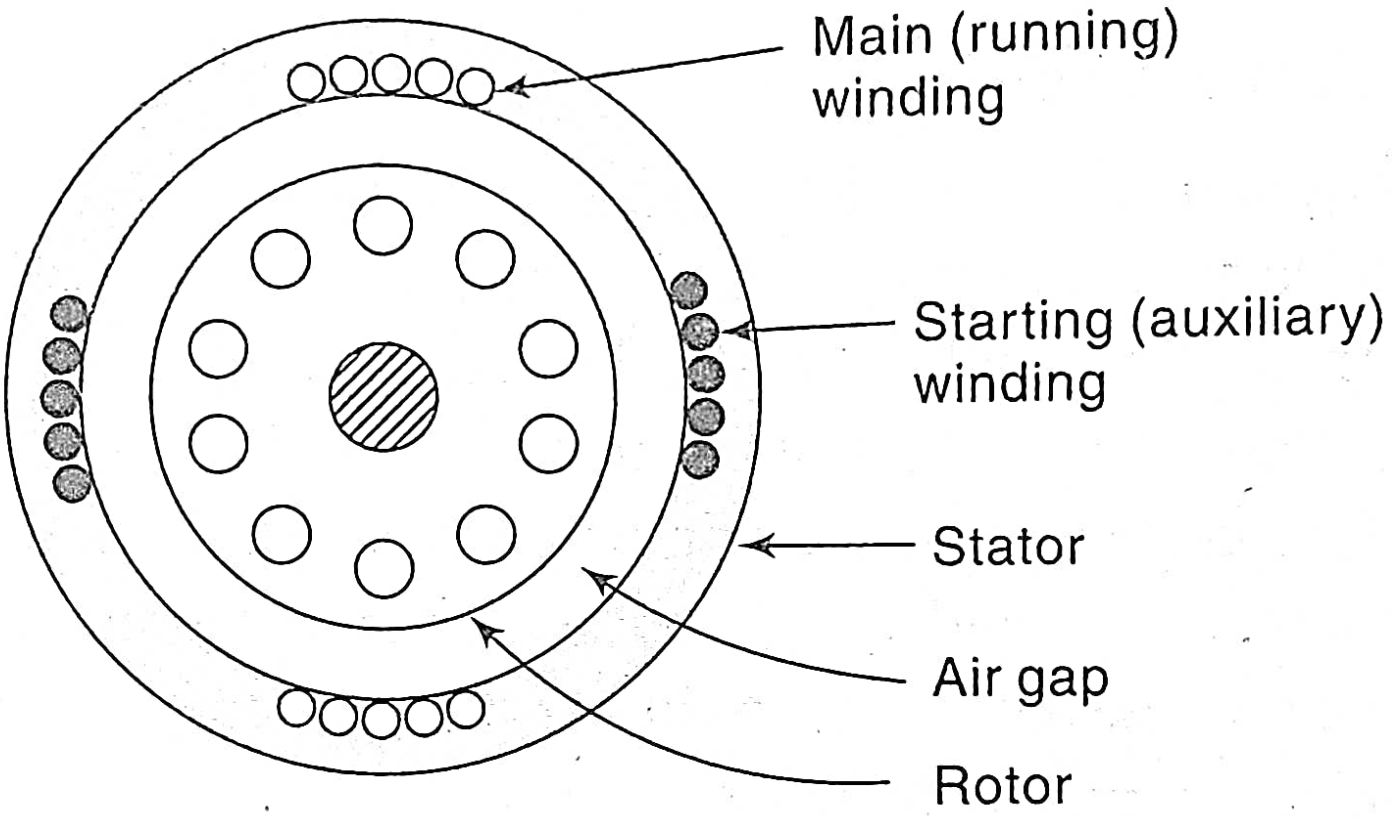


(e) When $\theta = 270°$

Torque –Speed Characteristics



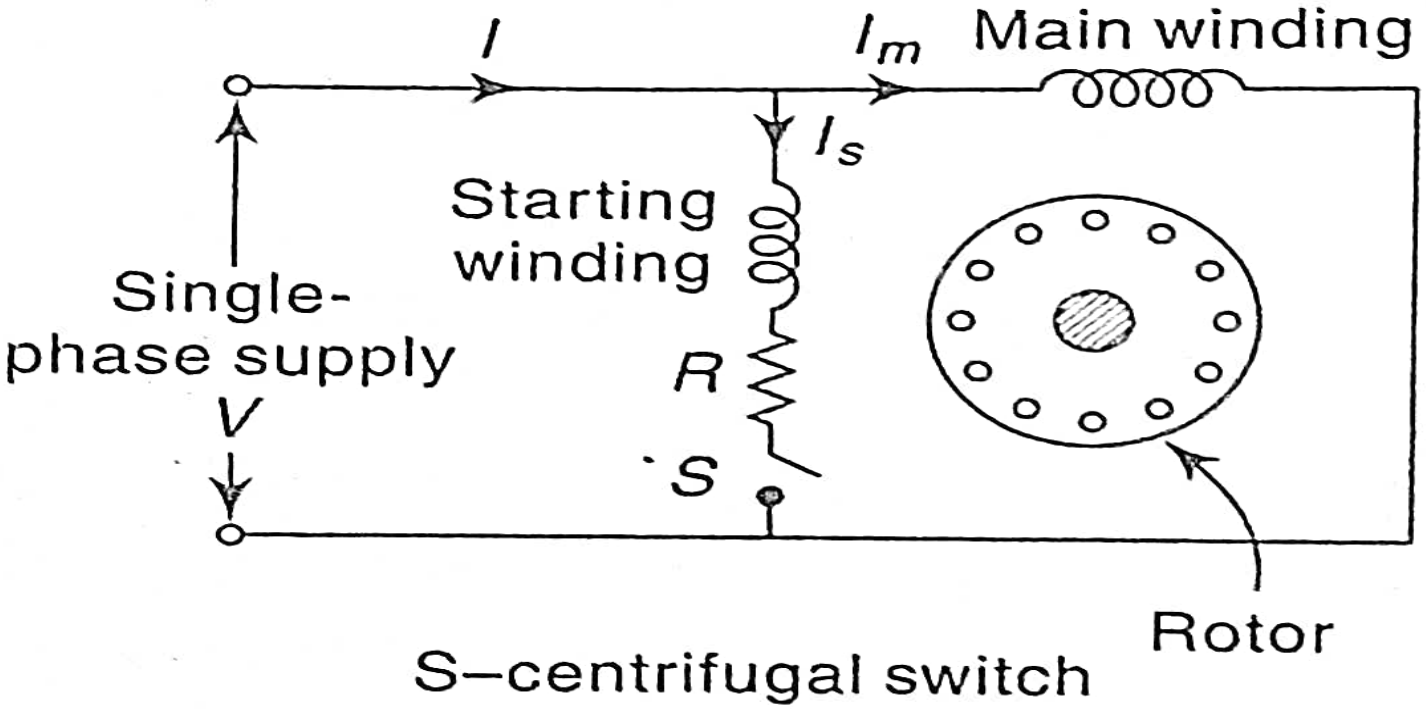
Working Principle



Types of Induction Motor

1. Split-phase induction motor
2. Capacitor Start Induction motor
3. Shaded Pole Induction Motor

Split Phase Induction motor



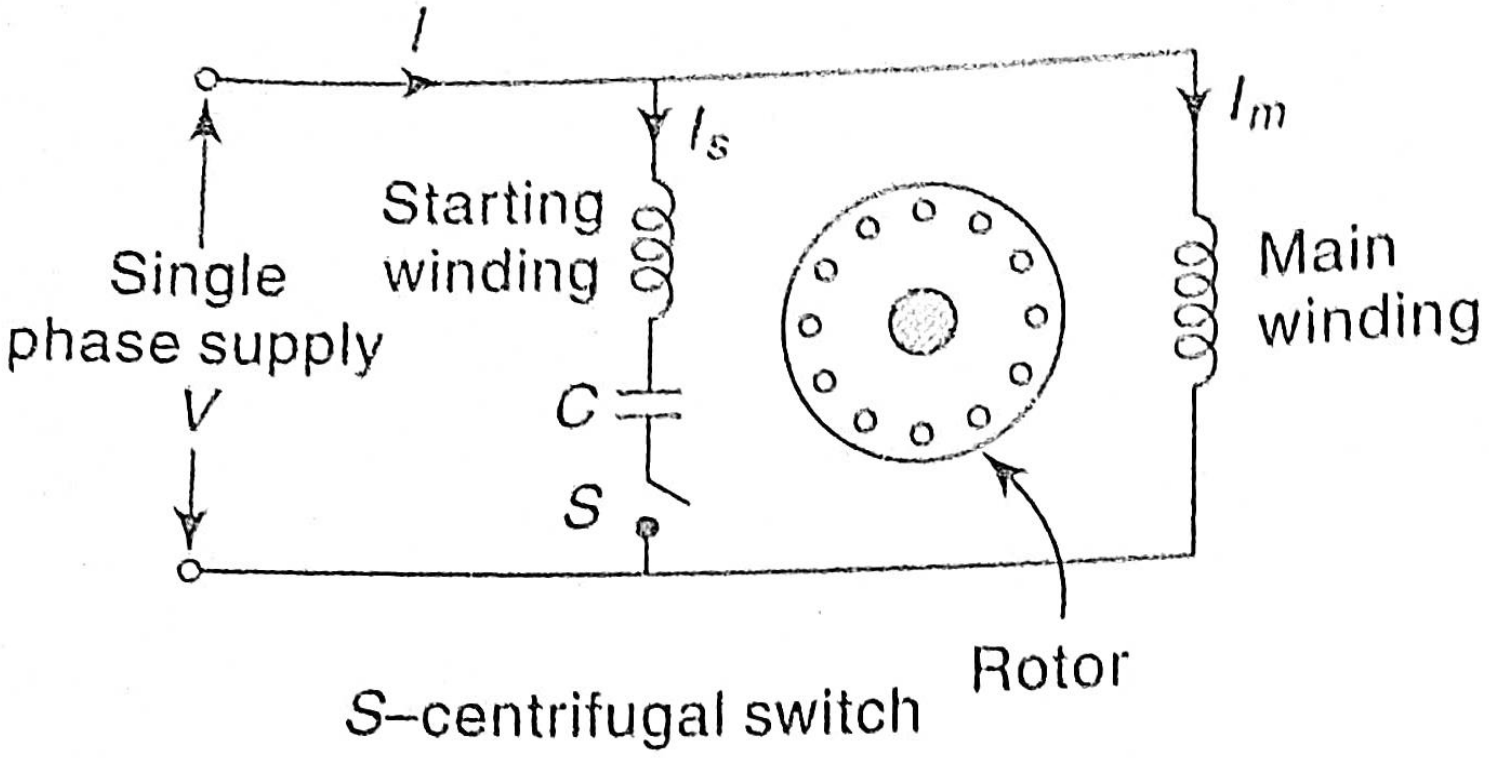
(a) Schematic diagram

Split-phase induction motor

- The starting winding (auxiliary) along with the series resistance R is connected across the main winding. The windings are spaced 90 degree electrically apart and are connected in parallel across single phase supply.

- Applications: These motors have low staring current and moderate starting torque. Used in fans, blowers, grinders, centrifugal pumps, washing machines, oil burners, office equipment.

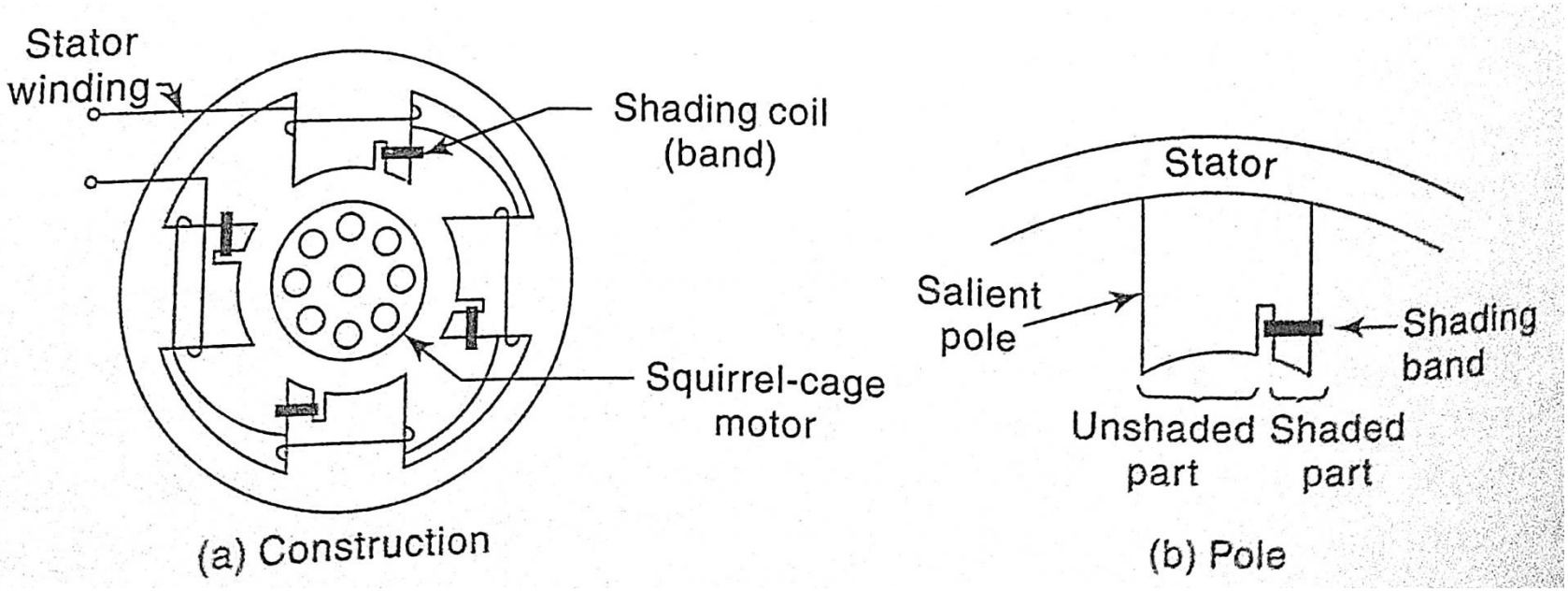
2. Capacitor- Start Induction motor



The construction is same as split phase induction motor. In this motor capacitor is connected in series with the auxiliary winding.

Applications: These motors high starting torque and hence are used for hard starting loads. Used for compressors, conveyors, grinders, fans, blowers, refrigerators, air conditioners etc.

3. Shaded Pole Induction motor



It consists of stator and squirrel –cage type of rotor. These stator consists of salient poles, i.e. projected poles.

Applications : These motors have low starting torque, power factor, and efficiency. These motors are commonly used for small fans, toy motors, advertising displays, film projectors, record players, hair dryers, photocopying machines.