

Lecture No. 58

Single Phase Induction Motor (Operating Principle)

Lecture delivered by:



Objectives

At the end of this lecture, student will be able to:

- Describe Double Revolving Field Theory
- Explain the basic principle of operation
- Discuss the need for Auxiliary winding



Introduction

- Applications
 - Fans , refrigerators, vacuum cleaners, mixers, washing machines and small farming equipments



Induction Motor in Vacuum Cleaner



Reasons for using Fractional-kW motors in household applications

- Power requirements of individual load items are small
- Input point power is 3-phase, which is being wired to 1-phase for safety
- Simpler in construction



Disadvantages of Fractional-kW motors

- In industry use, many such small motors exceeds the number of kW motors
- Analysis is complex
- Design is carried out by trial and error till the desired prototype is obtained
- Operational cost is more



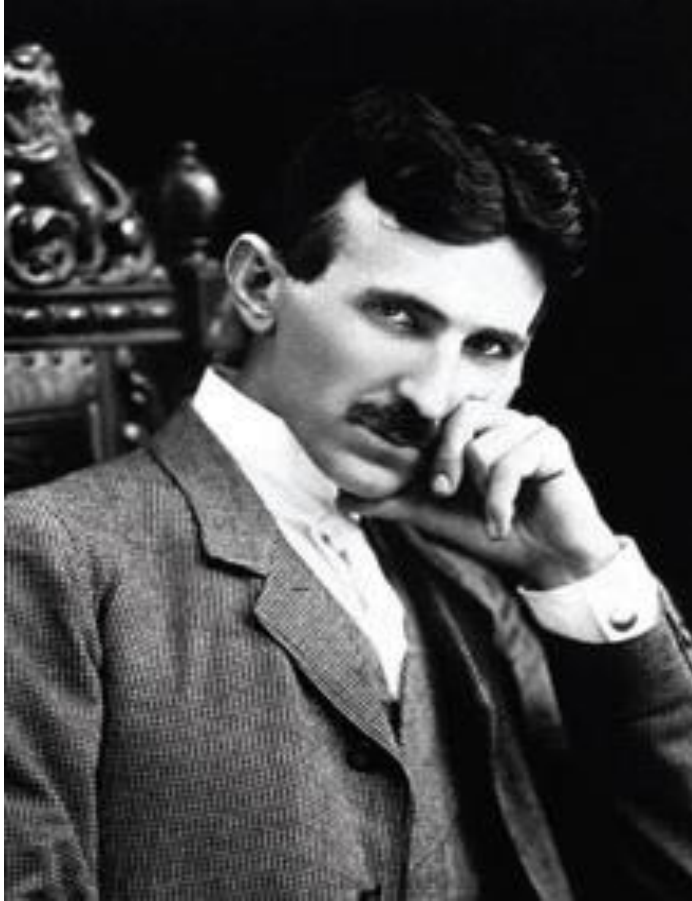
Law of Electromagnetic Induction



- According to Faraday's law of **electromagnetic induction**, a **voltage is induced** between the ends of a wire loop when the magnetic flux passing through the loop varies as a function of time



Principle of Single Phase Induction Motor



NIKOLA TESLA

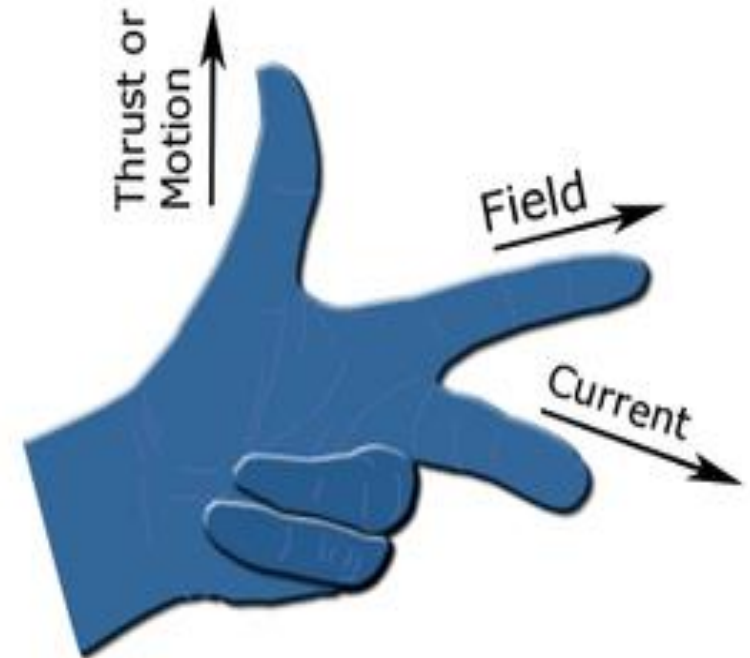
In 1882, Nikola Tesla discovered that ,an iron rotor can spin rapidly in an rotating magnetic field, produced by the interaction of two alternating currents out of step with each other

Source: <http://www.teslasociety.com/teslacoil.htm>

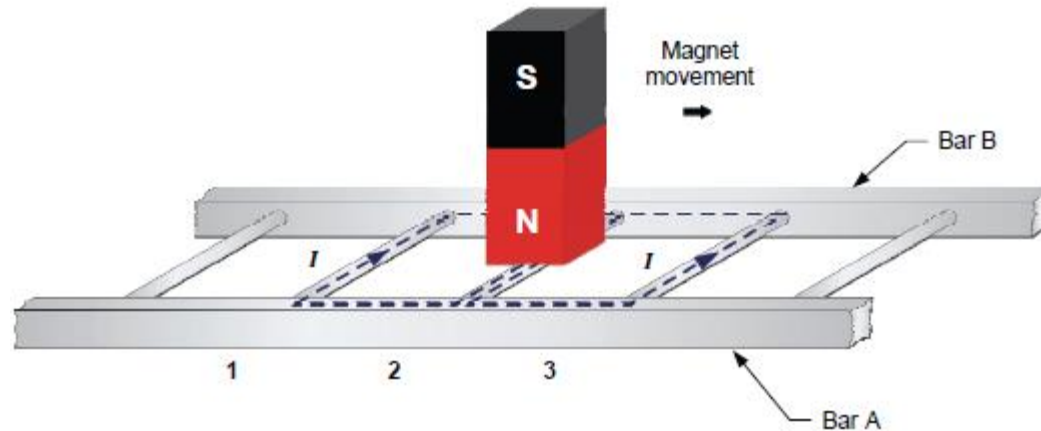


Fleming Left Hand Rule

- When current flows in a wire, and an external magnetic field is applied across that flow, the wire experiences a force perpendicular both to that field and to the direction of the current flow.



Principle of operation



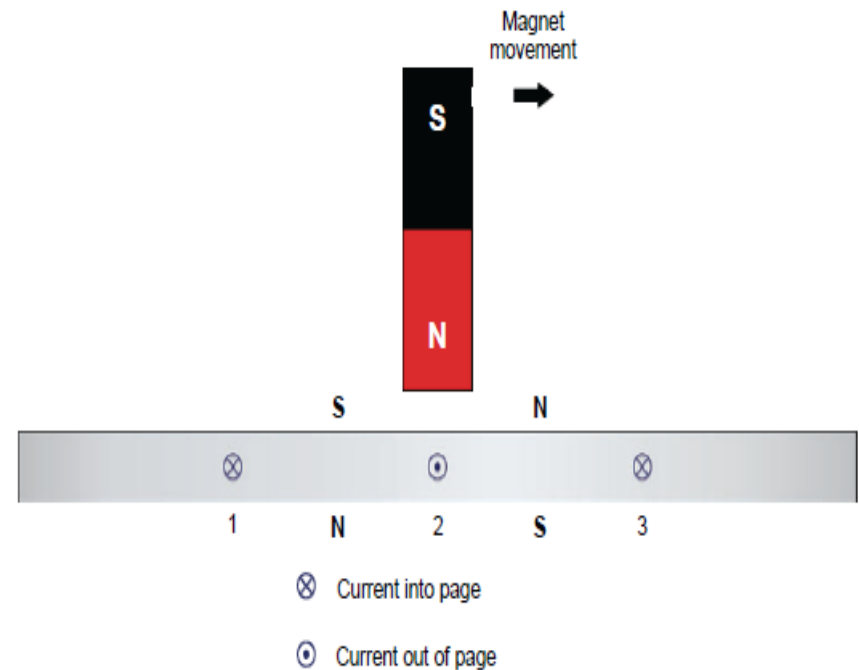
Source: Lab volt systems

- Magnet that is displaced rapidly toward the right above a group of conductors.
- Conductors are short circuited at their extremities by bars A and B and form a structure similar to a ladder.



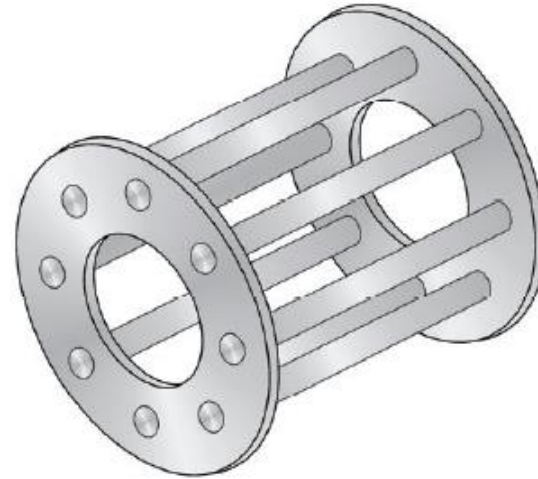
Principle Of Operation

- Interaction between the magnetic field of the magnet and the magnetic fields produced by the currents induced in the ladder creates a force between the moving magnet and the ladder.



Principle of Operation

Ladder



Squirrel cage induction machine

- Stator of the three-phase squirrel-cage induction machine acts as a rotating electromagnet
- Rotating electromagnet produces a torque which pulls the rotor along in much the same manner as the moving magnet pulls the ladder



Video: Principle of Single Phase Induction Motor



Special Thanks
Sapth K V

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Video: Rotating Magnetic Field

Rotating Magnetic Field

Principle of AC Motors

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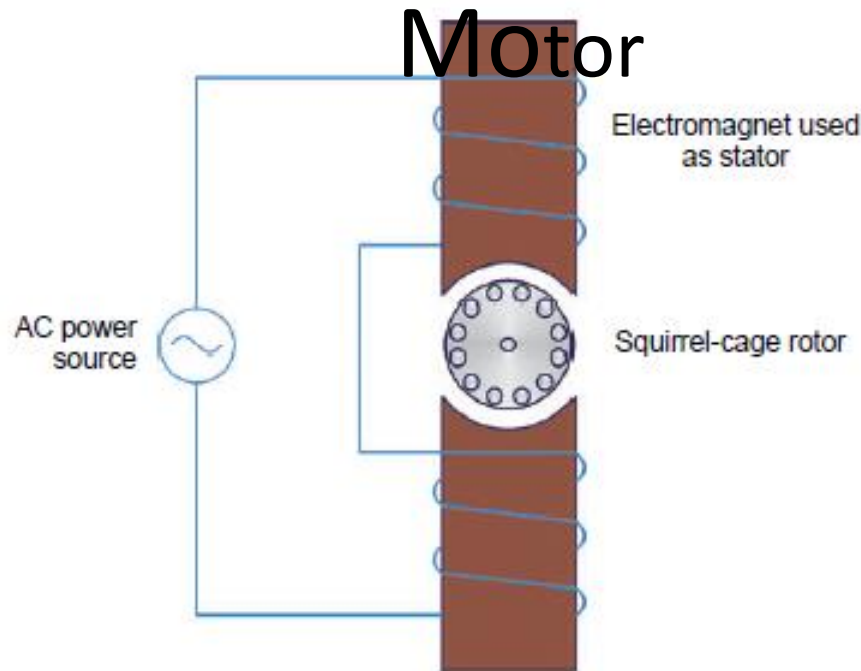


Double Revolving Field Theory

- When ac current is passed through a coil, an alternating field is produced
- This field can be considered as equivalent of two equal magnetic fields rotating at a constant speed in a direction opposite to each other
- If a conductor is kept stationary in this field it will not experience any torque as individual torques get canceled



Single Phase Squirrel Cage Induction Motor



Source: Lab volt systems

- When the rotor of the simple single-phase induction motor is turned manually, a torque which acts in the direction of rotation is produced, and the motor continues to turn as long as ac power is supplied to the stator electromagnet.



Single Phase Induction Motor

- Torque is due to a rotating magnetic field that results from the interaction of the magnetic field produced by the stator electromagnet and the magnetic field produced by the currents induced in the rotor
- Auxiliary winding is used which produces rotating magnetic field during starting and is isolated during running by centrifugal switch



Summary

- Single Phase Induction Motors are used for low power and domestic applications
- Single Phase Induction Motors are not self starting
- Auxiliary winding and other methods are used to start the motor

