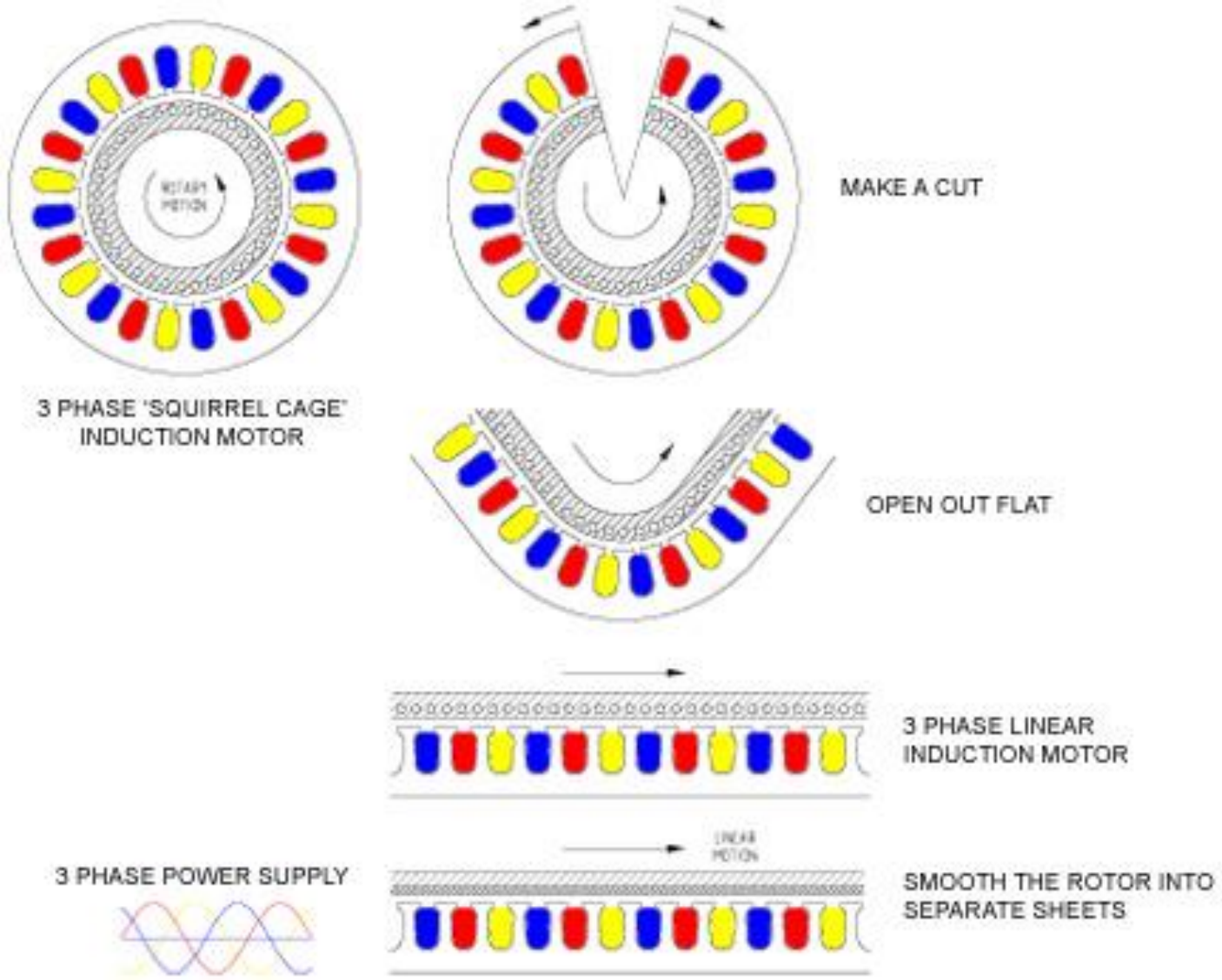
Course Code - EEE-401
Course Title – Energy Conversion and Special Machine
Lecture- Linear Induction Motor

Linear Induction Motor

Linear Induction Motor

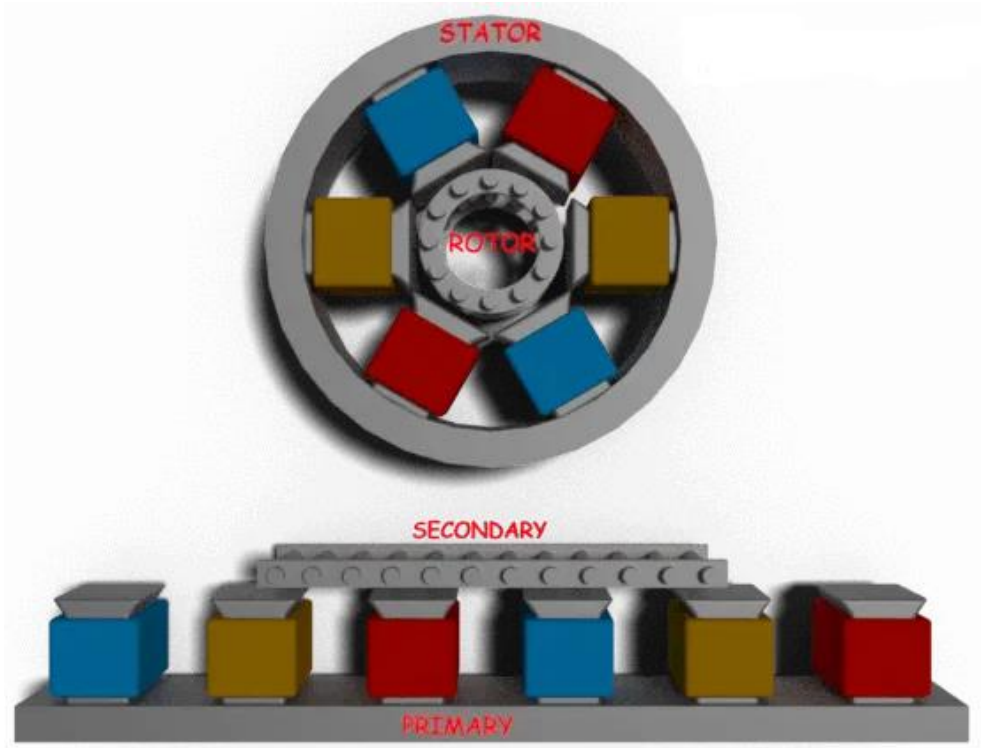
- A Linear Induction Motor (or LIM) is a special type of induction motor used to achieve linear motion rather than rotational motion as in the case of conventional motors.
- Linear induction motors are quite an engineering marvel, to convert a general motor for a special purpose with more or less similar working principle, thus enhancing its versatility of operation.
- If the induction motor of first figure is cut axially and spread out flat as shown in second figure, it corresponds to a linear induction motor (LIM).

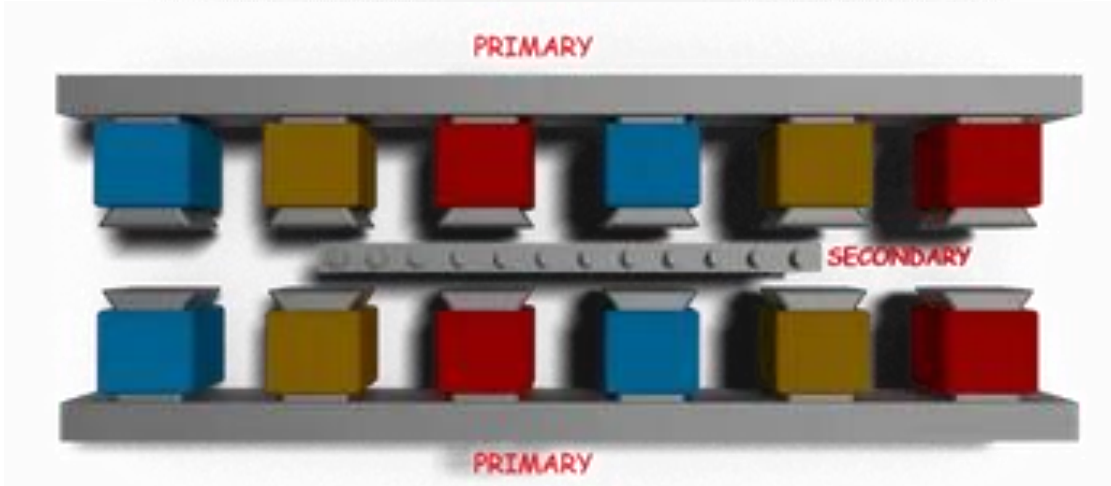


Linear Induction Motor

Linear Induction Motor Construction

- The basic design and construction of a linear induction motor is similar to a three phase induction motor, although it does not look like a conventional induction motor.
- If we cut the stator of a polyphase induction motor and lay on a flat surface, it forms the primary of the linear induction motor system.
- Similarly, after cutting the rotor of the induction motor and making it flat, we get the secondary of the system.
- There is another variant of LIM also being used for increasing efficiency known as the Double Sided Linear Induction Motor or DLIM, as shown in the figure below.
- It has primary on either side of the secondary, for more effective utilization of the flux from both sides.

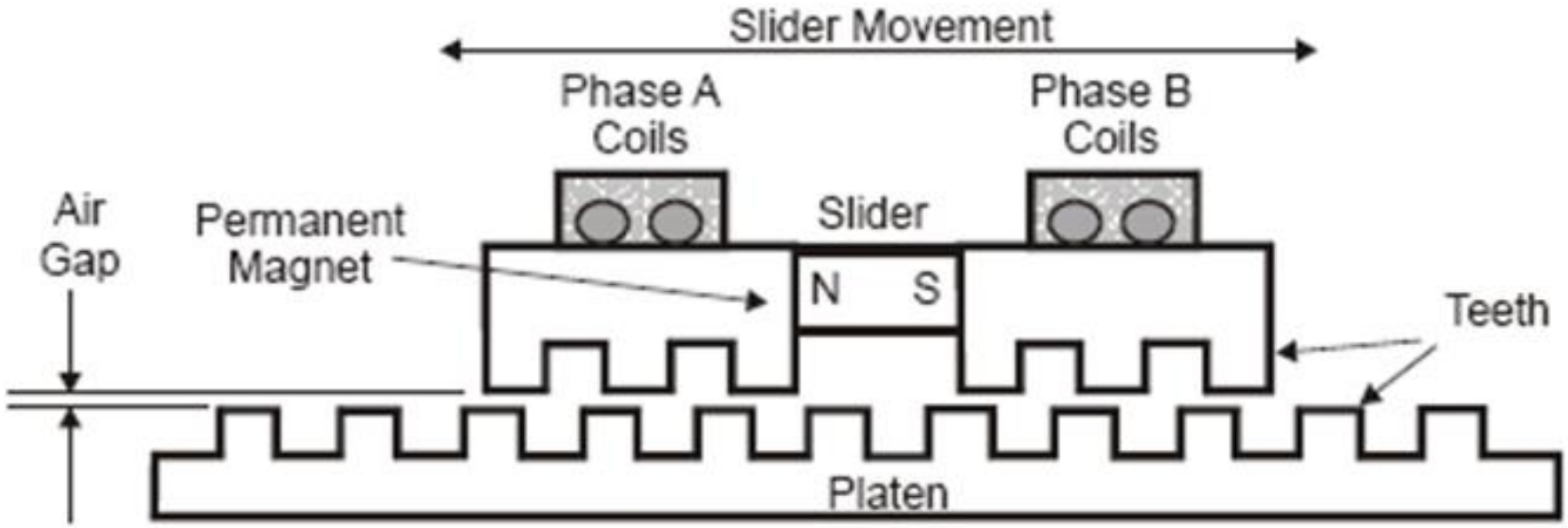




Linear Induction Motor

Linear Induction Motor Working Principle

- When the primary of a LIM gets excited by a balanced three-phase power supply, a flux starts traveling along the entire length of the primary.
- This linearly traveling magnetic field is equivalent to the rotating magnetic field in the stator of a three phase induction motor or a synchronous motor.
- Electric current gets induced in the conductors of the secondary due to the relative motion between the traveling flux and the conductors. Then the induced current interacts with the traveling flux wave to produce linear force or thrust.



Linear Induction Motor

Linear Induction Motor Working Principle

- If the primary is fixed and the secondary is free to move, the force will pull the secondary in the direction of the force and will result in the required rectilinear motion. When we give supply to the system the developed field will result in a linear traveling field, the velocity of which is given by the equation,

$$Vs = 2tfs$$

- Where fs is the supply frequency in Hz, Vs is the velocity of the linear traveling field in meter per second, and t is the linear pole pitch i.e. pole to pole linear distance in meter.

- For the same reason as in the case of an induction motor, the secondary or runner cannot catch the speed of the magnetic field. Hence there will be a slip. For a slip of s, the speed of the linear induction motor will be

$$V = (1-s)Vs$$

Linear Induction Motor

Application

- Automatic sliding doors in electric trains.
- Mechanical handling equipment, such as propulsion of a train of tubs along a certain route.
- Pumping of liquid metal, material handling in cranes, etc.
- It can be used in metallic conveyors, traveling cranes, haulers etc.

Advantages

- Low initial cost.
- Low maintenance cost due to the absence of rotating parts.
- No limitation of maximum speed due to centrifugal forces.
- No overheating of the rotor.
- Batter power to weight ratio.

Disadvantages

- A typical air gap in LIM is of the order of 25 mm while in a cylindrical motor it is about 1 mm i.e. it has a larger air gap which results in lower power factor.
- LIM has a much higher rotor resistance, operates at high slip at given thrust and has correspondingly low efficiency.
- Very high capital cost of reaction rail fixed along the center line of the track.